Studies on Foliar Diseases of Sunflower (*Helianthus annuus* L.) with Special Reference to Alternaria Leaf Blight Caused by *Alternaria helianthi* (Hansf.) Tubaki and Nishihara

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Among the several diseases affecting sunflower crop, foliar disease contributed more loss in yield. These include Alternaria leaf blight caused by *Alternaria helianthi* (Hansf.) Tubaki and Nishihara and rust cuased by *Puccinia helianthi* Schw. Survey on incidence of Alternatira leaf blight and rust revealed that Alternaria leaf blight was more severe in kharif and rabi seasons, while rust was less severe during 1996-97.

Survival of *A. helianthi* in infected stalks was more than 360 days in the laboratory conditions, while under natural conditions its survival was upto 240 days. The safflower was found to be collateral host for *A. helianthi*.

The culture filtrate of *A. helianthi* showed the wilting symptoms within 24 hr on tomato and sunflower seedlings and also inhibited the germination of both sunflower and sorghum seeds. Further, the culture filtrate inhibited root and shoot elongation of sunflower and sorghum. Toxin was partially purified. It was host specific and termostable, produced typical symptoms on sunflower leaves without yellow halo. Among the 110 sunflower genotypes screened only three genotypes viz., HPM-15R, HPM-116 and HPM-140 were found resistant to both Alternaria leaf blight and rust.

In case of *in vitro* evaluation of fungitoxicants mancozeb (0.3%0, cyproconazole (0.1%) were most effective in inhibiting mycelial growth and also per cent inhibiton of spore germination of *A. helianthi*. Plant extracts were not effective. For rust tridemorph (1000 ppm) and cyproconazole (1000 ppm) were most effective in inhibiting germination of *P. helianthi*. In field evluation of fungicides and plant extracts, chlorothalonil (0.2%), cyproconazole (0.1%) and mancozeb (0.2%) gave the best control of Alternaria leaf blight and rust resulting into increased seed and oil yield.

Studies on Safflower Mosaic Disease

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Safflower mosaic disease, causing considerable damag eto the crop, is a serious disease and present in almost all parts of Northern Karnataka wherever safflower is grown. Affected plants were characterised by production of light and dark green mosaid on upper leaves and heads, irregular flecks of light green colour on leaves, reduction in leaf size and blisters. In later stage of disease development, affected plants produced seeds of poor quality.

The virus causing mosaic in safflower was readily sap transmissible but not through seed. The virus was also transmitted by aphid vectors viz., *Aphis gossypii, Aphis craccivora, Uroleucon compositae, Pentalonia nigronervosa* and *Myzus persicae* from safflower to cowpea and cucumber. *Uroleucon compositae* was found to be the efficient vector with 80 per cent transmission. Though *P. nigronervosa* was not efficient but it was the new vector reported during the present studies.

The virus had a wide host range and infects 19 plant species belonging to 6 families. The virus had DEP of 10^{-4} to 10^{-5}, TIP of 70 to 75°C and it can retain its infectivity upto 54 hrs at room temperature and 104 hrs at low temperature. Based on symptoms, host range, transmission and physical properties, it was concluded that the safflower mosaic disease in this area, is caused by cucumber mosaid virus.

In the early infected crop (15 days after sowing) the disease had a severe effect on yield and oil content. Field trails indicated that the spread of the disease could be minimised by adopting early sowing i.e. first fortnight of September. The extract from *Prosophis julifera* was effective which delayed the symptom development for 12 days when applied 30 min before inocualtion. None of the safflower varieties screened were resistant to virus infection, but line 96-103 and 18 others exhibited some tolerant properties.

Studies on Root Knot Nematode (*Meloidogyne* Sp.) Infecting Tuberose (*Polianthes tuberosa* L.)

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On the basis of perineal pattern prevailing root knot nematode infecting tuberose was identified as *Meloidogyne arenaria*. It took 24 days to complete one life cycle under Dharwad conditions. This is the first report of *M. arenaria* on tuberose from Karnataka. Effect of various inoculum densities, viz., 0, 10, 100, 1000 and 5000 juveniles per plant was tested on tuberose. The inoculum level of 1000 second stage juveniles and above per plant was pathogenic to *Polianthes tuberosa* produced high root knot index and reduced plant growth parameters.

Studies involving dual inoculation of tuberose with five different vesicular-arbuscular mycorrhizae like *Glomus fasciculatum*, *G. macrocarpum*, *Gigaspora margarita*, *Acaulospora leavis* and *Sclerocysts dussii* and *M. arenaria* showed that *Glomus fasciculatum* and *G. macrocarpum* inoculated plants produced maximum plant growth parameters and recorded more mycorrhizal colonization percentage and VAM spore counts and reduced root knot index and final nematode population in the soil.

