Abstracts of ICAR-IIHR M.Sc Thesis

भा.कृ.अनु.प.–भारतीय बागवानी अनुसंधान संस्थान
हेसरघट्टा लेक पोस्ट, बेंगलूरू – ५६००८९

ICAR - Indian Institute of Horticultural Research
Hesaraghatta Lake Post, Bengaluru – 560089

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Compiled and edited by

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May 2022

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FOREWORD

The ICAR-IIHR has been mother to 2 National Institutes (ICAR-Central Institute for Subtropical Horticulture, Lucknow and ICAR-Central Citrus Research Institute, Nagpur), fostered 3 NRC's (ICAR-National Research Centre for Banana, Tiruchirappalli; ICAR-National Research Centre for Pomegranate, Solapur; ICAR-National Research Centre for Grapes, Pune) and one Directorate (ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand) as on today. The main research program of the institute in the initial years was to improve the productivity of Horticultural crops but with the emergence of new challenges in horticulture, emphasis was later shifted to breeding hybrids/varieties for biotic and abiotic stresses, developing integrated water and nutrient management protocols, pests and disease management technologies, efficient post-harvest management practices and conducting frontier research in the areas like hi-tech horticulture, precision farming, information technology and biotechnological interventions.

This institute has 8 distinctive 'Divisions' (Fruit Crops, Vegetable Crops, Flower and Medicinal Crops, Post Harvest Technology and Agricultural Engineering, Basic Sciences, Crop Protection, Natural Resources and Social Sciences & Training). The Pesticide Residue Laboratory at IIHR has been accredited in accordance with the standard ISO/IEC 17025:2005 in the field of chemical testing by NABL (National Accreditation Board for Testing and Calibration Laboratories, Department of Science and Technology, India). State of art Food Safety Referral Laboratory for testing contaminants in food, especially in horticultural produce has been recently established at ICAR-IIHR. Nearly 65 high standard laboratories having state of art equipment like electron microscope, ultra centrifuge, HPLC, GLC, GC-MS, ICP-MS, Liquid Scintillation Counter, Atomic Absorption Spectrophotometer, Gamma Chamber etc, to conduct research. Infrastructural facilities like phenomics facility, growth chambers, mist chambers, cold storage facilities, gene bank, seed processing and nursery units, poly houses and net houses, 100 % drip irrigated fields for crop divisions, local area network with video conferencing facilities, etc have been developed to enhance the research output. The institute also houses an ultramodern library, conference hall, auditorium, training hostel, bank, hospital, essential quarters and other facilities.

The ICAR-IIHR has been serving as a "Higher Educational Institute" for Post Graduate Students across the Country since the inception. This institute has signed an MoU with 15 State Agricultural Universities and 26 Private Educational Universities and Institutes for high quality research, education and training.

I am happy to note that the institute has produced more than 256 M.Sc students till 2022.

I complement Dr. M. Sankaran, Dr. D. Kalaivanan, Dr. Smaranika Mishra, Dr. Pritee Singh and Mr. Rajesh Kannan for the systematic compilation of M.Sc thesis abstracts under 14 ARS discipline which will be useful for the researchers and students in the respective discipline and also will be useful for planning the future research works.

(BNS Murthy)
Director, ICAR-IIHR

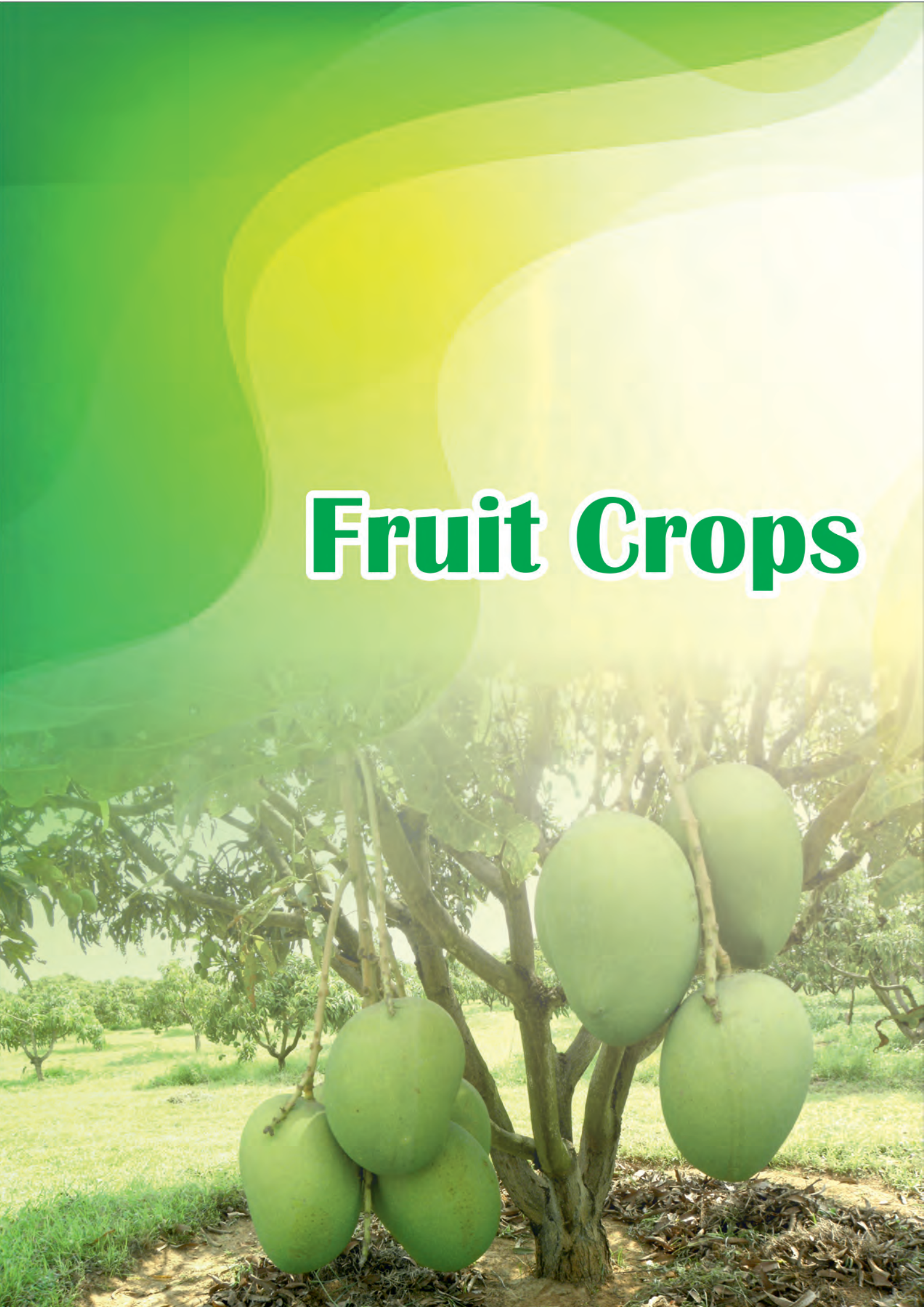
PREFACE

ICAR- Indian Institute of Horticultural Research, Bengaluru is a premier research institute for horticultural crops. It was established in 1968 with an objective to increase the yields of horticultural crops by developing high yielding varieties in fruits, vegetables, ornamentals, medicinal & aromatic plants and mushroom and also to develop advanced production technologies to increase the productivity of horticultural crops. Later with emergence of new challenges in crop production and protection in resource poor condition, more emphasis was given on breeding varieties for biotic and abiotic stress tolerance, breeding F1 hybrids, developing integrated pest and disease management technologies, developing integrated soil, water and nutrient management protocols towards optimum utilization of resources, developing post-harvest management practices to reduce the post-harvest losses and further value additions, and frontier research areas like hi-tech horticulture, precision farming, information technology, biotechnological interventions to increase yields, protect crops from insect- pests, disease and viruses, and extension of shelf life of crop produces. Research work carried out during the last four decades with the above objectives has paid rich dividends in terms of release of more than 300 varieties and hybrids and 145 sustainable production, protection and post-harvest management technologies. Apart from that the institute is recognized as the post graduate research and training centre in horticulture by good number of universities as a part of PG Education and currently it is working as an Outreach campus for PhD students of Horticulture from Indian Agricultural Research Institute, New Delhi and have MoUs with more than 40 State Agricultural Universities and Private Universities to carryout quality research, education and training. More than 256 MSc students have completed their degree from IIHR till 2022.

Looking into the significant research contributions from institute, an effort has been made to compile M.Sc students research work in the form of an e-Book on research abstracts of MSc which can serve as a ready reckoner for the students and researchers while designing their research programme.

Editors

Fruit Crops



Title: Studies on propagation of ber (*Zizyphus Mauritiana Lam.*) (1984)

B. N. Srinivasamurthy, UAS, Bangalore, Guide: Dr. Y.N. Reddy

Studies on seed germination, rootstocks and budding aspects of ber were conducted to standardize the propagation techniques. Extracted kernels germinated better with higher percentage as compared to intact seeds. Kernels pre soaked in water then treated with 1.0% thiourea gave 77.77% germination in Umran. The germination process of ber was slower in the dark. GA as pre sowing treatment substituted the light requirements of seeds. It was found that the germination percentage of seeds was significantly higher when the final exposure was given to red light. It was also found that better and faster germination occurred at 30 ºC. Further it was revealed that ber seeds could be stored up to 8 months without any loss in viability. Based on the studies conducted, it is recommended that KNO_3 treatment be given to the ber rootstocks in situ under dry land conditions, to make them more tolerant to drought. Urman is best suited for raising rootstocks, as the seedlings of this variety made a faster growth than the local types. When budding was done on topped defoliated rootstocks, the bud take was earlier, the success higher and the scion growth faster when compared to intact plants. Buds taken from main axis and four month old shoots were found to give higher success.

Title: Studies on sylleptic branching in Zizyphus species with special reference to productivity in ber (*Zizyphus mauritiana* Lam.) Var. Umran (1985)

Reju. M. Kuriyan, UAS, Bangalore, Guide: Dr. Y. N. Reddy

Studies on sylleptic branching of two Zizyphus species revealed that Z. mauritiana (ber)var. Umran produced lesser number of sylleptic branches than Z.oenoplia. In both species rhythm in the production of second order branches was noted. Various chemicals and growth regulators tried could not change the interval of sylleptic branching in ber, but BA, TIBA and morphactin increased the number of nodes and thereby sylleptic branches. Extent of shoot tip abscission was comparatively less in Z.oenoplia.Some of the vigorous first order branches in Z. oenoplia exhibited shoot tip reorganization. It was proposed that shoot apex at any given level of activity is self-regulatory, but its elevation from a lower to higher level of activity requires energy inputs from subtending structures. Z. oenoplia was identified to be more competitive and its use as rootstock for ber was suggested. Branch polymorphism was observed in ber.Vigorousshootscontributed93.03% fruits on any pruned shoot; rest being from normal shoots, whereas spurs type bore no fruits. Vigorous sprouts with more basal diameter, length and nodes produced more sylleptic branches and hence more fruits. The use of branch bifurcation ratios in predicting yield was proposed based on their strong correlations with yield attributes, branch yield and ultimate tree yield. Two control points, increasing the number of vigorous sprouts and sylleptic branches, were identified to increase yield in ber. Pre-pruning spray of KNO_3 or thiourea increased the number of vigorous and total sprouts and produced the former at lower node. Post-pruning sprays of BA, TIBA or morphactin effectively improved the second control point. Thiourea 3% + BA 100 ppm treatment was found to be the best in the simultaneous manipulation of two control points identified. The superior treatments along with appropriate cultural practices were suggested for maximizing productivity in ber.

Title: Assessment of some cultivars of Mango (*Mangifera indica* L.) for vegetative and fruit characters.(1985)

M. C. Subbaiah, UAS, Bangalore , Guide: Dr. C. P. A. Iyer

Observations were taken on 42 cultivars of mango collected from all over the country on various characters including vegetative growth, flowering and fruit characters, to obtain information on the extent of variability and also to help in selection of cultivars for specific purposes. The data were taken on seven year old trees. Wide variability was observed for number of growth flushes, length of shoots put forward in a year, time of flowering, length of panicles, initial fruit set, fruit number per panicle and date of harvest. The number of fruits per tree ranged from 5.0 in Langra to 247.5 in Pacharisi. In terms of fruit number. Chandrhkaran ,Gola, Himayatpasand, HyderSahebi, Kallapadi, Kasturimamidi, Lazat Baksh, Neelum, Pacharisi, Padiri and Panakalu were found to bepromising. In terms of fruit weight, Amini, Hyder Sahebi, Kallapadi, Kasturimamidi, Lazat Baksh, Neelum, Pacharisi, Padiri and Panakalu were found to be promsing. The weight of the fruit was found vary from 63 g in Chandrhkaran to 647g in Amini. The percentage of pulp in a fruit ranged from39.7 (Chandrhkaran) to 74.1 (Fazli).It was found that the cultivars Fazli, Himayat Pasand, Kallapadi, Padiri and Panakalu yielded maximum pulp per tree. The pulp: skin + stone ratio (edible to non- edible portion) wasfound to range from 0.65:1 in Chandrhkaran to 2.86:1 in Fazli. The total soluble ranged from 12.8º in cultivar Amini to 29.2º in cultivar Chandrhkaran. The acidity was found to be the least in cultivars Banganapalli, Imam Pasand, Lazath Baksh and Peddarasam (0.06%), whereas it was maximum in cultivar Suvarnarekha (0.65%). The total sugar content was found to range from 8.03 in Fazli to 20.41 percent in Rataul. Panakalu (17.63%), Amarapalli (17.24%), Langra (15.78%), Kallapadi (15.75%) and Dashehari (15.50%) also had high total sugar content. The sugar: acid ratio was found to range from16.66:1in Mohammada Vikarabad to 270.66 :1 in Rataul. Cultivars Lazath Baksh (257.3:1) and Rataul (270.6:1) recorded high ratio.

Title: Phenotypic variability studies in F1 grape hybrids (1986)

B. Rangaswamy, UAS, Bangalore, Guide: Dr. Rajendra Singh

Quantitative and qualitative characters, the extent of phenotypic variability, and the relationship between characters were studied in ten F_1 grape hybrids raised at IIHR,Bangalore. The study showed significant differences indicating large phenotypic variability for 11 quantitative characters. Other 10 quantitative characters expressed non-significant differences among the hybrids. Large phenotypic variability was also evident from variations among the hybrids with respect to PCV values of the 11 quantitative characters. Phenotypic variability occurrence was also apparent from variations among the hybrids with respect to PCV values of the other 10 quantitative characters. Occurrence of a wide phenotypic variability in experimental material was evident from the quantitative characters which expressed themselves in different combinations. It was evident from the study that the F_1 grape hybrids BB x CS and BC x TS had the highest percentages of fruitful canes, BC x TS and BB x CS had the maximum number of panicles and maximum number of bunches, AES x BC and BC X TS had the maximum yields; AES x BC and CS x CLB had the maximum bunch weights: CS x CLB and AES x CLB had the highest berry weights; AK x BC and AES x BC had the highest percentage of well-developed berries; BB x CS & AK x CLB had the highest percentages of juice; BB x CS had the highest TSS percentages and BB x TS and AK x BC were earliest ripeners.

Title: Studies on grape hybrids and their parents on different training systems (1987)

B. Revanna, UAS, Bangalore, Guide:Dr. Rajendra Singh

With an objective of identifying the superior grape hybrids in respect of different qualitative and quantitative parameters, studies were carried out on the comparison of parents comprising of twenty promising hybrids with ten parental varieties in a replicated trial in a completely randomized design at the Indian Institute of Horticultural Research, Hessarghatta, Bangalore, during 11986-87. The ten varieties used either as female or male parents were;(1) Anab-e-Shahi,(2) Angur Kalan ,(3)Bangalore Blue,(4) Bangalore Purple, (5) Black Champa, (6) Cheema Sahebi, (7) Convent Large Black, (8) Gulabi, (9) Queen of the Vineyards and (10) Thompson Seedless. Hybrids were evaluated against their parents in respect of vine growth parameters, yield attributes and quality components. Salient findings of the study are summarized below; significantly differences were observed among the parents and hybrids in respect of stem girth in June and October and October prunings weight. Significantly differences were also observed in respect of the number of days taken for bud burst, shoot length, leaf number /shoot specific weight, leaf area during the fruiting season and leaf dry matter content, Chlorophyll'b' and total chlorophyll (a+b) content during the fruiting season, yield attributes such as number of bunches /vine, mean bunch weight, bunch length and breadth, number of berries / bunch,50-berry weight and the yield / vine. Quality components such as juice, total soluble solids and seed (number) content also varied significantly among the parents and the hybrids. Dry matter content, area and specific weight of leaf during the growth season were positively correlated with yield/vine. Anab-e-Shahi hybrids 4/15(Anab-e-Shahi x Bangalore Purple) and 5/17 (Anab-e- Shahi x Black Champa) which had less shoot length after 60, 75 and 90 days of April pruning than Anab-e-Shahi seemed to be promising for yield. Based on the observations made on the vine growth parameters, yield and quality, it can be concluded that Anab-e-Shahi hybrid 5/17 (Anab-e-Shahi x Black Champa), Thompson Seedless hybrids 29/6 (Black Champa x Thompson Seedless) were improvements over their respective parents for yield and quality, Anab-e-Shahi hybrids, 4/15 (Anab- e-Shahi x Bangalore Purple) was improvement over Anab-e-Shahi for yield.

Title: Studies on grape hybrids and their parents on different training systems (1987)

B. Revanna, UAS, Bangalore, Guide:Dr. Rajendra Singh

Effect of different training systems on the yield and performance of some grape hybrids and their parents was investigated. Growth of the vine was more on the 'Bower' (129.18) than on the 'Head' (50.29) system of training. The number of shoots was more during April pruning in'Anab-e-Shahi' (8.51kg/vine) than other varieties. The weight of pruning per vine was more on 'Bower' system (6.87 kg) as compared to 'head' system (2.49 kg). Rate of shoot growth was slow in 'Arka shyam' (68.76 cm) but fast in 'Arka kanchan' (155.66 cm) on 'Head system'. It was slow in case of 'Arka hans' (82.44 cm) but steep in' Arkavati' (158.20 cm) trained on 'Bower' system. The highest stem girth was found in 'Thompson Seedless' (7.43 cm) and least in 'Anab-e-Shahi' (3.89 cm). The training system followed did not have any effect on stem girth. The degree of apical dominance was more on 'Head' system (0.79) than on 'Bower' system of training (0.67).Among the varieties, it was highest in 'Anab- e-Shahi' (1.00) while the least was in 'Arkavati' (0.40). Although the yield per vine in 'Arka Kanchan', 'Arkavati' and 'Black Champa' was more on the 'Bower' system, even on the 'Head' system they produced 60to 70% of the yield obtained on the 'Bower' system on unit area basis. Hence, these varieties can be recommended for growing on 'Head' system of training.

Title: Effect of urea and GA sprays on shoot growth and bunch characters in grape (*Vitis vinifera* L.) variety Arka Kanchan (1988)

N. M. Poonacha, UAS,Bangalore, Guide: Dr.S.D.Shikhamany

A field trial was carried out during 1987-88 on 'Arka Kanchan' grape with an aim to increase the berry and bunch size. Effect of 16 treatment combinations of four foliar sprays of urea (during the growth season, fruiting season, during both the seasons and unspread control) and four of GA sprays (atpre-anthesis, fullbloom, 10 days after fruit set and unspread control) on berry and bunch size was studied in grape 'Arka Kanchan'.Urea sprays during both the seasons increased only the vigour of the shoots in vines without any favourable effect on the bunch or berry weight. Urea sprays during fruiting season coupled with GA sprays on the 10^{th} day after fruit set increased the mean berry weight. Urea sprays (0.5%) at fortnightly intervals commencing from 30^{th} days after October pruning coupled with GA sprays on the 10^{th} day after fruit-set may be favorable for increasing the bunch weight of this variety. These investigations also suggested that berry and bunch weight in var. Arka kachan is more dependent on the metabolites during the fruiting season than on the reserves in the canes. In view of the fact GA sprays on the10^{th} day after fruit set increased the length of berries but not the diameter, with no exchange in the mean berry weight, there is scope to increase the diameter of the berries and thereby, the mean berry weight by application of auxin or cytokinin in addition to gibberellic acid.

Title: Phenotypic variability for qualitative and quantitative attributes of certain grape hybrids (1989)

S. Venkataram Prasad, UAS, Bangalore, Guide: Dr. Rajendra Singh

The present investigation was carried out during 1986 and 1987 at IIHR, Bangalore, to evaluate the hybrids of the crosses Anab-e-Shahi, Angurb Kalan, Bangalore Blue, Black Champa, Convent Large Black, Thompson Seedless and Queen of the Vineyard, with respect to growth, fruitfulness, yield, quality, petiole nutrient contents and resistance to diseases. The salient findings of these investigations were seen as considerable variations in stem girth observed among the hybrids and parents. The hybrids 5/12 and 4/30 from the cross Anab-e-Shahi x Black Champa, hybrids 9/3 from the cross Anab-e-Shahi x Queen of the Vineyard and hybrids 29/4 and 29/5 from the cross Black Champa x Thompson Seedless had more trunk girth than rest of the hybrids. The hybrids 8/29, 29/4 and 29/5 appeared to be highly vigorous, while rest of the hybrids had low vigour. The hybrids 26/8 registered the minimum pruning weight. The percentage of increase in pruning weigh to the hybrids was from 88.68% to 153.26% over the best parent, indicating for the tendency of the hybrids vigour. The parent Black Champa as a seed parent and Queen of the Vineyard as a pollen parent appeared to be best combiner for imparting high vigour to the progeny. The hybrids 7/12 and 8/24 had minimum number of shoots. The hybrids which recorded the lowest angle of the shoot was 7/12 and 8/24. The hybrid 4/30 recorded the lowest shoot length in the both season, while the hybrid 29/5 recorded the highest shoot length in growth season and the hybrid 5/12 in fruiting season. Cane diameter increased invariably in hybrids compared to their parents. The genotypes with high number of shoots had less percentage of cane maturity. The hybrids 29/4 and 29/5 from the crosses Black Champa x Thompson Seedless had invariably number of leaves the better parent Bangalore Blue had the highest tolerance to all the diseases. While Anab-e-Shahi and Thompson Seedless appeared to be highly susceptible. The hybrid 30/40 had the least incident of anthracnose, while the hybrid 29/5 was highly susceptible. The hybrid 21/28 had higher downy mildew disease tolerance among all the progenies, while the hybrid 5/12, 7/12 and 26/8 were moderately tolerant. Hybrids 4/30, 8/24, 29/3 and 29/4 were highly susceptible.

Title: Studies on shoot growth and berry development in different genotypes of grape (1991)

Kulapati Hipparagi, UAS, Bangalore, Guide: Dr. Rajendra Singh

Shoot growth and berry development pattern in different genotypes of grape was studied in five promising hybrids with five parental cultivars in a replicated trial. The five cultivars used as female or male parents were; Anab-e-Shahi, Angurb Kalan, Black Champa, Thompson Seedless and Queen of the Vineyard. Hybrids were studied against their parents in respect of vine growth parameters, yield attributes and quality components. Shoot length and leaf number per shoot at 90 and 105 days after bud break during the fruiting season were positively correlated with total soluble solids. Fresh weight of berries at 30, 45, 60, 75 and 90 days after fruit set was positively correlated with Brix-yield/15 berries and 50 berries weight at harvest. All the five hybrids had more shoot length and leaf number than their parents. The study has shown that Anab-e-Shahi hybrids E-5/12 and E-9/3 and Black Champa hybrids E-29/4 were improvements over their respective parents with respect to yield and quality attributes, while Black Champa hybrid E-29/4 were improvements over its parents with respect to yield and quality attributes, while Black Champa hybrid E-29/5 and Angurb Kalan hybrid F-5/4 were improvements over the irrespective parents with respect to quality.

Title: Studies on shoot growth and bunch development as influenced by the time of pruning and hydrogen cyanamide application in Thompson Seedless grape (*Vitisvinifers* L.) (1991)

G. C. Manjunatha, UAS, Bangalore, Guide:Dr. S. D. Shikhamany

Influence of different concentrations of cyanamide (0,1,2 and 3% a.i.) at different dates of pruning (5th October, 26th October and 16th November,1989) on bud break and the consequential effect of variation in bud break on different dates shoot growth, bunch development and berry quality was studied in Thompson Seedless grape under the mild tropical climatic conditions of South interior Karnataka. A Bud break at all nodal position, except the terminal two nodes was influenced by the dates of pruning as well as the cyanamide concentration. Irrespective of the concentration, cyanamide treatment increased the bud break, which in turn was associated with increased yield, brix-yield/cane and increase in the proportion of water berries. Cyanamide treatment hastened bud break by about 6 days in vines pruned on 5th October and about 4 days in vines pruned on 26th October for 50 % bud break to occur. Vines pruned on 16th November and not treated with cyanamide did not show even 50% bud break. Mean shoot length was reduced by delayed pruning and cyanamide treatment. Total shoot length/cane decreased with delay pruning but was unaffected by cyanamide treatments. Reduced total shoot length/cane was associated with reduced yield and brix-yield/cane and mean bunch and berry weights. Vines pruned on 5th October resulted in higher yield than those pruned later. Higher yield was mediated through higher weight of berries and bunch and increase in the number of clusters/cane. Cyanamide treatment did not increase the yield/cane. Proportion of water berries in a bunch decreased with delayed pruning. This however, was not affected by cyanamide treatment. Cyanamide treatment did not have any influence on the quality parameters. This study has thus shown that cyanamide can be used to hasten and increase bud break in Thompson Seedless vines pruned as late as 16th November under the agro-climatic conditions of Bangalore. Cyanamide at 1% a.i. was found to be the optimum. For achieving increase in yield through bud break by cyanamide, fruitfulness of buds on the cane should be improved.

Title: Inheritance and incrossability studies in papaya (1996)

S. Meenakshi, UAS, Bangalore, Guide: Dr. I. S. Yadav

All the plant and fruit characters studies showed higher phenotypic variance than genotypic variation which indicated the importance of environment in the manifestation of these characters. The phenotypic and genotypic variance were higher for plant height, fruit weight and fruit cavity index, it was moderate for plant spread, fruit length and low for stem diameter, fruit breadth, pulp thickness, TSS, total carotenoids and total sugars. The phenotypic coefficient of variation was higher than the genotypic coefficient of variation for all the characters. The coefficient of variation was high for fruit weight, fruit volume, fruit cavity index, fruit length and medium for fruit height, stem diameter, fruit breadth and total carotenoids. Plant spread, pulp thickness, TSS and total sugars had low coefficient of variation. Maximum fruit set was noticed when 3% sucrose was used irrespective of then cross combinations involving papaya varieties as female parents. However, among the cross combinations maximum fruit set was noticed in Pusa Dwarf x Carica cauliflora. In all cross combinations where Carica cauliflora was the female parent, the average fruit set was maximum with the use of 3% sucrose and among the cross combinations maximum fruit set was recorded in the cross Carica cauliflora x Lucknow Collection. Average number of seeds set was maximum under 5% sucrose levelin crosses where Carica papaya was used as female parents. Maximum number of seeds set was recorded in the cross Washington x Carica cauliflora at 5% sucrose level. Percentage of variable seeds was maximum 2% sucrose level in all the cross combinations studies. percentage of variable seeds was highest in the cross combination Pusa Dwarf x Carica cauliflora at 5% sucrose level.Cross combinations involving Carica cauliflora as female parent did not yield any viable seed. Varietal differences were observed in the cross ability of Carica papaya with Carica cauliflora. The cultivar Pusa Dwarf was found to be the best as female parent in crosses with Carica cauliflora.

Title: Ploidy manipulation and mutation studies in papaya (*Carica papaya* L.) (1997)

M. Mahadevamma, UAS, Bangalore, Guide: Dr. I. S.Yadav

Ploidy manipulation has been used in fruit crops to advantage by getting better sized fruits. In case of papaya with its chromosome number being 2n=18, there is good scope for making heading in breeding. Two varieties were selected for mutagenic treatment to create variability. In this experiment GA was used as a pretreatment chemical for seed material before mutagenic treatment to study the effect of various mutagens viz., gamma rays, EMS and colchicine on various growth parameters, mitosis and fix LD50 dosage, Seedlings, callus and shoot tips of Coorg Honey Dew were also used to know the irresponse and to find LD50 dosage. Germination and survival percent was the higher in Sunrise solo (53.67 and 44.22) than in Coorg Honey Dew (45.33 and 36.11).LD50 dose for Germination percent and survival percent for pretreated seeds with gibberellic acid was 9.5 kR and 7 kR for Sunrise solo and 7.5 kR and 4.5 kR for Coorg Honey Dew respectively.Gamma rays significantly influenced the seeding height both at and 30 days after Germination which decreased with increase in gamma rays dosage and was minimum(5.68 cm and 9.44 cm)with 20 kR maximum (7.15 cm and 11.93 cm) with control. Total chlorophyll content decreased with increase in gamma rays dosage and was the lowest (1.54 mg/g tissue) at 20 kR and the highest (2.15 mg/g tissue) with control. The maximum stomatal length (15.55 µ and 13.61 µ) and breadth (7.86 µ and 7.86 µ) were observed at 0.3% EMS and 8 h duration treatment respectively compared to control which recorded minimum stomatal length (10.41 µ) and breadth (5.75 µ). EMS treatment significantly reduced the plant height, plant spread, plant girth and intermodal length at the time of first flowering in Sunrise Solo variety. EMS treatment 0.3% recorded minimum plant spread at North-South (72.46 cm) and East-West (71.52 cm) direction, Plant girth (3.130 and intermodal length (3.59 cm) while control plants recorded maximum. Sixty days upon culture, the highest percent of green and enlarged ovules (29.00) was also noticed from ovules excised of sixty days after pollination while it was lowest (10.5) from ovules excised 90 days after pollination.

Title: Micropropagation of salt tolerant grape rootstock variety 'Ramsey' (1997)

K. T. Bollamma, UAS, Bangalore, Guide: Dr. I. S. Yadav

Micropropagation is a technique for rapid multiplication of plant in vitro. The present investigation was carried out to develop a protocol for micropropagation of salt tolerant grape rootstock variety 'Ramsey'. The experiments were conducted at the plant Tissue Culture Laboratory – I of the Division of Biotechnology, Indian Institute of Horticultural Research, Hessarghatta, Bangalore. Various experiments were conducted and result were analysed and discussed. Decontamination of 'Ramsey' nodal cutting were best achieved when they were pretreated for 1 hour or 4 hour and surface sterilized for 10 minutes. With this treatment the percent survival was higher when compared to other treatments viz., the contamination rate was lower in the above treatments. Softwood nodal cuttings gavelower contamination rate. Induction of multiple shoots from nodal explants was best achieved with modified MS medium supplemented with 3 ppm BA. At this rate of BA maximum number of leaves and nodes also were obtained. At a concentration of 5 ppm BA in MS basal medium callus with pink colour pigmentation was obtained. Further, it was found that half strength MS was a better basal medium with 3 ppm BA for induction multiple shoot. Half strength MS gave rise to a study plantlet with a good shoot and root system which could be directly acclimatized. Hardening was done using the closed sachet method with a very high survival percent.

Title: Growth and productivity of Robusta banana under nitrogen and potassium fertigation (1998)

S. S. Chandra Kumar, UAS, Bangalore, Guide: Dr. K. Srinivas

A field experiment was conducted at IIHR, Bangalore to study the growth and productivity of banana cv. Robusta under nitrogen and potassium fertigation.The findings are summarized hereunder. The fruit yield of 88.46 t/ha was obtained with 200 g of N and K and was on par with 150 g of N and K (85.66 t/ha). The lower yield of 78.19 t/ha and 56.39 t/ha were obtained with 100 g N and K and 50 g of N and K respectively. The yield attributing parameters like hand per bunch (7.43), fingers per bunch (96.02), average finger weight (207.37 g) and average bunch weight (19.90 kg) were higher with 200 g of N and K. The maximum leaf dry matter (1258 g), pseudo stem dry matter (1122 g), fruit dry matter (2010 g) and total dry matter (4390 g) were obtained with 200 g of N and K. The leaf dry matter (1207 g) and pseudo stem dry matter (1031 g) were higher with150 g of N and K which were on par with 200 g of N and K. However, leaf dry matter, pseudo stem dry matter and total dry matter were not influenced much by N and K ratios.But1:2 N and K ratio recorded maximum leaf dry matter (1116g),pseudo stem dry matter (974 g), fruit dry matter (1780 g) and total dry matter (3859 g). The bunch dry matter(r=0.995**), total dry matter(r=0.937**), stem dry matter(r=0.833**) and leaf dry matter (r=0.722**) were highly correlated with fruit yield. The quality parameters such as total soluble solids (TSS) and pulp to peel ratio were improved by N and K fertigation. A higher total soluble solid (24.01%) was recorded with 200 g of N and K which was on par with 150 g of N and K (24%). Whereas 23.25% and 22.50% TSS were recorded with 100 g of N and K and 50 g of N and K. application of 1:2 N and K ratio recorded higher TSS (24.4%) in fruit compared to 1:1 N and K ratio (23.68%). Higher net returns (Rs.3,88,568.00 per ha) was recorded with 200 g of N and K, while higher profit per rupee invested (Rs. 2.82) was with 150 g of N and K. Further, 1:2 N and K ratio obtained higher net returns (Rs. 3, 43,551.00 per ha) and profit per rupee invested (Rs.2.59).

Title: Studies on the response of grape genotypes in relation to different levels of moisture stress (1999)

H. K. Narendra Babu, UAS, Bangalore, Guide: Dr. G. S. Prakash

A pot trial experiment was conducted on six grape genotypes (Dogridge, Saltcreek, 1613,St. George, Vitis champini clone and cultivar Thompson Seedless) with three levels of moisture stress for a period of 14 days. Of the six grape genotypes studied, the root stocks,1613,St. Geroge,Vitis champini clone along with cultivar Thompson Seedless did not survive the stress under100 per cent moisture stress condition. However, all of them survived under 50 percent stress condition. Under 100 per cent stress, all the genotypes showed general reduction in Relative Water Content (RWC), Osmotic Potential (OP), Leaf Water Potential (LWP),Transpiration rate (AE), Net Photosynthetic Rate (Pn) and Stomatal Conductance (Gs).Under 50 per cent moisture stress RWC, AE, Pn, Gs, reduced in all the genotypes. Whereas, they were on par with the OP and LWP. Leaf temperature (LT) increased in all the genotypes at both the stress levels. The N,P and K content reduced in all the genotypes as a result of moisture stress. However, in Dogridge the N content in the leaves of stressed plants was almost on par with the well watered plants. Another experiment conducted on the diurnal variation of leaf RWC, OP and LWP were maximum in the morning in all the three genotypes (Dogridge, Saltcreek and Thompson Seedless) studied and reduced considerably by noon and slightly recovered in the afternoon under complete moisture stress. Soil moisture content was reduced in all the genotypes due to moisture stress. In the root development studies with six grape genotypes the highest root dry weight among all the categories of roots was found in Dogridge. Similarly, the dry weight of the shoot as well as the plant height was maximum in the root stock Dogridge.

Title: Response of grapes to micro-irrigation under different evaporation replenishmentrates (2001)

B. Boraiah, UAS, Bangalore, Guide:Dr. K. Srinivas

The field experiment was conducted at the Indian Institute of Horticultural Research, Hessarghatta, Bangalore during 1999-2000 to study the "Response of grapes to micro-irrigation under different evaporation replenishmentrates". The fruit yield of grape was higher with drip irrigation (30.20 t ha-1) compared to microjet irrigation (29.94 t ha-1). The yield attributing parameters like number of branches per plant (90.75), average bunch weight (473.33 g), 100 berry weight (380.99 g), berry diameter (22.23 cm2) and berry length (31.30 cm2) were higher with drip irrigation. Increasing the evaporation replenishment increased the fruit yield and other yield parameters like, the fruit yield was higher with 100 per cent evaporation replenishment(31.98 t ha-1) which was on par with 75 per cent evaporation replenishment (31.53 t ha-1),but it was lower with50percent evaporation replenishment (26.69t ha-1).Evaporation replenishment rates did not influence the growth parameters like leaf area of index leaf, fresh weight of index leaf, dry weight of index leaf, dry matter content of index leaf and pruning weight although they were higher with 100 per cent evaporation replenishment. The total soluble solids was marginally higher with drip irrigation (15.43 %) compared to microjet irrigation (15.37%), but the titrable acidity did not vary with the method of irrigation (0.34%). The sugar: acid was higher with drip irrigation (45.11) compared to microject irrigation (44.86).Irrigation scheduled with an evaporation replenishment rate of 75 per cent either with microject or drip irrigation resulted in higher yields. The water use with 75 percent evaporation replenishment was 945.75 mm.

Title: Variability and hybrid evaluation studies in papaya (*Carica papaya* L.) (2001)

Sukhen Chandra Das, UAS, Bangalore, Guide: Dr. M. R. Dinesh

In an experiment conducted at Indian Institute of Horticultural Research, Bangalore, half-sib analysis was carried out in papaya (Carica papaya L.) using twelve varieties and hybrids namely Coorg Honey Dew, Pink Flesh Sweet, Sunrise Solo, Waimanalo, Pant-2,Washington, Red Gold, Pusa Dwarf; PAU Selection,CO-4,H-39 and H-57.The objective of the study was to derive information on genetic advance and genetic advance over percent mean, physic-chemical characteristics, which could be used in breeding programme and performance of new hybrids in comparison with their parents. In addition to the above, a study was conducted to see the seed setting pattern and to study the suitable flower type for seed production two varieties of Carica papaya, Sunrise Solo (Gynodioecious) and Washington (Dioecious). All the plant and fruit characters studied showed higher phenotypic variance than the genotypic variance which indicated the importance of environment in the manifestation of these characters. The heritability estimates were high for the characters fruit length, pulp thickness, plant height, total carotenoids, ascorbic acid, fruit breadth and TSS, indicating that these characters are amenable for improvement through selection.Fruit length, fruit volume fruit cavity index, fruit weight, total carotenoids and ascorbic acid had high heritability and genetic advance indicating additive gene action, which showed that selection cam be made easily based on parental performance. For most of the characters, the genotypic correlation values were more than the phenotypic correlation values indicating of influence of environment. With regard to the seed setting pattern, the study showed that the variety Sunrise Solo comparatively matures earlier than Washington, early germination of seed was also seen in this variety. The percentage of fruit set and germination percentage in seeds was more in case of the variety Sunrise Solo than in the variety Washington.

Title: Irrigation and fertigation studies in high-density mango (*Mangifera indica* L.) (2002)

Hanamanth. Y. Asangi, UAS, Bangalore, Guide:Dr. K. Srinivas

The investigation on Irrigation and fertigation studies in high-density mango (Mangifera indica L.) var.“Arka Anmol” was carried out at Indian Institute of Horticultural Research, Hessarghatta, Bangalore during the year 2001-2002. Seven year old mango plants of Arka Anmol was grafted and dwarfing root stock Vellaikulamban and planted at a spacing of 5 m x 5 m, gives a plant density of 400 plants per hectare. The mango plants were subjected to two levels of irrigation (40% and 80%evaporation replenishment rate) and three level of fertigations (100%, 75% and 50% recommended dose of fertilizer) applied through drip irrigation system. Fruit yield(9.50 t/ha.),number of fruits per plant (99.92) and fruit volume (259cc) were higher with 80% of evaporation replenishment rate as compared to 40% of evaporation replenishment rate {(fruit yield (7.06 t/ha.) number of fruits per plant (63.58), and fruit volume(232.20 cc)}.The higher fruit yield (10.65 t/ha.) and number of fruits per plant (97.88) at 100%recommended dose of fertilizer, fruit yield (7.92 t/ha.), number of fruits per plant (64.38)were lower under 50% recommended dose of fertilizer. However, the interaction effect of 80 % evaporation replenishment rate and 100% of recommended dose of fertilizer reported highest fruit yield (12.50 t/ha.), number of fruits per plant 9113) as compared to other interactions. The acidity (0.40 %), peel weight (48.42 g), pulp weight (178.89 g), stone weight (38.05 g), peel to pulp ratio (3.84) and pulp to stone ratio (3.63) were higher at 80% evaporation replenishment rate as compared to 40% of evaporation replenishment rate. Whereas, higher TSS was reported at 40% of evaporation replenishment rate (18.58 o Brix). Similarly, TSS (18.20 o Brix), peel weight (48.18 g), pulp weight (182.83 g), stone weight (49.06 g), peel to pulp ratio (3.84) and pulp to stone ratio (3.63) were higher at100% RDF as compared to 50 % of RDF.

Title: Interspecific hybridization and mutagenic studies in papaya (*Carica papaya* L.) (2002)

L. C. Santosh , UAS,Bangalore, Guide:Dr. M. R. Dinesh

Interspecific hybridization was carried out using Carica papaya var. Surya as female parent and C. cauliflora as male parent. The study was aimed at creating variability and to fix LD50 value for the variety Surya.The experiment was conducted in experimental plots of India Institute of Horticultural Research, Bangalore during 2001-2002. Maximum fruit set was recorded at 5 per cent among the different levels of sucrose concentrations used. Maximum percent response was obtained from embryos inoculated on both MS medium supplemented with IBA 5 mg1-1. MS basal medium was ideal for germination of embryos producing maximum shoot length, number of nodes, internodal length, root length and number of roots. Maximum percent germination was recorded in control followed 0.1 percent EMS concentration. Maximum percent response was observed in control whereas maximum number of multiple shoots was recorded from the embryos inoculated on to 0.005 % EMS treatment.

Title: Studies on nursery and propagation techniques in polyembryonic root stocks of mango (*Mangifera indica* L.) (2002)

Venkata Rao, UAS,Bangalore, Guide :Dr.Y.T.N.Reddy

The investigation on “Studies on nursery and propagation techniques in polyembryonic rootstocks of mango (Mangifera indica L.)” was carried out at the Indian Institute ofHorticulturalResearch, Hessaraghatta, Bangalore-89 during the period 2001-2002.Fourteen polyembryonic varieties along with one mono embryonic Alphonso studied for seedling attributes related to germination, growth and vigour. Earliest germination was noticed in Muvandan and whereas the maximum germination percent and rate of germination was in Muvandan and Olour respectively. With regard to seedling growth characters like, seedling height, number of leaves and leaf area was maximum in Alphonso. In osmopriming treatments, the variety Alphonso recorded the maximum seedling height, girth, number of leaves and leaf area in treatment GA3 at 100 ppm concentration. Bark and stem percent was maximum in varieties Vellaikolumban and Bappakai in treatment GA3 at100ppm concentration. In media and biofertilizer experiment, the seedling height, girth and number of leaves were maximum in variety Alphonso and Muvandan in treatment comprising of potting mixture(1:2:1proportion)+ coco peat + VAM. The bark inverted variety Olour recorded the minimum graft height and sprout length whereas the seedling girth was maximum in variety Alphonso where bark inversion was carried out. Thus based on the different seedling growth and vigour characters, the monoembryonic varieties Alphonso, Totapuri and polyembryonic varieties Muvandan, Bappakai, E.C 95862 and Mylepelian were highly vigorous, whereas Kurukkan, Nekkare, Chandrakaran, Olour, Peach and Kensington varieties as vigorous and the Kitchner, Starch, Prior and Vellaikolumban varieties could be placed under less vigorous group.

Title: Studies on pre and post pruning growth regulator treatments on yield and quality of seedless grapes (*Vitis vinifera* L.cv. Sonaka) (2003)

B. Manjunatha, UAS, Bangalore, Guide:Dr. G. S.Prakash

Good quality grapes invariably fetches premium price in the market. Apart from good variety, agro- climatic conditions, cultural and canopy management practices greatly influence the fruit quality. Other factors like crop regulation and use of plant regulator play very important role. An attempt was made in the present studies to reduce the pronounced influence of apical dominance in seedless grapes cv. Sonaka by adopting different levels of sub cane system coupled with growth regulator treatments after October pruning. The results revealed the importance of various growth regulators tested. Biozyme (0.25 ml/litre) + GA3 (25 ppm) was found to be most effective in increasing the bunch size, berry weight than Quantum and BR. It increased the berry diameter up to 17 mm. Among the various sub canes tested, developing sub canes by pinching at five bud levels was found to be more effective than pinching at four and six bud level.

Title: Varietal evaluation, ploidy manipulation and biotechnological studies in papaya (*Carica papaya* L.) (2003)

Sameer Gururaj Joshi, UAS, Bangalore, Guide: Dr. M. R. Dinesh

Investigation on "Varietal evaluation ploidy manipulation and biotechnological studies in papaya'' was carried out at Indian Institute of Horticultural Research, Bangalore from June, 2002 to July, 2003. Varietal evaluation was carried out using eighteen C. papaya genotypes and two wild species viz., C. cauliflora and C. goudotiana. In the evaluation process significant differences were observed among the genotypes for the vegetative characters such as plant height, stem girth, number of leaves and plant spread and fruit characters such as fruit weight, fruit volume, fruit length, fruit width, pulp thickness, cavity index, total soluble solids, pulp colour and hundred seed weight. Cluster Analysis and Principal Component Analysis were carried out for the genotypes. Cluster analysis constructed a dendrogram, which grouped genotypes into three clusters. Cluster I comprised of Nigeria, PAU Sel, Coorg Honey Dew, Red Indian, Thailand, Madhubala, Pusa Nanha, Shillong and CO-5. Cluster II comprised of Pink Flesh Sweet, Co2, Dwarf,Pant-2, Waimanalo, Surya and Mauritius. Cluster III comprised of Sunrise Solo, Sunset Solo, Carica cauliflora and Carica goudotiana. The varieties Sunrise Solo and Sunset Solo got grouped with the wild species, mainly because of the fruit size. Genetic diversity and hybridity testing was also carried out using Randomly Amplified Polymorphic DNA markers. In the present investigation nineteen varieties and two species were selected.

Title: Comparison of micropropagation efficacy among different Grape hybrids with special reference to Shweta Seedless (2004)

Smita. R. Verghese, UAS, Bangalore Guide:Dr. B. N. S. Murthy

Among the six grape varieties Black Champa, Arka Neelamani, Anab-e-Shahi, Shweta Seedless and Arka Krishna taken up in the study Black Champa variety of grape responded the best to in vitro culture while Arka Krishna was the least responsive on MS medium supplemented with various levels of growth regulators; IBA and NAA. IBA supplemented to medium was found to be better for in vitro culture establishment compared to the one supplemented with NAA. Rooting, sprouting and growth response obtained varied with the variety. Black Champa, Arka Neelamani, Anab-e-Shahi,Shweta Seedless and Thompson Seedless gave higher root number and root length at higher concentrations of IBA tried (3 □M) compared to the lower concentrations. Arka Krishna showed the lowest root number and root length, which was observed at a lower concentration of IBA. All the varieties except Arka Krishna showed the maximum root weight at higher concentrations of IBA. Black Champa variety showed maximum rooting, sprouting and growth response at higher level of IBA (3 □M). This shows that in vitro culture can be taken up successfully for Black Champa variety of grapes. It was found that in Thompson Seedless higher IBA levels favoured rooting response, growth response and sprout weight while lower IBA concentration favoured better sprout height. Anab-e-Shahi showed variable response at different levels of IBA. It gave the highest root number, root length, and sprouts height and root weight at higher concentration of IBA while the sprout weight was observed to be maximum at lower level of IBA, Shweta Seedless variety resembled its parent Anab-e-Shahi in its rooting response and sprout height; while on the other hand, for higher sprout weight it needed a higher concentration of IBA than Anab-e-Shahi. In vitro culture of Shweta Seedless single nodal cuttings on a combined 2□M BA and 2□M IBA supplemented media gave the best shoot and root system without any callusing. Nearly 80 per cent survival was obtained when in vitro derived plantlets of representative samples transplanted into poly bags using the closed sachet method.

Title: Studies on drought and heat tolerance at seedling stage in varieties and hybrids of Pomegranate (*Punica granatum* L.) (2004)

K. C. Jayesh, UAS, Bangalore, Guide:Dr. S. H. Jalikop

In the recent times pomegranate has become a commercially important fruit crop due to wide consumer preference, and has attracted many growers especially for its wider adaptability, good yields, excellent shelf life and export potential of fruits, apart from its in built drought and heat tolerance. To understand genetic variation for drought and heat tolerance a study was undertaken. Hybridization was done from August to February employing 80 genotypes grown in Indian Institute of Horticultural Research. The varieties / hybrids involved in crossing and selfing were Ganesh, Ruby, Ornamental, Daru, Double flower, Amblidana, Kabul yellow, (Ganesh x Ornamental), (Ganesh x Daru). A total of 6 selfing, 25 single cross hybrids and 14 three ways cross hybrids were made. More number of fruit set was observed in selfing followed by in single cross and three way cross hybrids. Seeds of Yercaud, Kandhari, P-26, Jodhpurred,G-137,Jodhpur collection, Muscut, Dholka, P-23, H4, Jaloore seedless, P5/02 were used to raise seedlings and observations like Seedling height, primary root length, number of secondary roots, specific leaf area, cell membrane stability and chlorophyll content were measured after 105 days of sowing. Analysis of variance revealed significant differences for all the 8 characters studied among the 25 genotypes, which included 15 hybrids and 10 varieties. Heritability values in broad sense were high for all characters studied except for primary root length. Yercaud was found to have high heat and drought tolerance as measured by CMS (27.5%) and chlorophyll after stress. The two popular varieties Ruby and Ganesh showed no significant difference for plant height, number of secondary roots, specific leaf area, chlorophyll before and after stress. Hybrid double flower x Daru was found to be heat tolerant due to its low solute leakage while hybrid (Ganesh x Kabul yellow) x Ganesh showed high drought tolerance among the hybrids studied due to high chlorophyll content. Genotypes with higher plant height and primary root length possessed better heat tolerance. Chlorophyll after stress is positively correlated with all the 7 characters indicating decrease in temperature tolerance and leaf thickness will improve the drought tolerant hybrids.

Title: Interspecific hybrid progeny evaluation in papaya (*Carica papaya* L.) (2005)\

K. S. Praveen, UAS, Bangalore, Guide: Dr. M. R. Dinesh

Investigation on "Interspecific hybrid progeny evaluation in papaya (Carica papaya L)"was carried out at Indian Institute of Horticulture Research, Bangalore from June, 2004 to July, 2005. The main objectives of this investigation were to evaluate and establish invitro culture of selected hybrids and to confirm the hybridity of interspecific hybrids by using ISSR markers. The hybrids that were found to be resistant to PRSV were assorted for in vitro propagation as conventional seed propagation may result in loss of fixed character. An effective establishment of explants was noticed when they were treated with fungicide (Bavistin 0.2%) and bactericide (Streptocyclin 0.1 per cent) along with surface sterlilant mercuric chloride (0.1%) for 3 minutes. Molecular characterization to confirm the hybridity was done with ISSR marker as ISSR marker is known to overcome the disadvantages encountered in using SSR marker. It also known to give clear and reproducible banding pattern which helps in differentiating the parents and to confirm the hybridity and it is known to be a better market then other dominant markers such as RAPD.

Title: Intergeneric crossing, intervarietal progeny evaluation and mutagenic studies in Papaya (*Carica papaya* L.) (2011)

Bharathi Nirujogi, UAS,Bangalore, Guide:Dr. M. R. Dinesh

The investigation on “Intergeneric crossing, inter-varietal progeny evaluation and mutagenic studies in papaya (Carica papaya L.)” was conducted at Division of Fruit crops, Indian Institute of Horticulture Research, Bangalore during 2010-2011. A breeding programme was undertaken using Carica papaya var. Arka Surya and Vasconcellea cauliflora with a view to raise progenies resistant to Papaya ring spot virus (PRSV). An attempt was made to break the barrier using different chemicals like (sucrose 5% + boric acid 0.5% + calcium chloride 0.1%). Among the different chemicals used, boric acid0.5% resulted in good fruit set (96.2%). Final fruit retention till harvest (42.8) and seed recovered per fruit (178.6) were maximum in the case of sucrose 5%. Germination was recorded for the seeds treated with boric acid 0.5% (1.2%).Selfed progenies of gynodioecious hybrids Arka Surya and Arka Prabhath were evaluated for morphological and fruit traits. Variability was found within the progenies due to different genetic constitution of female and hermaphrodite plants in the population. However, quality of the fruits did not differ much. To create variability for plant height and other characters in the varieties Arka Surya and Arka Prabhath chemical mutagen, EMS was used along with KNO3 to increase the mutagen. LD50 was observed at 0.3 percent EMS. Early germination and maximum germination per cent were observed in control. EMS at 0.2 percent along with KNO3 can bring about dwarf statured plants. In the M0 generation, many morphological abnormalities were observed which shows the possibility of excellent variability in advanced generations.

Title: Study of intergeneric, mutagenic progenies and validation of intergeneric hybridity using markers in Papaya (*Carica papaya* L.) (2012)

G. L. Veena, UAS, Bangalore, Guide:Dr. M. R. Dinesh

Papaya is one of the most important fruit crops valued for its rich nutrient content mainly vitamin A and Carica Papaya Ring spot Virus (PRSV) is the major impediment in the commercial cultivation. The present investigation on "Study of intergeneric, mutagenic progenies and validation of intergeneric hybridity using markers in papaya (Carica papaya L.)" was carried out at the Division of Fruit crops, Indian Institute of Horticulture Research, Hessarghatta, Bengaluru during 2011-2012.The experiment on mutation was carried out using Ethyl Methane Sulphonate (EMS), along with KNO3 to increase the efficacy of the mutagen. EMS was used to induce variability in the variety Arka Prabhath with the objective of inducing variability for plant height. The LD50 was observed to beat 0.3 per cent EMS concentration. In M0 generation, many morphological abnormalities were observed, which showed the possibility of large variability in M1generation.Population derived by selfing a hermaphrodite tolerant plant for 'PRSV-p' from the intergeneric cross of Carica papayavar.'Arka Surya'x Vasconcellea cauliflora was evaluated for morphological characteristics. Molecular characterization to confirm the hybridity was done with ISSR and SSR markers. The primers UBC-841, UBC-836, UBC-815and SSR primer P8K72CCF/R showed clear bands, which confirm the hybridity of intergeneric progenies. In the present investigation regular pairing of homologous chromosomes was observed in Carica papaya, Vasconcellea cauliflora and their intergeneric hybrids. There was no heteromorphic chromosomal distribution in hybrids.The intergeneric hybrids, which were found to be tolerant to ' PRSV-p' were assorted for invitro propagation as conventional seed propagation may result in loss of fixed attributes, effective establishment of explant was noticed when they were treated with fungicide (Bavistin0.2%) and bactericide (Streptocyclin 0.1%) along with surface sterilant mercuric chloride(0.1%) for 4 min. The explants cultured on MS medium supplemented with BAP (0.5mg/L), and NAA(0.1mg/L) and GA3(1mg/L) recorded good elongation of shoot lets.

