

**ROLE OF CYCLIC SELECTIONS AND INDUCED MUTATIONS FOR
IMPROVEMENT OF RESISTANCE TO ATERNARIA LEAF BLIGHT
(*ALTERNARIA HELIANTHI*) AND SEED YIELD IN SUNFLOWER (*HELIANTHUS
ANNUUS* L.)**

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2003 (Year Submitted)

(Th7762) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Alternaria leaf blight (*Alternaria helianthi*) is one of the most important diseases of sunflower causing significant yield losses in India and other tropical countries. Development of resistant cultivars offer the most feasible economic means of disease control. However, high level of resistance to this disease is not available in the *Helianthus* species. Therefore, interspecific derivatives and germplasm accessions were tested for disease resistance, seed yield and yield components over three years. Eight genotypes showed consistently lower PDI values and higher seed yield over the check Morden. These potential lines can serve as source material for future resistance breeding programme.

Only partial resistance is available to *Alternaria* leaf blight in sunflower and is controlled by several genes with small effects. The best way to accumulate such partial resistance genes would be through recurrent selection. A recurrent selection with gamete selection can overcome the limitation of population size and selection intensity observed incase of selection based on sporophyte alone. There was significant reduction in the mean PDI values of the population after two cycles of selection and intermating (C₂). The populations improved by combining both sporophytic and gametophytic selection (C₂G₂) recorded significantly lower PDI values compared to populations improved by sporophytic selection alone. There is a need to involve more number of such cyclic selections to achieve desirable level of resistance.

Further, variability to *Alternaria* leaf blight resistnce can be generated through induced mutations. The mutation breeding programme utilising gamma rays (20 kr and 30 kr)in four genotypes has also yielded good results in generating a greater variability. Out of the 227 mutant derivatives selected in M₂ and evaluated in M₄ and M₅ generations, 22 lines have been identified as superior with low PDI values and higher seed yield. These lines can also serve as the base material for further improvement.

STUDIES ON SALT AFFECTED VERTISOLS OF UPPER KRISHNA PROJECT (UKP) COMMAND AREA

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2003 (Year Submitted)

(Th7807) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

A study on salt affected soils of UKP command areas was undertaken with objectives to study the nature and properties of salt affected soils occurring on different geological formations, understand their pedogenesis, examine their classification as per Soil Taxonomy and to understand the spatial and temporal variation of salinity in a pilot area.

Fifteen pedons from different geological formation were studied. The structure was predominantly subangular blocky in the surface grading to massive in the lower horizons. Slickensides were commonly observed in the lower solum in majority of the pedons. Among different fractions of sand, coarse, medium and fine sand fractions contributed to the bulk of total sand. The clay content increased with depth in all the pedons. The texture remained clay throughout the depth in all the pedons except Talawargera and Badyapur. Moisture retention in all the soils followed the trend of clay. The soil pH varied from slightly alkaline to strongly alkaline and it generally decreased with depth.

Among the different cations sodium predominated, followed by calcium and magnesium. Soluble potassium content was the least. Among the anions, sulphate generally predominated over chloride in most of the pedons. The cation exchange capacity increased with depth in almost all pedons and followed the trend of clay distribution. The soils derived from basalt recorded lower ESP values compared to those from granite gneiss and limestone with the exception of Malnoor. The calcium carbonate content was higher in soils derived from basalt and limestone than soils from granite gneiss.

The mineral composition of the sand fraction indicated the dominance of light minerals, composing of mainly quartz, feldspars, mica and calcite. The heavy mineral suite of the granitic soils composed of magnetite, epidote and rutile whereas limestone soils consisted of magnetite, epidote, hornblende, sphene and zircon on contrary to that of basaltic soils which consisted of magnetite, limonite, leucoxene, pyrite and sphene.

The soils are deep to very deep. The physiographic influence is clear in soils around Kaadimatti and those in Hunasagi valley. All these soils are subjected to shallow water table conditions. The physiography is, therefore, the main reason for wide spread salinity in these soils.

In the ORP area though the salinity in 0-15 cm depth decreased in post monsoon season the salinity level in 0-90 cm was higher in post-monsoon season compared to pre-monsoon largely due to lack of drainage.

According to soil Taxonomy all soils are grouped under Vertisols except Talawargera and Badyapur pedons which qualify for Inceptisols. At suborder level owing to the prevailing climatic condition they are grouped under Usterts.

**STUDIES ON EFFECT OF SOIL DEPTHS, N DOSES AND ITS SPLITS ON
GROWTH AND YIELD OF MAIZE (*ZEA MAYS* L.)
AND VALIDATION OF CERES-MAIZE MODEL IN GLBC AREA**

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(Th7796) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Field experiments were conducted at Agricultural Research Station, Kalloli, University of Agricultural sciences, Dharwad during kharif and rabi seasons of 2002-03 to study the effect of soil depths, N doses and its splits on growth and yield of maize and validation of CERES-Maize model in GLBC area. The treatments consisted of three soil depths (shallow, medium and deep black soils) as main plots and nine nitrogen levels (100% RDN, 150 %RDN and 200% RDN at sowing, 30 DAS, 45 DAS and at 60 DAS) as sub plots.

Significantly taller plants, higher LAI, dry matter, grain yield and yield attributes, NUE, B:C ratio, gross and net income, higher uptake of NPK by maize and readily available $\text{NH}_4\text{-N}$ and $\text{NO}_3\text{-N}$ were recorded in deep black soil as compared to medium deep and shallow black soils.

Application of 200 per cent RDN recorded significantly higher plant height, LAI, dry matter, grain yield and yield attributes, higher uptake of NPK by maize and readily available nitrogen as compared to 100 per cent RDN and was on par with 150 per cent RDN. Higher NUE and B:C ratio was noticed in the treatment receiving 150 per cent RDN in four splits but higher gross and net income were registered in 200 per cent RDN in four splits. Application RDN in four splits recorded significantly higher results as compared to two splits but was at par with three splits.

DSSAT's v.3.5 CERES-Maize model predicted number of days to anthesis, maturity, grain yield, test weight (rabi) and kernels per square meter (kharif) closer to that of observed values (deviation < 10%). However, the model over predicted LAI, stalk weight, total biomass, stalk nitrogen, biomass nitrogen and grain nitrogen (kg/ha and %) and under predicted harvest index wherein the deviation was >10 per cent.

Graphical as well as textural representation of grain and straw yield of maize generated by AEGIS/WIN in nine soil series of Jakanatti distributory showed that lower gain and straw yield was noticed in Jakanatti series (Lithic Haplusteps) and higher results were noticed in Vaderhatti series (Typic Haplusterts).

**INTEGRATED MANAGEMENT OF THE FRUIT BORER, *HELICOVERPA*
ARMIGERA (HUBNER)
(LEPIDOPTERA : NOCTUIDAE) IN TOMATO**

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ABSTRACT

Investigations were carried out on integrated management of fruit borer, *Helicoverpa armigera* in tomato during 2001 and 2002 seasons. From the investigations it is revealed that the mycopathogen, *Nomuraea rileyi* @ 2.0×10^{11} conidia per ha + NSKE (5%) sprayed four times proved as effective as HaNPV (250 LE/ha) + NSKE (5%) and endosulfan to lower the larval population and fruit damage. The *N.rileyi* + NSKE protection yielded as much as HaNPV + NSKE and endosulfan treatments and incremental benefit obtained was higher with *N.rileyi* + NSKE (Rs. 11.58) and proved next best endosulfan treatment (Rs. 16.80).

The module comprising of trap crop + *Trichogramma pretiosum* (45,000/ha) - NSKE (5%) - HaNPV (250 LE/ha) - endosulfan (1250 ml/ha) was not significantly superior to RPP and other modules consisting of *N.rileyi* as one of the IPM components viz., *N. rileyi* (2.0×10^{11} conidia/ha) - B.T.K. (0.625 kg/ha) - endosulfan - NSKE and *N. rileyi* - NSKE - HaNPV - endosulfan in restricting the larval incidence fruit damage as well as in increasing marketable fruit yield.

In tomato : marigold (15:1) trap crop ecosystem, imposition of NSKE (5%) on 7 central rows of tomato proved as effective as imposition of NSKE on all 15 rows of tomato in deterring the oviposition by adult female *H. armigera*, which resulted in lowest larval load, fruit damage and highest 5 plants yield per row. Trap crop (marigold) effectively trapped adult moths for oviposition upto 2 to 3 rows from its stand. Similarly NSKE treatment effectively reduced egg, larval load and fruit damage up to 2 rows from the treated row/s. *Nomuraea rileyi* and B.t.k. were most suitable bioagents in addition to HaNPV, which persisted in the field between, 7-10 days compared to *Beauveria bassiana* and *Metarhizium anisopliae* (5-7 days). Efficacy of bioagents based on persistence values were *N.rileyi* > B.t.k. > HaNPV > *B. bassiana* > *M.anisopliae*.

Spinosad 48 SC @ 30 g.a.i. per ha sprayed four times against *H. armigera* in tomato was superior over rest of the insecticides which reduced the fruit borer larvae to the extent of 75.73, 87.21, 100 and 100 per cent after first, second, third and

fourth spray, respectively. Fruit damage was equally reduced in spinosad, (76.87%) indoxacarb (71.38%) and thiodiocarb (72.13%) over control plot. Incremental benefit obtained was higher with spinosad (Rs. 32975) when compared to thiodiocarb (Rs. 27953) indoxacarb (Rs. 27667), methomyl (Rs. 27250), α -cyfluthrin (Rs. 25470) and alanycarb (Rs. 24365).

Dissipation of insecticide residues from the tomato fruits depends upon the temperature. Based on the average half-life value, the persistence of insecticide residues in tomato under field condition were alanycarb (1.87 days) > thiodiocarb (2.09 days) > α -cyfluthrin (1.87 days) > endosulfan (2.52 days) > methomyl (2.57 days) > spinosad (2.89 days) > indoxacarb (3.13 days).

**STUDIES ON THE MANAGEMENT OF COTTON OF PINK BOLLWORM,
PECTINOPHORA GOSSYPIELLA (SAUNDERS) (LEPIDOPTERA :
GELECHIIDAE)**

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(Th7784) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Pink bollworm, *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelichiidae) is assuming a major pest in Northern Karnataka. Investigations were carried out during 1998-99 and 1999-2000 at Dharwad on the seasonal incidence of pink bollworm, loss estimation and management through integration of sirene PBW in plant protection schedule, mass trapping and supervisory control.

The pink bollworm incidence was noticed during first week of September during both the seasons. early sown crop received less damage as compared to late sown

Considering the relationship between the field infestation and weather parameters over the seasons, minimum temperature both morning and evening RH had a significant negative correlation with green boll infestation. The activity of pink bollworm was observed from first fortnight of July to second fortnight of January.

Pink bollworm enters a facultative diapause. The incidence of diapause initiated from first fortnight of March and maximum incidence was observed during first fortnight of May. emergence of PBW moths from diapausing larvae was noticed with the onset of monsoon. Peak emergence was noticed in the month of July and August.

The highest and lowest loss due to pink bollworm infestation observed over the seasons in each parameter ranged from 10.66 to 59.15 per cent, 2.81 to 61.87 per cent, 3.44 to 37.83 per cent and 2.12 to 47.13 per cent in GOB, yield, germination and oil content, respectively. Similarly in qualitative parameters viz., fibre length, fibre strength and uniformity ratio were also affected significantly. The magnitude of loss observed in qualitative parameters were less than quantitative.

Superior control of PBW on green bolls was achieved in extended recommended plant protection (RPP) where synthetic pyrethroids were sprayed in addition to plant protection schedule compared to RPP. The extended RPP block recorded significantly higher seed cotton yield (20.56%) compared to RPP.

Application of sirene PBW for three times in addition to palnt protection schedule reduced the green boll, open boll and locule damage significantly compared to RPP recording higher seed cotton yield (28.61%) of 19.73 t/ha as against 15.34 q/ha in RPP.

Mass trapping with 35 traps/ha was quite convincing interms of moth trap catches resulting in significantlty low green boll, open boll and locule damage. Significantly higher seed cotton yield was obtained from mass trapping block with 35 traps/ha accounting for 24.14 per cent increase over RPP. Among different management practices, three applications of sirene PBW, followed by two applications, extended RPP with pyrethroids and mass trapping with 35 traps/ha were promising altrnatives to RPP.

MOLECULAR CHARACTERISATION, CLONING OF COAT PROTEIN GENE, EPIDEMIOLOGY AND MANAGEMENT OF PAPAYA RINGSPOT VIRUS

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(Th7753) Accession No

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ABSTRACT

Papaya ringspot is a major virus disease of papaya caused by Papaya ringspot virus. It was first reported from island of Oahu in 1938. Its spread to over 30 countries has threatened commercial cultivation and papaya based industries in the world.

The roving survey for disease incidence in Karnataka was undertaken and disease map was produced, which revealed the presence of disease in all the districts except Udupi, Hassan and Kodagu. The disease was severe in northern districts showing 75 to 100 per cent incidence. Infected plants showed mosaic, vein clearing, distortion and mature fruits. In advanced stage, plants dry and collapse at canopy level. The PRSV was transmitted by aphid vector and sap inoculation to healthy plants. The studies revealed that, PRSV had Thermal Inactivation Point of 45° C, Dilution End Point of 10⁻³ and Longevity *in vitro* of 18h. electron microscopic observations revealed flexuous rod shaped virus particles of 750 x 12 nm size. The virus was purified by extraction in phosphate buffer, PEG precipitation, density gradient centrifugation and ultra centrifugation. The antiserum was produced by immunizing rabbit with purified Papaya ringspot virus. SDS-PAGE revealed 31 kD protein band corresponding to PRSV coat protein with coomassie blue and silver nitrate stain. double Antibody sandwich and direct Antigen coating enzyme Linked Immuno Sorbent assay indicated presence of virus particles in skin of stem and fruit but not in flowers, latex, roots and seeds of diseased plant. Western blotting analysis revealed presence of virus particles in samples by formation of dense blue colored band on nitrocellulose membrane. The dot Immuno Binding Assay indicated presence of virus in samples by forming blue colored complex on nitro cellulose membrane. In immuno diffusion test precipitation line appeared around wells containing diseased samples. Immuno RT-PCR yielded 550 bp long Coat Protein gene of PRSV.