Shringar and Suvasini were found resistant to *M. arenaria* which recorded less root knot index, final nematode population in soil, number of eggs/egg mass and reproduction factor value. Evaluation of bioagents like *Paecilomyces lilacinus* and *Pasteuria penetrans* and two nematicides each at two different levels revealed that *Paecilomyces lilacinus* (10 g/plant) and nematicides carbofuran and phorate each at 2 kg a.i/ha were found effective in mitigating the pathogenic effects of nematode. These treated plants recorded more plant growth parameters, reduced root knot index and final nematode population in the soil.

Studies on Powdery Mildew of Greengram (*Vigna radiata* (L.) Wilczek) Caused by *Erysiphe polygoni* DC.

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Among several diseases affecting green gram crop, powdery mildew, caused by *Erysiphe polygni* DC. is important in kharif season and becomes a major constraint in greengram cultivation. Therefore, this disease has been studied in detail with different objectives aiming at the control of this disease.

Based on the study of different dates of sowing (9th July to 7th September) it is observed that the early sowing (9th July) is best in terms of lesser disease incidence and highest grain yield. The rate of disease development per unit per day was observed between 28th August and 7th September. The plants of 40 and 50 days old were highly susceptible to the disease. Maximum conidial germination was observed between 18-22°C temperature and 90 per cent of relative humidity.

In case of *in vitro* evaluation of five fungicides and one plant extract, Difenconazole (0.05 and 0.1%) was found most effective. *Ocimum canum* extract (8 and 10% was least effective in inhibiting the conidial germination. Whereas, in field evaluation of fungicides, Difenconazole (0.1%) gave best results in controlling the disease and recorded maximum grain yield. *Ocimum canum* extract (10%) was least effective and recorded lowest yield. Wettable sulphur gave the highest cost : benefit ratio, whereas penconazole gave the lowest. The rate of spread of powdery mildew was low in, Definconazole tretaed plot.

Among seven inoculation techniques tried, dusting of conidia with camel hair brush was found to the best one. Among 11 weed hosts tested, *Euphorbia hirta* was proved to be a collateral host for powdery mildew of greengram.

Among 58 greengram genotypes screened for resistance to disease, only black greengram was found to be resistant against powdery mildew.

Studies on Foot Rot of Sunflower (*Helianthus annuus* L.) Caused by *Sclerotium rolfsii* Sacc.

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Among several diseases affecting sunflower, foot rot caused by *Sclerotium rolfsii* Sacc. one of the important diseases in rainfed areas of northern Karnataka. As it is on increase therefore this disease has been studied with main objective of its biological control. The pathogen isolated by tissue isolation from infected sunflower roots was found pathogenic to sunflower and was identified as *Sclerotium rolfsii* Sacc. on the basis of morphological characters.

Among the organic amendments tested, FYM was more effective followed by neem cake, wheat straw and paddy straw in reducing the population of *S. rolfsii*. Further the population of fungi, bacteria and actinomycetes increased with the increase in the interval after incorporation of amendments. Bicontrol has proven as effective means of reducing diseases through potentila antagonists. *In vitro* studies *T. harzianum* number of sclerotial bodies of *S. rolfsii* formed were also significantly reduced. Seed treatment @ 4 gm/kg seed as well as soil application @ 20 ml per pot with antagonistic organisms effectively reduced the foot rot. However, soil application with *T. harzianum* was relatively less effective.

Six genotypes viz., 6-D-1, Gene poo, MSFH-17, DSH-4, Morden, DSH-17 were tested for their varietal resistance. Although, none of the genotype showed desired level of resistant reaction but DSH-17 showed less disease.

In vitro T. harhianum + Blitox combination reduced growth and sclerotia of *S. rolfsii*, whereas *T. viride* + Thiram was particularly effective in reducing the production of sclerotial bodies. In pot experiments, the per cent mortality of sunflower seedlings was least in *T. harzianum* + Thiram combination as compared to other treatments.

Studies on Fusarium Stalk Rot of Sorghum (*Sorghum bicolor* (L.) Moench) Caused by *Fusarium moniliforme* Sheldon

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Among the several diseases affecting sorghum crop, Fusarium stalk rot of sorghum caused by *Fusarium moniliforme* Sheldon has become increasingly common wherever sorghum is grown. Five fungal species, namely, *Fusarium moniliforme*, *F.moniliforme* var. *subglutinans*, *F. semitectum*, *F. oxysporum* and *Fusarium* sp. (Section Liseola) were isolated from the roots and stalks of diseased platns during kharif and rabi seasons. *F. monilioforme* was the dominant species which accounted for 5.36 per cent in kharif and 12.49 per cent in rabi season.

In pathogenicity test, *F. monilioforme* was proved to be the most destructive pathogen which caused lodging of plants to the extent of 85 per cent. Various microorganisms were isolated from rhizosphrere soil and identified as *Aspergillus niger*, *A. flavus*, *Penicillum chrysogenum* which produced inhibition zones of 1.0, 1.0 and 1.5 mm in size against *F. moniliforme* respectively. Whereas *Trichoderma viride* and *T. harzianum* overgrew and arrested the growth of *F. moniliforme*.

