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# **The Indian Agricultural Sciences ABSTRACTS**



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## SAMPLE ENTRY

1 ← 001 Paul, P.R.C.; Xavier, F.; Leena, A. (College of Veterinary and Animal Sciences, Trissur (India), Department, of Livestock Production Management) → 2 → 6  
Dairysoft: A computer programme for dairy farms. Indian → 3  
Journal of Animal Sciences (India). (Mar 2006).v. 76(3) p. → 4  
260-262 KEYWORDS: DAIRY FARMS; COMPUTER → 5  
SOFTWARE

To exploit the full potential of dairy sector, a computerized record management system dairysoft was developed. Visual Basis 6.0 was used as front end while MSAccess 97 was utilized as back end for the software. The menu base dairysoft was provided with facilities for obtaining necessary reports along with separate data entry options.

1. Entry number
2. Author(s)
3. Title in English
4. Source
5. Keywords
6. Organisation where work was carried out

**E11 Land Economics and Policies**

270. Bali, J.S.; Indian Institute of Kharagpur, Division of Soil and water conservation. Kharagpur (India). land use planning for sustainable development in India. Journal of Soil and Water Conservation (India). (Oct 2009) v.8(4) p.35-38 KEYWORDS: LAND USE PLANNING. INDIA.

**E16 Production Economics**

271. Shekhar, J.; Chaudhary Swaran Kumar Himachal Pradesh Krishi Vishwavidyalaya, Malan (India). Rice and Wheat Research Centre). Mankotia, B.S.; Chaudhary Swaran Kumar Himachal Pradesh Krishi Vishwavidyalaya, Malan (India). Rice and Wheat Research Centre). Dev, S.P.; Chaudhary Swaran Kumar Himachal Pradesh Krishi Vishwavidyalaya, Malan (India). Rice and Wheat Research Centre). Productivity and economics of rice (*Oryza sativa*) in system of rice intensification in North-Weastern Himalayas. Indian Journal of Agronomy (India). (Dec 2009) v. 54(4) p. 423-427 KEYWORDS: ORYZA SATIVA. ECONOMICS. INTENSIFICATION. CROP MANAGEMENT.

A field experiment was conducted at Malan during kharif 2006 and 2007 to evaluate the productivity and profitability of rice under system of rice intensification (SRI) and integrated crop management (ICM). The SRI involved transplanting of 10-12 days old single seedling/hill at 25 cm x 25 cm; ICM involved transplanting of 15-18 days old 1-2 seedlings/hill at 20 cm x 20 cm spacing and were compared with conventional transplanting (CT) of 4 weeks old 2-3 seedlings/hill at 20 cm x 10 cm spacing. The treatments (CT, SRI, ICM) were tested in 2 sets, 1 with same date of nursery sowing (consequently with different transplanting dates) and another with same date of transplanting (with different dates of nursery sowing). The SRI and ICM methods outperformed CT under same date of nursery sowing. The plants under SRI and ICM were taller by 7.4 cm and 6.1 cm, respectively and matured 7 days earlier compared to CT (124 days). More tillering at hill level compensated and thus effective tillers/ m<sup>2</sup> in ICM (247) were at par with CT (244) but were less in SRI (203). Panicle weight (g) was significantly more in SRI (3.75) followed by ICM (3.01) and CT (2.85). On an average ICM (6.67 t/ha; 14.5%) and SRI (6.43 t/ha; 10.6%) produced significantly more grain yield compared to CT (5.81 t/ha). NPK uptake was significantly more in ICM (98.9, 19.6,96.8 kg/ha) followed by SRI and CT. On an average, ICM recorded significantly higher net return (Rs 40,943/ha) and benefitcost ratio (2.04) followed by SRI (Rs 39,120/ha and 1.98). Under same date of nursery transplanting, the number of effective tillers/m<sup>2</sup> were significantly less under SRI (164) and ICM (214) and so the productivity and profitability in new methods was less. Thus, it is concluded that under mid hills of Himachal Pradesh, ICM was promising to increase the productivity and profitability of transplanted rice.

272. Harish Kumar, K.; University of Agricultural Sciences, GKVK, Bangalore (India). Chinnappa, B.; University of Agricultural Sciences, GKVK, Bangalore (India). Economic analysis of cashew processing in Karnataka. Journal of Plantation Crops (India). (April 2010) v. 38(1) p. 66- 71 KEYWORDS: CASHEWS. ECONOMIC ANALYSIS. PROCESSING.

The study to investigate the processing aspects of cashew nut in Kamataka is based on primary data collected from 30 cashew processing units spread over Udupi and Dakshina Kannada Districts of Kamataka. The data were analysed using descriptive statistics, investment measures and break even analysis. Investment feasibility of cashew processing units was done using discounted cash flow techniques such as Net Present Value, Benefit Cost Ratio and Internal Rate of Return. The study indicated that variable cost of processing of cashew nut worked out to Rs. 48,844 per tone of which the cost of raw materials constituted major item with 81.01 percent. The marketing costs and fixed costs were in the order of Rs. 3862 per tonne and Rs. 2289 per tonne, respectively.

The total cost of processing inclusive of variable cost, marketing cost and fixed cost came to Rs. 54,433 per tonne. Processing units realized net returns of Rs.3,880, Rs.3,537 and Rs.3,009 per tonne in large, medium and small size units, respectively. Business ratios indicated that the medium and large size units were more efficient compared to the small size units. Investment on cashew processing was economically viable as indicated by results of Net Present Value, Benefit Cost Ratio and Internal Rate of Returns. Further, scope for increasing the efficiency and reducing the cost of small processing units was observed.

273. Harish Kumar, K.; University of Agricultural Sciences, GKVK, Bangalore (India). Chinnappa, B.; University of Agricultural Sciences, GKVK, Bangalore (India). Trade performance of Indian cashew. *Journal of Plantation Crops (India)*. (Aug 2010) v. 38(2) p. 138-143 KEYWORDS: CASHEWS. IMPORTS. EXPORTS. GROWTH RATE.

Trade performance of Indian cashew was analyzed by collecting secondary data on export of cashew kernels, Cashew Nut Shell Liquid(CNSL) and import of raw cashew nuts for the years 1974-75 to 2007-08. The growth rate of kernel exports was 5.37 per cent with instability index of 8.70 per cent and the export of CNSL was 6.15 per cent with instability index of 41.92 per cent during the post-liberalization period was observed. Among the different countries USA, is a stable market for Indian cashew kernel and CNSL. Further, export potential is to be tapped by creating brand image loyalty in the potential markets abroad.

#### **E50 Rural Sociology and Social Security**

274. Bhan, Suraj; Soil Conservation Society of India. New Delhi (India). Bharti, V.K.; Directorate of Information and Publications of Agricultural, ICAR. New Delhi (India). Hans Raj; Directorate of Information and Publications of Agricultural, ICAR. New Delhi (India). Sustainable manifold livelihood opportunities. *Journal of Soil and Water Conservation (India)*. (Oct 2009) v.8(4) p.39-45 KEYWORDS: SUSTAINABILITY. EDUCATION.

#### **F01 Crop Husbandry**

275. Dhaka, Amreeta; K.P. Patel College of Home Science, Gujarat (India). Das, Manish; DMAPR, Gujarat (India). Khurana, S.M. Paul; Central Potato Research Institute Campus, Modipuram, Meerut (India). Processing quality of potato varieties stored at ambient temperature. *Indian Journal of Plant Physiology (India)*. (Jun 2010) v.15(2) p.181-185 KEYWORDS: PROCESSING QUALITY. POTATOES. TEMPERATURE.

Potato tubers of four cultivars viz., Kufri Chipsona-1, Kufri Chipsona-2, Kufri Jyoti and Kufri Bahar were stored at room temperature (22–38°C, RH 37–80%) after harvest. Freshly harvested and stored tubers were processed into chips, laccha and french fries and evaluated for losses due to rotting, sprouting and weight loss. Dry matter content was found to be highest in Kufri Chipsona-2 in freshly harvested and 90 days stored potatoes followed by Kufri Chipsona-1, Kufri Jyoti and Kufri Bahar. Similarly, the chips colour and general acceptability were significant and highly acceptable in Kufri Chipsona-1 and Kufri Chipsona-2. In freshly harvested potatoes, quality of the products (chips, french fries and laccha) was highly acceptable ranging between 8 and 7 in both processing varieties. Reducing sugars, total phenols, sucrose and browning were within acceptable range in both Kufri Chipsona-1 and Kufri Chipsona-2. The findings of the study suggest that 90 days storage of potatoes at normal temperature with proper ventilation could be explored for storing processing potatoes.

276. Keshavkant, S; Pt. Ravishankar Shukla University, School of Life Sciences, Raipur (India). Naithani, S.C.; Pt. Ravishankar Shukla University, School of Life Sciences, Raipur (India). Chilling induced superoxide production, lipid peroxidation and leakage loss in *Shorea robusta* seedlings. *Indian Journal of Plant Physiology (India)*. (Jun 2010)

v.15(2) p.192-197 KEYWORDS: COOLING. LIPID PEROXIDATION. SHOREA ROBUSTA. SHOREA. SEEDLINGS.

Aerial parts of the chilling sensitive young sal (*Shorea robusta*) seedlings showed excess generation of active oxygen species (AOS) and malondialdehyde (MDA) in response to exposure of chilling temperature (9–14.1°C) during November to March in field conditions. Approximately 5–6 fold increase in AOS was estimated in aerial parts of chilling exposed seedlings than the control (greenhouse) seedlings. Accumulation of AOS was found to be closely associated with the rise in MDA in leaf (4.4 fold) and shoot (3.8 fold) tissues, whereas, control seedlings exhibited insignificant accumulation of both. Chilling exposed seedlings also showed significant promotion in the leakage loss of organic (protein) and inorganic (K<sup>+</sup> and Ca<sup>++</sup>) electrolytes from leaf and shoot tissues, but an insignificant leakage of electrolytes was recorded in greenhouse seedlings. The field grown sal seedlings (exposed to chilling) revealed a strong positive correlation between the rates of AOS and MDA accumulation ( $r = 0.98^{**}$ ) and also between magnitude of MDA levels and leakage loss of various electrolytes ( $r = 0.99^{**}$ ), during chilling periods. Our results clearly showed that leaf and shoot of field grown sal seedlings are severely damaged due to chilling stress, whereas, the protected (greenhouse) seedlings are showing vigorous growth during same periods of analysis.

277. Bhullar, M.S.; Punjab Agricultural University, Dept of Agronomy, Ludhiana (India). Uppal, S.K.; Punjab Agricultural University, Dept of Plant Breeding & Genetics, Ludhiana (India). Kapur, M.L.; Punjab Agricultural University, Dept of Plant Breeding & Genetics, Ludhiana (India). Effect of agronomic practices and varieties on productivity of sugarbeet (*Beta vulgaris*) in semi-arid region of Punjab. Journal of Research Punjab Agricultural University (India). (Mar & Jun 2009) v.46(1-2) p.6-8 KEYWORDS: SOWING DATE. SUGARBEET. VARIETIES.

A field experiment was conducted during 2002-03 and 2003-04 to evaluate the effects of sowing dates, and varieties on sugarbeet yield in semi-arid environment of Punjab. The crop sown on October 10 gave the highest root yield (77.2 t ha<sup>-1</sup>) and was significantly better than September 25 and October 25 sowings during 2002-03, while in 2003-04, September 25 sown crop produced the highest root yield (88.3 t ha<sup>-1</sup>) and was at par with October 10 sowing. On an average, the delay in planting from September 25 to October 10 was at par while further delay in sowing i.e. Oct 25, brought 19.4 per cent reduction. September 25 and October 10 sowings produced statistically higher root and sugar yield than October 25 sowing during both the years. Among varieties, cv. Posada yielded 22.3 per cent higher mean root yield (84.6 t ha<sup>-1</sup>) and 28.9 per cent mean sugar yield (12.2 t ha<sup>-1</sup>) than H 10064. Sucrose content in roots did not vary due to sowing dates and varieties. The root yield, sucrose content and sugar yield were not influenced by sowing methods.

278. Singh, Kulvir; Punjab Agricultural University, Regional Research Station, Faridkot (India). Singh, Rupinder; Punjab Agricultural University, Regional Research Station, Faridkot (India). Effect of planting geometry and nitrogen levels on performance of Bt cotton (*Gossypium hirsutum* L.) Cultivar RCH-134. Journal of Research Punjab Agricultural University (India). (Mar & Jun 2009) v.46(1-2) p.14-16 KEYWORDS: COTTON. NITROGEN FERTILIZERS. PLANTING. PRODUCTIVITY. YIELD FACTORS. VARIETIES.

A field experiment was conducted at PAU-Regional Station, Faridkot during Kharif seasons of the year 2006 and 2007 with an objective to evaluate the performance of RCH-134 Bt under different planting geometry and nitrogen levels. The experiment comprised of three planting geometries (100 x 60, 100 x 75 and 67.5 x 75 cm) in main plots and three N levels (112.5, 150 and 187.5 kg N/ha) in sub-plots of split plot design with four replications. The pooled data indicated significantly reduced seed cotton yield of 2596 kg/ha in narrow plant geometry of 67.5 x 75cm as compared to 100 x 60 (2985kg) and 100 x 75cm (2986kg) combinations. The latter two geometries, though statistically at par but yielded about 15% higher seed cotton yield than 67.5 x 75cm. Among N levels, there was a significant reduction in seed cotton yield at 112.5 kg N/ha during both the years as compared to other two higher levels. Highest seed cotton yield



of 3120kg/ha was observed with application of 187.5kg N/ha followed by 150kg (2894kg) while least seed cotton yield (2553kg) was recorded with 112.5 kg N/ha.

279. Arora, N.K.; Punjab Agricultural University, Department of Horticulture. Ludhiana (India). Gill, M.I.S.; Punjab Agricultural University, Department of Horticulture. Ludhiana (India). Bud level optimization for pruning in flame seedless grapes. Journal of Research Punjab Agricultural University (India). (Mar & Jun 2009) v.46(1-2) p.41-43 KEYWORDS: GRAPES. PRUNING. SOFT FRUITS.

To standardize the pruning technique in Flame Seedless grapes under north-Indian conditions, an experiment was conducted over a period of three years from 2005 -2007, at New Orchard of Punjab Agricultural University, Ludhiana. The pruning of vines was done at four levels viz., 3, 4, 5 and 6 buds in the last week of January. The highest percentage of fruitful buds was observed in the treatment in which 4 buds per cane were retained. The number of bunches (64.1/vine), yield (25.8 Kg/vine) and brix yield (454.5) were significantly higher, when 4 buds were retained on each cane after pruning. Whereas, the minimum number of bunches (47.5/vine), yield (18.2Kg/vine) and brix yield (295.4) were obtained, when 6 buds per cane were left after pruning. The bunch weight and fruit quality parameters were also improved in the treatment in which 4 buds per cane was retained after pruning. On the basis of present study, it is recommended that in Flame Seedless grapes, the pruning should be done at 4 buds level for obtaining higher yield and better quality fruits.

280. Gangwar, M; Punjab Agricultural University, Department of Microbiology, Ludhiana (India). Dutt, Deepti; Punjab Agricultural University, Department of Microbiology, Ludhiana (India). Effect of Azorhizobium and vam inoculation on fertilizer economy and yield of maize (*zea mays.l* ). Journal of Research Punjab Agricultural University (India). (Mar & Jun 2009) v.46(1-2) p.55-59 KEYWORDS: AZORHIZOBIUM. MAIZE. VESICULAR ARBUSCULAR MYCORRHIZAE.

A field experiment was conducted in 2005-06 on maize variety PMH-1 with dual inoculation of Azorhizobium and VAM (*Glomus fasciculatum*) along with application of formononetin. The seeds inoculated with Azorhizobium and VAM and treated with formononetin showed positive interactions for germination, percent mycorrhizal infection, N and P contents, total chlorophyll and other growth parameters as compared to control. Azorhizobium +VAM + formononetin treatment increased nitrogenase activity of treated plant roots. A 22.1 per cent increase in grain yield over control was observed by the dual inoculation and formononetin treatment.

281. Chawla, Amanpreet Kaur; Punjab Agricultural University, Department of Soil and Water Engineering, Ludhiana (India). Singh, K.G.; Punjab Agricultural University, Department of Soil and Water Engineering, Ludhiana (India). Singh, Angrej; Punjab Agricultural University, Department of Soil and Water Engineering, Ludhiana (India). Effect of mulch and drip irrigation on soil hydro thermal regime and potato yield (*solanum tuberosum l.*). Journal of Research Punjab Agricultural University (India). (Mar & Jun 2009) v.46(1-2) p.68-71 KEYWORDS: TRICKLE IRRIGATION. MULCHES. REDUCING SUGARS. SOLANUM TUBEROSUM.

Field studies were conducted to observe the effect of mulch and drip irrigation on quality of potato (*Solanum tuberosum L.*). The different types of mulch were plastic, biodegradable and organic. The different drip irrigation levels were low (LDI), medium (MDI) and high (HDI) with 0.6, 0.8 and 1.0 IW/CPE ratio respectively and conventional irrigation. Plastic mulch increased the minimum soil temperature by 2-3°C and brought it to an optimum range (10-12°C) required for better crop growth, which helped in improving quality of crop. The average yield of all the three mulch treatments under drip irrigation was 28.6 per cent higher than the no mulch drip irrigation treatment. The highest yield of 312.3 q/ha was obtained under HDI treatment (averaged over all mulches) against a yield of 238.7 q/ha obtained for the conventionally irrigated mulched treatment, registering an increase of 30.8 per cent. Mulch also helped in improving the processing quality of the crop.



282. Shanmugavadivu, R.; Sugarcane Breeding Institute, Coimbatore (India). Plant Physiology Sec.). Rao, P.N.G.; Sugarcane Breeding Institute, Coimbatore (India). Plant Physiology Sec.). Endogenous gibberellin level in the shoot apices of flowered and non-flowered stalks of sugarcane varieties. Indian Journal of Plant Physiology (India). (Jul - Sept 2009) v. 14(3) p. 303-305 KEYWORDS: FLOWERING. SUGARCANE. GIBBERELIC ACID.

Flowering in sugarcane is influenced by a number of plant and environmental factors. Among the plant factors, the growth hormones plays a vital role in production of floral stimulus. The endogenous levels of gibberellins (GA<sub>3</sub>) was analyzed in the shoot apices of flowered and non-flowered stalks of sugarcane varieties Bo 91, Co 86249, Co 1148 and Co C 671 at the end of the flowering season using HPLC. In sugarcane shoot apices, the gibberellic acid (GA) recorded a prominent peak at the retention time of 6.4 min. Data on endogenous gibberellin-like substances showed significant variations between the flowered and non-flowered stalks as well as varieties. The shoot apices of flowered stalks contained 25 to 45% higher endogenous GA level in the four varieties studied.

283. Purakavastha, T.J.; Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry). Bhadraray, S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry). Chhonkar, P.K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry). Screening of Brassica species for hyper-accumulation of zinc, copper, lead, nickel and cadmium. Indian Journal of Plant Physiology (India). (Oct-Dec 2009) v. 14(4) p. 344-352 KEYWORDS: BRASSICA. ZINC. COPPER. NICKEL. ORGANIC ACIDS. CADMIUM.

In a sand culture experiment five different species of Brassica, (1) *B. juncea* (Indian mustard) cv. Pusa Bold, (2) *B. campestris* (Yellow mustard) cv. Pusa Gold, (3) *B. carinata* (Ethiopian mustard) cv. DLSC-1, (4) *B. napus* cv. Early napus, (5) *B. nigra* cv. IC-247 were grown in a phytotron for screening possible hyper-accumulator of heavy metals, viz. Zn, Cu, Pb, Ni and Cd. The plants were grown with Hoagland solution (control) and Hoagland solution enriched with medium and high levels of heavy metals up to maximum vegetative stage. Results showed that all the heavy metal contents in stalks of Brassica species increased due to enrichment of Hoagland solution with heavy metals. The plant growth was affected at higher level of metal enrichment. Among the species, *B. napus* contained highest amount of Cu, Pb, Ni and Cd in stalks, while *B. cannata* alone and *B. cannata* jointly with *B. juncea* showed highest Zn contents in medium and high metal levels, respectively. This was reflected in highest Zn uptake by *B. carinata* followed by *B. napus*. In case of Cu the trend interchanged among these two species. For Pb, Ni and Cd, *B. napus* accumulated highest amount outperforming all the other species. The most novel aspect of current study remained in the fact that probably for the first time *B. napus* and *B. carinata* reported as promising accumulator of Zn, Cu, Ni, Pb and Cd; which performed better than otherwise most reported *B. juncea*. Succinic acid was characterized and quantified as one of the dominant organic acids in root exudates of promising Brassica species. In this respect the greater secretions of this acid by roots of *B. napus* reflected its probable role in metal acquisition through complexation.

284. Venugopalan, M.V.; Central Institute for Cotton Research, Nagpur (India). Sankaranarayanan, K.; Central Institute for Cotton Research, Coimbatore (India). Blaise, D.; Indian Institute for Soil Science, Bhopal (India). Nalayini, P.; Central Institute for Cotton Research, Coimbatore (India). Prahray, C.S.; Central Institute for Cotton Research, Coimbatore (India). Gangaiah, B.; Indian Institute for Soil Science, Bhopal (India). Bt cotton (*Gossypium* sp.) in India and its agronomic requirements - a review. Indian Journal of Agronomy (India). (Dec 2009) v. 54(4) p. 343-360 KEYWORDS: COTTON. AGRONOMIC CHARACTERS. GOSSYPIUM. INDIA. FIBRES.

India has emerged as a major global partner in the production, processing and trade of raw cotton and its finished products. The genetically modified Bt cotton, containing the cry gene sourced from the soil bacterium *Bacillus thuringiensis* sub-species *Jurstaki*,

providing resistance against boll worms, represents a landmark in cotton research and development. The large scale adoption of Bt cotton by Indian farmers in a span of 7 years is the power of this technology. Introduction of the Bt gene has altered the morphological, phenological and physiological characteristics of these introgressed cultivars. The development and commercialization of Bt cotton varieties like BN Bt and incorporation of herbicide tolerance are likely to further revolutionize the cotton production scenario. To harness the benefits of the Bt cotton and to sustain their yield potential, sound agro-techniques need to be standardized. This review provides an update on the agronomic research undertaken on Bt cotton especially under the diverse growing conditions in India and the effect of these agro-techniques on Cry toxin expression and fibre quality parameters.

285. Mahapatra, B.S.; Central Research Institute for Jute and Allied Fibres, Barrackpore (India). Mitra, S.; Central Research Institute for Jute and Allied Fibres, Barrackpore (India). Sinha, M.K.; Central Research Institute for Jute and Allied Fibres, Barrackpore (India). Ghorai, A.K.; Central Research Institute for Jute and Allied Fibres, Barrackpore (India). Research and development in jute (*Corchorus* sp.) and allied fibres in India - a review. *Indian Journal of Agronomy* (India). (Dec 2009) v. 54(4) p. 361-373  
KEYWORDS: QUALITY. WEEDS. FIBRE CROPS. JUTE. CORCHORUS CAPSULARIS. NUTRIENTS.

Jute and allied fibre farming, trading and industry provide sustenance to over 5 million people of our country. The productivity of jute had doubled from 1.10 t/ha during independence to about 2.24 t/ha during 2006-07. Development of high-yielding varieties along with relatively cheaper and user friendly location specific technologies using locally available materials made this possible. Identification of promising herbicides had increased the net return of the production system while judicious use of local organic nutrient sources had improved the productivity as well as soil-health in jute and allied fibre systems. The mechano-microbial retting technology developed at CRIJAF had reduced the water requirement of retting, while the machines developed like multi-row seed drill, bast fibre extractor, flax extractor, nail weeder, herbicide brush, etc. had increased the efficiency and profitability of the production system. Successful models of ramie and sisal based multitier systems have been developed for both traditional and non-traditional areas. Significant achievements have been made in fibre quality research also, as it is the prime requirement for product diversification and value addition. In this paper, attempts have been made to summarize and present the achievements made so far in the jute and allied fibre research and also to highlight the constraints faced by this sector and its possible mitigation options.

286. Husain, K.; Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Clothing & Textile). Malik, Y.P.; Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (India). Project Coordinating & Germplasm Management Unit). Srivastava, R.L.; Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (India). Project Coordinating & Germplasm Management Unit). Pandey, R.; Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (India). Project Coordinating & Germplasm Management Unit). Production technology and industrial uses of dual purpose linseed (*Linum usitatissimum*) : an overview. *Indian Journal of Agronomy* (India). (Dec 2009) v. 54(4) p. 374-379  
KEYWORDS: LINSEED. LINUM USITATISSIMUM. SOFT FIBRES. FLAX.

Flax (*Linum usitatissimum* L.) is a rabi crop of India, grown both for seed and fibre since very long time. The varieties, which are grown for seed and fibre both, are known as dual purpose linseed. In India, oil flax is under cultivation in 16 states, while dual purpose linseed is being grown in few pockets. As climatic conditions of the country does not suit much for the cultivation of fibre flax, but dual purpose linseed varieties like 'Gaurav', 'Jeevan', 'Nagarkot', 'Shikha', 'Rashmi', 'Meera', and 'Parvati' may be grown in Himachal Pradesh, some districts of Punjab, Bihar and Uttar Pradesh, Tawa command area of Madhya Pradesh and Kota command area of Rajasthan. A good crop of dual purpose linseed can be obtained by sowing of these varieties under irrigated situation (2-

3 irrigations) during last week of October to mid November using 50- 60 kg seed/ha at a row distance of 20 cm, fertilizer application of 60-90 kg N + 13.2-17.6 kg P + 25-33.3 kg K/ha along with need based plant protection measures. Development of improved varieties having quality fibre with good seed yield, refining agro-techniques, proper post-harvest technologies especially retting and scutching techniques along with the testing of quality standards and suitable government policies are essential for the promotion of this crop in India.

287. Husain, K.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Chandra, R.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Srivastava, R.L.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dubey, S.D.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Singh, K.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Saxena, M.C.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Effect of zinc and farmyard manure on productivity and profitability of rice (*Oryza sativa*)-linseed (*Linum usitatissimum*) crop sequence. Indian Journal of Agronomy (India). (Dec 2009) v. 54(4) p. 395-400 KEYWORDS: RICE. ZINC. LINSEED. SEQUENTIAL CROPPING. ORYZA SATIVA. NUTRIENTS.

A field experiment on rice (*Oryza sativa* L.) - linseed (*Linum usitatissimum* L.) crop sequence with 8 treatments was conducted for 3 consecutive years in silty loam soil having 0.85 ppm Zn between 2002-03 and 2004-05 at Kanpur. Application of zinc (through zinc sulphate 25 kg/ha) and farmyard manure (FYM) 5 t/ha to rice in rice-linseed crop sequence recorded maximum linseed equivalent yield (2.71 t/ha) and net monetary return (Rs 17,419/ha) which were on par with Zn in both the crops + FYM in rice and Zn in linseed + FYM in rice. Like linseed equivalent yield (LEY), oil yield of linseed (mean of 3 years) was also recorded higher with treatment of Zn in both the crops + FYM while other treatments of FYM followed it closely. Application of Zn alone irrespective of crop season also brought numerical increase in the yield of rice and linseed, LEY and NMR over recommended dose of fertilizer (RDF). However, net monetary return (NMR) recorded was higher when Zn was applied to rice alone when compared with Zn application in rice and linseed as well as linseed alone. The uptake of zinc was recorded maximum when it was applied to both crops either with or without FYM 5 tonne/ha than single crop alone. The nutrient status of the soil after the harvest of third crop of linseed was better when both Zn and FYM were applied to rice crop. Thus, it would be better to apply Zn (through zinc sulphate 25 kg/ha) and FYM 5 t/ha to rice in rice - linseed crop sequence for higher productivity and profitability of the system along with enriched soil as well as good oil yield from linseed.

## **F02 Plant Propagation**

288. Dar, H.A.; Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Division of Pomology, Srinagar (India). Singh, S.R.; Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Division of Pomology, Srinagar (India). Srivastava, K.K.; Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Division of Pomology, Srinagar (India). Sharma, M.K.; Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Division of Pomology, Srinagar (India). Sundouri, A.S.; Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Division of Pomology, Srinagar (India). Regeneration of sour cherry (*Prunus cerasus*) through In-vitro propagation. Indian Journal of Plant Physiology (India). (Jun 2010) v.15(2) p.144-149 KEYWORDS: REGENERATION. PRUNUS CERASIFERA. PRUNUS. PROPAGATION BY CUTTINGS. HORMONES.