Title: Role of B-genome in evolution of Banana (Musa spp) cultivars and spread of Banana Streak Virus (BSV) (2012)

M. Kishor Kumar, UAS, Bangalore, Guide: Dr. A. Rekha

Plantains and bananas originated from intra and inter specific hybridization between two wild species. M. acuminate Colla. and M. balbisiana Colla., which contributed A and B genomes respectively. B genome is very important as it is associated with resistance to pests, diseases and drought tolerance, determination of the starch type. Although integration of BSV DNA into the host's genome is not required for viral replication, the genome of banana contains numerous endogenous BSV (eBSV) sequences of banana Bgenome. With this background investigation on "Role of B-genome in evolution of Banana (Musa spp) cultivars and spread of Banana Streak Virus (BSV)" was carried out. Results revealed that Musa F1hybrids displayed a wide segregation in all selected morphological characteristics, floral characters such as male bud shape, bract apex shape, wax on the bract, compound tepal basic color, stigma color, lobe color of compound tepal etc showed highest segregation compared to other morphological traits. Sample of 50accessions of natural hybrids representing various genome combinations were tested with the SSR marker (Ma_gSS8) amplified an allele of 733bp in the accessions with exclusively AA genome, 652 bp in accessions having only the BB genome and both the alleles in the interspecific hybrids, which reveled the use of this marker in distinguishing the genomes. And using degenerate conserved primer specific for RT/RNase H regions of ORF-III of BSV amplified eBSVs from two parents i.e. Calcutta-4 and Beeheekela, 20 from out of 82 F1 hybrids and in few natural hybrids, Multiple alignments of these sequences with already known sequences of eBSV present in the NCBI database indicated that natural hybrid (BB), male parent Beeheekela (BB) and F1hybrids (AAXBB) sequences showed 91.32-96.4% nucleotide identity, indicating the BSV genome is passed on from male parent to the hybrids, whereas female parent (Calcutta-4) eBSV has nucleotide homology of only 63% which indicates this eBSV of AA genome has not passed on to the hybrids, however this has 90.3% homology with natural hybrid of ABB group indicating the fact that in nature it might be transferred or integrated in to the BB genome.

Title: Effect of organic practices on growth, flowering, fruit yield and quality of mango cv. Alphonso (2013)

Vinay K. C., UAS, Bangalore, Guide: Dr. Y.T.N. Reddy

The study on "Effect of organic practices on growth, flowering, fruit yield and quality of mango cv. Alphonso" was carried out at the Division of Fruit Crops, Indian Institute of Horticultural Research (IIHR),Hessarghatta, Bangalore during the year 2012-13 on the vegetative growth, flowering, fruit yield and quality parameters of the Alphonso mango. Based on the results obtained from the study, all the growth parameters (Tree height, Tree spread, Trunk girth and No. of flushes) were found to be non significant among different treatments. Flowering shoot percentage were found to be significantly higher with the treatment T12 (50% RDF FYM + AZO + PSB + VAM) (90.00%) and minimum flowering % was observed in treatment T14 (No Manure / Fertilizer) (55.00%). Fruit drop percentage was found to be significantly higher with the treatment T14 (NO Manure / Fertilizer) (81.07%) and lower fruit drop percentage recorded in treatment T11 (100% RDF FYM + AZO + PSB + VAM) (29.17%) at peanut stage of fruit growth, marble and harvest stage the fruit drop percentage found no significant. Weight of fruits per tree was found to be significantly higher with treatment T12 (50% RDF FYM + AZO + PSB + VAM) (61.9Kg/tree) and lowest weight of fruits per tree (30.0Kg/tree) was found in treatment T14 (No Manure / Fertilizer).Average fruit weight was found to be significantly higher with treatment T12 (50% RDF FYM + AZO + PSB + VAM) (255.50g) and the lowest average fruit weight was observed in treatment T14 (NO Manure / Fertilizer) (210.17g).The treatment T12 (50% RDF FYM + AZO + PSB + VAM) was found significantly superior in terms of fruit quality parameters like reducing and non reducing sugars, ascorbic acid, TSS, carotene and lower acidity.

Title: Evaluation of advanced generation intergeneric hybrid progenies of Papaya for PRSV (Papaya Ring Spot Virus) tolerance (2014)

Sunil Gowda, D. C , UAS, Bangalore, Guide : Dr. C. Vasugi

Papaya (Carica papaya L) belongs to the family Caricaceae is one of the most economically important fruit crops of the tropical and subtropical regions of the world. The fruit has high nutritive and medicinal value. The crop is highly susceptible to PRSV disease worldwide. None of the varieties are resistant and various methods have not been successful in controlling the disease. Hence development of virus resistant/ tolerant cultivars through conventional breeding is the only reliable tool for long term control of this disease. In view of this, the present experiment was carried out at the division of fruit crops, IIHR, Bangalore, during the year 2013-2014. The study includes the evaluation of 38 advanced generation progenies along with their parents for morphological, fruit, quality and biochemical parameters, disease resistance and use of molecular markers for confirmation of hybridity. Among the 38 intergeneric hybrid progenies evaluated, the progenies R6P2 and R6P4 were found to be moderately resistant to papaya ring spot virus disease under field condition. These progenies recorded high canopy spread and stem circumference than both the parents. The fruit weight and pulp thickness were also high and was on par with the female parent. Similar trend was observed for the traits TSS, titrable acidity and total sugars. The vitamin C, total carotenoids and lycopene were also found to be moderately high in these progenies. Peroxidase activity was low and total phenols were high compared to the female parent. It is concluded from the present investigation, that the moderately resistant progenies R6P2 and R6P4 may be advanced to F6 generation for further evaluation considering the disease intensity score and also morphological characters, fruit quality and biochemical parameters.

Title: Intergeneric hybridization and progeny evaluation in Papaya (*Carica papaya* L.) (2015)

Lichamo Jyanthan, UAS, Bangalore, Guide: Dr. C. Vasugi

Studies on “Intergeneric hybridization and progeny evaluation in papaya (C. papaya L.)” was carried out in the Division of fruit crops, Indian Institute of Horticultural Research, Bengaluru during 2014-2015. Two systematic experiments were carried out; to overcome the cross ability barriers between Carica papaya hybrid vatrieties Arka Surya and Arka Prabhath with Vasconcellea cundinamarcensis and to evaluate the adavanced intergeneric hybrid progenies(38) of the cross Arka Surya x V. cauliflora for PRSV tolarence. In overcoming the intergeneric cross ability barriers, among the nutrients tried, the combined effect of Sucrose 5 per cent + Boric acid 1.0 per cent + Calcium Nitrate 1.0 per cent + Magnesium Sulphate 1.0 per cent + Potassium Nitrate 1.0 per cent resulted in significantly highest mean value for fruit set (58.50 %), number of fruits harvested (31.00), number of fruits recovered with fertile seeds (5.0) and number of seeds recovered (282.00).In the evaluation of advanced intergeneric hybridprogenies (38) of the combination Arka Surya X V. cauliflora for PRSV tolerance, significant differences were observed among the progenies for vegetative characters such as plant height, stem girth and canopy spread and fruit characters viz.,fruit weight, fruit length, pulp thickness, number of fruits, yield per tree, total soluble solids, carotenoids and lycopene. Traits like fruit weight, fruit width, fruit volume were found to be significantly correlated both phenotypically and genotypically. On the basis of PRSV tolerance, fruit and yield parameters seven progenies viz., R5P16, R6P16, R7P16, R14P7, R17P16, R19P1 and R35P10 were identified for further advancement.

Title: Studies on utilization of wild species of guava (*Psidium guajava* L.) for crop improvement (2017)

Alfia M. A, UHS, Bagalkot, Guide: Dr. C.Vasugi

Studies on utilization of wild species of guava (Psidium guajava L.) for crop improvement" was carried out at the Division of Fruit crops, ICAR-Indian Institute of Horticultural Research, Bengaluru during 2016-2017. The phenology of wild species, its cross ability and the volatile aroma profile was carried out. The results revealed that synchronization was noticed for peak flowering (28 days), duration of flowering (60 days) and anther dehiscence (7.00-8.00 a.m) of P. guineense and P. chinensis (22, 58 and 8.00-10.00 a.m, respectively) with Arka Kiran (30, 65 and 7.00-9.00 a.m, respectively). On the basis of hybridization, P. chinensis was found to be a good combiner with cultivated varieties, among which, Arka Rashmi revealed high values (fruit set-97.07 %). Cytological studies on cultivars and wild species revealed that chromosomes obtained were not in active mitotic metaphase. The fruit morphological studies revealed that fruits of wild species were small (P. cattleianum-22.90, P. guineense-31.41 and P. chinensis-29.70 g) with hard seeds (P. guineense-13.33 and P. cattleianum-11.17 kg cm-2) except P. chinensis (5.00 kg cm- 2). The TSS, titrable acidity, vitamin C, total sugars, reducing sugar and non reducing sugar of wild species (P. cattleianum- 7.730B, 1.28%, 242.53 mg 100-1 g, 5.49 g 100-1g, 4.45 g 100-1g, 1.48g 100- 1g,respectively, P. guineense-11.13, 0.60, 77.27, 7.67, 5.26, 3.52 respectively and P. chinensis-9.67, 0.69, 232.47, 8.56, 5.13, 3.13 respectively) was comparable whereas, total carotenoid and lycopene (P. cattleianum-7.60 and 2.30 mg 100-1 g, respectively and P. chinensis-5.30 and 3.00 mg 100-1 g) content was found to be inferior to the cultivars. The volatile aroma profile revealed that P. chinensis was rich in mono terpenoid (limonene-19.81%), P. guineense in sesquiterpenoid (α-Cedrene-41.10%) and alcohol (β-Bisabolol-3.12%), P. cattleianum in esters ((Z)- Valerenyl acetate-3.37%). Hence, the wild species could be exploited for transfer of these traits to the hybrids.

Title: Studies on the performance of different Papaya (*Carica papaya* l.) cultivars grown under net house and open field condition (2017)

Ganesha A., Dr.YSR Horticulture University, Guide: Dr. G. Karunakaran

An experiment was conducted at the IIHR- Central Horticultural Experiment Station, Hirehalli, Tumakuru, Karnataka to study the performance of four papaya cultivars grown in two different environmental conditions i.e., net house and open field. Four papaya cultivars viz., IGH, Arka Surya, Red Lady and Arka Prabhath were established under insect proof screen house as well as in the open field. The papaya cultivars were assessed for their morphological, yield and quality attributes both in the net house and open field conditions to identify the variation in growth and yield among the cultivars as well as the environmental conditions. The cost economics was also worked out for cultivation of papaya in both the environments to know the economic feasibility. The study revealed that significant differences were existed among the cultivars and the environmental conditions for various morphological parameters. The papaya cultivars grown under net house showed better results than the papaya cultivars that grown under open field condition. The microclimate prevailed in the net house favoured varied metabolic activities of the plants and promoted the plant growth significantly. It also favoured early flowering and early harvest compared to the open field. The fruit yield and quality varied significantly among the four cultivars and environmental conditions. The fruit yield was found to be more in the net house than the open field. Among the cultivars, the cultivar Red Lady was recorded maximum yield compared to other cultivars with big sized fruits. The total soluble solids, total sugars, reducing sugars and ascorbic acid content were found to be recorded more in the fruit grown in net house than the open field. Of the four cultivars, the cultivar Red Lady was found to be performed better in all the quality traits. There was no incidence of PRSV inside the net house throughout the course of experiment. Whereas, all papaya cultivars in the open field was affected by PRSV. The result revealed that both the cultivar Arka Surya and Arka Prabhath were susceptible that expressed more symptoms on the plants. The Benefit: Cost ratio was found to be more to the cultivar Red Lady cultivar that grown under net house condition due to its higher yield and high returns than the other cultivars.

Title: Analysis of Genetic diversity in Pomegranate using SRAP (Sequence Related Amplified Polymorphism) Marker (2017)

Shwetha H.K., Dr.YSRHU, AP, Guide: Dr. Kanupriya

Pomegranate (Punica granatum L.), is one of the most important fruit crop of arid and semiarid regions. In the present study, Sequence-related amplified polymorphism (SRAP) was used to assess the genetic diversity of 114 pomegranate genotypes maintained in the field gene bank at ICAR-Indian Institute of Horticultural Research, Hessarghatta, Bangalore. The DNA from these genotypes was isolated using CTAB method. Totally 40 SRAP combinations were used for screening, 10 primer combinations showed polymorphism. The selected primer combinations are used for polymerase chain reaction along with 114 pomegranate genotypes. The PCR products were then run on agarose gel electrophoresis the bands were observed under UV transilluminator. All intense, reliable, and clearly distinguished SRAP products were scored as presence (1) and absence (0) to analyse the maximum polymorphism producing primer combinations. The number of alleles per locus ranged from 1.66 to 4.00 with an average of 2.03. The average polymorphic information content (PIC) value was 0.24. The expected heterozygosity varied from 0.215 to 0.445 with an average of 0.306. The cluster analysis was performed using DARWIN version 6.0 software. The dissimilarity coefficients ranged from 0 to 1. All the 114 genotypes were grouped into three major clusters. There was no clear grouping based on origin. The analysis of molecular variance (AMOVA) indicated no significant genetic variation (p=0.31)between pomegranate genotypes from different geographical locations. Overall genetic variation among the population groups was low, while 99% of variation was due to within group differences. These results confirmed that SRAP markers could be powerful tools and an effective marker system for determining the genetic diversity and population genetic structure of the pomegranate.

Title: Characterization and Cytological studies in Pummelo (*Citrus maxima* L.) (2017)

G. Sandhya Rani, Dr. YSRHU, AP, Guide: Dr. M. Sankaran

The experiment was conducted at ICAR- Indian Institute of Horticultural Research, Hessarghatta, Bengaluru, during the period from July 2016 to May 2017, with the objective to characterize the pummelo accessions based on morphological and biochemical parameters and also cytological studies in selected accessions. Out of twenty one accessions characterized for morphological traits, highly significant variations were observed among all the tree, leaf and fruit characters. The maximum tree height (426.66 cm) was found in accession-I, canopy spread in north-south direction in accession 6 (551.66 cm) and in east- west direction in accession-7 (573.33 cm). Association analysis indicated that yield per plant showed positive and highly significant results with tree height (cm) (r=0.48), canopy spread in east west direction (cm) (r= 0.44), fruit diameter (cm) (r= 0.51) and number of fruits per plant (r= 0.90), leaf lamina length (cm) (r= 0.37) and showed positive significant association with canopy spread at north south direction (cm) (r= 0.27), fruit weight (g) (r= 0.30), average number of seeds (r= 0.27), juice recovery (%) (r= 0.25) and TSS 0Brix (r= 0.25 among the biochemical characterization, maximum TSS (15.06 °Brim) was recorded in accession-14 whereas reducing and total sugars in accession-21 (8.25 and 10.33 g/100g respectively. Accession-3 recorded maximum content of ascorbic acid (78.00 mg/ l00 g) and maximum acidity was in accession-15 (2.28 per cent). In aroma profiling 50 compounds were identified in selected accessions, and found that limonene, a mono terpenoid was found maximum in accession-20 (1) (49.33 per cent). In flavonoid profiling of selected accessions, 12 compounds were identified and among them naringen in was maximum in accession-22(4). Cytological studies were conducted in determining the chromosome number of selected accessions. Though there was morphological variation in size of leaves and fruits, there was no difference in chromosome number.

Title: Standardization of growth regulators for rachis elongation in crimson seedless and berry flower thinning in red globe Grapes (*Vitus vinifera* L.) (2017)

Sunita Patil, YSR Horticultural University, AP Guide: Dr. J.Satisha

Crimson Seedless is a coloured seedless grape, which is gaining popularity in India due to its attractive colour, good bunch and berry quality with better shelf life. this variety is highly sensitive to excess application of GA3 and following GA3 schedule similar to that of Thompson Seedless grapes adversely affects bunch quality.. A research trial was undertaken during the year 2016-17 at (ICAR - IIHR) located at Hessarghatta, Bengaluru was laid out in Randomized Block Design (RBD) comprising a total of four treatments. Among different treatments, pre-bloom spray of GA3@5 ppm could produce less compact bunches with highest total length of rachis(124.907cm), average bunch weight (507.486 g), berry weight (4.92g); berry length (25.85 mm); TSS (18.58^0B), sugar acid ratio(83.817); total sugars(18.2g/100g) and with least bunch compactness(0.940). Different organic and inorganic chemicals viz., 0.5 % Olive oil (T1); 0.3% Caffeine (T2);0.1 % Hydrogen Cyanamide (T3); 0.1 % Dinitro Ortho Cresolate (T4);0.5% Copper Sulphate (T5) were sprayed during full bloom stage and were controlled with manual berry thinning at 8-10 mm stage (T6) and untreated control (T7). Spraying of olive oil could increase rachis length (122.73cm) ,least bunch compactness (0.91) was observed and CuSO4(1.09) also could produce less compact bunches.However the average bunch weight, berry diameter and berry length was highest on vines sprayed with caffeine and olive oil. Bunch compactness was highest on control (2.56) vines and least bunch weight(599.375g) was also recorded on control vines. Among different treatments manual berry thinning at 8-10 mm stage could produce highest TSS and total sugars. Though the treatments like $CuSO_4$ and hydrogen cyanamide could produce loose clusters with good bunch weight, scorching of rachis was observed indicating their toxicity. Among the treatments studied the bunches treated with olive oil and caffeine could produce good quality bunches.

Title: Effect of foliar application of plant growth regulators and sea weed extract on fruit yield and quality of Mango (*Mangifera indica* L.) (2018)

Aseema Dash, CHES (ICAR-IIHR), Bhubaneswar, Guide: Dr. Deepa Samant

The present investigation was conducted at ICAR-IIHR-Central Horticultural Experiment Station, Bhubaneswar-751 019 during 2017- 201 8 to study the response of mango (Mangifera inhdica L.) variety 'Arka Neelachal Kesari' to foliar application of plant growth regulator (Brassin osteroid and Triacontanol) and sea weed extract (Ascophyllum nodosum extract i.e., ANE). The experiment was laid out in randomized block design with 10 treatments, viz., brassino steroid (0.1, 0.3 and 0.5ppm), triacontanol (1, 3 and 5ppm), ANE (1000, 3000 and 5000 ppm) and water as control. Treatments were foliar sprayed thrice at flower initiation, pea and marble stages of fruit growth. All the treatments of triacontanol and ANE recorded significant improvement in panicle length and width, fruit retention, size and weight of fruit, yield and fruit quality parameters, viz., total soluble solids (TSS), total sugar and TSS: acidity ratio over the control, whereas, no significant improvements for these parameters were recorded by brassino steroid treatments. Foliar application of ANE at higher concentration, i.e., 3000 and 5000ppm outperformed all the three triacontanol treatments. The ANE treatment @ 5000ppm recorded the maximum values for panicle size (25.74 cm length and 16.42cm width), no. of fruits/tree (133.25), average fruit weight (188.84g) and yield (25.l 7kg/tree), whereas, the lowest values were recorded under control (20.56cm panicle length and 12.07cm panicle width, 93.84 fruits/tree, 169.28g average fruit weight and 15.86kg/tree yield). The same treatment recorded the lowest fruit drop (49.89%), followed by 3000ppm ANE (50.78%). Maximum fruit drop was observed under control. With respect to fruit quality, ANE @ 3000ppm produced the fruits with highest TSS (19.62°B), followed by 5000ppm (19.29°B). However, TSS: acidity ratio was found to be highest in ANE @ 5000ppm. Hence, in mango, three foliar application of ANE @ 3000 or 5000ppm at flower initiation, pea and marble stages of fruit growth could be useful to tackle the problem of fruit drop and to get higher yields with improved fruit quality.

Title: Studies on flowering behaviour of important varieties of Mango (*Mangifera indica* L.) in Odisha (2018)

Krushna Chandra Mohanty, CHES, Bhubaneswar, Guide: Dr. G.C. Acharya

The present investigation entitled "Studies on flowering behaviour of important varieties of Mango (Mangifera indica L.) in Odisha" was carried out at Central Horticultural Experiment Station, CAR- Indian Institute of Horticultural Research at Bhubaneswar during 2017-18.The objective of the experiment is to study the flowering behavior of some popular mango cultivar under the East and South Eastern Coastal Plains Agro climatic conditions of Odisha. The treatments are laid out in factorial CRD with 3 replications and each replication consisted of 2 plants. The flowering intensity is concerned, significantly higher (59.44%) was observed in East direction whereas the lowest (42.22%) was in west direction. Highest sex ratio was observed in north direction (0.19) than East direction (0.14).In variety Dusheheri the sex ratio is 0.2 as compared to Amrapali (0.14).Highest percentage of fruit set at marble stage was found in cultivar Dusheheri (7.52%) followed by Amrapali (7.20%).Further it was highest in east direction (7.58%) and lowest in north direction (6.04%) but the final fruit set percentage at mature stage was found in cultivar Dusheheri (3.72%) and lowest in Arka Neelachal Kesari (1.87%).The fruit set was highest in east direction (2.92%) and the lowest in north direction (2.14%). The fruits of the East position branches had the maximum fruit weight (183.66g), maximum fruit length (9.01cm), maximum fruit diameter (6.13cm) and maximum TSS (9.16°Brix) as compared to other directions. Flowering intensity is highly positive and significantly correlated with total number of male flowers perpanicle (0.876) whereas it is highly negative and significantly correlated with days taken to 50%flowering. Fruit retention percentage at mature stage is highly positive and significantly correlated with fruit retention percentage at mature stage calculated from the total number of hermaphrodite flowers (0.945).Hence it can be concluded that the cultivar Amrapali has the maximum flowering duration and intensity as well as fruit weight and TSS making it an ideal variety for adoption by the Odisha farmers. The mango plants are to be pruned in such a way that there will be maximum orientation of canopy architecture towards East side to get better yield and quality of fruit.

Title: Effects of paclobutrazol on root traits, plant growth and nutrient uptake of Mango (*Mangifera indica* L.) (2018)

Manas Ranjan Sahoo, CHES, Bhubaneswar, Guide: Dr. Kundan Kishore

The present investigation, entitled “Effects of paclobutrazol on root traits, plant growth and nutrient uptake of mango (Mangifera indica L.)” was conducted during 2017-18 at Central Horticultural Experiment Station, (ICAR-IIHR), Bhubaneswar. There were five treatments with varied concentrations of PBZ (0, 0.25, 0.50, 0.75, 1.0 g a.i/plant) and each treatment was replicated five times. The experiment was laid out in completely randomized design (CRD). The experiment was conducted to study the effect of paclobutrazol on root traits, plant growth and nutrient uptake in mango s. In addition, the relationship between root traits and growth parameters were also ascertained. There was a significant effect of paclobutrazol on growth characters, root traits and leaf nutrient status (nutrient uptake) of mango. The plant height of mango seedlings was significantly reduced with the increase in concentration of PBZ. At higher concentration of PBZ (1.0 g a.i/plant), plant height was reduced by 20%, leaf area was reduced by 50% and internodal length was reduced by 40%. There was an increase in leaf chlorophyll contents with PBZ concentrations. Root traits like root weight, root length, root-shoot ratio, proportion of primary and tertiary roots were significantly reduced when PBZ was applied at higher concentrations. On the other hand, there was an increase in percentage of tertiary roots in PBZ treated mango seedlings. The proportion of secondary root in the root system of mango seedling was unaffected with _PBZ treatments. The anatomical study of treated roots of mango seedlings indicated restriction of vascular and cortical regions. Leaf nutrient status indicated reduction in the nitrogen, phosphorus and potassium content whereas the micronutrients (Fe, Mn, Zn) did not show any trend in result. Correlation studies indicated that leaf area was significantly and positively correlated with root traits. Similarly, root traits were significantly and positively correlated with leaf nutrient contents. It is evident that PBZ significantly influence plant growth, leaf chlorophyll contents and uptake of N, P, K.

Title: Studies on vegetative propagation in rambutan (*Nephilium lappaceum* L.) (2018)

Panchaal Bhattacharjee, UHS, Bagalkot, Guide: Dr. T. Sakthivel

Being a crop of exotic origin, the area expansion of rambutan is significantly relied on the supply of quality planting material. Studies on Vegetative propagation in Rambutan (Nephilium lappaceum L.) were carried out in order to standardize suitable vegetative propagation technique (viz. budding, air layering, grafting) and a micro propagation protocol for in vitro rambutan rootstock multiplication. The experiments were conducted at two different locations during 2017-18.Investigations on budding, air layering, grafting techniques in rambutan was carried out at Central Horticultural Experiment Station (CHES), Chettalli, Kodagu, Karnataka. Whereas, the micro-propagation experiments of rambutan was carried out in the plant tissue culture laboratory at ICAR-IIHR, Bengaluru, Karnataka.Patch budding was the best among the three different budding methods viz. patch, forkert and chip budding carried out with significantly higher rate of budding success (70.00 %), minimum days taken for sprouting (36.86 days) and significantly lowest rate of mortality (6.28 %).In air layering, among the two different rooting media substrates used coir fibre was better than coco peatin terms of success in rooting (22.50 %), survival (53.12 %).Amid of the different concentration of IBA was tried, significantly better response was observed in treatment of IBA 2500ppm.Within the interaction treatments, M T-Coir fibre with IBA 2500ppm was significantly the best treatment with highest percent success of rooting (37.21%), higher numbers of primary roots (13.33), and higher percentage of survival (87.50 %). Approach grafting method was superior among different methods of grafting studied with maximum rate of graft success (72.86 %), minimum days required for sprouting (46.29 days) and higher number of sprouted bud (4.29) along with a very low mortality rate (5.87 %). In micro-propagation studies nine different types of rambutan explants were tried, single nodal segments from both lab grown current season seedlings and one year old seedlings showed better survival rate of 46.67 % and 43.33 %, respectively. Best media for shoot initiation was found to be WPM + BAP (2mg/l) in both nodal explants from lab grown current season seedling and one year old seedling sources, exhibiting 91.67 % and 86.67 % of survival respectively with least numbers of days (9.33 and 9 days respectively) required to initiate shoot growth. Best in vitro rooting was achieved with MS + IBA (4mg/l) + IAA (4mg/l), in terms of highest rooting (78.33 %) with lesser days required for root initiation (38.67 days) and rooted plantlets were successfully hardened by transferring them to plastic cups containing coco peat.

Title: Studies on source -sink relations to optimize yield and quality in Grape (*Vitis vinifera* L.) cv. Red Globe"(2021)

Vinodh Kumar, V, Indira Gandhi Krishi Vidyalaya, Raipur Dr. J.Satisha

Grape (Vitis vinifera L.) is one of India's most important fruit crop, across the globe, in recent years many new green and colored varieties are finding place in export market. The important varieties are Crimson Seedless, Fantasy Seedless, Red Globe, Autumn Royal etc. Physiological parameters like photosynthetic rate, percent light penetration into the canopy were significantly influenced by canopy management practices where in 20 to 30 canes per vine with 30 leaves had highest photosynthetic rate which also had higher light penetration into the canopy compared to vines having 40 canes, 13 leaves and 40 bunches.. Pulp to peel ratio was significantly influenced by cane load and leaf load alone where in 30 canes and 11 leaves recorded maximum pulp to peel ratio. It was also affected by interaction effects of all the three factors viz., cane, leaf and bunch load. All the interaction effects viz, C×L, L×B, B×C and C×L×B were found to be significantly influenced the anthocyanin content which clearly indicates all the canopy components play major role in anthocyanins biosynthesis and /or degradation. Total phenol content was significantly influenced by all three canopy components like cane load, leaf number and bunch load and their interaction effect while flavonoids was significantly influenced by only cane load and bunch load while leaf number didn't affect the flavonoid content significantly.The above findings were supported by correlation studies between various parameters studied; the rate of photosynthesis is highly correlated with percent light penetration into the canopy. Leaf area was negatively correlated with percent light penetration, TSS, pulp to peel ratio and sugar acid ratio.. Percent light penetration also had positive correlation with TSS, pulp to peel ratio, yield per vine and sugar acid ratio. Among the parameters studied, leaf area was found be negatively correlated with light penetration, TSS, pulp to peel ratio and sugar acid ratio. There was weak correlation between leaf area and yield per vine. These relations clearly suggests that it is not the total leaf area which is important but, the effective leaf area with good light penetration into the canopy which may directly influence the parameters like rate of photosynthesis, TSS, pulp to peel ratio and sugar to acid ratio.

Title: Physico-chemical and molecular characterization of bael (*Aegle marmelos* Correa.) accessions (2022)

Udaya Kumar, K. P., UHS, Bagalkot, Guide: Kanupriya Chaturvedi

An experiment was carried out on physico-chemical and molecular characterization of bael (Aegle marmelos Correa.) accessions during 2020-21, with an objective to assess morphological, biochemical, molecular diversity and value addition of fruit pulp. The experiment was carried out on 24 accessions of bael conserved in field gene bank at Indian Institute of Horticultural Research, Bengaluru. Among 24 accessions, 18 accessions are seedling progenies from North Indian type, NB-1 and NB-3 are secondary collections from Andaman and Nicobar Island and remaining 6 accessions are seedling progenies of South Indian type from Nanjangud region of Karnataka. All the accessions showed variation in terms of DUS characters given by PPV & FR Authority, New Delhi. The analysis of variance revealed a significant difference concerning fruit and quality parameter. The maximum fruit length (10.6 cm), fruit width (11.6 cm), fruit weight (1478.8 g), pulp weight (894.3 g), shell weight (534.1 g), number of fruits (215), shell thickness in (2.7 mm), seed weight (65 g), number of seeds (50), pulp: shell (2.2 %). Quality parameters viz., TSS (36 °B), acidity (1.23 %), vitamin C (98.08 mg/100g), total sugars (25.07 g/100 g), phenols (24.39 mg GAE/g fw), flavonoids (74.63 mg CE/g fw), carotenoids (14.96 µg/g fw), moisture content (68.00 %), ash content (4.30 %), antioxidant content DPPH (96.24 mg AEAC/100g), FRAP (150.93 mg AEAC/100g) were recorded during the investigation. The SRAP marker characterization of the accessions revealed that the highest number of bands and PIC value was observed in primer combination (Me3Em3 and Me4Em5). Development of RTS was successful with T_4 (15% pulp +15°B TSS) showing highest overall acceptability. The investigation revealed that among 24 accessions, B-1, B-8 and B-18 were most promising for growth, yield and quality parameters. These accessions can be used for further evaluation or selection as a commercial cultivar or gene source in bael improvement programme.

Title: Evaluation of intergeneric hybrid progenies of Papaya (*Carica papaya* L.) for PRSV resistance (2022)

Megha Arun UHS, Bagalkot, Guide: Dr. C.Vasugi

The present investigations were carried out during 2020-2021 at the Division of Fruit crops, ICAR-IIHR, Bengaluru. Two systematic experiments were carried out viz., Evaluation of F_1 intergeneric hybrids (Arka Prabhath x V. cauliflora and Arka Prabhathx V. cundinamarcensis) for morphological, fruit and yield traits coupled with PRSV tolerance and screening the F_2 intergeneric population for PRSV resistance by challenge inoculation at seedling stage. In the evaluation of F_1 intergeneric hybrids, 7 progenies of Arka Prabhath x V. cauliflora (IGHF$_1$S4-1, IGHF$_1$S4-12, IGHF$_1$S4-13, IGHF$_1$S4-14, IGHF$_1$S4-15, IGHF$_1$S4-17 and IGHF$_1$S4-18) and 6 progenies of Arka Prabhath x V. cundinamarcensis (IGHF$_1$S1-17, IGHF$_1$S1-19, IGHF$_1$S6-20, IGHF$_1$S2-14, IGHF$_1$S5-12 and IGHF$_1$S5-14) were selected and forwarded to F_2 generation based on desirable fruit traits coupled with PRSV tolerance. Hybridity of the selected progenies was also confirmed using SSR marker. PRSV screening of F_2 population along with its parents was carried out by challenge inoculation. In Arka Prabhath x V. cauliflora combination, a total of 405 F_2 progenies and 157 BC_1 progenies and in Arka Prabhath x V. cundinamar censis,a total of 279 F_2 progenies and 50 BC_1 progenies which were free from PRSV were field planted after challenge inoculation. Chi-square (χ^2) test resulted in segregation ratio of 15:1 for susceptible to resistant in the combination of Arka Prabhath x V. cundinamarcencis and ratios of 15:1 and 13:3 in Arka Prabhath x V. cauliflora combination revealed di- genic inheritance of resistance to PRSV. In the evaluation of F_2 progenies that were field planted after challenge inoculation, 10 progenies (IGHF$_2$S7-19, IGHF$_2$S7-2, IGHF$_2$S7-12, IGHF$_2$S7-26, IGHF$_2$S8-6, IGHF$_2$S8-15, IGHF$_2$S8-22, IGHF$_2$S8-28, IGHF$_2$S9-9 and IGHF$_2$S10-12) of the combination Arka Prabhath x V. cauliflora and 8 progenies of Arka Prabhath x V. cundinamarcencis (IGHF$_2$11-24, IGHF$_2$12-25, IGHF$_2$10-28, IGHF$_2$10-29, IGHF$_2$12-2, IGHF$_2$12-25, IGHF$_2$14-15 and IGHF$_2$14-16)were found to have desirable fruit quality (TSS: 12.70 to 14.20 ^{0}B, fruit weight: 416.00 to 1905.30g, cavity per cent: 14.29 to 28.89, pulp thickness: 2.45 to 3.40cm) coupled with PRSV tolerance and could be considered for selection.

Vegetable Science

Title: Correlation and path coefficient analysis in Capsicum (*Capsicum annum* L.var.grossum Saddt.) (1981)

D.N.Narasimha Raju, UAS, Bangalore, Guide: Dr.D.P.Singh

Seventeen pure lines of capsicum were laid out in two randomized block design with three replications each under two spacing's of 50 cm x 40 cm and 50 cm x 30 cm, with aview to obtain information on variability, heritability, correlation among different traits and their contribution to trait yield. Moderate coefficients of variability (genotypic andphenotypic) were obtaining for early fruit number, plant height, number of secondary branches and numberof seeds under both the spacing's. The traits such as early fruit yield, total fruit yield and total fruit number under closer spacing and fruit breadth under normal spacing exhibited moderate coefficients of variability. The path analysis revealed that early fruit yield had the highest direct effect on total fruit yield. Fruit number (early and total) had positive direct and indirect effects on total fruit yield. The direct effect of days to flowering was low but indirect effects through early fruit yield and total fruit number were moderate and negative. Indirect effect of plain height and plant spread through early fruit yield and total fruit number were also moderate and positive. The study indicated that the ideotype of capsicum should be early flowering and should have more height, spread and number of fruits per plant.

Title: Varietal differences in Chillies for pungency, pigmentation and ascorbic acid contents (1981)

P.UshaRani, UAS, Bangalore, Guide: Dr.D.P.Singh

Significant differences were observed among 73 chilli genotypes for twenty traits except stem height. The maximum phenotypic and genotypic coefficients of variability were found for capsaicin content. The differences between PCV and GCV were narrow for ascorbic acid content, fruit length, plant height, pedicel length, stem diameter, plant spread, fruit diameter and 1000-seed weight indicating very little environmental influence. Heritability estimates were high for fruit length, ascorbic acid content and plant height. The maximum genetic advance was estimated for capsaicin content. Combination of high heritability and high genetic advance was obtained for fruit length and ascorbic acid indicating additive gene effects. Dry fruit yield was positively correlated with number of fruits, stem diameter, plant spread, plant height, number of primary and secondary branches, root dry weight, root volume and 50-fruit seed weight; capsaicin content had negative correlations with 50-fruit dry weight and fruit length. Capsanth in content had positive correlations with stem height, ascorbic acid and 50-fruit stalk weight. Ascorbic acid was correlated positively with capsanthin content, fruit length, pedicel length, 50-fruit stalk weight, 1000-seed weight and negatively with number of fruits and fruit length to such an extent that the fruit yield and pungency on one hand and the quality factors like ascorbic acid and pigment contents on the other could be improved simultaneously. Path coefficient analysis revealed that fruit number, stem diameter and 50-fruit seed weight were the major factors influencing dry fruit yield directly and positively while 50-fruit dry weight exhibited a negative direct effect on pungency. Stem height, ascorbic acid and 50-fruit stalk weight had positive direct effects on pigmentation. Ascorbic acid was positively and directly influenced by capsanthin content and 1000-seed weight.

Title: Genetical studies in Chillies (*Capsicum annum* L.) (1981)

M.B.Sontake, UAS, Bangalore, Guide: Dr.D.P.Singh

An investigation was undertaken to study heterosis, heterobeltiosis, combining ability and gene action of ten important characters in chillies (Capsicum annum) through a 9-parent full allels analysis. The investigation was carried out at the Division of Vegetable Crops, IIHR, and Bangalore. The heterosis percent of F_1 hybrids over all the parents was maximum for yield (24.63) followed by the number of secondary branches (24.42) number of primary branches (19.59) days to flower (13.52) and plant height (10.55). For other five parameters, it ranged between four to nine percent only. The maximum heterobeltiosis was expressed in terms of ascorbic acid in cross P_7xP_9 by 116.04% and minimum of 16.17% for plant height in cross P_7xP_6. For yield, it was 61.40% in cross P_2xP_5. In number of fruits per plant, none of the F_1 hybrids exhibited significant heterobeltiosis. There was not even a single heterobeltiotic F_1 hybrid for fruit diameter, fruit length, and number of fruits and yield which exceeded the top parent. The present investigation revealed the presence of additive dominant and epistatic gene-action in varying proportions. Single plant selection is suggested for fixing and improving characters like number of fruits, where gene action is mainly additive. For characters like fruit diameter and fruit length having major role of additive gene action and very little of non- additive component, initially single plant selection and later recurrent selection may be followed. Over dominance coupled with epistasis and to some extent additive gene action appeared to influence the number of primary and secondary branches, ascorbic acid and total carotenoids. Reciprocal recurrent selection and heterosis breeding can bring about improvement in those characters.

Title: Studies on improvement of bottlegourd (1982)

K.T. Shivanandappa, UAS, Bangalore, Guide Dr.A.B.Pal

A study was taken up to observe the expression of heterosis in the inter varietal hybrids of bottle gourd and scope of improvement by this method. Two round fruited varieties No.7 (Saharanpur, UP) and Karnataka Local as well as two long fruited varieties long Dhavidarand Jhalarwali together with a collection No.45-1-1- from South Africa were used for hybridization. The F1 hybrids exhibited vigour in the form of early seed germination (by 4days) and early fruit maturity (6 to 15 days). The flesh thickness of hybrid fruits was higher by 16-27%. Yield recorded 10-48% over the better parents. Spread of harvesting period was greater in hybrids.

Title: Studies on hybrid seed production in Brinjal (*Solanum melongena* L.) (1982)

N.Basavaraju, UAS, Bangalore, Guide: Dr.O.P.Dutta

Anthesis in brinjal line 22-1 commenced at 4.30 a.m and another dehiscence was complete by 7.45 a.m. the stigma was maximum (90%) on the day of anthesis pollination a day prior to anthesis gave 80% fruit set and was best suited for hybrids seed production. Pollen grains of brinjal variety supreme germinated best in 28% sucrose with 0.01% boric acid in vitro. Pollen grains can be stored for 3 days at 90% relative humidity without much loss of viability. Pollination operation, using glass rod and matchstick as pollination tools and butter paper bag as covering material were most suitable and gave the highest number of seeds (1304 to 13170) and maximum seed weight (6.67 to 6.9 g)per fruit. There are two flowering flushes of good fruit set in brinjal line 22-1. To get maximum seed number and seed weight, bud pollination during first 30 days is recommended. Brinjal seeds stored for two months period under room temperature gave 72.66 to 81.33% germination. However, two year old seeds gave 40 to 44% germination. Seeds stored for 6 years failed to germinate. For producing one kilogram hybrid seed in brinjal economically it took 17.36 hours to complete the operations like emasculation, pollination and flower covering in 809.0 flowers using glass rod as a pollination tool and cotton capsule as a covering material.

Title: Inter-relationship between powdery mildew resistance to other economic trails in Pea (*Pisum sativum* L.) (1983)

R.Krishna Manohara, UAS, Bangalore,Guide: Dr.A.B. Pal

An investigation was carried out to study the influence of the disease powdery mildew on growth and yield characters in pea (Pisum sativum L.). Eight parents with different reactions to the disease as resistant, tolerant and susceptible and six segregating populations (F_2) resulting from the crosses between different categories of the above parents were used. To have a better picture of the effect of the disease to different degrees of infestation the study was conducted under two sets of conditions. The first set of the crop (3 replications) was sprayed with fungicides to control the disease and the second set crop (3 replications) was not sprayed to enable disease infestation. The influence of disease on growth in terms of plant height was observed only during the later stage i.e., after infestation occurred which was further substantiated by negative correlation. The resistant and tolerant lines maintained superiority over susceptible varieties with regard to green pod yield. The general reduction in green pod yield of unsprayed plants as a result of disease infection was to the tune of 57% in the most susceptible variety. The difference in yield between resistance and susceptible was 34% during the fourth picking which was the peak period of production. The effect of the disease on green seed yield was similar to that observed in case of green pod yield, which was also shown by a negative correlation. There was increase in both pod size as well as seed number per pod up to the middle of harvesting period and then a gradual decrease which was also observed by negative correlation. Under both conditions resistant varieties were stable and under unprotected conditions the tolerant varieties suffered to some extent because of the disease with regard to number of pods per plant. In one particular F2 significant and positive correlation was observed which could be due to a higher frequency of tolerant segregants.The seed number per plant was found to be always superior in case of resistant and tolerant varieties compared to susceptible ones. The growth of stems as measured by thickness (diameter) was found to be unrelated to disease incidence, but the variance seen in this character could be attributed to genetic or varietal characters.

Title: Cross ability behavior and inter-relationship among nine different species of Capsicum (1983)

Anil Kumar. S. Patil, UAS, Bangalore, Guide: Dr. D.P. Singh

Cytomorphological studies in 9 capsicum species (C. pendulum, C. praetermissum, C.chacoensa, C. sinense, C. microcarphum, C. fasciculatum, C. baccatum, C. frutescens and C.annuum) and their 17 F_1 hybrids were conducted at IIHR, Bangalore. High cross ability, high pollen fertility and low meiotic irregularities were observed in the following F_1 hybrids which can be used successfully in a breeding programme for disease resistance.

Sl.No.		**Successful hybrids**
C.praetermissum	x	C.baccatum
C.praetermissum	x	C.annuum
C.microcarphum	x	C.pendulum
C.fasciculatum	x	C.praetermissum
C.fasciculatum	x	C.annuum
C.baccatum	x	C.praetermissum
C.fasciculatum	x	C.annuum
C.annuum	x	C.praetermissum
C.fasciculatum	x	C.baccatum

The above cross combinations indicate their close relationship with each other genetically.

Title: Genetic evolution of morphological, physiological and biochemical trait stomato (*Lycopersicon esculentum* Mill.) (1985)

B.K. Nandeesh, UAS, Bangalore, Guide: Dr.S.K.Tikoo

Seven high yielding cultivars from each growth habit, viz., indeterminate (ID), semi-determinate (SD) and determinate (D), randomly representing releases from USA and India since 1952 to date, were grown along with two accessions of Lycopersicon cerasiforme, and one accession of L. pimpinellifolium. The cultivated varieties were superior to the related wild species for yield, average fruit weight, locule number, and fruits per plant. All major yield components were observed to be independent of growth habit. Physiological parameters were monitored at 4 stages of crop growth. The differences between the growth habits were distinct 60 days after sowing. Leaf size was observed to be smaller in the wild types. Both leaf dry weight and leaf area (5th leaf) were correlated with fruit size, indicating that increased leaf size may have evolved with large fruits. Stem dry weight was highest in wild genotypes followed by ID, SD and cultivars. Harvest index (HI) was observed to be 65 to 70% in the determinate cultivars. SD had HIof 55% followed by ID with around 50% and wild types with 48%. The recent varieties thus are more efficient in mobilizing available resources towards economic yield. Total biomass was highest in the wild types followed by ID, SD and types. The wild genotypes were superior in TSS., ascorbic acid, acidity and also sugar: acid ratio. A progressive decline in these traits was observed from ID to D cultivars indicating that yield increase may have been at the expense of quality.Lycopene content was observed to be independent of growth habit.

Title: Studies on breeding tomatoes (*Lycopersicon esculentum* Mill.) for tolerance to moisture stress (1985)

N. Sudarsana Reddy, UAS, Bangalore, Guide: Dr. N. Anand

Studies were carried out using seven F_{10}, $9F_2$ populations and their 14 parents under intermittent moisture stress conditions during kharif season. F_1's as a group were superior to the parents for plant height, number of primary branches, number of flowers per cluster, percentage of fruiting clusters, root length, harvest index besides yield per plant. F_2 as a group exceeded the parental means for yield and harvest index. The F_2 of 554 x707 exhibited the highest mean yield of 1.218 kg/plant. Eight parents, four F1's and six F_2's exceeded Pusa Ruby for yield indicating the distinct possibility of replacing 'Pusa Ruby' with more efficient genotypes under moisture stress conditions. All the F_2's and five of the F_1's besides 10 of the parents exceeded Pusa Ruby for harvest index. Heterosis was observed in 2 F_1's and 4 F_2's for yield. Correlations differed between the different F_2 populations, F_1's and parents. Number of fruiting clusters and number of primary and secondary branches were consistently correlated with yields. Plasticity inherent in the characters, number of branches and number of fruiting clusters, is through to have influenced yields under moisture stress. Semi-determinate growth habit was suggested as ideal for stress conditions. A scheme of recurrent selection was envisaged for further yield improvement under moisture stress, low input conditions.

Title: Heterosis and combining ability studies in Onion (*Allium cepa* L.) using line x tester analysis (1985)

T.S. Aghora, UAS, Bangalore, Guide: Dr.C.S.Pathak

The study on heterosis and combining ability for 16 important characters was carried out using Line x Tester analysis involving 20 inbreds as lines and 3 male sterile lines as testers. Heterosis over the best parent was observed for all the characters except dry weight of leaves. Thirty five hybrids were heterobeltiotic for total bulb yield, highest heterosis being of the order of 89.56% in the cross MS39xIHR78.Thecrosses with high heterosis for plant height and number of leaves expressed positive heterosis for bulb yield. The studies on combining ability indicated the predominance of additive effects formost of the characters except average dry weight of the bulb. The tester MS1 and MS8 were found to be best general combiners for yield, whereas, among the lines Arka Kalyan, Arka Niketan, IHR-21 and N-53; selections were found to be better combiners. The lines IHR-52, Sel-1, Ihr-123 and SL.95 were the best combiners for three important quality characters, viz., total soluble solids, ascorbic acid and dry matter. Five hybrid combinations were identified for commercial exploitation of heterosis using male sterilelines.

Title: Comparative study of Pea lines with variable resistance to powdery mildew(*Erysiphae polygoni* DC) and rust(*Uromyces fabae* (Pers) de Bary) diseases(1986)

V.Nagaraju, UAS, Bangalore, Guide: Dr.A.B.Pal

A comparative study of pea lines with variable resistance to powdery mildew as well as rust diseases and their influence on yield components was carried out. Sixteen lines having different categories of resistance were used in the experiment laid out in a randomized block design with three replications. The observations were recorded on various growth and yield parameters. It was observed that the incidence of powdery mildew and rust diseases were negatively associated with the yield components. The resistant lines maintained superiority over susceptible lines with pods per plant, green pod yield per plant and number of seeds per plant. About 44.11% reduction in pod yield was recorded in susceptible lines. Yield per plant and yield per pods was negatively correlated with the disease incidence. Resistant lines were stable with regard to pods per plant. However; susceptible lines were adversely affected with regard to this trait.The qualitative characters such as sweetness were not much associated with disease intensity. Shelling percentage was found to be superior in case of pea line resistant to either of the diseases. In general, the characters like number of pods per plant, number of seeds per pod and number of seeds per plants was adversely affected by the two diseases. Pod yield per plant was affected more due to rust disease than powdery mildey was the correlation was negative and significant.

Title: Genetics and variability studies in first segregating generation of bell pepper x chilli crosses (1986)

S.M.Gopal, UAS, Bangalore, Guide: Dr. N. Anand

Five F_2 populations of bell pepper x chilli crosses were studied for frequency distribution interrelationship of quantitative characters besides heritability, genetic advance and coheritability for 15 characters. Normal distribution was observed in the F_2's for plant height and fruit length. The distribution for number of primary branches, fruit per plant and average fruit weight was positively skewed. Other characters had varied responses in different populations. Green fruit yield was negatively skewed. Transgressive segregate were observed for all characters except average fruit weight. Plant height, spread primary and secondary branches, fruit length, early yield and fruit number showed positive influence with green fruit yield. Average fruit weight was negatively correlated with green fruit yield. Green fruit yield, average fruit weight and fruit number had high estimates of heritability and genetic advance. Strategies to obtain large fruited high yielding bell eppepr types from bell x chilli crosses have been suggested.

Title: Studies on biometric characters, nutritional and pre-processing qualities in garden Pea lines (1987)

S.N.Jayasimha, UAS, Bangalore, Guide: Dr.A.B.Pal

Investigation to study the important morphological characters, nutritional constituents, pre-processing qualities and the inter-relationship among these characters were carried out utilizing 24 breeding lines of garden pea (Pisum sativum L.). Data on morphological characters indicated that the lines used were either early or mid season and short or medium tall in stature. These showed wide variability for characters like the number of reproductive nodes (7.5-13.50, total number of pods/plant (4.13-10.10), pod length (4.03- 7.57 cm), 100 green pod weights (66.25-421.50 g), number of seeds/pod (4.52-7.33) and 100 green seed weight (9.25-40.9 g). Observations on green pod yield/plot indicated that the lines 'RPH 68', and 'BK 12-SB' were high yielders compared to the rest. Correlations worked out at the phenotype level among 20 characters indicated that pod length correlated significantly and positively with 100 green pod weight, 100 green seed weight, phosphorous and ascorbic acid contents. Total number of pods/plant correlated significantly and negatively with crude protein content. Green pod yield/plot had positive correlation with iron content. Iron had highly significant and positive correlation with phosphorous content. Combined assessment of parameters indicated that the line 'RPD12-SB', 'RPA 9-5-3 Nm', 'RPH 68 BK', 'FC 1-32-1-2-SB(19)' and 'Bonneville' were promising for yield parameters. FC 1-32-1-2-SB (19)' 'RPG 1-11-GMS', 'RPB-12-3-BK8' and 'Bonneville' were ideal for quality parameters. The lines 'FC 1-32-1-2-SB (19)'and 'RPC13-3-7-6' were found to be most suitable for yield and processing quality.

Title: Studies on the potential ripening mutants to extend shelf life in Tomato(*Lycopersicon esculentum* Mill.) (1987)

Mahanth Gowda Patil, UAS, Bangalore, Guide : Dr. S .K. Tikoo

Studies on potential ripening mutants to extend shelf life in tomato were undertaken with a view to compare shelf life, lycopene, firmness, and other attributes of ripening mutants, with normal ripening cultivars including firm fruited ones and F_1 hybrids using normal ripening lines in crosses with nor and alc.shelf life (50% fruits turned soft) of the alclines IHR 1137 and 1313 was 30 and 37 days, respectively, compared to 37 days in nor at room temperature. Their corresponding values at 20 ºC temperature were 44.67 and 70days. Shelf life differed between the normal ripening varieties scope for isolating better keepers within the available tomato lines, (2) nor and alc. shelf life was much superior. The better colour development in alc lines could make them more suitable as parents in a breeding programme for extending shelf life. Mean shelf life of F_1 was significantly superior to their normal parents but lower than nor and ale genotypes under ambient and constant temperature (20 ºC). Highest mean Shelf life observed was 21.6 days and 51.0days at ambient and constant temperature (20 ºC) respectively in Floradade x nor. The corresponding values were 20 and 30 days in Floradade x 1137, Floradade x nor had the most delayed initiation of softening (21 days) followed by Floradade x 1137 (16.5 days).There was correspondence of lycopene content in normal parents and lycopene in F_1s. F_1s with nor had low lycopene content at various stages of ripening compared to F_1s with alc. The crosses of nor and alc with the high pigmented (hp) line IHR 1143 had significantly higher lycopene. There was an apparent correlation between firmness and shelf life, among normal ripening lines Floradade had maximum firmness value of 5.15 and 4.3 kg at B and D stages, respectively. IHR 709, IHR 674 and Se1-4 were next best for firmness. Significant differences were not observed between mutants normal ripening lines for yield, but highly significant differences were observed between parents and F_1 hybrids.

Title: Mutation breeding in Cauliflower (*Brassica oleracea* L.) (1987

M. Narayanaswamy, UAS, Bangalore, Guide : Dr. S.C. Pandey

Two varieties of cauliflower namely Pusa Deepali and Early Kunwari were treated with ethyl methane sulphonate to study the effects on various parameters. The 0.4% EMS treatment created maximum variability. Percentage disease intensity and disease index indicated that in all the treatments plants were susceptible, whereas 0.4% EMS treatments produced resistant plants at seeding stage. The germination and survival percentage decreased with increased EMS concentrations. High Genotypic and phenotypes variances were recorded for all the characters. High variability and genetic advance were recorded for whole plant weight, curd weight, leaf weight, harvest index, leaf area, germination and survival percentage. Positive and significant character association was recorded for fresh weight curd with leaf area, harvest index, whole plant weight and fresh weight of leaves. Path coefficient analysis revealed that whole plant weight had high direct effect on fresh weight of curds in positive direction.

Title: Studies on genetics and combining ability in Cauliflower (*Brassica oleracea.* L.var.Botrytis) (1988)

B.M.Shivalingappa, UAS, Bangalore, Guide: Dr. S.C. Pandey

A 5 x 5 complete diallel analysis was carried out to study the genetics and combining ability in cauliflower. Both additive and non-additive genetic variances were involved in all the characters. Preponderance of additive genetic variances was recorded for all except vitamin C content. The parent lines‘ Early Dawn’ and ‘Early Cauliflower ‘was found to be the best general combiners for days to curd initiation, days to curd maturity, plant weight and curd weight. Maximum heterotic and best specific combinations involved at least one good general combiner. High heritability was observed for days to curd initiation and maturity, plant height and plant weight and curd size index, whereas remaining characters had medium to low heritability. The ratio of degree of dominance revealed partial dominance for days to curd initiation and maturity, plant height and plant weight and curd size index, and curd to plant ratio. Positive and significant genotypic and phenotypic characters, association of curd weight were recorded with number of leaves, plant weight and curd size index and vitamin C content. Selection of parents for hybrids and population improvement programme was advised on the basis of per se performance and combining ability.

Title: Studies on genotype–environmental interaction in Onion (*Alliumcepa* L.) (1988)

B .Nagarjuna Gowda, UAS, Bangalore, Guide:Dr.C.S.Pathak

Fifteen onion genotypes comprising nine varieties and six elite genotypes were tested under twelve environments generated by the manipulation of nutrition and different sowing seasons. Nineteen characters which involved yield and yield components were studied for stability. The genotypes and environments differed significantly for all the nineteen characters, whereas genotype environment interaction was significant for most of the characters except fresh weight of bulb per plant, number of leaves per plant, firmness of bulb, undersized bulb percentage, TSS percent and neck thickness. These characters remained unaffected with the change in environment and can be grouped as most stable characters. On the basic of stability statistics, mean(µi), regression coefficient (bi), deviation from regression (S^2 di), UD-103 was identified as a stable genotype for estimated bulb yield, total bulb yield, marketable bulb yield per plot, split bulb percentage, bolting percentage & polar bulb diameter. Arka Niketan was stable for estimated bulb yield, total bulb yield per plot, bolting percentage, split bulb percentage, marketable & unmarketable bulb yield per plot, percent dry matter, rotten bulb percentage, single centered bulb percentage & equatorial bulb diameter. Among other varieties IHR-396 was stable for 12 characters & N-2-4-1 was stable for 10 characters including bulb yield. These four genotypes were well adapted to all the environments with above average estimated bulb yield.