Organic amendments such as neem cake, sunhemp and vermicompost were found effective in suppressing the saprophytic activity of the fungus. Among the organic amendments, neem cake was found most effective in suppressing the saprophytic activity of the fungus and as such it brought down the disease incidence to a considerable extent (26.67%).

In combination effects of antagonists and fungicides *T. viride* and carbendazm reduced the disease incidence to a considerable extent (80.00%). In case of *in vitro* evaluation of fungicides bavistin (1000 ppm) and thiophanate methyl (1000 ppm) were most effective in inhibiting the mycelial growth of *F. monilioforme*. Under pot culture studies, seed treatment with any fungicide did not reduce the disease. However, considerable disease reduction (86.67%) was obtained with soil drenching of bavistin (0.1%) to the infested soil.

Further Studies on Mosaic of Chilli (*Capsicum annuum* L.)

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The survey conducted during 1996-97 in the chilli growing parts of Northern Karnataka indicated that the mosaic incidence ranged from 0.1 to 75.0 per cent with an average incidence of 19.24 per cent and more mosaic incidence was noticed in irrigated condition (22.92%) compared to rainfed (16.4%). Among the varieties cultivated in the farmers fields local variety (61.98%) showed higher incidence than hybrids Mahyco-F1 (2.3%) and Kiran (3.76%).

In the field the symptoms were noticed as mosaic mottling, reduced leaf size, stunting, rat tailing veinbanding and curlings. Based onthe symptoms on seedlings of chilli cv. Byadgi kaddi and reaction on indicator hosts, the samples were grouped into four groups i.e. Group-I, Group-II, Group-III and Group-IV. Possibly the viruses involved were pepper vein banding, pepper vein mottle, tobacco mosaic and cucumber mosaic viruses.

The evaluation of plant extracts and insecticides indicated that application of 5 sprays of Metasystox (0.075%) and Dicofol (0.2%) in combination gave maximum reduction of mosaic disease, among plant extracts, Parthenium leaf extract (10%) gave maximum reduction of mosaic disease. Aluminium foil mulching, intercropping of chilli with onion, raising maize crop as border rows around the chilli field resulted in reduction of mosaic disease.

Among the 36 entries LCA-312, G-4, Pusa Jwala, LCA-206, GPC-69, Pant C-1 (Coimbatore0 and S-32 showed the resistant reaction against mosaic disease.

Biological Control of Pigeonpea Wilt Caused by *Fusarium udum* Butler

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Fusarium wilt of pigeonpea (*Cajamus cajan (L.) Millsp.*) caused by Fusarium udum is an important disease and is a major constraint in pigeonpea production.

Pathogenicity test revealed that, the affected plants exhibited loss of turgidity in leaves, slight interveinal clearing, foliage shows slight chlorosis and becomes bright yellow before wilting, wilted plants after splitting showed brown vascular discoloration.

The population of antagonistic bacteria, fungi and actinomyeetes were higher in rhizosphere soil of healthy plants. Fungi viz., *Trichoderma viride, Aspergillus flavus. A niger, penicillium spp.*, were isolated and found to be antagonistic to *F. udum Rhizosphere* soil wilted plants comprised mainly *F. udum.*

The highest percent survival of plants was recorded in neem cake amended soil and it was also most effective in reducing the wilt incidence. It was followed by compost, FYM and groundnut oil cake amended soil.

Among natagonistic organisms evaluated Trichoderma viride, T. harzianum (overgrew the test fungus) and *Pseudomonas fluorescens* (produced 7.5 mm inhibition zone) were most effective in reducing wilt incidence and also reduce spore germination and viability. Streptomyces spp., produced 13.2 mm inhibition zone.

Compatibility studies revealed that, *T. viride* and *T.harziamum* in combination with *Carbendazim* reduced the growth of F. udum. The combined effect of *T.viride+ Carbendazim* reduced the wilt incidence, follwed by *T.viride+ Captan, T.Harzianum + Carbendazim* and *T. harzianum+ Captan* treatment.

SEED SCIENCE AND TECHNOLOGY

Effect of Seed Colouring on Field Performance and Seed Storability in Hybrid Maize

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An investigation was carriedout to study the effect of seed colouring on field performance and seed storability in hybrid maize duimg 1996-97 a the Department of Seed Science and Technology, UAS, Dharwad. Seeds were treated with four dyes viz., Amaranthus red, Sunset yellow, Methylene blue and Potassium permanganate each at three concentrations of 0.0, 0.5 and 1.0 per cent in combination with or without fungicide and seeds were stored for 16 months in cloth bag under ambient conditions.