The structural staining revealed reduction in size and loss of columnar shape of palisade cell in diseased plant. There was complete disintegration of spongy cells. The reduction in polysaccharides and protein but increase in nucleic acid was observed in diseased plant. The number of fertile pollens was more in healthy flower. The reduction in size of fruits and papain content was observed in diseased

plant. Field trial on pesticides, anti-viral principles, viricides, oils and micronutrient demonstrated their ineffectiveness in controlling the disease but boron spray delayed disease appearance and improved fruit yield. In varietal screening all the 17 cultivars tested were found susceptible to PRSV. The seedlings in insect proof net were free from disease incidence till their transplanting. The meristem tip culture produced good callus in MS medium with 2,4-D and coconut water. The coat protein (CP) gene was amplified by synthesis of cDNA by RT-PCR. The DNA was synthesized by PCR with forward and reverse primers. The CP gene was cloned into pTZ57 R/T vector. The competent DH5- bacterial cells were transformed with pTZ57R/T containing CP gene. The CP gene sequencing results revealed 715 bp long sequence, which was analysed by NCBI BLAST and compared with isolates from different geographical locations.

ANIMAL BASED FARMING SYSTEMS FOR LONG TERM SUSTAINABILITY IN NORTHERN KARNATAKA - A SOCIO-ECONOMIC ASSESSMENT

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2003 (Year Submitted)

(Th7813) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

The study was conducted in three zones of Northern Karnataka with an overall objective of identifying and analyzing the optimality and sustainability of different animal based farming systems. The relevant data was collected from both primary (2001-02) and secondary sources 1990-91 to 2001-02) and were analyzed using tabular, functional and linear programming techniques.

The results show that there was a decline in the area under non agricultural uses, cultivable waste, current fallow and other fallow land, in the case of Zone-I and in the area under non-agricultural uses, cultivable waste and net area sown in Zone-II, there was a positive growth in barren and uncultivable land, current fallow and other fallow lands Zone-III. The share of area under cereals increased in the case of Zone-II and Zone-III, while it showed declining trend in Zone-I. Sugarcane during kharif and bengalgram during rabi were found to be most profitable crops in Zone-I, while in Zone-II, chilli (kharif) were most remunerative. Similarly onion (kharif) and maize (rabi) turned out to be most profitable crops in Zone-III.

Across the selected zones, milk production increased with the farm size and ranged from 4.5-5.0 litre/day/animal. In milk production, green fodder, concentrates and labour were significantly contributing factors in all the three zones, while dry fodder coefficient was significant in Zone-I and Zone-III. Seed coefficient was highly significant for all the crops and systems in Zone-I and Zone-III barring groundnut, while labour was the important input conditioning the crop production in Zone-II.

Sustainability Value Index was higher in all the categories of farms in all the zones of Farming System-I (FS-I) compared to farming System-II (FS-II). In Zone-I, there was marginal decline in the net returns from farming in Model-II compared to existing plant (Rs.66,121). However, there was slight increase in net income in Model-I (Rs. 96,321). As a result, per cent change in net returns over existing plan was marginal in Model-I (44.93%) and Model-II(42.34%). Across all the farm size categories, the net income was the highest in FS-I compared to FS-II, since FS-I contains dairy activity. In Zone-II, the net returns were the highest in FS-I (Rs.10055) compared to FS-II (Rs.8218) on small farms.

Similarly, on medium farms, it was Rs. 28129 and Rs.20704 in FS-I and FS-II, respectively. Contrarily, the trend was reverse for large farms. In Zone-III, the net farm income realized on small farms in FS-I was nearly twice (Rs.12,850) that of FS-II(Rs.5,662). While such a difference of income was marginal on medium farms.

Again income realized on large farms in FS-I was more (Rs.85,154) as compared to Rs.64,617 in FS-II.

**DOCUMENTATION, VALUEARIZATION AND PROMOTION OF UNDERUTILIZED
FOODS FOR NUTRITION
SECURITY OF SCHOOL CHILDREN**

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(Th7771) Accession No
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ABSTRACT

A study entitled Documentation, valuearization and promotion of underutilized foods for nutrition security of school children was undertaken. Totally 375 families from 27 villages comprising 6 agroclimatic zones of Northern Karnataka were interviewed to document the underutilized foods and to assess the nutritional status of families. The underutilized foods are those which are less available, less utilized or rarely used or region specific. Millets(8), pulses, oilseeds and spices(5each), vegetable(15), leafy vegetables and fruits(40 each) were documented as under utilized foods. The nutrient analyses of selected underutilized foods revealed better nutritional profile. Among the millets there was not much variation however in pulses, horsegram was superior compared to '*Lenki*', leafy vegetables (10) and other vegetables(5) were good sources of iron, α -carotene and ascorbic acid.

The valuearized 20 traditional foods with little, foxtail, barnyard and proso millets, soyabean, *lenki* and leafy vegetables viz, Bengalgram leaves, *sambar soppu*, drumstick leaves and *chandanabatta* leaves had better nutritional foods with respect to iron and α -carotene. The cost ranged from Rs. 0.45 to 5.35 per serving. The value added Ready To Eat products viz., foxtailmillet *chakali*, little millet *sev*, little millet khara gritters, gardencress *laddu* and soya *hurigalu* had better nutritional and storage profile and were highly acceptable.

The intervention with the value added traditional products viz., foxtail millet *bisebele bath* with bengalgram leaves, little millet *upama* with bengalgram leaves and gardencress *laddu* for 90 days for 10-12 yrs boys showed significant increase in height, weight, hemoglobin and serum retinol levels compared to control counterparts. There was also reduction in morbidity pattern among experimental subjects. Thus, the nutritious underutilized foods if incorporated in traditional diets can provide nutrition security and ultimately improve the health status of children and found to be a sustainable strategy for combating the hidden hunger.

MAIZE BASED INTERCROPPING STUDIES WITH GRAIN LEGUMES IN VERTISOLS

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(Th7792) Accession No

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ABSTRACT

A field experiment was carried out at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during kharif 2002 to study maize (cv. DMH-2) based intercropping system with grainlegumes viz., Frenchbean (cv. HPR-35), ricebean (cv.RBL-1) and soybean (cv. JS-335) in 1:1 and 1:2 row proportions along with respective sole crops using randomized complete Block Design with three replications. Irrespective of row proportions, legumes did not influence performance of maize significantly. Kernel yield of maize ranged from 4404 to 4556 kg ha⁻¹. Among legumes, soybean (912 kg ha⁻¹) and Frenchbean (863 kg ha⁻¹) recorded significantly higher seed yield than rice bean (710 kg ha⁻¹) and yields of these legumes under intercropping were lower than those of sole crops. Further, seed yield of legumes in 1:2 row proportion was significantly higher than the seed yield in 1:1 row proportion. Maize intercropped with legumes in 1:2 row proportion was superior in utilizing natural resources like light and soil moisture. Land equivalent ratio (1.84) in maize + frenchbean (1:2) and area time eqsuivalent rato (1.65) in maize + ricebean (1:2) were hgiher and comparable with other treatments involving 1:2 row proportion and were significantly superior over 1:1 row proportion and sole crops. higher maize equivalent yield (8068 kg ha⁻¹) , gross returns (rs. 40,519 ha⁻¹) , net returns (Rs. 29,054 ha⁻¹) and B:C ratio (2.53) were recorded in maize + Frenchbean (1:2) intercropping system. Thus, maize + Frenchbean/Rajmash in 1:2 row proportion was found Promising intercropping system in the Northern Transitional Zone of Karnataka.

STUDIES ON INTERCROPPING OF LITTLE MILLET WITH PIGEONPEA ON ALFISOLS OF DHARWAD

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(Th7765) Accession No
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ABSTRACT

A field experiment was conducted on shallow Alfisols at Saidapur farm of Main Agricultural Research Station, Dharwad during kharif 2002 to study the effect of cropping systems and row proportions on productivity and economics of little millet + pigeonpea intercropping systems. The experiment was laid out in Randomised Complete Block Design with nine treatments involving four cropping systems and five row proportions in three replications. Growing of little millet as sole and relay intercropping system recorded significantly higher grain yield (783 and 776 kg /ha, respectively) over intercropped little millet (549 kg /ha). Similarly, pigeonpea in sole stand with recommended planting geometry (90 cm x 30 cm) and wider planting geometry (90 cm x 20 cm) also recorded significantly higher grain yield (682 and 637 kg /ha, respectively) over intercropped pigeonpea (415 kg/ha). Among the row proportions of little millet and pigeonpea 5:1 row ratio recorded significantly higher grain yield of little millet (650 kg/ha) which was on par with 6:2 row ratio (580 kg/ha). But the pigeonpea yield was significantly higher in 2:1 and 4:2 row ratios (522 and 515 kg/ha, respectively). Intercropping of little millet and pigeonpea in 4:2 row ratio recorded significantly higher little millet equivalent yield (1466 kg/ha), LET (1.40), ATER (1.06), MA (2432) and SPI (1101). But it was on par with 2: 1 row ratio. The economics of intercropping systems revealed that growing of little millet + pigeonpea in 4:2 row ratio resulted in maximum gross returns (12095 Rs./ha), net returns (6608 Rs. /ha) and B:C ratio (2.20), which was on par with 2:1 row ratio. Thus intercropping of little millet with pigeonpea in 4:2 row ratio was most profitable in transitional tract of dharwad under rainfed conditions on Alfisols.

NUTRIENT MANAGEMENT IN RABI SORGHUM + CHICKPEA AND CHICKPEA + SAFFLOWER INTERCROPPING SYSTEMS IN NORTHERN TRANSITION ZONE OF KARNATAKA

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(Th7756) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Two field experiments were conducted to study the Nutrient management in rabi sorghum + chickpea and chickpea + safflower intercropping systems in northern transition zone of Karnataka at the Agricultural College Farm, University of Agricultural sciences, Dharwad, Karnataka, during rabi seasons of 1998-99 and 1999-2000.

Combined application of RDF + VC @ 3 t ha⁻¹ recorded significantly higher sorghum equivalent yield (2631 kg /ha) as compared to application of RDF (1855 kg /ha), rmicompost @ 1 to 3 t ha⁻¹ and 50% RDF + VC @ 1 t ha⁻¹. However, it was on par with RDF + vc @ 1 and 2 ha⁻¹ and 50% RDF+VC @ 2 and 3 t ha⁻¹.

Among all the treatment combinations, RDF + VC @ 3 t ha⁻¹ recorded significantly higher bengalgram equivalent yeild (1252 kg/ha) compared to RDF alone, vermicompost alone and 50% RDF + VC @ 1 t ha⁻¹. It was on par with RDF + VC @ 1 and 2 t ha⁻¹ and 50% RDF +VC @ 2 and 3 t ha⁻¹.

Integrated application of RDF+VC @ 3 t ha⁻¹ also recorded the higher values of growht and yield components in rabi sorghum, bengalgram and safflower, which were significantly superior over other treatmetn combinations. Nutrinent uptake (NPK) in rabi sorghum, bengalgram and safflower was highr with combined application of RDF and vermicompost as compared RDF or vermicompost alone.

In sorghum + bengalgram (3:1) intercropping system, combined application of RDF + VC @ 1t ha⁻¹ recorded significantly higher net returns (rs. 8699 ha⁻¹) as compared to application of only vermicompost @ 1 to 3 t ha⁻¹, RDF + VC @ 3 t ha⁻¹ (Rs. 6683 t ha⁻¹), 50% RDF+VC @ 1 to 3 t ha⁻¹. But it was on par with RDF, RDF+ VC @ 2 t ha⁻¹ and 50% RDF+ VC@ 2 t ha⁻¹. Applying RDF recorded on par net return (Rs. 3966 ha⁻¹) compared to RDF + VC @ 1 t ha⁻¹ and RDF + VC @ 2 t ha⁻¹ in bengalgram + safflower intercropping system.

EFFECT OF *IN SITU* MOISTURE CONSERVATION PRACTICES AND NITROGEN LEVELS ON GROWTH AND YIELD OF RABI SORGHUM IN VERTISOLS UNDER RAINFED CONDITION

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2003 (Year Submitted)

(Th7767) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

A field experiment was conducted to study the effect of *in situ* moisture conservation practices and nitrogen levels on growth and yield of rabi sorghum under rainfed vertisols during rabi 2002 at Main Agricultural research Station, University of Agricultural sciences, Dharwad. The experiment was laid out in split plot design with different *in situ* moisture conservation practices as main plots and nitrogen levels as sub-plots with three replications. Among the different *insitu* moisture conservation practices, formation of ridges and furrows (15.78 q/ha) and compartment bunding 914.96 q/ha) recorded 34.4 and 27.4 per cent higher grain yield, respectively over flat bed (11.74 q/ha) method of sowing. Whereas broad bed and furrows (13.56 q/ha) was on par with compartment bunding. Plots laid out with *in situ* moisture conservation practices better yield. Improved growth and yield components and higher nutrient uptake was observed with *in situ* moisture conservation practices over flat bed. Irrespective of *in situ* moisture conservation practices, nitrogen levels had significant effect on growth and yield of rabi sorghum. Application of 75 kg N per ha produced higher grain yield (15.12 q/ha) over application of 25 kg N per ha (12.53 q/ha), but was on par with 50 kg N per ha (14.38 q/ha). The per cent increase in yield was 21 and 15 per cent with application of 75 and 50 kg N per ha, respectively over 25 kg N per ha. Ridges and furrows and compartment bunding with 50 kg N per ha recorded 49.47 and 37.99 per cent higher net returns, respectively compared to flat bed method of sowing (farmer's practice). Interaction effects were not significant.

EFFECT OF *IN SITU* GREEN MANURING AND NITROGEN LEVELS ON HYBRID COTTON (DHH-11) UNDER TRANSITIONAL TRACT OF DHARWAD

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2003 (Year Submitted)

(Th7758) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

A field experiment Effect of *in situ* green manuring and nitrogen levels on hybrid cotton (DHH-11) under Transitional Tract of Dharwad was conducted at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad under rainfed condition on black clay loam soil during 2002. Experiment was laid out in a randomised complete block design with factorial concept. There were 12 treatment combinations comprising of four green manuring crops (Lucerne, Sunnhemp, Dhaincha and Horsegam) and three nitrogen levels (100% , 75% and 50% RDN) with a control treatment (sole cotton with RDF alone).

Lucerne green manuring recorded significantly higher seed cotton yield (1549 kg/ha) with a ginning percentage of (37.71) over all othe green manuring crops. Application of 100 per cent RDN recorded significantly higher seed cotton yield (1535 kg /ha) over 75 per cent (1343 kg/ha) and 50 per cent RDN (1225 kg/ha). The interaction effect between green manuring crops and nitrogen levels was significant. Lucerne green manuring with 100 per ent RDN recorded significantly higher seed cotton yield (1869 kg./ha) than all other treatment combinations. The sole cotton with RDF recorded significantly lower seed cotton yield (1180 kg/ha) than all other green manuring crops with 100 per cent RDN.