Title: Variability, heritability, correlations and path analysis in Carrot (*Daucuscarota* L.) (1988)

B.N.Nagaraja, UAS, Bangalore, Guide: Dr.C.S.Pathak

Thirty nine genotypes of carrot representing the collections from diverse geographic area of the world were studies for variability, heritability, correlations and path analysis. Significant differences were observed for all the 17 characters studies. The PVC andGCV values were larger for specific leaf area, specific leaf dry weight, fresh weight ofleaves, dry weight of leaves, fresh weight of roots, carotene content, percent forked roots and undersized roots. However, these PVC and GCV values were lower for rest of the traits. High heritability values associated with high genetic advance was observed for carotene content, root yield, fresh leaf weight, dry leaf weight, fresh weight of roots and specific leaf area, which indicated that selection for these characters will be effective. Rest of the characters had moderate or low heritability. The genotypes IHR 3, IHR 75,IHR 128 and IHR 205 exhibited deep orange colour of roots and these had high carotene content. Root yield was positively correlated with root length, root diameter, top length, fresh weight of roots, number of leave, fresh weight of leaves, dry weight of leaves, specific leaf of area and carotene content. Path analysis studies revealed that among the components characters, diameter of root exerted maximum positive effect on root yield both directly and also indirectly through traits like top length, specific leaf area and number of leaves.

Title: Studies on heat tolerance in Garden Pea (*Pisum satvum* L.) (1991)

Oinam Kumar Singh, UAS, Bangalore, Guide: Dr.A.B.Pal

Twelve garden pea lines viz.,UN-5-29(P), IHR 575, UN-5-29(S), RPN-34, IHR-544, RPD-9-1 (P), UN-57 (G), RPD -9-1 (S) (early lines), IHR-476, Bonneville, FC-1-32-1-1-40 and IHR-570 (mid- season lines) were evaluated for growth and yield parameters during rabi and summer seasons and the relative performance of the lines at high temperature, its effect on yield and yield components and the role of chemical constituents in offering heat tolerance were studied. High temperature was found to affect the growth and consequently the yield during the summer season. All the growth and yield parameters decreased drastically when the growing temperature reached 35°Cat maximum and 17 °C at minimum. At this temperature shelling percentage increased in the case of early lines but decreased in the mid season lines. Number of days taken for 1st flowering was reduced in the early lines where as it increased in the mid season lines at high temperatures. Chemical constituents such as starch, protein and sugar also decreased during summer to the extent of 2.02 to 48.09%. Both positive as well as negative significant correlations were found among many of the characters during summer than rabi. In general, there was genotypic variation in heat tolerance in garden pea lines. Lines with long duration had less tolerance to heat as compared to short duration lines. Chemical constituents of the plants were also altered by temperature with wide variations among the lines. Among the lines tested, IHR-544 and IHR-575 were found to be the most heat tolerant lines and were most suitable for cultivation during the summer season.

Title: Identification of tomato (Lycopersicon esculentum Mill.) F1 hybrids with potential for yield, quality and resistance to bacterial wilt (*Pseudomonas solanacearum* E.F.Smit) (1991)

H.V. Sathyanarayana, UAS, Bangalore, Guide: Dr. N. Anand

Attempts were made to identify potential F_1 hybrids in tomato resistant to bacterial wilt suitable for fresh market and/or processing. A line x tester analysis was carried out with five lines carrying dominant gene for resistance to bacterial wilt, two of them (Sl.6 and Sl.11) additionally being resistant to nematodes. The testers involved (6) were endowed with good horticultural qualities and high yield but susceptible to bacterial wilt. The hybrids and parents were evaluated in wilt sick soil (10^8 cfu/g soil), with inoculation (10^7 cfu/ml) as well as in wilt free soil under staked conditions. F_1 hybrids obtained from all the resistant parents exhibited very high degree of resistance to bacterial wilt (100%survival). Combining ability analysis revealed that the bacterial wilt resistant lines, BWR 5 followed by BWR resistant 15 and among testers IHR 1614 and IHR 858 were good general combiners. The highest yielder among the 12 fresh market hybrids was BWR 5 x IHR 858 IHR 858 IHR 858 (estimated yield 71.75t/ha). Based on fruit quality analysis for lycopene, TSS, acidity and pH, seven F_1 hybrids were found suitable for processing, best among them being BWR 15 x IHR 1614 (estimated yield 76.3t/ha).Among the 11 dual purpose F_1 hybrids, BWR 5 x 1032-1 was the best (estimated yield 68.87t/ha.

Title: Genetic transformation of water melon (*Citrullus lanatus*) by electroporation (1997)

M.V.Hema, UAS, Bangalore ,Guide :Dr.O.P.Dutta

Experiment was conducted at IIHR, Bangalore to optimize the parameters for water melon transformation using the Gus reporter gene by electroporation.The gene transfer was done invitro using seed-derived embryos and in vivo using nodal meristem of water melon variety Arka Manik. The uptake and expression of the said gene in the embryos was confirmed by histochemical staining with X-glue showing blue coloured cells. Further, the higher gus activity was observed by a higher staining pattern and intensity in the embryos electroporated with plasmid PB 1121 as compared to the plasmidP353G4INT. Higher Gus expression with both the plasmid was observed by using ten pulses from an experimental decay pulse of 400V over duration of 99 MSEC as compared with 5 pulses. Higher transformation frequencies (48.83%) were achieved by electroporation of watermelon nodal buds in vivo using dot blot analysis of R1 plants. Southern transfer and hybridization of the restriction digested R1 genomic DNA samples confirmed the stable integration of the gene/DNA fragments in the water melon genome.

Title: Evaluation of paprika (*Capsicum annum* L.) lines and hybrids for yield and colour (1998)

Chandrashekar Achar ,UAS, Bangalore, Guide:Dr.A.A.Deshpande

An investigation was carried out in paprika (Capsicum annum) to study the extent of heterosis, combining ability and thereby to locate high yielding paprika hybrids with high colour and ascorbic acid. Data obtained from 21 hybrids of 7 lines x 3 testers were subjected to RBD and Line x Tester analysis. The mean performance of hybrids was superior over their parents for most of the yield and quality parameters. Non-additive gene effects were predominant for fruit length, fruit number; dry fruit, yield, percent pedicel, ascorbic acid and capsaicin content whereas additive genes were found to be predominant for pericarp, seed and capsanthin content. However, involvement of additiveand non- additive gene effects was observed for fruit width. Among female parents L_1 showed significant gca effects for 7 out of 10 characters studied, excluding number of fruits per plant, dry fruit yield and ascorbic acid content; L_2 showed significant gca effects for the similar characters as L_1 except fruit length. Among male parents T_1 had significant gca effects for quality parameters and pericarp yield. The data on magnitude of heterosis over better parent, best parent and commercial check revealed the superiority of some outstanding cross combinations. Considering total yield, yield of pericarp and quality parameters like capsanthin, capsaicin and ascorbic acid content, two hybrids of paprika type and are comparable with best parent L_1 for capsanthin and parent L_2 for capsanthin content. They have fairly high ascorbic acid content and suitable for paprika Oleoresin industry.

Title: Studies on heterosis in chillies (*Capsicum annum* L.) using geni cytoplasmic male sterility (1998)

S. Thippeswamy, UAS, Bangalore, Guide:Dr. A. A. Deshpande

The studies on heterosis in chillies (Capsicum annum L.) using geni cytoplasmic male sterility were carried out. Three male sterile lines and 10 male parents drawn from breeding lines resistant to different diseases and germplasm selections were crossed in Linex tester fashion to get 30 F_1 hybrids. These hybrids were compared with 13 commercial F_1 hybrids for 20 growth, yield and quality parameters. Mean performance of hybrids was superior than mean performance of parents for majority of characters viz., plant spread, number of tertiary branches ,number of laterals, days taken from flowering to fruit ripening, first and second harvest, fruit length, percent pedicle, percent seed content, first harvest and total number of fruits, first harvest and total dry fruit yield per plant and capsaicin content (%). For total dry fruit yield per plant maximum of 54.85%heterosis over better parent and 20.21% over best commercial F_1 hybrid was recorded. Combining ability studies have shown the predominance of additive gene action over non-additive effects for majority of characters except plant spread, days from flowering to fruit ripening, fruit length (I harvest), percent pedicel capsaicin and capsanthin content. However, involving of additive and non- additive gene effects were noticed for number of laterals first harvest fruit length and width, first harvest fruit number and first fruit yield per plant. Cytoplasmic effects on expression of characters revealed no cytoplasmic differences for majority of characters. However, these differences indicted that the differences is not only due cytoplasmic alone but to genome x cytoplasmic interactions. In the present study, when comparison was made between the male sterile lines and their respective maintained lines, the maintainer lines had higher number of seed per fruit under open set.

Title: Studies on F1 hybrids tomato for long shelf life developed using slow ripening mutants (Alcobaca and ripening inhibitor) (1998)

L. Roopa , UAS, Bangalore, Guide: Dr. A. T. Sadashiva

The objective of the study was to study the potential of Alcobaca (alc) and ripening inhibitor (rin) for their combining ability, heterosis for yield, quality and shelf life and to identify F_1 hybrids tomato with long shelf life. The experimental material consisting five lines (4 alc and 1 rin), six testers, 30 F_1 hybrids obtained from line x tester fashion and four commercial checks (Avinash-2,To-230, Arka Shreshta, Arka Abhijit) were evaluated. The GCA effects were significant for the characters shelf life, yield and fruit firmness for the lines 2052 (alc) and 2053 (alc). While for the testers (IIHR cultivars) the gca effect was significant in 858 for shelf life, 1614 for pericarp thickness, firmness and shelf life and Flora-Dade (FD) for fruit weight and shelf life. The data on magnitude of heterosis over better parent and standard check revealed the superiority of some outstanding cross combinations. Four hybrids expressed significant heterosis over best parent for number of fruits per cluster, six hybrids for pericarp thickness, four hybrids for fruits for fruit firmness and twelve hybrids for yield per plant. Fifteen hybrids expressed standard heterosis for pericarp thickness, four for fruit firmness, fifteen for life at different stages. Two hybrids, namely 2052 x 858 and 2053 x FD were found to be outstanding. These hybrid shad firm fruits, the firmness values being 5.53 and 4.95kg/cm^2. The fruits stored for 22.26 and 33 days, till 50% softening at room temperature. The fruits of these mutant heterozygotes developed red colour upon ripening similar to the normal ripening fruits. They yielded 56.59 and 58.96t/ha.

Title: Development of F1 hybrids with resistance to bacterial wilt in tomato (*Lycopersicon esculentum* Mill.) (2000)

R. Prashanth, UAS, Bangalore, Guide: Dr. A. T. Sadashiva

Fifty F_1 hybrids obtained by crossing 10 lines and 5 testers in a line x tester mating design were evaluated along with their parents in both wilt infested and wilt free soil to knows their reaction to the bacterial wilt and their performance for yield and yield components. The hybrids were highly resistant to infestation of bacterial wilt ranging from 91-100%whereas the check Pusa Ruby was found to be 100% susceptible. The F_1's expressed superior heterosis and heterobeltiosis for characters like yield, days to first fruit maturity, days to 50% flowering and fruit quality parameters. Combining ability analysis revealed predominance of non-additive gene action for parameters like yield, number of fruiting clusters, fruit per cluster and quality parameter while additive gene action was observed in plant height, days to 50%flowering and TSS. The line IIHR 2038, IIHR 2042 and NOR-1 were found to be good combiner and crosses such as BWRs x 2038, BR11x 2038, BWRI x 2042, 15SBSB x 2042 and BR11 x NOR-1 were outstanding in respect if yield, firmness and early bearing. These hybrids also recorded hundred percent survival to bacterial wilt and further can be commercially exploited.

Title: Combining ability studies in virus resistant Capsicum lines (2000)

B. C. Narasimha Prasad, UAS, Bangalore, Guide : Dr. A. T. Sadashiva

The investigation was undertaken to assess the combining ability of virus resistant chilli lines, to study the extent of heterosis of their hybrids for different characters and to locate resistant parents and hybrids for virus with special reference to cucumber mosaic virus. Combining ability studies have shown the predominance of additive gene action for fruit maturity, fruit length, fruit width, plant spread, primary branches, secondary branches, percent pericarp, percent seed content, number of fruits per plant and dry fruit yield per plant and non-additive gene action for days to 50% flowering and tertiary branches. The data on magnitude of heterosis over mid-parent, better parent, best parent and standard check revealed that the hybrid VR-42 x VR-55 was found superior over mid-parent, better parent, best parent and standard check dry fruit yield per plant. When the parents and their hybrids were screened for virus resistance under field conditions, it was seen that six parents viz., VR-42, VR-14, VR-47 and VR-55 exhibited some degree of resistance. In an experiment conducted to study resistance to cucumber mosaic virus, parents VR-42 and VR-55 were found completely free from infection. This was also confirmed by ELISA test.

Title: Isolation of sources of combined resistance to purple blotch, basal rot and white rot in Onion (*Allium cepa* L.)(2001)

Somanna Chittiappa, UAS, Bangalore, Guide: Dr. R.Veere Gowda

Study was conducted to identify sources of multiple resistance to purple blotch, basal rot and white rot diseases in onion by screening 50 genotypes using seed, bulb and seedling inoculation methods both under natural and artificial epiphytotic conditions ,and to evaluate biochemical and morphological factors responsible for disease resistance. The lines YL-58. WPL-95, 73, Pusa Red-135, Kalipathia Local-303, MS-48-26 and MS11-36 showed multiple resistances for purple blotch, basal rot and white rot diseases. Moderate resistance to purple blotch and white rot was notice in Sel 14-2, YL-61, WPL-95, MS65-11, MS-65XPBR-415 and MS11XPBR-409. Screening at seed stage revealed that 19genotypes were resistant (81-100%) to purple blotch,13 moderately resistant to (61-80%) basal rot and only one genotype YL-68 moderately susceptible(41-60%) to white rot. Screening at bulb stage the genotypes Sel 14-5, Sel13-26, WPL-158, 165, 169, PWO-1-PAU-309, MS-48-25 were found to have moderate multiple resistance to basal rot and white rot. However, five genotypes each for basal rot and white rot were found resistant (Rose-69,WPL-95,169,PBR-5PAU-306andAK-IIHR-307)and(WPL-69,PBR-5-PAU- 306, Pusa Red-135, MS(YL) Pure(s)-414, respectively). Screening at seedling stage in open field revealed that the lines Sel11-34,MS65-8,9,and MS65 X PBR-415 to had multiple resistance to purple blotch and basal rot, and lines WPL-158,169,73,AK-IIHR-307 and MS48-100 were moderately resistant. Plant screening in poly house revealed that none of the onion genotypes were resistant to purple blotch, basal rot and white rot. However, moderate resistant was observed in seven genotypes (WPL-169, 158, 165, MS 48-25, PWO-1-PAU-309, Sel13-26 and Sel 14-5). The biochemical studies indicated that the resistant varieties recorded high reducing sugars and phenols as compared to susceptible ones. Onion plants with tubular (erect) leaves were found to be moderately resistant to purple blotch.

Title: Genetic analysis of yield and yield components in Cucumber (*Cucumis sativus* L.) (2001)

G.D.Dinesh Kumar, AS, Bangalore, Guide: Dr.M.Pitchaimuthu

On study was carried out, to estimate heterosis, heritability, genetic advance, gene action, gene action and study the inheritance pattern of qualitative characters in cucumber. Among the F_1 hybrids evaluated, IIHR-101 X IIHR-34 exhibited an appreciable amount of desirable heterotic effects for most of the yield contributing characters viz., total yield per plant, average fruit weight, fruit number per vine, fruit length, fruit girth, flesh thickness and number of branches per plant. Hybrid IIHR-81 x IIHR-82 showed positive heterotic effects for only fruit length and flesh thickness. Whereas negative heterotic effect was observed for days to first female flower opening, days to first fruit harvest and nodal position of first female flower. Both highest heritability and genetic advance were observed in hybrid IIHR-101 x IIHR -34for flesh thickness and vine length whereas, IIHR-81 xI IHR-82 cross combination was observed for total yield per plant., number of fruits per vine and average fruit weight. Most of the yield contributing traits in hybrid IIHR-101 x IIHR -34 was under the control of dominance gene action hence, it would be beneficial to emphasize heterosis breeding. In cross IIHR-81 x IIHR-82 most of the traits were under the influences of both additive and non additive gene action hence, reciprocal recurrent selection would be beneficial. In the cross IIHR-82 X C. sativus var. C.hardiwickii, it has been conspicuous that bitter principle was under the control of single dominant gene and one can isolate non bitter plant from segregating generation as a in bredline to utilize in the hybridization.

Title: Line X tester analysis for heterosis and combining ability using male sterility in okra (*Abelmoschus esculentus* L. Moench) (2001)

S. Thippeswamy, UAS, Bangalore, Guide: Dr.M.Pitchaimuthu

Thirty F_1 hybrids obtained from crossing five lines and six testers in a line x tester mating design were evaluated along with their parents and their performance for yield and yield components along with Yellow Vein mosaic virus resistance in Okra. The estimation of gca effects of all 11 parents revealed that IIHR-MS-5 and IIHR-MS-2 showed the highest positive significant effects and were good combiner for plant height, number of fruits per plants, marketable yield, total yield per plant and fruit weight.IIHR-MS-5 had highest gca for number of branches per plant, fruit length and fruit girth. Among the testers the magnitude of gca effects for high marketable yield, total yield per plant, plant height, node at which first flower appearance and fruit girth was high in the Arka Anamika.Parbhani Kranti had high gca for fruit weight, fruit length and number of ridges. Significant sca effect in desirable direction was noticed in the cross combinations in IIHR- MS- 5 X 120-11-8-1 for days to first flower appearance and the cross IIHR-MS-1 X 116-12-23-6 for days to first fruit picking. In crossIIHR-MS-2 X Arka Anamika had significant sca effect for number of branches per plant. The per se performance of IIHR-MS-2 X Arka Anamika showed higher magnitude of sca with 313.7 g market able yield per plant. Thus, cross having high per se performance for marketable yield and highly significant sca effect. Therefore, sca effect for marketable yield could consider the basis for selection of crosses. All the crosses with significant sca effect for different characters had positive heterosis. In majority of crosses, high sky effect was due to high X high and high X or low X high cross combinations, indicating the importance of additive X additive and additive X dominance or dominance X additive type of interaction. The hybrid IIHR–MS-2 X Arka Anamika and IIHR-MS-5X Parbhani Kranti can be exploited commercially for marketable yield, more number of fruits per plant and earliness.

Title: Genetic variability studies in Cauliflower (2001)

Prasanna, UAS, Bangalore, Guide: Dr. B. Varalakshmi

A study was undertaken to estimate the genetic variability, heritability for yield and its components and their association with yield in early cauliflower. Twenty five genotypes of cauliflower were evaluated in randomized block design with two replications. Genotypic coefficient of variation (GCV) was found to be less than the phenotypic coefficient of variation (PCV) with respect to all the characters studied. High GCV and PCV were observed for characters like yield per hectare, blindness, buttons and leafy curds. Narrow differences between GCV and PCV were seen in character like days to curd initiation, days to curd maturity, curd size,net plot yield, yield per hectare, vitamin C content and buttons indicating that there is no environmental influence in the expression of these parameters. It was observed that high heritability associated with moderate values of genetic gain as percent of mean for petiole length, curd size, net plot yield, yield per hectare and vitamin C content, indicating that these characters are governed by additive gene action and so direct selection will be effective to improve the genotypes for these characters. The character association revealed high significant positive association of curd diameter on curd yield at both phenotypic and genotypic level only. Therefore for, genetic improvement in cauliflower it is better to adopt direct selection trough curd diameter, fresh leaf weight, number of leaves and leaf area index and indirect selection through plant weight, curd size and plant height. Among plant characters it is suggested to select semi erect leaf orientation plants with white or cream colour and full compact curds to improve yield in early cauliflower.

Title: Studies on male sterility in Onion (*Allium cepa* L.) (2002)

K.M. Saraswati, UAS, Bangalore, Guide: Dr.R. Veere Gowda

The main objectives of the investigation were to study, "Development and morphological analysis of flowers, Micro-sporogenesis and Micro-gametogenesis; seed set and seed yielding abilities of male fertile and male sterile lines. The salient achievements are summarized below. Developmental and morphological analysis of male sterile and male fertile plants: The flower buds of male sterile and male fertile lines took 97.3 and 105.5days respectively from the time of visible initiation to complete withering of filaments. The male sterile line had flower bud size 0.6 x 0.6 Sq.cm. This was comparatively less than that of male fertile line 0.8 x 0.9 Sq.cm. The total flowering period observed in both sterile and fertile lines was 22.3 and 24 days respectively .Peak flowering was observed on 15^{th} day in sterile whereas on 17^{th} day in fertile line from the visible flower initiation. Majority of the flower buds (22-34%) opened between 7 a.m. and 10 a.m. in male sterile line. Whereas infertile line between 7a.m. and 4a.m. Peak period of an thesis was observed at 7 a.m. in both male sterile (34%) and male fertile (16%) lines. Maximum anther dehiscence was at 11 a.m. (100%). The lines MS11, MS48 and Arka Kalyan were more receptive on 3^{rd} day of crossing with 96,93 and 91% seed set respectively whereas, MS39 and MS 65 were receptive till 5^{th} day of crossing after opening, with 100% and 97% seed set respectively. Arka Kalyan recorded the highest pollen germination (50-75%)with the lowest pollen absorption (21.76%).Studies on micro-sporogenesis and micro-gametogenesis in onion flower: Studies showed that the tapetum in male fertile lines was essentially peripheral type. Following the release of microspores from tetrads, radial and inner tangential walls of the tapetum broke down and the tapetal protoplast released into the locular cavity and engorged the developing microspores. Whereas the sterile lines used in the present investigation exhibited abnormalities. Soon after the formation of microspores. Investigation on seed set and seed yielding abilities of male sterile and male fertile lines revealed that the Pusa Red (42), Arka Pragathi (42.97), MS 48 (38.57) and MS 39(40.37) recorded lower number of days for flower stalk emergence.Arka Pithamber (84.43) and MS48 (98.5) were found to had highest percent flowering. Arka Niketan recorded highest seed weight per plant (3.28g). Arka Pithamber had highest umbel weight (12.03g). The parental lines did not show significant differences for number of flowers perumbel, number of seeds per umbel percent recovery of seeds per umbel and seed set percentage. The crosses which had significant differences for different characters were plant height MS11 x Arka Bindu (68.28 cm); number of days for stalk emergenceMS48 x Arka Bindu (98.50); highest percent flowering MS11 x PBR-2(96); number of flower stalks MS39 x Arka Kalyan (6); highest length and diameter of the scape MS39 xPBR-1(707.27 x 1.47 Sq.cm); highest umbel size index MS65 x Arka Kalyan (25.19);number of seeds per flower MS48 x PBR-2(42); highest seed weight per umbel MS39 xArka Bindu (1.33 g); seed weight per plant MS11 x Arka Pithamber (7.27 g); umbel weight MS11 x PBR-1 (6.23 g); 1000 seed weight MS65 x Arka Niketan. Correlation studies for different characters among parental lines and crosses Study revealed that the strong positive correlation for umbel diameter and umbel weight (r=0.967), seed weight per umbel were recorded between seed weight per plant (r=0.788) and umbel size index (r=0.657).Umbel weight recorded positive correlation between seed weight per umbel (r=0.776), seed weight per plant (r=0.632) and umbel size index (r=0.816). Strong correlation among the crosses were observed between percent flowering and plant height(r=0.51) and umbel diameter (r=0.515). Between number of days for stalk emergence and umbel index (r=0.512), seed weight per umbel (r=0.381),umbel equatorial diameter(r=0.722) and umbel weight. Seed weight per umbel had significant correlation for seed weight per plant (r=0.592) and umbel weight (r=0.444) in turn seed weight per plant recorded positive correlation for number of flower stalks per plant(r=0.529).

Title: Isolation of resistance source for combined diseases viz., purple blotch, basal rot and white rot in Onion (*Allium cepa* L.) by saprophytic and gametophytic screening (2002)

A. U. Subbaiah, UAS, Bangalore, Guide: Dr. R. Veere Gowda

With plant pathogens and the insects that spread them are exploding worldwide, finding new ways to fight diseases has become an absolute necessity. The first line of defense against plant diseases in natural resistance, which can often be transferred between and among the species by cross breeding for which resistance sources must exist. Evaluation of resistance for long has been done by sporophytic screening which is time consuming and laborious. Hence, it would be desirable to use strategies that allow an early selection of resistant genotypes, male gametophytic screening is one of them. Apparently, pathogenesis-related mechanisms involved in disease resistance are expressed in both vegetative (sporophytic) and generative (gametophytic) tissues. The primary objective of our study was to develop and evaluate screening methodologies for identifying genotypes within heterogeneous populations that have resistance (Multiple resistances) to purple blotch, basal rot and white rot diseases of the onion caused by Alternariaporri, Fusarium oxysporum f.sp. cepae and Sclerothium cepivorum respectively. Our selection procedures were developed initially with the sporophytic generation where sixteen genotypes were evaluated under field condition, poly house condition where the seedlings were subjected to different concentrations of the pathogens ($4x10^4$Conidia ml^{-1}, and $1x10^4$ spores ml^{-1} and 1-2 Sclerotia per seedling for purple blotch, basal rot and white rot respectively)and then tested the bulbs under storage conditions for the storage diseases namely basal rot and white rot at $45x10^4$ $sporesml^{-1}$ and 6-7 sclerotia per bulb respectively. And in the gametophytic generation the pollens of eight male fertile genotypes were subjected to the crude culture filtrates of the above said diseases in accordance with the proposal that a possible overlap between generations might result from selection of genes expressed in both stages. Considering the economics losses caused by these three important diseases of Onion, the importance of the work carried out is of significance to Indian agriculture, as some promising results were obtained in accordance with our objective.

Title: Heterosis and combining ability studies in Cauliflower (2002)

Deepa Singh, UAS, Bangalore, Guide: Dr. B. Varalakshmi

Line X tester analysis involving six lines and six testers was carried out in early cauliflower (Brassica oleracea var. Botrytis) at IIHR, Hessarghatta, Bangalore during 2000-2001. Thirty-six hybrids along with twelve parents and a check hybrid (NS-60) were evaluated in a randomized complete block design with three replications. The heterosis over mid parent was significant in majority of the F_1 hybrids tested for days taken for 50% curd initiation, days taken for 50% curd maturity, stem weight, stem length and curd diameter indicating the pre-dominance of dominant type of gene action for these traits. Number of crosses showing significant heterosis over mid-parent was very less for number of leaves, leaf weight, leaf area, plant height, plant weight, curd weight and pronounced for the expression of these traits. Two hybrids viz., Katki x IIHR-263 (-3.50%) and First Early x IIHR-263 (-8.00%) exhibited lowest negative standard heterosis and the curd weight of these hybrids were on par with the curd weight of the standard check hybrid, NS-60. Significant GCA effects were observed in First Early, IIHR-217-1-4-6 and IIHR-263 for 50% of curd initiation whereas IIHR-Sel 3, IIHR-217-1-4-6, IIHR-302 and IIHR-305 for 50% curd maturity indicating that these were the best general combiners for earliness. Four hybrids, IIHR-Sel.3 x IIHR-250-4-1-11,IIHR-73-24 x IIHR-302,IIHR-73-24 x IIHR-305 andArka Kanti x IIHR-217-1-4-6 were good specific combiners for earliness. Four hybrids viz., IIHR-Sel. 3 x IIHR-302, Arka Kanti x IIHR-302, Early Kunwari x IIHR-250-4-1-11 and Early Kunwari x IIHR-217-1-4-6 were the best specific combiners for curd weight. The ratio of GCA and SCA variance reveals the dominant gene action to be predominant for all the characters. Thus, the present investigation reveals that these characters can be improved by heterosis breeding.

Title: Development of F1hybrids resistant to viruses in chilli (*Capsicum annuum* L.) (2002)

K. T. Shasikumar, UAS, Bangalore, Guide:Dr. K. Madhavi Reddy

Chilli is cultivated as one of the important cash crops throughout India, grown both as vegetable and as a spice. Mixed infection of viruses in chillies is a common feature in nature, hence there is a strong need to develop multiple virus resistant variety/hybrids with desirable fruit type. In the present investigation, in order to develop chilli F_1 hybrids resistant to multiple viruses with high yielding ability, eleven lines, five testers and fifty five F_1 hybrids along with two standard checks and a susceptible check were evaluated at IIHR. Among the parental lines evaluated, P3 was found earlier for the characters like days to 50% flowering and days to first fruit maturity; P1 showed highest mean plant height; P5 showed highest mean for plant spread and dry fruit yield per plant. P6 was the best among the lines for fruit length, and P4 for fruit width and P8 showed highest mean number of fruits per plant. Significant negative heterosis was noticed in the cross P3 x P16 for 50% flowering and P2 x P12 for days to first fruit maturity. Out of 55 hybrids developed, 19 expressed resistance to PVBV, PVY & Chi VMV; and 18 hybrids expressed resistance to CMV individually.However,two hybrid combinationsviz.,PMR69 x Perennial and PMR69 x Punjab Gucchedhar showed multiple resistance to all four viruses with an yield potential of 86.8 and 84.0 g dry yield/plant.

Title: Diallel studies in chilli (*Capsicum annuum* L.) (2002)

C. Venkata Ramana, UAS, Bangalore, Guide: Dr. K. Madhavi Reddy

Combining ability analysis of 8 x 8 diallel cross (including reciprocals) was carried out in chilli, involving cucumber mosaic virus (CMV) resistant and susceptible lines. The variances for general combining ability (gca) and specific combining ability (sca) were highly significant for all the characters, suggesting the importance of both additive and non-additive gene action. The sca variance played an important role in the genetic control of days to 50% flowering, days to 50% ripening, fruit width, plant height, plant spread, number of fruits per plant, green fruit yield per plant and per cent CMV incidence. On the contrary additive gene action was observed for fruit length. The genotype VR-27 was judged to be the best general combiner for fruit yield per plant and Perennial, Punjab Lal,Punjab Gucchedar and Pant C-1 proved to be good general combiners for per cent CMV incidence. The crosses Punjab Gucchedar x Pant C-1 and Tiwari x EG-174 have greater sca effect for fruit yield. These two crosses may directly be used for commercial cultivation after further testing over a range of environments. Fifteen of the twenty eight crosses had significant reciprocal effect for green fruit yield per plant. Hence, the influence of maternal effect on the economic traits is evident in the present material.

Title: Genetic variability studies in French Bean | (*Phaseolus vulgaris* L.) (2003)

Saiyad Mansur Basha, UAS, Bangalore, Guide : Dr. T. S. Aghora

Investigations on genetic variability studies in 47 genotypes of french bean (Phaseolus vulgaris L.) were carried out at Indian Institute of Horticulture Research, Bangalore. Wide range of variability was observed for most of the characters studied. The analysis of variance revealed significant differences among the genotypes for all the characters studied. Phenotypic coefficient of variability was found to be higher than the genotypic coefficient of variability. The estimates of phenotypic and genotypic coefficient and variability were high for green pods per plant, number of pods per plant, plant height and 100 seed weight; moderate for number of branches per plant, number of inflorescence per plant, number of seeds per pod, pod length, pod width, pod weight and low values were observed for days to first flowering, days to 50 per cent flowering and days to pod maturity. Heritability estimates in broad sense were very high for pod length, green pod weight per plant, pod length, pod width, number of pods per plant, plant height, number of branches per plant, number of inflorescence per plant, days to first flowering, days to 50 per cent flowering, days to pod maturity, 100 seed weight, pod weight and number seeds per pod. The genetic advance as per cent mean was high for green pod yield, plant height, number of pods per plant, number of inflorescence per plant and 100seed weight number of branches per plant, pod length, pod width and number of seeds per pod have showed moderate genetic advance over mean.The path coefficient analysis revealed highest positive direct effect of number of pods per plant and pod length. The indirect contribution of component characters on green pod yield was high through number of pods per plant, number of branches per plant, number of inflorescence per plant and 100seed weight. In D2 analysis 11 clusters were formed, out of which cluster I with 17genotypes was the biggest followed by cluster II consisting of 12 entries and cluster III and V had 5, 2 and 4 entries respectively, cluster VI and X had 2 entries and all the other remaining cluster were solitary. The intra-cluster distance was maximum for cluster III. The highest inter duster distance was recorded between cluster V and VI while the cluster VII and VIII were the least divergent. The investigation revealed that the cluster V (Arka Anoop, AFA I0, PNK 30, PNK34) and VI ((AK x 220)12-3IPS1) possess the potential green pod yield.

Title: Genetics of yield and yield components in Cauliflower (2003)

Devaraju, UAS, Bangalore, Guide:Dr. B. Varalakshmi

An investigation on generation mean analysis in cauliflower was carried out at Indian Institute of Horticultural Research, Hessarghatta, Bangalore, during 2002-2003. The objective was to estimate heterosis, heritability and genetic advance and gene action for various quantitative characters. The parents, hybrids and segregating generations were evaluated in RCBD with 3 replications. The salient features of the present investigation are summarized here under. All the crosses exhibited earliness for curd initiation and curd maturity over the parental population mean except IIHR Sel-5 x First Early. Significant heterosis observed for days taken for curd initiation, curd maturity, total plant weight stalk length and yield per plant in the cross IIHR 223 x IIHR 302, either in positive or negative direction. In cross IIHR 223 x IIHR 217-1-4-6-12, significant heterosis was observed for days taken for curd initiation, curd maturity, total plant weight, stalk weight and curd yield per plant, whereas in IIHR 217-1-4-6-12 x IIHR 73-24 for the character days taken for curd initiation, leaf number and leaf weight. The heterosis was significant for all the characters except for stalk length in the cross IIHR Sel-5 x First Early. In the F1 hybrid of IIHR 217-1-4-6-12 x IIHR 73-24 desirable negative heterosis for days taken for curd initiation was noticed. Highest heritability and genetic advance was observed for the characters curd yield per plant, stalk weight, leaf weight and total plant weight in cross IIHR 223 x IIHR 30. The cross IIHR Sel-5 x First Early recorded the highest heritability and genetic advance for the characters like curd yield per plant, stalk weight and total plant weight. Majority of yield contributing characters in IIHR 223 x IIHR 302 and IIHR 223 x IIHR217-1-4-6-12 controlled by non-additive gene action where the hybrid vigour was exhibited. Hence it is beneficial to emphasize on heterosis breeding on these crosses. In IIHR 217-1-4-6-12 x IIHR 73-24 most of the characters were under the operation of additive gene action. It could be fixed by simple selection in segregating generations. Most of the characters of the cross IIHR Sel-5 x First Early were under the influence non-additive gene action, so it is wise to go for heterosis breeding to exploit the hybrid vigor.

Title: Genetic analysis of yield and yield components in okra (Abelmoschus esculentus L. Moench) (2004)

Y. C. Chandrashekar, UAS, Bangalore, Guide: Dr. M. Pitchaimuthu

An investigation was carried out, to estimate heterosis, heritability, genetic advance, gene action, gene action and study the incidences of YVMV in okra. Among the F_1 hybrids evaluated, P7 X BO-13 exhibited an appreciable amount of heterotic effect or hybrid vigor for most of the yield contributing characters viz., total yield per plant, marketable yield per plant, fruit weight, number of fruits per plant, fruit length and fruit girth. The same hybrid also exhibited heterosis effect on earliness, days to first fruiting and days to first picking. The heritability and genetic advance as percent mean ranged from 1.0%(days to 50% flowering) to 87.06% (days to flowering) and 107% number of branches per plant in the cross Arka Anamikax BO-13. The F_1 hybrid Arka Anamika x BO-13 most of the traitswere under the influences of additive and non- additive gene action. In order to use of these both gene action reciprocal recurrent selections would be beneficial.The other F1 hybrids Parbhani Kranti X VRO-6 and P.Kranti x BO-13 much of the yield contributing traits were under the influences of dominant gene action where the hybrid vigor was exhibited. The incidence of yellow vein mosaic virus disease was found to be very low in BO-13 (0%) and VRO-6 (3.33%) among the parents. Among the hybrids. Arka Anamika x BO-13, P. Kranti X BO-13 and P7 x BO-13 were found to be resistant to YVMV under field condition.

Title: Pollination and variability studies in Cauliflower (2004)

T. R. Vinay, UAS, Bangalore, Guide: Dr. B. Varalakshmi

The present investigation was taken up to study the level of self-incompatibility and genetic variability among the selected fifteen genotypes of early cauliflower. Fertility index was estimated by seed set as well as fluorescence microscopic methods. By seed set method, out of 15 genotypes, seven genotypes namely IIHR-223, IIHR-217-19-6-12, IIHR-263, IIHR-73-5, IIHR-318, IIHR-351 and IIHR-266-16 were found to be self- incompatible as the fertility index was very high and more than one. This high fertility index might be due to the fact that self-incompatible genotypes possess highly expressive S-alleles. Due to these S-alleles action in self-incompatible genotypes seed set was very less under self-pollination (bagging and manual selfing of open flowers). GenotypesIIHR-250-4-1-11-28,IIHR-272,IIHR-217-3-14,IIHR-352,IIHR-316-17,IIHR-73-3,IIHR-305 and IIHR-73-24 were self- compatible because their fertility index was less than one. The ultimate categorization of all the fifteen genotypes into self-incompatible and self-compatible based on fertility indices remained the same under both the methods. The analysis of variance revealed highly significant differences among the genotypes for days to curd initiation, day to curd maturity, leaf number, plant weight, leaf weight and curd weight. It was observed that high heritability values were associated with moderate value of genetic advance or gain for days to curd initiation and days to curd maturity. Moderate heritability with moderate genetic advance has been observed for characters like leaf weight, curd weight, curd diameter, low heritability with low genetic advance was observed for characters like total plant weight, leaf number, curd size, stalk length and stalk weight indicating that these characters are governed by non additive gene components and the selection based on phenotypic appearance will not be effective and hence they can be exploited by heterosis breeding.

Title: Characterization of chilli (*Capsicum annuum* L.) germplasm for quantitative and qualitative characters (2004)

V. T. Sreenivasa, UAS,Bangalore, Guide :Dr. K. Madhavi Reddy

A field experiment was conducted during kharif 2002 at Division of Vegetable Crops, Indian Institute of horticultural research, Hessarghatta Bangalore to "Characterize the Chilli (Capsicum annuum L.) germplasm for quantitative and qualitative characters. The design adopted was Augmented design with four standard checks viz., Arka Lohit, Pusa Jwala, G-4 and Punjab Lal. Two hundred accessions were evaluated for their variability. Phenotypic coefficient of variability was found to be higher magnitude than the genotypic coefficient of variability for all the seventeen character studied. High percentage of PCV coupled with high heritability and high genetic advance was observed for number of fruits per plant, fruit length, fruit width, fruit pericarp thickness, Ascorbic acid, capsaicin, capsanthin, oleoresin, fresh to dry recovery, fresh yield per plant and dry yield per plant. Correlation analysis revealed that positive significant association of fresh fruit yield per plant with number of fruits per plant (0.907,0.921), plant spread (0.443, 0.455), ascorbic acid (0.358,0.365),plant height (0.316,0.328),oleoresin (0.237,0.242),number of seeds per fruit (0.185, 0.1990 and capsanthin (0.183, 0.185). Path coefficient analysis for fresh fruit yield per plant indicated that number of fruits per plant (0.861), fruit length (0.175), capsanthin(0.084),fruit width (0.066) and pericarp thickness (0.0.49) are the most important characters, which can be used as selection criteria for improving yield. No parallelism was observed between genetic diversity and geographical diversity.The characters ranking indicated that, fresh fruit yield per plant followed by ascorbic acid, number of fruits per plant and capsanthin were the major contributors towards genetic divergence. None of the combinations of selection indices constituted for fresh fruit yield per plant recorded more than 100 per cent relative efficiency, which revealed that straight selection was superior to selection indices for this character.

Title: Genetic analysis for chilli veinal mottle virus resistance in Chilli (*Capsicum annuum* L.) (2004)

M. S. Adarsha, UAS, Bangalore, Guide :Dr. K. Madhavi Reddy

Though India is the largest producer of chilli in the world covering an area of 8.922 lakh, its production (9.213 lakh t) and productivity (1030 kg/ha dry yield) are considerably low. Among the factors that limit its production, viruses play an important role.A round 21 viruses are reported to be affecting chilli in India, of which chilli veinal mottle virus (ChiVMV) and cucumber mosaic virus (CMV) transmitted mechanically and aphids in non-persistent manner are very important. In India cultivars with good amount of poty virus resistance coupled with high yielding potential are lacking in chilli. A few varietiesviz.,PantC-1,Tiwari,Punjab Lal are developed for virus resistance, their acceptability in the country is limited. Therefore, a few experiments were conducted to confirm resistance to ChiVMV in the improved lines at IIHR, to study genetics of resistance to ChiVMV resistance; and to study heterosis, combining ability and gene action of the hybrids developed using promising ChiVMV resistant lines. Segregationpatternsfordiseasereactionin F_1,F_2 and back cross generations along with their corresponding parents suggested monogenic recessive condition for ChiVMV resistance. Heterosis study indicated the superiority of some outstanding hybrids over better parent. Combining ability studies indicated that both gca and sca effects were important for all the characters studied, however the gcavariance was lesser than thes \geavariance expressing the non- additive preponderance. Parents with high mean performance and significantly desired effects along with F_1s having significantly desired sca effects have been pooled. The gene action study illustrated that the characters viz., number of secondary branches per primary branch, average fruit weight, stalk length, fruit width and ChiVMV resistance were under control of both additive and non-additive effects. Epistasis was operating in few traits viz., early flowering, plant height, plant spread, fruit width and seed ratio per fruit. Fruit length was under the control of additive gene action.

Title: Breeding french bean (*Phaseolus vulgaris* L.) for resistance to mung bean yellow mosaic virus(2008)

A. H. Naveen, UAS, Bangalore, Guide: Dr. T. S. Aghora

The genetic information on resistance to mung bean yellow mosaic virus (MYMV) was generated in french bean (Phaseolus vulgaris L.) by employing diallel analysis involving one resistant line IIHR-55 (IC 525260) and four susceptible commercial cultivars viz.,Arka Komal, Arka Anoop, Arka Suvidha and IIHR-78 and their F_1 and F_2 progenies. Environmental conditions at experimental site were quite favorable for the disease development. Further, screening of F_1 and F_2 populations was also done under laboratory conditions for confirmation of resistance. The frequency distribution of resistant and susceptible grouped in the ratio of 1: 15. The X^2 analysis results were found highly significant at $P < 0.05$ and acceptance of null hypothesis gave a good fit to duplicate gene interaction ratio 1:15 resistant to susceptible, respectively .It was found that two recessive genes governed the resistance in donor parent. Based on the F_2 mean per se performances, it was concluded that plants of the crosses IIHR 55 x AK and IIHR 55 x AA were promising with high yield and resistance. The combining ability studies indicated high proportions of gca variances than sca variances for all the characters studied indicating the predominance of additive gene action. Negative association of quantitative characters with % disease incidence and coefficient of infection were significant for all the characters except days to 50 per cent flowering and days to pod maturity. The magnitude of negative correlation of PDI and CI was high for pod yield per plant and pod number per plant. It was found that none of the parental lines was superior general combiner for all the traits. Similarly none of the cross combination had SCA effects for all the characters. Among the parents, and F_1s studied, the parental line IIHR-55 (IC525260) was the best general combiner with high gca effect, the crosses IIHR 78 XAK and IIHR 78 X AA were best specific combiners with high sca values and the cross IIHR 78 X AA was best reciprocal combiner for most of the quantitative characters studied, viz., plant spread in both directions, pod yield per plant, pod number per plant, ten pod weight. The identified RAPD marker $OP7_{730}$ which is linked to MYMV resistance in French bean can be successfully used for rapid screening and identification of genotypes resistant to MYMV.

Title: Characterization and evaluation of cauliflower germplasm (2009)

H. M. Santhosha, UAS,Bangalore,Guide :Dr. B. Varalakshmi

An investigation was carried out to study the morphological characterization; character association studies and genetic divergence in early cauliflower at IIHR during the kharif season of 2008-09. In the present investigation through characterization studies, out of 51 early cauliflower genotypes, IIHR-272, IIHR-263, IIHR-266 and IIHR-390 showed superior performance for high marketable curd weight and white compact curds along with resistance to biotic stresses hence these lines may be directly used for cultivation or as a source of desirable traits in a breeding programme for the improvement of curd yield in cauliflower. High genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were observed for characters like, plant weight, leaf weight, curd size, net curd weight, net plot yield, yield per hectare, protein, vitamin-C and marketable curd weight. Moderate values of GCV and PCV were observed for characters like, leaf number, curd depth and curd diameter. It was observed that high heritability values were associated with high values of genetic gain or advance for plant weight, leaf weight, curd diameter, curd size, net curd weight, net plot yield, yield per hectare, protein, vitamin-C, marketable curd weight and high heritability values with moderate genetic advance for leaf number, indicating these characters are governed by additive gene action. Character association revealed highly significant positive association of plant weight, leaf number, leaf length, leaf breadth, leaf weight, curd depth, curd diameter, curd size, net curd weight, net plot yield and yield per hectare with marketable curd weight at both the phenotypic and genotypic levels. Path coefficient analysis also revealed that maximum direct effect of characters like, plant weight, leaf number, leaf length, curd size, net curd weight on marketable curd weight at both the levels. Therefore for, genetic improvement in cauliflower it is better to adopt direct selection through plant weight, leaf number, leaf length, curd size, net curd weight. In genetic divergence study, 51 genotypes differed significantly for the 16 quantitative characters considered collectively and highest diversity was found between genotypes.. It was observed that marketable curd weight, plant weight, net plot yield and curd size had contributed predominantly towards divergence.

Title: Validation of molecular markers linked to ToLCV resistance in Tomato varieties/F_1hybrids(2010)

Shamprasad Phanis ,UAS, Bangalore, Guide: Dr. A. T. Sadashiva

Tomato (Solanum lycopersicum L.) is one of the most important and extensively grown vegetables around the world. Successful cultivation of tomato crop has been hindered due to attack by numerous pests and devastating diseases. Chiefly of these limiting factors, the tomato leaf curl disease caused by Tomato Leaf curl Virus (ToLCV) is a destructive disease of tomato in many parts of India and world. The use of molecular markers linked to genes for resistance is a tool, which can be used efficiently in plant breeding through marker assisted selection (MAS). In this study three molecular markers Ty1, Ty2 and Ty3 linked to ToLCV resistance were validated with fourteen ToLCV resistant entries after screening against ToLCV resistance under screen house. These resistant entries included four ToLCV resistant varieties (Hisar Anmol, Vyabhav, Nandhi and Sankranthi), six ToLCV resistant commercial hybrids (Abhinava, Arka Ananya ,Lakshmi,NS-501,Shakthiman and US-618); three advanced breeding lines (IIHR-2611, IIHR-2822 and IIHR-2823) and a ToLCV resistant wild accession Solanum habrochaites LA1777 (IIHR-2101) and Pusa Ruby was used as a susceptible check. Among these, two advanced breeding lines IIHR-2822 and IIHR-2823 showed the presence of the all three genes TY1,Ty2 and Ty3 for ToLCV resistance, the wild accession S. habrochaites LA 1777 (IIHR-2101) showed the presence of two genes Ty2 and Ty3, Abhinava showed the presence of Ty1 gene and Hisar Anmol (H-24), Vyabhav, Arka Ananya, Lakshmi, NS-501 showed the presence of onlyTy2gene and none of them showed the Ty3a gene presence. The varieties Nandhi and Sankranthi; hybrids Shakthiman and US-618 and the advanced breeding line IIHR-2611 (TV 55) did not show any presence of the Ty1, Ty2 and Ty3resistant genes.

Title: Identification of molecular markers linked to male sterility in Onion (*Allium cepa* L.) (2010)

V. Dhanya, UAS, Bangalore, Guide :Dr. R. Veere Gowda

Onion is one of the most important vegetable crops. Onion hybrids are very popular. Male sterility has been utilized for the production of F_1 hybrids. Molecular markers help us to identify a male sterile and maintainer line which facilitates early development of F_1 hybrids with stable male sterility system. Keeping this in view, the present study was conducted in onion. Studies on morphological and floral characters of male sterile (A), maintainer (B) and male parent (C) lines have showed significant differences for different parameters. Molecular characterization of these lines using RAPD marker could not differentiate the genotypes successfully. However Dendrogram and PC Aanalysis clustered the genotypes accurately. The first cluster consisting of MS-65 and MS-48group and the second cluster consisting of MLT group. This result has also in agreement with the morphological character, as multiplier onions are different from single onions. A marker was identified which could able to classify male sterile (A) and male fertile (B) genotypes by using ORF 725 primers. Among the male sterile and maintainer lines tested with ORF 725 marker, the lines MS-65(A and B), PBR (A and B), Rose onion (A and B) were successfully differentiated by amplifying both forward and reverse primers to produce two bands in male sterile (A) and one band in male fertile (B) lines. This marker was not able to differentiate A and B lines of Arka Pragati, MS-48 and MLT group. Among F1 hybrids tested, the F_1 451 (MS-65 x Sel-13) produced two bands but 394 (MS-65 x PBR) and 452 (MS-48 x Sel-14) produced single bands indicating these are lacking stable cytoplasmic male sterility. This is because male sterile lines used in these hybrids are not stabilized. This may be also due to the N-cytoplasmic contamination of S-cytoplasmic hybrid seed lot.

Title: Studies on genetic diversity in okra (*Abelmoschus esculentus* L. Moench) (2010)

Prakash Kerure, UAS, Bangalore, Guide: Dr. M. Pitchaimuthu

Okra is a popular green vegetable crop grown in India for its delicious tender pods. The extent of initials genetic variability or genetic diversity determines the level of crop improvement to large extent. Hence, the investigation on genetic variance was carried out with 44 okra genotypes. The high GCV and PCV were observed for plant height, inter-nodal length, first flowering node, first fruit producing node, average fruit weight and number of seeds per fruit. High heritability coupled with high GAM were observed for all the characters, studied, except for days to 50% flowering and days to80% maturity showed high heritability with low GAM. In genetic divergence study, 44 okra genotypes had differed significantly for the 12 quantitative morphological characters and grouped into 12 clusters based on D2 analysis. The cluster III was the largest with eight genotypes followed by cluster I and VIII with seven, cluster II with five, cluster XII with three genotypes while, cluster IV, V, VI, IX, X and XI were included two genotypes each. Maximum inter cluster distance was observed between the cluster VI and VIII (35.57) and inter cluster distance as in cluster XII (28.14). The characters namely days to 50%flowering (35.62%), 100 seed weight (28.44%), number of seed per fruit (17.23%) and average fruit weight (8.14%) were directly contributed towards maximum divergence. The extent of genetic diversity at molecular level was estimated for 44 okra genotypes using DNA markers (RAPD). The total genomic DNA was extracted and subjected to RAPD analysis using 14 arbitrary decamer primers, produced good polymorphic bands across the genotypes. RAPD data's were subjected to calculate a SED matrix using Wards method. It clearly showed two major groups, first consisting of three genotypes and second one further grouped in to 11 sub groups included 41 genotypes. The present study also clearly grouped the six wild species in one cluster and five cultivated species in another cluster from the total of eleven okra genotypes; these results were hold good with by using ITS markers.

Title: Assessment of genetic variability and identification of DNA markers linked to fruit quality traits in chilli (*Capsicum annuum* L.) (2011)

Ponnam Naresh, UAS, Bangalore, Guide: Dr. K. Madhavi Reddy

Chilli is an indispensable commodity in every Indian cuisine due to its pungency, spicy taste, appealing colour and flavor of fruits. Understanding genetic variability and population structure is of great importance and a prerequisite for association mapping to identify marker trait associations. Investigation on Genetic variance for major fruit quality traits was carried using 116 chill genotypes. The high GCV and PCV were observed for total capsaicinoids, total carotenoids, red and yellow fractions of total carotenoids and total soluble solids. High heritability coupled with high GAM was observed for all the major quality traits studied. Investigation on population structure was carried out with100 chilli genotypes using 24 genome-wide simple sequence repeat (SSR) markers using STRUCTURE and DARwin softwares. The 100 accessions were divided into three sub populations. The three clusters seemed to have very distinct parentages with few genotypes categorized as having and mixed ancestry from atleast two clusters and represented a good population structure which is amenable for association analysis. Allele mining approach was followed to see Sequence variation in candidate genes responsible for colour and pungency. Results revealed that Capsanthin capsorubin synthase gene coding region was present in yellow pepper line LCA 1068 (Aparna) with 99% similarity to sequence of By adagi Dabbi (dark red line) except for a single nucleotide polymorphism (G935A) and an amino acid change (R312K).In case of pungency, Acyltransferase gene several single nucleotide polymorphisms (SNPs) were found scattered throughout the amplified sequence of 840bp. Phylogenetic analysis of sequences showed clear demarcation between AT3-1 and AT3-2(tandem duplicates of AT3) and the non-pungent lines are not clustered into single cluster suggesting the existence of contrasting modes for varied level of pungency.

Title: Genetic diversity and evacuation of advanced lines for resistance to downy mildew (*Psuedopernospora cubensis*) diseases in Cucumber [*Cucumis sativus*](2011)

R. Veena, UAS, Bangalore, Guide:Dr. Amrik Singh Sidhu

An investigation was under taken to assess the genetic diversity, heritability, genetic advance, morphological and molecular characterization and screening for downy mildew disease resistance in advanced lines was conducted at IIHR, Bangalore, during 2010-2011. To assess the genetic variability and diversity of 38 genotypes of diverse origin were tested for 17 quantitative morphological traits. Genotypic and phenotypic variation was high for node at first female and male flower appear and yield per plant. High heritability coupled with genetic advance over mean was recorded for node at first female flower appears and yields per plant. Fruit yield had positive and highly significant association phenotypically and genotypically with 100 seed weight, vine length, numberof fruits per plant and flesh thickness. Vine length, number of fruits per plant and flesh thickness had positive and direct genotypic and phenotypic effects on fruit yield per plant.The cucumber lines were analyzed by using 13 RAPD primers those produced 103 DNAmarkers bands. A total of 67 polymorphic bands were obtained with a mean of 5.15 bands per primer. The cluster drawn out of the distance matrix grouped various genotypes in to two major cluster as A and B, thanagain major cluster A is sub divided in to A1 to A9.The highest dissimilarity percentage was between genotypes IIHR-409-2 and 595920.The genotypes Swarna Ageti, Sangeeta, Nandini, Barsati,Ajax,VR-101,VR-06-07,IIHR-405, Karur Local IIHR-407-1,and IIHR-409-2 were found to be moderately resistant and Cucumis hardiwickii showed highly resistant to the downy mildew disease.