Throughout the storage period, seeds treated with Amaranthus red and Sunset yellow showed higher germination

percentage and vigour index compared to Methyl blue while, seeds treated with Potassium permanganate resulted in drastic reduction of germination and vigour index. Potassium permanganate treated seeds exhibited higher EC values throughout the storage over other dyes. The seed moisture content fluctuated concomitantly with the change in relative humidity and temperature of storage atmosphere. Among dyes, seed treatment with Amaranthus red offered resistance to insect infestation, while potassium permanganate showed least infection of storage fungi during storage.

The germination percentage and vigour index was maximum at 0.5 per cent concentration of dyes, followed by 1.0 percent and minimum in control. Throughout the storage period, the EC of seed leachate was more in the seeds treated at higher concentration of dyes, while the percentage of insect infestation and occurence of fungi were less at higher concentration. The fungicide treated seeds recorded higher germination percentage and vigour index and less EC, insect infestation and storage fungi infection throughout the storage.

The field performance studies with dye treated seds indicated that there was no adverse effect on field emergence, growth parameters, yield and yield attributes in maize.

Effect of Growing Seasons on Performance of Parental Lines and Varieties of Sorghum (*Sorghum bicolor* L. Moench)

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The experiment was conducted durig kharif and rabi season of 1996-97 at the Main Research Station, Dharwad to study the effect of growing seasons on quantitative and qualitative characters of parental lines and varieties of sorghum. The experiment consists of threee main (sowing dates) and 14 sub (genotypes) treatments and laid out in randomised block design with three replications. The analysis of variance showed significant differences among genotypes, environments and their interactions for majority of characters. The non linear (remainder) component was significant for plant height and flowering which are important charactt.rs for successful seed production.

All the genotypes showed higher values for growth parameters, yield and yield components during kharif and late kharif, but rabi recorded higher seed quality parameters. The genotypes took more number of days to flowering rabi compared to kharif and maintainer lines were slightly early compared to their respective male sterile lines.

The majority of the genotypes had stable pigmentation in all the seasons, but the genotypes AKMS-14B, CS-3541 and CSV-14R showed changes in the intensity of plant pigmentation as an effect of season. Among genotypes, SB7001 recorded higher seed yield during kharif and late kharif while M35-1 in rabi season. The seed yield of female parents during kharif and late kharif was very low even though they exhibited more ear length, ear width, which may be due to higher incidence of downy mildew and sugary diseases. The quality of seeds produced during rabi was superior compared to kharif/late kharif for hybrid or parental line seed production.

Effect of Late Leaf Spot, Rust and Harvesting Dates on Seed Yield and Storability of Groundnut (*Arachis hypogae* L.)

CHETANA PATIL 1997 MAJOR ADVISOR : Dr. A. NAGARAJA

The investigations were carried out to study the effect of late leaf spot and rust diseases on yield and seed quality of groundnut varieties TMV-2, Dh-40, Dh-3-30, JL-24, TAG-24 andR-8808 and the effect of harvesting dates on storability of these varieties at the Main Research Station, University of Agricultural Sciences, Dharwad. The variety R-8808 recorded maximum days for 50 per cent flowering and maturity. The intensity of late lead spot was high in Dh-40 whereas rust was more severe on JL-24 under unprotected condition. The variety TAG-24 had significantly low incidence of late leaf spot and more number of pods plant^{-1}, sound matur ekernel, yield plant^{-1} and yield plot^{-1} under disease protection coupled with normal harvesting. The variety Dh-40 revealed higher shelling percentage, germination and oil content, whereas variety R-8808 possessed higher 100 seed weight. Contrary to this, variety TMV-2 recorded lower values under unprotected condition coupled with delayed harvesting.

In storability studies, except electrical conductivity and fungal colonization all other seed quality parameters declined gradually with the increased period of storage. However, there was fair degree of retention of seed quality in crop protected condition coupled with normal harvesting. The variety Dh-40 recorded maximum germination and oil content throughout the storage period (six months) under disease protection, while under unprotected condition its germination was minimum and

was accompanied with high electrical conductivity and fungal invasion. However, the variety JL-24, registered highest vigour under disease protection and at normal harvest. In seed colonization the fungi increased as the storage period increased, but was minimum under disease protected condition and at normal harvest. Of the two fungi, inection of *Aspergillus* spp. was severe on TMV-2, while *Macrophomina* spp. was found only on Dh-40.

Effect of Seed Colouring on Field Performance and Seed Storability on Soybean (*Glycine max* (L.) Merrill)

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An investigation was carried out to study the effect of seed colouring on field performance and seed storability on soybean (*Glycine max* (L.) Merrill) during 1996-97 at the Department of Seed Science and Technology, UAS, Dharwad. Seeds were treated with four dyes viz., Amaranthus red, Sunset yellow, Methylene blue and Potassium permanganate eacha t three concentrations of 0.0, 0.5 and 1.0 per cent in combination with or without fungicide and seeds were stored for 9 months in cloth bag under ambient conditions.