Dormant cutting procured from mature plants, were subjected to forcing treatment for in-vitro propagation. The culture media i.e., Murashige and Skoog medium (MS) with three strength levels viz., full, half and three fourth were used. Plant growth regulators viz. BAP (0.25 mg l<sup>-1</sup>, 0.50 mg l<sup>-1</sup>, 0.75 mg l<sup>-1</sup>) and IBA (0.00 mg l<sup>-1</sup> and 0.01 mg l<sup>-1</sup>) were supplemented with MS media. The design of experiment was CRD with

three replications. MS half strength basal medium supplemented with 0.50 mg l<sup>-1</sup> BAP plus 0.01 mg l<sup>-1</sup> IBA resulted in the highest survival percentage of in vitro cultures. MS medium supplemented with 1 mg l<sup>-1</sup> BAP + 0.10 mg l<sup>-1</sup> IBA fortified with 2 mg l<sup>-1</sup> BAP + 0.10 mg l<sup>-1</sup> IBA recorded the maximum proliferation efficiency. MS medium supplemented with BAP @ 0.1 mg l<sup>-1</sup> and devoid of auxin recorded the optimum elongation of micro shoots. MS medium fortified with 2 mg l<sup>-1</sup> IBA gave the highest rooting percentage and average number of roots per explant. The studies culminated in standardization of protocol for in vitro propagation of sour cherry rootstock.

289. Saha, S.; University of Kalyani, Cytogenetics and Plant Biotechnology Research Unit, Kalyani (India). Ghosh, P.D.; University of Kalyani, Cytogenetics and Plant Biotechnology Research Unit, Kalyani (India). Sengupta, C.; University of Kalyani, Microbiology Laboratory, Department of Botany, Kalyani (India). An efficient method for micropropagation of *Ocimum basilicum* L.. Indian Journal of Plant Physiology (India). (Jun 2010) v.15(2) p.168-172 KEYWORDS: MICROPROPAGATION. OCIMUM BASILICUM. OCIMUM. SHOOTS.

An efficient plant regeneration protocol has been developed from nodal explants of *Ocimum basilicum* L., medicinally important herbaceous plant species belonging to the family Lamiaceae. Axillary shoot bud proliferation was initiated from nodal explants cultured on Murashige and Skoog (MS) medium supplemented with various concentration of benzyl adenine (BA) (0.25–2.0 mg l<sup>-1</sup>) and kinetin (KN) (0.25–2.0 mg l<sup>-1</sup>). Maximum numbers of shoots (6.2±0.1) with average length (3.7±0.0) were induced on medium containing 0.5 mg l<sup>-1</sup> BA. Shoots culture was established by repeated subculturing the original nodal explant on the same medium. Rooting of shoots was achieved on half strength MS medium supplemented with 1.0 mg l<sup>-1</sup> NAA. Well-developed complete plantlets were transferred to plastic pots containing a mixture of (1:1) soil and vermiculite showed 90% survival rate.

### F03 Seed Production and Processing

290. Thakur, Anju; Dr. Y.S. Parmar University of Horticulture and Forestry, Department of Basic Sciences, Solan (India). Thakur, P.S.; Dr. Y.S. Parmar University of Horticulture and Forestry, Department of Silviculture and Agroforestry, Solan (India). Dutt, V.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Kashmir (India). Thakur, C.L.; Dr. Y.S. Parmar University of Horticulture and Forestry, Department of Silviculture and Agroforestry, Solan (India). Conservation of *Podophyllum hexandrum* through seeds. Indian Journal of Plant Physiology (India). (Jun 2010) v.15(2) p.110-116 KEYWORDS: STORAGE. GERMINATION. SEEDS. SEEDLINGS. VIGOUR.

*Podophyllum hexandrum* Royle, inhabitant of north-western Himalayas, is an endangered and prioritized medicinal herb for conservation purpose. This herb shows delayed and low seed germination with poor seedling survival. The aim of this study was to develop a complete package for attaining higher and early germination percentage and to innovate suitable storage environment for prolonging germination potential of seeds, which is otherwise lost quickly. The findings revealed that germination percentage, onset of germination and vigour index can be improved by subjecting seeds to presowing chilling, hydropriming for 8 days or chemical treatments with petroleum ether, triacontanol or sodium hypochlorite. Storage of seeds at 10°C in plastic jars was most suitable for maintaining germination ability, even after one year, which otherwise is lost in six months at room temperature. Sowing of seeds in mixture of soil + FYM + coco peat (2:1:1) resulted in maximum seedling emergence and survival. The study will be useful for conserving this herb species.

291. Nautiyal, Nirmala; University of Lucknow, Department of Botany, Lucknow (India). Awasthi, Sapna; University of Lucknow, Department of Botany, Lucknow (India). Influence of copper on embryo viability and development in hyacinth bean seeds. Indian Journal of Plant Physiology (India). (Jun 2010) v.15(2) p.137-143 KEYWORDS: COPPER. EMBRYONIC DEVELOPMENT. LABLAB PURPUREUS. LABLAB. SEEDS.



An experiment was conducted to study the role of Cu in biosynthesis and accumulation of seed reserves and impact of exogenous ABA application on Cu deficiency. Fertilized ovules of hyacinth bean (*Dolichos lablab* L.), cultured aseptically at 8 and 10 days after anthesis developed copper deficiency after 5 days in culture at 0.02  $\mu$ M Cu resulting in reduction in seed reserve accumulation and loss in viability of embryos. The results suggest that decrease in the activities of acid invertase and Cu enzymes, ascorbate oxidase and polyphenol oxidase and induction of some Cu stress proteins resembling HSP70 affected the seed development in hyacinth bean at deficient Cu. Exogenous ABA application (0.1 mM) enhanced the level of some reserves but was unable to reverse the Cu deficiency effects.

292. Singh, Kumar Kant; Indian Agricultural Research Institute, Seed production Unit. New Delhi (India). Sharma, S.K.; Indian Agricultural Research Institute, Seed production Unit. New Delhi (India). Effect of distillery effluent based pressmud compost on seed yield and seed quality attributes of paddy (*Oryza sativa*) cultivar Pusa Basmati No 1. *Journal of Soil and Water Conservation (India)*. (Oct 2009) v.8(4) p.67-71 KEYWORDS: RICE. SEEDS. YIELDS. GERMINATION. SEED. COMPOSTS. QUALITY. SEED. SEED.

An investigation was carried out to study the effect of distillery effluent based pressmud compost (DEPC) on seed yield and seed quality attributes of paddy cv. Pusa Basmati-1 at Seed Production Unit, IARI, New Delhi. The treatments consisted of 1.5 tonnes DEPC (T -1), 1.5 tonnes DEPC + 50% NPK (T -2), 3 tonnes DE PC (T-3), 3 tonnes DEPC + 25% NPK (T-4), 6 tonnes DEPC (T-5) and recommend dose of NPK/ha (T-6) and were laid out in four replications in a randomized block design (RBD). The observations on seed yield and seed quality attributes, viz. number of total tillers/hill, number of productive tillers/hill, days to 50% flowering, plant height (cm), panicle length (cm), number of grains/ panicle, filled grains/panicle, grain yield, harvest index, 1000 seed weight, germination, seedling length, seedling dry weight and vigour index were recorded. The data recorded during kharif 2000-2001 and 2001-2002 were pooled and subjected to statistical analysis. The significantly higher seed yield of 51.65 q/ha was recorded in T-4 followed by T-6 (51.08 q/ha) and T-5 (49.29q/ha). The seed quality attributes were also significantly higher for 1000-seed weight (21.04 g), seed germination (81%), seedling length (22.8 cm), and vigor index (1847) were recorded in T-4 (3 t/ha distillery effluent pressmud compost + 25% recommended dose of fertilizer) followed by T-6 (100% of recommended dose of fertilizer) and T-5 (DEPC + 25% NPK) respectively. To obtain higher seed yield (51.65 q/ha), an application of 3 t/ha distillery effluent pressmud compost + 25% recommended dose of fertilizer is recommended.

#### **F04 Fertilizing**

293. Shirpurkar, G.N.; Agricultural Research Station, Niphad (India). Sonawane, P.D.; Agricultural Research Station, Niphad (India). Rasal, P.N.; Agricultural Research Station, Niphad (India). Effect of integrated nutrient management on yield and economics in groundnut-wheat crop sequence. *Journal of Maharashtra Agricultural Universities (India)*. (May 2010) v.35(2) p.175-178 KEYWORDS: WHEATS. GROUNDNUTS. FARMYARD MANURE. COMPOSTING. AZOTOBACTER. PHOSPHORUS. YIELDS.

The 100 percent RDF produced significantly higher grain yield (32.48 q ha<sup>-1</sup>) than 50 percent RDN (60:60:40 kg NPK ha<sup>-1</sup>) + 25 percent N Through FYM + Azo + PSB (T4) and 50 percent RDN (60:60:40 kg NPK ha<sup>-1</sup>) + 25 percent N through vermicompost Azo + PSB (T5). Wheat genotype NIAW-301 produced significantly higher grain yield (31.53 q ha<sup>-1</sup>) than HD-2189. The pooled dry pod yield of groundnut was non significant due to fertilizer level and genotypes. 100 percent RDF recorded significantly more return of Rs 32511, which reflected in significantly more in benefit: cost ratio of 2.19 over other treatments.

294. Pandey, Sunil Kumar; Banaras Hindu University, Institute of Agricultural Sciences, Department of Plant Physiology, Varanasi (India). Bahuguna, R.N.; Indian Agricultural

Research Institute, Division of Plant Physiology, New Delhi (India). Pal, Madan; Indian Agricultural Research Institute, Division of Plant Physiology, New Delhi (India). Trivedi, A.K.; Banaras Hindu University, Institute of Agricultural Sciences, Department of Plant Physiology, Varanasi (India). Hemantaranjan, A.; Banaras Hindu University, Institute of Agricultural Sciences, Department of Plant Physiology, Varanasi (India). Srivastava, J.P.; Banaras Hindu University, Institute of Agricultural Sciences, Department of Plant Physiology, Varanasi (India). Effects of pre-treatment and foliar application of zinc on growth and yield components of mungbean (*Vigna radiata* L.) under induced salinity. *Indian Journal of Plant Physiology* (India). (Jun 2010) v.15(2) p.164-167 KEYWORDS: FOLIAR APPLICATION. VIGNA RADIATA. SALINITY. ZINC.

Mungbean (*Vigna radiata* L.) is an excellent source of high quality proteins. In sprouted mungbean, high level of ascorbic acid (Vitamin C), riboflavin and thiamine is found. But the production of mungbean is threatened by salinity. In the present study observations were made for two consecutive years regarding growth parameters and yield attributes of mungbean under induced salinity condition. Results from the present study revealed that under salinity condition growth and yield attributes were adversely affected while application of zinc as zinc sulphate minimized the adverse effect under salinity.

295. Jain, Vanita; Indian Agricultural Research Institute, Division of Plant Physiology, New Delhi (India). Khetarpal, Sangeeta; Indian Agricultural Research Institute, Division of Plant Physiology, New Delhi (India). Aravind, Smitha; Indian Agricultural Research Institute, Division of Plant Physiology, New Delhi (India). Saikia, Siddhartha Prateem; North East Institute of Science & Technology (CSIR), Division of Medicinal Aromatic & Economic Plants, Assam (India). Enhanced levels of soil nitrogen and endogenous phytohormones in maize (*Zea mays* L.) inoculated with *Azospirillum brasilense*. *Indian Journal of Plant Physiology* (India). (Jun 2010) v.15(2) p.198-201 KEYWORDS: BIOFERTILIZERS. GIBBERELIC ACID. IAA. NITROGEN. ZEA MAYS. AZOSPIRILLUM BRASILENSE. AZOSPIRILLUM.

The para-nodulated maize plants grown in soil supplemented with *Azospirillum* thrice during the growth period performed better than the control plants. The para-nodules were formed along primary roots in the presence of 2,4-dichlorophenoxyacetic acid (2,4-D) and *Azospirillum*. The content of the endogenous hormones viz. indole acetic acid (IAA) and gibberellic acid (GA) was enhanced in para-nodulated maize plants cultivar Kiran. However, the level of abscisic acid (ABA) declined. The dry weight and leaf area of the para-nodulated plants increased as compared to the control plants. The ammonia concentration (56% more) and nutrients were higher in the para-nodulated plants as compared to the control plants. The soil nitrate and ammonical N levels were higher in the pots with treated plants and inoculated with *Azospirillum* as compared to their levels in control pots. Bacterial phytohormone synthesis seems to be responsible for the *Azospirillum* mediated plant growth promotion.

296. Singh, Parkash; Punjab Agricultural University, Department of Soils, Ludhiana (India). Benipal, D.S.; Punjab Agricultural University, Department of Soils, Ludhiana (India). Brar, B.S.; Punjab Agricultural University, Department of Soils, Ludhiana (India). Performance Of Maize-Wheat Cropping System As Affected By Organic And Inorganic Fertilizers And Changes In Sulphur Content Of Crops. *Journal of Research Punjab Agricultural University* (India). (Mar & Jun 2009) v.46(1-2) p.23-26 KEYWORDS: MAIZE. WHEATS. CROPPING SYSTEMS. ORGANIC FERTILIZERS. INORGANIC FERTILIZERS. SULPHUR.

297. Singh, Ravinder Pal; Punjab Agricultural University, Department of Soils. Ludhiana (India). Singh, Balwinder; Punjab Agricultural University, Department of Soils. Ludhiana (India). Dhillon, N.S.; Punjab Agricultural University, Department of Soils. Ludhiana (India). Phosphorus sorption parameters after 35 years of fertilization to maize-wheat cropping system. *Journal of Research Punjab Agricultural University* (India). (Mar & Jun

2009) v.46(1-2) p.27-33 KEYWORDS: ADSORPTION. DESORPTION. FERTILIZERS. SOIL. MAIZE. SORPTION. WHEATS.

Surface soil samples (0-15 cm) from 7 differentially fertilized plots (N0P0K0, N100P0K0, N200P0K0, N100P22K0, N200P44K0, N100P22K41 and N200P44K82) of a 35 years long-term experiment on maize-wheat sequence at PAU Research farm, Ludhiana were collected to study the effect of various fertilizer treatments on soil phosphorus (P) adsorption desorption. These soils differed widely with respect to their P adsorption and desorption properties. Phosphate adsorption increased with increasing levels of added P in all the soils. The extent of P adsorption was comparatively lower in plots receiving higher amounts of P. Phosphorus adsorption data was found to fit best to Langmuir ( $r^2$  0.94) and Freundlich isotherms ( $r^2$  0.92) for each on the seven soil samples. Soil P adsorption maxima obtained from Langmuir isotherm varied from 196 to 313 g g<sup>-1</sup> soil. The bonding energy values obtained from Langmuir isotherm plot were the lowest in control and N200P0K0 treatments whereas these values tended to increase with P addition. Freundlich constants  $K_1$  and  $K_2$  (extent and rate of adsorption) calculated from the regression lines also showed similar trends. The plot of desorbed P/adsorbed P was linearly correlated for each of the seven soil samples. Computation of desorbable P capacity (or desorption maxima,  $D_m$ ) and desorption rate constant ( $K_d$ ) from this relationship indicated higher  $D_m$  values in soil samples collected from control (N0P0K0) and alone N fertilized (N100P0K0 and N200P0K0) plots as compared to treated with P fertilizers. The  $K_d$  values were higher in P fertilized plots than control (N0P0K0) and N200P0K0 treated plots.

298. Suresh, G.; Directorate of Oilseeds Research, Hyderabad (India). Tripathi, S.B.; Indian Grassland and Fodder Research Institute, Jhansi (India). Gupta, J.N.; Indian Grassland and Fodder Research Institute, Jhansi (India). Sharma, D.K.; Indian Grassland and Fodder Research Institute, Jhansi (India). Herbage production and soil fertility changes in different pastures as influenced by fertilization under semi-arid conditions. Indian Journal of Agronomy (India). (Dec 2009) v. 54(4) p. 465-470 KEYWORDS: SOIL FERTILITY. FERTILIZATION. PRODUCTION. CROPS.

A field study was conducted between 2001 and 2004 on six different pasture systems [natural pasture, buffel grass (*Cenchrus ciliaris* L.), stylo (*Stylosanthes hamata* L.), buttel + stylo + shrub (*Leucaena leucocephala* L.), buffel + stylo + shrub + tree (*Albizia lebbek* L.)]. The performance under fertilized and unfertilized situations in relation to amount of rainfall received was analysed over the years. A total of 19 species were encountered in natural pasture which included 6 grasses, 5 legumes and 8 forbs. Significantly the highest pasture production (9.90 t/ha) was recorded in buffel + stylo + shrub-based mixed pasture. Over all, there was about 21.8% increase in yield due to fertilizer application. The fodder shrub *Leucaena* contributed about 16% to the total biomass. The physico-chemical properties of soil improved under different pastures after 4 years in increasing water-holding capacity, pore space, and decreasing bulk density particularly under fertilized situation. The build up of organic carbon content was higher under sole *Stylosanthes*. The soil dehydrogenase and phosphatase enzymatic activity were enhanced in both fertilized and unfertilized pastures. Dehydrogenase activity was the highest in fertilized pure legume. Supplementation of legume and top feeds viz., *Leucaena* and *Albizia* in *Cenchrus ciliaris* based fodder improved the quality in crude protein, ether extract, calcium and phosphorus contents with reduction in neutral detergent fibre and acid detergent fibre contents.

## F06 Irrigation

299. Singh, Balwinder; Punjab Agricultural University, Department of Soils, Ludhiana (India). Kumar, Balwinder; Punjab Agricultural University, Department of Soils, Ludhiana (India). Nutrient potential of underground irrigation water in Ferozepur district. Journal of Research Punjab Agricultural University (India). (Mar & Jun 2009) v.46(1-2) p.17-22 KEYWORDS: NITRATES. POTASSIUM. QUALITY. SULPHUR. IRRIGATION WATER.



A detailed village-wise survey of water samples of Ferozepur district was carried out for assessing the supply of K, N and S from underground irrigation waters. For this purpose 500 water samples were collected from 50 villages of ten development blocks of Ferozepur district. Potassium and sulphate concentrations varied from 0.05 to 2.47 and 0.34 to 65 me L<sup>-1</sup> with mean values of 0.26 and 8.85 respectively. Nitrate-N concentration varied from nil to 20 mg L<sup>-1</sup> with a mean value of 3.93. On an average, it is estimated that one hectare foot of irrigation water supplies 11.8, 31.2 and 425 kg of NO<sub>3</sub><sup>-</sup>-N, K and S, respectively in this district. Quality of tubewell water for irrigation changes with time. There is a tendency towards increasing trend in EC and RSC over a period of 15 months. Thus, quality of irrigation water is deteriorating with time in this area.

300. Sidhu, A.S.; Punjab Agricultural University, Department of Horticulture, Ludhiana (India). Bal, J.S.; Punjab Agricultural University, Department of Horticulture, Ludhiana (India). Effect of irrigation regimes on growth, flowering and biochemical changes in ber plants. *Journal of Research Punjab Agricultural University (India)*. (Mar & Jun 2009) v.46(1-2) p.44-49 KEYWORDS: FLOWERING. GROWTH. IRRIGATION. CANOPY. FRUIT CROPS.

The present investigation was conducted at New Orchard, Punjab Agricultural University (PAU), on loamy sand soil during the cropping seasons of 2003-04 and 2004-05 based on fixed irrigation water to class A pan ratio (IW/Pan E ratio) of cumulative pan evaporation (CPE) of 50 mm, 75 mm, 100 mm, 125 mm and 150 mm. The frequently irrigating plants of CPE 50 mm excelled in canopy volume, scion/stock girth and leaf area as compared to stressed plants of CPE 125 mm and CPE 150 mm. The mild to moderate stress plants of CPE 75 and CPE 100 mm attained linear increase in canopy volume and leaf area. The plants irrigated under stress conditions of CPE 150 mm were first to flower, attain full bloom and first to complete flowering phase. Maximum fruit set (13.7%) in first year and 11.7 per cent in the second year was attained in plants irrigated at 75 mm. The imbalanced source-sink activity, failure of phloem unloading and high soil moisture stress accumulated significantly higher concentration of proline, showed high C:N ratio but had low protein content in stressed plants irrigated at CPE 150 mm. The best irrigation schedule for young ber plants was identified at CPE 75 mm and eleven irrigations were suggested for initial establishment and better production.

301. Praharaj, C.S.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn.). Sankaranayaranan, K.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn.). Khader, S.E.S.A.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn.). Gopalakrishnan, N.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn.). Sustaining cotton productivity and soil fertility through in situ management of green manure and crop residues in semi-arid irrigated condition of Tamil Nadu. *Indian Journal of Agronomy (India)*. (Dec 2009) v. 54(4) p. 415-422 KEYWORDS: SOIL FERTILITY. CROP RESIDUES. GOSSYPIUM HIRSUTUM. PRODUCTIVITY. TAMIL NADU. GREEN MANURES.

A field experiment was undertaken between 2004 and 2007 in upland cotton (*Gossypium hirsutum* L.) on alkaline black clay loam Typic haplustalfs soil with low fertility at Coimbatore under irrigated condition to explore the suitability of burying of cotton residues vis-a-vis green manure (GM) sunnhemp (*Crotalaria juncea* L.) in situ. The treatments to cotton 'Surabhi' included in situ growing and burying of GM crop, recycling of cotton residues and addition of farmyard manure (FYM) alone and in all combination (5 t/ha of FYM, 2.5 t/ha of crop residues or GM 15 kg seed/ha), along with conventional practice of crop nutrition with and without a N:P:K dose of 60:13:25 kg/ha as the controls. Results revealed that simultaneous planting of sunnhemp and cotton under ridge-furrow system, followed by burying of sunnhemp 2.5 t/ha in situ before flowering followed by earthing up was optimum for higher cotton productivity (1.70 t/ha), net return (Rs 23,240/ha), B:C ratio (1.37) and fibre productivity efficiency (FPE, 9.40 kg/ha-day). However, grain yield of rotational finger millet [*Echinochloa polystachya* (L.)] 'CO 13' crop grown on the residual fertility was not influenced by the treatments. The

system (cotton-finger millet) productivity (2.46 t/ha) was also favoured by GM treatment. Soil fertility parameters after the trial indicated that in situ incorporation of GM also resulted in higher OC (0.53, 0.55%) and N:P:K (200:23.5:599 and 194:18.3:590 kg/ha) availability in 0-15 cm and 15-30 cm soil respectively at the end of 3 years of cropping over absolute control. Climatologically favourable year (2007) played a significant role in realization of higher boll weight, seed cotton yield, net return, B:C ratio and system productivity over others. The present study suggests that in situ incorporation of sunnhemp GM substitute inorganic fertilizers in cotton.

302. Tripathi, M.L.; Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Morena (India). Zonal Agricultural Research Stn.). Trivedi, S.K.; College of Agriculture, Gwalior (India). Yadav, R.P.; Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Morena (India). Zonal Agricultural Research Stn.). Effect of irrigation and nutrient levels on growth and yield of coriander (*Coriandrum stivum*). Indian Journal of Agronomy (India). (Dec 2009) v. 54(4) p. 454-458 KEYWORDS: FERTILIZERS. YIELDS. CORIANDER. ECONOMICS.

A field experiment was carried out on sandy loam soil at Morena during winter season of 2006-07 and 2007-08 to study the effect of irrigation schedules and nutrient levels (% recommended NPK fertilization) on growth, yield, quality of coriander (*Coriandrum sativum* L.). Irrigation at 20, 40 and 60 days after sowing (DAS) maintained higher umblets/plant, umbel/plant, 1000-seed weight, production efficiency, nutrient use and N, P, K and S uptake. Maximum seed yield (1.96 tonne/ha), biomass production (4.66 tonnes/ha), net returns (Rs.86,815/ha) and B:C ratio (8.19) were also recorded under 3 irrigations, which resulted in 38.31% and 3.93% increase in seed yield over 2 (20 and 40 DAS) and 4 (20, 40, 60 and 80 DAS) irrigation respectively. The application of 100% recommended dose of fertilizer (RDF) (60:17.6:16.6:30 kg N:P:K:S/ha) registered significantly higher yield attributes, water use efficiency, production efficiency, N: P: K and S uptake and 20.65% and 12.04% increased in seed yield over 50% and 75% RDF respectively. The: interaction effect of irrigation and fertility levels on seed yield was also found significant and positive. The maximum yield (2.09 tonne/ha) was recorded with the combined application of 3 irrigations and 100% RDF followed by three irrigation and 125% RDF (2.02 tonne/ha).

303. Sharma, K.C.; Central Sheep and Wood Research Institute, Bikaner (India). Arid Region Campus). Integrated nitrogen management in fodder oats (*Avena sativa*) in hot arid ecosystem of Rajasthan. Indian Journal of Agronomy (India). (Dec 2009) v. 54(4) p. 459-464 KEYWORDS: AZOTOBACTER. ECONOMICS. ENERGY CONSERVATION. NITROGEN. AVENA SATIVA.

A field experiment was conducted during rabi of 2006-07 and 2007-08 at Bikaner to find out the effect of different levels of nitrogen (0, 50, 100 and 150 kg/ha), biofertilizer (uninoculated and inoculated with *Azotobacter*) and sheep manure (0 and 10 t/ha) on performance of fodder oats (*Avena sativa* L). Results revealed that 150 kg N/ha significantly increased the growth attributes leading to higher dry matter (11.13 t/ha) and crude protein yields (988.7 kg/ha). Seed inoculation with *Azotobacter* increased the dry matter and crude protein yields by 5.93 and 7.00% over uninoculated control. Sheep manure 10 t/ha significantly increased the green fodder, dry matter, and crude protein yields to the extent of 21, 22.1 and 26.0% respectively over no sheep manure. Interaction effect of nitrogen and sheep manure was significant and dry matter yields recorded at 100 kg N/ha alongwith 10 t sheep manure/ha and 150 kg N/ha alone were at par. Highest values of net returns (Rs 23,285/ha), net B:C ratio (1.00), N, P and K uptake, energy responsiveness (8.32 MJ/Re) were recorded at 150 kg N/ha. However, maximum values of energy ratio (8.26) and energy productivity (458.9 g/MJ) were obtained with 100 kg N/ha, whereas, highest values of agronomic N-use efficiency (43.9 kg dm/kg-N applied) and physiological N-use efficiency (68.7 kg dm/kg N uptake) were recorded with 50 kg N/ha. Application of *Azotobacter* inoculation and sheep manure registered higher values of above traits than their respective control except agronomic and physiological N-use efficiencies, where control treatment recorded greater values. The residual soil organic carbon and available N contents were significantly influenced

with application of nitrogen and sheep manure. The results show that nitrogen 100 kg/ha alongwith Azotobacter inoculation and sheep manure 10 t/ha may be applied for higher and quality fodder of oats.

304. Pawar, H.C.; Mahatma Phule Krishi Vidyapeeth, Rahuri (India). Dept. of Biochemistry). Naik, R.M.; Mahatma Phule Krishi Vidyapeeth, Rahuri (India). Dept. of Biochemistry). Satbhair, R.D.; Mahatma Phule Krishi Vidyapeeth, Rahuri (India). Dept. of Biochemistry). Mehetre, S.S.; Mahatma Phule Krishi Vidyapeeth, Rahuri (India). Dept. of Biochemistry). Proline, P5CS activity and glycine betaine content in intra-hirsutum (Hxh), inter-specific (HxB) and G. arboreum cultivars under water stress. Indian Journal of Plant Physiology (India). (Apr-Jun 2010) V. 15(2) p. 125-130 KEYWORDS: DROUGHT STRESS. PROLINE. IRRIGATION. GOSSYPIUM HIRSUTUM.

Water stress created by withholding irrigation caused significant increase in free proline and glycine betaine content in the leaves of intra-hirsutum (HxH), inter-specific (HxB) and G. arboreum cultivars of cotton. The increase in the levels of proline is mainly attributed to de-novo synthesis of proline as evident from increased activity of P5CS specifically in G. arboreum cultivars. However, besides de novo synthesis of proline, loss of feed back inhibition of free proline appears to operate in regulating the levels of free proline in intra-hirsutum and inter-specific hybrids. Cotton is a natural glycine betaine accumulator and hence, a higher level of glycine betaine was recorded in control plants, which further increased on imposition of stress. A significant variation in the levels of free proline and glycine betaine was observed in all the cultivars tested. The levels of both the osmolytes increased simultaneously and can be used to select the drought tolerant segregating population involving breeding of cotton for drought tolerance.