Title: Development and performance studies ofF1 hybrids in Manjarigota type of Brinjal (*Solanum melongena* L.) (2011)

Khapte Pratapsingh, UAS,Bangalore ,Guide:Dr. T. H. Singh

Brinjal is an important solanaceous vegetable crop grown in India and throughout the world. The Manjarigota type of brinjal is of purple colour with white strips and has great demand in south India due its colour and taste. Twenty one crosses resulting from a L x T design comprising of seven lines and three testers were studied to know the combining ability and magnitude of heterosis. Combining ability analysis revealed that L_3 and L_4showed good general combiner for most of the characters. The tester T_2 were identified asgood general combiner for yield and yield attributing characters. Among the 21 crosses,L_4 x T_2 was identified as best specific combiner as it showed high sca effect and per seperformances (2.73 kg) for fruit yield per plant. For heterosis out of 21 crosses, L_4 x T_2(69.56%) and L_3 x T_2 (49.68%) were the most heterotic and could be exploited for commercial cultivation. The cross L_4 x T_3 exhibited highest magnitude of heterosis over commercial check for average fruit weight (14.22%), L6 x T_2 exhibited significantly heterobeltiosis (-4.89) for days for fifty per cent flowering which is desirable. The hybrid L_4 x T_2 exhibited highest magnitude of mid parent heterosis (90.74%) for number of fruits per plant and highest heterobeltiosis (98.74%) for estimated yield tonnes per hectare in desired direction. The hybrid L_4 x T_2 exhibited highest heterosis over mid parent and commercial check for fruit length. For fruit diameter L_6 X T_2 exhibited highest heterosis over mid parent and commercial check.

Title: Studies on combining ability for purple blotch disease resistant, bulb yield and quality components using male sterile lines in onion (*Allium cepa* L.) (2012)

Ambresh, UHS, Bagalkot, Guide: Dr. R. Veere Gowda

The present investigation was conducted at Central Horticultural Experimental Station, CHES (ICAR- IIHR), Bhubaneswar, Odisha during Rabi season of 2017-18 with the objectives of evaluation of germplasm for yield and yield attributing traits, assessment of genetic variability for fruit biochemical traits and screening of germplasm for anthracnose resistance. Fifty genotypes were evaluated for 10 yield and yield attributing quantitative traits and 8 fruit quality (biochemical) traits and anthracnose resistance (field and in vitro screening). From the analysis of variance it was concluded that there is significant difference among the genotypes for all the characters studied. The genotypes IIHR-B-HP-39 (yield per plant & dry yield per plant), IIHR-B-HP-89 (fruit length, pedicel length, fruit weight & dry recovery percentage), IIHR-B-HP-86 (number of fruits per plant, total capsaicinoids & dihydro capsaicinoids), IIHR-B-HP-64 (total carotenoids & yellow carotenoids),IIHR-B-HP-55 (red carotenoids & ASTA colour value), IIHR-B-HP-17 (nor-dihydro capsaicin) are found best for the respective traits improvement. High GCV and PCV, high heritability coupled with high genetic advance were observed for all the traits studied like number of fruits per plant, yield per plant, dry yield per plant, dry recovery percentage, fruit length, fruit width, fruit weight, fruit shape index, total carotenoids, red carotenoids, yellow carotenoids, ASTA colour value, total capsaicinoids, capsaicin, dihydrocapsaicin, nor- dihydrocapsaicin indicating the lesser influence of environmental effect, preponderance of additive gene action. These traits can be improved by simple selection. Whereas for earliness trait, non-additive gene action was reported there by heterosis breeding is best for developing hybrids with earliness. All the genotypes were grouped into 8 clusters, the cluster I consisted of 17 genotypes, cluster II with 20 genotypes, cluster III with 5 genotypes, cluster V with 4genotypes, cluster IV,1 genotypes and remaining clusters were mono-genotypic. Maximum intercluster distance was found with cluster VIII and VI and high cluster mean value for yield was recorded in cluster VI, so parents selected from these two clusters will be resulted in better crop improvement programme for enhancing yields. These fifty genotypes were screened for anthracnose resistance in field and in vitro by fruit puncture method, and found all the genotypes are moderately to highly susceptible except two genotypes (IIHR-B-HP-17 (C.chinense and IIHR-B-HP-131(C.annuum)) which are found to be highly resistant and can be used as donors for breeding anthracnose resistance in chilli.

Title: Evaluation of rootstock and scion in Brinjal (*Solanum melongena* L.) for growth, yield and fruit quality(2017)

Tejashwini Rathod, Dr. Y. S. R. Horticultural university, Guide: Dr. S. S. Hebbar

An investigation was conducted on grafting in brinjal during rabi season of 2016-17 with the major objectives of monitoring the changes induced by different rootstock-scion combinations in terms of plant growth and fruit quality of brinjal at ICAR-IIHR. The experiment was laid out in randomized block design with three brinjal hybrids Mahyco-9, Lalitha and Sharpova grafted onto Solanum torvum Swartz and non grafted were used as control. The effect of rootstock on the agronomic characteristics of the three brinjal cultivars, allow a series of considerations on the feasibility of this technique in the cultivars tested. The grafted plants produced maximum yield than non-grafted ones when grown for the potential economic value. Graft success was recorded about 85 to 87% in all the rootstocks and scion combinations, on an average it was reported 85%. Overall vegetative growth was highest in grafted plants. Maximum plant height was recorded in grafted Mahyco-9. The highest number of branches was recorded in grafted hybrid Lalitha. Number of leaves was recorded maximum in grafted Lalitha. Leaf, stem, root dry weight and leaf area index were recorded maximum in Mahyco-9 and the highest fruit dry weight was recorded in grafted Sharpova. A positive effect of grafting was recorded when Solanum torvum Swartz was used as rootstock. Flowering was early in grafted Mahyco-9 followed by grafted Lalitha. Days taken for 50% and 100% flowering in self rooted and grafted Lalitha took minimum number of days. Fruit set, number of fruits, yield per plant was recorded maximum in grafted Mahyco-9. The highest fruit length was recorded in grafted Mahyco-9 whereas, fruit diameter and volume was recorded highest in grafted Sharpova. Grafted Mahyco-9 performed best in flowering and yield characters when Solanum torvum Swartz was used as rootstock.

Title: Genetic variability studies for fruit qualitative traits and anthracnose resistance in Chilli (*Capsicum annuum* L.) (2017)

Sambidhan Bhue, OUAT, Bhubaneswar, Guide: Dr. P. Naresh

Onion is an important vegetable crop grown in India and throughout the world. Purple blotch caused by Alternaria porri is one among serious fungal diseases that affect onion, causing heavy yield loss ranging from 2.5 to 87.8 per cent. So there is need to develop hybrids with male sterility background for resistant to purple blotch disease coupled with higher yield. Twenty eight crosses resulting from a L x T design comprising of four lines and seven testers were studied to know the combining ability and magnitude of heterosis. Combining ability analysis revealed that L_3 showed good general combiner for most of the characters. The tester T_4 and T_5 were identified as good general combiner for yield and yield attributing characters. Among the 28 crosses, L_2 x T_4 was identified as best specific combiner as it showed high sca effect and per se performance, were as cross L_3 xT_5 exhibited high perse performance for total and marketable bulb yield. For heterosis out of 28 crosses, L_2 x T_4 and L_3 x T_5 were the most heterotic and could be exploited for commercial cultivation. The cross L_2 x T_4 (-42.62%) had exhibited highest magnitude of heterosis over commercial check for purple blotch disease resistance in desired direction. L_2 x T_1 (-7.78%) exhibited significant stranded heterosis for days to maturity. L_3 x T_1(36.84%) showed significant mid parent heterosis for ten bulb weight. The cross L_3 x T_5exhibited highest magnitude of heterosis over commercial check for total bulb yield tonnes per hectare (27.44%) and for marketable bulb yield per hectare (28.65%),L_2 x T_2(-33.33%) exhibited significant heterosis over standard check for unmarketable bulb yield per hectare.

Title: Varietal evaluation for floral biology in relation to fruit and seed yield in Okra [*Abelmoschus esculentus* (L.) Moench] (2018)

E. Nandhini. UHS, Bagalkot, Dr. K. Padmini

The study was conducted at the experimental field of ICAR-IIHR, Bengaluru, during kharif season of the year 2016 to evaluate ora varieties for floral biology with respect to fruit and seed yield. Among the different varieties, Srivilliputhur Local (19.93) was recorded maximum number of flowers per plant followed by Arka Anamika (18.37) and Arka Abhay (18.33) and minimum number of days taken for 50per cent flowering was observed in Ankur-48 (40.33) and Arka Anamika (41.33).In all the varieties, peak anthesis was noticed during 8.00 to 9.00 a.m. Anther dehiscence was found to be maximum after 10 minutes of anthesis in all the varieties. Among the varieties, maximum pollen viability was observed at the time of anthesis in Ankur-48(98.26%) and Arka Anamika (96.22%). Duration of pollen viability was maximum inArka Anamika at 8 hours after anthesis (70.56%) and existed up to 24 hours after anthesis (44.60%). In-vitro pollen germination was high in all the varieties after 48hours of incubation. Peak stigma receptivity was observed between 8.00 and 9.00 a.m. on the day of anthesis in all the varieties. Duration of stigma receptivity was highest in Arka Anamika until 12 p.m. (66.00%). All the varieties were self-compatible with less pollen limitation and lower dependency on pollinators. The maximum fruit set (81.43%), highest fruit yield (12.77 t ha^{-1}) and seed yield (1.91 t ha^{-1}) was observed in Arka Anamika.This could be attributed to highest number of nectarines (56.47),highest pollen viability at 4 hours of anthesis (87.57%), highest stigma receptivity during 8.00 and 9.00 a.m. (84.33%) and maximum stigma receptivity at 12.00 p.m.(66.00%). Number of nectaries was found to be maximum in Arka Anamika (56.47),which favored open pollination by honey bees while the nectar glands was found to be absent in Thirunelveli Local andAnkur-48.Among the different modes of pollination, open pollination recorded better fruit yield, whereas selfing by bagging recorded higher seed yield. Number of flowers per plant, flower length, corolla length, ovary breadth, number of ovules, position of anther and stigma, style length, in-vitro pollen germination and duration of stigma receptivity were significant and positively correlated with pod and seed yield characters.

Title: Identification of male sterile lines in white Onion (*Allium cepa* L.) (2019

Naveen Kumar BS, IGKV, Raipur, Dr. R. Veere Gowda

The present investigation on“ Identification of male sterile lines in white onion” (Allium cepa L.)” was carried out at the Vegetable crops division, Indian Institute of Horticultural Research (IIHR), Bengaluru. The experimental site had red clay loam soil and is located an altitude of 890 meters above mean sea level.The experiment was carried out with Randomized block design with 5 genotypes and 3 replications namely PW0-18, TW-18, PWR-18, RW-18, AW-O-18.Male sterile lines and the irrespective fertile lines were identified by visual observation, bagging and staining technique in the 5 genotypes and they are morphologically characterized for the growth and yield related characters in both bulb and seed crop. Among the observations taken PWR-18 performed well in growth and AW-O-18 is performed well in yield related characters in bulb crop. In seed crop PWR-18 showed well in both growth and yield related characters. Floral characterization of the genotypes was done to study of development of flower from bud to seed in onion.

Title: Induced mutagenesis in Cluster Bean [*Cyamopsis tetragonoloba* (L.) Taub] (2019)

Lavanya H. N. , UHS, Bagalkot, Guide: Dr. Smaranika Mishra

Induced mutagenesis in cluster bean variety Pusa Navbahar was studied using gamma irradiation. In M_1 generation lower doses of 150 to 200 Gy was found beneficial whereas higher dose of 600 Gy showed detrimental effect on germination, seedling growth parameters, pollen sterility and survival at maturity. M_2 generation was grown along with control (Pusa Navbahar) and three checks namely MDU 1, Swarna and Sonali. Total 9 types of mutants (dark green, branched, dwarf, white flower, sterile, long pod, short pod, curve pod, small leaf) were observed and the mutation frequency was high at higher doses whereas both mutagenic effectiveness and efficiency showed decreasing trend with increasing dose.M_2 generation revealed significant variations with respect to mutants and mutants over control for the traits like plant height, pod length, pod width, pulp to seed ratio and reaction to powdery mildew. For these traits GCV, PCV, heritability and genetic advance were estimated. Plant height, pulp to seed ratio and powdery mildew showed moderate GCV and PCV whereas, pod length and pod width showed low GCV and PCV. Moderate to high heritability and genetic advance were recorded for plant height, seed to pulp ratio, pod length and reaction to powdery mildew. Hence, based on these traits, 29 superior lines were selected and subjected for nutrient analysis. Sufficient variation was observed for all the nutrients and minerals studied. It was noted that for improving P, K, Ca and Mg content 350 to 450 Gy was beneficial whereas for N, Cu, Zn and Fe content improvement 100 to 150 Gy is useful. 100 Gy found to be useful in improving protein, antioxidant and phenol content in cluster bean. This study was found successful in generating variability for yield attributing traits and nutritional content. Further evaluation of the identified lines will help in isolating desirable genotype.

Title: Development of F1 hybrid in Bell pepper (*Capsicum annuum* var. grossum) (2020)

Varsha V., UHS, Bagalkot, Guide: Dr. Smaranika Mishra

In the present study, 7 parents and 21 derived F_1 hybrids in half diallel mating design were evaluated along with a commercial check (Indra) in randomized block design for various yield, quality and reaction to powdery mildew disease. Among seven parents, Arka Basant was identified as good general combiner for most of the traits and Arka Mohini and California Wonder for total yield per plant. All the studied parameters were governed by non-additive gene action suggesting heterosis breeding for the improvement of these traits in bell pepper. Crosses Arka Mohini X CW308, Arka Basant X California Wonder and Yolo Wonder X California Wonder were good specific combiners for majority of traits studied including total yield per plant. Further, studies on heterosis revealed that Arka Gaurav X Yolo Wonder showed maximum heterosis over commercial check for earliness traits and Arka Mohini X CW308 followed by Yolo Wonder California Wonder, Arka Basant X CW308, Arka Mohini X Arka Basant, Arka Mohini X UHFBP4, Arka Gaurav X UHFBP4 for total yield per plant. Reaction to powdery mildew disease revealed that though the parents are susceptible, crosses like Arka Gaurav X Arka Basant, Arka Gaurav X CW308, Arka Basant X Yolo Wonder, Arka Basant X California Wonder and Yolo Wonder UHFBP4 were moderately susceptible to the disease. From the above study it was found that best hybrid for total yield per plant was Arka Mohini X CW308 with maximum heterosis of 37.47% for yield over commercial check with good sca effects and highest per se value followed by Yolo Wonder X California Wonder with the commercial heterosis of 37.37% for yield. Hence these two best hybrids with good sca effects, high per se value, heterosis and also with desirable square-green fruit can be exploited for commercial cultivation by testing in multi-location trials. Obtained results suggest that heterosis breeding is advantageous in increasing yield and quality traits in bell pepper.

Title: Genetic divergence and stability analysis for leaf yield and quality traits in Drumstick (2020)

Supriya Mandal, UHS, Bagalkot, Guide: Dr Raja Shankar

The present investigation entitled “Genetic divergence and stability analysis for leaf yield and quality traits in drumstick” was carried out at ICAR-Indian Institute of Horticultural Research, Bengaluru-560089, Karnataka, during the period 2019-2020. The experiment comprised of 52 genotypes of drumsticks and was laid out in randomized complete block design (RCBD) with two replications to estimate the parameter of genetic variance and divergence and genotypic stability across three leaf harvesting seasons (September, 2019; December, 2019 and March, 2020). The ANOVA revealed all the quantitative traits related to morphology and biochemical characteristics had significant difference, which indicated the existence of wider genetic variation in the selected gene pool of drumstick. The correlation studies showed leaf yielding characters such as whole leaf yield, edible leaf yield in respect of shoot, plant and hectare had significant and positive correlation with stem girth, no. of shoot/ plant, stem length, shoot thickness, node to flower initiation, leaf length, leaf width, no. of leaf/ shoot.The degree of divergence estimated using Mahaloanobis D^2staistics classified the 52 drumstick genotypes into four major clusters and six sub clusters. Molecular diversity estimated using 20 SCoT DNA markers, the highest polymorphism (100%) was found with SCoT 36 however SCoT 10 showed the least polymorphism. Similarly, higher polymorphism information content was recorded with primer SCoT 36 (0.35) as against lowest with primer SCoT 10 (0.01). Based on PIC values, SCoT 36, SCoT 24 and SCoT 31 were most informative marker for future use in drumstick genotypes. Cluster analysis based on unweighted Neighbour joining (NJ) clustering method grouped 52 genotypes into three major clusters and 6 sub clusters. The bar plot diagram obtained from STRUCTURE indicates the division of total genotypes into two population groups (at K = 2 maximum delta K was potted). For leaf yield and nutritional stability index, the pooled analysis revealed that the mean square value due to main effect of genotypes and environment was highly significant for majority of characters related morphological and biochemical traits. It is concluded based on leaf yield, quality and organoleptic evaluation, IIHR-D-120, IIHR- D-28 and IIHR-107 found be higher yielder, which had 2.5 times higher yielding than commercial varieties such as PKM-1 and PKM-2 and Bhagya. Additionally, IIHR-D-28 secured higher score for leaf powder colour (7.17). IIHR-D-55 (Ca) and IIHR-D-59 (Protein) and IIHR-D-80 (low oxalate) found superior with majority of nutrients. Hence genotypes identified for stable leaf yield, quality and organoleptic superiority can be commercially exploited.

Title: Validation of molecular markers linked to phytophthora root rot and root knot nematode resistance loci in segregating populations of Chilli (*Capsicum annuum* L.) (2021)

Swathi H. A., IGKV, Raipur, Dr. Madhavi Reddy

Chilli or hot pepper (Capsicum annuum L.) is one of the most important Solanaceous vegetable crops grown extensively in tropical and sub-tropical parts of the world. However, the commercial production of chilli is limited by various biotic stresses, among soil borne fungal diseases, Phytophthora root rot caused by Phytophthora capsici posing serious threats to chilli cultivation in regions with high humidity and rainfall. The obligate plant parasitic root knot nematode Meloidogyne species (M. incognita) causes characteristic galls and retards the growth of the plants. So identification of the molecular markers and their validation at the seedling stage mainly helps in chilli improvement programme. The present study was undertaken to validate the molecular markers linked to Phytophthora root rot and root-knot nematode resistance loci indifferent segregating (BC_1, F_1) populations of chilli. The experiments were conducted at the ICAR-Indian Institute of Horticultural Research, Bengaluru, Karnataka, during October 2020 to May 2021. In the present study 120 plants of BC_1F_1 [(IHR3291 x Arka Mohini) x IHR3291],150 plants of BC_1F_1 IHR3288 x (IHR3288 x IHR3291) and 150 plants of F_2 population derived from the cross IHR 3291 x Arka Mohini were evaluated for Phytophthora root rot resistance under artificial epiphytotic condition against the virulent local IIHR isolate (gene bank accession number MK256294). 30 plants of BC_1F_1 [(IHR 3291 x Arka Mohini) x IHR 3291], 22 plants of BC_1F_1 IHR 3288 x (IHR 3288 x IHR 3291) and 32 plants of F_2 population derived from the cross IHR 3291 x Arka Mohini were found phenotypically resistance against Phytophthora root rot. The phenotypically resistant plants were again validated /genotyped with the five molecular markers linked to the Phytophthora root rot resistance viz., Hpms E034, Hpms E062, CAMS 405,SSR9 and CAMS 839 and the plants were forwarded to next generation based on the homozygous loci for all the five markers. Among eighty-four phenotypically resistant plants of different population, thirty two plants were shown both phenotypic and genotypic resistance against Phytophthora root rot and the plants were even validated with the two molecular markers linked to the root knot nematode resistance viz., SCAR_N and SCAR_CD and their PCR amplification data was recorded. The plants which have shown combined resistance to both Phytophthora root rot and root-knot nematode were forwarded to next generation.

Floriculture & Landscaping

Title: Propagation and cytotaxonomic studies in some Indian orchids (1981)

S.R.Nagabhushan, UAS, Bangalore, Guide : Dr.Foja Singh

Investigations to standardize propagation techniques in some Indian orchids and cytological studies in 15 species of Indian orchids belonging to five genera were carried out. Among five basal media (K.C., V.W., BN3F, M.S. and M) compared with regard to germination and growth of Spathoglottis plicate and Phaius wallichii. Vacin and Went's (V.W.) medium proved to be the best in which germination of seeds was faster than in the others. Pseudobulbs of Dendrobium aggregatum treated with IBA at 1000 and 2000 ppm put forth maximum rooting, number of roots and root length. The effect of NAA at 2000 ppm on the Pseudobulbs was similar to that of IBA at 1000 and 2000 ppm. Cytotaxonomical studies showed that among the five species of Paphiopedilum (P.fairieanum, P.hirsutissimum, P.insigne, P.venustum and P.villosum) four species except P.venustum were found to be diploids with 2n=26. P.venustum possessed 2n=36 which may be hypoploid due to centric fission. In these species the chromosomes were large. All the three species of Cymbidium (C.aloifolium, C.giganteum, and C. grandflorum) possessed a chromosome number 2n=40 which represented a clear homogenous assemblage. In the genus Pholidota the species P.imbricate also had a chromosome number of 2n=40. In the genus Aerides all the species investigated (A.lawrence, and A.odoratum) possessed 2n=40 chromosomes. In Rhynchostylis the only species investigated R- retusa possessed 2n=38. It was concluded that both numerical and structural alteration in chromosomes have played an important part in the evolution of different orchid species, which got stabilized through the agency of vegetative reproduction.

Title : Effects of gibberellic acid on growth and flowering of china aster (*Callistephus chinesis* Nees.) (1982)

R.Jayanthi, UAS, Bangalore, Guide : Dr.A.Mukhopadhyay

Gibberellic Acid at concentrations of 0 (control, spraying with distilled water), 10,25,50,100,250,500 and 1000 ppm were sprayed at 60 and 75 days after sowing on China aster cultivar 'Heart of France' to observe the effects on growth, flowering and chemical composition. The results indicated that GA3 spray at 50 ppm and above effetely increased plant height at all stages of growth, whereas 100 and 500 ppm concentrations were most effective in increasing the number of main branches. The influence of GA3 was not evident on the production of axillary branches. Flowering was accelerated considerably as a result of GA3 spray and the maximum acceleration of 52 days was obtained by 250 ppm spray. Though total flower production was not increased, the marketability of the flowers was significantly increased by GA3 sprays of 50-25 ppm as GA3 treated flowers were of better quality in terms of size (diameter), fresh weight and longevity. The total nitrogen content of leaves increased at vegetative stage in GA3 treated plants which might have contributed towards production of more branches. Similarly, sugar content in leaves at vegetative stage improved in GA3 treatments which might have helped the plants to produce better quality flowers. The flowers of the GA3 treated plants contained maximum amount of reducing and non-reducing sugars, which might have contributed towards better flower life.

Title: Studies on genetic variability and correlations in china aster (*Callistephus chinesis* Nees.) (1982)

T.Manjunatha Rao, UAS, Bangalore, Guide : Dr.S.S.Negi

Wide and significant variations for all the 12 characters were observed among the 38 genotypes of China aster studies. The difference between phenotypic and genotypic coefficient of variation was medium for a number of laterals per plant and narrow for the remaining characters. High heritability as well as high genetic gain were observed for flower weight and number of ray florets, whereas medium heritability along with high genetic gain was observed for number of laterals per plant. High heritability accompanied by medium genetic gain was found for plant height, plant spread, stalk length and stem girth. Stalk length had positive and significant correlations with plant height, plant spread, number of laterals per plant, number of flowers per plant, days to flower, flower size, flower weight and number of ray florets per head. Positive and significant associations were observed between flower size and each of the following seven characters, viz., plant height, plant spread, stalk length, number of laterals per plant, days to flower, flower size, flower weight and number of ray florets per head. Number of flowers per plant exhibited positive and significant relationship with plant height, plant spread, stalk length, number of main branches per plant, number of laterals per plant and days to flower. Path coefficient analysis revealed that plant height and plant spread were the major factors influencing stalk length directly. Number of flowers per plant, number of ray florets per head and flower size were also important as their total indirect effect on stalk length was high. Flower size was found to be influenced directly by stalk length, number of ray florets per head and plant spread. Plant height and the maximum total indirect effect on flower size., number of laterals per plant had the maximum direct effect on number of flowers per plant. This was followed by number of main branches per plant. Selection showed that selection based on 11 characters would be more efficient than straight selection to an extent of 42.5% in stalk length and 21.5% in number of flowers per plant, but there was practically no improvement over straight selection in flower size.

Title : Cytotaxonomical studies in Indian Dendrobiums (Orchidaceae) (1982)

C.T.Yeshoda, UAS, Bangalore, Guide : Dr.Foja Singh

Twenty different species of Indian Dendrobiums are collected from the Western Ghats and North Eastern India was evaluated cytotaxonomically. Out of the twenty species, eleven species had 2n=38 chromosomes and nine had 2n=40 chromosomes. All the species endemic to Western Ghat region had 2n=38 (n=19) chromosomes, but the species from Eastern India had both 2n=38 as well as 2n=40 (n=19, 20) chromosomes. Chromosomes were found to be very small in size in this genus. Length of chromosomes ranged between 2.75 pm in D.herbaceum and 4.5 pm in D.aggregatum. Size of chromosomes ranged between2.0 and 2.75 pm in other species. In this investigation karyotypes were not much helpful in delineating different species from each other. Species having close morphological similarity had very distinct unrelated karyotypes. Out of the twenty species studied, five species showed the presence of satellites, mostly one pair except in D.nobile which had two pairs of satellite chromosomes. The satellites were very distinct and hint towards the polyploidy origin of the species. The differentiation of Dendrobium species as evident by karyotypic variation may be due to the increase in telocentric chromosomes by centric fission or simple translation or inversion. However, the structural changes in chromosomes appear to have little effect on the external morphology of different species.

Title: In vitro propagation of Orchids (1984)

Sulalappa, UAS, Bangalore, Guide : Dr.Foja Singh

The major objectives of the investigations were to standardize the method for in vitro propagation of orchids both through seed/embryo culture and meristem culture. Bletilla hyacinthine, Dendrobium phalaenopsis were selected for the seed/embryo culture studies while Epidendrum radicans, Dendrobium phalaenopsis, Vanda 'Miss Joaquim' and Cymbidium munronianum, C. aloifolium were selected for tissue culture studies. Modified Vacin Went medium was found most suitable for the germination of Bletilla hyacinthine seeds while Burgeff N3f medium supported the best germination in Dendrobium phalaenopsis, IAA (1 mg l^{-1}) when incorporated in the medium enhanced seed germination and subsequent growth in both the species. It was also observed that coconut water 15% v/v had no effect on seed germination but it was very much helpful in subsequent growth and development of seedlings. Tissue culture studies revealed that Vacin-Went medium best suited for callus formation and differentiation in all the species studied followed by MS and Kc media. IAA and NAA incorporated in the medium (1 mg l^{-1}) gave more number of plantlets compared to control in Epidendrum radicans, while in Vanda 'Miss Joaquim' the best results were obtained by incorporating coconut water15% v/v in addition to IAA and NAA (1 mg l^{-1}). It was also observed that NAA+BA (1 mg l^{-1}) was helpful in producing multiple plantlets from the nodal sections of Epidendrum radicans.

Title: Morphological evaluation of some Rose cultivars (1985)

Sudeep Vyapari, UAS, Bangalore, Guide : Dr.R.N.Bhat

Investigation was carried out to study and compare the extent of morphological variability including vegetative and floral characters, pollen fertility status and disease tolerance of 50 rose cultivars. Majority of the cultivars were exotic and of recent origin. All the cultivars except 'Careless Love' had erect growth habit. Considerable variation was observed for plant height, average leaf area and density of thorns in different rose cultivars. Variability was also observed to exist for flower bud size, flower diameter, number of petals, petal length and petal breadth. Of the 50 cultivars, 14 had moderately fragrant flowers and cv. Fragrant hour was highly fragrant. The cvs. Ambassador and Ghazal had maximum and minimum stalk length. On estimating the pollen fertility using versatile stain, the cv. Ferry Porche had maximum whereas 'Yankee Doodle' had minimum pollen fertility percentage. It was also observed that 27 cultivars were highly susceptible to black spot and 34 cultivars were tolerant to powdery mildew. Based on the morphological evaluation of 50 rose cultivars, 9 were selected suitable for garden display, 7 each for cut flowers and exhibition purpose.

Title: Changes in growth, flowering and chemical composition as influenced by bulb size, spacing and depth of planting in Tuberose (*Polianthes tuberosa* Linn.) cv. Single (1985)

H.T.Nagaraju, UAS, Bangalore, Guide : Dr.A.Mukhopadhyay

The objectives of the study were to investigation the effects of varying bulb sizes (bulb diameter of 1 cm and 3 cm), spacing (15 x 15 cm and 30 x 30 cm and depths of planting (3 cm and 7 cm) on the nitrogen and sugar contents of bulbs, bulblets and leaves at flowering stage. By using large sized bulbs the bulb production was more, flower spike emergence was early with higher yield of spikes. Flower quality parameters like length of spike, length of rachis, number of florets per spike and longevity of spike in field improved when large sized bulbs were planted. Wider spacing resulted in earlier emergence, larger yield of flower spikes, besides improvement in length of of rachis, number of florets and vase life of spikes. However, yield of spike and florets per unit area were more with closer spacing. Deeper planting improved the length of spike,, number of florets per spike, length of rachis and longevity of spike in field and number of florets produced per unit area. Use of larger bulbs or narrow spacing resulted in higher total nitrogen in bulblets. Leaf nitrogen content was higher at wider spacing. Reducing and total sugar contents in leaves of plants from large bulbs were higher, whereas at closer spacing, reducing, non-reducing and total sugars of increased appreciably compared to wider spacing.

Title: Studies on floral variability and sensitiveness of cutting to gamma radiations in some Jasmine genotypes (1987)

K.A.Deviah, UAS, Bangalore, Guide : Dr.H.C.Srivastava

Analysis of variance showed highly significant differences among the genotypes for all the characters studied. The genotype and phenotypic coefficients of variation were found to be high for length of style, width of petal, length of anthers, weight of 100 flowers and weight of 100 flower buds. In general, phenotypic coefficients of variation (PCV) was marginally higher than genotypic coefficients of variation (GCV) except for length of flower bud, and it indicated low environmental influence on the expression of these characters. The high difference between PCV and GCV for flower bud length indicated that this character is influenced by environment. Heritability estimates were high for all the characters studied. Flower bud length revealed a comparatively lower estimate. Combination of high heritability and high estimate of length of style, width of petal, length of anthers, 100 flower weight, 100 flower bud weight, length of petal, diameter of flower, length of corolla tube, and number of petals per flower indicated additive gene action. percentage of rooting was high in all the genotypes and decreased with increase in dosage of gamma radiations. Untreated cutting (control) produced highest number of roots per cutting and the number of roots decreased with increase in the dosage of gamma radiations. Untreated cutting produced longest and thickest roots compared to irradiated cuttings. In general, there was a gradual decrease in the length and thickness in irradiation cuttings in all the genotypes studied. Thus, it can be concluded that gamma irradiation resulted in decrease in percentage of rooting, number of roots per cutting, length and thickness of roots.

Title : Studies on pollen fertility, seed set and seed germination in some Rose cultivars (1988)

M.G.Sandhya, UAS, Bangalore, Guide : Dr.R.N.Bhat

The investigation was on the pollen fertility status, seed setting behavior of three cultivars after natural selfing, artificial selfing and artificial cross pollination, tracing the pollen tube growth in stylar region, seed viability and seed germination in rose. The percentage of pollen fertility estimated in 48 cultivars by using versatile stain was found to vary widely with cultivars. Among the Hybrid Teas, cv. Chandrama (76.9%) had maximum pollen fertility. cvs. Aquarius (19.31%) and Roi des Rois (20.47%) had minimum pollen fertility among Hybrid Tea and Floribunda group, respectively. Seed setting was observed to vary greatly with season. High temperature (>27 ºC) adversely affected the fruit and seed set. Naturally selfed flowers of cv. Happiness did not set fruit in both the seasons due to lake of pollen grains falling on the stigma whereas artificial selfing improved the fruit set in cvs. Happiness and Paradise. cv. Queen Elizabeth was found to be better seed parent followed by 'Paradise' and 'Happiness' based on the degree of fruit setting. Fruit set as well as seed set was low in case of selfed flowers when compared to crosses. Although fruit set maximum (100%) in 'Queen Elizabeth' when crossed with cvs. Happiness and Paradise seed set was maximum (23.06) in the cross between 'Paradise' x 'Queen Elizabeth' followed by 'Paradise' x 'Happiness' (17.20) during July-Nov., 1987. Seed viability test was carried out by using topographical tetrazolium test for the first time in rose. Embryo along with the cotyledon stained more than half was considered as viable. Embryos unstained and hollow inside were considered as non viable seed. As per the test, percentage of seed viability was 'Paradise' and 'Happiness' in cv. Proud Land (56%) followed by 'Cyclamen' (52%) and 'Queen Elizabeth' (51.2). open- pollinated seeds of cvs. Cyclamen, Proud Land and Queen Elizabeth were successfully germinated on moist vermiculite at a constant temperature of 4 ºC. Seed germination was observed from 85-134 days in refrigerated condition. Seed germination was maximum (42.6%) in cv. Cyclamen and was poor in case of cvs. Proud Land (13.35) and Queen Elizabeth (10.6%).

Title: Studies on radiation sensitivity in some Bougainvillea cultivars (1990)

P.T.Srinivas, UAS, Bangalore, Guide : Dr.R.N.Bhat

The present investigation was on relative radiation sensitivity, sprouting behavior, morphological variations, pollen fertility and finally selection of desirable mutants in three Bougainvillea cultivars viz., 'Dr.R.R.Pal', 'Lady Mary Baring' and 'Stanza'. The survival percentage estimated in three cultivars was found to vary widely. The LD_{50} for 'Lady Mary Baring', it was 2.0 kR. Detailed studies on the morphological abnormalities with exposure to gamma rays revealed that the cuttings were very sensitive to radiation. The abnormalities observed in leaves include asymmetrical development of leaf blade, variation in size, notching, mottling and bilobed conditions in some of the leaves of the cuttings treated with more than 1.0 kR of gamma rays. Stimulation in plant height was observed at 1.0 kR in 'Dr.R.R Pal,' and 'Stanza' and in 'Lady Mary Baring' at 2.0 kR of gamma rays. An interesting induced somatic mutant in cv. 'Lady Mary Baring' was observed with changes in flower and bract colour in one of the well established plants at 3 kR of gamma rays. The bract colour was completely changed to light pink as compared to Indian yellow in the parent cultivar. The flower tube was changed to light green and star colour was changed to light yellowish green with the backside of star changed to pink. In 'Stanza' one of the interesting features observed was partial leaf variegation in two of the leaves at 2.kR. The mature leaves showed cream yellow variegation on one side of the margin. However, other leaves in this branch were normal. Rooting behavior varied widely in the cultivars after exposure to gamma rays. In Dr.R.R Pal, the development of adventitious and lateral roots was minimum at 1.0 kR, followed in 'Lady Mary Baring' at 1.5 kR and 'Stanza' at 2.0 kR. The pollen fertility estimated in all the three cultivars in the treatments showed that the pollen grains were shriveled and deformed and they failed to take the stain confirming sterility as in the parent cultivars.

Title: In vitro propagation of Anthurium (1993) L.Hemantha Kumar, UAS, Bangalore, Guide : Dr.Foja Singh

M.G.Sandhya, UAS, Bangalore, Guide : Dr.R.N.Bhat

Foliage anthuriums are gaining importance as indoor plants and are highly valued in the internal market and for export. The availability of planting materials however is very limited. The present studies were conducted to standardize methods for in vitro propagation of two important foliage species Anthurium bakeri and Anthurium magnificum. In vitro germination of seeds of A. bakeri were best supported by Nitesh medium followed by Vacin Went medium, Murashige and Skoog medium was not found suitable for germination or subsequently growth. Among the growth of seedlings (0.5 mg l^{-1}). NAA did not promote see germination or growth but induced callusing in the seedling early germination (0.1 mg l^{-1}) and subsequent growth (0.5 mg^{-1}). Tissue culture studies revealed that leaf segments were the best explants for callus induction and subsequent growth as compared to periole segments, Nitsch medium was found to be the best for the growth. Among the growth regulators BA (0.1 mg l^{-1}) + 2,4-D (0.1 mg l^{-1}) were found more suitable for callus induction and subsequent growth in A. bakeri. Nitsch medium was also found to be the best for A. magnificum. Explants was observed in a combination of BA (1 mg l^{-1}), however higher concentration of BA (5 mg l^{-1}) inhibited the production of callus and its further growth. It was observed during the experiments that callus formation was promoted only in dark (45-60 days). The cost of production per in vitro seedling was Rs. 0.67.

Title: Hybridization studies in tuberose (*Polianthes tuberosa*) (1993)

G.K.Seetharamu, UAS, Bangalore, Guide: Dr.R.N.Bhat

The detailed hybridization studies including pollen viability, in vitro pollen germination, seed setting behavior in nine tube rose genotypes were conducted for the first time. The percentage of pollen viability varied considerably between genotypes. Among the double type of tuberose, maximum pollen viability was observed in IIHR-5 (89.9%) and IIHR-3 (88.3%). In single type to tuberose, maximum pollen viability as observed in IIHR-6 (89.3%). The percentage of in vitro pollen germination by hanging drop technique in tuberose genotypes revealed that the double types the highest percentage of pollen germination was observed in IIHR-2 (62.75%) and the lowest was in IIHR-3 (47,46%). Among the single types, maximum percentage of pollen germination was recorded in IIHR-6 (62.95%0 and the minimum in cv. Single (45.92%). The fruit set by open- pollination was highest in IIHR-6 (76.0%) whereas it was lowest in IIHR-1 (18.0%). Self incompatibility was observed in tuberose genotypes. Crossing of different single type of tuberose revealed that only in crosses between cv. Single x cv. Variegated a low percentage of success (1.31%) was observed after third and fourth day of pollination. The crosses involving double type of tuberose as a pollen parent with single type, the fruit set and fruit retention was considerably improved on fourth day after anthesis followed by third and second. Day. In single type to tuberose cv. Single and IIHR-6 were found to be better as seed parents. Among the double types, IIHR-2 and IIHR-3 were found to better as pollen parents. The crosses between IIHR-6 x IIHR-3 gave better fruit set (31.71%) followed by IIHR-1X cv. Double (35.29%). The open-pollinated seed germination was maximum in cv. Variegated (76.0%) followed by cv. Single, (64%). In seeds obtained from artificial cross-pollination, the seed germination was maximum in crosses between IIHR-1 x cv. Double (90.0%) followed by cv. Single X IIHR-2 (88.8%).

Title: Cytological and pigmentation studies in certain cultivars and mutants of Bougainvillea (1996)

N.Anand, UAS, Bangalore, Guide : Dr.R.N.Bhat

Studies were carried out to compare the cytological pigment differences associated with varied bract colours in certain Bougainvillea cultivars and mutants. The Bougainvillea genotype including induced mutants were selected. The quantitative and qualitative status of pigments showed considerable variations. The estimated betacyanin content expressed as O.D. value was observed to be maximum in cv. Elizabeth (1.7638) followed by colchicines induced mutant 'Zakariana' (1.2007) with the lowest bract (pH 5.87). Estimated bract betaxanthin content was found to be maximum in cv. Mrs. Enid Lancaster (1.5422) followed by cv. Tomato Red (1.0922). Therefore the ratio was of bract betacyanin to betaxantin was the highest in cv. Dr. H.B. Singh (2.4901) with highest record bract pH (6.53) and the lowest betacyanin to betaxanhin ratio was observed in cv. Lady Mary Baring (0.1497). Qualitative estimation of bract pigments by paper chromatography on the basis of Rf values were grouped. Two betaxanhin bands were observed in all the genotypes studies except in cv. Dr.H.B.Singh. this variation in pigment content seems to influence upon light and dark coloured bracts of induced mutants. Cytological studies in the cultivars and mutants indicated no loss of the chromosomes in gamma irradiated and colchicine treated mutants. Miotic behaviour varied from normal behavior showing less number of univalents and pollen mother cells having laggards. Whereas in highly abnormal behavior more number of univalents and laggards were observed in metaphase I and anaphase I and II, respectively. Among the mutants gamma rays induced mutant 'Zakariana' had less miotic behavior than its parent. Thus the uniformity in gametic chromosome number and variations in bract colour is attributed to the effects of genes controlling the bract colour expression.

Title: Variability studies in carnation (*Dianthus caryophyllus* L.) (1997

K.Mahesh, UAS, Bangalore, Guide : Dr.R.N.Bhat

An investigation was undertaken to study the nature and magnitude of various genetic parameters and association among important quantitative characters in carnation at the IIHR, Bangalore. The study involved nine genotypes and variability was observed for all of the characters except for flower weight and number of flower buds per stem. Out of 25 metric characters studied, 15 characters were found to be useful for breeding programme. Heritability with higher genetic advance were exhibited by leaf area at 6th node and number of secondary branches which have no commercial value but the latter plays an important role for commercial propagation. Genotype correlation coefficients were higher than phenotypic correlation coefficients. Most of the characters exhibited significant positive correlation among themselves except for very few characters. Flower diameter had significant positive correlation with petal width, petal length, and flower length, leaf area at 6th, 9th and 15th node. Path coefficient analysis was done for three most important characters, namely, flower diameter, node number at which flowering and number of primary branches. Genotypes 'White with red edge', 'Arthur Sim' and 'Scania' were found to be superior for different horticultural characters and useful in breeding superior hybrids. The genotypes such as 'Scania'. 'Dustry Pink', 'Pink', 'Arthur Sim' and 'Sam's Pride' were found to be having pleasant fragrance.

Title: In vitro studies on *Anthurium andreanum* Lind and *A. crystallinum* Hort. (1997)

Mrityunjay.B.Angadi, UAS, Bangalore, Guide : Dr.Devinder Prakash

The investigations were conducted on Anthurium andreanum and A.crystallinum at IIHR, Bangalore, for standardizing the best nutrient medium and to supplement adjuvants for in vitro seed germination and subsequent seeding growth, callusing, differentiation and acclimation. In vitro seed germination was rapid (7 days) on Morels medium, followed by half strength Nitsch, Nitsch, MS, Vacin and Went and Knudson-C media. Nitsch medium was the best to promote subsequent seeding growth parameters like root length (9.70 cm), number of roots (3.30), shoot length (3.24 cm), fresh weight (498.70 mg), dry weight (50.60 mg) and FW/DW x 100 index (985.20). Nitsch medium supplemented with coconut water supported the early seed germination (100 days) while the early seeding growth (fourth leaf) was promoted by banana pulp (100 days). However, ragi and wheat malt were inhibitory. MS medium containing 1 ppm each of BAP and 2,4-D was effective in inducing callus and further growth. Higher concentration of 2,4-D (6 ppm inhibited the callus growth in both the species. Lower concentration of BAP (1 ppm) induced more number of shoots per flask (36), root length (9.98 cm), number of roots(8.90), leaf length (1.84 cm) and the leaf breadth (1.22 cm) but higher concentrations (2.5 and 5.0 ppm) reduced the number of shoots and also inhibited the rooting. NAA(1 ppm)induced more number of roots (12.55) with higher root length (1.45 cm). All the plantlets were survived completely under mist chamber, green house and laboratory conditions. However, seedlings grown under mist chamber were superior for shoot length (6.49 cm), root length (10.29 cm), leaf length (3.66 cm) and leaf breadth (2.33 cm) in both the species.

Title: Embryo culture of certain economically important Orchids (1998

Shakeel Ahmed, UAS, Bangalore, Guide : Dr.Devinder Prakash

The in vitro studies conducted in Cymbidium aloifolium Sw., Dendrobium nobile Lind and D. pierardii Roxb. revealed that, Vacin and Went medium was best for early (6.33 weeks) and highest germination (48.33%) in C. aloifolium, while Knudson C medium was best for D. nobile and D. pierardii with 100% germination. Nitsch medium was also equally effective as that of Knudson C in case of D. nobile. Coconut water increased leaf length (1.23 cm) and stem thickness (0.17 cm) in in vitro plantlets of D. pierardii. Banana pulp increased leaf number (4.0) and leaf length (1.37 cm) in D. nobile. Wheat and sago were better alternatives to agar as they promoted growth. Wheat malt increased shoot length in C. aloifolium (1.74 cm) and D.nobile (0.94 cm). It also promoted leaf length (1.30 and 1.13 cm) and stem thickness (0.23 and 0.17 cm,) in D. nobile and D. pierardii. Sago increased leaf number in C. aloifolium (3.85) and D.pierardii (3.65), shoot length (3.13 cm) in C. aloifolium,s leaf length (1.12 cm) and stem thickness (0.18 cm) in D. pierardii. Even in D. nobile it could replace agar with slight beneficial effects. BAP (1 ppm) had a growth promotive effect in D. nobile. In Dendrobium species 2,4-D (1 to 6 ppm) with BAP)1 ppm) induced callus. 2,4-D and BAP (1 ppm each) were found best for early induction of callus (65.63 days), higher callus intensity, better callus size (5.31 mm), weight (30.85 mg) and with very quality. But, 2,4-D (1 to 6 ppm) was inhibitory for C. aloifolium protocorms. Polyhouse with higher relative humidity (80.85%) was better than Green house for hardening of Dendrobium hybrid ‘Sonia’, since survival percentage was highest (66.25%), as compared with green house (56.88%).

Title: Studies on microsporogenesis and mega sporogenesis in hybrids of Tuberose (Polianthes tuberosa L.) (1998)

K.C.Satisha, UAS, Bangalore, Guide : Dr.Meenakshi Srinivas

Floral biology, histological and histochemical studies of the reproductive structures of tuberose cvs. Shringar and Suvasini were studied. In 'Shringar' and 'Suvasini' an average of 17.76 and 26.86 days were required for anthesis from the stage of visible initiation. The anther dehiscence started at 6 pm and 6.20 p.m in 'Shringar' and 'Suvasini' respectively.The maximum anther dehiscence was observed around 6.20 pm in 'Shringar' and 'Suvasini' it was 7.00 p.m. histological and histochemical changes in anthers of 'Shringar' revealed that, during early stages of development, sporogenous cells had intense polysaccharide, protein and rich polysaccharides, proteins and RNA. The tapetum started degenerating, thus assisting nutrition of developing microspores. This was followed by the development of pollen wall with exine and intine around the mature spores. In 'Suvasini', PMCs were intense in insoluble polysaccharides, RNA and rich protein content. In the anthers, tapetum is not well differentiated. In the pollen sac, pollen development is incomplete because of improper differentiation of tapetum. They were exposed to malnutrition as a consequence, the pollen development is not proper. At pollen grain stage they had rich polysaccharide, protein and intense RNA content. Histological and histochemical studies conducted on the developing ovule revealed that the ovule was anatropous, crassinucellate and bitegmic. The development stages viz., archesporium, megaspore mother cell, megaspore tetrad had low polysaccharides, intense proteins and RNA indicating a high rate of metabolic activity. The egg cell, synergids had rich polysaccharides proteins and RNA.

Title: Cytomorphological Studies in tuberose (1998)

P.L.Jayasree, UAS, Bangalore, Guide : Dr.Meenakshi Srinivas

In tuberose (Polianthes tuberosa L.) the two high yielding F_1 hybrids viz., Shringar (single) and Suvasini (Double) were compared with their parents viz., Mexican single and Peral double for their somatic chromosome number, meiotic behavior, leaf and floral axis anatomy. Three of them except Suvasini were evaluated along with three other F_1 hybrids for the effect of tuber size (small and medium) on establishment and expression of both vegetative and floral characters. Somatic chromosome number in all four varieties was similar and was 2n=60. Five pairs of large chromosomes and 25 pair's small chromosomes were present. At diakinesis, one, two or three nucleoli were present in the four varieties. However, their frequency varied with varieties. Course of meiosis was nearly normal in all four varieties, culminating in the production of four microspores in most of the PMCs. The pollen fertility varied among the varieties. There were no differences in the leaf anatomy among the four varieties viz., Mexican single, Peral double, Shringar and Suvasini. Anatomy of floral axis is also similar in the four varieties. In the comparison of bulb size, appropriate choice of bulbs for planting based on size is variety specific in case of the three varieties studied viz., IIHR-2, IIHR-4, and Peral double.

Title: Microsporogation studies on chrysanthemum (Dendranthema grandiflora Tvelev) (1998)

M.Viswanath, UAS, Bangalore, Guide : Dr.T.M.Rao

The investigations were conducted on chrysanthemum (D. grandiflora Tvelev) at IIHR, Bangalore, for optimizing the nutrient medium for multiple shoot induction, for in vitro rooting and to evaluate the efficacy of low cost gelling agents in chrysanthemum. Shoot tips of 5 mm and 10 mm long gave better establishment (60 %, and when cultured on various media started growing within a week after inoculation. Sterilization of chrysanthemum shoot tip explants using mercuric chloride at 0.1% for two minutes gave better survival for 'Ravikiran' (80 %), 'M-14' (73.3 %) and '87-17-1' (60 %). For 'Yellow Gold', 0.05 % mercuric chloride for three minutes was better. For nodal segment explant, mercuric chloride at 0.1% for two minutes was found to be better for all the four genotypes. After eight weeks of inoculation an average of six shoots was induced by BAP (2 mg/1) as well as kinetin (2 mg/1) when supplemented in MS basal medium. Cultivar Ravikiran produced eight shoots on BAP (2 mg/1). Maximum shoot length (3.25 cm) was obtained in cultivar Ravikiran in MS basal medium supplemented with BAP 1.5 mg/1. The medium with IBA 1mg/1 was effective in inducing maximum root length and number of roots for all the four genotypes. At four weeks the root length ranged from 2.5 cm to 3.2 cm. Cultivar Ravikiran was superior with an average of 18.8 roots having 3.28 cm root length. Gelrite and Agar as gelling agents performed better compared to Isubgol and Sago for multiplication of Chrysanthemum when nodal segments were used as explants. The shoot length was more (1.98 cm) and number of leaves was maximum (7) in gelrite. The survival of plantlets transferred to pots containing cocopeat and sand was high in cultivar Ravikiran (80 %) followed by M-14 (75 %).

Title : Effect of coco peat media and electrical conductivity on production of Gerbera jamesonii (1998)

Padmanabha Pillai, Bangalore University, Guide: Dr.C.Aswath

The experiment was carried out with gerbera to study the influence of coco peat based potting mixtures on production and leaf nutrient content of Gerbera jamesonii. The treatments include 100, 75, 50 and 25 per cent coco peat mixed with various proportion of normal growing media supplied with nutrient solutions having three different electrical conductivity 1.3 ds/m (E1), 1.8 ds/m (E2) and 2.3 ds/m (E3). The medium containing higher proportion of coco peat had good physico- chemical properties. The pH of the growing media decreased with increase in nutrient EC levels. The medium containing 100% coco peat supplied with nutrient solution having EC of 1.8 ds/m (E2) produced good quality flowers. The build up of EC was high in 100 per cent coco peat medium and low in normal growing medium. The phosphorus, potassium, calcium, magnesium, sulphur and micronutrients in leaves were determined after 4 months after planting. The leaf phosphorus, manganese, zinc, copper and sodium contents were high in 100 per cent coco peat medium while potassium and calcium contents were at optimum level. However, magnesium, sulphur and iron content were high in normal growing medium. In general, the nutrient contents increased with increased coco peat proportion.

Title: Chemical regulations of vase life of cut Anthuriums (2000)

M.N.Anuradha, UAS, Bangalore, Guide : Dr.Devinder Prakash

Research was carried out to extend the vase life of cut Anthurium flowers of cv. Liver Re, Meringue and Casino by using different chemicals in combination with sucrose and germicides. The prime objective was to standardize optimum concentration of vase solution for the above cultivars by using growth regulators and metal salt in combination with sucrose and germicides. Studies include the use of growth regulators namely Triadimefon, Benzyl adinine, Mineral salts and $AgNO_3$. Each of these at 4 different concentrations, each in combination with two levels of sucrose, 4 & 6% and germicide 8 HqO at 400 ppm were used. It was observed that the chemicals used have shown to have maximum quantity of cumulative water uptake and higher water uptake to water loss ratio in the treated spikes. As a result there was a better water balance to maintain fresh weight which eventually leading to the increased longevity of flower. Best vase life improvement in the three cultivars was by 87%, 89%, and 93% respectively with chemical treatment over control. The period of initiation of the symptoms associated with senescence was drastically delayed by treatment with different concentrations of TAF, BA, AGNO 3 in combination with sucrose and germicides over control. Though all the chemicals used had beneficial effects in terms of better water relations to extend vase life in all 3 cultivars of anthuriums.

Title: Genetic and pollen studies in *Gladiolus spp*. (2000)

M.V.Balaram, UAS, Bangalore, Guide : Dr.T.Janakiram

Gladiolus is one of the important bulbous ornamentals grown in many parts of the world. In India it has now gained importance as a cut flower for domestic consumption and also for export. A study was carried out at IIHR, Bangalore to generate information on genetic and pollen related characters in Gladiolus spp. Studies on the relative performance of India (11) and exotic (24) Gladiolus genotypes showed that Indian cultivars were early in spike emergence, had more florets per spike, more spikes per corm, high corm multiplication rate, larger corms, more viable pollen and short flowering duration. While, exotic genotypes had larger florets, more florets open at one time, longer spikes and high cormel multiplication rate. Since, exotic cultivars exhibited better spike/floret characters which are of economic importance they may be grown on a commercial scale. High phenotypic and genotypic co-efficient of variation, heritability and genetic advance recorded for number of shoots per plant, number of spikes per corm, number of daughter corms, number of cormels percorm, 25 cormel weight and propagation co-efficient suggests selections of genotypes based on these traits for further improvement through effective breeding programmes. Studies on the association of various morphological traits through correlation and path co- efficients analysis showed that, plant height, spike girth, number of florets open at one time, florets length, weight of daughter corm and rachis length had positive and significant correlations with maximum direct effects on number of florets per spike. While leaf number, floret diameter and spike length though had positive and significant correlations. Spike weight, and equatorial corm diameter had maximum indirect effects with significant and positive correlations. Number of daughter corms had significant positive association and direct effects on number of shoots per plant and 25 cormel weights. While, number of shoots per plant through had significant and positive correlation, it exhibited maximum indirect effect. The feasibility studies on storing pollen from five promising varieties viz., Darshan, Dhiraj, Sagar, Sapna and Shobha developed at IIHR and G. callianthus a wild fragrant species at sub zero temperatures of -65 ^{O}C and -196 ^{O}C (in liquid nitrogen) showed negligible loss in the viability, vigour and fertility levels of pollen (from all the genotypes) upon storage compared to fresh pollen. Hence, there are no species/varietal specific pollen storage temperatures.