Lucerne green manuring crop recorded significantly higher green matter yield (8.48 t/ha), dry matter yield (3.51 t/ha) and nitrogen uptake (92.71 kg/ha) than other green manuring crops. Lucerne green manuring with 100 per cent RDN recorded maximum net returns of Rs. 22,361/ha and a B:C ratio of 2.37.

INFLUENCE OF DIFFERENT SOURCES OF PHOSPHORUS ON PHOSPHORUS ACQUISITION AND UTILIZATION IN SOYBEAN

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2003 (Year Submitted)

(Th7787) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

A pot experiment was conducted during kharif, 2002 to study the P acquisition and utilization in soybean genotypes from different P sources applied to sand and soil mixture at College of Agriculture, University of agricultural Sciences, Dharwad. The experiment was laid out in completely randomized design with three genotypes (viz., KHSb-2, MAUS -2 and JS-335) and three different sources of phosphorus (RP, RP + MPSB and SSP). The sterilized soil was used with recommended dose nitrogen and potassium.

The morphological, physiological and biochemical parameters of soybean genotypes differed significantly with different phosphorus sources. The genotype KHSb-2 had higher values for morphological and physiological parameters with higher utilization of available P in the soil. The genotype KHSb-2 recorded higher root dry weight than the genotypes JS-335 and MAUS-2 at all the growth stages. Application of SSP increased root dry weight of all the genotypes as compared to other treatments. Application of phosphorus in the form of SSP resulted in greater increase in the yield of soybean genotypes. However, it was on par with RP and RP + MPS. The P content in leaf, P uptake in leaf and plant varied significantly. Maximum P content was recorded in the genotype JS-335 followed by the genotypes KHSb-2 and MAUS-2 45 and 60 DAS.

The acid phosphatase activity significantly increased in the treatment receiving no phosphorus source compared with phosphorus, supplemented in the form of RP, RP + MPSB and SSP. The plant height, total dry matter and leaf P uptake were strongly and positively correlated with total P uptake whereas, ACPH activity and PUEF were negatively correlated. The most efficient genotype KHSb-2 responded well to the application of RP compared to the genotypes MAUS-2 and JS-335, in terms of P acquisition and seed yield.

GENETIC ANALYSIS OF HETEROSIS AND COMBINING ABILITY OF NEW LINES OF SUNFLOWER (*HELIANTHUS ANNUUS* L.)

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2003 (Year Submitted)

(Th7788) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

A study was undertaken to assess the magnitude of heterosis and combining ability involving seventeen inbred lines of sunflower. The inbreds comprised of five new male sterile lines and twelve diverse restorer lines (six branching and six non-branching) which were crossed in all during summer 2003 for nine characters by adopting line x tester analysis considerable average heterosis was observed for all characters studied. Highest magnitude of average heterosis was observed for seed yield per plot (150.34) followed by seed yield per plant (118.86), head diameter (26.79), plant height (15.32), 1000-seed weight (7.49) and oil content (2.13).

For the characters, days to 50 per cent flowering, days to 100 per cent flowering and days to maturity, the recorded negative average heterosis. Percentage contribution of component characters, viz., 1000 -seed weight, plant height and head diameter towards expression of heterotic effect for seed yield was to the extent of 15.06, 30.82 and 53.86 per cent, respectively.

None of the crosses had high SCA effect for all the traits studied. In majority of the crosses, high SCA effects was due to high x high or low x high general combining ability of parents. The best cross for seed yield, (4546A # NDOL-3 X VI-46 (Br) and for oil content (4546A # NDOL-3 x RHA-265 (NB) with high SCA effect have been identified. DSF-15A among the females and VI-66 and RHA-265 among males were identified parents for exploitation of heterosis based on gca effects. Considering the seed yield potential of hybrids involving branching and non-branching restorer lines, the study indicated the possibility of utilizing non-branching restorer lines in heterosis breeding programme despite the disadvantage of shorter period of pollen supply in hybrid seed production plots.

INTROGRESSION STUDIES IN COWPEA (*VIGNA UNGUICULATA* (L.) WALP)

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(Th7810) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

The present investigation on cowpea (*Vigna unguiculata* (L.) Walp.) was carried out to elicit the information on nature and amount of variability generated in respect of seed yield and its componets, to study the relative performance of introgressed populations with different level of introgression involving a land race (Goa Local) and to study the relative performance of Goa Local with nearly determinate (KM-1) and nearly indeterminate (C-152) genotypes. A land race (Gao Local) with bold seed was crossed with commercial cultivar KM-1 and C-152 F_1 to obtain the F_1 seeds. In addition to three parents and seeds, the seeds of F_2 , F_3 , F_4 , F_5 , BC_{11} F_4 and BC_{12} F_4 seeds of two crosses viz., KM-1 x Goa Local and C-152 x Goa Local were obtained from department of Genetics and plant breeding, college of Agriculture, Dharwad. Which were developed by selfing and selection on the basis of seed yield per plant. The segregating populations were evaluated for eleven quantitative traits. The amount of variability for seed yield, clusters per plant, pods per plant, pods per cluster and hundred seed weight was considerably high.

The GCV, heritability and GAM values were less in single cross populations than that of backcross populations. Thus indicated the fact that backcross helped in widening the GCV, heritability and GAM values. On the basis of mean, range, variance and other genetic parameters, it was found that the cross C-152 x Goa Local is superior than the cross KM-1 x Goa Local.

Highly significant positive correlation of seed yield was observed with pods per plant and clusters per plant in all the populations. Path analysis revealed the importance of pods per plant as the most important yield attributing trait. There was increase in the value of direct positive effect from straight cross to backcross populations indicated the cumulative effect of backcrossing. More number of transgressive segregants were recorded in backcross populations involving Goa Local compared to their respective single cross segregants.

STUDIES ON GENETIC DIVERSITY IN SESAME (*SESAMUM INDICUM* L.)

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2003 (Year Submitted)

(Th7814) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

A field experiment was conducted during *kharif* 2002 to study the genetic variability, correlation, path co-efficient analysis and genetic diversity in sesame (*Sesamum indicum* L.) genotypes. The experiment was laid out in randomized block design with three replications.

The study included a total of 62 genotypes including two checks viz., E-8 and DS-1 and evaluated for nine quantitative characters. The study revealed wide range of variability and high heritability for all the characters. The genetic advance as per cent over mean was high for seed branches, number of seeds per capsule and plant height indicating additive gene action for these traits. From correlation studies, it was observed that seed yield per plant was significantly associated with plant height, number of primary branches, number of capsules per plant and number of seeds per capsule. The maximum direct effect on seed yield per plant was exhibited by number of capsules per plant followed by capsule length and plant height.

D² analysis including all the nine characters revealed that number of capsules per plant and number of seeds per capsule contributed greatly towards divergence. The genotypes viz., IVT-7, DS-1, DCB-1869, DS-13, IVT-2 and E-8 in cluster-VI recorded the highest cluster mean values for characters such as plant height, number of primary branches, number of capsules per plant, oil content and seed yield per plant. These genotypes could be used as base materials for further breeding programme.

INVESTIGATION IN TO LATE ACTING SELF-INCOMPATIBILITY IN TAMARIND (*TAMRINDUS INDICA* L.)

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2003 (Year submitted)

Th8256 (Accession number)

University Library, UAS, Dharwad (Location)

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ABSTRACT

Although late acting self-incompatibility'~ is JOrde angiosperms, its peration *Tamannodus indica* was obscure.spread among Recent studies have confirmed the existence of LASI in Tamarind. LASI is known to operate either at pre or at post-zygotic levels. Amongst, the post-zygotic is wide spread. In Tamarind, it was found, using *semi in vivo* method and aniline blue technique that the pollen tubes entered normally cut ends of stylar tissue following self and/ or cross-pollination was Sflme and existed a difference among trees with strong self-incompatibility (SI) with that of self-compatibles (SC) for mean pollen entry. The self-pollination was unsuccessful in trees with strong (100% SI) SI while those with ,SC it was not only successful but also could produce normal pods/ seeds which germinated normally. Most rejection of selfed fruits occurred within 4 days, but late abortions of growing embryos were evident in fruits retained in trees with SI following self-pollination; mostly resulted in inflated pods with chaffy seeds which failed to germinate. Cross-pollination in these trees was successful with normal fruit/ seed production and the seeds germinated normally with maximum germination. Maximum inbreeding depression was observed in trees with strong SI while in those of SC it was either very low or absent. .The fruit set and fruit retention pattern across different pollination types on different days after pollination indicated that the LASI operates from the time of fertilization till the advanced stage of pod development (120 days). Amongst, period from 120 to 150 seems very crucial as fruit drop seizes completely after 150 days. All the fruits that are retained beyond 150 days would be carried to maturity, maximum. Followed in cross-pollination. Generally, cross-pollination results in better female fitness components followed by open followed by self. Nevertheless, in trees with strong SC, more selfed pods were carried to maturity.

GENETIC EVALUATION OF DIVERSE COTTON (*GOSSYPIMUM HIRSUTUM* L.) PLANT TYPES AND THEIR SEGREGATING POPULATIONS

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Th7785 (Accession Number)
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ABSTRACT

Cotton productivity in India is too low as against the global average. It is because of high cost of plant protection linked with inherent defects of the large bushy and late maturing plant types. Hence, the present study was aimed to identify suitable plant types for the given situation.

The potential diverse varietal lines were grouped into compact and robust plant types mainly based on their stature. Intra (compact x compact and robust x robust) and inter (compact x robust) plant type crosses were made to assess the heterosis, variability, transgressive segregation, association and path analysis in F_2 populations.

Even though, robusts recorded higher mean bolls per plant, boll weight and also utilized more three dimensional space compared to compacts, the seed cotton yield (SCY) of compacts found to be nearly equal to robusts. This could be attributed to increased number of bolls per unit area.

Compacts revealed early in maturity compared to robust. These compact x robust crosses revealed high magnitude of heterosis in F_1 and also showed fairly high magnitude of variability and higher desirable transgressive segregants for SCY compared to intra plant type crosses.

Correlation studies indicted strong positive association between boll weight and boll number with SCY, whereas interboll distance and sympodial angle were negatively associated with yield. Highest correlation values were observed between SCY and number of bolls per plant in all F_2 's except HH-178.

Path analysis in both compacts and robust revealed that the lint yield recorded highest direct positive effect on SCY and also most of the characters studied recorded high indirect effect on SCY through lint yield. The heterotic superiority. Higher variability and high desirable transgressive segregants obtained from inter plant type crosses indicate the advantage to evolve intermediate plant type

with reduced horizontal growth to exploit the three dimensional space with high breeding value for yield.

**STUDIES ON GENETIC DIVERSITY BASED ON PRODUCTIVITY AND
VARIABILITY FOR QUALITY TRAITS IN FINGER MILLET (*ELEUSINE
CORACANA* GAERTN.)**

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2003 (Year Submitted)

(Th7789) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

A field experiment was conducted during *kharif* 2002 to study the genetic variability, correlation, path on-efficient analysis and genetic diversity for productivity traits and variability for some quality traits like protein content, calcium content, popping and malt quality in finger millet (*Eleusine coracana* Gaertn.) genotypes. The experiment was laid out in randomized block design with two replications.

The study included a total of 178 genotypes obtained from ICRISAT, Hyderabad including two checks viz., Local and GPU-28 and evaluated for fifteen productivity traits. The study revealed wide range of variability and high heritability for all the traits. The genetic advance as per cent of mean was high for total number of tillers, productivity tillers, days to 50 per cent flowering, fingers number per ear, length of earhead, length of finger, florets numbers per spikelet, spikelet density, ear weight per plant, test weight, straw yield per plant and grain yield per plant indicating additive gene action for these traits. Correlation studies revealed that seed yield per plant was significantly associated with all the traits except with plant height, days to 50 per cent flowering and days to maturity. The maximum direct effect on seed yield per plant was exhibited by ear weight per plant followed by straw yield per plant.

D² analysis including all the 15 productivity traits revealed that florets number per spikelet and length of ear head contributed greatly towards divergence. The genotypes viz., 1E 2995, 1E 3020, 1E 3032, 1# 3135, 1E3142, 1E3154, 1E 3163, 1E 3241, 1E 3242, 1E 3263, Local and GPU-28 in cluster-VII recorded the highest cluster mean. These genotypes could be used as base material for further breeding programme. Due to existence of good amount of variability for quality traits, potential genotypes are identified for its diversified uses like popping and malt.

***IN VITRO* REGENERATION AND CELL LINE SECTION FOR ALTERNARIA RESISTANT CALLUS IN SESAME (*SESAMUM INDICUM* L.)**

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Th8282 (Accession number)
University Library, UAS, Dharwad (Location)
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ABSTRACT

In *vitro* regeneration and cell line selection for *Alternaria* resistant callus was attempted in sesame (*Sesamum indicum* L.) for three genotypes viz. E8 (a susceptible variety of national importance), Gulbarga local (location-specific susceptible land race) and RT-273 (resistant advance line) using hypocotyl, cotyledon sub-hypocotyl and root explants. Hypocotyl segments were best for callusing across genotypes.

Both rapidly proliferating callus induction and callus maintenance was achieved for RT -273 on $\frac{1}{2}$ MS with 0.5 mg/l NAA, 0.5mg/l BA and 1mg/l Kinetin. MS with 2mg/l NAA, 3mg/l BA and 15 μ M AgNO₃ was best suited for both callus induction and callus maintenance for E8 and Gulbarga local. Profuse root induction was achieved, in all the genotypes, on $\frac{1}{2}$ MS with 0.5 mg/l NAA, 0.5mg/l BA and 1mg/l kinetin. However, shoot induction was possible from hypocotyl segment derived callus maintained on MS with 2mg/l NAA, 3mg/l BAA and 15 μ M AgNO₃ for 1½ to 2 months in E8(<2%). Shoot induction was noticed in RT-273 (<2%), from cotyledonary segments derived callus maintained on $\frac{1}{2}$ MS with 0.5 mg/l NAA, 0.5mg/l BA and 1mg/l kinetin maintained for 1½ to 2 months.

Callus survival curve, for E8 and Gulbarga local, was derived by incorporating different concentrations (0, 15, 30, 45, 60, 75, 90 and 100 % by volume) of culture filtrate of *Alternaria sesami* fungus and found that the callus, from both genotypes, survived up to 45%. There was stimulatory effect for callus growth at 15% v/v. Utilizing the information, 50% (v/v) incorporation of culture filtrate was used as a thumb rule to develop resistant cell lines through *in vitro* mutagenesis. Callus of E8 and Gulbarga local was exposed to UV rays at different hours (1, 2, 3, 4 and 5 hrs) and irradiated callus was plated on MS with 50% v/v culture filtrate. Resistant callus obtained is being characterized. Shoot and root regeneration from resistant callus is underway.