#### **F07 Soil Cultivation**

305. Jain, V.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Khetrapal, S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Aravind, S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Saikia, S.P.; North East Institute of Science and Technology, Jorhat (India). Div. of Medicinal Aromatic and Economic Plants). Enhanced levels of soil nitrogen and endogenous phytohormones in maize (*Zea mays* L.) inoculated with *Azospirillum brasilense*. Indian Journal of Plant Physiology (India). (Apr-Jun 2010) V. 15(2) p.198-201 KEYWORDS: BIOFERTILIZERS. NITROGEN. SOIL. ZEA MAYS. AZOSPIRILLUM BRASILENSE. GIBBERELIC ACID.

The para-nodulated maize plants grown in soil supplemented with *Azospirillum* thrice during the growth period performed better than the control plants. The para-nodules were formed along primary roots in the presence of 2,4-dichlorophenoxyacetic acid (2,4-D) and *Azospirillum*. The content of the endogenous hormones viz. indole acetic acid (IAA) and gibberellic acid (GA) was enhanced in paranodulated maize plants cultivar Kiran. However, the level of abscisic acid (ABA) declined. The dry weight and leaf area of the para-nodulated plants increased as compared to the control plants. The ammonia concentration (56 % more) and nutrients were higher in the para-nodulated plants as compared to the control plants. The soil nitrate and ammonical N levels were higher in the pots with treated plants and inoculated with *Azospirillum* as compared to their levels in control pots. Bacterial phytohormone synthesis seems to be responsible for the *Azospirillum* mediated plant growth promotion.

#### **F08 Cropping Patterns and Systems**

306. Aulakh, C.S.; Punjab Agricultural University, Department of Agronomy, Ludhiana (India). Singh, Surjit; Punjab Agricultural University, Department of Agronomy, Ludhiana (India). Walia, S. S.; Punjab Agricultural University, Department of Agronomy, Ludhiana (India). Gurpreet Kaur; Punjab Agricultural University, Department of Agronomy, Ludhiana (India). Farmers' Perceptions On Organic Farming In Punjab. Journal of Research Punjab Agricultural University (India). (Mar & Jun 2009) v.46(1-2) p.9-13

KEYWORDS: ORGANIC AGRICULTURE. ORGANIC FERTILIZERS. PEST CONTROL. SURVEYS.

A survey of forty seven organic growers was conducted during 2007-08 to get information on crops being grown and organic manures being used by the organic growers and to know the farmers' perception about organic farming and constraints in its adoption. The survey indicated that 38.3 per cent of the organic growers were large farmers, 23.4 per cent medium and semi medium each and 14.9 per cent small. In Ferozepur district, majority of the organic growers were large farmers (78%) where as in Ropar district, 75 per cent organic growers were small farmers. Rice, wheat, pulses and vegetables were the prominent crops being grown under organic farming using organic manures like farmyard manure and vermicompost. The most of the organic growers were managing insect pest and diseases by using neem based pesticides. Though the productivity level of organic crops was low yet the majority of organic farmers (62%) were satisfied with organic farming and practising it mainly due to the perception that organic farming improves the soil health, environment and human health (69.5%). The improved market infrastructure for organic foods and the availability of quality biopesticides to farmers can help in adoption of organic farming in Punjab as lack of market facilities (67.1 %) and difficulty in control of insect pest and diseases (60.2 %) were the top most constraints expressed by the organic growers.

307. Bhushan, Bharat; Punjab Agricultural University, Dept of Soil. Ludhiana (India). Sheoran, P.; Punjab Agricultural University, Dept of Soil. Ludhiana (India). Sidhu, B.S.; Punjab Agricultural University, Dept of Soil. Ludhiana (India). Samanpreet Kaur; Punjab Agricultural University, Dept of Soil. Ludhiana (India). Effect of tillage and nitrogen management on grain yield, water expense and soil physical properties in maize-wheat cropping sequence under rainfed Shivaliks of Punjab. *Journal of Soil and Water Conservation (India)*. (Oct 2009) v.8(4) p.51-55 KEYWORDS: TILLAGE. CROP YIELD. INFILTRATION. SOIL CHEMICOPHYSICAL PROPERTIES. WHEATS. CROPPING SYSTEMS.

The crops in the shivaliks of Punjab usually suffer water stress under limited and erratic water supply condition. A field experiment was conducted on a sandy loam soils during 2004-05 and 2005-06 to study the effect of tillage and nitrogen management on grain yield, water expense and soil physical properties in maize-wheat cropping sequence under rainfed conditions. The soil of the experimental site is classified as a fine loamy fluventic ustochrept. The treatments of conventional tillage and reduced tillage along with chemical weed control were at par with respect to grain yield of maize. The tillage had no significant effect on grain yield of wheat. 100% inorganic fertilization gave significantly higher maize grain yield over other treatments, while the treatments of 100% inorganic fertilization, and 50% through organic source and 50% through inorganic source were at par with respect to grain yield of wheat. The water expense efficiency was higher under conventionally tilled plots in maize, while in wheat, it was higher in reduced tilled plots with chemical weed control. The infiltration rate, bulk density and nitrogen uptake were significantly affected by different tillage and nitrogen management.

308. Singh, R.J.; Vivekananda Parvatiya Krishi Anusandan Sansthan, Almora (India). Krishi Vigyan Kendra). Ahlawat, I.P.S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Gangaiah, B.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Direct and residual effects of nitrogen management in Bt cotton (*Gossypium hirsutum*) - wheat (*Triticum aestivum*) cropping system. *Indian Journal of Agronomy (India)*. (Dec 2009) v. 54(4) p. 401-408 KEYWORDS: NITROGEN. CROPPING SYSTEMS. GOSSYPIUM HIRSUTUM. TRITICUM AESTIVUM.

A 2-year field investigation was carried out in New Oelhi from 2006 to 2008 on a sandy loam soil having 217 kg/ha of available N. In cotton (*Gossypium hirsutum* L.) 8 treatments comprising combination of 4 N management practices (Control, 100% recommended dose of N (150 kg/ha) through urea (RDN), 75% RDN through urea + 25% RDN through FYM and 50% RDN each through urea and FYM) and 2 cropping systems - sole cotton and cotton + groundnut (*Arachis hypogaea* L.) intercropping in 1:3



additive series. N management in cotton-wheat cropping system were tested in RBO with 3 replications. For comparison, sole groundnut with recommended N and phosphorus fertilizers was also grown. In rabi, cotton plots were sub-divided in to 4 to accommodate levels of N (0, 50, 100 and 150 kg/ ha) to wheat. Groundnut as an intercrop enhanced the productivity of cotton by 0.25 tonne/ha and succeeding wheat by 0.16 tonne/ha. These increases in productivity of cotton and wheat coupled with additional intercrop groundnut yield (0.47 tonne/ha) together enhanced the productivity of cotton + groundnut - wheat systems in seed cotton equivalent yield by 0.58 tonne/ha and net returns by Rs 14,421 /ha over cotton-wheat system. Among N management practices, substitution of 25% RON through FYM in cotton gave the highest system productivity (4.82 tonne seed cotton equivalent yield/ha) and B: C ratio (2.09) than all N through urea and 50% N through each source. However, net returns and soil N balance were in favour of 50% RON substitution through FYM besides (Rs 72,748 /ha). Wheat crop responded to 100 kg N/ha fertilization. It was therefore inferred that integration of groundnut as intercrop along with FYM besides 50% N of cotton along with 100 kg fertilizer N/ha to wheat was the most profitable and sustainable N management system.

309. Nalayini, P.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn.). Anandham, R.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn.). Sankaranarayanan, K.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn.). Rajendran, T.P.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn.). Polyethylene mulching for enhancing crop productivity and water use efficiency in cotton (*Gossypium hirsutum*) and maize (*Zea mays*) cropping system. Indian Journal of Agronomy (India). (Dec 2009) v. 54(4) p. 409-414 KEYWORDS: GOSSYPIUM HIRSUTUM. MULCHING. YIELDS. ZEA MAYS. CROPPING SYSTEMS. POLYETHYLENE. PRODUCTIVITY.

Field experiments were conducted consecutively for 2 years at Coimbatore between 2002-03 and 2003-04 crop seasons during winter (August-February). Cotton (*Gossypium hirsutum* L.) followed by summer (March-May), maize (*Zea mays* L) crops using different thickness black polyethylene mulch film of 30,50,75 and 100 micron were evaluated against conventionally planted (no mulch) cotton - maize cropping system for moisture conservation and enhanced crop production efficiency. Higher uptake of nutrients due to higher temperature coupled with higher available soil moisture caused significant increase in root cation exchange capacity, nutrient uptake, dry matter accumulation and partitioning of assimilates under polyethylene mulching with an average yield enhancement of 1.83 to 1.90 fold in cotton and 1.95 to 2.10 fold in maize crops besides saving water. The water requirement of mulched cotton was 58.63 ha-cm whereas conventionally grown cotton was 84.19 ha-cm. The water use efficiency of mulched cotton was 43.2 kg/ha-cm as against 16.6 kg/ha-cm for conventionally planted no mulch cotton crop. The poly-mulched cotton-maize system recorded the highest net return (Rs 74,177/ha) and benefit cost ratio (1.68) as against the conventional system (Rs 29,863 and 1.04).

### **F30 Plant Genetics and Breeding**

310. Joshi, Rohit; G.B. Pant University of Agriculture and Technology, College of Basic Sciences and Humanities, Department of Plant Physiology, Pantnagar, Uttarakhand (India). Shukla, Alok; G.B. Pant University of Agriculture and Technology, College of Basic Sciences and Humanities, Department of Plant Physiology, Pantnagar, Uttarakhand (India). Kumar, Pramod; Indian Agricultural Research Institute, Division of Plant Physiology, New Delhi (India). In vitro selection of hill maize (*Zea mays* L.) hybrids for low phosphate tolerance. Indian Journal of Plant Physiology (India). (Jun 2010) v.15(2) p.159-163 KEYWORDS: ZEA MAYS. HYBRIDS. PHOSPHATES. TOLERANCE. IN VITRO. ELECTROPHORESIS. MERISTEM CULTURE.

Genotypic response of hill maize hybrids viz. Vivek-4, Vivek-5, VL-42 and Him-129 to low concentrations of phosphate (low-P) was studied in vitro. An induction in

anthocyanin accumulation and increase in total protein content were observed with decreasing concentration of P in the medium. SDSpolyacrylamide gel electrophoresis of in vitro cultured plants showed the over expression of 4–6 polypeptides under P deficient levels than to sufficient. Thus, results thereby indicated that many proteins to be specifically synthesized de novo under Pi deficiency as part of the adaptive mechanism under low P condition. Amongst the four hybrids of maize Him-129 and Vivek-5 showed relatively good response in terms of anthocyanin accumulation in stem and higher total protein content along with activation of few extra new bands of polypeptides under P deficiency and so, proved their tolerance against low P stress.

311. Alam, Badre; Rubber Research Institute of India, Plant Physiology Division, Kottayam (India). Jacob, James; Rubber Research Institute of India, Plant Physiology Division, Kottayam (India). Earl, Hugh J.; University of Georgia, Plant Sciences Building, Department of Crop and Soil Sciences, Athens (USA). Photosynthetic efficiency of transgenic tobacco plants (*Nicotiana tabacum* L.) over-expressing mtID gene under drought and paraquat stress. *Indian Journal of Plant Physiology (India)*. (Jun 2010) v.15(2) p.186-191 KEYWORDS: TRANSGENICS. TRANSGENIC PLANTS. NICOTIANA TABACUM. DROUGHT STRESS. CARBON DIOXIDE.

The objective of this study was to examine the performance of genetically transformed tobacco plants over-expressing mannitol 1-phosphate dehydrogenase (mtID) in maintaining better photosynthetic activity than the untransformed wild plants during water deficit stress and in combination with paraquat stress. Inhibitions in the rates of net CO<sub>2</sub> assimilation (PN) and the non-cyclic photosynthetic electron transport across photosystem II (ETR) due to water deficit stress were much smaller in the mtID transformed plants (22% and 9%, respectively) than in the untransformed wild ones (55% and 52%, respectively). These differences were even more marked when the plants experiencing water deficit stress were treated with paraquat, which blocks the photosynthetic electron transfer chain and diverts the excitation energy into producing reactive oxygen species (ROS). The minimal inhibitions in the photochemical activity (9–10%) of mtID transformed plants resulting from the environmental stresses agree with their expected efficient use of photosynthetic electrons. Results of the present study thus suggest that mtID transformed tobacco plants tolerated the stress better than the untransformed wild plants which is noteworthy for further attention.

312. Mallick, Niharika; Indian Agricultural Research Institute, Division of Genetics, New Delhi (India). Vinod; Indian Agricultural Research Institute, Division of Genetics, New Delhi (India). Sharma, J.B.; Indian Agricultural Research Institute, Division of Genetics, New Delhi (India). Singh, Bhanwar; Indian Agricultural Research Institute, Division of Genetics, New Delhi (India). Tomar, S.M.S.; Indian Agricultural Research Institute, Division of Genetics, New Delhi (India). Genetics of stem rust resistance in common wheat genotypes WR95 and Selection T3336. *Indian Journal of Genetics and Plant Breeding (India)*. (May 2010) v.70(2) p.109-113 KEYWORDS: WHEATS. STEMS. INHERITANCE (ECONOMICS). GENETIC MARKERS.

Genetic stocks WR95 and Sel.T3336 were screened against most prevalent races of stem rust viz., 40A, 40-1 and 1176 at seedling stage under controlled conditions. Both the genetic stocks, WR95 and Sel.T3336 were found resistant to all the three races. Genetic analysis revealed that WR95 carries a single recessive gene for rust resistance. An effort was made to locate the gene using monosomic series, however, the gene proved to be hemizygous ineffective in monosomic F<sub>1</sub>s. WR95 was also screened with validated molecular markers of the stem rust resistance genes Sr24, Sr25, Sr26, Sr31, Sr36, and Sr38. None of these genes could be detected in WR95 showing that the resistance gene present in WR95 is diverse from these genes. Sel T3336 showed segregation for one stem rust resistance gene against race 40-1. However, screening with molecular markers showed the presence of stem rust resistance genes Sr24 and Sr26 in Sel.T3336. The resistance identified in WR95 may prove very useful in breeding.

313. Lakshmana, D.; Regional Agricultural Research Station, Bijapur (India). Biradar, B.D.; RARS, Bijapur (India). Deshpande, S.K.; UAS, Deptt. of Genetics and Plant Breeding, Dharwad (India). Salimath, P.M.; UAS, Deptt. of Genetics and Plant Breeding, Dharwad (India). Fertility restoration studies involving three diverse cytoplasmic-nuclear male sterility systems in Pearl millet. *Indian Journal of Genetics and Plant Breeding (India)*. (May 2010) v.70(2) p.114-119 KEYWORDS: PENNISETUM GLAUCUM. MALE INFERTILITY. CYTOPLASMIC MALE STERILITY.

Pearl millet [*Pennisetum glaucum* (L.) R. Br.], hybrids grown widely in India are all based on A1 CMS source. Though alternative sources of CMS were available and found to be highly stable, their utility is restricted due to non-availability of suitable restorers. The investigation on fertility restoration reaction of the various lines revealed that out of the 105 lines, 38 exhibited satisfactory (60%) seed setting on A1, 63(50%) on A4 cytoplasm and 47 lines (44.76%) on A5 cytoplasm, acted as restorers. The frequency of restoration on A4 cytoplasm was quite high compared to A1 and A5 indicating the possibility of developing hybrids on A4 source. Among the three sources of male sterility the seed set percentage was highest on A1 (78.51) followed by A4 (76.10) and A5 (68.72) in kharif season. However, during summer only on A4 source the seed set per cent was 70%. The proportion of restorers exhibiting 80% seed set was highest on A4 followed by A5 and A1 across kharif and summer seasons. The mean seed set percentage (across the seasons) on A4 was highest (73.50%) followed by on A1 (71.60%) and 66.60% on A5.

314. Yadav, O.P.; Central Arid Zone Research Institute, Jodhpur (India). Evaluation of landraces and elite populations of pearl millet for their potential in genetic improvement for adaptation to drought-prone environments. *Indian Journal of Genetics and Plant Breeding (India)*. (May 2010) v.70(2) p.120-124 KEYWORDS: PENNISETUM GLAUCUM. DROUGHT RESISTANCE. BREEDING METHODS. GENETIC DISTANCE. ADAPTATION.

Pearl millet growing regions in north-western India are characteristically drought-prone which emphasizes the importance of drought tolerance for pearl millet cultivars targeted for these regions. This study was conducted to evaluate the potential of five each of landraces and elite composites by evaluating their 25 crosses under drought conditions of arid zone for three years. Variation in landraces and elite composites accounted for more than 60% of variation in crosses for various traits. Both landraces and elite composites possessed contrasting GCA effects showing their differential ability to produce crosses adapted to drought environments. While the landrace 220 had significant and positive effects for biomass and stover yield, the landrace 184 had significant negative effects for biomass, grain and stover yields. The landraces 235 and 238 largely produced grain type materials. Elite composites, in general, had much lesser effects than landraces. The elite composite 923 had maximum positive effects for grain yield which was presumably due to its positive significant effects for harvest index and average effect for biomass. The composite HHVBC had highest desirable effects for stover yield and hence can be a potential source of improving stover yield in the genetic background of elite material. The results showed that there existed exploitable differences in landraces and elite composites which can be utilized in genetic improvement for adaptation to drought-prone environments.

315. Parameshwarappa, S.G.; University of Agricultural Sciences, Department of Genetics and Plant Breeding, Dharwad (India). Salimath, P.M.; University of Agricultural Sciences, Department of Genetics and Plant Breeding, Dharwad (India). Upadhyaya, H.D.; University of Agricultural Sciences, Department of Genetics and Plant Breeding, Dharwad (India). Patil, S.S.; University of Agricultural Sciences, Department of Genetics and Plant Breeding, Dharwad (India). Kajjidoni, S.T.; University of Agricultural Sciences, Department of Genetics and Plant Breeding, Dharwad (India). Patil, B.C.; University of Agricultural Sciences, Department of Genetics and Plant Breeding, Dharwad (India). Characterization of drought tolerant accessions identified from the minicore of chickpea (*Cicer arietinum* L.). *Indian Journal of Genetics and Plant Breeding (India)*. (May 2010)



v.70(2) p.125-131 KEYWORDS: CHICKPEAS. DROUGHT RESISTANCE. DROUGHT. YIELDS.

Terminal drought is one of the major causes of yield losses in chickpea (*Cicer arietinum* L.) and there is scope for recovery of major part of this loss through genetic improvement. The progress in breeding for drought tolerance is slow due to the quantitative and temporal variability of available moisture across years and the low genotypic variance in yield under drought. Deep and prolific root system is a high priority trait that can improve drought tolerance in chickpea. Ten accessions which were identified as drought tolerant based on drought susceptible index (DSI) and drought tolerant efficiency per cent (DTE%) were evaluated during rabi 2006–07 along with standard check Annigeri-1 and drought tolerant checks ICC 4958 and ICC 10448 under irrigated and rainfed condition for seed yield and root traits. Wide range of genetic variability, moderate to high heritability and high genetic advance for yield and its component traits was observed in drought tolerant accessions evaluated under moisture stress and irrigated situations during 2006–07. Among the drought tolerant genotypes evaluated, ICC 13124 showed maximum yield levels under irrigated (1220 kg/ha) as well as rainfed condition (990 kg/ha). The per cent reduction in yield was minimum (18.9%) as compared to checks under moisture stress for this genotype. Observations on root length, root weight and root volume showed that ICC 13124 was equally good in respect of root traits which can be used in the breeding programme aimed at drought tolerance.

316. Tanveer, Hasan; Krishi Vigyan Kendra, Bilari, Moradabad (India). Choudhury, P. Ray; Directorate of Seed Research, Mau (India). Dixit, G.P.; Indian Institute of Pluses Research, Kanpur (India). Jha, G.K.; IARI, Division of Agricultural Economics, New Delhi (India). Detection of molecular divergence and development of DNA fingerprints in fieldpea cultivars. *Indian Journal of Genetics and Plant Breeding* (India). (May 2010) v.70(2) p.132-139 KEYWORDS: RAPD. GENETIC MARKERS. GRAIN.

Studied the molecular divergence and develop DNA fingerprints in selected popular fieldpea cultivars from India. Those RAPD primers from the four sets (viz. OPP, OPBA, OPAQ and OPH) which showed at least 75 percent band polymorphism were selected for molecular diversity analysis. Twenty four primers generated a total of 256 amplified fragments out of which 228 (89.06%) were polymorphic. On an average, 10.67 bands were amplified per primer. Cluster analysis based upon DNA amplification polymorphism using Jaccard's similarity coefficient and UPGMA could unveil substantial amount of polymorphism among the cultivars. Genotype specific bands were represented in a diagrammatic form and can be used as a reference fingerprint. The arithmetic mean heterozygosity (Hav) value and marker index (MI) was found to be 0.592 and 6.317, respectively, indicating the efficiency and usefulness of RAPD as a marker system.

317. Tripathy, S.K.; OUAT, S.K. Sinha Molecular Lab., Plant Breeding and Genetics, College of Agriculture, Bhubaneswar (India). Sardar, Suchinnata S.; OUAT, S.K. Sinha Molecular Lab., Plant Breeding and Genetics, College of Agriculture, Bhubaneswar (India). Mishra, P.K.; OUAT, S.K. Sinha Molecular Lab., Plant Breeding and Genetics, College of Agriculture, Bhubaneswar (India). Analysis of seed storage protein pattern: a method for studying genetic variation and diversity among vigna genotypes. *Indian Journal of Genetics and Plant Breeding* (India). (May 2010) v.70(2) p.140-144 KEYWORDS: GENETIC VARIATION. STORAGE PROTEINS. VIGNA. ELECTROPHORESIS.

A method based in protein gel electrophoresis was employed in order to improve the analysis of genetic relationships among populations of *Vigna*. It has been used to estimate genetic divergence among 34 improved varieties, five local land races, one wild progenitor of mungbean (*Vigna sublobata*) and a land race of urdbean. In total, 20 polypeptide bands were resolved for seed storage proteins (albumin and globulin) by SDS-PAGE. The electrophoregrams revealed 11 and nine polypeptide bands for albumin and globulin respectively that have exhibited an array of polymorphism both in quality and quantity of bands. The varieties, C.No. 3 and C.No. 36 had similar protein type for albumin and globulin seed protein fraction, but differed in thickness of bands. Mayurbhanj local (an urdbean local cultivar) and TCR 213 (a wild progenitor of

mungbean) had absence of a globulin band GL9 (27.5kd) and GL8 (30.2kd) respectively, but such bands were present in all other accessions leading to serve as molecular marker(s) for their identification. Mutants of mungbean differed in polypeptide banding pattern as compared to their parents indicating the mutation of genes in multigene families for seed storage protein expression. Cluster analysis revealed high genetic diversity of Keonjhar local, Pant M-5, OUM 75-1 and Mayurbhanj local(urdbean) from rest of the genotypes. The results obtained support the idea that seed storage protein analysis can be successfully applied to phylogenetic analysis of *Vigna* genotypes.

318. Pattanashetti, S.K.; University of Agricultural Sciences, Department of Genetics and Plant Breeding, Dharwad (India). Gowda, M.V.C.; University of Agricultural Sciences, Department of Genetics and Plant Breeding, Dharwad (India). Mutational origin of genetic diversity in groundnut (*Arachis hypogaea* L.). Indian Journal of Genetics and Plant Breeding (India). (May 2010) v.70(2) p.145-154 KEYWORDS: GENETIC VARIATION. GROUNDNUTS. RAPD. ISOENZYMES.

To investigate the mutational origin and nature of genetic diversity in groundnut, mutants derived from Dharwad Early Runner and others along with natural types, and intra and interspecific derivatives belonging to all the four botanical types were assessed for their morphological, biochemical and molecular diversity. Similarity among the natural and mutant categories suggests the key role of mutations in creating enormous diversity in terms of different subspecies and botanical types of groundnut. Behaviour of the Dharwad Early Runner derived mutants and several unusual features are indicative of the non-Mendelian turnover mechanisms. Multiple gene differences between the mutants and their parents, paternal inheritance and tissue-specific expression of glutamate oxaloacetate transaminase isozyme, response of mutants to 5-azacytidine (a demethylating agent) and limited molecular diversity compared to enormous morphological diversity suggests the possible involvement of epigenetic mechanisms in the differentiation of groundnut into different subspecies and botanical varieties.

319. Boranayaka, M.B.; Agricultural college and Research Institute, Department of Plant Breeding and Genetics, Madurai (India). Ibrahim, S.M.; Agricultural college and Research Institute, Department of Plant Breeding and Genetics, Madurai (India). Ananda Kumar, C.R.; Agricultural college and Research Institute, Department of Plant Breeding and Genetics, Madurai (India). Rajavel, D.S.; Department of Agricultural Entomology, Agricultural college and Research Institute, Madurai (India). Induced macro-mutational spectrum and frequency in sesame (*Sesamum indicum* L.). Indian Journal of Genetics and Plant Breeding (India). (May 2010) v.70(2) p.155-164 KEYWORDS: SESAMUM INDICUM. EMS. MUTANTS.

A mutation breeding study was carried out with sesame varieties viz., SVPR 1 and Cardeboriga using 5 doses each of gamma rays (10,20,30,40 and 50 krad) and ethyl methane sulphonate (0.8, 1.0, 1.2, 1.4 and 1.6%). In general the spectrum of viable mutants included mutants with alteration in branching habit, plant height, phyllotaxy, nodal distance, flower character, nodal distance of the first capsule, capsule and seed characters with a total of 68 mutants in SVPR 1 and 32 mutants in Cardeboriga from gamma irradiated population and 83 mutants in SVPR 1 and 49 mutants in Cardeboriga from EMS treated population. Among the wide spectrum of viable mutants, economically important mutants such as mutants with determinate plant type, early flowering, more number of branches and capsules, altered phyllotaxy, main stem with shorter inter nodes, multicapsules per axil, multilocules, increased capsules etc., were isolated for further studies.

320. Pattanashetti, S.K.; University of Agricultural Sciences, Department of Genetics and Plant Breeding, Dharwad (India). Gowda, M.V.C.; University of Agricultural Sciences, Department of Genetics and Plant Breeding, Dharwad (India). Inheritance of necrotic mutants of groundnut (*Arachis hypogaea* L.). Indian Journal of Genetics and Plant Breeding (India). (May 2010) v.70(2) p.165-171 KEYWORDS: MUTANTS. GROUNDNUTS.

In groundnut, parent Dharwad Early Runner on treatment with ethyl methane sulphonate and 5-azacytidine (a demethylating agent) resulted in two independent lesion mimic mutants namely, Necrotic 1 and Necrotic 2 belonging to Spanish (var. vulgaris) and Valencia (var. fastigiata) type, respectively. Inheritance studies involving Non-necrotic 1, Non-necrotic 2 (Non-necrotic versions of Necrotic 1 and Necrotic 2) and parent Dharwad Early Runner as ovule parents and Necrotic 1 and Necrotic 2 as pollen parents indicated that necrosis phenotype is under the control of five genes. Though the two necrotic mutants were isolated independently and belongs to different botanical groups, they are essentially similar with respect to necrotic phenotype and genotype. But, Non-necrotic 1, Non-necrotic 2 and parent Dharwad Early Runner differ for their allelic constitution in two or three genes. Response to 5azacytidine (a demethylating agent) suggested that Dharwad Early Runner is in hypermethylated state, necrotic mutants viz., Necrotic 1 and Necrotic 2 are in moderately-methylated state, while non-necrotic variants and Dharwad Early Runner like variants are in hypomethylated state. Results indicate the possible 'epigenetic' nature of these necrotic mutants.

321. Lavanya, D. Leena; Sugarcane Breeding Institute, Division of Crop Improvement, Coimbatore (India). Hemaprabha, G.; Sugarcane Breeding Institute, Division of Crop Improvement, Coimbatore (India). Genetic diversity within sucrose rich parental pool of sugarcane and its application in sugarcane breeding through hybridization and selection. Indian Journal of Genetics and Plant Breeding (India). (May 2010) v.70(2) p.172-181  
KEYWORDS: GENETIC VARIATION. SUGARCANE. HYBRIDIZATION. SELECTION.