Title: Effect of different growing media and pH on growth and development of *Anthurium andreanum* L.(2000)

R.Smitha, UAS, Bangalore, Guide : Dr.M.L.Choudhary

Anthurium is gaining importance in the global cut-flower trade because of its attractive and long lasting flowers. Commercial cultivation of this crop started recently in India and hence there is a need to standardize the growing techniques. Anthurium plants require a growing medium with good physical and chemical properties for their proper growth and development. In the present study coir pith, a waste product of coir industry, was tested in combination with different proportions of normal potting medium (soil, sand and FYM in 2:1:1 ratio) to find of their suitability as substrate for Anthurium. Coir pith and normal potting medium ratio of 100:0, 75:25, 50:50, 25:75 and 0: 100 were tried in the experiment. In each growing media three levels of pH (4.5-5.5, 5.5-6.5-75) were maintained to determine the optimum range of pH for Anthurium. The experiment was designed in a completely randomized factorial design with fifteen treatment combinations. Increased proportions of coir pith in the growing media improved the physical properties viz., maximum water holding capacity, porosity and drainage. The bulk density and particle were lowered with the addition of coir pith due to the increase in pore space and lighter weight of particle. The pH of the growing medium was decreased with increasing proportions of coir pith whereas CEC was found to be increasing with increasing amounts for coir path. The available NPK status of coir pith containing medium was higher than that of normal potting medium. The growth parameters like leaf area, number of levers, petiole length, petiole thickness and number of roots were maximum in 100% coir pith medium. The number of suckers per plant, fresh weight and dry weight were higher in T2 (75% coir pith + 25% normal potting medium) and T1 (100% coir pith) growing media when compared to other growing media treatments. Early flowering was also noticed in these two media where plants flowered within a period of eight months. Leaf water potential was improved by increasing amounts of coir pith in the growing media. The light of these results, it can be concluded that for better growth and development of Anthurium the most suitable growing medium is the one containing coir pith alone. Among the different pH levels maintained in the media, slightly acidic pH range of 5.5-6.5 was optimum for the growth of Anthurium plants.

Title: In vitro regeneration of Chrysanthemum (*Dendranthema grandiflora* Tzvelev) (2000)

J.B.Noorjahan, UAS, Bangalore, Guide : Dr.M.L.Choudhary

In vitro direct regeneration without a callus intermediary is a pre-requisite for developing efficient transformation system, in ornamental crops including chrysanthemum (Dendranthema grandiflora Tzvelev) which is one of the popular flower crops of the world. An experiment was conducted to develop an efficient direct regeneration protocol for chrysanthemum. The surface sterilized shoot tip and leaf explants of cvs. Ravikiran and Chandrika were cultured on Murashige and Skoog medium fortified with different concentration of BAP (0.2-2.5 mg/1), Kinetin (0.2-2.5 mg/1), IAA (0.1-1.0 mg/1) and NAA (0.5-1.0 mg/1). The MS medium supplemented with 0.2 mg/1BAP or Kinetin+0.1 mg/1 was found best for obtaining maximum frequency of regeneration. Puncturing the surface sterilized explants before inoculation increased the frequency of regeneration from leaf explants. The number of regenerated adventitious shoots obtained was significantly more from cv. Ravikiran when compared to cv. Chandrika. Histological studies conducted showed that direct shoot regeneration was obtained from the mesophyll cells. The histochemical studies carried out revealed that arising shoot primordial, leaf primordial and pro-vascular stands showed intense protein and nucleic acid content. Preliminary studies on Agrobacterium mediated genetic transformation revealed that chrysanthemum transformants with Kanamycin after a co-cultivation period of 48 hours.

Title: Performance, dormancy and disease screening studies in Gladiolus (2001)

G.Shankar Murthy, UAS, Bangalore, Guide : Dr.T.Manjunatha Rao

Gladiolus is one of the most important bulbous ornamentals grown commercially for cut flower purpose. An investigation was carried out on performance of cultivars, breaking of dormancy and screening of cultivars against fusarial wilt disease at Indian Institute of Horticultural Research, Hessaraghatta, Bangalore. The performance was best adjudged in Gladiolus cultivars 'Sapna' for days to flower, floret diameter and florets open at one time, 'Sagar' for plant height and corms and cormels produced per corm, hybrid '87-22- 1' for spike and rachis length, 'Meera' for number of florets per spike and 'Darshan' for number of marketable spikes per corm. High phenotypic and genotypic co-efficient of variation, heritability and genetic advance were found for the characters viz., rachis length, number of side spikes per corm, duration of flowering, cormels produced per corm, cormel size and cormel weight. Marketable spikes per corm had significant and positive genotypic correlation co-efficients with number of side spikes per corm and cormel size. It also had positive direct effects with rachis length, number of florets per spike, vase life and corms produced per corm. Treatment of small sized corms of Gladiolus hybrid '87-22-1' with ethrel at 250 ppm for 48 hours reduced the days to sprout, while treatment with ethrel at 1000 ppm resulted in maximum sprouting percentage. Whereas, the treatment of medium sized corms of Gladiolus hybrid '87-22-1' when treated with thiourea at 500 ppm resulted in early sprouting, while the maximum sprouting percentage was recorded from the corms treated with 50 ppm BA for 48 hours. Pollen from the second basal floret collected after one day of tying and incubated for 3½ hours showed maximum pollen germination. Fresh pollen had maximum germination than room temperature and cold stored (-65 ºC) pollen. Pollen of all the cultivars germinated well in the absence of fusaric acid, while with the addition of fusaric acid there was drastic reduction in germination and there was complete inhibition of pollen germination at higher levels of fusaric acid.

Title: Genetic studies in tuberose (*Polianthes tuberosa* L.) (2002)

K.N.Radhakrishna, UAS, Bangalore, Guide : Dr.Meenakshi Srinivas

A study was undertaken to evaluate tuberose genotypes for qualitative and quantitative characteristics and to understand the variability land heritability of different morphological traits. Fourteen genotypes of tuberose were evaluated. Hybrids Prajwal, 1x6 (T) and Shringar exhibited superior performance for loose flower yield while Vaibhav and Suvasini recorded higher spike yield. Hybrids IIHR-2, 1x6 (T) and Shringar exhibited good multiplication of bulbs.

Title: Hybridization and development of inbred line in Petunia (2011)

Swathi Kolukunde, UAS, Bangalore, Guide : Dr.T.Tejaswini

Petunia is a popular bedding plant and also used in landscaping for its aesthetic value. Petunia is a major contributor in flower seed industry with an increasing demand for F_1 hybrids. Cost of developing hybrids is mainly dependent on cost of inbred development and hybridization. Inbreeding depression leading to poor seed set and reduced seed germination are problems encountered by seed industry. In this background the present study was taken up with the objectives to evaluate various selfing techniques to identify the efficient one for production of large quantity of seeds in short duration to facilitate inbred development and also for hybrid production. Among the different methods of selfing (threading, manual pollination, bagging of single bud and bagging of multiple buds), bagging of multiple buds resulted in minimum days to seed set (22 days), cent percent seed set, higher pod weight (0.252g) and number of seeds/g (8000). Seed germination percentage was high in manual pollination (86.44%) followed by bagging of multiple buds (68.44%). Inbred line IIHRP-WT recorded higher pod weight (0.149g), number of seeds/g (7350) and cent percent seed set compared to other inbred lines. In crossing programme, pollination with pollen mix of same line gave the highest pod weight (0.1109g) and number of seeds/g (11400) over the other methods viz., pollination with single anther and pollen mix of same plant. Floral morphology studies revealed variations for flower colour (white, purple, pink, magenta, bicolour of white and pink), anther and pollen colour (white, yellow and purple), number of anthers (5-7), position of stigma in relation to anthers (pin and thrum), receptivity of stigma in relation to anthesis, dehiscence of anthers and pollen viability (40.66-97.77%). All the inbred lines showed their ability to seed set in selfing experiments except in IIHRP-SI wherein self incompatibility was confirmed.

Title: Characterization of bird of paradise (*Strelitzia reginae* L.) for morphological and physiological traits (2017)

Shilpa,K. N., UHS, Bagalkot, Guide: Anuradha Sane

Anendeavor was made during 2015-16 to characterize 21 genotypes of Bird of Paradise (Strelitzia reginae L.) for various morphological and physiological traits under open field condition at ICAR- Indian Institute of Horticultural Research, Hessaraghatta, Bengaluru, Karnataka. Among growth parameters, genotype BOP 41 recorded higher plant height (166.3 cm), fans per plant (29.67), leaves per plant (389) and plant spread (NS-279.67 cm, EW-275.33cm) indicating the vigor o fplant. Genotype BOP 33 exhibited higher leaf lamina length (40.51 cm), lamina breadth(13.67 cm), leaf length (124.18 cm) with higher specific leaf area (311.92 cm^2 g^{-1}).Among flower quality parameters BOP 45 recorded higher spike length (149.43 cm)and stalk length (128.66 cm), whereas maximum fresh weight (140.09 g), spa the diameter (23.09 mm), spike diameter (16.33 mm) with longer vase life (10 days) was recorded in genotype BOP 33. Genotype BOP 41 found superior with respect to spike yield per plant (41.33). Among physiological parameters, genotype BOP 45 recorded higher leaf wax content (0.62 mg cm^{-2}) with relative water content (94.91%). Whereas transpiration rate (6.61 m mol m^{-2} s^{-1}), photosynthesis rate (7.33 µ mol CO_2 $m^{-2}s^{-1}$)with stomatal conductance (0.11 mol m^{-2} s^{-1}) and total chlorophyll content (2.63 $molm^{-2}$ s^{-1}) was higher in genotype BOP 16 and stomata number was maximum (40.80mm^{-2}) in genotype BOP31. With respect to flowe r color pigment maximuman thocyanin content was found in genotype BOP22(124.65 mg $100g^{-1}$),while genotype BOP 6 recorded maximum carotenoid content (22.31 mg $100g^{-1}$) indicating bright colored flower production. The genotypes expressing better morphology can be used as a trait specific germplasm in breeding programme. The results of physiological parameters viz., leaf wax, stomatal density and transpiration rate will be useful for breeders to identify BOP genotypes with better drought tolerance.

Title: Effect of fertigation, irrigation and mulching on growth and nutrient uptake pattern in African marigold (*Tagetes erecta* L,) (2017)

K.Raja Babu, Dr. YSRHU, AP, Guide: Dr. H.P. Sumangala

An investigation entitled “effect of fertigation, irrigation and mulching on growth and nutrient uptake pattern in African marigold (Tagetes erecta L,)” was conducted at Indian Institute of Horticultural Research, Hesaraghatta, Bengaluru during 2016.The experiment was laid out in split plot design to study the effect of Irrigation (1.0 ER, 0.8 ER and 0.6ER) and fertigation and mulching (fertigation of WSF @ 100% RDF with mulching, fertigation of WSF @ 75% RDF with mulching, fertigation of WSF @ 100% RDF without mulching,fertigation of WSF @ 100% RDF without mulching, soil application of normal fertilizers @ 100% RDF with mulching and soil application of normal fertilizers @ 100% RDF without mulching) on growth and nutrient uptake in African marigold. Among drip irrigation levels 1.0 Evaporation Replenishment (ER) recorded significantly highest flower yield (13.40t ha^{-1}) followed by 0.8 Evaporation Replenishment (ER). Among fertigation and mulching treatments 100 % RDF and mulching recorded significantly highest flower yield (14.01t ha^{-1}) followed by 75% RDF and mulching. Among drip irrigation levels 1.0 Evaporation Replenishment (ER) recorded significantly highest available nutrients in soil, plant nutrient content and nutrient uptake of N, P and K followed by 0.8 Evaporation Replenishment (ER). Among fertigation and mulching treatments 100 % RDF and mulching recorded significantly highest available nutrients, plant nutrient content and nutrient uptake of N, P and K followed by 75% RDF and mulching. Among interaction effects, 1.0 ER + Fertigation with WSF @ 100 % RDF and polyethylene mulching recorded significantly highest values for all vegetative, yield parameters and nutrient parameters followed by 0.8 ER + Fertigation with water soluble fertilizers @100 % RDF and polyethylene mulching.

Title: Evaluation of Tuberose *(Polianthes tuberosa L.)* for quality, yield and tolerance / resistance to root knot nematode *(Meloidogyne incognita)* (2017).)

D. Priyanka Gandhi, Dr. Y.S.R. Horticultural University, Guide: Dr. T. Usha Bharathi

The present investigation was carried out with 27 genotypes which includes eighteen single and nine double genotypes of tuberose to assess the performance, magnitude of variability, degree of association, direct and indirect effects of yield contributing characters on yield and genetic divergence in tuberose (*Polianthes tuberosa* L.) germplasm and screening it for tolerance/resistance to root knot nematode (*Meloidogyne incognita*). Analysis of variance revealed high significant differences among the accessions for all the parameters except diameter of the bulb and number of bulblets per clump in single genotypes and tepal thickness in double genotypes. Mean performance revealed that a single and double genotype was not superior for all traits and different genotypes were identified to be superior for various traits. High phenotypic coefficient of variation and genotypic coefficients of variation were observed for number of leaves, spike length, rachis length, weight of single floret, matured bud weight, number of spikes per meter^2, weight of florets per spike and loose flower yield per metre^2. The highest heritability and genetic advance as per cent of mean were registered high for number of leaves, mature bud weight in single genotypes. Association analysis was carried out for 13 characters which indicated that spike yield per plant showed positive and significant association with plant height, number of florets per spike, weight of single floret, matured bud weight and duration of flowering in single genotypes. Clustering based on D^2 statistics grouped tuberose genotypes into nine clusters, indicating the presence of wide range of genetic diversity among the genotypes under investigation.

Twenty seven germplasm of both single and double tuberose were screened for their tolerance / resistance to *M. incognita*. Suarna Rekha recorded the least gall index and found to be resistant, followed by Calcutta Double, Bidhan Rajani-3, Variegated. Histological characterization revealed active giant cells in susceptible germplasm with dense cytoplasm and multi nucleated condition. Whereas, in the tolerant ones, the giant cell formation was disrupted with higher number of phenolic cells and cells with lignified cell wall that prevented the successful establishment of nematode feeding site. The resistant and tolerant varieties recorded significantly higher accumulation of phenol as well as polyphenol oxidase (PPO), peroxidase (PO) and phenyl alanine ammonia lyase (PAL) activities compared to the susceptible varieties. Nutritional changes in nematode infected leaves recorded significant difference in nutrient content among nematode infected germplasm and revealed higher nutrient content in nematode resistant, tolerant genotypes than susceptible ones.

Title: Intraspecific hybridization and compatibility studies in tuberose (*Polianthes tuberosa* L.) (2018).

Rosalind Lallawmzuali, UHS, Bagalkot, Guide: Dr. T. Usha Bharathi

An experiment was conducted in eight single genotypes of tuberose *viz*., Arka Shringar, Arka Prajwal, Arka Nirantara, Arka Sugandhi, IIHR-6, IIHR-12, Mexican Single and Variegated to study the floral and pollen biology, interspecific hybridization, compatibility, pollen - pistil interaction and seed germination. All genotypes recorded 6 petals per floret except Arka Nirantara which showed 7 to 8 petals, arranged in singkle whorl. Anthesis was observed in the evening hours starting from 16:30 hours to 17:44 hours simultaneously followed after 20-30 minutes by anther dehiscence which started from 17:04 hours to 17:27 hours among the genotypes. Arka Nirantara showed highest pollen viability over the other genotypeson 1st day of anthesis (87.14%), whereas, IIHR-6 showed maximum in vitro pollen germination on the 1st day of anthesis (60.07%). Low pollen vaibility and in vitro germination was observed for the genotypes Arka Prajwal and IIHR-12. The shape of the pollen grains ranged from oblate speroidal to sub-oblate among the genotypes. The matured pollen grains of tuberose are bicellular in nature. Intraspecific hybridization revealed that highest pod set was obtained in the cross between Arka Sugandhi x IIHR-6 (82.67%) and the number of seeds per pod and filled seeds per pod were the highest in the cross Arka Nirantara x Variegated (44.00 total seeds and 40.10 filled seeds). Pod set was not observed both in the direct and reciprocal crosses of Srka Prajwal and IIHR-12 due to the cross incompatibility in genotypes. Pollen pistuil interaction studies revealed that pre and post fertilization barriers governed the incompatibility. Seed germination was highest in the cross combination IIHR-5 X Mexican Single (70.00%) and the seeds germinated within 31.22 to 46.00 days. Seedling vigour was observed the maximum in the seedlings obtained from Arka Sugandhi x IIHR-6 (1227.87).

Title: Standardization of regeneration protocol for *in vitro* mutation of tuberose (*Polianthes tuberosa* L.) (2021).

Mahananda, UHS, Bagalkot, Guide: Dr. T. Usha Bharathi

A study was carried out to standardize the direct regeneration and *in vitro* mutagenesis protocol for tuberose cv. Arka Vaibhav in ICAR-IIHR Bengaluru during the year 2019-2020. Three different explants *viz*., terminal stem scale, immature flower bud and tepal segment were used in the experiment to identify the best responsive explant for direct organogenesis. The terminal stem scale explant pre-treated with 0.1% carbendazim + 0.05% chlorothalonil + 0.05% cetrimide and surface sterilization with 70% ethanol (1 min) + 4% sodium hypochlorite (10 min) + 0.1% $HgCl_2$ (15 min) resulted contamination free aseptic culture. Pre-treatment of immature flower bud and tepal segment with 1 drop tween-20 + 70% ethanol (30 sec) + 1% sodium hypochlorite (3 min) and 0.1% carbendazim (30 min) + 1 drop tween-20 + 70% ethanol (30 sec) + 2% sodium hypochlorite (10 min) gave contamination free culture. MS medium supplemented with 4mg/l BAP + 0.1mg/l IAA was the best medium for shoot multiplication of terminal stem scale explant. Maximum root induction (99.44%) was observed in MS medium supplemented with 1.0 mg/l IBA. Plantlets responded positively when acclimatized in cocopeat alone with 100.00% of survival rate. Different doses of gamma rays (15, 20, 25, 30, 35, 40 & 45 Gy) and EMS (0.1, 0.15, 0.2, 0.25 & 0.3 %) were used in *in vitro* mutagenesis study to determine the lethal dose for the terminal stem scale explant. The lethal dose (LD_{50}) of acute gamma ray was found to be 20.25Gy with the mortality rate of 50 per cent. Media incorporation of EMS concentration (0.138%) was determined as LD_{50} value and higher doses beyond that was detrimental for the *in vitro* survival of explants. EMS at 0.2 per cent for the duration of 30 minutes was found to be optimum for the pre-treatment of explants before *in vitro* inoculation. Among different explants studied, terminal stem scales were best for all *in vitro* responses.

Title: A study on disease resistance mechanism against black spot (*Diplocarpon rosae*) and powdery mildew (*Podosphaera pannosa*) in rose (*Rosa spp.*) (2021)

Saidulu Yeluguri, UHS, Bagalkot, Guide: Dr. Tejaswini Prakash

The present investigation on rose was carried out in the Division of Flower and Medicinal crops, at ICAR-IIHR, Bengaluru to screen the available germplasm for disease resistance source and to study the role of various defense related biochemical compounds and physiological characteristics in resistance against black spot and powdery mildew. Based on the results of 57genotypes screened in field for natural incidence of black spot over two seasons i.e., 2015 and2016, Knock Out variety was found to be immune (0 PDI). Eight genotypes that showed varied levels of resistance against black spot infection in field were studied in detached leaf assay with artificial inoculation of D. rosae to confirm their disease reactions. The variety Knock Out which was found to be immune for black spot in field has developed hypersensitive reaction upon artificial inoculation and was categorized as highly resistant (0.1-5 PDI). The variety Arka Nishkant was found to moderately resistant (10.1-15 PDI) under artificial inoculation against its reaction being resistant in field. These selected eight genotypes after artificial inoculation by D. rosae were analyzed for various defense related biochemical compounds during disease progression at regular intervals. It was found that compared to susceptible genotypes, the activity of defense related enzymes viz., catalase, peroxidase, polyphenoloxidase, superoxidedismutase and phenylalanine ammonia lyase and other defense related secondary compounds viz., phenols and flavonoids was high and quick during the progression of disease in resistant genotypes, contributing for resistance.Further, healthy leaves of eight selected genotypes exhibiting different levels of resistance against blacks pot and powdery mildew when investigated for different physiological characteristics viz.,number of stomata and size of stomata, leaf thickness, epicuticular wax content and gas exchange parameters, the exact role of these studied characteristics in disease resistance could not be established.

Plantation, Spice, Medicinal & Aromatic Crops

Title: Genetic analysis and estimation of antioxidant activity in Kalmegh (*Andrographis paniculata* Nees.) (2017)

Narmatha Dayana,S., UHS, Bagalkot, Guide: Dr.Hima Bindu,K.

The present investigation on Kalmegh was carried out during 2016-17 at ICAR-IIHR, Bengaluru. The study aimed at identifying potential parents and superior hybrid combinations for high herbage yield and and rographolide content in kalmegh. Six lines viz.,IIHRAP 25-4(L_1), IIHRAP 32-1(L_2),IC111295 (L_3), IIHRAP 18-7(L_4), IIHR AP 30-8 (L_5), IIHR AP 18-4 (L_6) were crossed with three testers viz., Anand Kalmegh-1 (T_1), IIHR AP 27-2 (T_2) and IC111291 (T_3) and the 18 hybrids obtained through line x tester mating design were evaluated for the important quantitative traits. The mean performance, combining ability, heterosis, gene action, and correlation, direct and indirect effects of all the parameters were estimated. Combining gca and per se, IIHR AP 18-7(L_4) was the best parent for eight important quantitative characters. Based on perse performance, sca effects and standard heterosis the hybrid IIHR AP 25-4 x IC111291 (L_1 x T_3) was the best hybrid for most of the important quantitative traits and could be recommended for exploitation through heterosis. The higher magnitude for specific combining ability variance for all the characters studied implied the preponderance of non-additive gene action. All the characters showed high phenotypic variance when compared to genotypic variance and the estimates of heritability were found to be high. The correlation and path analysis revealed that total and rographolide yield per plant is highly related to leaf area index, number of leaves at harvest per plant, leaf dry weight per plant, stem dry weight per plant, leaf and rographolide yield per plant and stem and rographolide yield per plant. In case of estimation of antioxidant activity, 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay showed more antioxidant activity than ferric reducing antioxidant power (FRAP) assay. In both the assays, the hybrid progenies were reported to have high antioxidant activity than that of parents.

Title: Evaluation of Velvet Bean (*Mucuna pruriens*) genotypes for yield and nutrient recycling potential at different nutrient levels (2020)

Tanuja, S.P., UHS, Bagalkot, Guide: Dr.S.Sujatha

A field experiment was carried out at ICAR-Indian Institute of Horticultural Research, Hessarghatta, Bengaluru during 2019-20 to study the variability in growth, yield, quality and nutrient recycling potential at different nutrition levels in five genotypes of Mucuna pruriens. The experiment was laid out in randomized complete block design (RCBD) incorporating factorial component with three replications. The treatments comprised of twenty five treatment combinations involving five genotypes (Arka Aswini, Arka Shubra, Arka Daksha, IIHR-PS1 and Arka Dhanvantari) and five nutrient levels. Among genotypes, Arka Dhanvantari recorded maximum vine length (389.71 cm), days to flower initiation (92.14 days) and 50% flowering (110.11 days), while Arka Shubra recorded maximum fresh (14.61 t ha^{-1}) and dry biomass yield (2.97 t ha^{-1}) at flowering, seed yield (2.58 t ha^{-1}) and number of root nodules (11.20). Among nutrient levels, application of 100:80:40 kg N:P_2O_5:K_2O ha^{-1}+15 t FYM ha^{-1} resulted in improved plant growth and increased fresh(11.74 t ha^{-1}) and dry biomass yield at flowering(2.32 tha^{-1}) and seed yield (2.47 tha^{-1}) than other nutrition levels. Both L-DOPA content (4.45%) and L-DOPA yield (116.09 kg ha^{-1}) were maximum in Arka Shubra. Application of100:80:40 kg N:P_2O_5:K_2O ha^{-1} + 15 t FYM ha^{-1} resulted in increased L-DOPA content (4.33%)and L-DOPA yield (108.78 kg ha^{-1}). Arka Shubra was superior in terms of nutrient recycling potential (107.22 kgN,5.40 kgP and 73.46kg Kha^{-1})and improved soil fertility status with 12.18 g kg^{-1} of soil organic carbon and 203.15 mg kg^{-1} of available N. Higher soil availability of nitrogen (214.33 mg kg^{-1}), phosphorus (36.59 mg kg^{-1}) and potassium (135.03 mg kg^{-1}) at 0-25 cm depth were noticed with application of100:80:40 kgN:P_2O_5:K_2O ha^{-1}+15 t FYM ha^{-1}.

Post Harvest Technology

Title: Studies on some factors influencing quality of Guava Jelly (1981)

K.H.Ramanjenaya, UAS, Bangalore, Guide: Dr.Amba Dan

Experiments were carried out to find varietal suitability for jelly making, fixing optimum stage of maturity of the fruit, ascertaining the optimum temperature for storage jelly and exploring the possibility of using plastic containers in place of glass container. The results indicated that a pink fleshed variety 'Beaumount' has given the best quality jelly. Another pink fleshed variety developed at the institute was also found to give higher yields of good quality jelly thus supporting the findings. Firm ripe fruits were found to be better for better quality and quantity of jelly than using mature and ripe fruits. The progressive deterioration in the quality of jelly stored at room temperature could be reduced to the minimum when stored at low temperature 5+1ºC. For packing jelly PVC and HDPE containers can also be used instead of glass containers without any appreciable loss in the quality of jelly, and PVC was better than HDPE for this purpose.

Title: Studies on storage of Mango (*Mangifera indica*) (1983)

C.M.Kala, UAS, Bangalore, Guide : Dr.Shantha Krishnamurthy

An investigation on the effect of using skin coating waxol, in combination with heat treatment and fungicides on ripening and keeping quality of the important cultivar 'Alphonso' mango was made. The experiment had 10 treatments with replicates for each treatment. The effects of treatments on physicochemical changes, ripening and spoilage were observed during a storage period of 20 days. Post harvest hot water treatment of Alphonso mango at 52+ 1 ºC for 5 minutes resulted in hastening of ripening process, reduced spoilage and development of uniform orange surface colour of the fruit. The use of Benlate at 500 ppm reduced the spoilage and the extent of reduction was on par with hot water treatment. Further reduction of spoilage by combination of hot water and fungicides (Benlate and T.B.Z. at 500 ppm) was not evident. Waxol treatment retarded ripening by 5 days as compared to the control, and retained freshness of the fruit up to 20 days of storage. Waxol treatment combined with (i) hot water alone and (ii) with fungicides Benlate and T.B.Z. at 500 ppm were the best, with reference to the quality of ripe fruits and control of spoilage after 20 days of storage at ambient conditions. Organoleptic quality of the fruit was not affected by post harvest treatment.

Title: Storage studies in Coorg Mandarins (*Citrus reticulata Blanco*) (1983)

Y.Raghuramulu, UAS, Bangalore, Guide : Dr.Shantha Krishnamurthy

An investigation on the extension of storage life of winter crop of Coorg Mandarins was made using skin coatings with waxol and 'Tal Prolong', combined with or without packing in ventilated polythene bags and stored in cartons. The effect of treatments on physiological losses in weight, physicochemical changes, shelf life spoilage and organoleptic quality was observed during the storage period of 4 weeks, at ambient conditions. Packing the fruits in ventilated polythene bags and storing in cartons reduced the moisture loss significantly and extended the shelf life. Skin coating with 'Tal Prolong' at 1% and 2% was not as effective as 3% Waxol treatment in retaining the freshness of the fruit. There was no significant effect on the chemical on the chemical composition like juice content, TSS, Vitamin C, and sugar content due to treatments. Organoleptic evaluation of fruits revealed that waxol treated fruits packed in polythene bags were the best after 20 days of storage at room temperature.

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C.M.Kala, UAS, Bangalore, Guide : Dr.Shantha Krishnamurthy

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Title: Storage studies in Banana, var. Robusta (1984)

C.G.Kushalappa, UAS, Bangalore, Guide : Dr. Shantha Krishnamurthy

An investigation was in the comparative effects of skin coatings with 6% waxol, 1% and 2% Tal prolong with and without packaging of fruits in vented polyethylene bags and the use of polyethylene absorbent 'purafil' on extension of shelf life, ripening, weight loss and other related chemical changes at ambient conditions of storage. It was observed that Tal prolong in unpacked, retarded ripening of the fruit by 5 days. In packed prolong and waxol treated fruits, there was delay in ripening by 7 days. This delay in ripening was correlated with reduced rates of softening of the fruit and development of yellow surface colour. Changes in firmness, moisture, pulp/peel ratio, acidity and alcohol insoluble residues were also recorded. Losses in weight were reduced considerably. The quality of ripe fruits in untreated control, packed in polyethylene bags was superior to those kept without packing. Tal prolong treated fruits were acceptable, through slightly inferior, because of its yellowish green surface colour and soft texture. Use of purafil resulted in excellent quality as compared to all the other treatments.

Title: Studies on packaging of Mango (*Mangifera indica* L.) (1985)

V.R.Prasad.S, UAS, Bangalore, Guide : Dr. Shantha Krishnamurthy

An investigation to compare the effect of combination of post harvest dip treatments with waxol (3%) and hot water with waxol, with or without wrapping in tissue paper and polyethylene film on physic-chemical changes and keeping quality of Alphonso mangoes during storage at room temperature was made. It was observed that combination treatment of hot water alone followed with wrapping in polyethylene (HDPE) delayed ripening as compared to the unwrapped fruit of the corresponding treatment. Weight loss was reduced by more than 50% in the wrapped fruits. Spoilage was high (20%) in polyethylene wrapped fruits. Wrappers had to be removed after 10 or 15 days of storage for further ripening of the fruit at ambient conditions of storage. Organoleptic evaluation of the ripe fruits in waxol with hot water treatment showed good colour, texture and taste as compared to the control fruits which had shriveled by 15^{th} day of storage.

Title: Effect of hot water washing on seed viability and juice quality in Tomato (1986)

B.C.Anand, UAS, Bangalore, Guide : Dr.Amba Dan

Temperature of water up to 60 ºC and time of holding the fruit there for 8 minutes in case of Pusa Ruby was found to be optimum for ensuring the highest seed viability. Varietal responses to hot water at 60 ºC for 8 minutes were similar. In respect of chemical composition of the tomato juice, prepared in the above experiments., the results showed that hot water washing of tomato not only had a higher juice yield and increased juice viscosity, but also resulted in reduced microbial load with better retention of ascorbic acid as well as lycopene. It had favorable effect on the flavour of product and undesirable effect on pH and total soluble solids. There was no significant variation in seed viability and juice quality when fruits at two stages of ripeness were used for hot water washing, varieties like NTDR-1, Selections-4 and Selection-11 responded favorably, followed by Roma and Punjab Chahara. From the point of view of chemical composition, sensory properties and microbial status of the juice, Roma cultivar was found to be the best suited followed by Selections-4 and Punjab Chahara.

Title: Effect of temperature on storage of Coorg Mandarins (*Citrus reticulate* Blanco) (1988)

Shekarappa.G.Angadi, UAS, Bangalore, Guide : Dr.Shantha Krishnamurthy

An investigation was carried out to compare the effectiveness of postharvest dip treatment with waxol (3%) combined with and without packing in ventilated polythene bags (polybags) on storage behavior and keeping quality of winter crop of Coorg mandarins at ambient (15 + 2 ºC) and low temperature (10 + 1 ºC) conditions. In unpacked fruits, waxol treatment showed significantly lower PLW as compared to untreated control after 19 and 42 days of storage at room and low temperatures respectively. In fruits packed in polybags, waxol treatment showed least PLW (5.16%), followed by untreated control (9.83%) at room temperatures. Packing in ventilated polybags helped in minimizing the weight losses significantly, as compared to unpacked treatments. Juice content decreased during storage for 19 and 42 days at room (25 + 2 ºC) and low temperature (10 + 1 ºC) respectively. In fruits packed in polybags, the juice content varied from 42.7 to 42.8% at room temperatures storage and 36.1 to 40.8% at low temperatures storage. At room temperatures storage the peel and weight decreased during 19 days storage period in untreated control and waxol 3% treatments (50.6 to 42.5% and 50.6 to 44.4% respectively.) Total titratable acidity expressed as percent citric acid decreased during storage at both room and low temperatures. At the end of the storage under room temperature conditions, the increase was seen from 4.04 to 7.33% in waxol treated fruits packed in polybags. waxol treated fruits kept in polybags had good colour, freshness, flavour and taste as compared to other treatments during the storage period of 19 days at room temperature and 42 days at low temperature (10 + 1 ºC). Overall, waxol treatment was found to be better than other treatments, since it showed reduced weight losses, retained good colour, freshness, flavour and taste both at room temperature (25 + 2 ºC) and low temperature (10 + 1 ºC) storage. Packing the fruits (untreated control and waxol treated in ventilated polybags was found to be better as compared to without packing at low temperature storage.

Title: Studies on the mineral composition of Banana during storage (1988)

M.S.Ganapathy, UAS, Bangalore, Guide: Dr. Shantha Krishnamurthy

Mineral content and physicochemical changes in three commercial cultivars of banana during ripening were studied at ambient storage conditions. Rasabale banana had low calcium, potassium and iron contents, and the highest sodium content, both in the pulp & peel as compared to Robusta and Dwarf Cavendish banana. Peel had 2 to 4 times more calcium, sodium, potassium and 2 times more of iron as compared to pulp in all the three cultivars. Rasabale showed maximum weight loss during ripening (16.3%) with least firmness of the pulp (1.14 kg/cm^2) and maximum increase in pulp to peel ratio (3.01 to 7.00) as compared to 12.7% weight loss, firmness of 3.75 kg/cm^2 and pulp peel ratio of 3.47 in Dwarf Cavendish and Robusta cultivars. Dry weight of the pulp decreased and that of the peel increased in all the varieties during ripening.

Title: Changes in mineral composition of Mango fruits during storage (1991)

R.A.Reena, UAS, Bangalore, Guide : Dr. Shantha Krishnamurthy

Changes in weight loss, firmness, moisture, dry weight, surface colour and minerals were studied at 5 stages of ripening in four cultivars of mango namely Alphonso, Bangapalli, Rasapuri and Totapuri. The weight loss during ripening ranged from 13.4 to 17.4%. The loss of green colour was accompanied by appearance of yellowish orange colour. At the ripe stage, 'L' values ranged from 44.7 to 67.9, 'a' and 'b' values ranged from 4.0 to 8.1 and 23.4 to 34.9 respectively. Moisture content decreased with an increase in dry weight of the fruits during ripening. Alphonos mango recorded the lowest Ca content in both pulp (8.2 mg) and peel (73.9 mg), lowest peel Na content (6.0 mg) and highest P (112.4 mg) and Fe contents (100.2 ppm) in the peel and K content in the pulp (828 mg). Bangapalli recorded the highest of (466 mg) in peel, Fe (99 ppm) in the pulp, K (986 mg) in the peel and lowest K of 598 mg and Na content of (5.6 mg) in the pulp. Rasapuri recorded the low contents of all the minerals. Calcium content in the peel and pulp were 245.9 mg and 9.4 mg. Fe content was the lowest (5.8 ppm) in the pulp and in the peel (3.5 ppm), highest Na content in the pulp (11.2 mg) and in the peel (12.6 mg). Totapuri showed the highest Ca-content of 13.3 mg in pulp, P content of 78.4 mg & the lowest peel K content of 676.7 mg. these changes have been correlated with the shelf life of the cultivars.

Title: Studies on storage of Pomegranate (*Punica granatum* L.) cv. Ganesh (1992)

C.T.Shivananda, UAS, Bangalore, Guide : Dr.Shantha Krishnamurthy

Studies were made on the comparative effects of skin coating with 'Waxol', individual fruit wrapping with kiln film and a combination of these with storage at room temperature (RT) 25+1 ºC and low temperature (LT) of 8 ºC on the shelf life of pomegranate cv. Ganesh during –Feb, 1991-92. Weight loss of the fruit which is the main cause for desiccation and unmarketability of the fruit could be significantly reduced by waxol treatment and further reduced by film wrapping and low temperature storage. The respiration rate was high up to the 6^{th} day, showed a sudden decrease by 8^{th} day and it continued up to 22 days of storage. Among the changes in physic-chemical constituents, a slight decrease in firmness, acidity, reducing sugars, colour of the juice were observed during storage. Increases in TSS and total sugar content were also observed. Peel weight decreased in control and waxol treated fruits, but it remained the same in film wrapped fruits. Waxol treated fruits showed less spoilage as compared to untreated and film wrapped fruits. The maximum shelf life at RT was 3 weeks in film wrapped and 2 weeks in unwrapped fruits as compared to 10 weeks in film wrapped fruits held at 8 ºC. Sensory evaluation indicated that film wrapped fruits, held at 8 ºC was the best with good colour, freshness, taste and flavour.

Title: Storage studies in Guava. *Psidium gaujava* L. (1992)

P.Padma, UAS, Bangalore, Guide: Dr.Shantha Krishnamurthy

Studies were made on the combined effects of skin coating and wrapping with film and tissue paper on changes in physic-chemical, quality and shelf life of two cultivars of guava viz., Sarder and Allahabad Safeda held at room temperature 25+1 ºC (RT). Total weight loss of the fruits could be reduced significantly by Waxol treatment film wrapping. The peel colour development as measured by 'L', 'a' and 'b' values indicated, maximum increase in 'L' and 'b' values were observed in the control as compared to the treatments. There was a decrease in firmness, acidity, vitamin C and starch contents and an increase in reducing and total sugar contents. The shelf life could be extended from 5-6 days in the control to 8-9 days by waxol treatments and wrapping in paper.

Title: Effect of stage of harvest, storage temperature, pulsing and preservative chemicals on vase life of Gerbera (*Gerbera jamesonii* HOOK.) (1995)

R.Gopinath, UAS, Bangalore, Guide : Dr.Sangama

Gerbera is a popular cut flower having a seventh position in the global flower market. In India, gerbera cut flowers are produced both in open as well as under poly house. Gerbera cut flower has large flower head on a long slender stem. Due to its inherent structure, the post harvest handling and storage of gerbera cut flower is a challenge. After harvest, under water stress gerbera cut flowers exhibit bending and lose its market quality. Therefore, this study has been focused to find out suitable varieties for good postharvest quality to determine optimum stage of harvest and concentrations of preservative chemicals to enhance shelf life and vase life of gerbera cut flowers. Two gerbera single cultivars viz., Local Red and Local Yellow cut flowers harvested at three stages were evaluated. Observation on fresh weight, transpiration loss of water, uptake of water, water balance revealed that cv. Local Red cut flowers harvested at three stages were evaluated. Observation on fresh weight, transpiration loss of water, uptake of water, water balance, percent stem bent and vase life revealed that cv. Local Red cut flowers performed better over cv. Local Yellow cut flowers. Maximum mean vase life of 6.66 days was obtained with cv. Local Red cut flowers where as cv. Local Yellow cut flowers had vase life of 5.33 days. Among three harvest stages evaluated, cv. Local Red cut flowers harvested when ray florets were 3/4th open as compared the harvest stages of ray florets of half and fully open position. Higher vase life of 6.66 days was obtained at 3/4th open stage as compared to 5 days and 5.83 days with half and fully open stage respectively. Pulsing with sucrose 4% and AgN03 250 ppm resulted in increased shelf life of 2 days with 7.33 days of vase life as compared to control cut flowers (6.66 days). Vase solution of sucrose 2% + STS 20 ppm was found beneficial in obtaining vase life of 11.33 days over control cut flowers (6-66 days) in cv. Local Red.

Title : Effect of stage of harvest, storage temperature, pulsing, preservative chemicals and packaging on vase life of Gladiolus (*Gladiolus hybridus* Hort.) (1996)

N.S.Phanindra, UAS, Bangalore, Guide : Dr.Sangama

Gladiolus is an important cut flower, referred as queen of bulbous flowers, throughout Commercially cultivated for its long lasting spikes having florets of varied colour, shape and size. Commercially for easy handling and packaging Gladiolus spikes are harvested when basal floret show colour stage. It is observed that at this stage many florets are yet to grow and open but many a time they fail to open and even bend under water depletion. Therefore under this investigation, suitable varieties, optimum harvest stages, pulsing, packages, storage temperature and vase solutions were determined for better shelf life and vase life of Gladiolus cut flowers. Two Gladiolus cvs. Local Yellow and Psittacinus hybrid spikes harvested at three harvest stages were evaluated. Observation on spike length, rachis length, percent florets opened, fresh weight, transpiration loss of water, uptake of water, water balance, % bent/breakase, shelf life and vase life revealed that maxium vase life of 8.92days was obtained with cv. Psittacinus hybrid cut flowers where as cv. Local Yellow spikes gave vase life of 7.78 days. Among three harvest stages of cv. Psittacinus hybrid spikes evaluated revealed that spikes harvested at basal floret showing stage gave longer ase life of 9 days followed by 8.5 days of vase life with spikes harvested at basal floret half emerged and vase life was least (7.5 days) when harvested at basal floret was fully emerged. Among five packages tried, cellophane paper wrapping during storage of Gladiolus spikes was found more suitable in maintaining the flower freshness by reducing 10.78-24.30% PLW as compared to the other packages evaluated. Pulsing with sucrose 8% and AgN03 250 ppm improved the floret opening (89%) and vase life (10.28 days) over the control (7.7% and 8.12 days respectively) in cv. Psittacinus hybrid spikes. Storage up to 6 days at 4 ^{o}C was found optimum with respect to vase life and floret opening where as storage for 4 days at 7^{o}C was found optimum. Storage for two days at RT reduced the vase life (5.22 days) of Gladiolus cv. Psittacinus hybrid spike. Vase solution of BA 50 ppm and STS 20 ppm increased the vase life of Psittacinus hybrid spikes by 3 days over the control (8.66 days).

Title: Standardization of post harvest handling techniques for carnation (1998)

H.K.Beelagi, UAS, Bangalore, Guide : Dr.Sangama

Carnation is one of the important commercial cut flower crops of the world. Standardization of post-harvest handling techniques for carnation was carried out. Results of the experiment on determination of optimum harvest stage revealed that maximum vase life of 32.8 days was obtained at tight bud stage in cv. Michelle Lek Miche and vase life of 23 days was obtained with tight bud and cross bud stage in cv. Lek Petra. Pulsing solution of 10% sucrose + 100 ppm silver thiosulfate improved post-harvest quality of carnation cut at cross bud stage. Among different post- harvest practices, maximum vase life of 23 days was obtained with solution of 2% sucrose + 50 ppm of kinetin.

Title: Standardization of post harvest handling techniques in Rose (*Rosa hybrid* L.) (1998)

V.Surendra Kumar, UAS, Bangalore, Guide : Dr.Sangama

Rose is one of the important commercial cut flowers. In recent years there is an increase in production of rose cut flowers under polyhouse. This has necessitated to standardize post harvest handling techniques for polyhouse grown roses under our situation. Hence studies were carried out to determine the optimum harvest stage, pulsing treatment and post-harvest practices to enhance the vase life. Five rose varieties Tinike, Dream, Sasha, Prophyta and Lambada were evaluated for post-harvest qualities. Sasha with vase life of 10.58 days was found superior over other varieties. Optimum harvest stage was when one petal unfolded for varieties Sasha and Sunny Prophyta with vase life 10.74 days and 10.49 days. Pulsing trial was carried out in variety Sasha. Pulsing treatment with 3% sucrose plus 200 ppm 8-Hydroxy quinolone citrate was given for different duration. Results revealed that four hours pulsing was beneficial in improving the post harvest qualities such as vase life (11.63 days) in variety Sasha cut flower. Effect of different post harvest practices on vase life of rose variety Sasha was determined. It revealed that stem re-cutting on alternate days in vase gave maximum vase life of 11.13 days.

Title : Standardization of drying techniques for static Cut flowers (2000)

P.Padmavathamma, UAS, Bangalore, Guide : Dr.Sangama

Limonium (Statice) flowers are gaining popularity for this bright colour inflorescence in fresh attractive and dry form. Dry flower quality is greatly influenced by both pre and postharvest factors. Under the present study, optimum harvest stages for better dry flower quality was determined in three limonium var. Autumn yellow, Autumn blue and Crepe Limonium. Optimum harvest stage for all the three varieties tried was when 90% of the flowers had opened on the inflorescence which gave better quality dry flower. Among 3 varieties used, var. Autumn yellow found superior with respect to colour and texture. Best quality dry flower was obtained by shade drying compared to oven and sun drying. Dry flower texture was improved with 1:3 glycerol: water pretreatment.

Title: Enzymatic liquefaction of sapota fruit pulp (*Manilkara achrus* Mill.) for beverage making (2001)

C.B.Manjunath, UAS, Bangalore, Guide : Dr.I.N.Doreyappa Gowda

Sapota [Manilkara achras, Mill] commonly known as chikoo is one of the major fruits of India. Sapota fruits are rich in carbohydrates and tannins. The presence of fairly large quantities of tannins modifies the taste of the fruit and imparts an astringent taste. Sapota fruits are higher in calorific value, the pulp is sweet and rich in flavour. The post harvest loss in fruits is a major problem of farmers as well as of the fruit industry. Since sapota has a very short post-ripening life converting these perishable fruits into value added product like beverages to prevent losses and for better utilization. Fruit juices are generally cloudy due to the presence of a wide range of colloidal dissolved natural polysaccharides and other small particles like protein fragments or polyphenols. These kinds of pulp/juices are not very attractive and difficult to concentrate. These cloudy substances can be dissolved using pectinase enzymes. Standardization of best enzyme formulation and optimum concentration for liquefaction of sapota pulp was carried out using pectinase enzymes. The results revealed that enzymatically liquefied sapota pulp yielded higher juice compared to control. Also enzymatically liquefied juice recorded higher TSS, sugars and lower viscosity. Maximum juice yield was recorded in Pectinex Ultra at 0.1% - 62.25% yield followed by 0.08%, 61.25% juice yield) and lowest in control i.e., untreated sample (C_O: 40.00%). The viscosity of the un liquefied juice (control) was 2.94 cps and it was reduced to least (1.24 cps) at the highest concentration (C4) of enzymes tried. Due to the interaction effects, Least viscosity was observed in E_2 C_4 (1.20 cps). The main objective of enzymatic liquefaction was to dissolve colloidal suspended juice particles so that the beverages prepared from this will be more attractive due to very clear and sparkling nature of liquefied/ clarified juices.

Title : Effect of low temperature storage on post harvest quality of carnation (*Dianthus caryophyllus*) cut flowers of different harvest stages (2002)

M.Siva Prasad, UAS, Bangalore, Guide : Dr.Sangama

Storage of cut flowers is an important postharvest horticultural technique to regulate market and low temperature storage is the most common commercial method used for cut flowers. 'The maintenance of flower quality during storage and length of time that flowers can be stored depends on several factors such as genetic characteristics, respiration rate, water loss, ethylene production and action, bacterial and fungal development. Storage of cut flowers mainly depends on the stage of harvest. Therefore, this investigation was carried out to determine the optimum stage of harvest for better storage life and quality. An experiment was conducted to study the effect of stage of harvest and bud opening solution on the postharvest quality and vase life of carnation cut flower cvs. Pink Donna and Design. Four harvest stages viz., tight bud, cross bud, paint brush and fully open stages of the two cultivars were pretreated in bud opening solution containing 10 per cent sucrose + 200 ppm 8-Hydroxy Quinoline Sulfate (HQS) + 25 ppm Aluminium sulfate. Tight bud stage flowers pretreated in bud opening solution showed maximum vase life of 12 days in cv. Pink Donna, 11.3 days in cv. Design. It was also observed that pretreatment in the bud opening solution resulted in increase of flower diameter, higher water uptake and reduced number of days taken for bud opening. Rate of respiration and ethylene production were found to be least in tight bud stage flowers.

Title : Osmo-air dehydration of pineapple (*Ananus comosis* L.) (2002)

H.B.Rashmi, UAS, Bangalore, Guide : Dr.I.N.Doreyappa Gowda

Studies were carried out to determine the optimum sugar syrup concentration for osmo-air dehydration of pineapple fruits using “Giant Kew” variety and to evaluate quality parameters somatically dehydrated product. Pine apple fruits were washed, peeled, cored and cut in to rectangular pieces and subjected to osmosis for 24 hours in three varying concentrations of sugar syrup (50, 60 and 70° Brix syrup along with 0.2% citric acid and 700 ppm of potassium metabisulphite) followed by draining the pieces and drying in a drier at 60-65 °C. The dry product was packed in 400 gauge polythene covers and stored at ambient conditions (18-28 °C, 53-76% RH) and at Low temperature (4 ± 1 °C, 85-90% RH) up to 6 months. The product was analysed initially and subsequently at 3 months and 6 months. Significantly higher amount of moisture removal from fruits was observed in 70° Brix syrup closely followed by 60° Brix syrup. Pineapple fruits subjected to osmosis at 60° Brix gave maximum dry fruit yield and showed lower moisture, higher ascorbic acid, carotenoids and also higher overall acceptability scores in sensory evaluation initially and also after a storage periods of six months. Storage at low temperature helped in the retention of ascorbic acid, carotenoids, total sugars and sugar acid ratio. Fresh product had lower moisture and reducing sugars. At the end of 6 months storage, the loss of ascorbic acids was to an extent of 37.14% and carotenoids were to an extent of 52.25%. At the end of storage, the product stored at low temperature had better overall acceptability score due to better retention of colour and flavour during storage.

Title: Modified atmosphere packaging of Papaya (*Carica papaya* L.) fruits for extension of storage life (2003)

Sukhvinder Pal Singh, UAS, Bangalore, Guide : Dr.D.V.Sudhakar Rao

Papaya is a commercial fruit crop of the sub-tropical and tropical regions of the world. Short postharvest life and chilling sensitive nature of the fruit limits its long duration storage, transportation and marketing. Quality conservation becomes indispensable for papaya because the greatest part of the amount harvested is destined to fresh fruit commerce. So, there is a need to develop an appropriate postharvest technology where the benefits of modified atmosphere as well as low temperature storage can be obtained to improve the storage life and maintain quality, thus allowing a greater rationalization in its distribution and commercialization. 'Solo' papaya is extolled for its demand in the domestic and international market. The present investigation was carried out to standardize the optimum modified atmosphere packaging (MAP) conditions for papaya fruit to extend its storage life at different storage temperatures and to study the effect of MAP on the alleviation of chilling injury (CI). Mature green fruits were individually packed in different types of polymeric films viz., LDPE, PP, Pebax® and stored at 7, 13 ºC and room temperature (27-32 ºC). The physiological response and ripening behavior of the fruits was studied at regular intervals after storage and were evaluated for various quality parameters. MAP of individual papaya fruits with Pebax® or LDPE film could extend the storage life and maintain the quality up to two weeks over one week in non- packed fruits under ambient conditions. At low temperature (13 ºC), the storage life of papaya could be extended to one month when pack ed in LDPE or Pebax® film without any CI symptoms and the fruits ripened normally in one week under controlled conditions (20 ±1 ºC & 75-80% RH).The fruits stored at 7 ºC failed to ripen normally and showed severe CI symptoms and disease incidence.

Title: Studies on enzymatic liquefaction of Banana (*Musa spp*.) fruit pulp for juice preparation (2004)

M.P.Swethak, UAS, Bangalore, Guide : Dr.I.N.Doreyappa Gowda

Two varieties of banana i.e. “Grand Naine” and “Robusta” were studied for enzymatic juice extraction. After extraction banana based beverages were prepared i.e. Nectar and concentrate (squash). The products were studied at room temperature for a period of 4 months and analyzed organoleptically and chemical composition at an interval of two months i.e. initially, after 2 months and 4 months. The enzymatic liquefaction of banana pulp yielded higher juice compared to control in both the varieties, “Grand Naine” and “Robusta”. The liquefied juice yield increased with the increase in enzyme concentration and prolonged incubation time, in both varieties. The enzymatically liquefied juice recorded higher TSS, sugars and lower viscosity. Among the varieties, “Grand Naine” yielded higher juice compared to “Robusta”. Higher TSS and sugars were seen in “Robusta” pulp after liquefaction, but lower viscosity was observed in “Grand Naine” variety of banana. In nectar, product prepared from “Robusta” banana variety using liquefied juice gave higher TSS and non reducing sugars. But “Grand Naine” variety nectar showed lower viscosity and higher reducing sugars. The nectar prepared from liquefied juice of “Grand Naine” variety of banana using enzyme (Pectinex ultra SP-L) with a concentration of 300 ppm enzyme and an incubation time of five hours was rated superior in overall acceptability. The squash prepared from liquefied juice of variety “Robusta” banana using enzyme (Pectinex ultra SP-L) with a concentration of 300 ppm with incubation time of five hours was rated superior in overall acceptability.

Title: Individual shrink wrapping of papaya fruits (cv. Taiwan Red Lady) for extension of storage life and quality maintenance (2005)

S.S.Baskar, UAS, Bangalore, Guide : Dr.D.V.Sudhakar Rao

Mature green 'Taiwan Red Lady' papayas individually shrink wrapped in three different types of polymeric films. viz., BDF-2001, D-955 and PE were stored at 13 ºC, 18 ºC and RT to study its effect on extension of storage life, alleviation of chilling injury and quality parameters (Total antioxidant capacity, Ascorbic acid, Total carotenoids, Lycopene, Phenols, firmness and surface colour development). The rates of respiration, ethylene production of unpacked fruits during ripening after different intervals of storage were measured to study the physiological response of papaya to shrink-wrapping and storage temperature. The storage life of papaya could be extended to 2, 3 and 4 weeks at RT, 18 ºC and 13 ºC respectively followed by 3 to 4 days for ripening after unpacking the fruits. Shrink-wrapping prevented the development of chilling injury during 4 weeks of storage at 13 ºC where as non-wrapped fruits exhibited chilling injury symptoms after 2 weeks of storage. The respiration behaviour of shrink-wrapped fruits during ripening after different intervals of storage was normal exhibiting typical climacteric peaks at all the storage temperatures. Among the different films tried the appearance of fruits was better in PE and D-955 wrapped films, whereas the surface colour development was poor when wrapped in BDF-2001 film at all the storage temperatures. The quality parameters of fruits in terms of antioxidant capacity, total phenols and carotenoids were also better in fruits wrapped with the former films compared to the latter. However, at RT the Vit-C and caratenoids retained better when the fruits were wrapped with BDF film.