Throughout the storage period, seeds treated with Amaranthus red and Sunset yellow showed higher germination percentage and vigour index compared to Methylene blue while seeds treated with Potassium permanganate resulted in drastic reduction of germination and vigour index. Potassium permanganate treated seeds exhibited higher EC values throughout the storage over other dyes. The seed moisture content fluctuated concomitantly with the change in relative humidity and temperature of storage atmosphere. Among dyes, seed treatment with Potassium permanganate showed least infection of storage fungi during storage.

The germination percentage and vigour index was maximum at 0.5 per cent concentration of dyes, followed by 1.0 per cent and minimum in control. Throughout the storage period, the EC of seed leachate was more in the seeds tretaed at higher concentration of dyes, while the occurrence of fungi was less at higher concentration. The fungicide treated seeds recorded higher germination percentage, vigour index, less EC and storage fungi infection throughout the storage. The field performance studies with dye treated seeds indicated that there was no adverse effect on field emergence, growth parameters and yield and yield attributes in soybean.

Effect of Dates of Harvesting on Seed Yield, Quality and Storability in Sunflower (*Helianthus annuus* L.) Genotypes

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An attempt was made to study the "Effect of Dates of Harvesting on Seed Yield, Quality and Storability in Sunflower (*Helianthus annuus* L.) Genotypes". The experiment was laidout in randomised block design with factorial concept in four replications during kharif 1996-1997 at the Agricultural College Farm, Dharwad. The experiment consisted of two factors i.e., four sunflower genotypes (Morden, KBSH-1 (AXR), CMS-234B and 6D-1) and six dates of harvesting (15, 20, 25, 30, 35 and 40 days after flowering) with 24 treatment combinations. Over the genotypes with the advancement of harvesting dates from 15 to 40 DAF increase in seed yield and yield attributing characters were recorded. All the genotypes recorded maximum capitulum diameter, dry weight of the capitulum, filled seed number, per cent seed set per head, oil content, test weight, seed yield per plant and seed yield per hectare, when harvested at 35 DAF and subsequently decreased to a slight extent when harvested at 40 DAF, while, the husk percentage and initial moisture content of seed was found to decrease with advancement of harvesting dates. As the harvesting date was advanced from 15 DAF to 40 DAF the increase in percentage germination and decrease in abnormal seedlings, dead seeds and fresh ungerminated seeds were recorded in all the genotypes when the test was conducted at 30 days after harvest. The highest germination (52.96%) recorded when harvested at 40 DAF and was below the minimum certification standards of 70 per cent for sunflower crop, which indicated the prevailence of dormancy within seed even upto 30 days after harvest. With the advancement of harvesting dates from 15 DAF to 40 DAF the field emergence percentage increased over the genotypes while, the EC decreased. The seed quality parameters were tested at 60, 120, 180 days after harvest during storage. With the advancement of harveating dates from 15 DAF to 40 DAF percentage germination, seedling length, dry weight of seedling and seedling vigour index when harvested at 35 DAF and subsequently decreased to a slight extent when harvested at 40 DAF. Harvesting this stage i.e., between 35 to 37 DAF is best sunflower genotypes wherein they recorded the maximum yields and its attributing characters and further these seeds could be stored without loss in seed germination and vigour even upto 180 DAH.

Effect of Stages of Harvesting and Drying Methods of Seed Quality in Onion

PLANT PATHOLOGY

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An experiment was carried out at Agricultural College, Dharwad during 1995, to study the effect of stages of harvesting and drying methods on seed quality in onion. The experiment consisted of six stages of harvesting (35 days, 42days, 49 days, 56 days, 63 days and 80 days after 50% flowering) and five methods of drying (sun drying, shade drying, hot air drying at 35ºC, dehumidified air drying without cooling the air and dehumidified air drying with cooling the air.) The experimental results were analysed under randomised block design.

Out of six stages of harvesting, harvesting of onion seeds at 63 days after 50 percent flowering (H_3) or 125 days after bulb planting recorded highest 1000 seed weight (3.35g), more number of seeds per umbel (731.50), highest seed yield per plant (13.00 g) and seed yield per hectare (70 qtl).

harvesting of onion seeds at 63 days after 50 percent flowering or 125 days after bulb planting (H_5) had higher seed quality in terms of laboratory germination, field emergence, shoot length, root length and vigour index recording 78.00 percent, 76.50 percent, 8.50 cm, 6.50 cm and 11.30, respectively.

Irrespective of stages of harvesting, seeds dried at 35ºC air temperature resulted in increased seed quality in terms of laboratory germination (51.50%), field emergence (46.60%) vigour index (776) and other related quality parameters follwed by seeds dried under sun. Seeds harvested at 63 days after 50% flowering (125 days after bulb planting) and dried at 35ºC air temperature recorded highest seed quality in terms of laboratory germination (82.88%), field emergence (73.30%, vigour index (1429) followed by seeds harvested at H5 and dried under sun.