EVALUATION OF RESISTANCE TO *SCLEROTIUM ROLFSII* SACC. IN GROUNDNUT (*ARACHIS HYPOGAEA* L.)

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2003 (Year Submitted)

(Th7794) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Stem and pod rot caused by *Sclerotium rolfsii* is a major constraint in the groundnut production and the cultivation of resistant varieties is considered best strategy to overcome the problem. In India, only limited progress has been made because of lack reliable screening techniques.

Evaluation of germplasm (27) and breeding lines (50) under artificially inoculated condition revealed heritable genotypic difference for disease incidence. Significant genotype x season interaction indicated the relevance of repeated screening over seasons. Increased plot size and more replications significantly reduced the experimental error indicating their importance in screening for resistance. But in the present study, monitoring of the disease before harvest was also found important and it had significant impact on the population stand leading to drastic effect on the final yield. Genotypic difference existed for response to disease before and at harvest. As far as, disease up to harvest is concerned ICGV 86590, B 37c and R 9227 x TG 49-12 were found resistant and they could be exploited in breeding programmes for improving the existing cultivars.

The molecular diversity analysis of the germplasm set using RAPD assay with 21 primers showed polymorphism ranging from 16.67 per cent (OPF 13) to 85.00 per cent (OPK 13). The primers OPK 13, OPK 18, OPF 2 and OPF 14 showed high polymorphism. Maximum diversity was observed between highly susceptible genotype, TMV 2 and resistant genotype, R 9227 and they could form an ideal combination for developing a mapping population to identify molecular markers associated with resistance. Distinct clustering of susceptible and resistant genotypes revealed the possibility of developing markers associated with resistance.

STUDIES ON VARIABILITY GENERATION BY COMBINATION OF HYBRIDIZATION AND INDUCED MUTATION IN GROUNDNUT (*ARACHIS HYPOGAEA* L.)

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2003 (Year Submitted)

(Th7759) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

A field experiment was undertaken at the Main Agricultural Research Station, Dharwad during the kharif season of 2002-03 and at the Agricultural Research Station, Arabhavi during summer 2003-04 to compare the efficiency of direct hybridization followed by mutagenesis to release additional genetic variability, frequency of desirable segregants and to study shift in character associations between the two comparative populations. A set of three crosses involving four genotypes (GPBD-4, ICGV-86252, VG-9521 and ICGV-86699) formed the base material for this study. Half the quantity of F₁ seeds of each of the three crosses were treated with EMS (0.5%) and remaining half quantity was advanced as such. The study revealed an increase in variability of traits as a result of hybridization with mutagenesis as compared to hybridization alone. The highest phenotypic and genotypic coefficients of variability were observed for the characters like plant height, numbers of primary branches, number of pods per plant, pod yield per plant, kernel yield per plant, 100-kernel weight and rust severity score. Mutagen treated populations gave relatively higher percentage of superior segregants for pod yield (20.83%), disease (rust) resistance (7.33%), SMK percentage (41.67%) and shelling percentage (94.33%) as compared to untreated population (16.50%, 5.67%, 40.50% and 11.33%, respectively). EMS treated population also produced higher population of superior recombinants for combination of pod yield, disease resistance, shelling percentage and SMK percentage (1%) as compared to untreated population (0.33%) in F₃ generation.

Correlation studies in F₃M₃ generation revealed shift in association towards the desirable side in respect of pod yield with shelling percentage and kernel yield with shelling percentage in the cross GPBD-4 x ICGV-86252 and pod yield with shelling percentage in both VG-9521 x ICGV-86252 and VG-9521 x ICGV-86699 crosses. Thus, hybridization followed by mutagenesis in the present study showed promise for not only increasing the variability but also to increase the frequency of desirable transgressive segregants and to bring the shift in direction of association between different character pairs in the desired direction.

EVALUATION OF GRAIN AMARANTH COLLECTIONS FOR PRODUCTIVITY AND QUALITY TRAITS (*AMARANTHUS* SPP)

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2003 (Year Submitted)

(Th7755) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

A field experiment was conducted during *kharif* 2002 to study the genetic variability, correlation, path coefficient analysis, genetic diversity and selection indices for productivity traits and variability for quality traits like protein content, minerals and popping quality in grain amaranth (*amaranthus* spp). The experiment was laid out in 8x8 simple lattice design with four replications. The study included 64 genotypes and observations were recorded on thirteen productivity traits.

The study revealed wide range of variability, high heritability and high genetic advance as per cent mean for number of leaves, number of branches, panicle fresh weight, panicle length, dry weight of panicle, dry weight of stem, harvest index and seed yield per plant. Correlation studies revealed significant association of seed yield with panicle fresh weight, panicle length, number of spikes per panicle, dry weight of panicle, dry weight of stem and harvest index. The maximum positive direct effect on seed yield per plant was exhibited by panicle fresh weight followed by harvest index at genotype level.

Sixty four genotypes were grouped into eleven clusters based on D² analysis. Higher inter-cluster distance was noticed between cluster-II and XI, while higher intra-cluster value was noticed in cluster-II. The genotypes in the cluster-III showed highest cluster mean values for panicle fresh weight, harvest index and seed yield per plant. Selection index involving panicle fresh weight, panicle length and panicle dry weight was the best which exhibited the highest relative efficiency and suggested to consider these characters while making selection. The genotypes were also evaluated for protein, mineral and popping quality. The iron content was high in IC-35665 and zinc in BGA-2, BGA-2 and BAS-3 were found to be promising for yield, protein and popping quality as compared to the check. These may be utilized for future grain amaranth improvement programme.

**GENETIC ANALYSIS OF WILT RESISTANCE AND IDENTIFICATION OF LINKED
DNA MARKERS IN
PIGEONPEA (*CAJANUS CAJAN* (L.) MILLSP.)**

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(Th7781) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Fusarium wilt (*Fusarium udum* Butler) is an important soil borne disease of pigeonpea that causes substantial yield loss. It is difficult to transfer the disease resistance genes into locally adapted cultivars due to linkage-drag and ambiguity in phenotyping through conventional breeding techniques. The present investigation was conducted to identify FAPD markers linked to wilt reaction by using F₂ population derived from contrasting parents. The parents and the F₂ populations derived from the crosses GS-1 x ICPL-87119 and GS-1 x ICP – 8863 evaluated for wilt reaction in the national sick-plot for *Fusarium* at Agricultural Research Station, Gulbarga. In both the crosses, resistance was governed by single dominant gene.

The parents (GS-1 and ICPL-87119) were screened with 340 random primers for polymorphic amplicons through PCR. In all, 39 primers yielded 45 polymorphic amplicons through PCR. In all 38 primers yielded 45 polymorphic bands between parents. Bulk segregant analysis in 2 sets of bulks and subset population analysis revealed the linkage of two primers (OPM03 and OPAC11) with susceptibility. Individual plant analysis showed expected segregation ratio of 3 presence: 1 absence of specific amplicon for both markers. The RAPD markers OPM03 704 and OPAC11500 found association with susceptibility. Considering the wilt reaction and susceptibility-linked RAPD marker, the genotype of all 254 F₂ plants was deduced. The genotypes so deduced for wilt gene confirmed expected genotypic ratio, IRR: 2Rr: 1rr, for a monohybrid. Both the markers validated in 18 genotypes with known wilt reaction to detect the marker-trait association. The marker OPM03704 correctly identified 12 genotypes while OPAC11500 identified 9 out of 18 genotypes. To convert the RAPD markers into more reliable SCAR markers, both the fragments were cloned in vector pTZ57R and sequenced. Based on the sequence information, SCAR primers were designed for the RAPD marker OPM03704.

CLONING AND EXPRESSION OF *CRYIA* (C) GENE FROM NATIVE *BACILLUS THURINGIENSIS* (BERLINER) ISOLATES

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2003 (Year Submitted)

(Th7786) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

The focus of the present study was to clone the full length and truncated *CryIA* (c) gene from native *Bacillus thuringiensis* isolates. Bioassay of certain native isolates of *B. Thuringiensis* along with reference strain HD-1 showed that a native isolate, D-1 showed the maximum mortality of 90.6 per cent at 72 hours. Among the 21 isolates tested for presence of *CryIA* gene D-1, PP-6, PP-9 possessed *CryIA* (a), *CryIA* (b), *CryIA* (c). PP-7, SI-3, D-21 did not possess any of these genes.

Primers were designed to pick up full length 3.5 Kb *CryIA* (c), and truncated 2 Kb *CryIA* (c), gene, using the conserved regions of *Cry* gene. The amplified products using these primers were cloned into pTZ57R at *Eco* 321 site containing T-overhangs through T/A cloning strategy. Of the several clones obtained, two clones pKM1308 and pKM1508 harbouring 3.5 Kb and 2Kb respectively were analysed further. The presence of insert in the constructs has been confirmed by restriction analysis, PCR amplification and plasmid preparation. Restriction of pKM1308 recombinant clone with *Bam* H resulted in production of two fragments one of 3500bp corresponding to full length *CryIA*(c) and another 2868bp corresponding to vector. The restriction of 2.0kb recombinant with *Bam*HI yielded a single band of 4868 bp indicating the presence of the insert. The recombinants pKM1308 and pKM1508 were sequenced. The obtained sequences were used for nucleotide-nucleotide BLASTn search to know homology with different *B. thuringiensis* genes. The gene fragments showed 98% homology to many of the *Cry* gene including *CryIA* (c), *CryIA* (a), *CryIA* (b), and *cry 218*. Blast search also revealed that the 3.5Kb was cloned in reverse orientation in pKM1308 and the 2.0 Kb insert was in correct orientation in pKM1508.

**STUDIES ON *IN VITRO* AND *IN PLANTA* TRANSFORMATION IN PIGEONPEA
(*CAJANUS CAJAN* L.)
CV. ICPL-8863 (MARUTI)**

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(Th7757) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

In vitro and *in planta* transformation of pigeonpea was achieved using *Agrobacterium tumefaciens* strains EHA105 harboring pBinBt3 plasmid having *cryI*Ac gene linked to the cauliflower mosaic virus (CaMV) 35 S promoter and neomycin phosphotransferase (*npt II*) gene under the control of nopaline synthase (nos) promoter and terminator.

Initially, protocol was developed for *in vitro* multiple shoot regeneration. Using this protocol *in vitro* transformation were attempted. Cotyledonary node with cotyledon were pre-cultured on MS medium with 2 mg l⁻¹ BAP for two days, co-cultured for two days in dark, washed with MS broth containing cefotaxime transferred to shoot induction (MS + 2 mg l⁻¹ BAP) followed by elongation (MS + 0.1 mg l⁻¹ BAP) and rooting medium (MS + 0.5 mg l⁻¹ IBA). Rooted shoots were established in greenhouse. This protocol for pigeonpea transformation using *CryI*Ac gene was repeated 8 times through all the steps. In one batch 2 per cent of established plants showed PCR amplification for *npt II* and *cry lac* primer.

In *in planta* approach, different methods such as simple dipping injury followed by dipping, injection and vacuum infiltration were used at different developmental stages like germination, seedling and at flowering stage. Among different methods vacuum infiltration of the germinating seeds and flower injection were found to be suitable for transformation.

**STUDIES ON REGENERATION AND *AGROBACTERIUM* MEDIATED *IN VITRO*
AND *IN PLANTA*
TRANSFORMATION IN CHILLI (*CAPSICUM ANNUUM* L.)**

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(Th7754) Accession No

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ABSTRACT

In vitro regeneration potential was studied in two popular local cultivars viz., Byadgi Dabbi and Sankeshwar local. Different explants (distal half of cotyledon, Basal half of cotyledon, Whole cotyledon, Shoot tip and Hypocotyl portion) were cultured on medium with various level of BAP (2 to 12 mg/l) for multiple shoot bud induction. Sankeshwar local was found to give better response compared to Byadgi Dabbi. Highest percent response was obtained from whole cotyledon cultured on 10 mg/1 BAP. Addition of 2 mg/l GA₃ in shoot bud induction medium (10 mg/1 BAP) produced better differentiated shoot buds. Elongation and rooting was observed on MS with 0.1 mg/1 NAA + 0.2 mg/1 BAP and 2 mg/1 1BA, respectively.

Different concentrations and combinations of growth regulators were tried to study callus induction and regeneration from cotyledon and hypocotyl explants. Though calli were induced, regeneration could not be achieved. However, on higher level of IAA with 0.5 mg/1 kinetin cream, compact and small calli were induced under complete darkness and shoots were regenerated after 45 days of exposure to light.

For *in vitro* transformation, shoot tips were co-cultivated with *Agrobacterium* strain EHA 105 carrying pBin Bt_a construct having *Cry 1(Ac)* gene. Average of 0.535 per cent PCR positive plants were obtained.

Simple dipping and vacuum infiltration was carried out at different stages with *Agrobacterium* culture harbouring pCAMBIA having *gus* gene or pBinBt_a having *cry1 (Ac)* gene.

Simple dipping of seeds completely inhibited germination. Dipping of seedlings in culture inoculum having different concentrations of Triton X-100 showed expression of *gus* gene in leaf samples of plants. In case of floral dip, per cent flowers showing GUS expression was highest when treated with culture inoculum having 0.02 per cent Triton-x-100. However, vacuum infiltration of germinating seeds with *Agrobacterium* having pCAMBIA 1301 showed GUS expression in five per cent of plants. Per cent transformation was low (0.5%) when germinating seeds were vacuum infiltrated with *Agrobacterium* culture having *cry1 (Ac)* gene.