Title: Studies on osmotic dehydration of Banana (*Musa spp*.) (2005)

K.S.Thippanna, UAS, Bangalore, Guide : Dr.R.B.Tiwari

Banana (Musa spp.) a member of Musaceae family is one of the most important fruit crops of India with an annual production of 175 lakh tones having great socio-economic significance. Bananas are good source of Vitamin C, Vitamin B_6, and potassium. Banana being a highly perishable fruit suffers from high post harvest losses to an extent of about 20 to 40 per cent. Therefore, it is necessary to develop shelf stable value added products. Osmotic dehydration process involves subjecting fruit pieces to aqueous solution of sugar with high osmotic pressure which removes 30-50% of the water prior to drying. The inclusion of osmotic process in conventional dehydration has two major objectives quality improvement and energy savings. Present investigation was conducted to know the effect of syrup concentrations and duration of osmosis on weight loss, olid gain and yield of osmotically dehydrated banana slices of varieties Robusta and Ney Poovan. There were 13 treatments, 2 varieties and 2 replications and the data was statistically analysed using Factorial Completely Randomized Design (FCRD). Observation on physico-chemical composition and sensory characteristics were taken during experimentation. Variations were observed with respect to fruit size, TSS, acidity and sugar contents in fresh fruits of variety Robusta and Ney Poovan. Statistically significant variations were observed for weight loss, moisture loss, solid gain, yield, sugars, titrable acidity, NEB and sensory quality parameters. Maximum weight loss (26.43%), moisture loss (31.08%), solid gain (4.65%), yield (32.88%), reducing sugar (53.78%), non- reducing sugar (19.93%) and total sugar (73.73%) in banana slices were recorded with osmotic pretreatment of 70° Brix syrup for 24 hours. Osmotiaclly dehydrated Robusta slices had higher acidity (1.31%) than the Ney Poovan (1.00%). An increase in syrup concentration from 50 to 70 °Brix and duration of osmosis from 4 to 24 hours increased weight loss, moisture loss, solid gain and yield in the banana slices. However, osmotic pretreatment with 60 °Brix sugar syrup for 24 hours resulted in highest sensory score (83.50) while it was lowest in control (65.00). Osmotic pretreatment of banana slices with 60 °Brix sugar syrup for 24 hours was found best and Robusta slices were rated significantly superior over Ney Poovan.

Title: Standardization of drying techniques for carnation (*Dianthus caryophyllus* L.) cut flowers (2005)

S.Ravichandra, UAS, Bangalore, Guide: Dr.Sangama

Globally dried flowers have gained popularity for their eco-friendly nature, durability and suitability in varied floral arrangement. Aesthetic qualities such as colour, shape, size, texture and shelf life of dried flowers are greatly influenced by variety, harvest stage and dehydration process. Hence this study was taken up with carnation which is an important cut flower. Objectives of this investigation were to find out a suitable variety, harvest stage and dehydration processes for quality dried flowers of carnation and to explore possibilities of using these dried flower suitability in varied floral art. Experiment was carried in vars. Malaga and Dona cut flowers harvested at tight bud, half open and fully open stages. Three dehydration methods tried were, sun, shade and hot air oven. Data on sensory score for aesthetic qualities of carnation dried flowers revealed that var. Malaga received highest sensory score of 3.8 as compared var. Dona (2.7). Among different harvest stages tried fully open stage was found optimum with respect to 4.2 sensory score for dried flower colour, texture and shape as compared to sensory score of 1.5 and 2.7 for tight bud and half open stage dried flower appearance respectively. Significant improvement with sensory score of 4.6 obtained for overall appearance of sand embedded hot air oven dried flowers of var. Malaga as compared to sensory score of 1.2 and 1.7 for sun and shade dried flowers respectively. Maximum sensory score of 4.2 and more than four months of shelf life was obtained for arrangements of these dried flowers in glass and least for wreath (3.2) with shelf life of 25 days.

Title: Development of value added products of medicinal importance from pomegranate (*Punica granatum*) fruits (2006)

N.Adaha, UAS, Bangalore, Guide : Dr.I.N.Doreyappa Gowda

The present investigation on “Development of value added products of medicinal importance from pomegranate (Punica granatum) fruits” was conducted at Post Harvest Technology Division, Indian Institute of Horticultural Research (IIHR), Hessaraghatta, Bangalore, during the year 2005-2006 to explore the possibility of use of stevia leaf powder extracts in the preparation of pomegranate beverages, to study the physico- chemical composition of pomegranate beverages in fresh condition and after storage at different conditions and to study the sensory qualities and overall acceptability of the products initially and different storage conditions.There was slight increase in total soluble solids, pH, and total sugars during storage. However the increase in total soluble solids and total sugars were relatively lower in the beverages prepared with sugar and stevia leaf powder extract at 50:50. A decreasing trend was found in acidity, anthocyanin and ascorbic acid content during the storage. The retention of these parameters was more in beverages with higher juice percentage. The beverages prepared with sugar alone as sweetening agent had better appeal with respect to colour, flavour and consistency. Nevertheless, beverages with sugar and stevia (50: 50) leaf powder extract also showed acceptable organoleptic qualities. The RTS (Ready to Serve) beverages prepared with 20% juice, 15 ^{o}B and 0.25% acidity in both type of beverages that is sugar alone, and sugar and stevia (50: 50) had better overall acceptability. Squash prepared with 30% juice, 40 ^{o}B and 1.0% acidity had better overall acceptability in both non-stevia and stevia incorporated beverages. Low temperature storage was found to be preferable for the quality retention during longer duration storage.

Title : Studies on storage of bitter gourd (2007)

Shankar Gouda, UAS, Bangalore, Guide : Dr.K.P. GopalKrishna Rao

The storage life of bitter gourd fruits, harvested at 12 and 15 days after fruit set could extended to five and six days respectively by polyethylene wrapping in different modifications. Physiological losses in weight of the bitter gourd fruit could be reduced by wrapping with different polyethylene films. PE wrapped (ventilation) fruit had lowest PLW followed by PE wrapped (with ethylene absorbent) during storage at both the harvesting stages. The highest firmness was recorded in fruit PE wrapped (ventilation) followed by PE wrapped (with ethylene absorbent) in both the harvesting stages, but the fruits harvested at 15 days after fruits set showed higher firmness than the 12 days after fruits set. The PE wrapped fruits had the lower total soluble solids. The PE wrapped (ventilation) fruit had the highest ascorbic acid content followed by PE wrapped (with ethylene absorbent) fruits in both the harvesting stages, but the fruits harvested at 12 days after fruits set had higher acidity than that 15 days. The highest chlorophyll was found in PE wrapped (ventilation) fruits in both the harvesting stages. The storage life of bitter gourd fruits could be extended to 18 (harvested at 12 days after fruit set) and 20 (harvested at 15 days after fruit set) days by polyethylene wrapping (with ethylene absorbent). The PE wrapped (with ethylene absorbent) fruits showed decrease in respiration rate whereas, those unwrapped films showed a gradual increase in respiration rate during storage. The PE wrapped (with ethylene absorbent) fruits had the lowest Physiological loss in weight during storage followed by PE wrapped (ventilation) fruits. The PE wrapped (with ethylene absorbent) fruits had the highest firmness by PE wrapped (with ethylene absorbent) fruits in both the harvesting stages, but the fruits harvested at 15 days after fruits set had showed higher firmness than that 12 days after fruits set. The PE wrapped (with and without ethylene absorbent) fruits had the hard texture; where as PE wrapped (ventilation) fruits had optimum edible texture in the both the harvesting stages, but the fruits harvested 15 days after fruits set had higher firmness. The highest ascorbic acid content was found in PE wrapped (with and without ethylene absorbent) fruits followed by PE wrapped (ventilation). The PE wrapped (with and without ethylene absorbent) fruits had the highest chlorophyll content. The PE wrapped (with and without ethylene absorbent) wrapped fruits were deep green in colour. Sensory evaluation panel observed the development of off flavour and bitter taste in the unwrapped fruits.

Title: Studies on osmotic dehydration of Guava (*Psidium guajava* L.) (2007)

P.Anitha, UAS, Bangalore, Guide : Dr.R.B.Tiwari

Guava (Psidium guajava L.) is one of the commercial fruits of tropical as well as subtropical regions. It occupies an important place in the horticultural wealth of India and ranks fourth with respect to area and production after mango, banana and citrus. It is a rich source of vitamin C and pectin. Guava is a seasonal fruits with very short shelf life, therefore it needs to be preserved as self stable value added products using drying technology such as osmotic dehydration. Osmotic dehydration process involves subjecting fruit pieces to aqueous solution of sugar with high osmotic pressure which removes 30-50% of the water prior to drying. The inclusion of osmotic process in conventional dehydration has two major objectives quality improvement and energy savings. This studies was aim to know the effect of syrup concentrations (50, 60 & 70^0 Brix) and duration of osmosis (4, 18 & 24 hours) on weight loss, solid gain and yield of osmotically dehydrated guava slices of varieties Allahabad Safeda and Pink Flesh. Data was analysed using Factorial Completely Randomized Design (FCRD). Observation on physic-chemical composition and sensory characteristics were taken.Variations were observed with respect to fruit size, TSS, ascorbic acid content, acidity and sugar content in fresh fruits of variety Allahabad Safeda and Pink Flesh. Statistically significant variations were observed for weight loss, moisture loss, solid gain, yield, sugars, ascorbic acid content, titrable acidity, NEB and sensory quality parameters. In osmotically dehydrated gyava slices the values ranged f weight loss (22.73 to 34.55%), moisture loss (36.16 to 53.24%), solid gain (6.24 to 13.97%), yield (32.37 to 39.67%), reducing sugar (29.57 to 38.64%), non-reducing sugar (8.37 to 23.68%) and total sugar (39.02 to 63.32%). Increase in the syrup conentration from 50 to 70 ^{0}Brix and duration of osmosis from 4 to 24 hours resulted in increase in weight loss, moisture loss, solid gain and yield in the guava slices. In general, an increase in reducing sugar and non-enzymatic browning (NEB), and decrease in non-reducing sugar and overall sensory score was observed during storage. Dehydrated guava slices were acceptable after 4 months of storage at room temperature. For osmotic dehydration, Allahabad Safeda was rated significantly superior over Pink Flesh.

Title: Studies on packaging and storage of osmotically dehydrated Amla (*Emblica officinalis* L.) (2010)

N.Sumitha, UAS, Bangalore, Guide : Dr.R.B.Tiwari

Indian gooseberry (Emblica officinalis L.), an important fruit crop, is being grown on commercial scale in different parts of India. There is a great demand for amla fruits and its products owing to their nutritional, medicinal properties and delicacy. The osmo dried aonla has tendency to become brown during storage. The present investigation aimed at finding out the suitable packing material and storage condition for maintaining the colour and quality of osmo-air dried amla segments during storage. Different kinds of packages viz., 200 gauge high density polyethylene (HDPE) bag, punnet and polyethylene terpthalate (PET) jar were used to pack the osmo-air dried aonla segments. Packed samples were stored at room temperature (20-30 ^{o}C, 53-76% RH) under light and dark conditions, and at low temperature (15 ^{o}C, 55-60% RH) for six months. Product was analyzed for changes in their chemical constituents and organoleptic qualities at two months intervals up to the end of storage period. Studies revealed that samples packed in PET jar and stored at low temperature retained highest ascorbic acid and acidity. Furthermore, there was an increase in reducing sugar, total sugars, and partial reduction in non-reducing sugar content in amla segments during storage. Significantly low non- enzymatic browning was recorded in case of PET jar stored under low temperature. Highest overall acceptability was observed in samples packed in PET jar and stored under low temperature. In contrast, lowest sensory score was recorded in case of samples stored at room temperature under dark condition. Thus, it can be concluded that, packing samples in PET jar and storing them under low temperature is a promising way to improve the storage life of osmo-air dried amla segments.

Title: Modified atmosphere packaging of Sapota (*Achras zapota* L.) fruits for extension of storage-life and quality maintenance (2010)

B.Manasa, UAS, Bangalore, Guide: Dr.D.V.Sudhakar Rao

Sapota on account of its taste and low cost of production is very popular in India. It is highly perishable which is a major problem in extending its shelf-life. Modified atmosphere packaging is recently getting popular by virtue of its role in extending shelf- life of the produce. The packaging is intended to create an appropriate gaseous atmosphere around a commodity to enhance shelf-life and to conserve the quality of produce. An attempt was made to increase the storage-life of sapota using different packaging films coupled with low temperature storage. Mature sapota fruits (cv. Cricket Ball) were packed in low-density polyethylene (LDPE) and cryovac PD-961 films with different permeabilities to gases and stored at 10 ^{o}C, 15 ^{o}C and room temperature. The results showed that the storage life of sapota fruits could be extended up to 3 weeks at 10 ^{o}C and 1 week at 15 ^{o}C when the fruits were packed in non-perforated LDPE and PD-961 films. These fruits ripened normally with maintenance of good quality in terms of firmness, total sugars, total soluble solids, acidity, reduced physiological loss in weight compared to non-packed when they were shifted to room temperature after unpacking. Today, estimation of antioxidant activity has become an important parameter to evaluate the nutritional quality of food. In our investigation, it was found that higher amount of ascorbic acid content, total phenols, total flavonoids, total antioxidants were also maintained in MA packed fruits during storage period. The MA packaging was not helpful in extending of storage-life at room temperature though packed fruits had uniform ripening with least weight loss compared to non-packed fruits.

Title: Alleviation of chilling injury of Custard Apple (*Annona squamosa* L.) fruits (2010)

R.A.Patil R.A, UAS, Bangalore, Guide : Dr.D.V.Sudhakar Rao

Experiments were conducted to study the effect of modified atmosphere packaging (MAP) on alleviation of chilling injury in custard apple (Annona squamosa L.) fruits. Three different kinds of flexible films viz., low density polyethylene (LDPE), Cryovac Opti 300 and Cryovac PD-961 of 30×25 size were used for packing the fruits. Eight fruits were packed in each film bag and these packs were further packed in ventilated CFB boxes. The boxes were stored in "Walk-in" cold rooms maintained at 8, 12 and 15 ^{o}C (85-90% RH) respectively. Each treatment was replicated thrice. At weekly intervals the fruits stored at different temperatures were taken out from film and allowed to ripen at room temperature (RT) to study their ripening behaviour. Experiments revealed that MAP of custard apple fruits with LDPE or Cryovac PD-961 film could alleviate the chilling injury to considerable extent, besides extending the storage life. Furthermore, MAP at lower temperature could maintain the quality of the fruits for a longer duration (two weeks) when compared to non-packed fruits at RT (four days). Fruits stored at 8 ^{o}C though maintained their quality up to three weeks of storage, but lacked desirable appearance due to development of chilling injury. At 12 ^{o}C, the fruits could be kept in unripe condition up to two weeks, when the fruits were packed either in LDPE or Cryovac PD-961 film. These fruits ripened normally without CI in three days when they were shifted to RT after unpacking. However, at 15 ^{o}C the MA packed fruits ripened within the pack by two weeks of storage life when compared to one week in non-packed fruits. Hence, it can be concluded that the storage life of custard apple fruits could be extended at 12 ^{o}C without any CI by packing the fruits in LDPE or Cryovac PD-961 film.

Title: Studies on dehydration of Orchid flowers (2010)

Rameeza Salma, UAS, Bangalore, Guide : Dr.Sangama

Dehydration is an important process of moisture removal to enhance the shelf life and preserve the flower colour, shape, size and texture in natural form. Dried flower quality is depends on flower structure, variety, stage of harvest, time of harvest, desiccants, drying methods and their storage in a suitable packages. Hence the present study was conducted with the objectives of selection of suitable variety with optimum harvest stage, embedding media and drying method for better display quality with longer shelf life of dried flowers of Dendrobium orchid. Dried flowers of Dendrobium orchid var. Sonia-17 had higher sensory score of 22.80, 23.40 and 23.30 for colour, texture and shape respectively as compared to the dried flower sensory score of 15.00 &14.60, 17.00 & 13.00 and 21.20 for colour, texture and shape respectively in vars. Caesar Red and Emma White. Among three harvest stage viz., half opened, ¾th opened and fully opened flowers of Dendrobium orchid var. Sonia-17 dried flower qualities revealed that flowers harvested at ¾th opened stage yielded dried flowers of brighter colour, glossy texture, medium in size with small white centre, having petals and sepals in intact positions exhibiting an attractive shape. Silica gel embedded hot air oven dried flowers obtained a sensory score of 21.00 and 24.00 for colour and shape respectively whereas better texture (22.12) was observed in sand embedded hot air oven dried flowers. Dried flowers stored under dark in an air tight plastic container obtained a sensory score of 19.37 and 21.00 for colour and texture respectively which indicated good keeping quality of above six months. Among various products prepared from dried flowers, floral arrangement in acrylic package obtained a maximum sensory score of 22.40 as compared to dried flower arrangement in bamboo basket and dried labellum greeting card.

Title: Studies on osmotic dehydration of Carrot (*Daucus carota* L.) (2011)

R.Selvakumar, UAS, Bangalore, Guide : Dr.R.B.Tiwari

Carrot is one of the important root vegetables rich in bioactive compounds like carotenoids and dietary fibers with appreciable levels of several other functional components having significant health-promoting properties. Osmotic dehydration of carrot seems to be convenient alternative for long-term storage as compared to cold storage or canned products. Keeping this in view the present investigation was carried out on "Studies on Osmotic Dehydration of carrot (Daucus carota L.)". Among the osmotic pre-treatments 70°B syrup for 40h resulted in maximum weight reduction (11.24%), water loss (49.29%) and solid gain (38.05%). Pretreatments with low sugar syrup concentration of 40 and 50°B at both osmotic duration 20 and 40h resulted in an overall weight gain as values for weight reduction (WR) were negative (-9.37 to -29.00%), as well as an increase in solid gain and water loss in osmotically dehydrated carrot slices. Carrot slices subjected to 70°B syrup for 40h osmosis had maximum yield (58.33%) and lowest drying ratio (1.71:1) followed (58.26%) by 60°B syrup for 20h and (57.17%) 60°B syrup for 40h. Lowest yield 7.37 per cent and maximum drying ratio 13.88 was observed in untreated control samples. In osmotically dehydrated slices of carrot slices at initial stage the values were in range of reducing sugar (52.31-58.45%), non-reducing sugar (10.22-17.36%), total sugar (67.31-70.70%), carotenoids (32.04-39.09 mg/100 g) and total titrable acidity (0.31-0.52%). There was loss in carotenoids after six months storage and values ranged from (28.52-32.15 mg/100 g). Non- enzymatic browning in osmo-dried samples were very low at initial (0.100 to 0.151) and increased during storage which was (0.168-0.306) after six months of storage. Osmotically dehydrated carrot slices made by dipping in 50°B syrup for 40h were found superior with respect to sensory characteristics at initial as well as during storage. However, all osmotic dehydrated samples were found to be acceptable after six months of storage at ambient temperature. Hence osmotic dehydration was found to be very effective in improving the quality of dehydrated carrot slices.

Title: Estimation of field residue of Cabbage and development of fortified foods (2011)

Prashanth Naik, UAS, Bangalore, Guide : Dr.C.K.Naraayana

Cabbage represents an important group of plants which produce significantly large amount of biomass consisting of leaves. Cabbage outer leaves were reported to contain high amount of fibre and bioactive compounds with high antioxidant activity. So a study was conducted to estimate cabbage field residue and development of fortified foods. The results showed that total crop residue was 15.08 tonnes/ha (27.89%) and leaves were the major residue (13.13 tonnes/ha). After harvesting, the residual leaves were collected and divided into two lots; one was subjected for blanching to inactivate the native enzymes and another was unblanched, the leaves were dried at 60 ºC and powdered. Common bakery food products such as bread, biscuits and rusk were prepared by fortifying the raw material with blanched and unblanched residual cabbage leaves (RCL) powder at 5, 7 and 10% levels. The nutrient compositions such as protein, carbohydrates, fat, crude fibre, total carotenoids, vitamin C and total antioxidant acitivity were estimated for unblanched and blanched RCL, their powder and fortified products and found significant differences among the treatments. The data indicated that, with increase in RCL powder there was an increase in all the nutrient components except fat and carbohydrates. The fortified products were evaluated for sensory qualities which exhibited no significant differences among the treatments but 10% fortification was less preferred because of cabbage flavour and slight bitterness. Besides these products, encapsulation was also done with blanched RCL powder and powdered aonla pomace with twelve different combinations and their nutrient composition were also determined.

Title: Effect of ethylene action inhibitor and Ethylene absorbent on the postharvest life and quality of Guava (2011)

S.Vijay Rakesh Reddy, UAS, Bangalore, Guide : Dr. D.V. Sudhakar Rao

Guava (Psidium guajava L.) is one of the important fruits of tropics, also known as "Apple of tropics". Being a climacteric fruit, it is highly perishable in nature. Due to faulty or improper handling during transportation and storage, 25-30% of the produce goes waste. Hence to reduce these loses and to extend the shelf life of the fruits a study was conducted on effect of ethylene action inhibitor and ethylene absorbent on the postharvest life and quality of guava (Psidium guajava L.) cv. Lucknow -49" at Division of Post Harvest Technology, IIHR, Bangalore during 2010-11. Guava fruits were pre- treated with three treatments viz., ethylene action inhibitor (1-MCP 500 ppb), ethylene absorbent ($KMnO_4$ 10 g/kg) and control. After the pre-treatments, fruits were stored at three different temperatures of 8, 12 and room temperature (22-28ºC). 1-MPC treatment significantly reduce the respiration rate, ethylene production and delayed the ripening irrespective of the storage temperatures. However, $KMnO_4$ treatment was helpful in extending the storage life of guava fruits only marginally. At room temperature (RT) the 1-MPC treatment extended the postharvest life of guava fruits to 10 days compared to the control fruits that couldn't be stored for more than 5days. The storage life of 1-MPC treated guava fruits could be further extended to 30 days when stored at 12ºC compared to 15 days in un- treated fruits. At 8 ºC, through 1-MPC treated fruits stored 12ºC showed maximum firmness, total soluble solids and higher retention of ascorbic acid till the end of ripening compared to control and treatments.

Title: Hybridization and development of inbred line in Petunia (2011)

Swathi Kolukunde, UAS, Bangalore, Guide : Dr. T. Tejaswini

Petunia is a popular bedding plant and also used in landscaping for its aesthetic value. Petunia is a major contributor in flower seed industry with an increasing demand for F_1 hybrids. Cost of developing hybrids is mainly dependent on cost of inbred development and hybridization. Inbreeding depression leading to poor seed set and reduced seed germination are problems encountered by seed industry. In this background the present study was taken up with the objectives to evaluate various selfing techniques to identify the efficient one for production of large quantity of seeds in short duration to facilitate inbred development and also for hybrid production. Among the different methods of selfing (threading, manual pollination, bagging of single bud and bagging of multiple buds), bagging of multiple buds resulted in minimum days to seed set (22 days), cent percent seed set, higher pod weight (0.252g) and number of seeds/g (8000). Seed germination percentage was high in manual pollination (86.44%) followed by bagging of multiple buds (68.44%). Inbred line IIHRP-WT recorded higher pod weight (0.149g), number of seeds/g (7350) and percent seed set compared to other inbred lines. In crossing programme, pollination with pollen mix of same line gave the highest pod weight (0.1109g) and number of seeds/g (11400) over the other methods viz., pollination with single anther and pollen mix of same plant. Floral morphology studies revealed variations for flower colour (white, purple, pink, magenta, bicolour of white and pink), anther and pollen colour (white, yellow and purple), number of anthers (5-7), position of stigma in relation to anthers (pin and thrum), receptivity of stigma in relation to anthesis, dehiscence of anthers and pollen viability (40.66-97.77%). All the inbred lines showed their ability to seed set in selfing experiments except in IIHRP-SI wherein self incompatibility was confirmed.

Title: Standardization of blended guava and papaya fruit bar (2012)

L.Jeebit Singh, UAS, Bangalore, Guide : Dr. R.B. Tiwari

Guava and papaya are two commercially important crops grown widely standing 4th and 5th position in production among fruit crops in India thereby holding a prominent place among fruits. These fruits are rich in different phytochemical components like vitamins, minerals etc. On the other hand, these two fruits also suffer high post-harvest losses. Keeping this in view the present investigation was carried out on “Standardization of blended guava and papaya fruit bar”. Fruit bar prepared from guava pulp only recorded maximum yield (29.18 %) and drying ratio was 3.56. The lowest yield (24.15 %) was observed in fruit bar prepared from papaya pulp only and drying ratio was 3.85. I n blended fruit bars at initial stage the values were in the range of ascorbic acid (43.81- 226.6 mg/100g), carotenoids (0- 1627.1 µg /100g), reducing sugar (35.74-46.10 %), non- reducing sugar (21.22-32.83 %) and total sugar (65.67-73.57 %). Fruit bar prepared from 40 per cent guava pulp and 60 per cent papaya pulp was found superior with respect to sensory characteristics at initial and also during subsequent storage period. However, all the samples were found to be acceptable after four months of storage at room temperature. The fruit bar samples packed in biaxially oriented polypropylene (BOPP) showed better result with respect to nutrient retention and sensory characteristics. Microbially all the samples were found to be safe from consumption point of view till the end of four months of storage. Hence, blending of guava and papaya pulps to make fruit bar was found to be effective in yielding a product of nutritionally rich, stable and highly acceptable product.

Plant Physiology & Biochemistry

Title: Role of seed in spongy tissue formation in Alphonso Mango biochemical studies (2005)

Linda Louis, UAS, Bangalore, Guide: Dr.S.Shivashankar

Biochemical Studies showed that moisture content was significantly higher in seeds froms pongy- tissue-affected fruits (STS) than seeds from healthy fruits (HS).Analysis of seed components revealed that STS had significantly lower starch content (33.5%) and higher levels of soluble sugars (27.7%) than HS. The incidence of spongy tissue was associated with increased seed respiration rate and amylase activity indicating that the seed in ST fruits had switched over to germination phase. A substantial increase in the content of soluble protein (43.1%) in STS indicated de novo synthesis of various enzymes associated with germination. There was a significant increase in spongy tissue incidence in pre-harvest GA_3 treated fruits (70.2%), while there was a considerable reduction inincidence in paclobutrazol (16.4%) treated fruits as compared to 51.5% incidence in the control.GA_3 treatment also resulted in higher intensity of spongy tissue. The seeds from HS and STS fruits were distinctly different in their physiological status and biochemical composition. The data clearly indicated that spongy tissue in Alphonso mango is triggered by the onset of seed germination associated events. These events lead to development of spongy tissue in the pulp close to the stone by the continuous transfer of water from pulp to the germinating seed. This theory of seed origin of spongy tissue is amply supported by experimental data and more importantly this concept is able to explain all the facts known so far about spongy tissue.

Title: Biochemical studies on the development of corky tissue in Sapota [*Manikara achras* (Mill.)Fosberg] (2009)

Jaya Joshi,UAS, Bangalore, Guide: Dr.S.Shivashankar

Corky tissue (CT) of sapota is a physiological disorder characterized by hard lump in the pulp, slightly desiccated in nature and acidic to taste. This disorder shows no distinct external symptoms and becomes visible only when fruit is cut open. Under extremely severe conditions, corky skin eruptions are seen. Corky tissue incidence is estimated to vary from 20 to 50 per cent in Cricket Ball, while in other varieties like Kalipati it is up to5 per cent. Biochemical analysis revealed that total and reducing sugars, soluble protein and activities of amylase and lipase were higher in the mesocarp of healthy fruits compared to CT affected fruits, while content of starch and free amino acids were lower. These indicated that degradation of starch into sugars was hampered in CT affected fruits. Starch content, soluble protein and free amino acid were higher in healthy seeds than seeds from CT affected fruits, while total and reducing sugars and amylase activity were lower. Under field conditions, regulation of sink strength by exogenous application ofGA3 and PBZ showed that, CT occurred in the weaker sink thus confirming the role of inner-fruit competition in CT development. Seed viability seems to play an important role in CT development. Sink strength of fruit depends upon number of viable seeds it has. Moisture content in seed and mesocarp of healthy fruits was higher in comparison with that of CT affected fruits, showing thereby that seed from CT affected fruits had lost moisture leading to reduction in seed viability. Reduction in seed viability in corky tissue affected fruit was confirmed by data on germination, dehydrogenase activity, DNA content and analysis of endogenous levels of GA3, ABA and JA using HPLC. Conditions of increased temperature, evaporative demand and decreased relative humidity showed marked increase in corky tissue incidence.

Title: Induction of systemic acquired resistance in tomato inoculated with early leaf blight pathogen (2009)

S.Renuka, Mahathma Gandhi University, Kottayam, Kerala, Guide: Dr. S. Shivashankar

The results of this study provide evidence that application of simple non-toxic chemical solutions such as potassium phosphate can control early blight of tomato, Their low toxicity to animals, comparative environmental safety and nutrient value make them ideal foliar fertilizers which can be used for application in the field for disease control. The ability of potassium phosphate to induce high levels of three defence enzymes and four antioxidants in tomato leaf could be of use in elicitation of SAR in disease management programme. Thus potassium sulphate spray to tomato plants can provide a degree of protection to tomato plants against early leaf blight and help in disease control.

Title: Biochemical changes in seed in relation to corky tissue development of sapota [*Manikara achras* (Mill.) Fosberg] (2010)

Jayashree Ugalat,UAS, Bangalore,Guide: Dr. S. Shivashankar

Corky tissue is a physiological disorder affecting Cricket Ball variety of sapota to the tune of 50% or more especially in the summer season. The affected fruits do not show any external symptoms and becomes apparent only after the fruit is cut open. Corky tissue affected fruits are characterized by a hard lump within the pulp and are less sweet to taste and in extreme cases the fruits give out a unpleasant odour. As such, the corky tissue affected fruits become unit for consumption. Very little work has been reported so far on the biochemistry of the disorder. Studies conducted in this work showed that CT incidence increased with increasing number of fruits per panicle.GA3 treated fruits showed lower incidence of CT as compared to control and PBZ treatment increased the incidence of CT. CT incidence increased in fruits harvested during summer season (Mar-April) as compared to winter season (Nov-Dec) and similarly incidence was more under rain fed treatment as compared to irrigated treatment. Radio tracer experiment showed there was an increased flow of water away from the fruit to shoot during CT formation. Biochemical studies revealed that in CT affected fruit pulp, reduced sugars, total soluble sugars, proteins, fatty acids, mineral nutrients and enzyme activities like amylase, lipase were reduced and starch content was higher as compared to healthy fruit pulp. And in case of seeds of corky tissue affected fruits, protein, free fatty acids, starch and enzyme activity like total dehydrogenase, lipase and germination percentage showed decreasing trend, but reducing and total soluble sugars content were higher compared to seeds from healthy fruit. These above findings, indicated the dominant role of competition among different sinks and loss of viability of seeds in the induction of C Tinsapota.

Title: Biochemical studies on the development of aril browning in Pomegranate (2011)

Hemalata Singh, UAS, Bangalore, Guide: Dr.S.Shivashankar

Aril browning (AB) in pomegranate is a physiological disorder free of external symptoms. Browning of aril starts with a dark dot on the aril and spreads further to the entire aril. The incidence is at first observed at 50% fruit maturity near the calyx end just under the skin. Present studies showed that AB incidence was higher in panicles as compared to those on main shoots. Fruits exposed to sun showed lesser incidence. AB incidence also increased with fruit maturity. Biochemical studies revealed that sugars, TSS, starch and pH were higher in AB affected aril as compared to healthy arils whereas anthocyanin, polyphenols, titratable acidity, protein and ascorbic acid were less in AB affected aril. Enzyme activities like amylase, total dehydrogenase activity in seed werereduced in seed of AB affected aril compared to healthy, whereas enzyme activity like polyphenol oxidase was more in seed of AB affected aril as compared to seed of healthy aril. Healthy arils showed higher moisture content and the seed higher percentage and faster rate of germination as compared to seed of AB affected aril, revealing that seed of AB affected aril had lost moisture leading to reduction in seed viability. Field experiments with growth regulators showed that GA3 treatment reduced incidence of AB and PBZ treatment increased the incidence of browning as compared to control. These findings indicated that the development of AB in pomegranate is a result of combination of many factors like inters fruit competition, biochemical and physiological changes in aril during fruit growth.

Title: Bio-priming of tomato with endophytic fungi to mitigate abiotic stress (2019)

Arya Sunil, UAS, Bangalore, Guide: K. S. Shivashankara

Abiotic stresses like drought and salinity limits agricultural productivity. With the increasing threat of these stresses, there have been several approaches to understand the underlying mechanism responsible for plant stress tolerance. Among the different approaches, the most recent approach is the use of endophytes in improving crop performance. In this study, an attempt was made to test the ability of 8 fungal endophytes in mitigating drought and salinity stress in tomato hybrid Arka rakshak. The tomato seedlings were screened for drought and salinity stress tolerance using different concentrations of PEG-8000 (5, 10, 15, 20, 25%) and NaCl(100, 150, 200, 300, 350 mM), respectively. Concentration for 50% growth reduction was estimated by recording root and shoot length, and 20% PEG-8000 and 150mM NaCl concentrations were used to screen the fungal isolates. Among 8 fungal isolates tested, SF-5 and BD sustained seedling growth under 20% PEG-8000 and 150mM NaCl respectively. Further, SF-5 was evaluated at three levels of drought status(100,80 and 60% soil Field capacity), and BD at 4dS/m of salinity stress under greenhouse conditions. The plant streated with endophyte showed improved performance, as evidenced by increased plant height, number of leaves, branches, flowers and roots under both the stresses. In addition, these plants also exhibited improved relative water content and cell membrane stability. Under drought and salinity stress there was increase in Cytokinin, GA, proline, and sugar levels with the concomitant reduction in ABA levels in endophyte treated plants compared to control plants that were not treated with endophytes. This study suggests that the endophyte canbe used effectively for abiotic stress management.

Title: Phenotyping Capsicum species for desirable root traits and moisture stress tolerance (2019)

Madasetty Sai Venkata Raviteja, UAS, Bangalore, Guide: Dr. R. H. Laxman

The Capsicum genus belonging to family Solanaceae has many cultivars that are popularly grown worldwide. In India, the chilli crop is mostly raised under rainfed situations. Under limited water availability conditions roots mine water from deeper layers of the soil. Although, characterisation for root traits have been made using different containers in many crops, such efforts for phenotyping root characteristics in Capsicum species are very much limited. Therefore, the experiment was initiated to identify the appropriate container for high throughput phenotyping by growing Capsicum genotypes in three types of containershaving different dimensions. Among the three types of containers, the big containers with dimension of 32 cm height 30 cm diameter with 23 kg soil media capacity are the most suitable for phenotyping root characteristics compared to PVC pipe and pot type. Subsequently, 18 genotypes were phenotyped for plant growth and root characteristics in the big container which was identified as the appropriate container in the previous experiment. Out of 18 genotypes, eight contrasting genotypes were selected. Where, six genotypes namely, IHR 4517, IHR 3529, IHR 4501, IHR 4550, IHR 4491 and IHR 3241 with better root characteristics and two genotypes IHR 3447, IHR 3982 showing poor root development were selected and evaluated at 100% and 50% field capacity. The genotypes, IHR 4550, IHR 4501and IHR 3529 belonging to Capsicum chinense showed significantly higher root biomass, root volume and also performed better in terms of physiological characteristics like photosynthetic rate, stomatal conductance, transpiration rate, yield of PSII, electron transport rate, total chlorophyll content maintenance of relative water content and lower malondialdehyde content. Hence, from the results obtained in the study the genotypes, IHR 4550, IHR-4501 and IHR-3529 were identified as tolerant to deficit moisture stress.

Title: Metabolite diversity studies in ovaries of monoembryonic and polyembryonic Mango (Mangifera indica L.) varieties (2020)

Andonissamy Daniel, G., UAS, Bangalore, Guide: Dr. K. S. Shivashankara

Mango varieties can be classified as monoembryonic or polyembryonic. To exploit the role of metabolites in the ovaries for polyembryony formation, the present study was conducted. In this regard, the metabolite diversity was assessed in ovaries of monoembryonic and polyembryonic mango varieties at various stages and also attempted to identify the stages of segment formation in the ovary of polyembryonic varieties. The study on segment formation was carried out in polyembryonic varieties Vellaikolumban and Olour at different stages of ovary development i.e. before anthesis, one day after an thesis, 1^{st}, 2^{nd} and 3^{rd} week after anthesis. Clear segments were observed in one month old fruits. No segments were visible before that. Therefore, the segment formation may occur in between 3^{rd} week to 4^{th} week after anthesis. Profiling of metabolites was done in 2 monoembryonic and 2 polyembryonic varieties at different stages of development of ovary i.e. before anthesis, one day after anthesis, 1^{st}, 2^{nd} and 3^{rd} week after anthesis. All the polyamines, amino acids and sugars were more in monoembryonic varieties indicating that these metabolites may not be responsible for the formation of multiple embryos. The phytohormones such as SA, IAA, IBA, GA7, GA4 and zeatin were found to be high in polyembryonic mango varieties except ABA and ACC. ABA and ACC were high in monoembryonic mango varieties. The metabolite analysis of ovaries in polyembryonic varieties indicated that the formation of multiple embryos in mango may be more closely related to the higher concentration of IAA, IBA, and SA.

Title: Evaluation of Tomato and its wild relative genotypes for phosphorus acquisition and use efficiency (2020)

Soumya Patil, UAS, Bangalore, Guide: Dr. R. H. Laxman

Tomato belonging to family Solanaceae is cultivated across the world. It requires NPK in quite high quantity for growth and development. Phosphorus (P) being important macro nutrientis involved in photosynthesis, respiration, energy generation and nucleic acid biosynthesis. Availability of P is one of the major constraints limiting productivity, due to its fixation and binding with other elements in the soil. Plants have adapted through modifications in root morphology, increased organic acids exudation and acid phosphatase activity to utilize bound P. Identification of genotypes having higher P acquisition and use efficiency is highly desirable under P limiting conditions. Hence, 21 tomato genotypes and its wild relatives were evaluated under P sufficient and deficient conditions. Based on phosphorus acquisition efficiency (PAE) ten contrasting genotypes were selected for further study and were grown in quartz sand supplemented with modified Hoagland solution to supply two levels of P. The root length, root volume, root P content, root-shoot ratio and activity of acid phosphatase were higher under level IIP supply and use efficiency was higher in level I P supply. The genotypes, Arka Samrat, PKM-1, Solanum arcanum, Solanum galapagense, Solanum pimpinellifolium and Solanum peruvianum with better root characteristics, plant height, total plant P content were superior. They also had higher photosynthetic rate, stomatal conductance, transpiration rate, PSII yield and chlorophyll content. Thus, exhibited better performance under low P supply condition with higher P use efficiency.

Title: Studies on physiological response of wild species and cultivated Tomato genotypes under water deficit stress (2021)

Sukeshini S., UAS, Bangalore, Guide: Dr. R. H. Laxman

Tomato (Lycopersicon esculentum Mill.) is an economically important vegetable crop. Being an irrigated crop it is sensitive to deficit moisture stress situations. Frequency of deficit moisture stress situations is likely to increase under climate change situations with extreme rainfall events. Thus, it is important to identify genotypes tolerant to deficit water stress. Hence, studies were conducted to evaluate response of tomato genotypes and wild species under two moisture regimes and also to characterize their physiological and biochemical response. Sixteen tomato genotypes and wild species were evaluated under two water regimes, 100 per cent and 50% FC, moisture deficit stress. Overall, under 50% FC, reduction in various morphological characteristics was observed. Based on response of genotypes in terms of biomass and root characteristics ten contrasting genotypes were assessed further at 100 per cent and 50% FCfor physiological and biochemical response. Under 50% FC genotypes and wild species exhibited diverse response. With lower reduction in photosynthetic rate, MSI, RWC, total chlorophyll content and increased antioxidant activity, abscisic acid content under 50 per cent FC the cultivars, Arka Samrat, Arka Aditya, Arka Abhed, Arka Meghali and Arka Sourabh and two wild species, Solanum pimpinelifolium and Solanum galapagense exhibited tolerance to deficit moisture stress. It is suggested that cultivars could be utilized for cultivation under water limiting conditions, while wild species could be exploited as source of water stress tolerance in tomato breeding programme.

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Title: Evaluation of eggplant cultivars, wild relatives and landraces for water logging stress tolerance (2021)

S KRabiul Alam, UAS, Bangalore, Guide: Dr. R. H. Laxman

Water logging is one of the major threats to crops with increasing frequency of extreme rainfall events under climate change. Tolerant rootstocks have shown promise in imparting tolerance against water logging stress. Eggplant, being a hardy crop in the Solanaceous family, can be a promising rootstock candidate for grafting. Twenty-four genotypes of eggplant cultivars, landraces and wild relatives were evaluated under two water regimes, 100 per cent field capacity and water logging condition for eight days at 30 days after transplanting. Under waterlogged condition, reduction in various morphological characteristics was observed. Based on the response of genotypes in terms of total dry matter, visual score for tolerance, leaf yellowing and adventitious root formation, six contrasting genotypes were identified. And the contrasting genotypes were further assessed at 100 per cent field capacity and waterlogged condition for physiological and biochemical responses. The eggplant cultivars, landraces and wild relatives exhibited diverse response. With higher photosynthetic rate, transpiration rate, stomatal conductance, increased leaf antioxidant activity, root proline content, root alcohol dehydrogenase activity, root auxin, gibberellin, ACC, salicylic acid, abscisic acid and jasmonic acid, the wild relatives, Solanum insanum and Solanum mammosum and cultivars, Arka Neelkanth and Arka Keshav exhibited tolerance to waterlogging stress. It is suggested that these cultivars could be utilized for cultivation under waterlogged conditions, while both the wild relatives and cultivars could be exploited as rootstock for cultivation of solanaceous crops under water logging. Also, the tolerant wild relatives would provide a source of water logging stress tolerance in breeding programmes.

Title: Optimization of light intensity for better water use and productivity in vegetable crops (2022)

Lalthantluanga, UAS, Bangalore, Guide: Dr. K. S. Shivashankara

Vegetables grown under open field conditions are exposed to high light intensity and temperatures which effects crops growth, productivity and quality. Excess light can limit the yield and water use due to higher temperatures under open field conditions. Therefore, it is necessary to optimize the light use for improving the water use and yield of vegetables. In our study 3 levels of light intensity namely 100, 70 and 50% of full sun light was used. French bean, tomato and brinjal were used for the study. Shade nets were used to create the required light intensities. The low light regimes (70 and 50 %) showed overall better growth and productivity including improved shoot and root length, number of branches, total dry matter, pods/fruit yield, leaf area, leaf chlorophyll fluorescence. Gas exchange parameters like photosynthetic rate and stomatal conductance showed higher value while the transpiration rate showed lower rate under the 50% and 70% light intensities in all three crops. Light compensation point (LCP), light saturation point (LSP), maximum photosynthesis (A.max), carbon dioxide compensation point (CCP) and carbon dioxide saturation point (CSP) were higher under 100% light intensity while carboxylation efficiency was better in 50 and 70% light intensities. The water use efficiency was also better under low light regimes. Low light intensities improve the fruit weight, fat & water soluble vitamins, ascorbic acid (Vit-C), chlorophyll and carotenoids content in the fruits of brinjal and tomato than the control conditions with 100% light intensity but the total phenols, antioxidants and total flavonoids accumulated were higher under control conditions in all three crops. Hence, the partially shaded low light intensity regimes improve water use and also productivity in the 3 vegetables studied.

Biotechnology

Title: Studies on induced autotetraploids of Selenium viarum and Solanum mammosum and Somatic chromosomes of their diploid progenitors (1986)

B.K. Kumaraswami, UAS, Bangalore, Guide: Dr.R.Krishnan

Evaluation of induced autotetraploids was carried out in Solanum viarum and S.mammosum. In the first experiment, 14 C_5 generation induced autotetraploids of 'Glaxo' variety were compared for 31 characters relating to morphology, growth and berry yield with their diploid progenitor and four diploid, less spiny lines developed at IIHR. Varietal differences were observed for 17 characters. The four diploid IIHR entries exhibited parity with 'Glaxo' variety in dry berry yield and its components, absence of spines on stem and petiole and seed production potential. But they excelled 'Glaxo' variety by virtue of fewer vestigial curved (laminary) spines unlike straight well developed spines of 'Glaxo'. The presence of early maturing autotetraploid is a significant observation for which S.mammosum autotetraploid differed from those of S.viarum. Intra–plant variation for berry size in autotetraploid of S. mammosum was also seen and it could be due to the presence of aneuploids as in the case of S.viarum autotetraploid.C_2autotetraploid of S. mammosum were inferior for stem diameter, berry volume, length and diameter, berry wall weight, seed weight per berry, dry weight and number of seeds perberry. Somatic chromosomes of S. mammosum were studied for the first time and their number confirmed as 2n=22. A somatic chromosome of S. viarum was also studied. In chromatin contented. This confirmed our earlier studies on pachytene karyology and homology.

Title: Floral biology and seed character in diploids and induced autotetraploids of *Solanum viarum* (1986)

B.Sridhar, UAS, Bangalore, Guide: Dr.R.Krishnan

Studies on floral biology of diploids and Induced autotetraploids, and seed characters of diploids, autotetraploids and aneuploids were carried out in Solanum viarum, Dunal. In floral biology studies, time of anthesis, time of another dehiscence, pollen production, in vivo pollen germinability, pollen fertility, pollen shape, pollen tube growth, stigma receptivity and cross ability across ploidy and species levels of diploid and autotetraploid, were compared. In both diploid and autotetraploids, anthesis was delayed in tetraploid. Pollen production in autotetraploids of wild, Glaxo and IIHR varieties was lesser than diploid progenitors, but not in BARC autotetraploids. Seeds of diploid, euploids and aneuploids of S. viarum fractioned into six categories using five concentration of common salt solution were compared for their number, percentage contribution to total seed number, seed diameter, and hundred seed weight and seed germinablity. Differences were observed among diploids, euploids and aneuploids.

Title: Studies on Coleus forskhlii (1997)

M. Ravi Kumar, UAS,Bangalore ,Guide:Dr.R.Krishnan

In the endanged forskolin-yielding Coleus forskohlii Briq. Three experiments were conducted at the IIHR, Bangalore. In the first experiment promising F_1 hybrids exhibiting standard heterosis were evaluated for their yield potential and rate of propagation. Yield evaluation of F_1 hybrids AB and CA against standard check K was carried out at three planting densities of 27, 778, 17,778 and 12,346 plants per hectare. Fresh tuber yield increased with planting density. F_1 hybrids out yielded standard control to the extent of70.50% (AB) and 62.30% (CA). Variety x spacing interaction was observed. In the second trial under the same experiment establishment of terminal, middle and basal cuttings of three F_1 hybrids (AB, CA & DA) was compared with standard control K.Varietal differences were observed for sprouting in basal and middle cuttings. In the second experiment hybrids and backcross resulting from hybridization between non-tuberous and tuberous parents were evaluated for agronomic characters as well as root histo chemistry. The high dry matter productivity of the non-tuberous parent was shared by both F_1 and backcross. The comparative anatomical and histo chemical studies in the above material brought out differences in the content of various root tissues and in the accumulation of carbohydrates, proteins and nucleic acids in them. In the third experiment diploid progenitor and induced autotetraploid of inter varietal hybrids. As x D were compared for morphological, fertility and yield characters. Autotetraploid was inferior in all the seven morphological characters studied. However, only a marginal reduction in pollen fertility was recorded in autotetraploid. The decreased dry matter productivity of the autotetraploid was evident on all the four components.

Title: Studies on direct DNA uptake by Citrus (*Citrus aurantifolia* swingle) nodal buds through in vivo electroporation (1998)

Krishnarao Desai ,UAS, Bangalore,Guide:Dr.Akella Vani

Direct DNA uptake into immature floral buds in the size range of 2.5mm was shown to be possible through electroporation of plasmid DNA either naked or complexed with spermine or lipofectin. This is a first report in the world of DNA being taken up by a mature and highly differentiated tissue such as a floral bud. Two reporter genes were used viz., uid A gene of E.coli which codes for beta glucuronidase and gfp the gene for green fluorescent protein. Transient expression was observed 20-30 minutes after electroporation with plasmid DNA containing the coding sequence for gfp. The green fluorescence was visible with the help of a fluorescence microscope attached with FITC filters. All parts of the flower including the ovary and the pollen have taken up and expressed the GFP protein indicating that it should be possible to generate transgenic citrus through this technique. R1 progeny have been raised from seeds obtained from electroporated flowers.

Title: Transformation of geranium with glucanase-chitinase encoding genes using *Agrobacterium tumefaciens* (2000)

M.K.Prakasha, UAS, Bangalore, Guide: Dr. Sukhada Mohandas

Geranium (Pelargonium X hortorum) is a popular floricultural crop. Conventional breeding of Pelargonium X hortorum is hampered by its low fertility. The crop is attacked by various fungi like Fusarium oxysporum var. Radolens, Botryodiplodia theobromae, Rhizoctoniasolani, Phythiumsp., Botryosphoria obtusa and Phytopthora spp, which causes wilt, and Gleosporium spp causes Tip rot of geranium. Though these losses could be controlled to some extent using chemical pesticides the hazards posed by these chemicals to the environment prompted us to use genetic engineering techniques which help in stable integration of the gene into the plant and impart resistance. Hence the present investigation was undertaken to develop suitable protocols for regeneration of ornamental seed geranium(Pelargonium X hortorumcv. Scarlet) and to develop Agrobacterium mediated gene transformation system using Glucanase -Chitinase gene. Geranium hypocotyl when cultured on MS medium containing different concentration of thidiazuron (TDZ) formed somatic embryos, the somatic embyrogenesis initiation started after two to three weeks of incubation. The highest number of somatic embryos (12.60) were produced in MS medium containing 1.5 MTDZ and somatic embyrogenesis initiation was achieved in 14 days Highest number of shoot lets (10) were rooted on MS medium containing 0.1 mg/l of NAA in 21 days. Explants after Co-cultivation were put to regeneration media where selection pressure was imposed with kanamycin (100 mg/l) and cefotaxime (600 mg/l). The Co-cultivated explants on kanamycin supplemented medium showed somatic embryos formation, the untransformed and the control plants turned white and later died on kanamycin supplemented medium. The transformation efficiency was 45.23 %. The putative transformed shoots were transferred to the best rooting medium(MS+ 0.1mg/l NAA) containing kanamycin (100 mg/l) and cefotaxime (600 mg/l)). PCR analysis of putative transformed plants (pBIN AR) showed the presence of 820 bp npt-IIgene. A rapid screening of the total genomic DNA isolated from putative transformed plants and control was done using DIG labeled glucanase probe to identify the transformed plants. All the putatively transformed plants showed hybridization with the probe. All the transformants expressed high glucanase activity compared to control plants.

Title: Development of microsatellite markers and molecular analysis in Okra (*Abelmoschus esculentus* (L.) Moench) (2001)

Sujata.C.Hebballi, UAS,Bangalore,Guide:Dr.K.V.Ravishankar

Okra (Abelmoschus esculentus (L.) Moench) anannual, often cross-pollinated crop belonging to the family Malvaceae, is an important crop of the tropics and subtropics of the world. Simple sequence repeats (SSR`s) or microsatellites are useful DNA markers in plant genetic research. Microsatellite- enriched library was constructed using DNA from Arka Anamika. A total of 71 clones were sequenced. Fourteen simple sequence repeat (SSR) loci were characterized using 10 okra genotypes. Genetic analysis showed a total of 26 alleles with an average of 1.86 alleles per SSR locus Polymorphic Information Content (PIC) values ranged from 0 to 0.375 and the observed (H_O) and expected (H_E) heterozygosity values varied from 0to 0.111 and 0 to 0.526,respectively. Another objective of this study was to investigate the transferability of cotton SSR markers to okra because of the availability of a large number of cotton SSR markers. Ninety cotton SSR primer pairs were used to amplify okra genomic DNA. The results showed that only 26cotton SSR primer pairs tested in this study could amplify okra genomic DNA. Among these transferable SSR markers, 50 per cent of them detected polymorphism in okra genotypes. We obtained a total of 26 alleles with an average of two alleles per SSR locus and values of polymorphism information content (PIC) varying from 0 to 0.3750 and the observed (H_O) and expected (H_E) heterozygosity values varied from 0 to 0.52 and 0.080 to 1 respectively. Identification of transferable markers would help in okra genome research by providing additional DNA markers and also helps in comparative genome mapping study with cotton.

Title:Agrobacterium mediated transformation of African violets (*Saintpauli ionantha*) with glucanase chitinase gene (2001)

Narendra Ram, UAS, Bangalore, Guide:Dr.Sukhada Mohandas

African violet (Saintpaulia ionantha H. Wendland) is one of the most important ornamental plants used in indoor decoration, gardening and landscaping. These plants are attacked by Fusariumoxy sporum, Phytophthora sp., and Pythium sp which cause Crown Rot and by Botrytis sp. which causes Botrytis Blight.Present work were envisaged to incorporate the genes producing chitinase and glucanase which impart resistant to these diseases. Transgenic African violets were produced via Agrobacterium tumefaciens mediated transformation. To start with regeneration protocols were standardized through multiple shoot bud production from leaf and petiole explants using growth regulators BAP and NAA. BAP at 2.5mgl^{-1} and NAA at 1mgl^{-1}gave the highest number of shoot buds (40) in leaf explants. In petiole explants, BAP at 0.5 mgl^{-1} and NAA at 0.1 mgl^{-1}gave the maximum number of shoot buds. Rooting of these shoot buds was found to be maximum with NAA at 2mgl^{-1}. Leaf explants were inoculated with the strain LBA4404 of Agrobacterium tumefaciens harboring the binary carrying Glucanase-chitinase genes and npt II selectable marker. Regenerants obtained on the selection media containing Kanamycin (70 mgl^{-1}) and cefotaxime (800 mgl^{-1}) were excised and rooted on the media containing NAA.Integration of the transgenes in the plant genome was confirmed by PCR analysis and Southern hybridzation. Mean glucanase activity in the transgenic plants was 44220 muml^{-1}while that in control plants it was 27060 muml^{-1}. The crude protein extracts of transformed plants showed zones of inhibition when tested on Fusariumoxy sporum and Pythium while control plants did not show any such anti fungal activity.

Title: Agrobacterium mediated transformation of Chilli (*Capsicum annuum* L.) with glucanase and chitinase gene (2002)

S.T. Shivegowda, UAS, Bangalore, Guide: Dr.J.B.Mythili

Chilli is one of the most important vegetable crop which is susceptible to several fungal diseases which cause huge losses in crop yield. Genetic engineering through the introduction of genes coding for defense proteins viz., chitinase and ß, 1, 3 – glucanasevia. Agrobacterium is one of the approaches for developing disease resistant variety of this crop. Development of an efficient regeneration system is a pre-requisite for any genetic transformation studies. Keeping this in view, the investigation was carried out with the objective of developing efficient regeneration and transformation of chilli with glucanase and chitinase genes. An efficient and reproducible regeneration protocol for cultivar Pusa Jwala and G4 was developed using cotyledon explants. MS media supplemented with BAP,GA_3 and IAA gave rise to multiple shoot buds while the presence of Zeatin & GA_3 in the media gave rise to well formed shoots which could be rooted in IBA containing medium. Cotyledons of cv. Pusa Jwala were transformed with Agrobacterium tumefaciens at C 58 containing plasmid PBZ 100 having chitinase and glucanase genes and another Agrobacterium culture carrying binary vector PVG 1040, containing GUS gene. The presence of npt II in both the cultures, as selectable marker under the constitutive expression of CaMV35S promoter facilitated the selection and regeneration of transformed plants on a medium containing 100 mg l^{-1} kanamycin. The presence of the transgene was confirmed indirectly through PCR amplification of npt II gene and by histochemical assay of GUS gene. Of the 5 transformants obtained, 3 tested positive for PCR amplification of npt II gene.