Therefore, it is concluded that good quality seeds could be produced from seeds harvested 125 days after bulb planting (H5) and drying the seeds at air temperature of 35ºC.

Effect of Extraction and Drying Methods on Quality of True Potato Seed (*Solanum tuberosum L.*)

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Considering the inadequacy of information and importance of true potato seed extraction and drying, the present investigation was carried out at the Department of Seed Science and Technology, University of Agricultural Sciences Dharwad, during 1996-97.

Experiment consists of seven extraction methods viz., Manual (control), Mechanical, alkali (NaOH and $NaHCO_3$), acid (HCL and H_2So_4) and fermentation and six drying methods viz., Sun, shade, mechanical drying at air temperature of 35ºC and 40ºC dehumidified air drying and dehumidified air drying with cooling the air.

Among the extraction methods, acid extracted seeds required less time (4h) and less number of washings (4) with high seed recivery (4.72 g/kg of fruit), fermentation method of extraction required more time (48h), medium washings (7) and seed recovery (4.28 g/kg of fruit)., while mechanically extracted seeds required medium time (6h), high number of washings (8) and low seed recovery (4.18 g/kg of fruit) The $NaHCO_3$ method of extraction was costliest (Rs. 135/q of fruit), compared to all other methods. The HCl and H_2SO_4 extracted seeds were significantly superior in germination (96.37% and 96.83%), field emergence (91.12% and 91.66%) and vigour index (654 and 667) respectively. Lowest germination (90.20%, field emergence (87.16%) and vigour index (499) were observed in mechanically extracted seeds.

In drying studies, dehumidified air drying has taken less time (5 h) compared to sun drying (14 h) and shade drying (26 h). Seeds dried at air temperature of 35 ºC recorded high germination (95.76%), field emergence (91.11%) and other seed quality parameters, while shade drying recorded lowest values for germination (91.61%), field emergence (87.64% and other quality parameters. In interaction effect, acid extraction followed by manual (control) extraction and dried at 35ºC or in sun recorded higher seed quality parameters.

Seed Quality and Storability Studies in Chilli (*Capsicum annuum L.*)

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Experiments were conducted on chilli varieties Dyavanoor local and Byadagi kaddi at the main research section, University of Agricultural Science, Dharwad during *Kharif* 1996 to investigate the effect of fungicidal sprays on field performance, fruit yield and seed quality. In the laboratary, effect of containers, seed dressing fungicides and methods

of storage on seed stroability were looked into.The chilli varieties exhibited signiicant differences in dieback and fruit rot incidence. Dyavanoor local sprayed twice with chlorothaloni 0.1 per cent at 15 Byadagi kaddi produced higher fruit yields.

Seed quality parameters such as 100 seed weight, germination, shoot and root length seedling dry weight, vigour and field emergence were highest in the variety Byadagi kaddi sprayed twice with Chlorothalonil coupled with the fruit picked at 145 days after planting. With respect to storability over a period of six months, there was a fair degree of preservation of seed quality in seeds treated with Captan 2g per kg and stored in polythene bag. However, irrespective of fungicides, containers and methods of storage, the seed quality of both the varieties docreased while fungal colonization increased with the increased period of storage. The highest quality was realized from the seeds of variety Byadagi kaddi which were stored as fruits in polythene bag.

FARM POWER AND AGRO ENERGY

Investigations on the Characteristics of Bio-Materials on Biogas Production

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The experiments were conducted to evaluate the characteristics of three feed stocks namely; vegetable waste, cattle grass and willow dust in combination with animal dung for biogas production under batch fed system. The performance of above stocks were evaluated at three proportions of 1:1, 2:1 and 3:1 and compared with 100% animal dung. The prototype digesters of 75 liters capacity of three different height to diameter rations of 1:0.5, 1:1 and 1:1.7 with the above feed stocks at 3:1 proportions were compared with 1:1 size digester fed with 100% animal dung. The results revealed that the cumulative gas production in vegetable waste were 4077 ml, 3304 ml and 2993 ml in 1:1, 2:1 and 3:1 respectively, the values for cattle grass were 3512 ml, 3104 ml and 2675 ml and 2155 ml, 1745 ml and 1510 ml in willows dust respectively. A total gas production of 5833 ml was recorded in control treatment. The average percentage of methane content in 1:1, 2:1 and 3:1 proportions if vegetable waste were 31.3, 27.35 and 24.83, respectively. The corresponding values in cattle grass were 24.87%, 21.1% and 17.47% and 38.65%, 34.6% and 32.87% in willows dust respectively. The average methane content was 41.92% in control treatment. A total gas production of 452.89 liters, 409.83 liters and 337.18 liters were recorded in 1:1.7, 1:1 and 1:0.5 size digesters fed with vegetable waste and in cattle grass these values were, 419.34 liters, 367.24 liters and 300.66 liters and 383.16 liters, 339.27 liters and 270.97 liters in willow dust respectively and 435.72 liters was recorded in control treatment. The average percentage of methane content in 1:1 size digester from the vegatable waste, cattle grass and willow dust were 53.12, 45.68 and 54.06 respectively and 46.76% in control treatment.