**PLANT REGENERATION THROUGH CALLUS AND GENETIC
TRANSFORMATION USING *CRY1AC* GENE IN PIGEONPEA (*CAJANUS CAJAN*
L. MILLSP)**

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2004 (Year Submitted)
(Th7761) Accession No
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ABSTRACT

Optimization of *in vitro* protocols for callus induction and development of transgenic pigeonpea in two cultivars, ICPL-87119 and ICPL-8863 was undertaken. Cotyledonary leaf and epicotyl explants were tested across 48 combinations and concentration of growth regulators, wherein, 15 mg/l NAA + 0.5 mg/l kinetin induced regenerable callus from leaf explants and 0.2 mg/l NAA + 8 mg/l kinetin from epicotyl explants. Plant regeneration from leaf and epicotyl derived callus was optimized at 0.05 mg/l and 0.5 mg/l TDZ, respectively in both genotypes. In direct regeneration MS + 2 mg/l BAP induced highest percent shoot buds from CNC explants. A mean of 4.32 and 3.93 elongated shoots/CNC respectively, were produced in ICPL 8863 and ICPL 87119 at 0.1 mg/l BAP. Rooting was optimized on ½ MS + 0.5 mg/l IBA media in both genotypes. Potting mixture-containing soil; FYM in 1:1 ratio gave 48.01 per cent survivability. Directly CNC, leaf and epicotyl explants and the callus derived from them and *Agrobacterium* strains EHA 05 with pBinBt3 harboring *cry1 Ac* gene and GV2260 with pCAMBIA 1301 carrying *gus* gene were used in transformation. All factors of transformation process were standardized using *gus* gene: an efficiency of 4.16 and 3.125 per cent was achieved through direct regeneration and callus modes respectively. A transformation percentage of 4.28 was noted for *cry1Ac* gene, confirmed through PCR assay for *nptII* gene. In insect bioassay, growth inhibition of larvae ranged from 26.87 to 68.01% in ICPL 8863 and 12.13 to 66.61% in ICPL 87119 apart from 100% growth inhibition in few events. PCR and bioassay results indicated possible chimeric status of some of the putative transgenes.

INFLUENCE OF MOTHER PLANT NUTRITION AND GROWTH REGULATORS ON CROP GROWTH, SEED YIELD AND QUALITY IN CLUSTER BEAN

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2003 (Year Submitted)

(Th7815) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

The studies on influence of source of phosphate fertilizers, doses and P-solubilizers and foliar spray of growth regulators on growth, seed yield and quality in cluster bean Cv. Pusa Navbahar conducted during *kharif* 2002 at the Main Agriculture Research Station, Agricultural College, University of Agricultural Sciences, Dharwad indicated that, among phosphate fertilizers, rock phosphate increased the plant height (95.0 cm), per plant number of branches (5.7), number of clusters (25.8), number of pods (30.6), pod yield (9.3), seed yield (503.2 Kg/ha) compared to single super phosphate. Rock phosphate also recorded maximum seed germination (94.0%), vigour index (2993), seedling length (31.7 cm), seedling dry matter (9.92 mg) and field emergence (90.3%) with low electrical conductivity values (2.88 dSm⁻¹)

Among doses of fertilizers, higher dose of fertilizer 925.1:25:60 NPK kg/ha) recorded more plant height, per plant number of branches, clusters, pod besides maximum seed yield and better seed quality parameters. P-solubilizers showed beneficial influence on plant height, number of branches, clusters, pods yield and yield attributes and seed quality parameters. The interactions between phosphate fertilizer doses and P-solubilizers, had marginal influence on plant growth, seed yield and quality parameters. Foliar spray with NAA (40 ppm) increased the plant height and seed test weight. While GA₃ (20 ppm) increased the number of branches, number clusters, number of pods per plant, number seeds per pod, pod yield, seed yield per hectare. The seed quality parameters were not influenced by foliar spray of growth regulator.

SURVEY OF INDIGENOUS TECHNOLOGIES AND EVALUATION OF BOTANICALS AGAINST MAJOR STORAGE PESTS

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2003 (Year submitted)

Th8315 (Accession number)

University Library, UAS, Dharwad (Location)

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ABSTRACT

The survey of indigenous storage technologies available in Hyderabad Kamataka (Gulbarga and Bidar districts) and the effect of few promising botanicals against two major stored grain pests on sorghum and chickpea under laboratory conditions were carried out at Agricultural College Raichur, Karnataka during 2002-03.

Among the storage practices followed in the Hyderabad Kamataka region for cereals and pulses, sun drying was the predominant practice in Gulbarga and Bidar districts. The predominant storage structures used for storing cereals was gunny bags followed by hagevu and gunny bags for pulses.

The sweet flag and malathion were found equally effective in minimum multiplication of both *Sitophilus oryzae* and *Callosobruchus chinensis* on sorghum (2.50 and 1.00 adults/100 g of seed sample) and chickpea (1.50 and 1.00 adults/100 g of seed sample) respectively in the laboratory. Studies on seed mixing and storing along with various botanicals revealed that malathion and sweet flag were found significantly superior up to 60 days. Botanical powders when dusted over cloth bags, the population build up was not noticed in malathion and sweet flag treated bags in the beginning, later (after 60 days) incidence was noticed. The minimum seed damage was in malathion, followed by sweet flag rhizome powder on sorghum and custard apple seed powder and sweet flag rhizome powder on chickpea. The germination was unaffected in these treatments in both seed mixing and dusting.

UTILIZATION OF *METARHIZIUM ANISOPLIAE* (METSCHNIKOFF) SOROKIN FOR THE MANAGEMENT OF ROOT GRUBS IN SUGARCANE AND ARECANUT

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2003 (Year Submitted)

(Th7811) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Studies were conducted on management of root grubs by using mycopathogen *Metarhizium anisopliae* (Met.) Sorokin during 2002-03 at College of Agriculture, Dharwad; Agricultural Research Station, Sankeshwar, Belgaum district and at farmers field in Sirsi, Uttara Kannada district. The four isolates of *Metarhizium anisopliae* collected from different geographical regions tested against second instar grubs proved pathogenic to both *Holotricdhia serrata* (Fab.) and *Leucopholis lepidophora* (Blanchard). The isolate Ma-1 proved most effective and registered least LT₅₀ values of 312.96 h and 314.48h against three instars of *H. serrata* indicated that quantum of inoculum required decreases with increase in exposure time and lowest spore load of 1.3×10^4 (15 DAT), 4×10^5 (21DAT) and 1.7×10^7 per g soil (23 DAT) were required to kill 50 per cent population of first, second and third instar grubs, respectively. First instar grub was more susceptible as compared to second and third instars and LT₅₀ of first, second and instar grubs (when exposed to higher concentration of 2×10^8 conidia/g soil) was 231.51 h, 357.84 h and 476.64 h, respectively. Mortality of second instar grubs of *H. serrata* occurred quicker when inoculated with mycelial fragments as compared to conidial inoculation. At higher dosages of mycelial fragments (1.0 g/250g soil) and conidia (1×10^8 conidia/250 g) was registered LT₅₀ values of 429.36h and 445.76 h, respectively.

Among the two dosages *M. anisopliae* (Ma-1) evaluated in a field against sugarcane root grub, higher dosage (1×10^{13} conidia per ha) was found next best to chlorpyrifos and registered 91.95 per cent reduction in grub population (60 DAT). The highest cane yield was recorded in *M. anisopliae* @ 1×10^{13} conidia per ha (94.21t/ha) and it was on par with chlorpyrifos @15 l/ha (93.76 t/ha), however, IBCR was high with higher dose of mycopathogen (7.83) followed by drenching of chlorpyrifos @10 l/ha (6.09). Field evaluation of *M. anisopliae* (Ma-1) against arecanut root grub revealed that mycopathogen (@ 2×10^{13} conidia/ha) recorded 77.10 per cent reduction in grub population and was next best to chlorpyrifos drenching @5 l/ha (96.80).

POLLINATION POTENTIALITY OF HONEY BEES IN CORIANDER SEED PRODUCTION

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2003 (Year Submitted)

(Th7783) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Studies were made on pollinator fauna of coriander, foraging activity of bees and effect of bee pollination on qualitative and quantitative parameters on coriander seed at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during kharif season of 2002. Among 14 species of pollinators, *Apis florea* F. Was most prominent constituting 45.52 per cent followed by *A.cerana* (21.05%), *A.dorsata* (15.50%) and other pollinators (17.92%).

Foraging activity of different bee species varied. However, peak activity of *A.florea*, *A.cerana* and *A.dorsata* were observed at 1000 h to 1400 h. Whereas other pollinators was more active at 0600 h to 1000 h and 1600 h to 1800 h. Spraying of cacambe (10%) and jaggery (10%) had significant influence in attracting more number of pollinators, consequently, significantly more number of seeds (191.03 seeds/plant Vs 103.20 and 77.67 seeds/plant in open pollination without spray and caged plot without bees, respectively) and yield (6.90 kg/plot as against 3.18 and 2.20 kg/plot in open pollination without spray and caged plot without bees, respectively) were obtained in the treatment with cacambe (10%). Thus, there was an increase of 116.90 and 213.63 per cent in yield over open pollination without any spray and caged plot without bees, respectively.

However, cacambe (10%), jaggery (10%) and Bee-Q (1.25%) improved the germination to the extent of 84.67 to 88.00 per cent as against 72.33 and 68.67 per cent in open pollination without any spray and caged plot without bees, respectively. The root length was maximum in the treatment with cacambe (10%), Jaggery (10%) and Bee-Q (1.25%). Similar trend was obtained with respect to root length.

**INVESTIGATIONS ON ONION THRIPS, *THRIPS TABACI* (LINDEMAN)
(THYSANOPTERA : THIRIPIDAE)**

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(Th7816) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Investigations on the survey, seasonal incidence crop loss estimation and management of onion thrips, *Thrips tabaci* (Lindeman) was carried out during kharif, Rabi and summer seasons of 2002-2003 at Main Agricultural Research station, University of Agricultural Sciences, Dharwad and farmers fields. Survey for the pest status of onion thrips in three taluks of Northern Karnataka revealed maximum mean population of 43.59 thrips/plant in Haveri taluk followed by Dharwad taluk (38.58). Gadag taluk recorded minimum mean thrips population of 30.91/plant. The *Menochilus sexmaculatus* (Fabricius) and *Chrysoperla carnea* (Stephens) population ranged from 0.73 to 2.47 and 0.74 to 1.90 per plant, respectively in different taluks surveyed. The incidence of *T. tabaci* on onion was in its peak activity on the crop transplanted during first week of May, April and March. However, there was a decline in the thrips population on the crop transplanted during June-July. A maximum yield loss of 71.22 per cent due to onion thrips was recorded in untreated check where onion crop was left for natural infestation compared to completely protected crop which received five sprays of 0.05 per cent dimethoate 30 EC. The evaluation of newer molecules of insecticides and neem products under field condition during *kharif* and *Rabi* 2002 revealed that acetamiprid 20SP @ 0.2g/litre of water was highly effective in reducing the onion thrips population and also in recording highest bulb yield. Among the three neem products tested, they were inferior to all the insecticides molecules including the standard check dimethoate.

MONITORING OF KEY INSECT PESTS THROUGH LIGHT TRAPS

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2003 (Year Submitted)
(Th7721) Accession No
University library, UAS, Dharwad (Location)
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ABSTRACT

Investigations on monitoring of key pests through light traps were made at Dharwad. Karnataka during 2002-03. Efficiency of two different types of light traps i.e., fine trap (India) and modified ICRISAT light trap in attracting key pests of agricultural crops, population dynamics of key pests and relationship between trap catch with field incidence and weather parameters were also studied.

Fine trap (India) was found to be more efficient in capturing *Helicoverpa armigera* (Hubner), *Anomola* sp. and *Holotrichia serrata* (Gab.) However, both traps attracting *Eanas insulana* (Boisdual), *Earias vittella* (Fab.) *thysanoplusia orichalcea* (Fab.) *Mythimna separata* (Wlk.) *Spodoptera litura* (Fab.) *Chilo partellus* (Swin), *Leucinodes orbonalis* (Geunee) and *Maruca testualis* (Gayer).

Overall sex ratio of noctuid pests like *E. insulana*, *E. vittella*, *H. armigera*, *M. separata*, *T. orichalcea*, *T. signata* and *S. litura* was 1:0.732, 1:1.043, 1:106., 1:1.259, 1:0.866 and 1:1.259, respectively and that of pyralid pests, *C. partellus*, *M. testualis*, *L. orbonalis* was 1:0,846, 1:1.006 and 1:1,259. However, *H. serrata* and *Anomola* sp. Had a sex ratio of 1:0931 and 1:0.831, respectively.

Moths of *E. vitella* was observed from August to March with three major peaks and moths of *H. armigera* was observed throughout the year except in the month of May with four peaks. Two peak catches in each species of *T. orichalcea* and *T. signata* were observed between July to November. Activities of *S. litura* was observed between July to March with four peaks. *C. partellus* activity was recorded from August to May with three peaks while, *L. orbonalis* activity was recorded from August to May with three peak while, *L. orbonalis* activity was observed from July to December with two peak catches.

Relative humidity had positive influence on trap catches of all the species of Key pests while, temperature had negative influence. However, rainfall one week before trap catch of *H. serrata* and *Anomola* sp. had positive significant relationship. All Key pests captured during new moon days were more as against moths captured during full moon days except *C. partellus*.

Peak field incidence of all lepidopteran key pests was preceded as well as followed by peak moth catches in the light traps.

**EFFECT OF WET SHOOT FEEDING AND FREQUENCIES ON THE ECONOMIC
TRAITS OF MULBERRY
SILKWORM, *BOMBYX MORI* L.**

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2003 (Year Submitted)

(Th7795) Accession No

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ABSTRACT

The effect of wet shoot feeding and frequencies on the economic traits of silkworm, *Bombyx mori* L. was studied. The experiment was carried out during winter and summer season by using cross breed. Pure Mysore x NB₄D₂ silkworm and M-5, mulberry leaves. The chawki silkworms were fed with wetshootlet daily once, twice and thrice. While, late age silkworms were fed with wet cut shoot daily twice, thrice an four times and compared with standard feeding practices. The results revealed the superiority of wetshootlet and out shoot feeding to chawki and late age silkworm by significantly improving all the economic traits studied over the standard feeding practices. The overall performance of both the rearing revealed the superiority of two times wetshootlet feeding at chawki + three times wet cut shoot feeding/day at late age and resulted in shorter chawki (9251.96 h), fifth instar (166.50 h) and total larval (611.83 h) duration, highest chawki (1.527 g), mature larval (46.30 g) and pupal weight (18.72 g) and ERR (83.66%). Similarly, the treatment also recorded significantly highest cocoon yield/10,000 worms (22.14 kg), cocoons per 1000 larvae (837), cocoon weight (23.07/10 cocoons), cocoon shell weight (4.317 g/10 shells), cocoon shell ratio (18.33%), silk productivity (6.253 cg/day), filament length (959.66m), dinier (2.58), renditta (7.23) and least defective cocoons (12.93%), grasserie (10.55%) and flacherie (10.91%) disease. While, the standard feeding practice of three normal shootlet feeding at chawki + three times normal cut shoot feeding/day at late age recorded significantly lesser values for all the above traits. Hence, it is concluded that, two times wet shootlet feeding at chawki + three times wet cut shoot feeding/day at late age, could be adopted in commercial rearing after large scale multilocation evaluation in the field.