Genetic diversity in 82 high sucrose genotypes of sugarcane was estimated using 30 sugarcane specific STMS primers. The overall SI values using three diversity measures viz., Dice, Jaccard's and simple matching methods were 0.69, 0.54 and 0.74 respectively, indicating the existence of moderate diversity among the clones and the scope of improving sucrose content through breeding. The dendrogram analysis among the 82 sugarcane types showed that two pairs of clones (Co 200002 and Co 86005 and, Co 91017 and 89005) were identical. Though the clustering of clones reflected the pedigree relationship between the cultivars, deviations from this were observed and could be attributed to the high heterozygosity and polyploidy of the genus *Saccharum* that lead to gross differences in phenotype and genotype. The more diverse clones were Co 87009, Co 86002, Co 90006, Co 86014, Co 775, Co 87011 and Co 85037. Out of 3321 possible combinations, 443 combinations were genetically more similar (SI=0.83) which might not provide incremental gains through hybridization, while 813 combinations (SI=0.69) were genetically more diverse and 2206 combinations showed moderate diversity (SI=0.70–0.82). Such diverse clones and combinations have immediate application in breeding for improving efficiency and precision in sugarcane breeding. Based on diversity estimates, hybridization involving four genetically diverse, three genetically similar and three with intermediate similarities were affected and progeny performance correlated with genetic diversity. A strong correlation (-0.7265) between genetic diversity and cross performance and cross selection rate from crosses with high and medium diversity indicated the importance of diversity estimates in the choice of parents and to estimate genetically more similar crosses.

322. Sarkar, Jayoti; Indian Agricultural Research Institute, Division of Floriculture and Landscaping, New Delhi (India). Misra, R.L.; Indian Agricultural Research Institute, Division of Floriculture and Landscaping, New Delhi (India). Bhat, K.V.; Indian Agricultural Research Institute, Division of Floriculture and Landscaping, New Delhi (India). Singh, Anita; Indian Agricultural Research Institute, Division of Genetics, New Delhi (India). Singh, Sanjay K.; Indian Agricultural Research Institute, Division of Fruits and Horticultural Technology, New Delhi (India). Genetic diversity analysis in tuberose (*Polianthes tuberosa*) genotypes through Randomly Amplified Polymorphic DNA. Indian Journal of Genetics and Plant Breeding (India). (May 2010) v.70(2) p.182-188  
KEYWORDS: GENETIC VARIATION. RAPD. TUBERS. GERMPLASM.

The present investigation was undertaken for characterizing tuberose genotypes using DNA marker technology. Twenty tuberose genotypes comprising of both single-

and double-petal types collected from different parts of India were selected for analysis. The DNA extraction and RAPD conditions were standardized. For RAPD analysis 20 ng DNA template, 2.5 mM MgCl<sub>2</sub> and 1U TaqDNA polymerase was found effective. Out of 80 random decamer primers tested, 17 were selected based on high level of polymorphism. On the basis of primer resolving power and marker index, RAPD primers OPC-13 and OPD12 were identified as efficient primers for diversity analysis of tuberose. A total of 157 RAPD bands were generated by the 17 random decamer primers. The selected primers proved effective for DNA profiling in addition to diversity analysis. Genotypes Guwahati Double and Swarnrekha showed good morphological similarity revealing high similarity coefficient (0.90) suggesting them to be very closely related. The RAPD analysis also confirmed their relatedness as they grouped in the same cluster. The suitability of this technique for genotyping and diversity analysis was also established. Genotypes, Vaibhav and Pune Single were found to have least pair-wise similarity although they had a greater morphological similarity with each other.

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KEYWORDS: TRITICUM AESTIVUM. TESTING. HEAT STRESS. ENVIRONMENT. GENOTYPES.

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KEYWORDS: MILDEWS. URD. RAPD.

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KEYWORDS: COMBINING ABILITY. BRASSICA CAMPESTRIS.

325. Pradhan, K.; Orissa University of Agriculture and Technology, AICRP on Groundnut, Bhubaneswar (India). Das, P.K.; Orissa University of Agriculture and Technology, AICRP on Groundnut, Bhubaneswar (India). Patra, R.K.; Orissa University of Agriculture and Technology, AICRP on Groundnut, Bhubaneswar (India). Genotype x environment interaction for pod yield and yield components of groundnut varieties in warm sub-humid climate and moderately acidic soil. Indian Journal of Genetics and Plant Breeding (India). (May 2010) v.70(2) p.201-203  
KEYWORDS: GENOTYPES. GENOTYPE ENVIRONMENT INTERACTION. FRUIT. YIELDS. GROUNDNUTS. VARIETIES.

326. Sekhar, J.C.; Directorate of Maize Research, Hyderabad (India). Rakshit, Sujay; Directorate of Sorghum Research, Hyderabad (India). Kumar, Pradyumn; Directorate of Maize Research, New Delhi (India). Venkatesh, S.; Directorate of Maize Research,



Hyderabad (India). Sharma, Rakesh K.; Division of Entomology, IARI, New Delhi (India). Anuradha, M.; Maize Research Center of ARI, Hyderabad (India). Kumar, R. Sai; Maize Research Center of IARI, Hyderabad (India). Dass, Sain; Directorate of Maize Research, New Delhi (India). Improvement of resistance level in selected maize genotypes through cycles of selection against pink borer, *Sesamia inferens* Walker. *Indian Journal of Genetics and Plant Breeding (India)*. (May 2010) v.70(2) p.204-206 KEYWORDS: MAIZE. SESAMIA INFERENS. SESAMIA.

327. Kasturi Bai, K.V.; Central Plantation Crops Research Institute, Kasaragod (India). Muralidharan, K.; Central Plantation Crops Research Institute, Kasaragod (India). Arunachalam, V.; Central Plantation Crops Research Institute, Kasaragod (India). Rajagopal, V.; Central Plantation Crops Research Institute, Kasaragod (India). Heterosis for drought tolerant traits in coconut. *Journal of Plantation Crops (India)*. (Aug 2010) v. 38(2) p. 87-91 KEYWORDS: DROUGHT RESISTANCE. HETEROSIS. LIPID PEROXIDATION.

Heterosis expressed by four tall (West Coast Tall-WCf; Laccadive Ordinary Tall-LCf; Philippines Ordinary Tall-PHOT; and Andaman Ordinary Tall-AOT) and one dwarf coconut cultivar (Chowghat Green Dwarf-CGD) and cross combinations of tall cultivars with CGD (total eight crosses) were examined. Observations on three drought traits viz., leaf water potential, lipid peroxidation and photochemical efficiency were made during non-stress, stress and recovery periods. As the observations made in the three conditions are from the same plant, analysis of repeated measures was employed for testing the effects. Results of the analysis indicate good degree of heterosis in some of the cross combinations for leaf water potential and lipid peroxidation. CGD x WCT recorded significant mid parent heterosis (39%) for leaf water potential after recovery from stress. Significant heterosis for lipid peroxidation over better parent as well as mid-parent was observed for PHOT x CGD under non-stress (28.9 and 31.3%, respectively). Photochemical efficiency (Fv/Fm) values did not show significant heterosis (<6%) over their parents indicating the trait is likely to be governed by additive genes. To provide an estimate of heritability of the traits, data generated for two consecutive years in the same combinations were pooled and effect due to cultivars/crosses was taken as random. Heritability was also worked out for different conditions separately. Although the study uses an important dwarf cultivar, CGD known for drought and root (wilt) resistance, it needs to be confirmed by experimentation with other dwarf and tall cultivars.

328. Sreesmitha, V.; Central Plantation Crops Research Institute, Kasaragod (India). Rajesh, M.K.; Central Plantation Crops Research Institute, Kasaragod (India). Bobby Paul; Central Plantation Crops Research Institute, Kasaragod (India). Anitha Karun.; Central Plantation Crops Research Institute, Kasaragod (India). Ramesh Kumar, M.P.; Central Plantation Crops Research Institute, Kasaragod (India). Thomas, G.V.; Central Plantation Crops Research Institute, Kasaragod (India). In silico prediction of function and modelling of WRKY protein in coconut. *Journal of Plantation Crops (India)*. (Aug 2010) v. 38(2) p. 144-147 KEYWORDS: FORECASTING. COCOS NUCIFERA.

329. Nath, J.C.; Assam Agricultural University, Guwahatti (India). Horticultural Research Station. Effect of season and age of rootstock on graft success in cashew under Assam conditions. *Journal of Plantation Crops (India)*. (Aug 2010) v. 38(2) p. 154-156 KEYWORDS: CASHEWS. ROOTSTOCKS. SEASONS.

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331. Das, Gitali; Rubber Research Institute of India, RES, Nagrakata (India). Chaudhuri, Dhurjati; Rubber Research Institute of India, RES, Nagrakata (India). Varghese, Y.A.; Rubber Research Institute of India, RES, Nagrakata (India). Evaluation of Hevea clones in the mature phase under the agroclimate of Sub-Himalayam West Bengal. *Journal of Plantation Crops (India)*. (Aug 2010) v. 38(2) p. 105-110 KEYWORDS: HEVEA. WEST BENGAL.

Multidisciplinary evaluation of eighteen different clones of Hevea was initiated during 1990 at the Regional Experiment Station, Nagrakata, West Bengal to screen clones well adapted to the specific environmental condition of the region. At the time of panel opening for tapping, none of the clones were found to be superior in girth compared to the check clone RRII 105. However, girth was significantly higher in Haiken 1, RRIM 612, SCATC 93/114 and RRIM 703 compared to RRII 105. The bole volume of the clones varied from 0.07 to 1.1 ml. Among the clones evaluated, RRII 208 and SCATC 88/13 were the top rankers in terms of annual yield over nine years followed by RRIM 605. The winter yield contribution of RRII 208 and SCATC 88/13 was above 59 %. The pattern of yield in both panels was superior in RRII 208, SCATC 88/13 and RRIM 605 compared to the check clone. Percentage of plants showing severe tapping panel dryness (80-100 % occurrence) was high in SCATC 88/13 (19) followed by RRII 203 (15) and RRIM 612 (13) and minimum in RRII 208 and RRIM 605 (2). In general, wind damage was high among the clones with RRIM 605 recording the highest incidence followed by RRII 300, RRII 208, GT 1 and SCATC 93/114. The clones RRII 208, SCATC 88/13 and RRIM 605 were found to be the promising clones for this region.

332. Mydin, K.K.; Rubber Research Institute of India, Kottayam (India). Thomas, Vinoth; Rubber Research Institute of India, Kottayam (India). Mercykutty, V.C.; Rubber Research Institute of India, Kottayam (India). Variability in performance among mature half-sib progenies of Hevea brasiliensis (Willd ex Adr. de Juss. muell. Arg.). *Journal of Plantation Crops (India)*. (Aug 2010) v. 38(2) p. 125-131 KEYWORDS: CLONES. HEVEA BRASILIENSIS. PROGENY TESTING.

A study on half-sib progeny testing and selection was undertaken at the Central Experiment Station of the Rubber Research Institute of India during 1993-2004 to evolve new and improved rubber clones of varying parentage. A total of 15,0 rubber clones comprising open pollinated progenies often popular clones, with IS clones per progeny were evaluated in a Compact Family Block Design over four years of tapping. There was significant variability among and within the mature progenies with respect to rubber yield, growth attributes, timber yield and bark anatomical parameters. Based on estimates of general combining ability for rubber and timber yield, clones PB 28/83, Ch 26, RRII IOS, PB 215, PB 252, PB 217, PB 242 and PB 5151 were identified as promising parent material for polycross breeding via polyclonal seed gardens. More than 50 per cent of the clones within the progeny of parent clone PB 28/83 were high yielding. This clone has also exhibited positive estimates of general combining ability for annual mean yield, summer yield and timber yield, confirming its prepotent ability to produce superior progeny. From the present study, 29 promising clones derived from the half-sib progenies of eight parents of Malaysian and Indian origin could also be identified.

333. Bhat, S. Sreekrishna; Indian Cardamom Research Institute, Sakaleshpur (India). Regional Station). Thomas, J.; Indian Cardamom Research Institute, Myladumpara (India). Madhusoodanan, K.J.; Indian Cardamom Research Institute, Myladumpara (India). Dhanapal, K.; Indian Cardamom Research Institute, Sakaleshpur (India). Regional Station). A novel hybridization technique in cardamom (*Elettaria cardamomum* Maton). *Journal of Plantation Crops (India)*. (Apr 2010) v. 38(1) p. 75-77 KEYWORDS: PHYSICAL CONTROL. HYBRIDS. CARDAMOMS. ELETTARIA CARDAMOMUM.

334. Sangeetha, N.; Manonmaniam Sundaranar University, Tamil Nadu (India). Dept. of Biotechnology. Sankar, R.; Manonmaniam Sundaranar University, Tamil Nadu (India). Dept. of Biotechnology. Mercy, S.; Manonmaniam Sundaranar University, Tamil Nadu

(India). Dept. of Biotechnology. Hannah Selva Kumari, A.; Manonmaniam Sundaranar University, Tamil Nadu (India). Dept. of Biotechnology. Kavitha, M.; Manonmaniam Sundaranar University, Tamil Nadu (India). Dept. of Biotechnology. Ganesh, D.; Manonmaniam Sundaranar University, Tamil Nadu (India). Dept. of Biotechnology. In vitro conservation of zygotic embryos of *Coffea arabica* L.. Journal of Plantation Crops (India). (April 2010) v. 38(1) p. 82-86 KEYWORDS: ABA. COFFEA ARABICA. ZYGOTES. IN VITRO. EMBRYO CULTURE.

335. Baruah, Akhil Ranjan; Tea Research Association, Jorhat (India). Tocklai Experimental Station. Saikia, Hemanta; Tea Research Association, Jorhat (India). Tocklai Experimental Station. Bera, Biswajit; Tea Research Association, Jorhat (India). Tocklai Experimental Station. Detection of close genetic relatedness in some tea genotypes of Assam and Darjeeling using RAPD markers. Journal of Plantation Crops (India). (Apr 2010) v. 38(1) p. 11-15 KEYWORDS: CAMELLIA SINENSIS. RAPD. GENETIC CORRELATION. WEST BENGAL. ASSAM.

Random Amplified Polymorphic DNA (RAPD) markers are efficiently employed in detecting genetic variation and establishing genetic relationship in tea (*Camellia sinensis* (L.) O. Kuntze). In this study, the genetic relationship of 25 tea genotypes comprising ten TRA garden series clones, seven garden clones, six Darjeeling clones and two new clones were analyzed using RAPD markers. The ten random primers showed 51.47% polymorphism with an average polymorphism information content (PIC) value of 0.356. The mean Jaccard's coefficient of similarity for RAPD data was observed as  $0.810 \pm 0.070$ , indicating narrow diversity among the population. Cluster analysis based on genetic similarity using unweighted pair group method using arithmetic average (UPGMA) revealed no clear cut grouping pattern based on the sampling locality, suggesting widespread exchange of genetic materials between the sampling regions. However, irrespective of the place of selection or collection, the genetic diversity was found to be minimum among the populations.

336. Sujatha, A.; Andhra Pradesh Horticultural University, Ambajipeta (India). Horticultural Research Station. Chalam, M.S.V.; Andhra Pradesh Horticultural University, Ambajipeta (India). Horticultural Research Station. Kalpana, M.; Andhra Pradesh Horticultural University, Ambajipeta (India). Horticultural Research Station. Screening of coconut germplasm against coconut eriophyid mite, *Aceria guerreronis* Keifer in Andhra Pradesh. Journal of Plantation Crops (India). (Apr 2010) v. 38(1) p. 53-56 KEYWORDS: ACERIA GUERRERONIS. VARIETIES.

Eight tall coconut varieties (45 years age) and 17 new hybrids (15 years age) available at HRS, Ambajipeta were screened for resistance against coconut eriophyid mite, *Aceria guerreronis* Keifer for four years [2004 to 2007] under natural conditions of coastal ecosystem of Andhra Pradesh. Out of the eight varieties; the lowest mite damage index was recorded in Laccadive Ordinary (LO) - 1.99, Andaman Ordinary (AO) - 2.10, Philippines Ordinary (PO) - 2.23 and East Coast Tall (ECT) - 2.24 and West Coast Tall (WCT) - 2.54 while Laccadive Micro (LM) - 2.43 recorded the highest damage index. Among the 17 coconut hybrids screened, ECT x GB (Godavari Ganga - the first hybrid from Andhra Pradesh) - 1.87, LO x COD - 1.95, YHC-I (ECT x MGD) - 2.08 recorded the lowest mite damage whereas, LM x GB - 2.88, Java x GB - 2.83 and Fiji x GB - 2.75 recorded the highest damage among the crosses.

#### **F40 Plant Ecology**

337. Kumar, Lokesh; Punjab Agricultural University, Department of Horticulture, Ludhiana (India). Dhaliwal, H.S.; Punjab Agricultural University, Department of Horticulture Ludhiana (India). Effect of raising rough lemon (*Citrus jambhiri* lush.) on budding success under modified environmental conditions. Journal of Research Punjab Agricultural University (India). (Mar & Jun 2009) v.46(1-2) p.50-51 KEYWORDS: CITRUS JAMBHIRI. BUDDING. ENVIRONMENTAL FACTORS.



338. Ankegowda, S.J.; Indian Institute of Spices Research, Calicut (India). Kandiannan, K.; Indian Institute of Spices Research, Calicut (India). Venugopal, M.N.; Indian Institute of Spices Research, Calicut (India). Rainfall and temperature trends - A tool for crop planning. *Journal of Plantation Crops (India)*. (Apr 2010) v. 38(1) p. 57-61 KEYWORDS: AGROCLIMATIC ZONES. KARNATAKA. SPICE CROPS.

Analysis of rainfall and temperature of hill zone (high rainfall tract) of Karnataka (part of Western Ghats) carried out for 23 years (1986-2008) indicated that the tract received a mean rainfall of 2.617 mm in 123 rainy days with maximum contribution (80.94 %) from south west monsoon (June to September). July was the rainiest month (799.6 mm) with 28 rainy days. There was no significant trend in mean annual rainfall. The mean monthly maximum temperature (TMAX) ranges between 23.7°C (August) to 31.7°C (March) and mean monthly minimum temperature (TMIN) was in the range of 13.2°C (January) and 18.8°C (May). Temperature trend indicated that annual TMAX was increasing ((R)<sup>2</sup>=0.4903) while TMIN decreasing ((R)<sup>2</sup>=0.3656). Though the tract receives high rainfall, moisture stress is common between December and March and adequate moisture conservation (or irrigation wherever possible) is essential, particularly, for perennial crops in the juvenile stage. Based on the analysis, it is suggested that first dose of fertilizer application, prophylactic plant protection and shade regulation has to be completed during 18th to 21st week (30th April- 27th May) during pre-monsoon time and second schedule has to be adopted during 36th (3-9 September) to 39th week (24-30 September). These operations may continue up to 41<sup>st</sup> week for cardamom and black pepper crops depending upon receipt of rainfall. Beyond 41<sup>st</sup> week (8-14th November), the rainfall receipt is less and earthing up and mulching for cardamom and mulching for black pepper are to be done preferably before 43rd week (22-28th November) to conserve moisture and reduce the evaporation.

#### **F60 Plant Physiology and Biochemistry**

339. Shah, Sonal; Directorate of Medicinal and Aromatic Plants Research, Gujarat (India). Saravanan, R.; Directorate of Medicinal and Aromatic Plants Research, Gujarat (India). Gajbhiye, N.A.; Directorate of Medicinal and Aromatic Plants Research, Gujarat (India). Leaf gas exchange, chlorophyll fluorescence, growth and root yield of ashwagandha (*Withania somnifera* Dunal.) under soil moisture stress. *Indian Journal of Plant Physiology (India)*. (Jun 2010) v.15(2) p.117-124 KEYWORDS: CHLOROPHYLLS. FLUORESCENCE. SOIL WATER CONTENT. WITHANIA SOMNIFERA. WITHANIA. DRUG PLANTS. GAS EXCHANGE. DROUGHT STRESS.

Aswagandha (*Withania somnifera*, Dunal.) is an important medicinal plant. It is cultivated in India as rainfed crop for its roots. A field study was conducted to understand the response of this crop (cv. JA-134) to progressive soil moisture deficit. The treatments imposed were moderate (2 irrigations) and severe stress (single irrigation) along with well watered control (4 irrigations). As the soil moisture stress progressed during the crop growth period, soil decreased in stress treatments and reached to -10.93, -1.15 MPa at 169 DAS in severe stress, moderate stress at 30 cm soil depth whereas control had  $\phi_{\text{soil}}$  of -0.0088 MPa. Correspondingly predawn leaf water potentials were -0.615 and -0.506 MPa in severe and moderate stress treatments while, control sustained the  $\phi_{\text{soil}}$  of -0.373 MPa. At 169 DAS, total chlorophyll content was reduced 49% and 60% in moderate and severe stress, whereas proline content increased 2.75 and 3.96 times that of control in moderate and severe stress. Gas exchange and chl-a fluorescence were significantly altered under stress. Moisture stress reduced all the growth parameters studied compared to control plants. Reduction in dry weight of leaves and stems were 19.88% (3.52 g), 36.48% (5.19 g) respectively in severe stress compared to control. Whereas root dry weight increased 35% and 20% respectively in moderate and severe stress compared to control. The increased root biomass partitioning and higher root yield under soil moisture stress helped in off-setting the deleterious effect of water stress.

340. Pawar, H.C.; MPKV, Department of Biochemistry, Rahuri (India). Naik, R.M.; MPKV, Department of Biochemistry, Rahuri (India). Satbhai, R.D.; MPKV, Department of Biochemistry, Rahuri (India). Mehetre, S.S.; MPKV, Department of Biochemistry, Rahuri (India). Proline, P5CS activity and glycine betaine content in intra-hirsutum (HxH), inter-specific (HxB) and *G. arboreum* cultivars under water stress. Indian Journal of Plant Physiology (India). (Jun 2010) v.15(2) p.125-130 KEYWORDS: PROLINE. DROUGHT STRESS. COTTON. BETAINE.

Water stress created by withholding irrigation caused significant increase in free proline and glycine betaine content in the leaves of intra-hirsutum (HxH), inter-specific (HxB) and *G. arboreum* cultivars of cotton. The increase in the levels of proline is mainly attributed to de-novo synthesis of proline as evident from increased activity of P5CS specifically in *G. arboreum* cultivars. However, besides de novo synthesis of proline, loss of feed back inhibition of free proline appears to operate in regulating the levels of free proline in intra-hirsutum and inter-specific hybrids. Cotton is a natural glycine betaine accumulator and hence, a higher level of glycine betaine was recorded in control plants, which further increased on imposition of stress. A significant variation in the levels of free proline and glycine betaine was observed in all the cultivars tested. The levels of both the osmolytes increased simultaneously and can be used to select the drought tolerant segregating population involving breeding of cotton for drought tolerance.

341. Upadhyay, R.K.; Assam Central University, Plant Biochemistry and Molecular Biology Laboratory, School of Life Sciences, Silchar (India). Panda, S.K.; Assam Central University, Plant Biochemistry and Molecular Biology Laboratory, School of Life Sciences, Silchar (India). Dutta, B.K.; Assam Central University, Agricultural Ecology Laboratory, School of Environmental Sciences, Silchar (India). Biochemical impact of re-oxygenation in rice seedlings after submergence stress. Indian Journal of Plant Physiology (India). (Jun 2010) v.15(2) p.148-152 KEYWORDS: WATER TOLERANCE. OXIDATION. STRESS. ORYZA SATIVA.

Rice cultivars treated with 2, 4 and 6d of submergence and post submergence exhibited increase in reactive oxygen species, hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) and superoxide radical (O<sub>2</sub><sup>-</sup>). The analysis of lipid peroxidation showed high increment in malondialdehyde (MDA) production only after 2d of treatment. Significant increase in peroxidase (POX) and superoxide dismutase (SOD) activities were enhanced under post submergence treatment after 4d, but reduced after 6d while catalase (CAT) activity declined after 4d of treatment. The contents of ascorbate (AsA) and glutathione (GSH) also showed increasing trends. The objective of this experiment was to test the hypothesis that submergence induces oxidative stress with exposure dependent intensity and variability and activates defence system in *Oryza sativa* L. Though water is essential for plants, but submergence-associated O<sub>2</sub> alteration causes the toxicity.

342. Rafi, K. Mohamed; Jamal Mohamed College, PG & Research Department of Botany, Tamil Nadu (India). Aslam, A.; Jamal Mohamed College, PG & Research Department of Botany, Tamil Nadu (India). Kohila, S.; Mother Teresa Women's University, Department of Biotechnology, Tamil Nadu (India). Tanweer, J.; Jamal Mohamed College, PG & Research Department of Botany, Tamil Nadu (India). Shajahan, A.; Jamal Mohamed College, PG & Research Department of Botany, Tamil Nadu (India). Direct rhizogenesis from in vitro leaves of *Withania somnifera* (L.) dunal. Indian Journal of Plant Physiology (India). (Jun 2010) v.15(2) p.173-176 KEYWORDS: WITHANIA SOMNIFERA. AUXINS. EXPLANTS.

Direct in vitro rhizogenesis was induced in *Withania somnifera* (L.) Dunal leaf segments using exogenous addition of auxins. Among the four types of explants (internodal, nodal, young leaf and mature leaf segments), young leaves responded better and formed roots in the midrib region on the contact surface when placed on Murashige and Skoog's (MS) basal medium containing various types (IAA, IBA and NAA) and concentrations of auxins. The strength of the MS media (1/4, 1/2, 3/4 and full strength) treatments had apparent effect on rooting. Maximum rooting in young leaf (95%) occurred in 1/2 strength MS + IAA medium. The other types of auxins were good

for inducing root in other explants. Only 20 percent of the cultures produced roots if explants were grown on full-strength MS medium supplemented with IBA.

343. Emmanuel, E.S. Challaraj; Sourashtra College, Dept. of Microbiology, Madurai (India). Vignesh, V.; Sourashtra College, Dept. of Microbiology, Madurai (India). Anandkumar, B.; Indira Gandhi Centre for Atomic Research, Corrosion Science and Technology Division, Kalpakkam (India). Maruthamuthu, S.; Central Electro Chemical Research Institute, Corrosion Protection Division, Karaikudi (India). Bioaccumulation and physiological impact of rare earth elements on wheat (*triticum aestivum*). Indian Journal of Plant Physiology (India). (Jun 2010) v.15(2) p.177-180 KEYWORDS: BIOACCUMULATION. RARE EARTH ELEMENTS. TRITICUM AESTIVUM.

Rare earth elements (REEs) frequently occur together in rare earth minerals and have similarities in ionic radii and chemical activities with other elements in periodic table. REEs have beneficial effects on plant growth and soil properties. The aim of this study was to evaluate the influence of REEs on plant (Wheat) growth and their accumulation of rare earth elements. Inductively Coupled Plasma – Optical Emission Spectrometry (ICP-OES) was carried out to assess the fractionation of REEs in different tissues of wheat plant. The mean concentrations of rare earth elements were determined in roots, shoots and leaves of wheat. A greater biomass and significant accumulation of REEs were inferred in roots than in leaves and shoots. Increased levels of Chlorophyll, amylase and Superoxide dismutase (SOD) activity were observed in the REEs treated plants. This study implicates the role of REEs as fertilizers to improve plant biomass production.

344. Sharma, P.; Jawaharlal Nehru Agricultural University, Jabalpur (India). Horticultural Biotechnology Lab). Tripathi, M.K.; Jawaharlal Nehru Agricultural University, Jabalpur (India). Horticultural Biotechnology Lab). Tiwari, G.; Jawaharlal Nehru Agricultural University, Jabalpur (India). Dept. of Medicinal & Aromatic Plants). Tiwari, S.; Jawaharlal Nehru Agricultural University, Jabalpur (India). Division of Tissue Culture & Transgenic, Biotechnology Centre). Baghel, B.S.; Jawaharlal Nehru Agricultural University, Mandasaur (India). KNK-College of Horticulture). Regeneration of liquorice (*Glycyrrhiza glabra* L.) cultured nodal segments. Indian Journal of Plant Physiology (India). (Jan-Mar 2010) v. 15(1) p. 1-10 KEYWORDS: ORGANOGENESIS. GLYCYRRHIZA GLABRA. SEEDLINGS. CULTURE MEDIA. IN VITRO. REGENERATION.

A protocol has been established to propagate local cultivar of *Glycyrrhiza glabra* (L.) through indirect and direct in vitro organogenesis from nodal segment explants excised from 4-5 months-old plants. In the present study, induction medium Bs2D (Bs + 2.0 mg/l 2, 4 D + 20.0 g/l sucrose + 7.5 g/l agar) induced callusing in higher frequencies (65.93 %). Culture medium Bs.SB.SN (Bs + 0.5 mg/l BA + 0.5 mg/l NAA + 20.0 g/l sucrose + 7.5 g/l agar) was found to be more responsive for shoot proliferation (94.12 %), shoots per explant (9.32) and mean shoot length (5.20 cm). Among rooting media Bs.SI (Bs + 0.5 mg/l IBA + 10.0 g/l sucrose + 7.5 g/l agar) proved to be superior for higher root proliferation (84.92%) and mean root length (2.13 cm). Regenerated plantlets were established successfully in the field after hardening.