Title: In vitro regeneration and transformation in carnation (*Dianthus caryophyllus* L.) (2004)

H.M.Kallesh Prasad, UAS, Bangalore, Guide: Dr.J.B.Mythili

Carnation (Dianthus caryophyllus L. is one of the most important commercial flowers intheworld.Thecommercialvarietiesaregrownmainlythroughcuttings.Breedingmethods have focused on development of varieties with novel characteristics. As an alternative to the classical breeding programmes attempts have been made to develop transformation system using Agrobacterium tumefaciens based gene vectors. However, transformation in carnation is still far from routine and can show variable rate of success. Keeping this in view, the present investigation was carried out with the objective of developing efficient regeneration and transformation of carnation with reporter gene. An efficient and reproducible regeneration protocol for carnation genotypes IIHRS-1 and IIHRP-1 has been developed from leaf and stem explants. The explants did not show any significant difference in their regeneration response. However, significant differences in regeneration potential were observed with leaf explant exhibiting higher regeneration potential (5.5) as compared to stem explant (4.9). The best regeneration response and maximum regeneration potential was obtained in MS medium supplemented with NAA(0.1 mg/l) and TDZ (1.0 mg/l) for both the explants and both genotypes used. This medium also proved suitable for shoot elongation of regenerated shoots. The shoots could be rooted in MS medium supplemented with IAA (1.0 mg/l). Leaves of genotype IIHRS-1 were transformed with Agrobacterium tumefaciens strain LBA4404 with binary vectorpROK2 containing baculovirus chitinase gene under the control of 35S promoter and nptII serving as selectable marker under control of nos promoter. Inoculation time for 20 min.with the Agrobacterium culture followed by co-cultivation for 3 days in total darkness and 16h photoperiod for 2 days proved to be optimum. Putative transformants were regenerate data frequency of 28.9 % in selection medium supplemented with kanamycin (75 mg/l). Few shoots at random were tested for transgenic integration. Out of the three shoots tested for npt II amplification two shoots tested positive. The presence of transgene was thus indirectly confirmed through PCR amplification of npt II gene.

Title: Detection and identification of covert endophytic bacteria associated with in vitro cultures of Papaya (*Carica papaya* L.) (2004)

Sima Kumari, UAS, Bangalore, Guide: Dr.PiousThomas

The experiments were carried out using papaya cv. Surya, employing axillary shoots from field grown one year old plants. There were four major experiments namely (i) culture establishment in vitro and monitoring the incidence of cultivable endophytic bacteria,(ii) culture indexing for cultivable endophytic bacteria, (iii) isolation and identification of cultivable bacteria employing 16S rDNA sequence based molecular approach and (iv) molecular screening of index-negative culture for non-cultivable bacteria. Papaya shoot tips harbored a series of endophytic bacteria which gained entry in the micropropagated cultures through the explant. Visible fungal and bacterial contamination in tissue culture medium was seen in 0-16 % 19-4 3% of cultures in two batches. Out of the 65 visibly clean cultures of Batch-I, 26% (17 cultures) revealed covert bacterial association during medium/tissue-indexing and in Batch-II, 14% of such clean cultures showed up bacterial presence during the first or second in vitro cycle and other clean cultures remained index-negative on both medium/ tissue–indexed plates during the next four in vitro cycles. These included Microbacterium esteraromaticum, Pantoea sp., Echium sp., Brevundimonas aurantiaca, Sphingomonassp., Methylobacterium podarium and Rhizobium sp. Some endophytes displayed slow or in conspicuous growth in tissue culture medium resulting in gradual culture degeneration. They were identified as Paenibacillus sp., Ralstonia mannitolilytica, Sphingomonas sp. and Bacillus fusiformis. Most of the shoot tips showed the association of only one bacterial type. About 70-75 % of the endophytes belonged to Gram-negative group. Visibly clean and index negative cultures, after five - six in vitro cycles revealed the presence of non-cultivable bacteria during PCR based molecular screening to the tune of 56.25% - 80% in two batches. The index-negative cultures upon transfer to proliferation medium after five to six in vitro cycles showed satisfactory growth. No clear distinction could be made between non-cultivable bacteria harboring and other clean cultures based on their growth or proliferation. Endophytic bacteria, thus appeared to be integrally associated with papaya tissue-culture with varying side-effects.

Title: Genetic transformation of drought tolerant Tomato cv. Arka Meghali with pathogen resistance genes(2004)

Ashoka, UAS, Bangalore, Guide: Dr. Sukhada Mohandas

Tomato (Lycopersicon esculentum Mill) is the world's largest vegetable crop cultivated for its fleshy fruits. The crop is attacked by various fungi like Fusarium oxysporum,Alternaria solani etc., which cause wilt and blight diseases and cause serious economical losses to the yield. Though these losses could be controlled to some extent using chemical pesticides, the hazards posed by these chemicals to the environment prompt us to use genetic engineering techniques which help in stable integration of the gene into the plants and impart resistance. The present investigations were carried out with the objectives of developing transgenic plants of tomato cv. Arka Mehgali over expressing glucanase –chitinase genes. An efficient and reproducible regeneration protocol for tomato cv. Arka Meghali was developed. Among the various plant growth regulators combinations tried for regeneration, the best regeneration response was obtained in two treatments, one with 1.0 mg/l zeatin + 0.5 mg/l IAA and the other with 2.0 mg/l BAP + 0.1 mg/l IAA. In addition to shoot regeneration, these media produced sufficient elongation of the regenerated shoots. Rooting of in vitro formed shoots was induced in the MS media supplemented with different concentration of IBA and the maximum rooting occurred in media containing 2.5 mg/l IBA. Transformation was carried out using the Agrobacterium strain LBA4404 harbouring a binary vector p BinAR with glucanase- chitinase genes andnpt II as the selectable marker gene driven by CaMV35S promoter. It was found that kanamycin at 50mg/l inhibited regeneration totally in non-transformed explants. Therefore a kanamycin concentration of 75 mg/l was used for selection of transformants. Inoculation for 15 minutes with overnight grown Agrobacterium culture (0.4 OD at 600nm) and co-cultivation for 2 days followed by transfer to cefotaxime media (600 mg/l) for4 days before transferring to selection medium containing kanamycin (75 mg/l) was found to be optimum for effectively checking the bacterial over growth and retention of green colour of the explants. The presence of the transgene was confirmed indirectly through PCR amplificiation of the npt II gene and a transformation frequency of 4% was recorded. All the transformants tested expressed high glucanase activity compared to non-transformed plants.

Title: Agrobacterium mediated transformation of African Violets (*Saintpaulia ionantha*) with gus reporter gene (2004)

T.Jyoti,UAS,Bangalore,Guide: Dr.Sukhada Mohandas

African violet (Saintpaulia ionantha) is a perennial potted plant mostly used in indoor decoration and gardening. African violets do not produce seeds, so the only means of propagation is by tissue culture. This crop is attacked by various fungi like Fusarium sp.,Pythium sp., Botrytis and Phytopthora sp. Though these losses could be controlled to some extent using chemicals, genetic engineering techniques will help in stable integration of the resistant genes into plant. The present investigation was undertaken to develop suitable protocols for the regeneration of African violets (Saintpaulia ionanthacv. Sailors delight) and to develop Agrobacterium mediated gene transformation system using glucanase-chitinase gene. It was also felt necessary to confirm the integration of the gene through PCR and southern blot analysis and to study the gene expression in plants.Reneration through multiple shoot production from leaf and petiole explants was standardized using BAP and NAA.BAP(2.5mg l^{-1})and NAA(1mgl^{-1}) were found to be the best treatment with maximum number of shoot buds (40) while, BAP (0.50 mgl^{-1})and NAA(0.1mgl^{-1})were found to be the best treatment with maximum number of shoot buds with petiole explants. It was observed that NAA (2 mg l^{-1}) was the best for the rooting of multiple shoot buds obtained from both leaf and petiole. A suitable transformation system was also standardized using leaf as explant. Agrobacterium carrying the PKIWI plasmid with GUS as reporter gene and npt-II as selectable marker was used in the transformation procedure. Histochemical Gus assay was conducted for confirmation studies and the characteristic blue staining patterns confirmed the expression of the transgene.

Title: Studies on the influence of cytokinin in dependent (cki1) gene on shoot regeneration through its over expression in Tomato cv. Arka Vikas (2005)

D.K. Narasimha Murthy, UAS, Bangalore, Guide: Dr. J.B.Mythili

Gene expression associated with specific hormonal treatments during adventitious shoot bud formation from explants cultivated in vitro is poorly characterised. Attempts to identify the genes have led to the isolation of a cytokinin independent gene (CKI1) which has been implicated to have a role in shoot regeneration. The present study was under taken with the objective of studying its role in shoot regeneration through its over expression by Agrobacterium mediated transformationin tomato cv. Arka Vikas under inductive i.e., shoot inducing (SIM) and non inductive i.e., callus inducing (CIM) treatments. Combination of BAP 2mg/l and IAA 0.1mg/l and BAP 2mg/l and NAA 0.1mg/l were identified as shoot inducing medium (SIM) and callus inducing medium (CIM) respectively. Two gene constructs pMON530 with CKI1 gene and pCAMBIA 2301(without CKI1 gene) were used for transformation. For both the gene constructs, kanamycin was used as a selectable marker. Over expression of CKI1 gene resulted in regeneration of putative transformants to the extent of 8.0% in shoot induction medium(SIM) while there was no regeneration in callus induction medium (CIM) and in the medium devoid of cytokinin. CKI1 gene was also found to influence transformation frequency as evidenced by increase in the number of putatively transformed shoots(8.0%) with CKI1 gene as compared to 2.1% with gene construct without CKI1 gene. The presence of transgene was confirmed by PCR amplification of npt II gene and CKI1 gene specific primers. 3 out of the 4 transformants showed amplification of npt II band of expected size 750bp and 3700bp for the CKI1 gene. The results of the present study suggest that CKI1 gene may have a major role in perceiving endogenous cyotkinin signals than the presence or absence of exogenous cytokinin perse.

Title: Factors influencing somatic embryogenesis in Mango (*Mangifera indica* L.) for application in genetic transformation (2005)

Subhasis Samanta, UAS, Bangalore, Guide: Dr. J.B. Mythili

Mango (Mangifera indica L.),the king of fruits, is a prized summer fruit crop of India and Asia. The use of conventional plant breeding approaches for mango improvement has largely been ineffective because of its long life cycle, allogamous and allo tetraploid nature. The present investigation was carried out with the objectives of developing suitable and efficient protocols for regeneration through somatic embryogenesis and to study the feasibility of transformation of mango cv. Vellaikolumban using a reporter gene. Young fruits of 25-30 days of age were found to be ideal for culture initiation. Among the various media tried (MS,B5 and RO) for initial nucellar culture establishment, the best proliferation response was obtained in MS medium supplemented with 2.5 mg/l, 2, 4-D. Induction of somatic embryos from nucellar culture was optimized using B5 medium supplemented with 20% (v/v) coconut water and 250 mg/l of case in hydrolysate. Maturation of somatic embryos of 1.0-1.5 cm. length was obtained best inM3 medium composed of B5 salts, L- glutamine (400 mg/l) and ABA (1 mg/l). The faciation and necrosis of embryogenic cultures could be controlled through the use of salicylic acid at a concentration of 0.1 mg/l. Germination of mature somatic embryos with well-developed roots and shoots was achieved best in semi-solid medium (B5) supplemented with 3.0 mg/l GA_3. During Kanamycin sensitivity test, It was found that kanamycin at 200 mg/l inhibited regeneration totally in non co-cultivated embryogenic callus derived from nucellus. Among various stages of nucellar culture tried, it was found that embryogenic callus is amenable for transformation. Among various treatment tried,150 µl acetosyringone activated bacterial culture and a period of 3 days co-cultivation was found to give highest percent transformation response (75%).The presence of transgene was confirmed by GUS assay.

Title: Development of seedless grape hybrids through embryo rescue and their characterization using Molecular markers (2005)

K.P. Raghavendra, UAS, Bangalore, Guide: Dr.Leela Sahijram

Investigations on "Development of seedless grape hybrids through embryo rescue and their characterization using molecular markers" was carried out at the Indian Institute of Horticultural Research, Bangalore, from Aug 2004-Aug 2005. The main objectives of investigation were to carryout controlled crosses between cultivar Thompson Seedless and downy mildew resistant male parents, inovulo/ exovulo embryo culture and molecular characterization to confirm hybridity using molecular markers. Crossing of cultivar Thompson seedless (TS) with downy mildew resistant male parents would be helpful in obtaining hybrids having characters desirable from both the grower's and the consumer's point of view. Using conventional breeding procedures, it is not possible to obtain hybrid progeny form seedless x seedless crosses. Besides, using the traditional method even seeded x seedless cross may produce only up to 10% seedless plants. Most seedless varieties are stenospermocarpic. Through in vitro methods it is possible to rescue the developing embryo before it aborts and seedless hybrid progeny can be obtained. In ovulo embryo culture prior to embryo abortion provides an attractive alternative to conventional method by allowing the recovery of hybrid from the otherwise abortive ovules of seedless x seedless or seedless x seeded crosses. Molecular characterization to confirm the hybridity was done with ISSR marker. Each cross was found to have best time of ovule explanting at different week post pollination indicating that pollen donor parent and genotype also contribute to ovule and embryo formation rates. Two hundred and forty four hybrid plantlets were recovered from 1166(20.96%) embryos cultured which were excised from 1402 ovules cultured. The utility of ISSR marker in determining hybridity of the progenies of crosses TS X SV 18402 and TSX SV 12309 has been successfully demonstrated. By employing embryo rescue technique hybrid plants have been obtained from various crosses involving Thompson Seedless' as female parent and 6 different downy mildew resistant male parents.

Title: Molecular studies in drought tolerance of Banana (2008)

N.Chandrashekar, UAS, Bangalore, Guide: Dr.K.V.Ravishankar

The present study examines the genetic variation in drought tolerance among AA and BB genomic groups of banana using two characteristics i.e., leaf water retention capacity and carbon discrimination and in this study AA genotypes recorded relatively higher water use efficiency than BB genotypes. BB genotypes had higher leaf water retention capacity (77.73%) compared to AA genotypes (69.3%).From earlier studies two contrasting gentoypes, M. acuminate ssp burmanicecoides commonly recognized as 'Calcutta-4' and'Bee hee kela' BB were used for physiological and molecular studies during water stress. The per cent reduction in photosynthetic rate (PN) between control and stressed plants was 45.28% for 'Calcutta-4'and 36.0 1% for'Beeheekela', transpiration rate (E) was 30.24 (%) for 'Calcutta-4' and 22.36% for 'Bee hee kela', and stomatal conductance (gs)was 60.30% for 'Calcutta-4' and 56.1% for 'Bee hee kela', indicating BB genotypes are tolerant to water deficit conditions. Leaf water potential was higher in 'Bee hee kela' both in watered (-0.913MPa) and under stress (-1.518 MPa) situations when compared with'Calcutta-4' (AA) control (-1.35 M Pa) and stressed (-1.824 MPa) plants. Malondialdhyde content was estimated to be high in 'Calcutta-4' than that of 'Bee hee kela' indicating higher degree of membrane damage in Calcutta-4. The two antioxidant enzymes namely superoxide dismutase and catalase activities were found to be higher in 'Bee hee kela'stressed samples than 'Calcutta-4' indicating better oxidative damage with standing capacity.'Bee hee kela' with higher water potential, gs and antioxidant enzyme (SOD and catalase) activities. 'Bee hee kela' genotype is more drought tolerant than 'Calucutta-4'. Gene expression study using selected gene primers and cDNA revealed that drought not only changes the expression pattern of drought inducible genes but also changes the expression levels of growth and metabolism related genes.

Title: Identification of DNA markers linked to bacterial blight disease in Pomegranate (2009)

K.N.Avinash, UAS, Bangalore, Guide: Dr.K.V.Ravishankar

Pomegranate (Punica granatum L.) is one of the oldest known edible fruit of tropical and subtropical regions belongs to the family Punicaceae .Bacterial blight caused by Xanthomonas axonopodis pv. punicae is one of the severe disease limiting crop yield and productivity thus, affecting the cultivation. In IIHR , Bangalore, attempts are being made to incorporate resistance to popular cultivars through plant breeding methods. 'Ganesh' is a popular variety (susceptible to bacterial blight disease) and 'Daru' which is a resistant genotypes are being used as parents in breeding programme. A total of 80 F_2 populations derived from a cross between 'Ganesh' and'Daru' were used to identify molecular markers linked with the resistant trait. A total of 41 molecular markers, including 40 RAPD and one ISSR markers were selected. These primers were then used to amplify segregating F_2 from cross `Ganesh x Daru` to develop a preliminary linkage map in Punica granatum L. using Haldane mapping function. In linkage analysis, 35 markers were mapped on 8linkage groups. The linkage map length varied from 3.3 cm to 39.8 cm. The map covered a total length of 146.3 cm with an average marker density of 24.38 cm between the two adjacent markers. The maximum number of markers, 8 was found on the linkage groups LG2 and LG6. This linkage map developed forms a basis for development of high density mapping in pomegranate. An attempt was also made to identify marker linked to resistance by following Bulk Segregant Analysis. The primer OPD11 amplified band of approximately 1kbp size in resistant bulk and resistant parent `Daru`.

Title: Development of seedless grape hybrids through Embryo rescue and confirmation of hybridity by Molecular markers (2009)

K.S.Bhaskara Reddy, UAS, Bangalore, Guide: Dr.Leela Sahijram

A study on development of seedless grape hybrids through embryo rescue and confirmation of hybridity by molecular markers was carried out with the objective of rescuing embryos in crosses involving Thompson seedless as the female parent and four downy mildew resistant lines (SV12309, SV23501, SV12364, SV18315) as the pollen parents, to identify hybrids resistant to downy mildew (fungal) pathogen Plasmopara viticola and to develop molecular markers for grape hybrids so generated. Using conventional breeding procedures, it is not possible to obtain hybrid progeny in grape crosses involving seedless (steno spermocarpic) female parents. Such crosses can, however, be salvaged using sequential embryo rescue and hybrids can be obtained. For culturing ovules, berries of various crosses were collected at 8, 9, 10 and 11 Weeks Post Pollination (WPP). Initiation of growth and maintenance of ovules was done on Emer and Ramming semi solid medium supplemented with case in hydrosylate($50 mgl^{-1}$)+Myoinositol (50 mg l^{-1}) + L- cysteine (211.6 mg l^{-1})+ morpholino ethane sulphonic acid(1000 mg l^{-1}). At 8 weeks from in vitro incubation, embryos were excised from ovules and sub-cultured on semi-solid Woody Plant Medium (WPM) supplemented with benzyl adenine (BA) @ 0.25 mg l^{-1}. In four to eight weeks, the embryos started germinating and subsequently developed into full-fledged plantlets in liquid medium. Hybrid plantlets were then transferred to poly bags containing soil rite (75% peat moss + 25% per lite). A total of 122 hybrid plantlets were recovered from 955 embryos sub-cultured (which were excised from 1698 cultured ovules).The true hybrid nature of these hybrids was confirmed by using ISSR (UBC-807,UBC-817,UBC-825,UBC-828) markers.

Title: Transformation of Pomegranate with Antimicrobial peptide gene to confer resistance against bacterial blight and testing its expression (2009)

Nungshi Lepdon, UAS, Bangalore, Guide: Dr.Sukhada Mohandas

Pomegranate is a popular fruit crops and is of considerable economic importance. The bacterial blight of pomegranate is becoming a serious problem in major pomegranate growing area in India. All conventional ways and means of controlling this disease have been failed. In pomegranate, existing protocols have shown slow response on regeneration and less works has been reported on transformation works. Hence, in the present study, a systematic investigation was carried to standardize an efficient in vitro regeneration protocol from different explants of pomegranate cv. Bhagwa, find out the best treatment for faster regeneration and transforming it with AMP gene. As a result, are liable and efficient regeneration and transformation protocol was standarised. Agrobacterium tumefaciens carrying gene p CAMBIA construct with the constitutive CaMV 35S promoter, AMP gene terminator and npt II selectable marker (Kanamyc in resistance),was used for transformation of explants. Putative transformants were identified on selection medium containing kanamycin at different concentration. Transgenic insertion and expression at various levels were confirmed using PCR. Out of four putative transformants analyzed, three transgenic plants showed PCR +ve with AMP gene specific primer.

Title: Development of transgenic Banana resistant to Fusarium wilt (2010)

S.Pavithra, UAS, Bangalore, Guide: Dr.Sukhada Mohandas

Banana is one of the most important fruit crop, especially of the tropics. Banana cultivation and production are threatened by many pests and diseases. By far the most serious disease is Fusarium wilt which is caused by the soil borne hypomycete, Fusarium oxysporumf. sp.cubense (Foc).It is a serious disease, causing devastation of two important cultivars namely Rasbale AAB (syn.Rasthali) and Elakkibale AB(syn.Neypoovan) in Southern India. In the present study transgenic plants of both cultivars were developed by transformation with the antimicrobial peptide (AMP) gene cloned from onion seeds and with constructs developed in p CAMBIA 2301. Apical meristems from in vitro micropropagated plantlets were micro wounded with naked gold particles, followed by co- cultivation with Agrobacterium with binary vector pCAMBIA 2301 having npt II (Neomycin phosphotransferase-II) as a selectable marker gene and AMP as a resistant gene. Transformants were rigorously selected on the selection medium(Genticin/G418 50 mg/l). The integration of AMP gene was confirmed by PCR and RT-PCR in cultivar Rasbale and by PCR technique in cultivar Elakkibale. Out of 11 putative transformants of Rasbale 4 transformants confirmed the integration of AMP gene by PCR and 2 by RT-PCR. In Elakkibale, out of 12 putative transformants 6 showed amplification of AMP gene by PCR analysis. Therefore, the method standardized in the present study can be successfully used for transformation of banana.

Title: Identification of Molecular markers linked to bacterial wilt in Brinjal (2010)

Subhada Pattanayak, UAS, Bangalore, Guide: Dr.C.Aswath

Eggplant is an important vegetable in India and is grown throughout the tropical, subtropical and warm temperate regions of the world. Bacterial wilt caused by Ralstonia solanacearum is a severe soil borne vascular disease commonly occurring in the warm, humid tropics. An investigation was conducted to identify molecular markers linked to bacterial wilt resistance in brinjal in the F_2 mapping population developed by cross between a bacterial wilt resistant variety IIHR-7 with susceptible variety IIHR-108. 255F_2 plants were phenotyped by artificial root infection with Ralstonia solanacearum L.(3:1) ratio of resistance susceptibility was observed in F_2 and the genetic ratio indicated the resistance trait controlled by a single dominant gene. 39 EST-SSRs, 119 genomic SSRs and100 RAPDs were used to genotype parents, F_2 population though bulk segregant analysis (BSA). 29 genomic SSRs and 17 RAPDs had shown polymorphism inparental lines and were further used to screen the mapping population. No polymorphism was observed in the F_2 population. Thus, no marker linked to bacterial wilt resistance in brinjal was identified in the present F_2 population under study. Further, linkage analyses are to be performed to identify the genomic SSRs and RAPDs using more primers that are linked to the resistance trait in a larger population and integrated into a molecular marker assisted breeding programme of egg plant to breed bacterial wilt resistant varieties.

Title: Genetic diversity analysis and DNA fingerprinting of Tuberose (*Polianthes tuberosa* L.) (2010)

Khandagale Kiran Shahaji, UAS, Bangalore, Guide: Dr.C.Aswath

Polianthes tuberosa, (2n = 30) which is native to Mexico, is one of the most important among the bulbous ornamental. Fifteen RAPD and twenty ISSR primers were used to assess genetic diversity among ten tuberose varieties. Both RAPD and ISSR primers revealed 53% and 73% polymorphism which generated 59 and 95 polymorphic markers respectively. Polymorphic Information Content (PIC) and Resolving Power for RAPD was found to be ranging from 0.35 – 0.46; 0.8 –3.6 respectively and that of ISSR was 0.36 –0.49; 0.91 – 4.55 respectively. The dendrogram generated by UPGMA methodology using Jaccards co-efficient as distance matrix for RAPD and ISSR grouped the varieties into two major clusters and combined RAPD – ISSR cluster analysis grouped the 10 cultivars into3 major clusters, which have been further grouped into sub-clusters based on their genetic relatedness/variation. The results of spatial arrangement of these 10cultivars by Principal Component Analysis (PCA) using NTSys pc software were in congruent with earlier dendrogram analysis. Mantel's test indicated very good correlation with r = 0.86 for the combination of ISSR and RAPD-ISSR. To facilitate identification of tuberose cultivars, we developed a cultivar identification diagram (CID) in which seven ISSR loci can differentiate all ten cultivars taken in the study. Molecular fingerprints for five IIHR released cultivars using 57 polymorphic loci generated by 11 ISSR primers. The sizes of these loci were ranging from 2.2kb to 252bp. These fingerprints can be used as standard reference source for quick cultivar identification.

Title: Induction of somatic embryogeny activity in Pomegranate (*Punica granatum* L.) cultures of mature origin (2010)

A.S.Harsha, UAS, Bangalore, Guide: Dr.Leela Sahijram

A study on including somatic embryogenic activity in pomegranate was carried out byu singexplantsofmatureoriginviz.,petal,leafandanthers/stamensandmolecularprofiling of the embryogenic callus issued from these explants was carried out by using RAPD markers with an objective to developing standardized protocol for regeneration of pomegranate, to develop cultivars resistant to bacterial blight pathogen(Xanthomonas axonopodis pv. Punicae). Using conventional breeding procedures, it is difficult to develop resistant cultivars due to time and space constraint. Hence, somatic embryogenesis offers viable protocols since it produces both root and shoots meristems necessary for complete plant growth. For inducing somatic embryos, explants of field origin were collected. Initiation of growth and maintenance of explants was done on MS and WPM semi-solid media. Callus initiation was seen after 3 and 8 weeks of inoculation from petal and leaf explants respectively and somatic embryos were obtained. Response of anthers/stamens was seen positively which produced embryogenic callus. Shoot apex formation was seen from petal and leaf derived embryogenic callus 22 weeks of inoculation. Callus issued from petal and anther was subjected for RAPD marker analysis.12 different primers OPG03, OPG-05O, PG-08O, PG-13, OPG- 16, OPG-18, OPI-01, OPI-03, OPI-10, OPI-12, OPI-14 and-18 screened revealed clear amplification between petal derived and another derived callus from which it was strongly believed that the another derived callus is of sporophvtic origin.

Title: Identification of DNA Marker Linked to Rus Resistance in French Bean (*Phaseolus vulgaris* L) (2010)

S.Soumya, UAS, Bangalore, Guide: Dr.K.V.Ravishankar

French bean is one of the most important leguminous vegetables grown for its tender pods either for fresh consumption or for processing as canned, frozen dried product. Diseases are one of the most important production constraints for the successful cultivation of beans. Among diseases, rust caused by Uromyces appendiculatus has become epidemic in bean growing areas. In this study, the investigation was carried out using three resistant(IIHR-79, IIHR-31 and Arka Anoop) and two susceptible (IIHR-55 and Arka Suvidha) parents along with F_2 segregants from cross IIHR-31 x IIHR-55, to identify marker linked to rust resistance. A total of ten SCAR primers available from literature (SK14, SA14, SI19, SBC6, SAD12, SAE19, UR11-GT2, KB126, SF10 and SBA8) were used for screening for contrasting parents. Out of ten selected SCAR markers, three viz.,. SA14, SK14 and SF10 showed polymorphism between resistant and susceptible parents. For markers, $SA14_{800}$ and $SK14_{620}$ polymorphic band was observed between resistant parent IIHR-31 and susceptible parents (IIHR 55 and Arka Suvidha). Whereas, for the marker SF10 1072 polymorphic band was observed between resistant parent IIHR-79 and susceptible parents (IIHR 55 and Arka Suvidha). Identified markers $SA14_{800}$ and $SK14_{620}$were again validated in segregated population of F_2 cross IIHR-31 x IIHR-55 by BSA method. Simultaneously, 350 RAPD markers were screened for polymorphism for rust resistance. Out of 350 markers, OPA041150 marker showed distinct polymorphism for rust resistance in bulks of F_2 segregants. But, the attempt made to convert it into a SCAR marker was not successful.

Title: Development of Molecular Marker for Pulp Colour in Guava (*Psidium guajava* L.) (2010)

Sheetal Nandgav, UAS,Bangalore, Guide:Dr.Pious Thomas

Guava (Psidium guajava L.) is a highly heterozygous perennial fruit tree with a long juvenile phase which comes in the way of crop improvement through breeding. Molecular markers provide a tool for early assessment of desired traits allowing considerable saving in time. Pink pulp colour in guava is a preferred trait over white colour which is imparted by lycopene.This study was taken up with the objective of developing molecular marker(s) for pink pulp colour in guava through PCR based approaches namely Random Amplified Polymorphic DNA (RAPD) and Inter Simple Sequence Repeat (ISSR) and the candidate lycopene gene sequence based-approach. In all, 64 RAPD primers were used in order to identify polymorphismthatspecificallytopink-pulpgenotypes.Thetwogenotypes each from white-pulp and two pink-pulp types were taken up for the initial biparental RAPD screening. The primers OPB 5, OPB 9, OPC 8 and OPH 9 yielded consistent results in repeated trials allowing the identification of white/pink pulp colour types. Twenty ISSR primers were employed in biparental screening of which one primerUBC818 showed a polymorphic band. A set of 20 additional genotypes including 10 from red and 10 from white-pulp categories were used for validation of the short-listed RAPD primers and ISSR primer. The polymorphic bands did not seem working across all the genotypes of one or the other pulp category. In the candidate gene approach, three pairs of lycopene-gene targeting degenerate primers were designed using the lycopene cyclase gene sequence information. Among the nine primer combinations tried, four of them (FP1/RP1, FP1/RP2, FP2/ RP2 and FP3/RP1) yielded some polymorphic bands which proved promising for further detailed analysis.

Title: Stable integration and expression of chitinase in Transgenic Tomato (2010)

Shailesh Yadav,UAS, Bangalore, Guide:Dr.J.B.Mythili

Tomato is an important vegetable crop and various fungal diseases cause extensive yield losses. Conventional breeding for resistance to fungal diseases has met with limited success. Therefore transformation of crop plants with gene encoding pathogen cell wall degrading enzyme chitinase has been tried in various crops. The present study was carried out to identify homozygous line with stable and high transgene expression from primary transformants of tomato cv.Arka Vikas engineered with Trichoder maharzianum chitinase gene. 139 plants progenies of different 12 T_0 lines were screened by using both the partial length and full length gene specific primer of T.harzianum chitinase gene. 15T_1 plants were shortlisted based on PDI, plant morphology, similarity to parent phenotype and visual disease symptoms and vigour for forwarding to T_2 generation. 20-25 seedlings of each individual T_1 line was raised and analysed for the presence of transgene. The Progeny of twoT_1homozygous lines viz., N3-5 and N8-4did not segregate for the transgene in PCR analysis suggesting that they are homozygous lines. Gene expression analysis for chitinase was carried out in randomly chosen 2-3 plants from the progeny of two T_1 homozygous lines N3-5 and N8-4 and one T_1 heterozygous line N13-1 along with control through relative RT PCR(Multiplex RT PCR) using a 18 S as internal control. The chitinase gene expression in plants of two homozygous lines was 2.5 to 4.0 X more than that of hemizygous lines. The homozygous lines were also screened for disease expression by in vitro leaf bioassay as well as challenge in ovulation with Alternaria solani. Disease incidence in the leaves in the form of leaf spot was less evere in homozygous transgenic line than control.

Title: Development of transgenic Tomato with Polygalacturonase inhibitor protein gene constructs for Fungal resistance (2011)

Chidanand Ullagaddi, UAS, Bangalore, Guide:Dr.J.B.Mythili

Tomato is one of the most widely grown vegetable in the world. However, great yield losses are reported due to various fungal diseases. In this study, polygalacturonase inhibiter protein (PGIP) has been identified as a suitable candidate for development of transgenics resistant to fungal diseases. PGIP acts by interfering with the metabolism of the pathogen and thus disable the ability of the pathogens to gain entry into the plant. Tomato cv. Arka Vikas was transformed with PGIP gene (derived from chilli) constructs in two different orientation for resistance to fungal pathogens especially Alternaria solani. In the first orientation, the transcription of PGIP gene and nptII gene were in opposite direction, while in orientation II, the transcription of PGIP gene and nptII gene were in the same direction. Differential response of the explants to the PGIP gene orientation was observed with higher(15.3%) regeneration of putative transformants upon transformation with PGIP(orientation II) as compared to(7.1%) putative transformants with PGIP(orientation I). The presence of transgene was confirmed through PCR and RT-PCR of PGIP gene. Preliminary results of in vitro bioassay for expression of resistance to A. solani did not reveal any significant difference in the expression between controls (untransformed) and transformed plants with PGIP gene. In another study the role of PGIP gene on improving the regeneration frequency was investigated by comparing transformation with PGIP gene with transformation withTrichoderma harzianum(Th) chitinase gene construct along with p CAMBIA 2300 vector with nptII gene (control vector).The results of the experiment revealed that transformation with PGIP gene construct resulted in highest(65.9%) of explants giving rise to shoot initiation, followed by transformation with control vector with (40.0%) explants giving rise to shoot initiation and the least (15.0%) responding explants was obtained upon transformation with Th chitinase gene construct.

Title: Studies on Somatic embryogenesis in Papaya cv. Surya with reference to Endophytic Bacteria (2011)

Prabir Kumar Das, UAS, Bangalore, Guide:Dr. Pious Thomas

Papaya (Carica papaya L.) is an important fruit crop world over. Micro propagation of shoot buds approach has not been very successful for commercial propagation purpose. Feasibility of somatic embryogenesis from immature zygotic embryos is also suggested in papaya. A protocol has now been optimized for somatic embryogenesis from immature zygotic embryos of papaya cv. Surya. Immature zygotic embryos were established on half-strength MS medium with supplements (MS vitamins,6 percent sucrose,10mg l^{-1}2,4-D, 400 mg l^{-1} glutamine and 0.8 per cent agar (pH 5.7) giving high frequency and repetitive embryogenesis after3-4 sub culture passages. Continuous proliferation of somatic embryos was achieved on maturation and regeneration medium containing half-strength MS constituents,3 percent sucrose, 400 mgl^{-1}glutamine,0.2 mgl^{-1}BAP and 0.1mg l^{-1} NAA and 0.8 per cent agar. Medium containing a combination of 0.5 mg l^{-1} IAA and 0.5 mg l^{-1} IBA was ideal for root development. Endophytes are generally known to originate from the rhizosphere or phyllosphere and seeds are generally considered to be free from endophytes.Tissue and medium indexing on visibly clean embryogenic cultures initiated from immature seeds showed the association of cultivable bacteria in as mall section (1.4 per cent) of cultures after three subculture passages. One bacterium was isolated from such cultures, which is identified as Brachybacterium rhamnosum based on 16S rRNA gene sequence homology analysis. PCR-screening of visibly clean and index negative cultures using universal bacterial 16S rRNA gene primers indicated the presence of non-cultivable bacteria in index-negative cultures. This was confirmed by microscopy of tissue homogenate revealing viable bacteria in considerable number.

Title: Development of Transgenic Pomegranate cv. Bhagwa for Bacterial blight (2011)

H.G.Swetha, UAS, Bangalore, Guide: Dr.Sukhada Mohandas

Pomegranate is an economically important species of the tropical and subtropical regions of the world, due to its delicious edible fruits, pharmaceutical and ornamental usage. Pomegranate cultivation and production are threatened by many pests and diseases. By far the most serious disease is bacterial blight which is caused by the air borne bacteria Xanthomonas axanopodis pv.punicae. It is a serious disease, causing devastation in the pomegranate growing areas. In the present study transgenic pomegranate plants of variety Bhagwa were developed by transformation with the antimicrobial peptide (AMP) gene cloned from onion seeds and with constructs developed in p CAMBIA 2301. Explants like nodes, leaf, petals and cotyledons from poly house were micropropagated in different combination of hormones and the invitro plantlets were co-cultivated with Agrobacterium with binary vector p CAMBIA 2301 having npt II (Neomycin phosphotransferase-II) as a selectable marker gene and AMP as a resistant gene. Transformants were rigorously selected on the selection medium (kanamycin 100 mg/l).The integration of AMP gene was confirmed by PCR. Out of 4 putative transformants 3transformants confirmed the integration of AMP gene by PCR. In nodes, out of 2 putative transformants 1 showed amplification of AMP gene by PCR analysis. Therefore, the method standardized in the present study can be successfully used for transformation of Pomegranate.

Title: Co-transformation of Tomato cv. Arka Vikas with chitinase and Pgip genes for enhanced resistance to early and late blight pathogens (2012)

C.Guru prasad, UAS, Bangalore, Guide: Dr.J.B.Mythili

Tomato is one of the most widely grown vegetable in the world. Diseases are important economic factors limiting its production. Tomato is a host to many of the diseases and is majorly affected by blights (early and late) caused by Alternaria solani and Phytophthora infestans respectively. Genetic engineering approach to develop fungal resistant tomato using a single antifungal gene has met with limited success. Therefore, multiple gene transfer approach through co-transformation of two antifungal lgenes viz., polygalacturonase inhibiter protein(PGIP) and chitinase with different mode of action has been used in this study as a powerful approach to enhance the fungal disease resistance in tomato in compares on to transformants obtained with either PGIP or chitinase gene. Three different gene constructs were used in this study viz.,pCAMBIA2300 containing PGIP gene isolated from chilli along with npt II gene as selectable marker, Chitinase gene isolated from Trichoderma harzianum in pBIN and p CAMBIA vector with npt II and hpt II gene as selectable marker respectively. Transformation with single gene (either chitinase or PGIP) gave rise to significantly higher transformation efficiency of 20% and 80% respectively as compared to co-transformation with both the genes which gave a co-transformation efficiency of 6.2%. Out of 16 co-transfromants regenerated, 7 and 1 plants tested positive for the presence of PGIP and chitinase gene respectively and 1 plant tested positive for both the genes. Transformants were obtained only when the gene constructs were used with npt II as a selectable marker, Selection with hygromycin adversely affected the regeneration of transformants. In vitro bioassay against early and late blight pathogens were carried out only for transgenic plants with single gene and not for the co-transformants. Transgenic plants with single gene (chitinase or PGIP) have shown resistance against early and late blight pathogens.

Title: development of transgenic Pomegranate with disease resistant gene for control of Bacterial blight (2012)

M.H. Akshata, UAS, Bangalore, Guide: Dr.Sukhada Mohandas

Pomegranate (Punica granatum L.) is an economically important species of the tropical and subtropical regions of the world due to its delicious edible fruits, pharmaceutical and ornamental usage. The bacterial blight of pomegranate is becoming a burning problem in major pomegranate growing areas in India. As the causal organism is air borne, the conventional ways and means of controlling this disease have failed. Evolving a resistant genotype using resistant variety through conventional breeding may be a way out but it is a time consuming process. Transgenic approach appears to be promising to minimize the losses caused by disease. In the present investigation efficient protocols were developed to get healthy and well-formed plants from juvenile and mature-origin explants of the pomegranate cv.'Bhagwa' and transformants with PFLP gene. Different treatment combinations of hormonal concentrations were taken for leaf, petal, nodes and cotyledonary explants to standardize an efficient in vitro regeneration protocol and find out the best treatment for faster regeneration. Agrobacterium tumefaciens carrying gene p CAMBIA construct with the constitutive CaMV 35S promoter, PFLP gene, terminator and npt II selectable marker (Kanamycin resistance), was used for transformation of explants. Putative transformants were identified on selection medium containing kanamycin at different concentration. Integration of transgene and expression at various levels were confirmed using PCR. Out of 4 putative transformants analyzed, 3 plants showed amplification for PFLP gene specific primer and further screening is going on using different molecular techniques.

Plant Pathology

Title : Molecular diagnosis of Citrus greening bacterium (2002)

P.Kamesh Babu, UAS, Bangalore, Guide : Dr.M.Krishna Reddy

The investigations on Citrus greening disease indicated that survey based on symptoms indicated 38.5 to 63.7% disease incidence in Andhra Pradesh and 20.0 to 86.7% incidence in Karnataka. The graft transmission experiments using greening affected scion material from Sweet Orange, Coorg Mandarin and Lime indicated that grafting successfully transmitted greening disease. In the case of Rangapur Lime rootstock 100% transmission was observed, with different scion materials, whereas 50 to 100% transmission was observed when Acid Lime, Troyer Citrange, Cleopatra Mandarin and Rough Lemon were used as rootstocks. In the grafted plants, symptoms appeared 7 to 9 weeks after grafting. Collecting psyllids, feeding on infected plants and transferring them onto susceptible plants successfully transmitted greening bacterium. Hundred percent transmission was achieved when more than 5 psyllids per plant were released and symptoms appeared after 2 to 4 months. Positive results were obtained from the DNA isolated from grafted plant samples and psyllids when subjected to PCR amplification. Among the bark, midrib and leaf lamina tested for the quality DNA for PCR analysis for CGB, bark tissue was found to be the best source for quality DNA followed by midrib. Even though DNA was successfully isolated from leaf lamina, it was not amplified when subjected to PCR analysis for CGB. This may be due to lack of phloem tissue in lamina as the CGB resides in phloem tissue. Among the fresh tissue and shade-dried tissues tested for quality DNA, the fresh tissue samples are found to be the best source. For PCR amplification, rDNA primers specific- to rDNA region successfully amplified 1.2 kb DNA fragment from CGB infected plant material, but not from healthy citrus plants or water as template indicating the specificity of the primers. Positive amplification of PCR confirming the presence of CGB was obtained in Coorg Mandarin, Rangapur Lime, Sweet Orange. Kinnow Mandarin, Acid Lime, Seedless Lime and Rough Lemon.

Title : Identification and diagnosis of chilli veinal mottle potyvirus (CVMV) infecting hot pepper (*Capsicum annuum* L.) (2003)

H.M.Kantharaju, UAS, Bangalore, Guide : Dr.M.Krishna Reddy

Chilli Veinal Mottle Potyvirus (ChiVMV) is an important virus disease of chilli pepper in India. The virus produced initial symptoms of mosaic mottling on young leaves 10 days after inoculation followed by characteristic vein banding, reduction in leaf size, cupping in leaves and leaf distortion. Host range studies of ChiVMV revealed that only Plant species belonging to family Solanaceae (9 species out of 16 species of Solanaceae) were susceptible. Hosts, which took systemic infection, are Capsicum annuum L. cvs. Arka Lohit and California wonder, Datura metel, Nicotiana glutinosa L. Nicotiana tabaccum L. cvs. Bhavya and Gold line. One plant that found to be local lesion host is Nicotiana tabaccum L. cv. Hartensis. The ultra thin section of infected tissues revealed the presence of cytoplasmic cylindrical inclusions as pinwheels and short curved inclusion bodies typical of potyvirus group. ChiVMV was successfully purified from systemically infected Datura metel L. leaves 3-4 weeks after inoculation. First the virus was extracted using 0.02 M HEPES buffer (pH 7.5) containing mercaptoethanol, sodium diethyl dithiocarbamate, triton X-100 and urea. The virus was finally concentrated by sucrose density and differential centrifugation in HEPES resuspension buffer (pH 7.5) containing sodium sulfite and urea. The UV absorption spectrum of purified preparations of ChiVMV showed typical nucleoprotein pattern with a maximum and minimum absorbance at 260 nm and 240 nm respectively. The A260/2s0 ratios measured from several purified preparations were in the range of 1. 110 1 to 1.2101 and the virus yield estimated was 1.0 to 1.2 mg/100 of leaf tissue. Electron microscopy of the purified preparation of ChiVMV after negative staining with 2 per cent uranyl acetate revealed the presence of numerous virus particles which were flexuous rods measuring about 640 to 700 nm long, 12 nm in diameter indicating the relationship of virus under study belonging to potyvirus group. SDS Polyacrylamide gel electrophoresis of the purified preparation of ChiVMV coat protein on 12 per cent SDS gel revealed the presence of a band with an approximate molecular weight of 35000 daltons in freshly purified virus. A direct antigen coating ELISA (DAC-ELISA) and Dot Immuno Binding Assay (OIBA) were standardized and successfully used to detect virus and identify resistant and susceptible lines.

Title: Development of safe, effective and eco-friend (Pasteurization L.) techniques (2004)

Saritha, S.K.University,Andhra Pradesh, Guide : Dr.Meera Pandey

Steam and hot water are the best methods for substrate pasteurization for oyster mushroom cultivation by chemical pasteurization and solarisation although prevented contamination, the yield was reduced. This could be due to the fact that the straw in these treatments was not soft enough (cooked) for obtaining better nutrition by the mushroom mycelium. The average yield of the oyster mushrooms in chemical pasteurization was reduced by 55% and with solarisation the average yield is reduced by 75% when compared to Hot water treatment. Heat was found to be best method for killing the contaminants on the straw as compared to chemicals. Therefore, Hot water (or) steam pasteurization can still be the best recommendation for substrate pasteurization for oyster mushroom cultivation

Title : Molecular characterization of chilli veinal mottle virus infecting Chilli (*Capsicum annuum* L.) (2006)

C.Laxminarayana Reddy, UAS, Bangalore, Guide : Dr.M.Krishna Reddy

Chili Veinal Mottle Virus (ChVMV) disease is emerging as major constraint in the production of chilli pepper (Capsicum annuum L.) in India and many other Asian countries. This is the first attempt in India and elsewhere in the world to study the molecular characterization and variability of ChVMV isolates. The survey results revealed the presence of ChVMV in all chilli Karnataka, Maharashtra, Andhra Pradesh, Tamil Nadu and Kerala and the incidence ranged from Zero to 87.9 per cent. A survey was undertaken in chilli growing areas of Southern India for the ChVMV incidence, the virus was confirmed by DAC-ELISA. Biological differentiation of the 30 ChVMV isolates was carried out on 32 different host plants, indicating the similar type of reaction to the test plants with all the isolates. The Immunological differentiation of the ChVMV isolates were observed by performing ELISA by using ChVMV, PVBV, PVMV, PVY antisera. In the dot immuno assay, all the isolates showed positive reaction to the ChVMV polyclonal antisera. SDS-PAGE, RNA blot using the synthesized probe and Western blot were standardized for the detection of ChVMV and used for differentiation of isolates. All the above studies confirmed that the isolates were closely related. Analysis of 30 ChVMV isolates sequences revealed that the coat protein region is highly conserved and variation is present in the Nib region among the isolates. Further, the conserved regions present in the potyvirus genus were observed in all the isolates. The Phylogenetic analysis of ChVMV isolates along with the of the members of family Potyvirdae revealed that these isolates are distinct from other viruses by forming a separate cluster. The ChVMV isolates were classified into five strainal groups based on the phylogenetic analysis and identity matrices of both nucleotide and deduced amino acid sequences which exhibit more than 5 per cent variation at nucleotide level and more than 3 per cent variation at amino acid level. The partial NIb region, complete coat protein region and 3' UTR of 30 ChVMV isolates were sequenced. The comparison and phylogenetic analysis of ChVMV isolates nucleotide and deduced amino acid sequences with the other members of Potyviruses and Potyviridae revealed that the ChVMV isolates were distinct from all other viruses. The comparison and phylogenetic analysis among the ChVMV isolates indicated five groups, which may be considered as distinct strains as they exhibit more than five per cent variation at the nucleotide as well as more than three per cent at the amino acid levels. Screening of 87 chilli lines to ChVMV revealed that, 44 were immune, four highly resistant, four resistant, 14 moderately resistant, three susceptible and 18 highly susceptible. Resistant source in chilli against ChVMV was identified by screening 84 germplasm lines using AUSPC (Area Under Symptom Progress Curve) criteria and utilized in the breeding programme.

Title: Development of sporeless/low spore shedding strains of Pleurotus species (2006)

Sandhya Ravishankar, Kuvempu University, Shimoga, Guide : Dr.Meera Pandey

Di-mon matings were carried out between monokaryons of commercial Pleurotus species (P.florida and P.sajor-caju) with dikaryotic mycelia of natural sporeless mutant (Psm) yielded 16 (P.florida x Psm) and 18 (P.sajor-caju x Psm) hybrids. Exposure of spore suspension of commercial Pleurotus species (P.florida and P. sajor-caju) to Ultra violet radiation for variable timings resulted in yielding few mutants. The mutant obtained from exposure of spore suspension of P. sajor-caju exhibited sporelessness (low sporing character) with good morphology. The stability of the low sporing character was maintained even after 40^{th} generation. It proved the mutation obtained was permanent. Gill sections of low sporing UV mutant along with its parent P.sajor-caju and commercial species P. florida and sporeless mutant (Psm) observed under microscope, showed P. sajor-caju and P. florida more spore intensity. Low sporing UV mutant showed lower biological efficiency of 52.67%. Natural sporeless mutant (Psm) showed highest biological efficiency of 70.93%. The shelf life of sporophores of commercial Pleurotus sajor-caju and sporeless strains (Psm and low sporing UV mutant) in pp covers at room temperature was 2 days as compared to only one day in 1.33% ventilation pp cover, commercial perforated cover, pp covers lined with brown paper and air tight container. Under cold storage condition (4 ºC) UV mutant and Psm showed 14 days extended shelf life compared to 11 days in Pleurotus florida and 13 days in Pleurotus sajor-caju. As the ventilation increased number of storage days also reduced. The present studies on dehydration of commercial Pleurotus species and two sporeless strains were carried out at room temperature (28-32 ºC) and drier (40 ºC). It took 2-3 days for optimal drying (8- 10% moisture) at room temperature as against 5-6 hours in drier for both commercial. Pleurotus and two sporeless strains. RAPD analysis was carried out with random primers to know the polymorphism between the species and strains. The cluster analysis of RAPD markers showed two groups. In first group P. florida and Psm were closely related with 43% similarity, which also reflected in distance measure. Even though P. florida and Psm were closely related, morphological characters of both strains were different. P. florida have white sporophores with high spore content. Whereas Psm have light gray funnel shaped sporophores with no spores. In second group P.sajor- caju and UV mutant were closely related with 64% similarity. However sporophore morphology of both the strains was similar to certain extant. P.sajor-caju having gray sporophores with eccentric stipe and slight wavy margin with high spore content. Whereas UV mutant showed highly lobed (flower type) sporophores with very less spore content. Thus, RFLP and RAPD analysis found to be a suitable technique for observing the polymorphism between the strains.

Title: Molecular characterization of bhendi yellow vein mosaic virus (2008)

V.Venkataravanappa, UAS, Bangalore, Guide : Dr.M.Krishna Reddy

Bhendi yellow vein mosaic virus (BYVMV) is one of the most sever disease which take a heavy toll in India. The highest disease incidence was recorded in the districts of Gulbarga (75.0%) and least is in Bangalore rural (44.01%). BYVMV was successfully purified from the systemically infected okra leaves using the modified procedure with addition of sucrose gradient. SDS-PAGE analysis and western blotting of the purified preparation resulted in the presence of band with an approximate molecular weight of 28000 Daltones, which is expected monomeric size of BYVMV coat protein. The direct antigen coating ELISA (DAC-ELISA) was standardized and successfully used to detect virus using polyclonal antibody raised against ACMV and goat anti-mouse IgG-alkaline phosphatase conjugate.Dot immuno binding Assay (DIBA) was standardized and successfully used todetect virus using polyclonal antibody raised against ACMV. Dot blot hybridization was standardized using diagoxigenin labeled probes.The complete nucleotide sequence of 113 isolates has 84 to 100% similarity among themselves. Ten groups are formed in phylogenetic grouping that have sequence identity of less than 89% with other reported begomoviruses.These are Bhendi yellow vein Haryana virus (BYVHV), Bhendi yellow vein Guntur virus (BYVGV), Bhendi yellow vein India virus (BYVIV), Bhendi yellow vein Kamataka Virus (BYVKV), Okra leaf curl India virus (OKLCIV). Bhendi Yellow Vein Kerala Virus (BYVKV), Bhendi Yellow Vein Delhi Virus (BYVDV), Bhendi Yellow Vein Trichy Virus (BYVTV), Bhendi Yellow Vein Bhubaneswar Virus (BYVBV), Okra Enation Leaf Curl Virus (OELCV). Most of isolates of BYVMV showed high percentage of nucleotide sequence and amino acid identity with in ORFs AVl, AV2, ACI AC2 AC3, AC4, AC5 and intergenic region with BYVMV.NOL751, BYVMV-Madurai, OYVMV, BYVMV-Pak301, CLCuVA and (CLCuMV-(Okra] and some isolates showing the nucleotide sequence and amino acid identity ToLCNDV-A VT. The complete nucleotide sequence of 7 isolates has 84 to 100% similarity among themselves lead to form four groups which are associated with okra yellow vein mosaic disease .The full length of 36 isolates Beta DNA molecules ranging in size from 1324 to l403nt in length the sequence of these presumed full length DNA ~ molecules have these conserved features an A-rich region, a satellite conserved region (SCR), and a single open reading frame (putative coding region of gene C 1). The complete nucleotide sequence of 36 Beta DNA molecule revealed the occurrence of four types of Beta DNA molecules were present among the isolates viz., Bhendi yellow vein beta satellite (BYVB), okra leaf curl betasatellite (OLCuB), Ludwigia leaf distortion betsatellite (LuLDB), Croton yellow vein mosaic beta satellite (CroYVMB) and these may are associated with BYVMV. 57 different genotypes were screened for BYVMV under glasshouse and 29 different genotypes under natural conditions. None of genotypes tested was highly resistant or immune. Only 3 genotypes showing resistant reaction, 3 genotypes showing moderately resistant.

Title: Morpho-cultural characterization of indigenous Pleurotus isolates (2008)

A.Yasotha, Bharathiar University, Coimbatore, Guide : Dr.Meera Pandey

Pleurotus species is a promising mushroom form a group of edible species. Mushroom varieties are at present hard to protect since they are mainly characterized by variable fruit body and yield characteristics. It seems to be morphologically different and is taxonomically discrete. They are greatly influenced by environmental factors. In the present study, six isolates from different geographical regions, Bangalore, Shimoga, Madurai, Udaipur and Banswara (Rajasthan) were studied. All the six isolates showed high degree of variability in terms of colony morphology, media, temperature, mycelial characters and spore production. Pleurotus djamor grew faster than the other Pleurotus species at 25 ºC. Linear growth of mycelium was observed in all the region isolates. The two isolates, P. cystidiosus showed a different kind of growth which produced black heads of coremia on MEA, SSM and RC. Pinkish pigment in the mycelia of P. djamor was produced on MEA, PCA and SSM, which is a characteristic observation. Influence of temperature on the growth of isolates showed variability based on geographical regions. Bangalore isolates showed an optimum of 25 ºC, Shimoga, Madurai and Udaipur isolates of 30 ºC and Banswara (Rajasthan) isolate showed optima of 40 ºC suggesting the existence of variability. Out of six isolates, Bangalore and Udaipur showed a high degree of variability in mycelial thickness in both skeletal and generative hyphal system. There exists variability in the kind of hyphal system also. Bangalore, Shimoga and Udaipur isolates showed Dimitic hyphae, whereas Madurai showed monomitic hyphae. But Banaswara isolate showed trimitic hyphae, which is only showed the existence of variability in all study. Basidiospore and asexual spore characters are considered an important character for species identification. They are similar in structure but size varied. Only P. cystidiosus produced the asexual spore, which is used to distinguish from the other Pleurotus sp. Morphological studies are also used to determine the species. In this, only P. cystidiosus and P. djamor showed a different morphology that is P. cystidiosus showed very large fruiting bodies exists in a single and blackish brown in colour, whereas P. djamor showed pink colour fruiting bodies.