STUDIES ON COLLAR ROT OF SOYBEAN CAUSED BY *SCLEROTIUM ROLFSII* SACC.

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(Th7773) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Soybean (*Glycine max* (L.) Merrill) is a protein rich oil seed crop cultivated in tropical and sub-tropical regions of the world. Collar rot of soybean caused by *Sclerotium rolfsii*, has attained the major status in many soybean cultivating areas of northern Karnataka. Survey conducted in ten taluks of northern Karnataka during *kharif* 2002-03 indicated maximum disease incidence of 9.80% in Dharwad and traces in Bidar and Athani taluks.

Experiment. on effect of inoculum density on disease indicated cent per cent pre emergence disease incidence in four per cent and above inoculum levels.

Twelve isolates of *S. Rolfsii* collected from Karnataka, Maharashtra, Madhya Pradesh and Rajasthan showed marked differences in their growth rate, sclerotial initiation, colour size, number and test weight of sclerotia. The isolates also varied with respect to production of oxalic acid in culture medium. The Dharwad (Sr. DWR) isolate produced higher (0.92 mg/ml) amount of oxalic acid and least (0.24 mg/ml) was by Kota (Sr KTA) isolate. Isozyme studies of *S. Rolfsii* isolates indicated little variation in their protein makeup. The pathogenic variation of twelve isolates on four soybean genotypes (Bragg, Hardee, Improved Pelican and Lee) showed existence of six pathotypes.

Investigation on sensitivity of *S. rolfsii* to different systemic and non-systemic fungicides revealed, cent per cent mycelial inhibition in carboxin, carbendaxim (63%) + mancozeb (12%) and propiconazole. Carbendazim was found least effective. Among the non-systemic fungicides thiram was found most effective and zineb showed least effectiveness. *Trichoderma harzianum*, *T. Viride* and *Glicladium virens* were found highly antagonistic to *S. rolfsii*.

Screening of 64 soybean genotypes against *S. rolfsii* in pot culture revealed, 15 genotypes as moderately susceptible and remaining 49 as susceptible.

.Integrated management of collar rot using effective fungicides and bio-control agents alone and in combination indicated that seed treatment with the combination of carboxin @ 0.1% + *T. Harzianum* @ 0.6%, carboxin @ 0.1% + *T. Viride* @ 0.6%, thiram @ 0.1% + *T. Harzianum* @ 0.6% were found effective in reducing the pre and post emergence incidence of collar rot of soybean.

STUDIES ON DRY ROOT ROT DISEASE OF CHICKPEA (*CICER ARIETINUM* L.) CAUSED BY RHIZOCTONIA BATATICOLA (TAUB) BUTLER.

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2004 (Year submitted)

Th8301 (Accession number)

University Library, UAS, Dharwad (Location)

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ABSTRACT

Chickpea (*Cicer arietinum* L.) is one of the major grain legume crops of Karnataka. Dry root rot caused by *Rhizoctonia bataticola* (Taub.) Butler is one of the constraints in chickpea production. Roving survey was conducted during the *rabi* season of 2002 revealed that the maximum severity of the root rot was noticed in Gulbarga district (9.97%) followed by Raichur (5.16%) and Bidar (4.28%). Among the culture media tested potato dextrose agar and czapeck's agar were found better for growth and sclerotic production of the fungus. A temperature of 35°C and relative humidity of 75 per cent were found favorable for growth of the pathogen. Alternate cycles of light (12 hrs) and darkness (12 hrs) favored the good growth and sclerotic production as compared to complete darkness. The pathogen perpetuated up to 150 days in plant debris and 120 days in soil and 90 days when stored in refrigerators. Among the four levels of inoculum the early initiation of disease in chickpea was observed -at highest inoculum level of 4.0 per cent. The higher inoculum level had a profound effect on various growth parameters of chickpea plant. Among fungicides evaluated, hexaconazole (0.025%) and Benomyl (0.05%) among systemic fungicides, SAAF (0.1%) and Mancozeb (0.2%) among the non systemic fungicides were effective in inhibiting the growth of the fungus under *in vitro*. Among the bioagents tested *P. jluorescens* was effective in inhibiting the growth of the pathogen followed by *Trichoderma harzianum* in dual culture technique. Among 25 chickpea genotypes screened for dry root rot resistance using sick pot and blotter paper techniques, none of the genotype were immune and ICCV-94916-8 and GPC-12 were found resistant, but ICCV-98904 and ICCV-98906 showed moderately resistant to dry root rot pathogen.

EPIDEMIOLOGY AND MANAGEMENT OF SUNFLOWER NECROSIS DISEASE

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2004 (Year Submitted)

(Th7760) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Sunflower necrosis disease causes considerable damage to the sunflower crop and present in almost all the parts of Northern Karnataka wherever sunflower is grown.

The disease is characterized by mosaic, chlorotic/ring spots on leaves, marginal necrosis of leaves, calyx and head, necrosis of stem malformation of leaves and heads, severe stunting of plants, production of sterile flowers, twisted heads and partial or complete failure of grain filling.

Based on electron microscopic and serological studies it was concluded that the sunflower necrosis disease in this area, is caused by a member of Ilar virus group and also mixed infection with Tospo virus cannot be ruled out.

Epidemiological studies revealed that increasing temperature and long dry spell create favourable conditions for thrips population and migration of thrips that leads to spread of the disease. Hence October 2002 and April 2003 sown crop recorded highest incidence (32.42 and 32.25%, respectively). On the contrary during the month of September 2002 because of drizzling rain, moist conditions, the migration of thrips and spread of disease was reduced. Hence in our tract the disease incidence was maximum in early *rabi* and summer followed by late *kharif* during the year 2002-03.

The seed treatment (5 g/kg) with imidacloprid followed by confider spray (0.5 ml/l) was the most effective, it not only inhibited the disease and was responsible for increase in yield (90.52% and 13.16 q/ha, respectively). However spraying with confider alone (0.5 ml/l) followed by seed treatment with imidacloprid alone and cruiser seed treatment (3 g/kg) alone were next best treatments to manage the sunflower necrosis disease.

Out of 115 germplasm lines screened for disease incidence, 27 germplasm lines were free from the disease. However, germplasm line GMU 22 recorded the highest disease incidence of 24 per cent.

SOMACLONAL VARIATION IN SUGARCANE FOR RED ROT CAUSED BY *COLLETOTRICHUM FALCATUM* WENT.

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2004 (Year Submitted)

(Th7769) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Red rot of sugarcane caused by *Colletotrichum falcatum* Went in attaining more severe form recently in major sugarcane growing areas of Northern Karnataka. The survey conducted during 2002-03 revealed maximum disease incidence of 20.00 per cent in CoC-92061 around the Varda Sugars factory areas of Haveri district.

The standard plug method was used to prove the pathogenicity of the fungus, in which typical symptoms of red rot were observed. The pathogen exhibited least variation for its morphological characters when considered from host and culture medium.

For *in vitro* studies of callus growth, three varieties of sugarcane viz., CoC-671, CoC-93061 and CoC-86032 were used. The investigations on effect of growth regulators on callus induction, shoot and root regeneration revealed that, MS-medium containing 3.00 mg 2,4-D/l induced highest percentage of calli (83.90%) in shortest duration (13.08 days). However, MS medium containing 2.00 mg Ba/l + 0.50 mg NAA/l gave highest percentage of shoot regeneration (84.80%) in quickest succession (13.16 days), while treatment combination of ¼ MS medium + 5 mg NAA/l + 7 per cent sucrose recorded highest percentage of rooting (4.30%) in shortest time interval (6.79 days) in all the three varieties tested.

In studies on somoclonal variations of sugarcane calli to culture filtrate of *C. falcatum*, they were treated with 0.05, 0.10, 0.20 and 0.50 per cent concentration of culture filtrate. The culture filtrate at 0.05 per cent, showed least effect on growth and survivability of calli, but 0.50 per cent had detrimental effect. Further, variability in survival of calli of different sugarcane varieties was evident. The study revealed that CoC-671 showed maximum per cent survival at 60 days after incubation (38.98%) and shoot regeneration (55.20%) whereas CoC-92061 showed least per cent survival (37.59%) and shoot regeneration (48.09%).

CHARACTERIZATION OF AZIDE RESISTANT MUTANTS OF *AZOSPIRILLUM* SPP. FROM MAIZE ENDORHIZOSPHERE

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(Th7766) Accession No

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ABSTRACT

Investigations were carried out to obtain azide resistant mutants of *Azospirillum* having higher nitrogen fixation. Isolates were obtained by enrichment culture technique from root tissues of maize at different locations of Northern Karnataka. Their cultural and biochemical characteristics confirmed that, 63.66 per cent (13 isolates) were of *Azospirillum lipoferum* and 28.78 per cent (6 isolates) were of *Azospirillum brasilense*. The ability of fix nitrogen was confirmed by acetylene reduction activity (ARA). The highest ARA (422 and 646 n moles of ethylene/mg of protein/hr) and *invitro* N fixation (18.41 and 18.84 mg of dinitrogen fixed/gram of malate) was recorded in *Azospirillum* isolate ASD-7 and ASD-8, respectively. The *Azospirillum* strains ASD-7 and ASD-8 were subjected to NTG mutagenesis and higher resistance to sodium azide to improve their nitrogen fixing efficiency. Among these, two mutants had higher nitrogenase activity (ASD-802, 684 and ASD-801, 526 n moles of ethylene/mg of protein/hr) and *invitro* N fixation (63.01 and 47.53 mg of dinitrogen fixed/gram of malate respectively). The six efficient mutants along with their wild type and two reference strains were checked for their effect on growth and N uptake of maize in green house experiment at two levels of nitrogen. The results revealed that *Azospirillum* mutants ASD-802 inoculation significantly increased the shoot length, root length, dry matter content of shoot and root and N uptake of maize plants over other inoculations and/or uninoculated controls. Application of 100% N of RD further enhanced the above plant growth parameters significantly over 75% N of RD. Inoculation of *Azospirillum* mutants has also increased the colonization of *Azospirillum* in the rhizosphere and endorhizosphere. From the present investigation, it can be concluded that maize roots harbour *Azospirillum lipoferum* rather than *A. Brasilense*. Further Azi^R mutant ASD-802, obtained through mutagenesis, performed better than its wild type, in pot cultures in augmenting plant growth and N uptake of maize.

SUPPLY-DEMAND ANALYSIS OF PROFESSIONAL AGRICULTURAL MANPOWER IN KARNATAKA STATE

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2003 (Year Submitted)

(Th7817) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

The present study, based on both primary and secondary data, was undertaken in the state of Karnataka. The primary data were collected from the graduates who passed out from the University of Agricultural Sciences, Dharwad in the year 1990-91 for the purpose of studying the employment profile of Professional Agricultural Manpower. For estimating the supply of Professional Agricultural Manpower in Karnataka for the period from 1990 to 2002 and also for estimating the demand, secondary data were collected from Government, Corporate, Banking sectors and NGOs in the state. The data were processed using appropriate analytical techniques including tabular analysis, compound growth rate analysis and regression analysis.

Results revealed that the supply of Professional Agricultural Manpower at all the levels (Graduate, Post-Graduate and Ph.D) was observed to be steadily increasing over the years. The present demand for Professional Agricultural Manpower was the highest in the Department of Agriculture, followed by Department of Animal Husbandry and Corporate sector. The present level of potential unemployment in the state is about 55.60 per cent. A majority of Professional Agricultural Manpower was engaged in academic, research and extension work followed by marketing sector. Information Technology and Bio-technology, Agribusiness management, opportunities for self employment and effective RAWE programme were the new topics suggested to be introduced at the Graduate level, while agro processing was suggested at Post-Graduate level. This is necessary to enable the Professional Agricultural Manpower to be more competent in selection for jobs and efficient functioning therein.

Unless there is matching demand, there should be no establishment of the new colleges of agriculture and allied sciences. Even if new colleges are established, the intake for the whole State should not be increased. There is a need for filling up of the vacancies by the State Government atleast in a phased manner not only to run the Government Department smoothly and efficiently but also to overcome the short-term unemployment problem.

**PRODUCTION, PRICE BEHAVIOR AND EXPORT OF GROUNDNUT IN INDIA
WITH SPECIAL REFERENCE TO
GUJARAT STATE – AN ECONOMIC ANALYSIS**

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(Th7763) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

The Gujarat state ranks first in area and fourth in production with 1.8 million ha area and 1.5 million tones of groundnut production, respectively. The study highlighted on growth rates in area, production and yield, cost and returns, seasonality arrivals and prices and also growth rate and direction of export of Indian groundnut.

Various statistical techniques *viz.*, exponential growth functions, markov chain analysis, orthogonal polynomial regression, moving averages and correlation analysis were employed to analyze the data to fulfill the objectives. During Pre-TMO period, growth rate in area was found to be positive and significant whereas, that of yield was negative. During post TMO period, growth rates of area and yield were positive. It was mainly area led growth in groundnut costs and returns analysis revealed that groundnut was profitable in both Rajkot and Junagadh districts with net returns as Rs. 8859.04 and Rs. 4853.04, respectively. Growth rate of groundnut export was found to be positive for almost all the countries except U.K. and others. Transitional probability Matrix showed that the Indian groundnut export is concentrated in Asian markets only. Malaysia and Indonesia were found to be loyal for India groundnut. A continuous upward trend was observed in prices, while arrivals exhibited upward and downward trend. Higher market arrivals and lower prices were observed immediately after harvest of the crop. There was a strong integration among the selected markets. It was concluded that production and export of groundnut could be improved by judicious use of available water, maintaining international quality standards and proper was housing facilities linked with credit facility

PRODUCTION AND MARKETING MANAGEMENT OF SEEDS BY KARNATAKA STATE SEEDS CORPORATION LTD. IN DHARWAD DISTRICT

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(Th7808) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Study on the production and marketing management of seeds by Karnataka State Seeds Corporation in Dharwad district was carried out in Karnataka during 2002-03. By following proportionate random sampling three talukas of Dharwad district, two villages from each taluka, 183 respondents consisting of 45 dealers, 30 seed producing data was collected by using three different types of pre tested well structured questionnaires were employed. Secondary data was collected from KSSC office and district Statistical Department, Dharwad.