345. Chavan, M.L.; University of Agricultural Sciences, Dharwad (India). Dept. of Crop Physiology). Janagoudar, B.S.; University of Agricultural Sciences, Dharwad (India). Dept. of Crop Physiology). Dharmatti, P.R.; University of Agricultural Sciences, Dharwad (India). Dept. of Crop Physiology). Koti, R.V.; University of Agricultural Sciences, Dharwad (India). Dept. of Crop Physiology). Effect of drought on growth attributes of tomato (*Lycopersicon esculentum* Mill.) genotypes. Indian Journal of Plant Physiology (India). (Jan-Mar 2010) v. 15(1) p. 11-18 KEYWORDS: TOMATOES. GROWTH. GENOTYPES. LEAF AREA INDEX. LYCOPERSICON ESCULENTUM. DROUGHT STRESS.

Studies were undertaken to find the detrimental effect of drought on growth attributes of tomato (*Lycopersicon esculentum* Mill.) plants were evaluated in the field experiment at KRC College of Horticulture, Arabhavi, Karnataka. Experiment was laid out with two levels of irrigation and 50 tomato genotypes by adopting factorial RBD with two

replications. Drought was imposed two weeks after transplanting in both the IW/CPE ratio (ratio of irrigation water to cumulative pan evaporation) of 0.40 and 1.20 treatments. Irrigation was given when the pan evaporation reading reached 41.66 mm (1.20 IW /CPE ratio) and 125 mm (0.40 IW /CPE ratio). As the stress increased from 1.2 to 0.4 IW /CPE ratio, there was reduction in LAI, NAR and RGR was noticed at all the growth stage whereas, per cent light transmission was increased. At 45 DA T, irrespective of the irrigation levels, genotype L-3 had significantly maximum LAI, 75 DAT and at harvest, significantly maximum LAI was found in the genotype L- 33. During 45-75 DAT, genotype Arka Meghali had significantly higher NAR and RGR, and genotype GK-3 recorded significantly maximum NAR and RGR at 45 DAT- harvest whereas, during 75 DAT to harvest, the genotype L-13 recorded significantly maximum NAR and L-30 recorded significantly higher RGR. Among the genotypes, L-37 recorded significantly maximum per cent light transmission.

346. Farooqi, A.H.A.; Central Institute of Medicinal and Aromatic Plants, Lucknow (India). Plant Physiology and Biochemistry Div.). Khan, A.; Central Institute of Medicinal and Aromatic Plants, Lucknow (India). Plant Physiology and Biochemistry Div.). Srivastava, A.K.; Central Institute of Medicinal and Aromatic Plants, Lucknow (India). Plant Physiology and Biochemistry Div.). Ameliorative effect of paclobutrazol and chlormequat on drought stressed plants of *Vetiveria zizanioides*. Indian Journal of Plant Physiology (India). (Jan-Mar 2010) v. 15(1) p. 19-24 KEYWORDS: DROUGHT STRESS. VETIVERIA ZIZANIOIDES. PACLOBUTRAZOL. CHLORMEQUAT.

Vetiver is important source of essential oil production in drought region. Responses of *Vetiveria zizanioides* (vetiver) to drought stress and ameliorative effect of chlormequat chloride, paclobutrazol and ethrel application to drought stressed plants were studied. In the first experiment, relative water content, root yield, oil concentration, khusimol content and oil yield decreased under drought while khusinol and proline concentration increased under drought stress. Ameliorative effects of paclobutrazol and chlormequat chloride were observed in drought stressed plants as root yield, oil concentration and oil yield increased significantly in paclobutrazol treated stressed plants, while oil concentration and khusimol content increased significantly in chlormequat chloride treated stressed plants. In the second experiment oil concentration, and oil yield increased under drought stress and ameliorative effect of chlormequat chloride was observed on oil concentration in drought stressed plants. Changes in physiological traits indicated that paclobutrazol and chlormequat chloride can partially alleviate the detrimental effect of drought.

347. Lallu; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Oilseed Section). Baghel, R.S.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Oilseed Section). Srivastava, S.B.L.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Oilseed Section). Assessment of mustard genotypes for thermo tolerance at seed development stage. Indian Journal of Plant Physiology (India). (Jan-Mar 2010) v. 15(1) p. 36-43 KEYWORDS: MUSTARD. GENOTYPES. DRY MATTER CONTENT. YIELDS. BIOLOGICAL DEVELOPMENT. BRASSICA JUNCEA.

In the present study thirty six mustard (*Brassicajuncea* (L.) Czern & Coss) genotypes were assessed for thermotolerance at seed development stage. Seeds were sown in October (normal sowing) and November (late sowing) of rabi 2007-08. November sowing caused significant reduction in plant height, dry matter accumulation, branching behaviour, harvest index, yield and yield attributes. Delay one month in sowing of mustard leads to the loss of 40.6 % in seed yield over normal sowing. Genotypes BPR-541-4, NPJ-112, RGN-145 and RH-0119 were identified thermotolerant at terminal stage as these showed minimum < 20% reduction in the number of branches, siliquae number, dry matter at p&St flowering, seed yield and produced bold seeds. Heat susceptibility index values were < 0.5 and yield stability ratio was > 80.0%. Number of branches per plant ( $r=0.946$ ) and number of siliquae per plant ( $r=0.982$ ) showed positive correlation with seed yield in November sown crop.



348. Rani, C.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Botany and Plant Physiology). Toky, O.P.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Forestry). Datta, K.S.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Botany and Plant Physiology). Kumar, M.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Botany and Plant Physiology). Arora, V.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Botany and Plant Physiology). Madaan, S.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Botany and Plant Physiology). Sharma, P.K.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Botany and Plant Physiology). Angrish, R.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Botany and Plant Physiology). Physiological behaviour vis-a-vis water logging conditions in some tree species. Indian Journal of Plant Physiology (India). (Jan-Mar 2010) v. 15(1) p. 44-53 KEYWORDS: TREES. ADAPTATION. WATERLOGGING. GROUNDWATER TABLE. EVAPOTRANSPIRATION.

Strip plantations of two rows of ten trees species (*Eucalyptus tereticornis* clone-t0, *Eucalyptus tereticornis* clone-t30, *Eucalyptus tereticornis* clone-3, *Eucalyptus* hybrid clone (*Eucalyptus tereticornis* x *Eucalyptus camaldulensis*), *Tamarixaphylla*, *Prosopis juliflora*, *Callistemon lanceolatus*, *Melia azedarach*, *Terminalia arjuna* and *Pongamia pinnata*) each 60 meters apart were raised on field bunds at the CCS Haryana Agricultural University, Hisar animal fodder production farm area, comprising of about 30 acre' of water-logged pasture land along with the Balsamand canal. To monitor water table fluctuations immediately beneath the plantations due to evapotranspirational-drainage (ED), observation wells were dug on each of the bund between the two rows of trees. Morpho-physiological ED traits like tree height, diameter at breast height (DBH), leaf area index (LAI), stomatal density, stomatal conductance (gs), transpiration rate, potometric water loss (PWL), relative water content (RWC), excised leaf water loss (ELWL) and dimensions of the water conducting elements (tracheids and vessels) were also studied. Palpable fluctuations in the water table immediately beneath each plantation on a 24 hour diurnal cycle were observed and the magnitude of depression of water table beneath each plantation was taken as the ED potential of tree species. Amongst the different tree species ED, as determined by decline in water table beneath the plantation, was in the order of: *Eucalyptus* Clone-t0 (42.00mm) *Eucalyptus* hybrid (41.75mm) *Eucalyptus* Clone-t30 (22.50mm) *Tamarix* aphylla (22,00mm) *Prosopis* juliflora (19.25mm) *Eucalyptus* Clone-3 (16.50mm) *Callistemon lanceolatus* (11.75mm) *Melia azedarach* (11.50mm) *Terminalia arjuna* (5.50mm) *Pongamia pinnata* (5.25mm). Correlation analysis of ED potential with other parameters showed that ED potential had a significant positive correlation with LAI. Tree height, DBH, stomatal density and leaf transpiration rate also bore a significant positive correlation with ED potential. However, correlation trends with other physiological traits like PWL, RWC, ELWL and length and width of water conducting elements were not consistent. Our results indicate that species like *Eucalyptus tereticornis* clone-t0 and *Eucalyptus* hybrid are fast EDs primarily due to their ability to display large leaf area as compared to slow EDs like *Terminalia arjuna* and *Pongamia pinnata* where leaf area development is poor.

349. Das, R.; Assam Agricultural University, Jorhat (India). Dept. of Crop Physiology). Kalita, P.; Assam Agricultural University, Jorhat (India). Dept. of Crop Physiology). Characterization of some upland rice cultivars under moisture stress condition. Indian Journal of Plant Physiology (India). (Jan-Mar 2010) v. 15(1) p. 54-60 KEYWORDS: UPLAND RICE. MOISTURE CONTENT. GERMINATION. CHLOROPHYLLS.

A trial was conducted to assess the performance of some locally grown upland rice cultivars of Assam, , Kolong, Luit, Nilajee, ffi-50 and Gunni under different moisture regimes; 0 bar, -2 bar and -6 bar. Moisture deficit resulted in lowering of the seed germination percentage and seedling vigour in all the cultivars but the cultivars varied significantly in their response to moisture stress in regards to these traits. The local cultivars (Kolong and Luit) had comparatively higher seedling vigour and profuse root



with higher chlorophyll content was recorded in Kolong and Luit as compared to ffi-50 and other notypes. The leaf anatomical characteristics such as thickness of cuticle, palisade, and spongy renchyma cells were found to be higher in Luit; however, the stomatal index and stomatal size were N'er in this cultivar followed by Kolong. Higher values of RWC and chlorophyll stability index were 10 recorded in Luit followed by Kolong. These local cultivars also registered higher xylem number d xylem area in root. From the observations, it can be concluded that the local cultivars are having tter adaptive characters for moisture deficit situation compared to the high yielding cultivar IR-50.

350. Hebbar, K.B.; Indian Institute of Soil Science, Bhopal (India). Venugopalan, M.V.; Central Institute of Cotton Research, Nagpur (India). Dawale, M.; Central Institute of Cotton Research, Nagpur (India). Rao, M.R.K.; Central Institute of Cotton Research, Nagpur (India). Comparative performance of a rainfed cotton variety and hybrid under late sown condition. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2010) v. 15(1) p. 61-64 KEYWORDS: GROWTH. VARIETIES. PHOTOSYNTHESIS. COTTON. YIELDS.

The growth and physiological performance of a normal and late sown cotton variety (LRA 5166) and a hybrid (NIIII44) was tested during 2003-04 and 2004-05 cropping seasons under rain-fed condition. Normal planting (D1) was done with the commencement of rain while, late sowing (D2) was done 15 days after D1. Phenological development of the variety and the hybrid was similar up to flowering however, the hybrid had an extended reproductive period compared to variety both in D1 and D2.. Hybrids also accumula(ed more biomass and had higher LAI at reproductive phase and showed a strong correlation with photosynthesis rate (P N). This higher P N in addition to longer duration of reproductive stage enabled hybrids to produce far more number -of squares and bolls compared to the variety in D2.

351. Deshmukh, M.R.; Agharkar Research Institute, Pune (India). Patil, S.G.; Agharkar Research Institute, Pune (India). Screening of grape rootstocks for sulphaqte salinity. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2010) v. 15(1) p. 65-68 KEYWORDS: SODIUM. SULPHATES. GRAPES. GROWTH. ROOTSTOCKS.

Effect of Sodium sulphate ( $\text{Na}_2\text{SO}_4$ ) was recorded on various biochemical parameters of grape genotypes like Dogridge, Degrasset, Jawahar, H-516 and H-1204. Various concentrations of Sodinm sulphate viz. Control, 2, 4, 6, 8, 10, and 12dSm-l had a significant effect on the reduction in shoot and root growth which can be considered as the criteria for relative salt tolerance. Based on these criteria H-516 and Dogridge recorded the lowest reduction in growth attributes. It indicated that they were relatively salt tolerant to growth of rootstocks. Overall such salinity tolerant genotypes have special significance in grape improvement programme, as rootstock can be used for grafting of seedless/wine grape varieties for their cultivation under sulphate salinity soils.

352. Kumar, S.; Directorate of Rapeseed-Mustard Research, Bharatpur (India). Chauhan, J.S.; Directorate of Rapeseed-Mustard Research, Bharatpur (India). Andy, A.; Directorate of Rapeseed-Mustard Research, Bharatpur (India). Meena, M.L.; Directorate of Rapeseed-Mustard Research, Bharatpur (India). Pattern of glucosinolate changes in Indian mustard (*Brassica juncea* L.) during different developmental stages. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2010) v. 15(1) p. 69-72 KEYWORDS: MUSTARD. BRASSICA JUNCEA. DEVELOPMENTAL STAGES. LEAVES. GLUCOSINOLATES.

The changes in total glucosinolate in leaves, roots and stem at 3 developmental stages, pods and seeds of four advanced breeding lines BPR-897-4-11-8-4-91-2, BPR-897-4-11-8-4-91-5, BPR-897-4'11-8-6-93-10, BPR-897-4-11-8-6-93 -11 and Varuna variety of Indian mustard were investigated during 2008-09 cropping season. Highly significant data between developmental stages, plant parts and genotypes interactions suggested differential response of mustard genotypes to glucosinolates. Glucosinolates in leaves were, in general, higher than that of stem and roots except for roots at 45 days

after sowing (DAS). Genotype BPR897-4-11-8-91-2 accumulated more glucosinolates in stem as compared to leaves and genotype BPR 897-4-11-8-6-93-11 showed more glucosinolates in leaves than roots at 45 DAS. Glucosinolates in stem and roots decreased at higher rate in comparison to that of leaves. Leaf glucosinolates at 45 DAS had positive relationship with that of 60 DAS ( $r=0.871$ ). Total glucosinolates in pods and seeds were also positively correlated ( $r=0.814$ ) and hence could be a good criterion for identifying low glucosinolates lines at early stage.

353. Valli Khan, P.S.S.; Yogi Vemana University, Kadapa (India). Dept. of Botany). Prakash, E.; Università degli Studi di Palermo, Palermo (Italy). Dipartimento SENFIMIZO). Meru, E.S.; Biotechnology Research Centre, Tirupati (India). Effect of thiadiazuron and ascorbic acid on recurrent production of plantlets from seeds of *Syzygium alternifolium* (Wight.) Walp. Indian Journal of Plant Physiology (India). (Jan-Mar 2010) v. 15(1) p. 73-76 KEYWORDS: POLYEMBRYONY. IN VITRO. ASCORBIC ACID. SYZYGIUM. SEEDLINGS.

The current experiments were undertaken to study the effect of thiadiazuron (TDZ) and ascorbic acid (AA) on recurrent production of plantlets from seeds of *Syzygium alternifolium* (Wight.) Walp. The multiple shoots were induced from embryonal axes of seeds cultured on basic culture medium (BCM) containing half strength Murashige and Skoog (MS) salts, Bs vitamins, 2 mg/l glycine, 2% (w/v) sucrose, 0.8 % (w/v) agar, 1.0 mg/l TDZ and AA (1000 mg/l). Our findings suggested recurrent production of plantlets and their hardening process to obtain 70% survival rates. The tissue culture protocol can be used for en masse propagation and conservation of this important multipurpose fruit tree.

354. Yadav, S.K.; Indian Institute of Soil Science, Bhopal (India). Panwar, N.R.; Banaras Hindu University, Varanasi (India). Dept. of Soil Science). Ramana, S.; Indian Institute of Soil Science, Bhopal (India). Effect of organic nitrogen on yield and nutrient composition of rice (*Oryza sativa* L.). Indian Journal of Plant Physiology (India) . (Jan-Mar 2010) v. 15(1) p. 77-79 KEYWORDS: PLANTS. RICE. ORYZA SATIVA. YIELDS. ORGANIC COMPOUNDS. PLANT NUTRITION.

Field experiment was conducted to find the efficacy of substituting fertilizer N at different proportions (PS%, 50% and 75% of total N) with organic N sources i.e. farm yard manure (FYM), green leaf manure GLM), poultry manure and BGA on nutrient uptake (NPK) and yield of rice variety Sarju 52. In general the maximum uptake of the nutrients and grain yield were obtained with the application of 25% N through green manure + 75% through inorganic urea. GLM is more efficient than other organic sources at all the proportions of N.

355. Trivedi, A.K.; National Bureau of Plant Genetic Resources, Nainital (India). Regional Stn.). Ahmad, I.; Indian Institut eof Toxicology Research, Lucknow (India). Fibre Toxicology Div.). Ashquin, M.; Indian Institut eof Toxicology Research, Lucknow (India). Fibre Toxicology Div.). Effects of chrysotile asbestos exposure on certain biochemical parameters of *Lemna gibba*. Indian Journal of Plant Physiology (India). (Jan-Mar 2010) v. 15(1) p. 80-83 KEYWORDS: PHYTOTOXICITY. LEMNA GIBBA. LEMNACEAE. OXIDATION. STRESS.

Asbestos and its toxic potential on animal and human system has been extensively documented but meager information is available regarding its effects on plant model. Previously, we have shown that chrysoWe exposure exerts significant alterations in growth, physiological and biochemical parameters of an aquatic macrophyte, duckweed (*Lemna gibba*). In the present study *Lemna gibba* plants were exposed to four concentrations (0.5, 1.0, 2.0, and 5.0 J.1g ml<sup>-1</sup>) of chrysotile asbestos under laboratory conditions and alterations in the level of certain oxidative stress enzymes were evaluated at post exposure day 28 in order t., assess changes in their level as suitable biomarkers of chrysotile contamination because changes in their level will affect growth, development and physiology at molecular level. Chrysotile exposure caused an increase in the lipoxygenase, peroxidase, glutathione reductase, glutathione S-transferase and

monodehydroascorbate reductase activity and a decrease in dehydroascorbate reductase activity. These alterations might be considered as biomarkers of exposure to unsafe environment because oxidative stress due to environmental constraints renders such changes in plants to overcome oxidative stress and tolerate unsafe environment.

356. Das, M.; Directorate of Medicinal and Aromatic Plants Research, Anand (India). Performance of asalio (*Lepidium sativum* L.) genotypes under semi-arid condition of middle Gujarat. *Indian Journal of Plant Physiology* (India). (Jan-Mar 2010) v. 15(1) p. 84-89 KEYWORDS: YIELDS. LEPIDIUM SATIVUM. LEAF AREA INDEX. PHOTOSYNTHESIS. GENOTYPES.

Asalio (*Lepidium sativum* L.), is a low water requiring medicinal herb: the roots, leaves and seed, " are used for different medicinal preparations. A field experiment was conducted to assess the response of five important lines (No.99, No.31, No.37, No.16 and No.53) and one cultivar (GA-I) of Asalio in terms of leaf photosynthetic characteristics, growth and grain yield. The results revealed that there was wide variability in different genotypes with regard to all these above parameters. A line, No. 11 exhibited maximum growth in terms of all these characters. Maximum seed yield of 18.1q ha<sup>-1</sup> was also obtained in No. 16 with a harvest index (HI) of 32.2% and test weight (1000 seed weight) of 1.76 g, which was the maximum among all the genotypes. The significant variability among the genotypes with respect to all these above determinants indicates the utility of the line No.16 under semi-arid condition.

357. Choudhary, D.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Agarwal, G.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Singh, V.P.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Arora, A.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). In vitro micropropagation of *Gladiolus grandiflora* (Var. Snow Princes) flower from cormel explant. *Indian Journal of Plant Physiology* (India). (Jan-Mar 2010) v. 15(1) p. 90-93 KEYWORDS: MICROPROPAGATION. FLOWERS. CALLUS. IN VITRO. GLADIOLUS. CORMS.

Protocol for micropropagation of *Gladiolus grandiflora*, an economically important horticultural crop has been developed using aseptically grown cormel slices as explants. Better proliferation and multiplication of calli were obtained on Murashige and Skoog (MS) basal medium supplemented with 2.0 mg l<sup>-1</sup> NAA and 1.0 mg l<sup>-1</sup> BAP. Regenerable calli were formed from the basal region of in vitro cultured cormel slices in approximately three weeks after explants were placed on callus induction medium. For most prolific shoot induction one gram (fresh weight) of callus was placed on shoot induction medium containing MS basal salt and 0.5 mg l<sup>-1</sup> BAP. Shoot formation occurred one month after inoculation of callus on shoot induction medium. The standardized regeneration protocol will help to impart desirable traits in *Gladiolus* cultivar 'Snow Princess' for further transformation and genetic modification.

358. Saini, H.K.; Punjab Agricultural University, Ludhiana (India). Dept. of Horticulture). Gill, M.L.S.; Punjab Agricultural University, Ludhiana (India). Dept. of Horticulture). Factors affecting shoot regeneration in rough lemon (*Citrus jambhiri* Lush) rootstock. *Indian Journal of Plant Physiology* (India). (Jan-Mar 2010) v. 15(1) p. 94-98 KEYWORDS: ROOTSTOCKS. LEMONS. SHOOTS. LEAVES. ANTIBIOTICS. CEPHALOSPORINS.

The aim of this work was to standardize tissue culture parameters for gene transfer in rough lemon rootstock. Epicotyl segments were cultured with different concentrations of 6-benzylaminopurine (BAP), cefotaxime and hygromycin. Epicotyl segments (1-2 cm) from etiolated seedlings transferred to 16 h photoperiod for 2 weeks produced maximum number of adventitious shoot buds on MS, medium supplemented with BAP (0.5 mg l<sup>-1</sup>). Longitudinal cut gave the highest number of buds per explant as compared to transverse cut. Maximum bud induction frequency was obtained on MS + BAP (0.5 mg l<sup>-1</sup>) medium. The sensitivity of epicotyl segments cultured on regeneration medium MS + BAP (0.5 mg l<sup>-1</sup>) to antibiotics, cefotaxime and hygromycin was observed at concentration of 400

ppm and 2 mg l<sup>-1</sup>, respectively. The study can help in developing transgenics of rough lemon rootstock.

359. Kumar, S.N.; Central Plantation Crops Research Institute, Kasargod (India). Kasturi Bai, K.V.; Central Plantation Crops Research Institute, Kasargod (India). Photosynthetic characters in different shapes of coconut canopy under irrigated and rainfed conditions. *Indian Journal of Plant Physiology (India)*. (Jul - Sept 2009) v. 14(3) p. 215-223  
KEYWORDS: CANOPY. PHOTOSYNTHESIS. COCONUTS. WATER USE.

The details about the gas exchange parameters in leaves of coconut canopy in three different types of canopy shapes, viz. (i) oval shaped (ii) X-shaped and (iii) semi circle shape under rainfed and irrigated conditions are discussed. Mean photosynthesis rate (Pn), stomatal conductance (gs), internal CO<sub>2</sub> concentration (Ci) and transpiration rate (E) were significantly higher in irrigated palms. However, rainfed Palms had significantly higher WUE. The Pn rates were higher in leaves from 2nd to 10th leaf from top and then gradually declined with increase in age of the leaf. Similar trends were observed for gs and E. The relationship between the deviations of Ci/gs and Pn indicated two types of relationship, (i) asymptotic negative relationship in irrigated condition and (ii) low relationship under rainfed conditions. The Pn rates positively correlated with specific leaf weight in irrigated condition while negatively in rainfed conditions. Four general types of leaves were found in coconut canopies, viz. (i) leaves with higher Pn and higher WUE than mean performance of canopy leaves, (ii) leaves with higher Pn and lower WUE, (iii) leaves with lower Pn and higher WUE and (iv) leaves with lower Pn and lower WUE (lower leaves). Oval shaped canopy is more suitable for higher photosynthesis efficiency, WUE and productivity as compared to X-shaped and semi circle shaped canopies. These results indicate that canopy shape plays a role in the overall performance of photosynthesis and water use efficiencies and productivity in coconut. Results also indicate coconut as a source-limited plant.

360. Manickam, S.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn.). Prakash, A.H.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn.). Gopalakrishnan, N.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn.). Molecular analysis of the interspecific cross between *Gossypium hirsutum* Cv. Anjali and *G. aridum*. *Indian Journal of Plant Physiology (India)*. (Jul - Sept 2009) v. 14(3) p. 224-228  
KEYWORDS: GOSSYPIMUM HIRSUTUM. GENETIC MARKERS. HYBRIDIZATION. BIOLOGICAL COMPETITION.

Molecular characterization using random amplified polymorphic DNA markers (RAPD) was done to assess the hybridity of the cross *G. hirsutum* cv. Anjali x *G. aridum*. Morphologically, the triploid hybrid was intermediate between parents. Around 150 RAPD amplicons were generated from 21 random primers, of which 122 were polymorphic. Based on the presence or absence of DNA bands in the female parent, hybrid and male parent, the molecular markers were classified into seven types (I-VII). Of these seven types, Type IV marker was suitable for identifying the hybrid status of the cross because of the presence of male specific bands in the hybrids. Presence of Type IV markers (13.3%) confirmed the true hybrid status of the cross studied in the present study. In this study, 52.7% of the RAPD markers revealed additivity among parents and the hybrid. However, 37.3% of parental markers (Type III, V and VII) were absent in the hybrid while, 10% unique markers (Type VI) were present in triploid hybrid. Genetic similarities were calculated to determine the genetic relatedness between the parents and offspring.

361. Mukherjee, D.; Kurukshetra University, Kurukshetra (India). Dept. of Botany). Jakhar, S.; Kurukshetra University, Kurukshetra (India). Dept. of Botany). Combined application of serine and kinetin regulates leaf disc senescence in *Spinacia oleracea* L.. *Indian Journal of Plant Physiology (India)*. (Jul - Sept 2009) v. 14(3) p. 229-238  
KEYWORDS: KINETIN. SENESCENCE. SERINE. SPINACIA OLERACEA. LEAVES.

Investigation was carried out to know whether serine can delay senescence and if it has any additive effect when applied in combination with kinetin (Kn) to leaf discs of



senescent spinach leaves. The selected concentrations of serine and kinetin were 5 mM and 0.38 mM respectively and experiment was conducted under either 8 mmol photon m<sup>-2</sup> S-l or in dark for 6 days. The amount of protein along with pigments declined with time in untreated leaf discs and serine alone and in combination with Kn inhibited the degradation by controlling protease activity in light and dark. Progress of leaf disc senescence was characterized by an increase in total free amino acids; the increment was much greater in dark than in light. Protein bound amino acid content was also declined in control. However, serine individually and in presence of Kn brought down the accumulation of free amino acids and helped to retain bound amino acids significantly. This study reveals additive effect of serine with kinetin in delaying leaf senescence.

362. Mishra, S.N.; Mahrashi Dayanand University, Rohtak (India). Dept. of Biosciences). Lakra, N.; Mahrashi Dayanand University, Rohtak (India). Dept. of Biosciences). Tomar, P.C.; Mahrashi Dayanand University, Rohtak (India). Dept. of Biosciences). Makkar, K.; Mahrashi Dayanand University, Rohtak (India). Dept. of Biosciences). Rajam, M.V.; University of Delhi, Delhi (India). Dept. of Genetics). Salinity stress mitigation in *B. juncea* by putrescine: a pleiotropic effect. *Indian Journal of Plant Physiology (India)*. (Jul - Sep 2009) v. 14(3) p. 239-249 KEYWORDS: SALINITY. BRASSICA JUNCEA. PROTEIN CONTENT. POLYAMINES. PROLINE.

The salt stress mitigation by putrescine (Put) was evaluated in terms of endogenous titre of polyamines, proline, Na<sup>+</sup>/K<sup>+</sup> and changing protein profile of leaf and root tissues of the *B. juncea* cv. RH-30 seedlings under salinity (70-175 mM NaCl). Put supplementation controlled the decline in endogenous level of Put and spermidine in salt stressed seedlings. The proline accumulation was considerably high in both tissues of the seedlings at 175 mM NaCl with supplementation of Put. The higher Na<sup>+</sup> content in root than leaf, increased further with seedling age and salinity level was reduced by Put. However, the salinity caused decline in K<sup>+</sup> content in both tissues did not respond with Put application. Put increased protein contents in stressed seedlings root and leaf tissues. The Put induction of some new proteins of 23, 26, 29 kDa in leaf and 22,23,40,41,80 kDa in root tissues of the 14day seedlings might be involved in stress mitigation. The Put induction of 26 kDa protein in leaf and root. Tissues of the seedlings exposed to 175 mM NaCl was observed. Hence, the restoration of diminishing endogenous polyamines level, selective decrease in Na<sup>+</sup> without changing in K<sup>+</sup> content in leaf as well as in root, increased level of proline and certain specific proteins by Put application might culminated into stress mitigation in the *B. juncea* RH-30, thereby increased seedling biomass. It is suggested that salinity stress mitigation potential of Put might be a pleiotropic effect.