Title: Development of recombinant protein based diagnosis for chilli Veinal mottle virus infecting Chilli (2010)

M.J.Pavankumar, UAS, Bangalore, Guide : Dr.M.Krishna Reddy

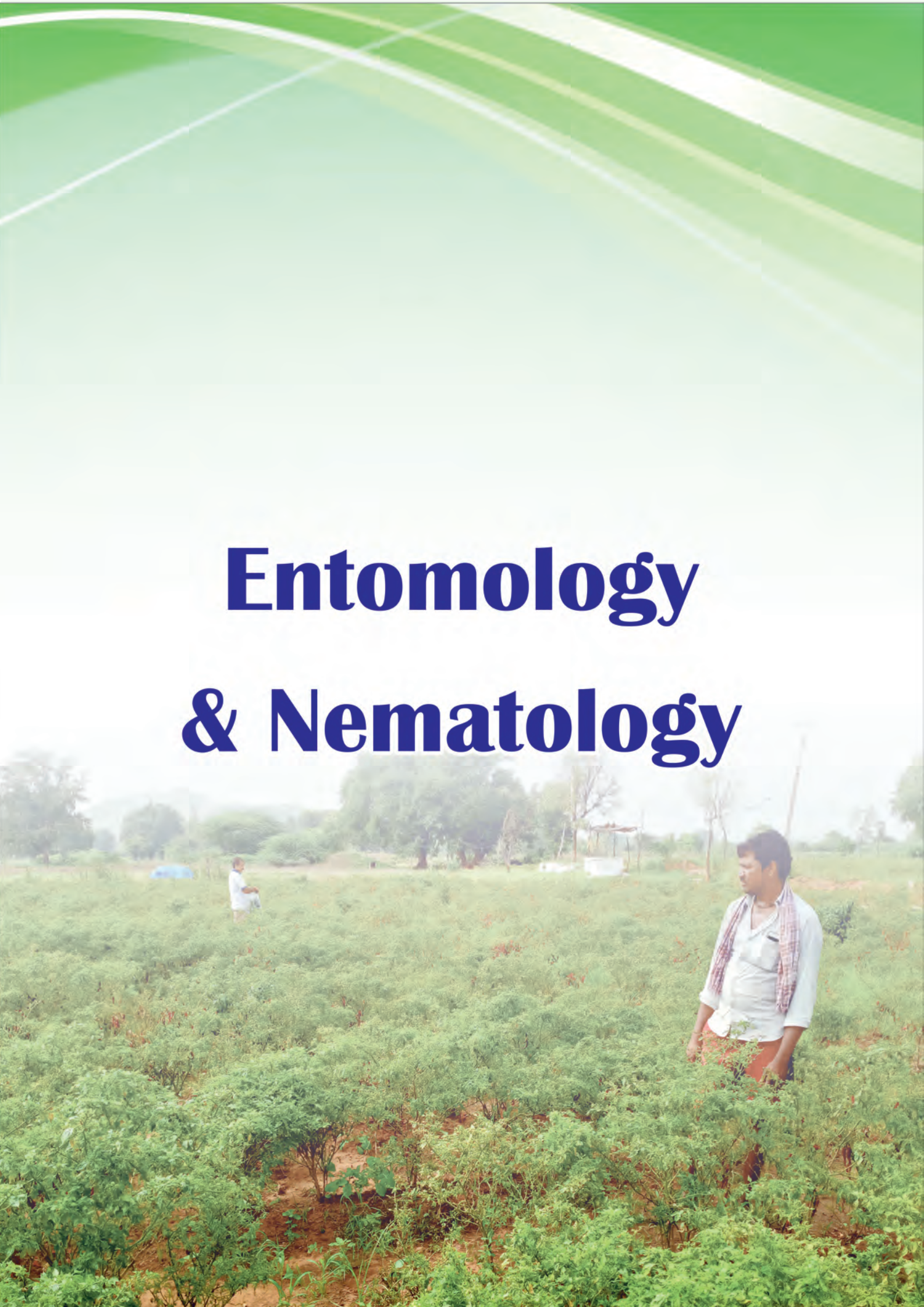
Chilli veinal mottle virus (ChiVMV) is a positive sense single stranded RNA virus, with monopartite genome belongs to genus potyvirus of family potyviridae. In this study, specific rabbit polyclonal antibodies against bacterially expressed coat protein of Chilli veinal mottle virus (ChiVMV, genus Potyvirus) were produced using a recombinant DNA approach. The ChiVMV coat protein (CP) gene was cloned in an expression vector pET- 15b (Novagen). Expression of the CP with an N-terminal hexahistidine tag in Escherichia coli BL 21 DE3 cells was induced by adding isopropyl-3-D-1- thiogalactoside (IPTG) to a final concentration of 250 µM. About 4 mg of bacterially expressed CP was purified from 500ml of bacterial liquid culture using a Ni-NTA resin column (Qiagen). The expressed CP which migrated as a protein of approximately 34 kDa in SDS-PAGE was identified by its strong reaction with polyclonal antibodies produced against ChiVMV purified particles in Western blots. Expressed and purified CP (SDS-PAGE 34 kDa band) was injected into a white female New Zealand rabbit, approximately 3 month old, four times at weekly intervals by intramuscular injections. The antiserum produced was evaluated for ChiVMV detection in DAC-ELISA. The antiserum raised against the expressed CP (ChiVMV) gave strong ChiVMV specific DAC-ELISA reactions and very weak background reactions with non- infected tissues. Three ChiVMV ELISA-positive samples of chilli, were also confirmed by reverse transcription (RT)-PCR and sequencing. The expected 1.2-kb viral cDNA was amplified from all three samples using ChVMV CPF/CPR primers. Excluding the 3′ poly- A tail, was 1,147 nucleotides (nt) long, comprising the 3′-terminal of the coat protein region (1 to 861 nt), and the 3′- untranslated region (865 to 1,147nt). Comparison of the Coat protein gene sequence with corresponding sequences of potyviruses in GenBank revealed that ChiVMV. Tomato had greatest nucleotide (90.3 to 93.8%) and amino acid (91.6 to 97.2%) identity with pepper isolates of ChiVMV from India, Where as it shared 90.2 to 93.0% nucleotide and 93.7 to 96.1% amino acid identity with ChiVMV isolates from China, Indonesia, Taiwan, Thailand and Vietnam.

Title: Diversity in Colletotrichum spp. infecting tropical fruit crops in Andhra Pradesh and southern Karnataka (2021)

Durga Venkata Ravi Teja Amulothu, Dr. YSRHU, AP, Guide : Dr. S Sriram

Carbendazim belonging to benzimidazole group of fungicides is one of the most widely used fungicides for the management of various soil borne and foliar pathogens. Resistance in Fusarium species against carbendazim has increased because of its specific mode of action (i.e.) binding with β -tubulin proteins and disrupting the mitotic cell division. Forty-two Fusarium speciesisolated from horticultural crops were tested for resistance to carbendazim and other benzimidazole fungicides.Ten isolates were tolerant to carbendazim even at 5000 ppm. These resistant isolates were from ornamental crops viz. carnation (7), marigold (1) and gladiolus (2). In 7 isolates there was cross resistance to benomyl and thiabendazole. Occurrence of multiple resistance to fungicides in Fusarium species was observed in many isolates with tolerance to different fungicides viz., copper oxychloride (9), tebuconazole (2), bitertanol (2), mancozeb (2), azoxystrobin (1), tebuconazole (1) and propiconazole (1) up to 5000 ppm concentration. However, all isolates were sensitive to captan, pyraclostrobin and chlorothalonil. The mechanism of carbendazim resistance in Fusarium resistant isolates was examined to find point mutations in β-tubulin gene. Point mutation from leucine to threonine at codons L240T, L246T, L250T, L253T, L263T, L273T, L289T and L311T was observed in all resistant isolates (FGS-SOL, FOD IIHR7 and FGMA-HOS) whereas, no point mutation (amino acid changes) was found in sensitive isolates (FOGF11-IIHR and FGUA-IIHR). The cytological observations on nuclear material and germiling morphology indicated no adverse effects on carbendazim resistant Fusarium isolates when treated with carbendazim.The efficacy of alternate fungicides viz., chlorothalonil (0.2%), captan (0.2%), bitertanol (0.2%), pyraclostrobin (0.1%), propiconazole (0.1%), mancozeb (0.2%), tebuconazole (0.1%) was evaluated for wilt incidence in gladiolus and marigold through pot culture. Fungicides captan, mancozeb, bitertanol,pyraclostrobin, chlorothalonil and propiconazole were highly effective in reducing the pathogen population and wilt incidence in marigold and gladiolus. Evaluation of bioagents like Trichoderma harzianum and fungicides against carbendazim resistant F. solani in marigold indicated that the combination of biocontrol agent (carbendazim tolerant TH-GJ16B isolate) with carbendazim (8.33% wilt) showed best result followed byanother T. harzianum isolate tolerant to copper oxychloride (TH-10) along with copper oxychloride (16.66% wilt). Treatments with TH-GJ16B isolate with copper oxychloride (16.66% wilt), TH-10 with copper hydroxide (25% wilt) and TH-GJ16B with copper hydroxide (25% wilt) were also found effective inminimizing wilt disease in marigold. Use of alternative fungicides and carbendazim tolerant Trichoderma isolates, will not only help in the management of Fusarium wilt in marigold and gladiolus but also in managing the carbendazim resistance by reducing the inoculum level of resistant isolates in soil over a period of time in the target locations where fungicide resistant populations occur.

Entomology & Nematology



Title: Species complex, biology and management of thrips on Grapes, cv. Bangalore Blue (2002)

R.Harish, UAS, Bangalore, Guide: Dr.Abraham Verghese

The investigations on the thrips species complex, biology & seasonal incidence of S.dorsalis in relation to weather climate parameters; extent of damage and management chemical control of S. dorsalis were made from 2001-2002 for two seasons one being carried out(winter and summer) in the field and laboratory during 2000-01. This study has revealed two families viz., Aeolothripidae and Phlaeothripidae as having new records of species that are associated with S. dorsalis. The larvae and adults of S.dorsalis caused damage to all stages of the crop. Under severe infestations, the leaves withered and ultimately fell down. The density of S. dorsalis and other species of thrips reached the peak level (12.92 and 0.74 during winter) at 30-40 days after pruning, when the crop was in tender leaf stage and flowering initiated. The female laid eggs singly in the tissues mostly on the tender pods, occasionally in older pods. The egg was kidney or oval shaped and glossy white in colour. The ovi position started after a period of 1.5 + 0.48 days and lasted for 1.89 + 0.65 days. Female laid on average 2.1+0.94 eggs per day and lived for 4.48+1.03 days. The pest number attained a peak during the first week of November (12.92 S. dorsalis /shoot) and third week of May (16.48 S. dorsalis/shoot) in winter and summer season, respectively. Regarding the effect of weather parameters on S.dorsalis infestation, temperature (both maximum and minimum) was found to have positive effect. Relative humidity, rainfall and wind speed were found to have negative effect. The percent damage due to attack of S. Dorsalis on Bangalore Blue grapes was 5.67 and 33.18during winter and summer, respectively. The efficacy of synthetic, contact and botanical insecticides viz., acephate 75% SP @ 0.075% verticel 100 SP 0.2% endosulfan 35 EC @0.07%. chlorphriphos 20 EC @ 0.05% carbaryl 50% WDP, cartap hydrochloride 5% SP,fipronil 5% SC, fish oil rosin soap, azadiracht in 0.03 EC, endosulafan + azadirachtin and soil raking were evaluated against S. dorsalis on grapes in the form of two folia applications at 10 days interval. Of the seen dosulfan followed by cartaphydrochloride and carbaryl proved effective in the control of S.dorsalis during both the seasons. Whereas, fipronil, endosulfan+ azadiracht in and acephate had moderate effect, verticel and soil raking were less effective in controlling S. dorsalis.

Title: Studies on short hole Xylosandrus crassiusculus on Grapes cv. Bangalore Blue (2003)

G. Keshava Reddy, UAS, Bangalore, Guide: Dr.Abraham Verghese

The investigations on different aspects of grapes hot hole borer, Xylosandrus crassiusculus (Motshulsky) (Coleoptera : Scolytidae) were carried out during 2002-03. During the survey, two species of scolytid beetles viz., Xylosandrus crassiusculus and compactus (Eichooff) were recorded on grapes vines. The present study revealed that Xylosandrus crassiusculus mainly preferred cv. Bangalore Blue grapes and its infestation was more in Bangalore North (Urban) area than other areas like in Bangalore rural and Kolar districts. Traps with 20% ethanol were found most effective in trapping scolytid beetles. The trap catches of scolytids showed significant negative relationship with minimum temperature and wind speed. The number of scolytid damaged holes on the main trunk was significantly and negatively correlated with total number of sprouts. From the study carried out at the IIHR vineyard, it was found that if control measures are taken immediately after noticing the shot hole borer attack on the trunks by regular and close monitoring for pest attack, the growth and development of the vines and yield (No.of bunches) are not affected. Distribution of Xylosandrus crassiusculus damage holes was found to be clumped or aggregated at all height intervals on the main trunk as variance-mean ratio was more than unity. It was found that scolytid holes density at all height intervals was significantly and positively correlated with total number of holes on the trunk. However, the number of holes presents at 0-30 cm and 60-90 cm height intervals showed highly significant 'r' values with total number of bored holes on the trunk. At 0-30 cm height, power model, $y=6.28x^{0.95}$ and 60-90 cm height power model, $y= 18.78^{0.66}$ would explain the reliability of variation of total number of scolytid holes of a vine up to 81% and 94%, respectively. So these models can be recommended for further sampling and prediction. Management studies showed that the efficacy of chemicals, dichlorvos +acephate+ carbendazim , dichlorvos + acephate and dichlorvos emerged as the most promising treatments from two trials. Accephate, neem oil and cypermethrin had moderate effect in controlling Xylosandrus crassiusculus.For low levels of infestation, especially if detected early, dichlorvos is sufficient. The swab with combination of chemicals was more efficacious, cost- effective and less hazardous, in terms of drift tonon-target areas compared to sprays taken by farmers.

Title: Bio-ecology, population dynamics, pest-predator antinteractions with reference to the aphid, Aphispunicae Passerini in Pomegranate ecosystem (2003)

K.Sreedevi, Kuvempu University, Shimoga, Guide:Dr.Abraham Verghese

Studies on "Bio-ecology, population dynamics and prey-predator-ant interaction with special reference to pomegranate aphid, Aphis punicae Passerini" were carried out during 2000-2003 at the Division of Entomology and Nematology, Indian Institute of Horticultural Research, Hessarghatta Lake - PO, Bangalore (12˚58'N; 77˚35'E), India. The major conclusion drawn from the present study were - The aphid, A. punicae has nymphal instars of duration 1 – 1.5 days each. Thus total nymphal duration was found to be 4 – 5 days and adult longevity ranged from 2 – 8 days. Total life cycle was observed to range from 6 to 13 days. The seasonal incidence of A. punicae has shown two peak periods.A major peak during January–February and a minor one during July–June were observed. Predators were found in abundance during both the peaks and showed numerical response to its prey, A. punicae The fungus, E. aphidis was found to occur inepizootic form on aphids. The ants were not associated with aphid during January –March, however, they were found associated during July–September. The crop phenology factors that influenced aphid population the most were tender shoots, which favoured the aphid multiplication while the full matured leaves and medium to large fruits that did not favour the population build up. Predators were also negatively correlated with the full matured leaves. Ants were positively related with full matured leaves and negatively with tender shoots showing just opposite relationship with what aphids showed. Among meteorological factors, the relative humidity and minimum temperature showed negative influence on A.punicae population. However, predators were not influenced by weather parameters, once again confirming that they were prey- dependent. Ants were positively related to the wind speed and temperature. The aphid infestation had negative impact on fruit size and development. Among different predators, C.sexmaculata was found to be the most abundant species followed by Scymnus on A.punicae in pomegranate ecosystem. Prediction models were developed for A. punicae with three independent variables viz., tender shoot, relative humidity and minimum temperature. These findings conserve as a basis to develop further IPM strategy.

Title: Population dynamics, biology and management of *Amrascas plendens* Ghauri (2004)

S.Rudresh, UAS, Bangalore, Guide: Dr. Abraham Varghese

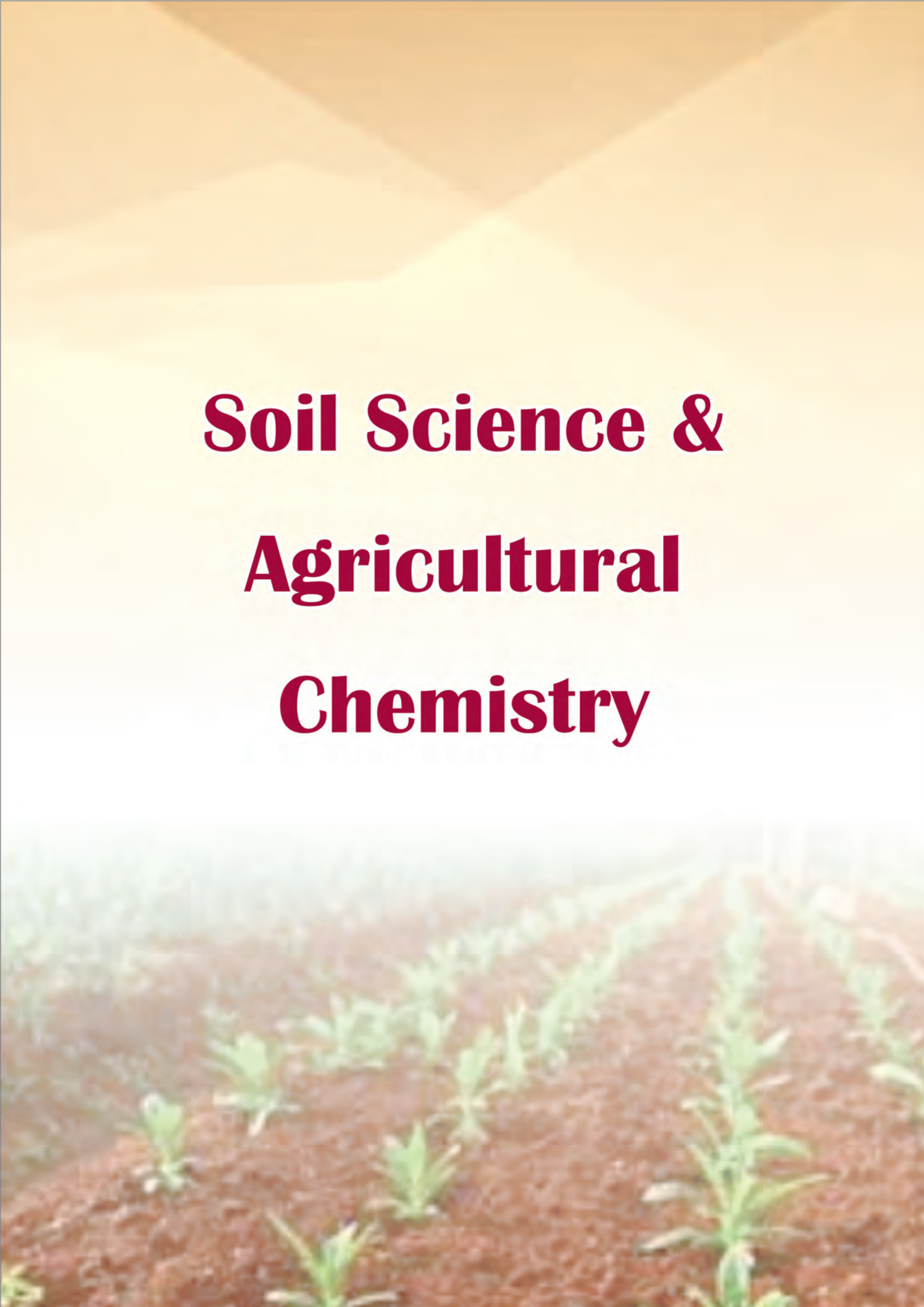
The present investigations were made during 2003-04 on the different aspect of Amrascasplendens Ghauri at IIHR namely, seasonal incidence, biology, extent of damage, management of A .splendens and response of leaf hopper to Alphonso, Banganapalli and Totapuri varietie. Seasonal incidence of A.splendens indicated that three population peaks were observed, with the second peak was observed during third week of April (23.20 mean leafhoppers per shoot). On these varieties the incidence gradually increased from February to March and reached its peak during April, from then the population started declining and reached a minimum during July to October, July to March and May to January, in Banganapalli, Totapuri and Alphonso, respectively. The Incidence of A.splendens had showed positive significant correlation with maximum temperature(r=0.38) minimum temp.(r=0.36) and flushing (r=0.67). Further, the studied showed that co-occurrence of factors like maximum temperature at third week prior to leaf hopper incidence and flushing at one week prior to leaf hopper incidence explained the leaf hopper density up to 65%. Eggs were slightly oval and transparent and were laid in the midrib,vienlets and occasionally in leaf lamina. Ovi position per days varied from 1 to 4 during peak season for per female. It took 4 to 5 days for hatching. During the study, three predators namely Isyndus heros Fab. And Mantis religiosa Lab., were found attacking the different stages of the leaf hopper. The female adults caused the major damage by ovi positing in midrib towards anterior region of tender leaf, which resulted in blockage of phloem tube due to which, drying of leaf apex backward was observed. The oviposition in the midrib caused anatomical changes in the leaf midrib and as well as in lateral veins of the leaves. The healthy midrib stained in toluidine blue mercuric bromophenol blue and periodic acid Schiff's reagent has indicated the presence of vascular bundles and other related structures, where as in infested tissue the staining was either blank or very lightly indicated the degeneration of tissue or the presence of chitinaceous materials in the midrib (left out material of chorion). Studies were conducted on the management of A.splendens during April 2005. The results showed that neem oil10 ml/l and NSKE 4 % giving 100 percent control of the leaf hoppers.

Title: Ecology and management of stone weevil (2005)

D.K.Nagaraju, Kuvempu University, Shimoga, Guide: Dr.Abraham Verghese

Mangost one weevil,(MSW) Sternochetus mangiferae (Fabricius) (Coleoptera:Curculionidae) is an important monophagous pest of mango, its ecology and ethology have escaped the attention of entomologists, but its effects as a pest of mango fruit is highly pronounced affecting yield and exports. In order to understand the insect better, for better management, there is a need to follow the insect, into its niches like seed and bark in an intensive manner. Hence, the present study was conducted at the laboratory and fields of Indian Institute of Horticultural Research (IIHR), Bangalore ($12^{o}58'N$; $77^{o}35'E$) during 2001-2005. The different linear and non-linear models employed could explain the variability in infestation at harvest due to the infestation in fallen fruits to the extent of 57 to 83% in different varieties. Further, per cent infestation at harvest was predicted using polynomial model order 2 equation in Alphonso and Banganpalli, and polynomial model order 3 in Totapuri. An adult infested by Beauveria bassiana (Balsamo) Vuillemin was found. The natural occurrence was <1%,but under laboratory conditions,the fungus gave 100% mortality of adults in 2-7 days when sprayed at 1.3×10^{9} spores per ml concentration. Carbaryl, acephate and deltamethrin with 3.33, 6.67 and 8.15% infestation, respectively were effective. Ethofenprox with 14.82% in festation gave intermediate control. Fish oil rosin soap and azadirachtin were not effective. The study clearly brought out for the first time that in festation begins on fruits of 2 - 4cm diameter. This is the time to initiate management interventions. The discovery that majority of the adults eventually rest in junctions of main trunk and primary branches augur well to target spot application of insecticides on the main trunk prior to fruiting, thus obviating full canopy sprays. The fact that older trees harboured more MSW is also crucial in being vigilant to MSW infestation. This is environment friendly cost effective and time saving, as trunk spot application requires only $1/5^{th}$ of spray liquid. The study showed that prediction of weevil in festation in a variety is possible. As stretches of mango of one variety are common in India, this will be useful in forecast and surveillance. The efficacy of B.bassiana demonstrated that the eco-friendly IPM is a potential future venture.

Soil Science & Agricultural Chemistry



Title: Comparative efficiency of citrus rootstocks in the absorption of ^{15}N and ^{32}P labeled nutrients (1988)

S.V.Keshava Murthy, UAS, Bangalore, Guide: Dr.B.R.V.Iyengar

Comparative efficiency of some commercially important citrus rootstocks and the scion cultivar Coorg mandarin in the absorption and utilization of N and P was studied through field and pot culture experiments and also kinetics of P absorption in solution culture using their isotopes ^{15}N and ^{32}P.Trifoliate oranges had significantly higher N concentration in the shoot but lower rate of N utilization. The nitrogen derived from fertilizer (Ndff) in the shoot was significantly more in Citrumelo, Troyer and Carrizocitranges, the two Trifoliate oranges and the scion cv. Coorg mandarin indicating their greater efficiency in the absorption nitrogen than the other rootstocks Rough lemon, Sourorange, Cleopatra and Kodakithuli mandarins. Trifoliate oranges , Citrumelo, Troyercitrange also had finer roots and higher anion exchange capacity. In studies on the comparative efficiency of citrus rootstocks in the absorption of P in pot culture, it was found that Trifoliate oranges, Rough lemon, Troyercitrange Kodakithuli mandarin andthe scion cv. Coorg mandarin derived more P from the fertilizer (P dff) than Cleopatramandarin and Sour orange. Field studies on the comparative efficiency of P absorption by scion cultivars Italian lemon and seedless lime budded on seven rootstocks revealed that Italian lemon on two hybrid rootstocks Carrizocitrange and Citrumelo derived significantly more fertilizer P than the other, where as in Seedless lime, Rough lemon and Trifoliate oranges resulted in higher Pdff. Mean effects of the two scion cultivars showed that the dwarfing rootstock Trifoliate oranges resulted in higher Pdff. Of the two scion cultivars, Italian lemon derived more P from the fertilizer than Seedless lime. Rootstocks Troyer citrange, Citrumelo, and scion cv. Coorg mandarin had higher inflow (l_n) and maximum uptake (l_{max}) rates than the others, indicating that they had greater number of absorption sites. In Rough lemon and Citrumelo the (l_{max}) increased with increase in the concentration of P in the external solution indicating that these two rootstocks respond to increase in the concentration of P in the soil solution brought about by fertilizer application. Rootstocks Rough lemon and Trifoliate oranges had lower K_m values (external P concentration corresponding to half the maximum rate of uptake) implying greater affinity of their roots for P and that they may be more efficient on unfertilized soils of low fertility.

Title: Persistence and degradation of chlorothalonil in selected soils (1998)

Binaya Kumar Choudhury, UAS, Bangalore, Guide: Dr.M.D.Awasthi

The study was taken up to determine the persistence and dissipation patternof a commonly used fungicide chlorothalonil in two major soils of India differing widely in their physic-chemical properties under the influence of various moisture regimes at non sterile conditions. The two soil types were black clay soil from National Bureau of Soil Survey & Land Use Planning (NBSS & LUP), regional station, Bellary, Karnataka and loamy sand soil. Persistence and degradation of chlorothalonilin soils were determined by adding 100 ppm of toxicant to both the soil at sterile and sterile conditions and incubating them under different soil moisture regimes. The two different soils collected from different locations represented fairly wide range of variation in soil characteristics such as textural make up, pH, organic matter content, CEC etc.,. The organic matter content was fairly high in black clay Bellary soil, while it was moderately low in loamy sand Hessarghatta soil.. The degradation pattern of chlorothalonil residues indicated a close correspondence to first order exponential degradation kinetics in soils and mainly influenced by soil moisture. Increased degradation was observed with increased moisture content from air dry condition to submerged condition. Higher persistence chlorothalonil was noticed in black clay Bellary soil than that of loamy sand Hessarghatta soil. Similarly marginally higher persistence was recorded in autoclaved soil condition than that autoclaved condition indicating that the involvement of micro-organisms in degradation was low at high concentration. The half life period ($t_{1/2}$) of chlorothalonil in black clay soil for autoclaved condition ranged from 8.4 to 12.3 days, while for non autoclaved it ranged from 8.1 to 11.2 days at different soil moisture regimes. Similarly for loamy sand soil, it ranged from 8.0 to 11.1 days for autoclaved condition and 7.8 to 10.8 days for non autoclaved condition at different soil moisture levels. The half life period decreased with increased moisture content of soil, and the half life period was higher for autoclaved soil condition than non autoclaved condition. The degradation of soil retained fungicide residues followed first order reaction (R^2>0.96). The degradation rate constant (K) increased with increasing moisture levels and K was always less in autoclaved condition than of non autoclaved condition. "K_{deg}"was fairly high for loamy sand Hessarghatta soil than that of black clay Bellary soil at particular point of time and treatments.

Title: Persistence and different formulations of imidacloprid in soil and okra (*Abelmoschus esculentus* L. Moench) plant (2000)

H.R.Indumathi, UAS, Bangalore, Guide: Dr. Debi Sharma

Persistence and degradation of imidacloprid was determined by fortification of soil and incubating under different soil moisture regimes. Plant uptake of imidacloprid was also studied by growing imidacloprid treated okra seeds in glass house. Dissipation pattern of imidacloprid in okra was studied by spraying imidacloprid at effective and a double dose under a supervised field trial at initial fruit set stage (45 days after germination).Imidacloprid dissipated slowly in soil at field capacity as well as 50% field capacity conditions. Residues of imidacloprid persisted for more than 75 days with half lives of 76.8 and 74.0 days respectively. There was no marked difference between the persistence of imidacloprid in soil under the two soil moisture conditions studied. The persistence of imidacloprid is only slightly higher at 50% field capacity condition than at field capacity condition. Imidacloprid was taken up by okra plant from treated (9 ga.i./kg) seeds and translocated residues were found to be 1.59 ppm at 15 days after germination. However these residues were detected in the plant for more than 30 days after germination, no residues were detected in fruits at harvest (50 days after germination). Foliar application of imidacloprid in okra resulted in high initial residues (1.12 to 2.01ppm and1.34 to 2.21ppm) in first and second seasons respectively. Imidacloprid residues in okra fruit following spray treatment persisted for more than 10days in lower concentration (0.3ml/L) and for more than 15 days in higher concentration(0.6ml/L) in both the season. The residue dissipated with a half life of 2.2 to 3.7 days in the first season and 2.4 to 4.0 days in the second season at the recommended and double the recommended doses of application respectively.

Title: Studies on persistence of hexaconazole in selected soils of Karnataka (2002)

Harish Kumar Dubey, UAS, Bangalore, Guide: Dr.M.D.Awasthi

The study was taken up to determine the persistence and dissipation pattern of a commonly used fungicide Hexaconazole in two major soils of India differing widely in their physical and chemical properties. The two soils types were black clay soil from National Bureau of Soil Survey & Land Use Planning (NBSS & LUP), regional station, Bellary, Karnataka and loamy sand soil from IIHR, Bangalore. Persistence degradation of Hexaconazole in soils was determined by adding 10 ppm of the toxicant to both the soil and incubating them under different soil moisture regimes. The degradation reaction rate constants "K" and half life values ($t_{1/2}$) for both the soils were computed from the amount of fungicide remaining in soils at different periods following periodic residue analysis. The two different soils collected from different locations represented fairly wide range of variation in soil characteristics such as textural make up, pH, organic matter content, CEC etc.,(loamy and Hessarghatta soil :Haplustalf and black clay Bellary soil:Typic chromustents) were used for the study. The organic matter content was fairly high in black clay Bellary soil, while it was moderately low in loamy sand Hessarghatta soil. There was a marked difference in the persistence hexaconazole in both the soil type. The degradation pattern of hexaconazole residues indicated a close correspondence to first order exponential degradation kinetics in soils and largely influenced by soil moisture. Increased degradation was observed with increased moisture content from air dry condition to submerged condition however there was a faster rate of degradation in 50 percentage field capacity soil moisture condition. Higher persistence of hexaconazole was noticed in black clay Bellary soil than in loamys and Hessarghatta soil. In general, the persistence of hexaconazole residues was high but persistence was influenced by moisture level. The half life period increased with increased moisture content of soil. The half life values were fairly high for black clay Bellary soil than loamy and Hessarghatta soil. The degradation of soil retained fungicide residues followed first order reaction (R^2>0.96). The degradation rate constant (K) increased with increasing moisture levels and K was always less in autoclaved condition than of non autoclaved condition. "K_{deg}" was fairly high for loamy sand Hessarghatta soil than that of black clay Bellary soil at particular point of time and treatments.

Title: Persistence and mobility of paclobutrazolin soil (2004)

L.Shalini, UAS, Bangalore, Guide: Dr.Debi Sharma

A field experiment was conducted at IIHR, Hessarghatta, Bangalore, to study the persistence and mobility of paclobutrazol, a predominantly soil applied plant growth regulator to counter alternate bearing in mango following its application to mango tree basins at the rate of 5 and 10 g as per hectare. Soil, water and mango samples from Konkan region of Maharashtra were also collected in order to assess the extent of paclobutrazol residue contamination in these samples, as this area is the largest consumer of paclobutrazol in India. Sample were collected from both conventional soil cultivated orchards and laterite rock cultivations. The study indicated that paclobutrazol persisted at all soil depths for at least 150 days and reduced to below detectable limit at 210 days. It persisted at the surface (0-15 cm) with half lives of 30.7 and 29.7 days from the lower and higher treatment concentrations respectively. It was also seen that paclobutrazol moved quickly down the soil to reach up to or beyond 60 cm. soon after its application. The residues of paclobutrazol in the conventional soil cultivated mango orchards located at Konkan region of Maharashtra ranged below detectable limit to traces. No detectable residues of paclobutrazol were found in soils from laterite rock cultivated mango orchard from the same region irrespective of the number of years for which paclobutrazol applications had been made. The paclobutrazol residues were either below detectable limit or present in traces in mango whole fruits collected from either type of orchards at harvest, notwithstanding the frequency of its application in the orchard. Water samples collected at the time of fruit harvest from open wells located orchards did not contain detectable residues of paclobutrazol.

Title: Soil and nutrient management studies in Coleus vettriveroides Jacob (2009)

B.Mamatha, UAS, Bangalore, Guide: Dr.T.N.Shivananda

Application of 100:50:50 NPK kg ha^{-1} recorded significantly higher plant growth (50.86cm), biomass accumulation (32.75 t ha^{-1}), and nutrient uptake (uptake of 50.60 kg N,7.21kg P,126.04 kg Kha^{-1}) of C.vettiveroides at 116 days after planting (DAP).C.vettiveroides plant grown in 18 inch diameter with 30 inch length PVC column produced significantly higher total root yield (315.2 g $plant^{-1}$) and biomass accumulation (3597.2 g $plant^{-1}$) at 121 DAP. Growth media comprising of sand and soil mixed in equal proportion (100 kg) added with 0.5 kg Farm Yard Manure (FYM) recorded significantly higher biomass accumulation (728.34 g $plant^{-1}$ and 1653 g $plant^{-1}$) of C. vettiveroides in cement pots and PVC column respectively at 135 DAP. Application of FYM (282.80 g $plant^{-1}$) or inorganic fertilizer (312.73 g $plant^{-1}$) along with bio-fertilizer recorded higher biomass accumulation of C. vettiveroides as compared with sole application of FYM (210.49 g$plant^{-1}$) or inorganic fertilizer (261.56 g $plant^{-1}$) at 130 DAP. Significantly higher root yield(3.16tha^{-1}),biomass accumulation (49.66 tha^{-1})and nutrient uptake (uptake of 50.13 kg N, 7.75 kg P, 119.11 kg Kha^{-1}) of C. vettiveroides recorded with application of recommended FYM (10 tha^{-1}) + recommended NPK (100:50:50 NPK kgha^{-1}) at 140 DAP. Application of Mukuna mulch 10 tha^{-1} recorded significantly higher plant growth (51.74cm) and application of FYM mulch 10tha^{-1} recorded higher biomass accumulation (33.37 t ha^{-1}) and nutrient uptake (uptake of 49.30 kg N, 9.41 kg P, 148.74kg Kha^{-1}) of C. vettiveroides at 139 DAP. The different chemical constituents identified in oil of root of C. vettiveroides are hydrocarbons (ß-Himachalene, etc.,), oxygenated compounds like alcohols (Vellerdiol, Isothujol, etc.,), aldehydes (ß-Cyclocitral, etc.,), esters (Sabinylacetate,etc.,), ketones (ß- Ionone,Traseolide etc.,).

Agricultural Statistics & Agricultural Economics

Title: Investigation and development of non-linear statistical models for disease forecasting in Grapes (2010)

N.Vijay, UAS, Bangalore, Guide: Dr.R.Venugopalan

An attempt was made to develop nonlinear stochastic models for disease forecasting in Grapes. Grape (Vitis SPP.) is an important crop for the farmers for getting higher returns and with consumer for delicacy and as a medicinal fruit. Downy mildew is one of the most destructive vine diseases known leading to total crop losses. To this end, the present investigation was carried out to understand the role of weather factors on downy mildew incidence in Grapes (cv. Anab-e-Shahi) and disease progression over time epoch by developing suitable statistical models. Efforts were made to develop models individually for backward and fore pruning periods, resulting in meaningful interpretation to the researchers. Also, an attempt was made to investigate statistical considerations involved in the error structure and subsequent methodologies to be followed, while developing non-linear models.Statistical models developed for backward pruning data (May-June) showed that maximum temperature, Evaporation and relative humidity at 7.30 hrs, observed with a time lag of one week, collectively explain about 89.4% of the variation in downy mildew incidence. Statistical models developed forepruning data (September-October) showed that minimum temperature, relative humidity at 7.30 hrs and 13.30 hrs, observed with a time lag of one week, collectively explain 88% of the variation in weekly downy mildew incidence. Logistic and Gompertzn on linears to chasticstatistical models developed expressed the disease progression to the extent of 97-99%. These models when used to compute quantitative information about the biological parameters concerning intrinsic infection rate and maximum mildew severity over time-epoch showed for backward and fore pruning data, the rate of disease severity was maximum during the fourth-fifth week and fifth-sixth week after pruning, respectively. Resultant nonlinear models were used to compute the Area under Disease Progressive Curve (AUDPC). A perusal indicates that the values obtained by logistic and Gompertz are ranged from 48 to 84 and 25 to 65 respectively for backward pruning data. However, for the fore pruning data the results showed that AUDPC values were higher as it ranged from 78 to 86 and 61 to 65 respectively. These results indicate that the downy mildew rate of progression in Fore pruning is much severe than in backward pruning. SAS programming codes were generated for model building. The message arising out of this present investigation is that proper prophylactic measures, if taken by considering the model resulted significant weather factors along with knowledge about disease progression over time as depicted by nonlinear models, separately for backward and forepruning, not only results in an efficient and economic management strategies for controlling downy mildew incidence in grapes (cv. Anab-e-Shahi) but also considerably reduce crop yield loss thereby providing better return to the farmers. The graphical representation of non linear models fitted is depicted as below.

Title: Statistical models for stability research in Cucumber (2011)

G.S.Ravi, UAS, Bangalore, Guide: Dr.R.Venugopalan

Crop improvement research is mainly aimed to exploit initially the genetic diversity available in the germplasm and culminate with identifying stable lines for release as variety. Its main aim is to estimate the average response of the genotypes and also to test the consistency of the yield responses over years/environments. The presence of genotype X environment interaction (GEI) makes it difficult to assess the genetic potential of a variety. In the present study, three different approaches were used to develop stability models for assessing the stability of 33 cucumber lines tested over three consecutive years in one location (Bangalore), based on eight yield and related biometrical traits. GEI was highly significant for all the traits and the genotypes had divergent response to environmental changes. Presence of significant linear GE interactions in both yield per plot (Kg.) and number of fruits per plot indicated that there is still more potential for crop improvement over years. Measures of stability when used to group the 33 genotypes in to genotypes suitable for ideal environment, for favorable environment and for poor environment, fortified a distinct difference in their grouping using two approaches.Parametric and non-parametric measures were computed to assess the extent of contribution of each of the 33 genotypes to GE interaction. It was observed that the lines CH-36-71-6 and CH-32-36-6 were most stable in yield character. Also, a combined index by giving desired importance to all the traits was developed to rank the genotypes. Results showed that CH-20-1-10, CH-1-42-10 and CH-32-36-6 under ER model and CH-28-32-6, CH-20-1-10 and CH-32-36-6 under FP model were top 3stable genotypes. Finally, by considering relative performance of a genotype various non-parametric measures computed showed that CH-20-1-10 and CH-28-32-6 were found tobemoststable.SASprogrammingcodesandSTAB- IIHRweregeneratedfordataanalysis. Further, in any crop improvement research, as the breeders may expect that a genotype/ variety should also possess desirable characters of other yield related traits. Hence, an index based on the combined ecovalance value and relative performance of a genotype as compared to others (for a character under study), using rank based non-parametric measures may be still more practically meaningful so as to come out with hybridization trails.

Title: Evolving Statistical models for crop-logging studies in Brinjal (*Solanum Melongena* L.) (2012)

R.Hanumanthaiah, UAS, Bangalore, Guide: Dr.R.Venugopalan

Crop yield forecast before harvest is likely to provide valuable information to farmers, policy makers/government on sales, storage, and export, price fixation, grading, and marketing for advance planning so as to ensure sustainable crop production during the years ahead. Researchers are also interested to know explicitly by which stage of the crop, yield could be predicted more accurately and what are all the significant crop-logging parameters. Crop improvement research is also be benefited, as selection can be made in the early stages based on the significant crop-logging parameters identified. To this end, statistical models were developed using Multiple Linear Regression (MLR) and Artificial Neural Network (ANN) methods. Statistical models developed showed that Brinjal crop yield could be predicted well in advance as early as 26 Days After Planting (DAP) using three biometrical traits(plant height, plant girth and plant spread north south) to an extent of 71 %. As the DAP increases prediction of yield could be possible to an extent of 88 %. Identification and removal of outliers in the data set increased the prediction of MLR models in the range of 31% ,33% ,34 and 8% respectively across four crop growth stages.ANN approach which was also used to predict the yield resulted in R^2 values 83 % (stage 1), 89 % (stage2), 88 % (stage 3) and 68 % (stage 4), which was high as compared to MLR (except forstage 4). Cross-validation of MLR and ANN models for all four stages, showed good results as the prediction power was in the range of 78 to 87 %$R^{2-}$for MLR and 64 % to 85 %- for ANN. Hence, it is recommended to study the role of outliers before developing crop yield forecasting models and also to exploit ANN approaches by capturing the inherent non linearity among biometrical traits.

Seed Science & Technology

Title: Studies on seed production and storage aspects in bell pepper (*Capsicum annuum* L.) (2003

K.C.Manjunatha, UAS, Bangalore, Guide: Dr.H.S.Yogeesha

Field and laboratory experiments were conducted on bell pepper cv. Arka Gaurav at the Indian Institute of Horticultural Research, Hessarghatta, Bangalore during 2001-2002 to study the effect of mother plant fruit load as well as stages of fruit harvesting and postharvest ripening on seed yield and quality. Studies were also conducted on the seed storability as influenced by seed treatment with anti- oxidants and halogens under ambient and controlled conditions (15±2^{o}C temperature and 45 % RH).Regulating the fruit number per plant significantly affected the seed yield. Eight fruits/plant was found optimum with maximum seed yield (168.4 kg/ha) with better quality seeds. Stage of fruit harvesting had a profound influence on seed yield and quality in bell pepper. Harvesting fruits at full yellow was found the right stage. Post harvest ripening for five days under ambient condition had a positive effect on both seed yield and quality particularly when fruits were harvested at breaker and half yellow stage. Pre-storage of seed treatment with free radical quenching agents such as p-amino benzoic acid, p-hydroxyl benzoic acid, ascorbic acid, oxalic acid, as well as potassium iodide and sodium chloride effectively controlled seed deterioration and maintained significantly higher seed quality over untreated seeds at the end of twelve months of storage. Controlled storage condition was found better compared to ambient condition. Treatment with p-aminobenzoic acid recorded maximum germination of 79.5% at the end of twelve months. All the treated seeds stored under controlled condition were superior oven those stored under ambient condition.

Title: Studies on Seed Maturity, Harvest and threshing methods on seed quality in onion (*Alium cepa* L.)cv. Arka Bindu (2006)

M. Ramya, UAS, Bangalore, Guide: Dr.H.S.Yogeesha

Field and laboratory experiments were conducted in onion cv. Arka Bindu at the Indian Institute of Horticultural Research, Hessarghatta, Bangalore during 2004-2005 to study the physiological and biochemical changes associated with seed development, seed maturity and effect of threshing methods at different seed moisture levels on seed quality of onion. During seed development and maturation, protein accumulation occurred till 35 days after anthesis (DAA) where as starch accumulation continued till 45 DAA imparting more dry weight to the seeds with advancement in maturation. Dehydrogenase activity increased progressively with advancement in maturation indicating the formation of more living tissue with the accumulation of seed reserves. The analyse activity was very low till 15DAA and increased till 40 DAA and decreased thereafter at 45 DAA. With advancement of maturation and increase in polypeptide synthesis germination and vigour increased parallely. No germination was noticed till 20 DAA where polypeptide synthesis was very less. Harvesting the seeds at 40 and 45 DAA recorded higher seed yield/plant (4.84 and 5.57g, respectively) and number of seeds per umbel (473.33 and 469.2, respectively) compared to harvesting at early stages. Seeds harvested at 40 DAA had higher test weight (0.29g) and dry weight (0.27g) which remained almost constant after 40 DAA indicating that the seeds attained physiological maturity between 40 and 45 DAA. Among the different stage of harvesting, highly vigorous seeds were obtained when harvested at 40^{th} and 45^{th} DAA when compared to other stages. This was indicated by higher seedling vigour index (1456.4 and 1474.9 respectively) with higher germination percentage and first count. Manual threshing recorded higher first count (52.3%) and germination (81.9%) than that of beating with stick. Threshing the seeds at lower seed moisture levels (5±2%) recorded higher first count (58.4% and germination percentage (83.5%). Lowest was recorded at 11 ± 2% seed moisture. Similar trend was noticed for seedling root length, shoot length and vigour index. Seed with 5±2% moisture content recorded higher seed recovery percentage compared to their seed moisture levels.

Title: Studies on genetic diversity and sex linked markers in betel vine (Piper betle L.)(2011)

Ganesh Navanath Khadke, UAS, Bangalore, Guide: Dr.K.Himabindu

Betel vine is one of the heritage crops of India. In spite of being an important cash crop very limited research has been carried out in this crop. Molecular marker assisted investigations were undertaken to study the genetic diversity of betel vine accessions and Piper species and to identify of sex linked markers in P.betle. Genetic diversity analysis was carried out by using Inter Simple Sequence Repeats (ISSR) markers in 38 accessions of betel vine and one accession each of P. colubrinum and P. hamiltoni. Out of 60 ISSR primers tested, 15 were selected based on high and consistent polymorphism. The 15ISSR primers generated a total 82 bands of which 72 were polymorphic. The different band statistics and efficiency parameters showed that the primers viz., UBC-822, 825,826,863 and ISSR-1, ISSR-15 were more efficient and UBC-828 the least efficient primer to study the genetic diversity. Studies UPGMA dendrogram and PCA plot revealed P.colubrinum to be the most distant of the three species. The Andaman accessions of betel vine clustered based on geographical origin and shared 70% similarity. Gender based clustering was also observed in the betel vine accessions. The study revealed that of ISSR primers were efficient in divulging the differences between Piper species and within P.betle. ISSR markers were used to identify sex linked markers in dioecious betel vine. Female and male bulk DNAs were screened with 35 ISSR primers. Two primers viz., ISSR-10 and UBC-852 produced male specific bands of size 459bpand1250bprespectively. ISSR-23 amplified a female specific 636bp fragment. These primers were validated in the individuals of the bulks and showed a consistent sex specific expression. A sequence characterized amplified region (SCAR) was developed from the primer ISSR- 23. The SCAR primers developed can further be utilized in sex identification in betel vine.

Title: Studies on varietal characterization based on morphological and biochemical markers in vegetable soybean [*Glycine Max* (L.) Merrill.] (2011)

Dhananjaya, UAS, Bangalore, Guide: Dr.K.Bhanuprakash

The ability to distinguish and clearly identify varieties of cultivated species is fundamental for the operational aspects in the seed trade. In the present study nine vegetable soy bean genotypes were characterized based on morphological and biochemical markers. Based on seed coat colour, vegetable soybean genotypes were grouped into two groups viz., green and yellow. AGS-438 was grouped as yellow and remaining genotypes were grouped under green colour. The plant growth habit in vegetable soybean genotypes showed erect type in AGS-440 while, other genotypes were semi erect. Based on stem pubescence, the genotypes were distinctly grouped into two categories as present and absent. Pubescence is absent in GC-00209-4-1-1 and present in remaining genotypes. The leaf shape in vegetable soybean genotypes showed pointed ovate in AGS-440 while, round ovate in other genotypes. Nature of pod pubescence exhibited difference among the genotypes. The pubescence was absent in genotype GC-00209-4-1-1butpresentinrest of the genotypes. Based on pod pubescence density genotypes were grouped as dense and sparse. The genotypes AGS-435 and AGS-440 were grouped as dense and rest were grouped under sparse category. Therefore, these distinct morphological traits could be used as DUS test criteria for determination of genetic purity in vegetable soybean. Total soluble seed proteins by SDS-PAGE were fractionated into 15 bands, which showed heterogeneity among genotypes and could be able to identify all the genotypes. The electrophoresis separation of soluble seed protein zymogram indicated that, most of the tested genotypes could be easily distinguished in the Region B (66.0 to97.4KD), C (43.0 to 66.0 KD) and D (29.0 to 43.0 KD), since the banding pattern was quite distinct for each genotype in these regions. Similarly Esterase and Malate dehydrogenase isozymes produced marked differences in the banding pattern and their intensities could be used for the identification of vegetable soybean genotypes. The results of the study clearly suggested that biochemical markers could able to give discrete differences among the genotypes within a short period of time and be successfully utilized efficiently for characterization, documentation and identification of vegetable soybean genotypes.

Agricultural Extension & Training

Title: Time utilization and decision making in horticulture: antecedent to gender main streaming (2011)

T.P. Bharath Kumar, UAS, Bangalore, Guide: Dr.Nita Khandekar

Women in India, today stand poised between a collapsing past and an uncertain future seeing the quantitative and qualitative changes. Women are involved where physical labour is more, men participate in agriculture activities with lesser physical labour, but are involved in all important aspects related to agriculture. Although women work for longer hours and contribute substantially to family income, they are not recognized either by their family members or by the society. Hence, the research was conducted to study the time utilization and decision making of horticulture farmers as antecedent to gender main streaming. Four villages in two taluks of Kolar district were selected for the study. Data were collected from 120 respondents (horticultural workers and spouse) using structured interview schedule. Majority of the respondents were old aged, had medium level of education, family education status, farming experience, annual income, extension contact, innovativeness, risk orientation, scientific orientation and achievement orientation. Majority of the respondents had a low level of social participation, high level of mass media exposure and cosmopliteness. The time utilization and decision making in horticultural activities was of medium level. Most of the women respondents spent more number of Man days/year in horticultural activities where drudgery is involved. Most of the decisions were taken collectively by family members followed by jointly by husband and wife and husband alone. Women respondents were not involved in taking horticulture related decisions alone. Most of the respondents perceived that field preparation, harvesting, carrying fertilizer and harvested crops, seed treatment and use of various kinds of implements involved drudgery. Age, education, risk orientation and achievement motivation were significantly but negatively correlated whereas, land holding, annual income and innovativeness were positively and significant correlated with time utilization among male respondents. In case off male respondents age and education were significantly but negatively correlated, while, land holding and annual income were significantly and positively correlated with time utilization. Age, education, land holding and social participation were significant in case of both male and female respondents.

Plant Genetic Resource

Title: Genetic divergence, morphological and molecular characterization and conservation of germplasm in *Capsicum spp*. (2003)

Deepu Mathew, UAS, Bangalore, Guide: Dr.S.D.Doijode

The Capsicum germplasm with 56 accession studied had high level of genetic divergence for fruit number, fresh and dry fruit yield, seed number, fruit width, fruit wall thickness, fruit weight and flower weight. Based on these selection for the character fruit weight will be most successful in a breeding programme. Morphological characterization using 16 quantitative morphological characters following D- square statistics has resulted in 11 clusters. With higher genetic distances within C. annuum accessions than that between C. annuum and other wild species studied, consideration of all possible qualitative as well as quantitative characters and transformation of data to a common scale to avoid numerical weight age in morphological characterization were necessitated. Hierarchical cluster analysis using transformed data of 58 morphological characters had resulted in 7 major clusters. Using this methodology, wild species were very clearly distinguished from hot peppers. Bell peppers with their highly distinct morphological features had shown maximum genetic diversity from all other accessions. All the male sterile lines formed a single cluster and comparatively, C. chinense was proved to be genetically closer to C. annuum. Suryamukhi, a Nepalese accession and genetic identity of which was not previously known was found to be distantly related to C.praetermissum. C.frutescens was comparatively closer to C. praetermissum and all the 3 C. baccatum accessions formed a single cluster which was most distant from C.annuum. Storage at –20 ^{o}C in aluminium foil laminated pouches was found to be the best method to maintain seed viability, vigour, speed of germination and seedling dry weight in all the 10 hot pepper cultivars experimented over 22 months. Storage under modified atmospheric conditions using nitrogen and carbon dioxide had enhanced the seed storability. Storage at low temperature and sealed containers was proved to be superior than unsealed in maintaining seed quality parameters. Thus for most efficient conservation of Capsicum germplasm, seed storage should be performed at subzero temperatures of –20 ^{o} C in sealed aluminium foil pouches. Under circumstances where this facility is not available, storage could be done using iodine or chlorine (both 1percent w/w) and/or with nitrogen atmospheres.

Title: Pollen biology of few horticultural important plants (2008)

S. Shashikumar, UAS, Bangalore, Guide: Dr.S.Ganeshan

Studies on pollen biology were carried out in flowering plant species, categorized under herbs, shrubs and trees. The investigation carried out includes pollen biology, development of protocols for pollen collection, extraction and viability assessment through germination and staining methods. Storage under short, medium and long term duration using refrigeration, freezers, freeze-driers and cryo biological containers has been attempted, followed by post storage germination and field pollination studies were carried out. The study elucidates differential responses to various treatments imposed, new methods developed for pollen germination, and potential use of cryo preserved pollen for conserving nuclear genetic diversity. In all, 39 species have been investigated for floral/pollen biology, all the species have been studied for pollen collection, extraction, germination procedures, 18 species for storage protocols, post storage germinability and 8 species attempted for post storage fertility by assessment of fertilizing ability of stored pollen. New technique for germination of mango pollen was developed and the technique was optimized for other species. Interesting results was observed in pollen viability studies on gall midge infested flowers of Solanum melongena. The results obtained in this study provide newer insights to pollen biological investigations, in addition to morphological and quantitative studies, such as pollen production, anthesis, duration of flowering etc., Investigations carried out on pollen storage especially using cryogenic technology in these species and promising results have been obtained. Results of cryogenic storage of pollen was also predicted on extent and longevity of pollen under cryogenic storage condition based on non linear estimation which was effectively applied for estimating prediction based on few years data and was helpful in predicting survival of pollen for long term storage and management of nuclear genetic diversity in gene banks.

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