The important findings of the study were; seed production of jowar and cotton showing negative growth rate. The seed producing farmer expressed satisfaction regarding registration, timely supply of foundation seeds, technical guidance at the time of sowing, harvesting and processing. In marketing management product decisions are taken first by the marketing department and price decision was taken up by top level management. The KSSC has adopted a mixed type or distribution net work. The dealers in general felt that KSSC seeds were timely available, price was reasonable, demand was good, quality was best. Low extension services and low margin was major problem faced by dealers. Audiovisual coverage, was the major activity conducted by the KSSC in five talukas of Dharwad.

Majority of farmer purchased seeds 15 day before 80 sowing. Dealers, advertisements and the co-farmers were the principal sources of information about the availability of seeds in market.

Price of KSSC seeds was reasonable their quality was better and there was less risk. with KSSC seed was responded by farmers. CSH-16 jowar, DHH-11 of cotton and A-1 of Bengal gram was most preferred variety of KSSC. In conjoint analysis price factor carried maximum importance. Introduction of new varieties and reduction in prices were the major expectations of farmers.

**MILK AND MILK PRODUCTS: AN ANALYSIS OF CONSUMER PREFERENCES
AND CONSUMPTION
PATTERN IN HUBLI - DHARWAD URBAN CONGLOMERATION**

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ABSTRACT

The present study made an attempt to analyse the existing consumption pattern of milk and milk products by individual households and bulk consumers, and to predict the demand for liquid milk in HubliDharwad cities by using both primary and secondary data. The primary data was collected for the year 2002-03.

All the households consumed liquid milk, as it required for preparing tea, coffee, curds, butter, paneer, etc. About 59 per cent of the households, housewives made the buying decisions of milk and milk products. The per capita purchase varied from 125 ml/day in lower income group (IG₁) to 250 ml/day in higher income group (IG₄). About 59 per cent of the liquid milk was utilized for making tea or coffee by the households. Except few sweet marts, almost all the bulk consumers purchased and consumed liquid milk on daily basis. Sweet marts utilized all (100 %) of the liquid milk for the preparation of sweets only, and about 70 per cent and 15 per cent of the milk was utilized for the preparation of curds by the hotels and hostels, respectively.

Most of the consumers (both individual households and bulk consumers) preferred branded (packed) milk. Among the branded (packed) milk 'Nandini' was the most popular brand. Expenditure on milk and milk products (40.14 %), expenditure on non-food products (39.84 %) and income group (20.12 %) were found to be the important variables, discriminate the households as loose milk users and packed milk users.

The results of the conjoint analysis for liquid milk revealed that the households attached highest importance (42 % relative importance) to price. Brands name received least importance (10.5 % relative importance). The demand for liquid milk in the Hubli-Dharwad cities has been increasing over the years with an average linear growth of 22.92 per cent.

**MANAGEMENT OF AGRIBUSINESS UNITS – A CASE OF GRAPE AND RAISIN
PRODUCTION IN DRY AND HUMID
REGIONS OF ATHANI TALUK, BELGAUM DISTRICT**

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2003 (Year Submitted)

(Th7791) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Study on the management of agribusiness units - a case of grape and raisin production in dry and humid regions of Athani taluk, Belgaum district was carried out in Karnataka—state during 2002-03 by following proportionate random sampling with 120 farmers were selected and data was collected by personal interview.

The important findings of the study were - the cost of production of grapes were high in humid region (spacing-I Rs. 235684 and spacing-II Rs. 243440) compared to dry region (spacing-I Rs. 227366 and spacing-II Rs. 231053).

The net returns from grape production were high in humid region (spacing-I Rs. 531317 and spacing-II Rs. 588560) compared to dry region (spacing-I Rs. 474634 and spacing-II Rs. 532984) which could be attributed to good irrigation management in humid region. The total cost of production of raisins in humid region was Rs.359931 (sulphur fumigation method) and Rs.375247 (dipping oil method) while in dry region it was Rs.357206 (sulphur fumigation method) and Rs.371697 (dipping oil method).

The net returns in raisin making by sulphur fumigation method in dry region and humid region was Rs.428958 and Rs. 426333 respectively while by dipping oil method it was Rs. 610671 and Rs. 607121 for dry and humid region respectively.

The cost of marketing of grapes in local and distant market was Rs. 5125 and Rs. 6000 respectively for dry region while it was Rs. 5325 and Rs. 5700 respectively for humid region.

The producer share in consumer rupee (%) in grape marketing was 68.42 and 52.00 for local and distant market in both regions while in case of raisins it was 82.87 and 83.42 for raisins made by sulphur fumigation method and dipping oil method in both regions.

**PERFORMANCE EVALUATION OF FRUITS AND VEGETABLE PROCESSING
UNITS IN BANGALORE DISTRICT –
A SECTORIAL ANALYSIS**

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(Th7764) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

Fruit and vegetable processing industry in India derives its significance from its potential for employment at low capital cost, use of local resources, possibilities for forward and backward linkages and its scope for earning foreign exchange. The present study makes an attempt to assess the performance of the fruits and vegetable processing units in the private and public sectors of Bangalore district. The objectives were to study the investment pattern, the pattern of procurement of raw materials, economic aspects of processing units, the marketing pattern and business performance, all of which were analysed by employing the techniques of tabular analysis and business ratios. The procurement of raw materials was 4304.74 tonnes, valued at Rs. 476.94 lakhs and 220.38 tonnes, valued at Rs. 7.25 lakhs, respectively by the private and public sector units. The total cost of processing on an average amounted to Rs. 31147.38 and Rs. 30121.13 per tonne in private and public sector units, respectively. The average net returns per tonne of processed product was found higher in private unit (Rs. 1147.33/tonne) as compared to public sector unit (Rs. -979.56/tonne). Private sector major quantity of finished products through channel-11 (exporters), whereas channel-1 (dealer) was the only channel in public sector unit. Capacity utilization was high in private sector unit (45.65%) and lower in public sector unit (18.29%). Overall business performance of the private sector unit was more efficient than public sector unit. Problems regarding infrastructural facility, procurement and marketing were considered as the most important problems.

A STUDY ON PERCEPTION OF BENEFICIARIES AND NON-BENEFICIARIES TOWARDS WYTEP PROGRAMME IN DHARWAD DISTRICT

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(Th7768) Accession No
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ABSTRACT

Government of India has been planning and implementing number of rural development programmes. Recently, the WYTEP is being started in Karnataka with assistance from DANIDA since 1982. The objective of the programme is to secure the utilization of women's potential in agricultural production and thereby improving the productivity of farm holding for the betterment and quality life of rural family.

There is an obvious need to find out whether the huge investment made on it is properly utilized or not, reaching and how far the programme is justified, in terms of its success and the type of people getting the benefits. Hence, the present investigation was designed to study the perception, socio-economical and psychological characteristics and their relationship.

The study was conducted in the year 2002-03 in Dharwad district comprising 75 beneficiaries and 75 non-beneficiaries as sample for the study. The study has revealed high level of perception (53.33%) of the beneficiaries towards WYTEP programme, which has led to 54.67 per cent to achieve the increased income.

Majority belonged to middle age, illiterate, small and semi-medium land holding, low and semi-medium income group, medium innovativeness and risk orientation. Majority had contact with AA and AO (farm women), were in the habit of hearing radio and viewing Television.

The variables like education, achievement motivation, innovativeness, economic motivation and mass media participation had positive relationship with perception. Majority of 33.33 per cent had incremental income (Rs. 1001-2000) by becoming the beneficiaries of WYTEP programme. Major suggestions given were training on 'practical field problems', 'use of local words', 'commercial crops', agro-based subsidiary enterprises' and 'integrated pest management'. In the light of the findings, this programme use beneficiaries as extension workers, create 'employment opportunities', 'awareness to form groups and 'participate in social institutions'.

MORPHOLOGICAL AND MOLECULAR CHARACTERIZATION OF TEAK (*TECTONA GRANIS* LINN. F.) CLONES OF KARNATAKA

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ABSTRACT

Fifty teak (*Tectona grandis* L. f.) clones of Karnataka, maintained at Karka clonal bank and at Alur clonal seed orchard near Dandeli, were characterized at morphological and molecular levels apart from assessing their resistance levels to two important pests viz., trunk borer (*Alcterogystia cadambe*) and defoliator-skeletonizer complex (*Hyblea parea* & *Eutectona macheralis*). Using a set of seven simple leaf descriptors (viz. leaf petiole, leaf texture, leaf shape, leaf tip, leaf base, adaxial leaf pubescence and leaf colour) a key was developed to delineate teak clones that could be effectively adopted at the field level. Perhaps for the first time, 30 teak clones were fingerprinted with 20 random RAPD primers. Six clones (viz., MyHV2, MyHV3, MyHV7, MySa1, MySa2 and MyHaK2) possessed unique bands enabling them to be identified without ambiguity and further, thirteen pairs of clones shared a unique band. These informative primers show a great potentiality in genotyping unknown clones, maintaining clonal fidelity and in clonal registration. Moderately high level of genetic diversity was found among the 30 teak clones with an information index of 0.373 ± 0.243 . Clones of central provenance of Karnataka were more diverse (0.352) than those from southern (0.304) and northern provenance (0.317) as revealed by Shannon Information Index.

Significant inter-clonal differences were identified for the susceptibility levels to trunk borer and for defoliators. Eleven of the fifty clones were tolerant to defoliator attack with MyMK3 (24.33% leaf defoliation) and MyHV3 (37.28%) clones showing least attack. Clone MyHuT1 showed maximum tolerance to trunk borer (0.44 holes per tree) among the 12 tolerant clones. However, levels of tolerance to these two pests were independent. Association analysis showed that clones with higher pubescence and dark green colour were more often susceptible to defoliators' attack. Clones from southern origin performed better in terms of volume growth after twenty years (0.43 m^3) than those of the central (0.41 m^3) and northern (0.38 m^3) provenance of the state.

STUDIES ON PERFORMANCE OF SUBSURFACE DRAINAGE SYSTEMS OF PHASE-I AREA UNDER INDO-DUTCH NETWORK PROJECT IN UPPER KRISHNA PROJECT COMMAND

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2003 (Year submitted)

Th8276 (Accession number)

University Library, UAS, Dharwad (Location)

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ABSTRACT

The investigations were carried out during November, 1998 - May, 1999 on the evaluation of both the pipe and open subsurface drains (SSDs) executed in 14.90 ha out of 180 ha in the ORP area in Islampur - Devapur (J) villages under Phase-I work of Indo-Dutch Network Operational Research Project on " Drainage and Water Management for Salinity Control in Canal Commands" in Upper Krishna Project area and to compare them for their suitability in the area. The SSD works were undertaken by the above project in Agricultural Research Station, Bheemarayangudi for the reclamation of waterlogged saline area during 1998 summer.

The monitoring of drainage systems revealed that the average weekly and monthly weighted average discharges of the pipe SSDs were 15.89 and 17.12 per cent higher than that of the open SSDs, indicating slightly a better performance in removing the excess water from the study area. There exists a positive correlation between the NLBC flow depth and the weighted average drain discharge and it was more pronounced in case of open SSDs ($r = 0.751$) than the pipe SSDs ($r = 0.473$). The estimates of the areal hydraulic conductivity indicate that the flow was predominantly from below the drain level. Also, the areal values were much (nearly 16 to 21 times) higher than the point measurements of hydraulic conductivity which are in line with the findings of the earlier researchers. The performance of both types of drains was inadequate in controlling the water table due to wider spacing (50 m) in the study area. Compared to mid-drain spacing, the leaching of salts was more efficient at quarter-drain spacing in both the systems. Further, the pipe SSDs system was found to be comparatively more effective in leaching of salts and the change in soil reaction was insignificant implying the inefficiency of SSD system alone in reducing soil pHs without amendments. Further, the improvement in leachate quality in pipe SSD system was slightly better than the open SSD system and hence the leachate could be reused for irrigation in the study area. After the execution of drainage works, though the response of the farmers for taking up cultivation of crops was slow initially, it is expected that the cropping intensity would increase in the years to come because of the improvement in the land conditions.

EVALUATION OF GARLIC (*ALLIUM SATIVUM* L.) GENOTYPES FOR GHATAPRABHA LEFT BANK COMMAND AREA

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2003 (Year submitted)
Th8261 (Accession number)
University Library, UAS, Dharwad (Location)
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ABSTRACT

An investigation to evaluate fourteen genotypes of garlic under Ghataprabha Left Bank Command (GLBC) area was carried out at Kittur Rani Channamma College of Horticulture, Arabhavi (Tk. Gokak) during 2002-2003. The field trial was laid out in a randomised block design in both *kharif* and *rabi* season. Observations on growth parameters were recorded at monthly intervals starting from 60 days after planting.

Among the different genotypes evaluated during *kharif* and *rabi* season, Kundgol Garlic-2 recorded higher plant height (39.06 cm in *kharif* and 38.60 cm in *rabi*, respectively) and maximum leaf size (80.20 cm² in *kharif* and 86.86 cm² in *rabi* season).

Bulb Yield per hectare differed significantly and the highest Yield was recorded in genotype Kundgol Garlic-2 during both the seasons (11.41 t/ha in *kharif* and 12.68 t/ha, respectively).

Yield performance of Kundgol Garlic-2 was closely followed by Ankola Collection in *kharif* and *rabi* seasons. The highest sulphur content was recorded in variety Godawari (0.043% and 0.044% in *kharif* and *rabi* season, respectively), while the lowest sulphur content was recorded in Jamnagar-I (0.015% and 0.019% in *kharif* and *rabi* season, respectively) .

In the present study, promising garlic genotypes for both *kharif* and *rabi* under GLBC conditions are Kundgol Garlic-2 and Ankola Collection with higher yield and acceptable quality. The performance of Indore Local was better only during *kharif*, while North Canara performed better only during *rabi* season.

STUDIES ON DOUBLE CROSSES INVOLVING POTENTIAL TOMATO HYBRIDS

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2003 (Year Submitted)

(Th7809) Accession No

University library, UAS, Dharwad (Location)

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ABSTRACT

An investigation was under taken in tomato (*Lycopersicon esculentuin Mill.*) to isolate potential double cross hybrids, potential single cross F₁s for reciprocal recurrent selection, economic/ transgressive segregants and heterosis and combining ability for growth and yield attributes.

The study on double cross revealed that, the DT-HCS-7 X DT-H5N-3 was found to be potential double cross hybrid with considerable magnitude of heterosis. The major contributing factor in above mentioned cross was average fruit weight.

The basic information such as mean performance, gca effect, GCA variance and SCA variance derived from the double cross hybrids were used to identify SCF₁S, which act as base population for genetic improvement through recurrent selection programme. DT-H5N-3 and DT-HCS-7 were identified as potential parents in developing a variety. However, DT-H4U-1 and DT-H5U-2 (high mean performance, high SCA variance and negative gca effect) proved to be potential specific combiner useful to transgressive breeding.