363. Behera, K.K.; Utkal University, Bhubaneshwar (India). Post Graduate Dept. of Botany). Sahoo, S.; Utkal University, Bhubaneshwar (India). Post Graduate Dept. of Botany). Prusti, A.; Utkal University, Kuhrda (India). P.N. College (Autonomous)). Efficient in vitro micropropagation of greater yam (*Dioscorea alata* L. Cv. Hinjilicatu) through nodal vine explant. *Indian Journal of Plant Physiology (India)*. (Jul - Sept 2009) v. 14(3) p. 250-256 KEYWORDS: AUXINS. IN VITRO. MICROPROPAGATION. DIOSCOREA ALATA. YAMS.

Nodal vine segments from 45 days old plants of *Dioscorea alata* L. (cv. Hinjilicatu) were cultured on Murashige and Skoog's (MS) medium supplemented with different concentration and combinations of BAP and Kn along with NAA. Explants cultured in MS basal medium supplemented with 2.0 mg/l Kn +1.0 mg /l BAP + 0.5 mg/l NAA showed highest rate of shoot multiplication. When in vitro shoots were inoculated on to the half-strength MS basal media supplemented with 2.0 mg/l NAA and rooting was more profuse. Rooted shoots were transplanted in the green house for hardening and their survival was 90 % in the field condition without any morphological variation.

364. Singh, D.; Project Directorate for Farming Systems Research, Modipuram (India). Pandey, R.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Kumar, V.; Project Directorate for Farming Systems Research, Modipuram



(India). Effect of growth retardants on morpho-physiological parameters in cotton under irrigated conditions in cotton - wheat system. *Indian Journal of Plant Physiology (India)*. (Jul - Sept 2009) v. 14(3) p. 257-261 KEYWORDS: COTTON. YIELDS. LEAF AREA INDEX. WHEATS. GROWTH. IRRIGATION. PLANT ANATOMY. PLANT PHYSIOLOGY.

Growth retardant spray (pix and cycocel 50 and 100 ppm) on two cotton genotypes reduced the vegetative growth leaf area (20-25 %) and plant height (9-17 %) whereas it increased the reproductive growth i.e. boll weight (5-16%), harvest index (8-12%) and seed-cotton yield (4-9%). The net returns of cotton-wheat system increased by 6%. Two sprays at 90 and 120 DAS in cotton reduced the vegetative growth, yield attributes and seed-cotton yield resulting in less net returns (12% reduction) as compared to one spray. Seed-cotton yield, boll weight and harvest index of LHH 144 were significantly higher (4.5%, 15.8% and 17%, respectively) as compared to F 1861. Growth retardants increased the specific leaf weight (70-80%) resulting in higher leaf chlorophyll content (29-69%). This led to higher photosynthesis (20-22 %), photosynthetic radiation use efficiency (22 %) and photosynthetic water use efficiency (15.32 %). It is revealed that application of pix (50 ppm) in cotton at 90 DAS is useful in controlling excessive vegetative growth and enhancing the yield of cotton under irrigated conditions.

365. Ali, S.; Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Srinagar (India). Div. of Floriculture). Khan, F.U.; Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Srinagar (India). Div. of Floriculture). Siddique, M.A.A.; Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Srinagar (India). Div. of Floriculture). Khan, F.A.; Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Srinagar (India). Div. of Post Harvest Technology). Wani, S.A.; Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Srinagar (India). Div. of Floriculture). Effect of pulsing treatments of petal turgidity, membrane integrity and flower quality of cut daffodil. *Indian Journal of Plant Physiology (India)*. (Jul - Sept 2009) v. 14(3) p. 262-266 KEYWORDS: SUCROSE. TREATMENT DATE. NARCISSUS. KEEPING QUALITY.

Effect of different pulsing treatments on physiological behaviour and quality of cut daffodil was studied. Uniform scapes of daffodil at goose-neck stage were pulsed in 11 different pulsing solutions for 2, 3 and 6 hours duration. Pulsing treatments comprised of sucrose 6% alone and in combination with different levels of aluminium sulphate (25, 50 and 75 mg VI), sodium benzoate (30, 60 and 90 mg VI) and ascorbic acid (20, 40 and 60 mg VI). Distilled water without any chemical served as control. After pulsing scapes were transferred into other vases containing distilled water for assessment of their various post harvest attributes. Results indicate that pulsing of daffodil scapes in sucrose (6%) helped in improving the flower turgidity, membrane integrity and vase life as compared to control. Increased pulsing duration positively improve these parameters. Addition of different biocides further improves these parameters with best results in aluminium sulphate, followed by ascorbic acid and sodium benzoate.

366. Nema, J.; Jawaharlal Nehru Agricultural University, Jabalpur (India). Biofertilizer Production Center). Mitra, N.G.; Jawaharlal Nehru Agricultural University, Jabalpur (India). Biofertilizer Production Center). Shrivastava, S.K.; Government Engineering College, Jabalpur (India). Dept. of Applied Chemistry). Production of yield and acemannan in Aloe plants under pedo-ecological stresses. *Indian Journal of Plant Physiology (India)*. (Jul - Sept 2009) v. 14(3) p. 267-277 KEYWORDS: ALOE. ALOE BARBADENSIS. YIELDS.

Two Species Aloe barbedensis and Aloe ferox were cultivated under different irrigation and salinity stress conditions in order to evaluate the yield attributes along with the content of acemannan. The experiment was laid in factorial randomized block design with three replications under pot culture study. The results suggested that high salinity stress alongwith moderate moisture stress condition of the soil were favorable for better growth and yield parameters of Aloe plants. Leaf weight, gel fillet percent, gel percent and acemannan content in both the Aloe species increased under these soil

stress conditions. Various levels of salinity and moisture, individually effected the yield parameters. However, at every situation, *Aloe ferox* gave better performance relative to that of *Aloe vera*.

367. Naeem, M.; Aligarh Muslim University, Aligarh (India). Dept. of Botany). Masroor, M.; Aligarh Muslim University, Aligarh (India). Dept. of Botany). Khan, A.; Aligarh Muslim University, Aligarh (India). Dept. of Botany). Mohammad, F.; Aligarh Muslim University, Aligarh (India). Dept. of Botany). Augmenting photosynthesis enzyme activities, nutrient content, yield and quality of *seena sophera* (*Cassia sophera* L.) by P fertilization. *Indian Journal of Plant Physiology* (India). (Jul - Sept 2009) v. 14(3) p. 278-282 KEYWORDS: NUTRIENTS. CASSIA SENNA. PHOTOSYNTHESIS. ENZYME ACTIVITY.

In 3, pot experiment, the performance of *senna sophera* (a medicinal herb) was studied under five basal levels of phosphorus (0, 25, 50, 75 and 100 mg P kg<sup>-1</sup> soil). Physiological parameters were studied at 120, 150, 180 and 210 days after sowing (DAS). Application of 75 mg P kg<sup>-1</sup> soil treatment was the most beneficial and gave 20.4% higher photosynthetic rate at 150 DAS, 16.7% higher carbonic anhydrase activity and 15.6% higher nitrate reductase activity at 120 DAS, and 24.5% higher seed yield and 13.6 % higher seed protein content at 210 DAS than the control (no phosphorus).

368. Kaur, J.; Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding Genetics). Kaur, J.; Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding Genetics). Sharma, S.; Punjab Agricultural University, Ludhiana (India). Dept. of Botany). Effect of Plant growth regulators and pinching on biochemical changes and productivity of *safed musli*. *Indian Journal of Plant Physiology* (India). (Jul - Sept 2009) v. 14(3) p. 283-289 KEYWORDS: PRUNING. PRODUCTIVITY. PLANT GROWTH SUBSTANCES. BIOCHEMISTRY.

The biochemical changes and productivity of *Chlorophytum* (*safed musli*) were studied by the use of PGRs and pinching of inflorescence. The experiment was planned in split plot design. Treatments in main plot consist of sowing of one, two and three roots per hill. The treatments in sub plots were control, manual pinching of inflorescence (soon after its emergence), exogenous application of NAA 50 and 100 Jig ml<sup>-1</sup> and ethrel 250 and 500 Jig ml<sup>-1</sup> at 30 and 40 days after sowing (DAS). During growth period (40 and 70 DAS) photosynthetic efficiency in terms of total chlorophyll content and Hill reaction activity was found to be maximum in sowing of three roots per hill and pinched plants followed by the foliar application of NAA 100 Jig ml<sup>-1</sup>. Total soluble sugars, total soluble proteins and saponin content were maximum with three roots per hill and NAA 100 Jig ml<sup>-1</sup>. Sowing of one root per hill and ethrel treated plants showed minimum change in photosynthetic efficiency and biochemical parameters.

369. Shekhawat, K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Shivay, Y.S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Effect of nitrogen sources sulphur and boron on growth parameters and productivity of spring sunflower. *Indian Journal of Plant Physiology* (India). (Jul - Sept 2009) v. 14(3) p. 290-298 KEYWORDS: HELIANTHUS ANNUUS. SULPHUR. GROWTH. BORON. NITROGEN. PRODUCTIVITY.

A field experiment was conducted during spring seasons of 2005 and 2006 on a sandy loam soil at the research farm of the Division of Agronomy, Indian Agricultural Research Institute, New Delhi to study the effect of different nitrogen sources, sulphur and boron on growth, physiological parameters and productivity of spring sunflower (*Helianthus annuus* L.). The effect of the two sources of nitrogen, i.e. prilled urea (PU) and calcium ammonium nitrate (CAN) on various growth parameters of spring sunflower like leaf area index (LAI), crop growth rate (CGR), relative growth rate (RGR) and net assimilation ratio (NAR) were remained statistically on par with each other. However, the application of higher doses of sulphur (50 kg sulphur/ha) and boron (1.5 kg boron/ha) enhanced significantly all the growth parameters. LAI increased substantially between 50-75 days after sowing (DAS) and the highest values were recorded at 75 DAS. Application of the nutrients increased the dry matter accumulation of the crop plant and

hence, other growth indices like CGR, RGR and NAR also increased significantly. The crop achieved the highest CGR in between 50-75 DAS while the RGR and NAR values were recorded higher at the initial crop growth stages and declined thereafter. The highest seed yield (2 011.9 & 2 001.9 kg/ha in 2005 and 2006 respectively) and total biological yield (4 207.1 & 4 177.4 kg/ha in 2005 and 2006, respectively) were obtained with application of 1.5 kg B/ha, S application also showed a significant effect on seed and biological yields. Harvest index (HI) was not influenced significantly due to above fertilization.

370. Joshi, R.; Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Plant Physiology). Shukla, A.; Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Plant Physiology). Kumar, P.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). In vitro flowering in hill maize : a novel technique for future. Indian Journal of Plant Physiology (India). (Jul - Sept 2009) v. 14(3) p. 299-302 KEYWORDS: MAIZE. IN VITRO. ZEA MAYS.

In vitro flowering through shoot tip culture was analyzed in four maize genotypes, viz. Vivek-4, Vivek-5, VL-42 & Him-129. Plants were regenerated from first nodal region of shoot tip in MS medium supplemented with 2 mg/l BAP and 500 mg/l casein hydrolysate. Multiple shoot formation was observed in all these varieties. After six week (42 days) of culture miniature cobs were developed only in three genotypes, i.e. Vivek-5, VL-42 and Him-129, under 16 hr photoperiod and 150  $\mu\text{mol m}^{-2} \text{sec}^{-1}$  light intensity at  $25 \pm 2^\circ\text{C}$ . In vitro flowering may be used as an effective tool for advancing hybrid production aimed to study the physiological and molecular aspects of flowering in maize.

371. Pandey, N.; University of Lucknow, Lucknow (India). Dept. of Botany). Archana; University of Lucknow, Lucknow (India). Dept. of Botany). Boron-stress induced changes in water status and stomatal morphology in Zea mays L. and Catharanthus roseus L.. Indian Journal of Plant Physiology (India). (Jul - Sept 2009) v. 14(3) p. 310-314 KEYWORDS: DROUGHT STRESS. BORON. ZEA MAYS. TOXICITY. CATHARANTHUS ROSEUS. TRANSPIRATION.

Boron-stress induced changes in water status and stomatal morphology were studied in maize (Zea mays L. var. 32-A09J) and periwinkle (Catharanthus roseus L. var. Nirmal) plants. Compared to boron sufficient plants (0.33 mg B l<sup>-1</sup> supply), boron deficient (0.033 mg B l<sup>-1</sup> supply) and toxic (3.3 mg B P supply) plants showed accumulation of proline. The leaf water status measured as specific and relative water content was significantly increased with decreased water potential (II) in both crops under boron deficiency as well as toxicity. At deficient and toxic supply of boron, both plants showed reduced stomatal size and increase in stomatal index. Stomatal opening was also affected under boron deficiency and toxicity, more so in former in both plants.

372. Anuradha, M.; Central Tobacco Research Institute, Rajamundry (India). Rao, K.N.; Central Tobacco Research Institute, Rajamundry (India). Sivaraju, K.; Central Tobacco Research Institute, Rajamundry (India). Krishnamurthy, V.; Central Tobacco Research Institute, Rajamundry (India). Effect of boron stress on growth, soluble protein and enzyme activities in flue-cured tobacco. Indian Journal of Plant Physiology (India). (Jul - Sept 2009) v. 14(3) p. 315-318 KEYWORDS: TOBACCO. BORON. ENZYME ACTIVITY. GROWTH. PROTEINS.

Sand culture experiment was conducted using Hoagland solution to study the effect of deficient and excess levels of boron (B) on the growth, protein pattern and enzyme activities in flue cured tobacco (Nicotiana tabacum L). Boron deficiency resulted in stunted growth, drastic reduction in internodal length and progressive death of shoot apex followed by the growth of lateral shoots. The lateral shoots were also deformed and died subsequently. The leaves of boron deficient plants were thick and brittle. The boron content of the leaf lamina of the deficient plants ranged from 6 to 16 ppm. The plants supplied with excess of boron showed yellowing of leaf tips followed by progressive necrosis. Necrotic symptoms spread progressively towards the leaf margins and midrib.

When the symptoms were severe, the bottom leaves dropped prematurely. The boron content of the leaves showing severe symptoms of toxicity was 1950 ppm. Leaf soluble protein content decreased in both deficient and excess levels of boron. The activity of ascorbate peroxidase, polyphenol oxidase and phenylalanine ammonia lyase increased by 29, 18 and 14% respectively, in B deficiency whereas, the activity of acid phosphatase decreased by 33%. In excess boron, the activity of peroxidase and acid phosphatase increased.

373. Arun Kumar, A.N.; Institute of Wood Science and Technology, Bangalore (India). Natarajan, K.N.; University of Agricultural Sciences, Bangalore (India). Dept. of Crop Physiology). Joshi, G.; Institute of Wood Science and Technology, Bangalore (India). Rathore, T.S.; Institute of Wood Science and Technology, Bangalore (India). Variation in photosynthesis, transpiration and instantaneous water use efficiency in the clones of sandalwood (*Santalum album* L.). Indian Journal of Plant Physiology (India). (Oct-Dec 2009) v. 14(4) p. 328-335 KEYWORDS: TRANSPIRATION. SANTALUM ALBUM. PHOTOSYNTHESIS. SANTALUM. EFFICIENCY. WATER USE.

Variability in single leaf photosynthesis and related gas exchange parameters were studied on 37 clones of sandalwood (*Santalum album* L.). One-year-old grafts of each clone were grown under controlled conditions and gas exchange measurements were recorded using portable photosynthesis system under saturated light intensities and ambient CO<sub>2</sub> concentrations. Significant variations in single leaf photosynthesis (P<sub>n</sub>), stomatal conductance (g<sub>s</sub>), intercellular CO<sub>2</sub> concentration (C<sub>i</sub>), transpiration rate (Tr) has been observed among the clones studied. Instantaneous water use efficiency (WUE) calculated as P<sub>n</sub>/g<sub>s</sub> and carboxylation efficiency (CE) estimated by P<sub>n</sub>/C<sub>i</sub> also showed significant variation. Biochemical parameters such as total chlorophyll and buffer soluble protein differed significantly. Correlation studies showed linear positive relationship between P<sub>n</sub> and g<sub>s</sub> (r=0.80) suggesting that photosynthesis is controlled more by stomatal factors. Cluster analysis revealed that the clones did not cluster on the basis of their geographic locations.

374. Gupta, N.C.; Indian Agricultural Research Institute, New Delhi (India). Div. of Biochemistry). Sinha, S.K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Biochemistry). Jolly, M.; Indian Agricultural Research Institute, New Delhi (India). Div. of Biochemistry). Sachdev, A.; Indian Agricultural Research Institute, New Delhi (India). Div. of Biochemistry). Antisense RNA-mediated inhibition of GAMFAD2-1 encoding omega-6-desaturase. Indian Journal of Plant Physiology (India). (Oct-Dec 2009) v. 14(4) p. 336-343 KEYWORDS: ARABIDOPSIS. RNA. INHIBITION. GENE EXPRESSION.

Antisense RNA-mediated inhibition of gene expression is a valuable tool to metabolically engineer the composition of oilseeds to improve their nutritional value and provide the functional properties required for various purposes. To improve the efficiency of fad 2-1 inhibition and to selectively suppress it in developing seeds of soybean an antisense construct was designed in two stages. In the first stage, the PCR amplified conserved fad 2-1 gene sequence was cloned in the antisense orientation with respect to seed-specific (vicilin) promoter derived from pCW66 vector. In the second stage, the chimeric cassette was inserted in a plant transforming vector carrying "bar" gene and kanamycin resistance gene for plant selection. Efficacy of the chimeric construct was checked in the model plant *Arabidopsis thaliana*.

375. Sha Valli Khan, P.S.; Yogi Vemana University, Kadapa (India). Dept. of Botany). Devi, H.S.; Institute of Bioresource and Sustainable Development, Imphal (India). Medicinal Plants and Horticultural Resources Div.). Kishor, R.K.; Institute of Bioresource and Sustainable Development, Imphal (India). Medicinal Plants and Horticultural Resources Div.). Rao, B.N.; Indian Council of Agricultural Research Research Complex for North Eastern Hill Region, Imphal (India). Micropropagation and some acclimatization characteristics of *Centella asiatica* (Linn.) urban. Indian Journal of Plant



Physiology (India). (Oct-Dec 2009) v. 14(4) p. 353-359 KEYWORDS: MICROPROPAGATION. STOMATA. ADAPTATION. ADAPTATION. EVAPORATION.

The present study was focussed on micropropagation of *Centella asiatica*, its stomatal characteristics and percent water loss of in vitro grown leaves at culture establishment (CE), shoot multiplication (SM) and rooting (RT) stages in relation to acclimatization (AC) and field (FD) grown plants. Microscopic observations on the abaxial and adaxial leaf surfaces of AC and FD-grown plants showed elliptical stomata (length of 11-13  $\mu\text{m}$ ) with narrow apertures (2-4  $\mu\text{m}$  pore width). In comparison, the stomata of leaves for in vitro cultured shoots and plantlets showed circular stomata (diameter of 13-15  $\mu\text{m}$ ) with widely opened apertures (6-7  $\mu\text{m}$  pore width). Stomata on the either of leaf surfaces were not found to vary with respect to morphology especially shape and sizes. Abaxial leaf surface imprints have lowest stomatal index (SI) values when compared to adaxial leaf surface imprints. Leaves of CE, SM and RT had higher SI as compared to leaves of AC and FD. The percent moisture loss of in vitro leaves of CE, SM and RT was considerably greater than that of leaves of AC and FD. This holds true at each of 30, 60, 90 and 120 min interval of air-drying. The present study followed a simple acclimatization method to transfer rooted shoots from culture vessels to growth chamber under high humidity. Despite having stomata on both sides of the leaf, about 90 % of the in vitro grown *C. asiatica* plantlets recovered from transpiration stress after 4-weeks of acclimatization. Reproducible micropropagation protocols with higher rates of survival are beneficial for the cost-effective production of medicinally important herbs like *C. asiatica* through saving resources in terms of time, labor and money.

376. Sharma, P.; Punjab Agricultural University, Ludhiana (India). Dept. of Botany). Malik, C.P.; Punjab Agricultural University, Ludhiana (India). Dept. of Botany). Hormonal regulation of fibre elongation and the enzymic hydrolysis of abscisic acid conjugate in developing cotton (*Gossypium arboreum* L.) fibres. Indian Journal of Plant Physiology (India). (Oct-Dec 2009) v. 14(4) p. 360-363 KEYWORDS: GOSSYPIUM ARBOREUM. OVULE CULTURE. ABA.

Changes in endogenous levels of IAA, GA3 and ABA during in vivo fibre growth of *Gossypium arboreum* L. cv. LD 327 showed an overriding influence of ABA in limiting the rate of fibre elongation. The fiber growth of unfertilized cotton ovules cultured in vitro was elevated by the application of Fluridone markedly decreased the ABA level concomitant with an increase in the levels of promoter (IAA, GA3) in cultured ovules. The enzymic hydrolysis of the  $\beta$ -D-glucopyranosyl ester of ABA by glucosidases and esterase were studied in fibres at 15 and 35 days after anthesis. Since, the activity levels of two hydrolase did not correlate with the ABA contents at two stages of fibre growth, it is suggested that the high content of free ABA at 15 DAA was not a consequence of the increased activity of the ABA-Glc splitting enzymes. Our data suggest that ABA conjugate is final product of the AE metabolism under different stages of fibre growth.

377. Prakash, P.; Banaras Hindu University, Varanasi (India). Dept. of Plant Physiology). Kumari, A.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Singh, D.V.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Pandey, R.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Sharma, P. Natu; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Ghildiyal, M.C.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Starch synthase activity and grain growth in wheat cultivars under elevated temperature : a comparison of responses. Indian Journal of Plant Physiology (India). (Oct-Dec 2009) v. 14(4) p. 364-369 KEYWORDS: WHEATS. STARCH. TOLERANCE. GRAIN. GROWTH. TEMPERATURE.

Wheat (*Triticum aestivum* L.) cvs. HD 2285 and C 306 (relatively tolerant) and HD 2329 and 2428 (susceptible type) were exposed during grain development period to 5-7°C higher temperature in a normal glasshouse and 8°C higher than control in temperature control glasshouse of phytotron facility. There was more severe depression in grain growth, under elevated temperature in phytotron experiment and was



associated with greater decrease in the activity of soluble starch synthase (SSS) in the grains. Furthermore, relatively tolerant cultivars showed less decrease compared to susceptible cultivars in grain growth and also showed less decrease in SSS activity. Such parallelism in the effect of elevated temperature on grain growth and SSS activity and relatively tolerant cultivars showing less depression, further suggests that soluble starch synthase is the key component imparting sensitivity to high temperature for grain growth in wheat. The study suggested that thermotolerance for grain growth in wheat could possibly be improved through incorporation of thermostable form of this enzyme.

378. Bhatt, R.M.; Indian Institute of Horticultural Research, Bangalore (India). Div. of Plant Physiology and Biochemistry). Rao, N.K.S.; Indian Institute of Horticultural Research, Bangalore (India). Div. of Plant Physiology and Biochemistry). Upreti, K.K.; Indian Institute of Horticultural Research, Bangalore (India). Div. of Plant Physiology and Biochemistry). Shobha, H.S.; Indian Institute of Horticultural Research, Bangalore (India). Div. of Plant Physiology and Biochemistry). Floral abscission and changes in sucrose phosphate synthase and invertase activities in water deficient tomato. Indian Journal of Plant Physiology (India). (Oct-Dec 2009) v. 14(4) p. 370-376 KEYWORDS: TOMATOES. SUCROSE. PHOTOSYNTHESIS. FRUCTOFURANOSIDASE.

A study was conducted to determine the photosynthesis, sucrose phosphate synthase and invertase activities in four tomato (*Lycopersicon esculentum* Mill) cultivars, e.g. Mruthyunjaya, Pusa early dwarf (PED), Arka Ahuthi and Pusa Ruby exhibiting differential response in floral abscission under water stress. Among the four cultivars, Arka Ahuthi and Pusa Ruby were found to be more susceptible to abscission under water stress as indicated by more than 55.0% abscission of flower buds and flowers. In these cultivars. Water stress caused a substantial decrease in photosynthesis in all the cultivars, although the degree of decrease varied with cultivars. In the cultivars where the abscission of flowers and flower buds was more (Arka Ahuthi and Pusa Ruby), the reduction in photosynthesis was more (53-61.5%) compared to the cultivars where the abscission was relatively less (Mruthyunjaya and PED) (39.0-53.0%) during stress. There was a considerable decrease in SPS activity during stress in susceptible cultivars. In susceptible cultivars, the invertase activity in reproductive organs as well as leaf and developing young fruits decreased under stress. The decrease in photosynthesis along with a reduction in invertase activity may be important contributing factors for the abscission of flower and flower buds in abscission susceptible tomato cultivars under water stress.

379. Khetarpal, S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Pal, M.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Lata, S.; MMH College, Ghaziabad (India). Effect of elevated temperature on growth and physiological characteristics in chickpea cultivars. Indian Journal of Plant Physiology (India). (Oct-Dec 2009) v. 14(4) p. 377-383 KEYWORDS: GROWTH. PHOTOSYNTHESIS. YIELDS. CHICKPEAS.

A study was conducted to investigate the effect of rising temperature on growth and physiological characteristics in chickpea genotypes. Plants of Pusa 1108 and Pusa 1053 (both kabuli type) were raised in earthenware pots under natural environment. One set of plants was raised in a poly cover and exposed to high temperature (3.1°C above ambient) through out the growth period. Similarly, two sets of plants were exposed to high temperature at flowering and podding for short duration of ten days only. Plants of both the cultivars grown at high temperature through out the growth period exhibited enhanced vegetative growth in terms of increased shoot length, production of more number of branches, leaf area and dry weight accumulation per plant. Rate of photosynthesis increased, stomatal conductance decreased but membrane stability and proline concentration was higher in plants of both cultivars under high temperature but no significant changes were observed in relative water content and total sugars. Yield attributes like pod and seed weight and plant biomass of these plants was less than the plants exposed to high temperature for short duration only at flowering and podding stages. These findings suggest that 3.1°C increase in growth temperature may enhance

vegetative growth and photosynthesis in chickpea but may not influence the plant yield. On the other hand, short terms exposure of higher temperature at flowering or podding may have positive influence on yield of chickpea cultivars in timely sown crop under Delhi conditions.

380. Sivaprakasam, G.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Singh, V.P.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Arora, A.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Physiological and molecular analysis of effect of spermine on senescing petals of gladiolus. Indian Journal of Plant Physiology (India). (Oct-Dec 2009) v. 14(4) p. 384-391 KEYWORDS: SPERMINE. GLADIOLUS. GENE EXPRESSION.

Convincing evidences suggest the involvement of polyamines in the process of senescence. In order to unravel the mechanism underlying polyamines (spermine) regulated senescence in gladiolus, the present study was undertaken. Spermine at 5pM delayed flower senescence in ethylene-insensitive gladiolus by three days, along with increased fresh weight which was retained for longer period and increased vase solution uptake as compared to control. Activities of total SOD as well as that of its copper/zinc and iron isoforms were significantly enhanced by spermine. Qualitative analysis revealed. one Fe SOD and two Cu/Zn isozymes, Cu/Zn SOD1 and Cu/Zn SOD2. Cu/Zn SOD1 appeared to be constitutively expressed but at a higher level than Cu/Zn SOD 2, though the later is more responsive to spermine treatment. Spermine reduced the expression of GgCYP while up regulating GgSOD. Spermine is thus effective in delaying senescence. It increased the activity of all the isoforms of SOD thereby, reducing oxidative stress and prolonging the vase life. Spermine affected gene expression of GgCYP and GgSOD without any impact on GgERS1a, while slightly affecting the expression of GgERS1b. The differential impact of spermine is related to the differential role of these genes in senescence.

381. Singh, S.K.; Indian Agricultural Research Institute, New Delhi (India). Di v. of Fruits and Horticultural Technology). Singh, S.K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Fruits and Horticultural Technology). Sharma, R.R.; Indian Agricultural Research Institute, New Delhi (India). Div. of Fruits and Horticultural Technology). Endogenous phytohormones after pruning in three mango cultivars planted under high density. Indian Journal of Plant Physiology (India). (Oct-Dec 2009) v. 14(4) p. 392-396 KEYWORDS: MANGOES. PRUNING. ABA. SPACING.