Investigations on Charecterstics and Performance of Vegetable Oils as Fuels in I.C. Engines

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Experimental investigation was conducted on vegetable oils namely; sunflower, groundnut cotton seed and neem oils and their blends of 10,20 and 30 percent with diesel fuel to study their physical properties. The performanance tests were conducted on a single cylinder 5 hp victor diesel engine at four different load settings (20,40,60 and 80% of rated load) using blends of sunflower and groundnut oils and compared with that of diesel fuel.

The results indicated that the kinematic viscosity of vegetable oils and their blends at room temperature of 36° were 13.28 to 20.93 and 1.22 to 2.42 times higher than that of diesel fuel (2.570 Cst), respectively. The specific gravities of these oils and their than that of diesel fuel (0.8438 36°c), respectively. The calorific value of vegetable oils and their blends were 86.35 to 87.78 and 89.75 to 96.41 % of the calorific value of diesel fuel (10552.89 K.Cal/kg), respectively.

The engine performance tests indicated that the brake horse power developed with the blends of sunflower and groundnut oils were 2.70 to 15.52 % and 11.33 to 17.00% lower as compared to diesel (0.650 to 3.270 hp), respectively. The brake specific fuel consumption of engine for diesel was 6.82 to 30.61% and 16.66 to 34.60% lower than that of the brake specific fuel consumption observed for sunflower (0.290 to 0.769kg/bhp-hr) and groundnut oils (0.324 to 0.786 kg/bhp-

hr), respectively. The operating cost of engine for blends of sunflower and groundnut oils were 15.11 to 95.00 % and from 43.75 to 122.00% higher as compared to the operating cost of diesel (Rs.4.00 to 8.90 /bhp-hr), respectively.

Breeding Tomatoes for Processing and Fresh Market

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An investigation was carried out during kharif and rabi seasons of 1996-97 at the Division of Horticulture, University of Agricultural Sciences, Dharwad to find out variability for yield and quality characters and to select superior segregants for processing and fresh market in five F_2 tomato populations of L-15 x UC 204-B, DWD-2 x DWD-1, CA-1 x DWD-1, 79B-1380 x L-15 and DWD-1 x DWD-2. They were studied for various genetic parameters like F_1 and F_2 heterosis, variability, heritability (H), genetic advance (GA) and correlation coefficient in F_2 and analysis of variance in F_3 genetic advance (GA) and correlation coefficient in F_2 and analysis of variance inF_3 on eight characters viz., days to first flower, number of locules per fruit, pericarp thickness, TSS, pH, number of fruits per plant, yield per plant and average fruit weight. Positive F_1 heterosis was noticed in the cross DWD-1 x DWD-2 for fruit yield with desirable fruit size of 75-100 g. F_2 heterosis was not found advisable in all five populations because of high variability for different characters, especially to fruit size.However, it indicated the possibility of developing varieties through selection for different purposes like processing and fresh market as they showed high H and GA. This was elucidated from F_3 studies. The populations found suitable to advance for processing tomatoes were L-15 x UC204-B and DWD-2 x DWD-1 and that for fresh market and kitchen garden were DWD-1 x DWD-2 and 79B-1390 x L-15, respectively. Correlation studies have provided clue to select high yielding plants on the basis of number of fruits per plant as an important yield contributing character with due weightage of fruit size for specific purpose.

Studies on Induction of Rooting in Shots of Juvenile Plants in Guava (*Psidium guajava* L.)

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An investigation on induction of rooting in shoots of juvenile plants in guava using different growth regulator formulations was conducted during 1996-97. The study pointed out that among the different growth regulator formulations tried for air-alyering, IBA, 3000 ppm+ NAA, 3000 ppm formulation promoted rooting by 88 per cent as against 38 per cent in the control. The treatments IBA, 3000 ppm + NAA, 1000 ppm and IBA used singly at 3000 ppm also promoted rooting and better root characters. The use of medium concentration (3000 ppm) applied singly was more effective as compared to use of either lower (1000 ppm) or higher (5000 ppm) concentration in respect of both the growth regulators. It was also noted that pre-treatment of layers with IBA, 3000 ppm + NAA, 3000 ppm formulation helped better establishment of the root induced layers.

In case of experiment on juvenile semi-hardwood cuttings, it was found that the cuttings did not root at all in the absence of application of root promoting compounds. Among the different levels of IBA tried, the cuttings which received IBA, 2500 ppm gave the highest (33.33%) rooting.