HCS-7 X DT-H5N-3 had higher frequency of transgressive segregants, higher economic segregant per cent. The other important crosses, which registered higher frequency of desirable transgressive segregants were DT-HCS-7 X DT-HVI-5, DT-HANP-4 X DT-HVI-5, DT-HCS-7 X DT-H5U-2 and DT-H5N-3 X DT-HVI-5. Further DT-HCS-7 X DT-H5N-3-110-4, DT-HANP-4 X DT-HVI-5-11-6 and DT-H4U-1 X DT-HANP-4-112-12 were isolated as important segregants. The following parents were identified as good general combiners for various traits; DT-H5N-3, DT-HVI-5 for yield per plant and number of fruits per plant, DTHCS-7, DT-HVI-5 for pericarp thickness (distant market), DT-HANP-4, DT-HCS-7 for height and TSS. The double cross hybrid combinations with maximum significant sca effect for different traits were DT-HCS-7 X DT-H5N-3 for fruit yield per plant and DTHCS-7 X DT-H5U-2 for average fruit weight.

COMBINING ABILITY AND HETEROSIS STUDIES IN CHINA ASTER [*CALLISTEPHUS CHINENSIS* (L.) NEES.]

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Th8325 (Accession number)

University Library, UAS, Dharwad (Location)

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ABSTRACT

The investigation on combining ability and heterosis in China aster crosses were carried out at Kittur Rani Channamma College of Horticulture, Arabhavi. The 15 crosses synthesised by 6 x 6 diallel (without reciprocal) cross were evaluated along with parents in randomised block design with three replications and data was subjected to half diallel analysis.

Combining ability analysis revealed higher magnitude of SCA variance for all the traits under study except for days for bud to bloom and stalk length. The parent, Kamini was a good general combiner for early flowering, while P.G. White and P.G. Pink were found to possess additive genes for growth, yield and quality parameters, viz., plant height, plant spread, duration of flowering, number of flowers per plant, flower weight, flower yield, stalk length and flower diameter.

The two crosses Kamini x P.G. Violet and Kamini x P.G. White exhibited significant negative sca effects and significant negative heterosis over mid parent for early flowering. The cross P.G. Pink x P.G. Violet showed significant positive sca effects coupled with significant positive heterosis over better parent and standard check for plant height, number of branches, duration of flowering, number of flowers per plant and vase life. The cross P.G. Violet x P.G. White recorded significant positive sca effects coupled with significant positive heterosis for Yield and quality attributes, viz., duration of flowering, flower yield per plant, flower yield per hectare and stalk length. Non-additive gene action was predominant for majority of the traits and hence, recurrent selection scheme and heterosis breeding is suggested for improvement.

STUDIES ON DATES OF SOWING AND NUTRIENT MANAGEMENT IN AJOWAN (*TRACHYSPERMUM AMMI* L.) UNDER NORTHERN DRY ZONE OF KARNATAKA

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2003 (Year submitted)

Th8337 (Accession number)

University Library, UAS, Dharwad (Location)

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ABSTRACT

A field experiment was conducted at Kittur R Chana College of Horticulture, Arabhavi, during *Kharif* 2002 to know possibility of cultivation of ajowan under Northern Dry Zone of Karnataka, to find out the suitable sowing time and optimum dose of NPK application on growth, seed and essential oil yield. The two experiments were laid out in Randomized Block Design with 8 treatments to each experiment. The date of sowing experiment crop was sown from June second fortnight to October (at fortnight interval) and for nutrient management experiment the different levels of NPK were applied (50:25:25, 75:37.5:37.5, 100:50:50,

125:62.5:62.5, 150:75:75, 175:8.5:87.5, 200: 100: 100 kg ha⁻¹) over control (no fertilizer) in three replications. The results revealed that ajowan, a new crop to this zone, could be grown successfully. Among the different dates of sowing June second fortnight resulted highest seed (11.53 q ha⁻¹) and essential oil yield (50 l ha⁻¹) followed by October first fortnight sowing (9.38 q ha⁻¹ and 43.90 l ha⁻¹, respectively) since plants were exposed to longer period of growth with sufficient conserved moisture and favourable temperature for growth and yield attributing traits. But in September first and second fortnight sown crop resulted lower seed (4.75 and 5.86 q ha⁻¹, respectively) and essential oil yield (17.53 and 23.83 l ha⁻¹, respectively) because plants were exposed to adverse climatic conditions like supra. optimal soil moisture for prolonged period lead to wilting.

Among the different levels of NPK applied 125:62.5:62.5 kg ha⁻¹, resulted in better growth, yield attributing traits, seed (9.07 q ha⁻¹) and essential oil yield (39.57 l ha⁻¹) over control (2.43 q and 8.43 l ha⁻¹, respectively). Above and below this level of fertilizer application resulted in poor performance. Hence, for getting higher B: C ratio (3.90) application of 125:62.5:62.5 NPK kg ha⁻¹ was found to be optimum.

STANDARDIZATION OF DRYING TECHNIQUES IN CARNATION FOR VALUE ADDITION

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2003 (Year submitted)

Th8328 (Accession number)

University Library, UAS, Dharwad (Location)

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ABSTRACT

Experiments were carried out at Kittur Rani Channamma College of Horticulture Arabhavi on drying of cut carnation flowers for obtaining best quality dry carnation flowers. Data on shade drying of flowers harvested at different stages viz., paintbrush, cross bud and open embedded in two different desiccants (sand, silicagel) revealed that desiccating the open flowers in silicagel was superior with respect to colour and texture. While drying cross bud flowers was best with respect to shape and appearance. Less number of days (6.13) were required to dry open flowers than paintbrush stage flowers (8.97days). Silicagel desiccated the flowers faster (5.4 days) than sand (10.06 days). Experiment on glycerol pretreatment showed improvement in suppleness of dried carnation flowers. The flowers treated with 1:1 glycerol to water for 12 hours maintained best texture, colour, shape and appearance and was on par with the flowers treated with 1:5 glycerol to water for 24 hours. In the hot air oven, cross-bud stage flowers could be dried well at 40°C for 89.25 hours with sand desiccant. While in the microwave, drying at medium low level for 2.5 minutes and then at low level for 3.5 minutes produced the best quality dried flowers when silicagel was used as desiccant. Data on comparison of different drying methods viz., shade, sun, oven and microwave along with the two desiccants (sand and silicagel) revealed that drying cross bud flowers in shade for 164.67 hours and in hot air oven at 40°C for 68 hours by embedding in silicagel can produce best quality dried carnation flowers with respect to colour, shape, appearance and texture. Microwave drying of flowers in either of the desiccants performed poorly in spite of retaining the highest anthocyanin content (40.60%).

GENETIC VARIABILITY AND HETEROSIS STUDIES IN MUSKMELON (*CUCUMIS MELO* L.)

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2003 (Year submitted)

Th8252 (Accession number)

University Library, UAS, Dharwad (Location)

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ABSTRACT

The investigations on genetic variability and heterosis in muskmelon were carded out at Department of Olericulture, K.R.C.College of HorticultUre, Arabhavi during 2002-2003. The genetic stock of thirty five muskmelon accessions was evaluated to elicit infonnation on genetic variability, divergence and character association. Analysis of variance revealed highly significant ($P = 0.01$) differences among genotypes for twenty four out of twenty five growth, yield and quality parameters. The values of gcnotypic and phenotypic coefficient of variation were moderate for the characters like fruit shape index, cavity length, fruit fly incidence and per cent disease index for downy mildew indicating limited variability in the genuplasm evaluated for these traits. High heritability coupled with high genetic advance over mean were observed for fruit weight, fruit shape index and cavity length indicating additive gene action for these traits and hence, selection for these traits would be gainful.

Correlation studies revealed highly significant and positive association of yield with average fruit weight, flesh thickness, vine length and cavity length, suggesting possibility of simultaneous selection for these traits. Path analysis revealed that the direct selection on average fruit weight and cavity width for yield would be gainful as they had high direct effect.

The 35 genotypes were grouped into 15 clusters by using D_2 analysis. While the Cluster I constituted 15 genotypes, Cluster III included 5 genotypes followed by Cluster XIV with 3 genotypes. The remaining clusters had one genotype each.

The 15 hybr.ids were evaluated along with their eleven parents and commercial check variety Pusa Madhnrns to study the extent of heterosis for growth, yield and fruit quality parameters. Highly significant positive heterosis over better parent and commercial check for yield per vine, average fruit weight and fruit number per vine were observed. The promising crosses for yield and component traits were IC-203053 x Arka Jeet,, IC-203073 x Arka Jeet and Kajri x Arka Jeet. These crosses had also high heterosis for quality parameters like flesh thickness, TSS and sugars.

NUTRITIONAL COMPOSITION AND ALTERNATE USES OF SAFFLOWER
(*CARTHAMUS TINCTORIUS* L.)
PETAL AS NATURAL FOOD COLOURANT

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(Th7793) Accession No
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ABSTRACT

The safflower floret is an important part of the plant claimed to have medicinal properties. Safflower petals of spiny (Annigeri-1) and non-spiny (NARI-6) varieties collected from the Regional Agricultural Research Station. Annigeri-1 UAS, Dharwad were analysed for physico-chemical and nutritional composition and explored for alternate uses. Colour of the florets ranged from brownish orange in Annigeri-1 to reddish orange in NARI-6. Annigeri -1 was superior to NARI-6 in physical parameters viz., length (1.30 cm), breadth (0.146 cm), weight (0.136 g) and volume (9.534 ml). The florets contained higher amounts of protein (11.41-12.34%), fat (6.75-7.46%), fiber (12.69-13.66%), low carbohydrate (49.33-49.50%) considerable amounts of carotene (1589.83 - 2100.80 g/100g), L-ascorbic acid (55.64.3 mg/100g) and minerals viz., calcium, iron and phosphorus (518.88-613.14, 9.010-15.207, 132.30-183.86 mg/100 g, respectively) safflower florets have low sodium (27.28 mg/100g), high potassium (2600-2900 mg/100 g) and good sources of trace elements viz., manganese zinc and copper (0.982-0.945, 0.526-1.441, 1.004-1.165 mg/100g, respectively), Qualitative and quantitative analysis of pigment revealed that NARI-6 contained higher amounts of safflamine and carthamine (29.53 and 0.530%, respectively) compared to annigeri-1 (28.20 and 0.273%, respectively). Petal stored for 12 months at room temperature and pigment for 6 months at 50°C of NARI-6 variety was stable compared to Annigeri-1. Petal powder or pigment can be incorporated to an extent of 0.5 per cent in safflo-badam milk, 3.5 per cent in shira and coloured rice and 5.0 per cent in *sajjaka* without affecting the functional and sensory qualities at the same time resulting in the nutritional benefit. Safflo-badam milk with petal powder was liked by 91.25 per cent of consumers and that with pigment by 73.75 per cent.

WEAVING COMPUTERIZED *NEGI* MOTIFS IN TRADITIONAL LAKKUNDI SAREES

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(Th7772) Accession No
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ABSTRACT

The present investigation entitled 'Weaving computerized *negi* motifs in traditional Lakkundi sarees' was conducted during 2000-03. Totally 125 wage weavers and 8 master weavers from Lakkundi and Shigli villages of Gadag district were interviewed using self-structured questionnaire by personal interview method to collect the historical background and demographics of polycot saree weavers. PSP and GC Kala-2000 software was used to digitize thirteen commonly used *Kasuti* motifs. Five sarees were woven on the powerloom by incorporating *Kasuti* motifs with jacquard mechanism. Fifty each rural and urban women expressed their acceptability for newly designed sarees. History revealed that contrast-bordered *lungi* resembling the polycot sarees was produced even before independence on throw shuttle pit loom at Lakkundi. Merchants from Prasiddhi handlooms, Bangalore during 1990's encouraged weaving polycot sarees with cone technique.

Majority of the wage weavers belonged to middle age with secondary education and nuclear families whereas, majority of master weavers followed joint family norms. *Kuruhinashettys* and *Devangas* predominate weaver's community. Sarees 1,2 and 4 were woven with digitized *negi* motifs, retaining traditionality. Sarees 3 and 5 were woven with elaborate pallav, to meet consumer demand, a revival over traditionality. The weavers produced 17 plain sarees per week. However, the rate of production of computerized saree was relatively low because of extra weft figuring that led to loom stoppage. Many of the rural consumers opined that the computerized elephant with howdah, deer creeper, lotus, lotus butta, diagonal birds creeper, gopuram and wheat spike-lotus resembled the hand-embroidered motifs. In general the consumers preferred sarees 1,2,3 and 4. The net profit earned on newly designed sarees was computerized motifs.

COMPARATIVE OF LECITHIN BASED AND TRIS DILUENTS FOR MICROBIAL LOAD AND FERTILITY OF BUL SEMAN

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The present study was planned to evaluate the microbiological quality of different sources of egg yolk as an additive in semen extender, to evaluate the microbiological quality of Tris and Biociphos plus^R extender and to compare the quality of semen diluted in Tris and Biociphos plus^R extender with respect to fertility. The mean values of microbial count for farm egg yolk, market/shop egg yolk and industry egg yolk emulsion^R were 483.33 ± 70.32 , 1566.67 ± 469.19 and 00.00 (zero) CFU/ml and microbial count ranged between 200-700, 100-3200 and 00.00 (zero) CFU/ml, respectively for three different egg yolk sources. The corresponding values of microbial count for Tris extender prepared from market egg yolk, Tris extender prepared from market egg yolk Tris extender TTTris extender from industry egg yolk emulsion^R were 100.00 ± 36.51 , 55.78 and 00.00 ± 00.00 (zero) CFU/ml respectively. The range values for microbial count were between 00.00-200 for Tris extender prepared from farm egg yolk, 00.00-400 CFU/ml for Tris extender prepared from industry egg yolk emulsion^R.

The Biociphos plus^R semen dilutor did not show any contamination. The mean pre freeze motility of semen diluted in Tris and Biociphos plus^R extenders was 72.50 ± 2.76 and $72.92 \pm 1.68\%$, respectively. The mean values for post thaw motility of semen diluted in Tris/(farm egg yolk) and biociphos plus^R extenders were 42.50 ± 0.97 and $48.75 \pm 1.96\%$, respectively. The conception rate for the Tris extender ranged from 44.4 to 61.9 per cent with a mean conception rate of 53.24, whereas for the Biociphos plus^R extender the conception rate ranged from 42.8 to 66.7 per cent with a mean conception rate of 52.24%.