In both biennial and regular bearing mango cultivars, there was significant effect of pruning on the level of endogenous hormones in shoot buds. The higher IAA, ABA and lower GAs were found in 'on' year of mango shoots. The IAA was highest in Mallika (4.57, 4.62 flg g-l fw) while highest ABA (0.52, 0.55 flg g-l fw) and lowest IAA (0.297, 0.310 flg g-l fw) were recorded in Amrapali. Shoot-tip pruning removes the source of apical dominance and stimulate axillary bud development. Moderately pruned trees did show highest IAA and moderately pruned Mallika had the highest (4.63, 4.70 ug g-1fw) while lowest was in un-pruned Amrapali trees. The lowest ABA (0.14, 0.09 flg g-l fw) and highest GA like substances (1.36, 1.31 flg g-l fw) were found in the buds of Dashehari while lowest level of GA-like substances (0.78, 0.75 flg g-l fw) were estimated in Amrapali. The control trees had the lowest IAA and the highest GA-like substances while lowest level of GA-like substances was in moderately pruned trees. The un-pruned Dashehari trees had the highest GA-like substances while lowest was found in light pruned Mallika. Light pruned Amrapali showed higher ABA while the lowest was estimated in moderately pruned Dashehari.

382. Mathad, P.; Gulberga University, Gulberga (India). Dept. of Post Graduate Studies and Research in Botany). Pratima, H.; Gulberga University, Gulberga (India). Dept. of Post Graduate Studies and Research in Botany). Copper toxicity causes oxidative stress in Brassica juncea L. seedlings. Indian Journal of Plant Physiology (India). (Oct-Dec

2009) v. 14(4) p. 397-401 KEYWORDS: BRASSICA JUNCEA. COPPER. TOXICITY. OXIDATION. STRESS.

A relationship between Cu<sup>2+</sup> ion toxicity and oxidative stress was investigated in *Brassica juncea* L. seedlings by treating with different concentrations of copper (0.2, 0.4, 0.6 and 0.8 mM). A uniform decrease in germination, biomass, root and shoot elongation with increasing concentrations marked as the primary signs of copper injury. Seed germination was completely inhibited at 0.8 mM copper. An increasing concentration of copper treatment showed an uniform decrease in chlorophylls and  $\alpha$ -carotene composition with a significant accumulation of free proline suggesting an osmoprotection from copper. Copper stress resulted, an increase in lipid peroxidation with increasing copper concentrations. The increase in total peroxide content was accompanied by a decrease in catalase (CAT) and superoxide dismutase (SOD) activity at 0.4 and 0.6 mM copper. However, peroxidase (POX) and glutathione reductase (GR) activities increased with increasing copper concentrations. The glutathione, ascorbate and polyphenol contents showed a decrease at a higher metal concentration. These results suggested an induction of oxidative stress in *Brassica juncea* L. seedlings under copper toxicity.

383. Kalita, P.; Assam Agricultural University, Jorhat (India). Dept. of Crop Physiology). Kalita, R.; Assam Agricultural University, Jorhat (India). Dept. of Crop Physiology). Das, R.; Assam Agricultural University, Jorhat (India). Dept. of Crop Physiology). Morpho-physiological characterization of some wheat genotypes under rainfed condition. *Indian Journal of Plant Physiology* (India). (Oct-Dec 2009) v. 14(4) p. 402-406 KEYWORDS: WHEATS. GENOTYPES. DRY MATTER CONTENT. YIELDS. LEAF AREA INDEX. NITRITE REDUCTASE.

A study was conducted to characterize the morpho-physiological traits of seven genotypes of wheat, viz. Sonalika, HDR-77, PBW-343, PBW-154, Raj-3077, C-306 and K-8027 under rain fed condition. Sonalika, HDR-77 and C-306 are recommended for Assam. Genotypes were found to show significant variation for all the studied traits. Highest leaf area per plant was recorded in PBW-154 followed by Sonalika, whereas, highest specific weight of flag leaf (SL W) was observed in C-306 followed by PBW-343, HDR-77 and Sonalika. Genotype K-8027 registered the highest values of relative leaf water content (RL WC). Highest in-vivo nitrate reductase activity in the leaves was observed in C-306 followed by Sonalika and HDR-77. At maximum tillering stage, highest total leaf chlorophyll content was found in PBW-343, but at ear emergence, C-306 contained highest amount of total leaf chlorophyll. Genotype C-306 was found to accumulate highest total plant biomass and grain biomass followed by PBW-343, however, in terms of harvest index (HI) C-306 was superior followed by Raj-3077 and HDR-77. The study showed that cv. PBW-343 is a promising genotype from physiological and yield point of view next to C-306 for the rainfed condition of Assam.

384. Singh, S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Environmental Sciences). Variation in physiological traits for thermotolerance in wheat. *Indian Journal of Plant Physiology* (India). (Oct-Dec 2009) v. 14(4) p. 407-412 KEYWORDS: TRITICUM AESTIVUM. WHEATS. HARVEST INDEX. HEAT STRESS. YIELDS.

The wheat cultivars grown under elevated temperature of 3.5°C showed significant increase in average leaf area (LA), leaf area per shoot, leaf weight ratio (LWR) and leaf length, whereas it reduced the specific leaf weight (SL W), leaf width, plant height, total dry weight and days to flowering and maturity of wheat cultivars. The mean grain yield declined by 36 % under warmer condition, which was attributed to maximum reduction in biological yield (35%) followed by grain growth rate per spike (24%), number grains/spike (20%), number of spikes/pot (12%), 1000 grain weight (4%) and harvest index. The biological and economic yields of wheat were reduced at the rate of about 10% per °C increase in temperature. Amongst the cultivars, C 306, K 68, Kundan, HD 2329 and HD 2687 manifested higher productivity under warmer condition. High temperature also increased nitrogen content both in leaf and stem at flowering and maturity as well. However, the content of total sugar reduced drastically in shoots both

at flowering and maturity stages. The starch content, however, increased markedly in leaf both at flowering and maturity.

385. Singh, N.B.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Crop Physiology). Kumar, V.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Crop Physiology). Singh, G.S.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Crop Physiology). Singh, Y.P.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Crop Physiology). Singh, I.J.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Crop Physiology). Kumar, J.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Crop Physiology). Singh, K.N.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Crop Physiology). Srivastava, J.K.; Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Crop Physiology). Variability in response to zinc application in wheat genotypes. Indian Journal of Plant Physiology (India). (Oct-Dec 2009) v. 14(4) p. 413-417 KEYWORDS: WHEATS. GENOTYPES. ZINC. YIELDS. CHLOROPHYLLS.

Field experiments were conducted during two consecutive rabi seasons at experimental research farm of C.S. Azad University of Agriculture & Technology, Kanpur to find out the physiological variability and yield under rice-wheat cropping system. Results revealed a significant differential response of wheat genotypes in term of specific flag leaf weight, total chlorophyll, zinc content in leaf, yield and its determining attributes at different levels of zinc application under rice -wheat cropping system. Genotypes namely PBW 343 and K9162 were found to be more responsive as compared to other genotypes both at high and low levels of zinc under rice-wheat cropping system where soil is abnormally deficient in zinc. Further yield gain in PBW343 and K9162 was about 6.0% more over control and hence !these genotypes could be selected as a most efficient cultivars for successful cultivation under zinc deficient soil.

386. Mahatma, M.K.; Navasari Agricultural University, Navsari (India). Dept. of Biotechnology). Khandelwal, V.; Navasari Agricultural University, Navsari (India). Dept. of Biotechnology). Jha, S.K.; Navasari Agricultural University, Navsari (India). Dept. of Biotechnology). Kumar, V.; Navasari Agricultural University, Navsari (India). Dept. of Biotechnology). Shah, R.R.; Navasari Agricultural University, Navsari (India). Dept. of Biotechnology). Genetic diversity analysis of elite parental lines of cotton using RAPD, ISSR and isozyme markers. Indian Journal of Plant Physiology (India). (Apr-Jun 2009) v. 14(2) p. 105-110 KEYWORDS: COTTON. GENETIC RESOURCES. ISOENZYMES. POLYMORPHISM. RAPD.

The genetic diversity and similarity were investigated in nine elite parental lines of cotton using 25 RAPD, 3 ISSR and 2 isozyme markers. Total 189 amplicons were generated using all 30 markers, of which 117 bands were found to be polymorphic. Highest polymorphism was seen with ISSR primers (66.66 %) while, it was least (42.85%) with the isozymes. Based on Jaccard's similarity coefficient, the similarity index was in the range of 0.11 to 1.00 among nine parental lines. The lowest similarity (11% ) was found among LRA-5166, GCot.10 and 76 IH-20. The dendrogram of cotton lines showed two major clusters. The Parental line LRA-5166 was found in one cluster and the rest eight parental lines were found in different sub-sub cluster of another cluster. The results suggested that the genetic constituents of LRA-5166 is quite different than other tested parental lines.

387. Ranjan, R.; T.P. Varma College, Narkatia Ganj (India). Dept. of Botany). Sime, G.; University of Hawassa, Hawassa (Ethopia). Dept. of Applied Biology). The possible role of oxidative stress and ABA in jasmonic acid mediated breakage of embryonic dormancy in apple. Indian Journal of Plant Physiology (India). (Apr-Jun 2009) v. 14(2) p. 111-115 KEYWORDS: APPLES. JASMONIC ACID. GERMINATION. ABA. OXIDATION. STRESS.

Embryos isolated from dormant seeds of apple were cultured in light in the presence of jasmonic acid (JA, 20 JIM) for 7 days in parallel to control non-treated ones. H2O2 and



ABA levels were quantified and antioxidant enzymes namely, superoxide dismutase (SOD), catalase (CAT) and glutathione reductase, (GR) activities were determined in the embryos during the culture. JA treatment stimulated the germination of embryos and activities of SOD, CAT and GR. JA treatment also increased the H<sub>2</sub>O<sub>2</sub> levels on day 1 of embryo culture. In contrast, JA inhibited the levels of ABA during the first 3 days of culture, after that increase in the levels of ABA was observed. Simultaneous increase in H<sub>2</sub>O<sub>2</sub> and a decrease in ABA levels were also observed during the culture. The results suggest the induction of oxidative stress by JA and a signalling role of JA in the breakage of embryonic dormancy is postulated.

388. Kawale, M.V.; RTM Nagpur University, Nagpur (India). Post Graduate Department of Botany). Choudhary, A.D.; RTM Nagpur University, Nagpur (India). Post Graduate Department of Botany). In vitro multiple shoot induction in *Trichosanthes cucumerina* L. Indian Journal of Plant Physiology (India). (Apr-Jun 2009) v. 14(2) p. 116-123  
KEYWORDS: TRICHOSANTHES CUCUMERINA. IN VITRO. REGENERATION.

An efficient, rapid and large scale in vitro multiplication protocol was developed for the medicinally potent climber *Trichosanthes cucumerina* L. of family Cucurbitaceae. Various factors like source of explant and its age, nutrition and hormonal supplement have been found to affect morphogenesis of *T. cucumerina*. 8 days old cotyledonary node without cotyledon was found to be most efficient explant in regard to multiple shooting. The highest regeneration frequency of 61.1 (20.3 shoots/explant) was found with White's media supplemented with 0.1mg/l kinetin and 2mg/l BAP. Although roots were induced on MS basal medium, but frequency was increased when supplemented with either IAA or IBA. Regenerated plants were successfully acclimatized and about 40% plantlets survived under ex vitro conditions. They flowered, fruited and were morphologically uniform and identical to donor plants.

389. Jain, S.C.; University of Rajasthan, Jaipur (India). Medicinal Plants and Biochemistry Lab., Dept. of Botany). Jain, R.; University of Rajasthan, Jaipur (India). Dept. of Chemistry). Singh, R.; University of Rajasthan, Jaipur (India). Medicinal Plants and Biochemistry Lab., Dept. of Botany). Antioxidant activity of mimosin isolated from in vitro regenerated plants of *Mimosa hamata* Willd.. Indian Journal of Plant Physiology (India). (Apr-Jun 2009) v. 14(2) p. 124-129  
KEYWORDS: MIMOSA. REGENERATION. IN VITRO. CHROMATOGRAPHY.

Plants are major source for the discovery of new products of medicinal value for drug development. Different strategies including use of in vitro system, have been extensively studied to improve the production of plant chemicals. The present study is focused on the application of tissue culture technology for the production of some important plant pharmaceuticals. Under this, biosynthetic potentialities of in vitro regenerated plants of *Mimosa hamata* Willd. on Murashige and Skoog's (MS) medium have been evaluated for their phytochemicals and antioxidant activity. Three mimosins A, B and C were isolated and identified on the basis of physical and spectral data from the n-butanol fraction of in vitro regenerated roots, using column chromatography. Similarly, in both in vivo and in vitro plant parts (root, stem and leaves) free radical scavenging activity was also studied using 2,2-diphenyl-1-picrylhydrazyl (DPPH) method and compared with standard antioxidants (quercetin and ascorbic acid). The extract of in vivo roots was found to be a good scavenger of DPPH radicals (RC<sub>50</sub> 5 J.1g1ml) as compared to in vitro root extract (RC<sub>50</sub> 9 J.1g1ml) comparable to the standards. It is evident from the results that *M. hamata* synthesizes useful bioactive metabolites and a potential source of natural antioxidant(s).

390. Bedi, S.; Punjab Agricultural University, Ludhiana (India). Dept. of Botany). Kaur, H.; Punjab Agricultural University, Ludhiana (India). Dept. of Botany). Gill, G.K.; Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding and Genetics). Effect of flooding stress on seedling growth and protein profile of roots in maize. Indian Journal of Plant Physiology (India). (Apr-Jun 2009) v. 14(2) p. 135-141  
KEYWORDS: SEEDLINGS. SEED SIZE. MAIZE. ZEA MAYS. FLOODING.



Seedlings of three maize (*Zea mays* L.) cultivars (Parbhat, Paras and Navjot) were exposed to flooding under laboratory conditions for 24h at 7, 14 and 21 days after emergence. Excess moisture stress adversely affected growth parameters such as root length, shoot length, leaf chlorophyll content, seedling fresh and dry weight. Electrophoretic studies of the root proteins indicated repression of some proteins due to flooding. Pre-treatment of seedlings with CoCl<sub>2</sub> (10 and 15mg mP) and KCl (1%) ameliorated the adverse effects of flooding and restored protein pattern to some extent.

391. Prakash, A.H.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn.). Gopalakrishnan, N.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn.). Induction of high frequency of somatic embryoids in Indian cotton Cv. Surabhi through temperature stress. *Indian Journal of Plant Physiology* (India). (Apr-Jun 2009) v. 14(2) p. 142-146 KEYWORDS: COTTON. TEMPERATURE.

An elite Indian cultivar of cotton (*Gossypium hirsutum* L.) Surabhi was tested for its embryogenic potential. Callus was induced from three explants viz. roots, cotyledons and hypocotyls on MS medium supplemented with auxins and cytokinins in different combinations. The hypocotyls were amenable to callus induction than roots or cotyledons. The ideal combination for callus induction was MS containing 0.5 NAA + 0.5 BA, 0.5 2, 4 D + 0.25/0.5 Kin and 0.5 2, 4-D + 0.25/ 0.5 BA. The friable callus was cultured on the same media combinations except that only KN03 was provided as nitrate source. The cultures were divided into two sets with one being maintained at optimum temperature (28f: 2°C) and other exposed to a higher temperature stress (33f: 2°C). Under controlled temperature, there was good callus production but no embryoids were formed even after forty day of culture. Irrespective of the hormonal combinations, the callus exposed to temperature stress of 33°C entered into embryogenesis. The callus maintained on 2,4-D as auxin source formed embryoids which were watery and turned brown with time. A combination of 0.5 NAA + 0.5 BA was found to be the best which lead to production of embryoids in eighty per cent of the cultures. However, when these embryoids were transferred to maturation medium devoid of hormones, they failed to germinate.

392. Ramawat, N.; Chaudhary Sarwan Kumar Himachal Pradesh Agricultural University, Palampur (India). Dept. of Agronomy). Sharma, H.L.; Chaudhary Sarwan Kumar Himachal Pradesh Agricultural University, Palampur (India). Dept. of Agronomy). Kumar, R.; Institute of Himalayan Bioresource Technology, Palampur (India). Nature Plant Products Div.). Simulating sowing date effect of barley varieties using CERES-barley model in North Western Himalayas. *Indian Journal of Plant Physiology* (India). (Apr-Jun 2009) v. 14(2) p. 147-155 KEYWORDS: BARLEY. SOWING DATE. YIELDS. PHENOLOGY. HIMALAYAN REGION.

CERES-Barley model was calibrated and validated for three varieties (Dolma, Sonu and HBL-113) of barley sown on four dates between October and December under optimal agronomic management conditions in north western Himalayas. Cultivar specific genotypic coefficients were developed for these varieties during calibration. The model successfully predicted phenological stages, yield attributes and grain yield, but failed to simulate straw yield, biomass and harvest index of barley. Significant association between simulated and observed grain yield were supported by the test of significance for intercept and slope of regression line ( $R^2=0.7204$ ). The model was validated with fair degree of accuracy for grain yield ( $R^2=0.7545$ ). Simulation guided management practices were worked out for these varieties under potential production and resource limiting situations.

393. Vikas, V.K.; Tamil Nadu Agricultural University, Coimbatore (India). Centre for Plant Breeding and Genetics). Satheesh, V.; Tamil Nadu Agricultural University, Coimbatore (India). Centre for Plant Breeding and Genetics). Subramanian, M.; Tamil Nadu Agricultural University, Coimbatore (India). Directorate of Research). Kalarani, M.; Tamil Nadu Agricultural University, Coimbatore (India). Dept. of Crop Physiology). Singh, V.P.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant

Physiology). Evaluation of rice hybrids and their parents for drought tolerance. Indian Journal of Plant Physiology (India). (Apr-Jun 2009) v. 14(2) p. 156-161 KEYWORDS: GENOTYPES. RICE. HYBRIDS. DROUGHT RESISTANCE.

A study was carried out to assess the drought tolerance ability of 39 rice genotypes (12 parents and 27 hybrids) using PEG-6000 induced moisture stress, on the basis of morphological, physiological, biochemical and histological parameters such as germination percentage, shoot length, root length, seedling dry weight, promptness index (PI), germination stress index (GSI), protein fraction and root anatomy. In vitro screening revealed that morphological and physiological characters were reduced significantly at -0.75MPa compared to control (0.00MPa). Among the genotypes, Nootripathu, Norungan, PMK 2, Norungan x PMK 2 and Nootripathu x PMK 2 performed better under stress in terms of morphological and physiological characters. SDS-PAGE analysis revealed prominent expression of 65 kDa and 78 kDa proteins in stressed parents, viz. Norungan, and Nootripathu and hybrids Norungan x PMK 2 and Nootripathu x PMK2. The expression was totally absent in PMK 2 stressed plants. These proteins could possibly be responsible for the development of water stress tolerance. Root anatomy of Norungan x PMK 2 and Nootripathu x PMK 2 grown under control and stress situation was studied. Increase in the number of xylem vessels of varying diameter, wider pith and compact cell arrangement was noticed in roots under stress.

394. Behera, K.K.; Utkal University, Bhubaneshwar (India). Post Graduate Dept. of Botany). Sahoo, S.; Utkal University, Bhubaneshwar (India). Post Graduate Dept. of Botany). An efficient method of micropropagation of ginger (*Zingiber officinale* Rosc. Cv. Suprava and Suruchi) through in vitro rhizome bud culture. Indian Journal of Plant Physiology (India). (Apr-Jun 2009) v. 14(2) p. 162-168 KEYWORDS: IN VITRO. MICROPROPAGATION. GINGER. TISSUE CULTURE. ZINGIBER OFFICINALE.

An efficient, simple micropropagation method was developed for *Zingiber officinale* Rose. (cv, Suprava and Suruchi) using fresh rhizome sprouting bud in semisolid culture media. Explants were cultured on Murashige and Skoog's (MS) medium supplemented with different concentrations and combinations of RAP (6-benzyl-amino-purine) and NAA (α-naphthalene acetic acid) for shoot and root induction. Explants cultured on MS basal medium supplemented with 2.0 mg/l RAP+0.5mg/l NAA showed highest rate of shoot multiplication. In vitro shoots were rooted on to the half strength MS basal medium supplemented with 2.0 mg/l NAA and rooting was better. Rooted shoots were transplanted in the green house for hardening and their survival was 95% in the field condition.

395. Pandey, S.K.; Banaras Hindu University, Varanasi (India). Dept. of Plant Physiology). Srivastava, J.P.; Banaras Hindu University, Varanasi (India). Dept. of Plant Physiology). Variability in senescence pattern and membrane stability in wheat genotypes under normal and late sown conditions. Indian Journal of Plant Physiology (India). (Apr-Jun 2009) v.14(2) p.169-173 KEYWORDS: FILTRATION. CHLOROPHYLLS. OSMOTIC STRESS. SENESCENCE. WHEATS.

A field experiment was conducted during rabi season to find out the senescence pattern and membrane stability of flag leaf and their relationships with yield in three genotypes of wheat (HUW-234, HUW -468 and Chirya-3) under normal and late sown conditions. Changes in chlorophyll content of flag leaf of mother shoot were recorded at 5, 10, 15, and 20 days after anthesis. The chlorophyll content in the flag leaf of main shoot (MS) decreased rapidly after 10 days of anthesis and more so in genotype HUW-468 and Chirya-3 under late sowing and resulted in lower mean chlorophyll content. On the other hand, mean electrolyte leakage under late sowing was more in genotype HUW-234 and HUW-468. Chirya-3 exhibited lesser damage in flag leaf cell membrane under late sown conditions. The study showed that the major reduction in main shoot and yield under late sowing was due to a decrease in grain number per ear. Genotypic differences existed with respect to sustenance of grain weight per ear and cell membrane stability under terminal heat stress in wheat. An ability to sustain higher grain weight along with

cell membrane stability under heat stress is therefore, desired for higher yield under late sown conditions.

396. Tayade, A.S.; Marathwada Agricultural University, Parbhani (India). Dept. of Agronomy). Dhoble, M.V.; Marathwada Agricultural University, Parbhani (India). Dept. of Agronomy). Dry matter partitioning and plant growth response of transgenic Bt and non Bt cotton. Indian Journal of Plant Physiology (India). (Apr-Jun 2009) v. 14(2) p. 174-180  
KEYWORDS: GROWTH. COTTON. DRY MATTER CONTENT. TRANSGENIC PLANTS. PEST CONTROL.

Field experiment was conducted at Parbhani during kharif season of 2004 and 2005 to study the effects of nutrient and pest management on growth and development of Bt cotton (*Gossypium hirsutum* L) with special reference to dry matter production and its partitioning towards sinks. The Bt cotton recorded significantly less dry matter /plant than non Bt (NBt) cotton hybrids during both years. Green boll was found to be the major sink for photosynthate in Bt cotton at 120 days after sowing and it was to the extent of 37.28 and 51.68 per cent of total dry matter during first and second season crop respectively. It was observed that MECH 184 Bt produced significantly higher seed cotton yield (1658. Kg/a) over it NBt counterpart (1071 Kg/h). The performance of MECH 184 Bt was exceedingly superior and it produced 54.20 and 52.77 % more seed cotton yield than NBt counterparts MECH184 and PHH316, respectively. Moreover, the transgenic MECH 184 Bt cotton hybrid recorded significantly higher harvest index, matured earlier as compared to both MECH 184 and PHH 316 NBt cotton. The MECH 184 Bt cotton hybrid was found quite effective in reducing the insecticidal spray to the extent of 60 % over its NBt counterpart. The insecticidal pest management in cotton was found promising in managing cotton pest complex and finally realized significantly higher seed cotton yield than biopesticidal pest management. The application of graded level of chemical fertilizer, i.e. 80, 40 and 40 kg per ha of N, P and K and 100, 50 and 50 kg per ha of NPK under rainfed condition were equally effective in enhancing growth and yield attributes. Moreover, the improvement in growth and yield attributes was significantly superior over application of FYM (10 t/ha). Thus, it was concluded that due to increased retention of bolls, the crop growth pattern and biomass partitioning has changed substantially in Bt cotton.

397. Raja, G.; Bharathidasan University, Tiruchirappali, (India). Dept. of Plant Science). Kumari, B.D.R.; Bharathidasan University, Tiruchirappali, (India). Dept. of Plant Science). Ramachandran, A.; Anna University, Chennai (India). Centre for Climate Change and Adaptation Research). Influence of VAM fungi and microbial inoculants on growth, nutrients, and biochemical constituents in *Jatropha curcas* L.. Indian Journal of Plant Physiology (India). (Apr-Jun 2009) v.14(2) p.181-185  
KEYWORDS: BIOFERTILIZERS. JATROPHA CURCAS. MICROBIAL PESTICIDES.

Field experiment was conducted to study the effect of VAM fungi and its interaction with other microbial inoculants, *Azospirillum* spp, *Azotobacter* spp. and phosphate solubilizing bacteria on plant biomass, nutrients and biochemical constituents in *Jatropha curcas* L. Application of combined microbial inoculants, *Azospirillum* + *Phosphobacteria* + *Azotobacter* + VAM fungi significantly enhanced the fresh biomass, total soluble protein and phenols as well as relative water content over other inoculants and uninoculated control. The study indicated effectiveness of biofertilizers in increasing plant growth, nutrients and biochemical constituents of *Jatropha* plants.

398. Babar, L.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Chemicals). Tanwar, R.S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Chemicals). Singh, S.B.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Chemicals). Dureja, P.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Chemicals). Plant growth promoting activity of *Stevia rebaudiana* betroni on rice seedlings. Indian Journal of Plant Physiology (India). (Apr-Jun 2009) v. 14(2) p. 186-189  
KEYWORDS: SOLVENT

## EXTRACTION. STEVIA REBAUDIANA. RICE. SEEDLINGS. HORMONES. PLANT GROWTH SUBSTANCES.

Effect of different solvent extracts of dried leaves of *Stevia rebaudiana* Betroni on shoot and root length of rice seedlings in a pot experiment was studied at Indian Agriculture Research Institute, New Delhi. The extracts (hexane, dichloromethane and methanol) when applied at 1.0, 0.5 and 0.25 mg mP concentrations showed significant increase in seed germination, shoot and root length after 15 days of application. Among all the extracts tested maximum increase was exhibited by hexane extract with an increase in root and shoot length 19.14 and 18.12% respectively as compared to control (9.4 and 13.8% respectively).

399. Murkute, A.A.; Indian Institute of Technology, New Delhi (India). Centre for Rural Development and Technology). Sharma, S.; Indian Institute of Technology, New Delhi (India). Centre for Rural Development and Technology). Singh, S.K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Fruits and Horticultural Technology). Micropropagation of Trifoliolate orange (*Poncirus trifoliata*). Indian Journal of Plant Physiology (India). (Apr-Jun 2009) v. 14(2) p. 190-193 KEYWORDS: IN VITRO. MICROPROPAGATION. CITRUS. PONCIRUS TRIFOLIATA.

An attempt was made to develop an in vitro regeneration protocol for trifoliolate orange (*Poncirus trifoliata*), the important *Phytophthora* collar rot tolerant rootstock genotype of citrus. Among different plant growth regulators used, 1 mg/l BAP, 0.5 mg/l NAA, and 40 mg/l adenine sulphate significantly improved culture response including percentage forming shoot buds, days required for shoot initiation, shoot length and number of resultant shoots per explant. Rooting was achieved on half-strength MS medium supplemented with NAA and IBA either in combination or individually at different concentrations. Medium containing 0.5 mg/l IBA + 0.5 mg/l NAA gave the maximum root initiation response. However, the higher number of roots per shoot and highest root length was achieved when half-strength MS medium was fortified with 0.5 mg/l NAA and 0.5 mg/l IBA respectively. The hardening medium consisted of cocopeat and soilrite (2:1) in which the survival rate of hardened plants was found to be 82.2% after one month.

400. Ashraf, J.M.; Allahabad Agricultural Institute, Allahabad (India). Dept. of Biochemistry and Biochemical Technology). Mishra, P.K.; Allahabad Agricultural Institute, Allahabad (India). Dept. of Biochemistry and Biochemical Technology). Kumar, U.; Allahabad Agricultural Institute, Allahabad (India). Dept. of Biochemistry and Biochemical Technology). Chaudhary, M.; Allahabad Agricultural Institute, Allahabad (India). Dept. of Biochemistry and Biochemical Technology). Prakash, V.; Allahabad Agricultural Institute, Allahabad (India). Dept. of Biochemistry and Biochemical Technology). Antioxidative defense to lead stress in root cells of *Cicer arietinum* L.. Indian Journal of Plant Physiology (India). (Apr-Jun 2009) v. 14(2) p. 194-199 KEYWORDS: LEAD. CICER ARIETINUM. SUPEROXIDE DISMUTASE. ANTIOXIDANTS. ANTIOXIDANTS. OXIDATION. STRESS.