It could be surmised that the pre-treatment of juvenile shoots in the ground nursery (gene bank) with IBA 3000 ppm + NAA, 3000 ppm would be beneficial for multiplication of plant material by air-layering in guava. Alternatively, juvenile shoot cuttings could also be used for multiplication under mist by application of 2500 ppm IBA.

Evaluation of Introduced Cashewnut (*Anacardium occidentale* L.) Cultivars Under Transitional Tract of Karnataka

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The investigations on growth and productivity of eight cashewnut cultivars viz., Vengurla-1, Vengurla-2, Vengurla-3, Vengurla-4, Vengurla-5, Vengurla-6, Ullal-1 and Ullal-2 of three year old were carried out at Agricultural Research Station, Kanabargi during the year 1996-97 and standardization of season for *in situ* softwood grafting in cashew was carried out at plantation unit, Division of Horticulture, University of Agricultural Sciences, Dharwad during the year 1996-97.

Cultivar Vengurla-5 was the earliest to produce new flush in the season, where as, Vengurla-3 and Vengurla-4 were the last to prduce new flush in the season. Vengurla-3 recorded the highest tree volume and number of shoots per square metre are of tree canopy. Vengurla-4 recorded the maximum leaf area per shoot among the cultivars. The shortest period of blooming was observed in Vengurla-2 (96.93 days), followed by Vengurla-5 (100.68 days). The longest period of blooming was observed in Ullal-1 (142.75 days). The highest number (376.16) and percentage (42.47) of perfect flowers per panicle were recorded in Vengurla-3. The highest sex ratio of 0.73 was recorded in Vengurla-3, followed by Vengurla-5 (0.47), Vengurla-2 (0.47) and Vengurla (0.43).

Ullal-2 recorded the highest fruit set per cent (11.62) per panicle, and the highest fruit retention per cent was observed in Vengurla-4 (47.81). Vengurla-4 produced the highest nut yield per tree of 376.66 g and 976.06 g during 1996 and 1997, respectively. Vengurla-3 was next in nut yield per tree for both the years. Shelling percentage was maximum (28.42) in Ullal-1, followed by Vengurla-4 (27.40%) and minimum in Vengurla-2.The maximum total soluble solids (18.25°B) and total sugar content (13.84%) was found in Vengurla-3. Apples of Ullal-1 recorded the highest ascorbic acid content (260.31 mg/100g). Among the month of grafting (August to March), August and September recorded the highest success percentage (99.33% both), followed by October (80.00%).

Standardization of Agrotechniques for Seedling Tuber Production from True Potato Seeds (TPS)

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Field experiments were conducted at the Main Research Station, Dharwad during kharif and rabi seasons of 1996-97 to know the effect of growth retarding chemical mapiquat chloride and levels of plant population densities on true potato seedlings (HPS 7/67) transplanted for the production of seedling tubers in nursery. During kharif the experiment was laid out in split plot design with three concentrations (0,100 and 150 ppm) of mapiquat chloride sprayed twice (first spray in nursery a day prior to transplanting and second spray at 30 days after transplanting) as main plot treatments and four population densities (100, 133, 200 and 267 plants/m^2) as sub plot treatments. The top performing seven treatment combinations from kharif experiment were retested in randomized block design during rabi season. The results of the experiment indicated that the seedling tuber yields in kharif and rabi (24, 78 and 22.38 t/ha respectively) were comparable, suggesting the suitability of both the season for raising seedling tubers from TPS. Spraying of mapiquat chloride had significantly influenced the growth parameters (leaf area and plant spread) and yield parameters (Tuber number, weight of tuber and tuber dry matter). But it had no significant effect on total or graded tuber yield per hectare.

The levels of plant population densities had significant influence in total as well as graded seedling tuber yield. The population density of 200 plants/m^2 had yielded higher (26.51 t/ha) seedling tubers closely followed by 267 plants/m^2 (24.93 t/ha) during kharif 1996. The population densities also influenced the weight of the tubers, tuber number, leaf area and plant spread. The two seasons, experiments conclusively revealed that the treatment combination D_2C_1 (133 plants/m^2) without any spray of mapiquat chloride) with a mean yield of 25.10 t/ha was found most profitable in view of its high (1.39) net production value. Mapiquat chloride as well plant densities had no effect on the storage qualities of the tubers.

Storage Studies in Tomato (*Lycopersicon esculentum* Mill.) cv. Megha Fruits

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An investigation was carried out to evaluate the effectiveness of packaging with or without $KMnO_4$ and post-harvest treatment with ethanol vapour (2 ml and 4 ml per kg fruits), waxol (6 and 12%), neem oil, boric acid (0.5%) and bavistin (500 ppm) on physico-chemical changes, organoleptic characters, post-harvest disease control and shelf-life of