The study was conducted to evaluate the lead (Pb) induced changes at the cellular levels in the *Cicer arietinum* L. cv. Abrodhi. The seedlings were grown hydroponically, and subjected to increasing concentration of Pb (0, 0.5, 1.0 and 2.0 mM) as Pb(NO<sub>3</sub>)<sub>2</sub> for 5 days. The activities of enzymes involved in antioxidative defense such as superoxide dismutase (SOD), guaiacol peroxidase (POD) were markedly enhanced while catalase (CAT) decreased prominently with increasing the concentration of Pb. The non-enzymatic anti oxidative scavengers, viz. ascorbic acid, non-protein thiols, phenol and proline contents showed a progressive increase during the time of Pb treatment. The maximum increase or decreases in the level of the above biochemicals were observed at 2.0 mM concentration. The results suggested that Pb toxicity causes oxidative stress in seedlings and the antioxidative enzymes play a pivotal role against oxidative injury.

401. Sinha, P.; Lucknow University, Lucknow (India). Botany Dept.). Khurana, N.; Lucknow University, Lucknow (India). Botany Dept.). Nautiyal, N.; Lucknow University,



Lucknow (India). Botany Dept.). Boron stress influences economics yield and quality in crop species. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2009) v. 14(2) p. 200-204 KEYWORDS: CROPS. QUALITY. BORON. YIELD COMPONENTS. ARACHIS HYPOGAEA.

Boron plays an important role in improving the economic yield and quality of the produce. Studies conducted in refined sand at graded B levels (ranging from acute deficiency to excess) reveal that both deficiency and excess of B affect the seed quality of groundnut (*Arachis hypogea* L.) Var T3, sesame (*Sesamum indicum* L.) cv. T4, sunflower (*Helianthus annuus* L.) cv. NSFH-592, pigeonpea (*Cajanus cajan* L.) cv. UPAS, soybean (*Glycine max.* L.) cv. JS 80-21, blackgram (*Vigna mungo* L.) cv. T-9, and quality of fruit in tomato (*Solanum lycopersicum* L.) var. DL-3, tubers in potato (*Solanum tuberosum* L.) cv. TPS and carrot root (*Daucus carota* L.) cv. EN. at 0.3 J.1M B visible foliar symptoms of boron deficiency initiated in young leaves as interveinal chlorosis with marked reduction in growth. The affected leaves became thick, brittle and deformed later turning to necrotic in prolonged deficiency. Boron toxicity symptoms initiated at 30 J.1M B in old leaves as chlorotic spots along with the margins. These spots enlarged, coalesced and turned necrotic. Biomass, weight of pods and seeds were maximum at 30 UM B. Low (30 J.1M B) as well as high (30 J.1M B) B reduced the economic yield and deteriorated the quality of the produce by lowering the concentration of starch, protein in seeds and storage organs, lycopene and ascorbic acid in tomato fruits and oil in oil seeds. The concentration of sugars and phenols was enhanced in B deficiency in all crops except in sunflower, potato and carrot where the of sugar content decreased in B stress (deficiency as well as excess B) condition whereas excess B reduced the sugar concentration in sesame and pigeon pea seeds. The concentration of boron in different parts paralleled with the increase in boron supply. Critical B concentration has been worked out in the edible and economically important plant part for each species.

402. Bahuguna, R.N.; Gobind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Plant Physiology). Pandey, M.; Gobind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Molecular Biology and Biotechnology). Nath, M.; Gobind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Molecular Biology and Biotechnology). Guru, S.K.; Gobind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Plant Pathology). Kumar, J.; Gobind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Plant Physiology). Shukla, A.; Gobind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Plant Physiology). Physiological evaluation of *Trichoderma harzianum* against sheath blight in rice. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2009) v. 14(2) p. 205-208 KEYWORDS: RICE. TRICHODERMA HARZIANUM. ORYZA SATIVA. RHIZOCTONIA SOLANI.

*Trichoderma harzianum* (LS: TH38) induced systemic resistance in rice (*Oryza sativa*) by enhancing various components involved in pathogen suppression. Different physiological processes that are related with growth promotion were positively induced by *T. harzianum* even under infection by sheath blight. Thus reduction in disease severity and nullifying its negative impact on the plant growth implicates the importance of *T. harzianum* as a biocontrol agent. However, comparative study with systemic fungicide bavistin showed that the efficacy level of *T. harzianum* against sheath blight disease needed further improvement in order to replace chemical fungicides.

403. Hayat, S.; Aligarh Muslim University, Aligarh (India). Plant Physiology Section, Dept. of Botany). Mori, M.; National Institute of Agrobiological Sciences, Ibaraki (Japan). Plant Disease Resistance Unit, Div. of Plant Sciences). Fariduddin, Q.; Aligarh Muslim University, Aligarh (India). Plant Physiology Section, Dept. of Botany). Bajguz, A.; University of Bialystok, Bialystok (Poland). Institute of Biology, Dept. of Plant Biochemistry). Ahmad, A.; Higher College of Technology, Al-Khuwair (Sultanate of Oman). Dept. of Applied Sciences). Physiological role of brassinosteroids: an update.



Indian Journal of Plant Physiology (India). (Apr-Jun 2010) V. 15(2) p. 99-109  
KEYWORDS: BRASSINOSTEROIDS. GROWTH. YIELDS. PHOTOSYNTHESIS. ENZYMES.

The entire range of the developmental processes in plants is largely regulated by the shift in the hormonal balance. Out of the recognized hormones, attention has largely been focused on auxins, gibberellins, cytokinin, abscisic acid and ethylene. Brassinosteroids (BRs) were initially assigned a position of a lesser importance than the above recognized plant growth regulators. At present BRs have evolved as essential regulators of growth and development. Much progress has been achieved in their isolation, characterization and possible mechanism of action. However, their practical applicability has lacked far behind. BRs are recognized as regulators of transcription and translation thereby changing the pattern of total proteins, enzymes, and the rate of photosynthesis and finally the seed yield, at harvest. In this review we have discussed the importance of BRs in regulating the enzyme level, enhancing photosynthetic rate and other related aspects, determining biological yield, under natural conditions.

404. Thakur, A.; Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni-Solan (India). Dept. of Basic Sciences). Thakur, P.S.; Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni-Solan (India). Dept. of Silviculture and Agroforestry). Dutt, V.; Sher-e-Kashmir University of Agriculture and Technology, Jammu (India). Thakur, C.L.; Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni-Solan (India). Dept. of Silviculture and Agroforestry). Conservation of Podophyllum hexandrum through seeds. Indian Journal of Plant Physiology (India). (Apr-Jun 2010) V. 15(2) p. 110-116  
KEYWORDS: GERMINATION. SEEDS. SEEDLINGS. VIGOUR.

Podophyllum hexandrum Royle, inhabitant of north-western Himalayas, is an endangered and prioritized medicinal herb for conservation purpose. This herb shows delayed and low seed germination with poor seedling survival. The aim of this study was to develop a complete package for attaining higher and early germination percentage and to innovate suitable storage environment for prolonging germination potential of seeds, which is otherwise lost quickly. The findings revealed that germination percentage, onset of germination and vigour index can be improved by subjecting seeds to presowing chilling, hydropriming for 8 days or chemical treatments with petroleum ether, triacontanol or sodium hypochlorite. Storage of seeds at  $-10^{\circ}\text{C}$  in plastic jars was most suitable for maintaining germination ability, even after one year, which otherwise is lost in six months at room temperature. Sowing of seeds in mixture of soil + FYM + coco peat (2:1:1) resulted in maximum seedling emergence and survival. The study will be useful for conserving this herb species.

405. Shah, S.; Directorate of Medicinal and Aromatic Plants Research, Anand (India). Saravanan, R.; Directorate of Medicinal and Aromatic Plants Research, Anand (India). Gajbhiye, N.A.; Directorate of Medicinal and Aromatic Plants Research, Anand (India). Leaf gas exchange, chlorophyll fluorescence, growth and root yield of ashwagandha (*Withania somnifera* Dunal.) under soil moisture stress. Indian Journal of Plant Physiology (India). (Apr-Jun 2010) V. 15(2) p. 117-124  
KEYWORDS: WITHANIA SOMNIFERA. FLUORESCENCE. GROWTH. YIELDS.

Aswagandha (*Withania somnifera*, Dunal.) is an important medicinal plant. It is cultivated in India as rainfed crop for its roots. A field study was conducted to understand the response of this crop (cv. JA-134) to progressive soil moisture deficit. The treatments imposed were moderate (2 irrigations) and severe stress (single irrigation) along with well watered control (4 irrigations). As the soil moisture stress progressed during the crop growth period, soil moisture decreased in stress treatments and reached to  $-10.93$ ,  $-1.15$  MPa at 169 DAS in severe stress, moderate stress at 30 cm soil depth whereas control had 0 soil of  $-0.0088$  MPa. Correspondingly predawn leaf water potentials were  $-0.615$  and  $-0.506$  MPa in severe and moderate stress treatments while, control sustained the 9 of  $-0.373$  MPa. At 169 DAS, total chlorophyll content was reduced 49% and 60% in moderate and severe stress, whereas proline content increased 2.75 and 3.96 times that of control in moderate and severe stress. Gas exchange and chl-a fluorescence were significantly altered under stress. Moisture stress reduced all the

growth parameters studied compared to control plants. Reduction in dry weight of leaves and stems were 19.88% (3.52g), 36.48% (5.19g) respectively in severe stress compared to control. Whereas root dry weight increased 35% and 20% respectively in moderate and severe stress compared to control. The increased root biomass partitioning and higher root yield under soil moisture stress helped in off-setting the deleterious effect of water stress.

406. Nautiyal, N.; University of Lucknow, Lucknow (India). Dept. of Botany). Awasthi, S.; University of Lucknow, Lucknow (India). Dept. of Botany). Influence of copper on embryo viability and development in hyacinth bean seeds. Indian Journal of Plant Physiology (India). (Apr-Jun 2010) V. 15(2) p. 137-143 KEYWORDS: COPPER. HYACINTHUS. ABA.

An experiment was conducted to study the role of Cu in biosynthesis and accumulation of seed reserves and impact of exogenous ABA application on Cu deficiency. Fertilized ovules of hyacinth bean (*Dolichos lablab* L.), cultured aseptically at 8 and 10 days after anthesis developed copper deficiency after 5 days in culture at 0.02 11M Cu resulting in reduction in seed reserve accumulation and loss in viability of embryos. The results suggest that decrease in the activities of acid invertase and Cu enzymes, ascorbate oxidase and polyphenol oxidase and induction of some Cu stress proteins resembling HSP70 affected the seed development in hyacinth bean at deficient Cu. Exogenous ABA application (0.1 mM) enhanced the level of some reserves but was unable to reverse the Cu deficiency effects.

407. Dar, H.A.; Sher-e-Kashmir University of Agriculture and Technology, Srinagar (India). Div. of Pomology). Singh, S.R.; Sher-e-Kashmir University of Agriculture and Technology, Srinagar (India). Div. of Pomology). Srivastava, K.K.; Sher-e-Kashmir University of Agriculture and Technology, Srinagar (India). Div. of Pomology). Sharma, M.K.; Sher-e-Kashmir University of Agriculture and Technology, Srinagar (India). Div. of Pomology). Sundouri, A.S.; Sher-e-Kashmir University of Agriculture and Technology, Srinagar (India). Div. of Pomology). Regeneration of sour cherry (*Prunus cerasus*) through in - vitro propagation. Indian Journal of Plant Physiology (India). (Apr-Jun 2010) V. 15(2) p. 144-149 KEYWORDS: REGENERATION. PLANT PROPAGATION. PRUNUS CERASUS.

Dormant cutting procured from mature plants, were subjected to forcing treatment for in-vitro propagation. The culture media i.e., Murashige and Skoog medium (MS) with three strength levels viz., full, half and three fourth were used. Plant growth regulators viz. BAP (0.25 mg l<sup>-1</sup>, 0.50 mg l<sup>-1</sup>, 0.75 mg l<sup>-1</sup>) and IBA (0.00 mg l<sup>-1</sup> and 0.01 mg l<sup>-1</sup>) were supplemented with MS media. The design of experiment was CRD with three replications. MS half strength basal medium supplemented with 0.50 mg l<sup>-1</sup> BAP plus 0.01 mg l<sup>-1</sup> IBA resulted in the highest survival percentage of in vitro cultures. MS medium supplemented with 1 mg l<sup>-1</sup> BAP + 0.10 mg l<sup>-1</sup> IBA fortified with 2 mg l<sup>-1</sup> BAP + 0.10 mg l<sup>-1</sup> IDA recorded the maximum proliferation efficiency. MS medium supplemented with BAP 0.1 mg l<sup>-1</sup> and devoid of auxin recorded the optimum elongation of micro shoots. MS medium fortified with 2 mg l<sup>-1</sup> IDA gave the highest rooting percentage and average number of roots per explant. The studies culminated in standardization of protocol for in vitro propagation of sour cherry rootstock.

408. Upadhyay, R.K.; Assam Central University, Silchar (India). Plant Biochemistry and Molecular Biology Lab.). Panda, S.K.; Assam Central University, Silchar (India). Plant Biochemistry and Molecular Biology Lab.). Dutta, B.K.; Assam Central University, Silchar (India). Agricultural Ecology Lab.). Biochemical impact of re-oxygenation in rice seedlings after submergence stress. Indian Journal of Plant Physiology (India). (Apr-Jun 2010) V. 15(2) p. 154-158 KEYWORDS: ORYZA SATIVA. BIOCHEMICAL ENGINEERING. WATER TOLERANCE. OXIDATION. STRESS.

Rice cultivars treated with 2, 4 and 6d of submergence and post submergence exhibited increase in reactive oxygen species, hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) and superoxide radical. The analysis of lipid peroxidation showed high increment in malondialdehyde

(MDA) production only after 2d of treatment. Significant increase in peroxidase (POX) and superoxide dismutase (SOD) activities were enhanced under post submergence treatment after 4d, but reduced after 6d while catalase (CAT) activity declined after 4d of treatment. The contents of ascorbate (AsA) and glutathione (GSH) also showed increasing trends. The objective of this experiment was to test the hypothesis that submergence induces oxidative stress with exposure dependent intensity and variability and activates defence system in *Oryza sativa* L. Though water is essential for plants, but submergence-associated  $O_2$  alteration causes the toxicity.

409. Joshi, R.; Gobind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Plant Physiology). Shukla, A.; Gobind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Plant Physiology). Kumar, P.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). In vitro selection of hill maize (*Zea mays* L.) hybrids for low phosphate tolerance. Indian Journal of Plant Physiology (India). (Apr-Jun 2010) V. 15(2) p. 159-163 KEYWORDS: IN VITRO. SELECTION. ZEA MAYS. PHOSPHATES. PHOSPHORUS.

Genotypic response of hill maize hybrids viz. Vivek-4, Vivek-5, VL-42 and Him-129 to low concentrations of phosphate (low-P) was studied in vitro. An induction in anthocyanin accumulation and increase in total protein content were observed with decreasing concentration of P in the medium. SDS polyacrylamide gel electrophoresis of in vitro cultured plants showed the over expression of 4-6 polypeptides under P deficient levels than to sufficient. Thus, results thereby indicated that many proteins to be specifically synthesized de novo under Pi deficiency as part of the adaptive mechanism under low P condition. Amongst the four hybrids of maize Him-129 and Vivek-5 showed relatively good response in terms of anthocyanin accumulation in stem and higher total protein content along with activation of few extra new bands of polypeptides under P deficiency and so, proved their tolerance against low P stress.

410. Saha, S.; University of Kalyani, Kalyani (India). Dept. of Botany). Ghosh, P.D.; University of Kalyani, Kalyani (India). Cytogenetics and Plant Biotechnology Research Unit). Sengupta, C.; Univeristy of Kalyani, Kalyani (India). Microbiology Lab.). An efficient method for micropropagation of *Ocimum basilicum* L.. Indian Journal of Plant Physiology (India). (Apr-Jun 2010) V. 15(2) p. 168-172 KEYWORDS: MICROPROPAGATION. OCIMUM BASILICUM. IN VITRO.

An efficient plant regeneration protocol has been developed from nodal explants of *Ocimum basilicum* L., medicinally important herbaceous plant species belonging to the family Lamiaceae. Axillary shoot bud proliferation was initiated from nodal explants cultured on Murashige and Skoog (MS) medium supplemented with various concentration of benzyl adenine (BA) (0.25-2.0 mg l<sup>-1</sup>) and kinetin (KN) (0.25-2.0 mg l<sup>-1</sup>). Maximum numbers of shoots (6.2:1:0.1) with average length (3.7:1:0.0) were induced on medium containing 0.5 mg l<sup>-1</sup> BA. Shoots culture was established by repeated subculturing the original nodal explant on the same medium. Rooting of shoots was achieved on half strength MS medium supplemented with 1.0 mg l<sup>-1</sup> NAA. Well-developed complete plantlets were transferred to plastic pots containing a mixture of (1: 1) soil and vermiculite showed 90 % survival rate.

411. Rafi, K.M.; Jamal Mohamed College, Tiruchirappali (India). Post Graduate and Research Dept. of Botany). Aslam, A.; Jamal Mohamed College, Tiruchirappali (India). Post Graduate and Research Dept. of Botany). Kohila, S.; Mother Teresa Women's University, Kodaikanal (India). Dept. of Biotechnology). Tanweer, J.; Jamal Mohamed College, Tiruchirappali (India). Post Graduate and Research Dept. of Botany). Shajahan, A.; Jamal Mohamed College, Tiruchirappali (India). Post Graduate and Research Dept. of Botany). Direct rhizogenesis from in vitro leaves of *Withania somnifera* (L.) Dunal. Indian Journal of Plant Physiology (India). (Apr-Jun 2010) V. 15(2) p. 173-176 KEYWORDS: IN VITRO. WITHANIA SOMNIFERA. AUXINS. DUNALIELLA.

Direct in vitro rhizogenesis was induced in *Withania somnifera* (L.) Dunalleaf segments using exogenous addition of auxins. Among the four types of explants

(internodal, nodal, young leaf and mature leaf segments), young leaves responded better and formed roots in the midrib region on the contact surface when placed on Murash and Skoog's (MS) basal medium containing various types (IAA, IBA and NAA) and concentration of auxins. The strength of the MS media (1/4, 1/2, 3/4 and full strength) treatments had apparent effect on rooting. Maximum rooting in young leaf (95%) occurred in Yz strength MS + IAA medium. The other types of auxins were good for inducing root in other explants. Only 20 percent of the cultures produced roots if explants were grown on full-strength MS medium supplemented with IBA.

412. Alam, B.; Rubber Research Institute of India, Kottayam (India). Plant Physiology Div.). Jacob, J.; University of Georgia, Athens (United States of America). Dept. of Crop and Soil Sciences). Earl, H.J.; University of Guelph, Ontario (Canada). Dept. of Plant Agriculture). Photosynthetic efficiency of transgenic tobacco plants (*Noctoniana tabacum* L.) over-expressing mtID gene under drought and paraquat stress. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2010) V. 15(2) p. 186-191 KEYWORDS: TOBACCO. DROUGHT. NICOTIANA TABACUM. PARAQUAT.

The objective of this study was to examine the performance of genetically transformed tobacco plants over-expressing mannitol-phosphate dehydrogenase (mtID) in maintaining better photosynthetic activity than the untransformed wild plants during water deficit stress and in combination with paraquat stress. Inhibitions in the rates of net CO<sub>2</sub> assimilation (P N) and the non-cyclic photosynthetic electron transport across photosystem II (ETR) due to water deficit stress were much smaller in the mtID transformed plants (22% and 9%, respectively) than in the untransformed wild ones (55% and 52%, respectively). These differences were even more marked when the plants experiencing water deficit stress were treated with paraquat, which blocks the photosynthetic electron transfer chain and diverts the excitation energy into producing reactive oxygen species (ROS). The minimal inhibitions in the photochemical activity (9-10%) of mtID transformed plants resulting from the environmental stresses agree with their expected efficient use of photosynthetic electrons. Results of the present study thus suggest that mtID transformed tobacco plants tolerated the stress better than the untransformed wild plants which is noteworthy for further attention.

413. Keshavkant, S.; Pandit Ravishankar Shukla University, Raipur (India). School of Life Sciences). Naithani, S.C.; Pandit Ravishankar Shukla University, Raipur (India). School of Life Sciences). Chilling induced superoxide production, lipid peroxidation and leakage loss in *Shorea robusta* seedlings. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2010) V. 15(2) p. 192-197 KEYWORDS: SUPEROXIDE DISMUTASE. LIPID PEROXIDATION. SHOREA ROBUSTA. SEEDLINGS. COOLING.

Aerial parts of the chilling sensitive young *sal* (*Shorea robusta*) seedlings showed excess generation of active oxygen species (AOS) and malondialdehyde (MDA) in response to exposure of chilling temperature (9-14.1°C) during November to March in field conditions. Approximately 5-6 fold increase in AOS was estimated in aerial parts of chilling exposed seedlings than the control (greenhouse) seedlings. Accumulation of AOS was found to be closely associated with the rise in MDA in leaf (4 fold) and shoot (3.8 fold) tissues, whereas, control seedlings exhibited insignificant accumulation of both. Chilling exposed seedlings also showed significant promotion in the leakage loss of organic (protein and inorganic (K<sup>+</sup> and Ca<sup>++</sup>) electrolytes from leaf and shoot tissues, but an insignificant leakage of electrolytes was recorded in greenhouse seedlings. The field grown *sal* seedlings (exposed to chilling) revealed a strong positive correlation between the rates of AOS and MDA accumulation ( $r=0.98^*$  & 1 and also between magnitude of MDA levels and leakage loss of various electrolytes ( $r=0.99^{**}$ ), during chilling periods. Our results clearly showed that leaf and shoot of field grown *sal* seedlings are severely damaged due to chilling stress, whereas, the protected (greenhouse) seedlings are showing vigorous growth during same periods of analysis.

414. Nayak, M. Gangadhara; Directorate of Cashew Research, Puttur (India). Swamy, K.R.M.; Directorate of Cashew Research, Puttur (India). Studies on the effect of



Paclobutrazol on growth and yield of cashew (*Anacardium occidentale* L.). *Journal of Plantation Crops (India)*. (Apr 2010) v. 38(1) p. 72-74 KEYWORDS: CASHEWS. DWARFISM. PACLOBUTRAZOL. SOIL.

415. Balasubramanian. S.; KDHP Co. Pvt. Ltd., Munnar (India). Comparative studies on chlorophyll fluorescence and certain physiological features with inherent drought tolerance and quality of tea (*Camellia sinensis* L.). *Journal of Plantation Crops (India)*. (Apr 2010) v. 38(1) p. 26-21 KEYWORDS: CHLOROPHYLLS. DROUGHT RESISTANCE. PHOTOSYNTHESIS. PROLINE. QUALITY. TEA.

Chlorophyll fluorescence, net photosynthesis rate, transpiration rate, water use efficiency, stomatal conductance, leaf moisture, chlorophyll content and concentration of proline of tea leaves with different stages of maturity in a shoot as well as 30 different tea clones with various levels of inherent drought tolerance and quality were studied during periods of drought. In a tea shoot, leaf maturity showed significant positive correlation with chlorophyll content, chlorophyll fluorescence ( $F_v$  and  $F_v/F_m$ ), net photosynthesis rate and water use efficiency. In the case of various clones, significant correlation could not be established between chlorophyll content and chlorophyll fluorescence as well as net photosynthesis rate. Inherent moisture content of mother leaves of various clones showed significant positive correlation with minimal fluorescence and variable fluorescence. Leaf temperature at the time of measurement of photosynthesis exhibited significant correlation with net photosynthesis rate as well as transpiration rate. Maximal fluorescence yield and variable fluorescence of various clones showed significant negative correlation with transpiration rate. Significant negative correlation was observed between  $F_m$  and water use efficiency. Correlation between stomatal conductance as well as proline concentration, which are considered to be indicators for drought tolerance, was non-significant. There was a strong negative correlation between chlorophyll fluorescence ( $F_v$  and  $F_v/F_m$ ) and transpiration rate and quality of tea produced from different leaves of a tea shoot. However, significant correlation could not be established between chlorophyll fluorescence with inherent drought tolerance as well as quality of CTC black tea manufactured from different clones.

416. Salakinkop, S.R.; Central Coffee Research Institute, CRS, Chickmagalur (India). Shiva Prasad, P.; Central Coffee Research Institute, CRS, Chickmagalur (India). Biradar, I.B.; Central Coffee Research Institute, CRS, Chickmagalur (India). D'souza, Maria Violet; Central Coffee Research Institute, CRS, Chickmagalur (India). Vinaya Kumar, B.N.; Central Coffee Research Institute, CRS, Chickmagalur (India). Ananth Murthy, M.; Central Coffee Research Institute, CRS, Chickmagalur (India). Raghuramulu, Y.; Central Coffee Research Institute, CRS, Chickmagalur (India). Jayarama; Central Coffee Research Institute, CRS, Chickmagalur (India). Influence of volume of growth media and dimension of nursery bags on vigour of coffee seedlings and their performance in the field. *Journal of Plantation Crops (India)*. (Apr 2010) v. 38(1) p. 47- 52 KEYWORDS: ECONOMICS. SEEDLINGS. TRANSPLANTING. VIGOUR. YIELDS.

Nursery and field experiments were conducted at Central Coffee Research Institute for two years (2004 and 2005) using Randomized Block Design with three replications. Pooled data for two years of nursery experiment showed that plant height, tap root length, stem girth and dry matter of seedlings raised in bigger poly bags (32.5x20.0 cm) were superior than seedlings raised in normal poly bags (22.5x15.0 cm) at field planting stage. In the field experiment, the highest stem girth, bush spread, number of primaries, length of the longest primary and nodes on the longest primary were recorded in all the treatments established from first year seedlings compared to plants established from second year seedlings. Seedlings from bigger poly bags (25.0x20.0 and 32.5x20.0 cm) showed more growth and percent establishment than normal poly bag seedlings after one year of field transplanting.



**F61 Plant Physiology - Nutrition**

417. D'Souza, G.F.; Central Coffee Research Institute, CRS, Chickmagalur (India). Rajeswari, N.; Central Coffee Research Institute, CRS, Chickmagalur (India). Ramesh Babu, H.N.; Central Coffee Research Institute, CRS, Chickmagalur (India). Renuka Swamy, N.S.; Central Coffee Research Institute, CRS, Chickmagalur (India). Evaluation of different arabica and robusta rootstock and arabica scion combinations for carbon exchange rates and water use efficiency in coffee. *Journal of Plantation Crops (India)*. (Aug 2010) v. 38(2) p. 118-124 KEYWORDS: ARABICA COFFEE. ROOTSTOCKS. PHOTOSYNTHESIS.

Evaluation of fifteen graft combinations for carbon exchange rates (CER) in comparison with self grafts and pure line seedlings of scion materials indicated significant differences with regard to net photosynthesis ( $P_n$ ), transpiration rate ( $E$ ), stomatal conductance ( $g_s$ ), internal  $CO_2$  concentration ( $C_i$ ), carboxylation efficiency (CE) and instantaneous water use efficiency (IWUE) between the rootstock scion combinations of arabica and robusta coffee. The arabica rootstocks such as SIn. 9 and Sin. 58 were found to induce higher carbon exchange rates (CER) and Instantaneous water use efficiency (IWUE) in S.795 scion material. The genetically divergent rootstocks of the same species are better compared to self rootstocks and diploid ( $2n=22$ ) robusta rootstocks to improve CER of tetraploid ( $2n=44$ ) arabica scion materials. Interaction studies indicated that the arabica rootstocks were better than robusta rootstocks for the three arabica scions in terms of improvement in CER. A positive relationship between  $P_n$  and shoot weight and root weight indicated that  $P_n$  governs dry matter production and productivity in graft combinations. Instantaneous water use efficiency has shown a strong negative relationship between  $g_s$  ( $r=-0.492$ ) and  $E$  ( $r=-0.752$ ) indicating regulatory mechanism of stomatal conductance in maintaining the WUE in coffee plants.

418. Pandey, Renu; Indian Agricultural Research Institute, New Delhi (India). Influence of certain chemicals on nitrate reductase activity and its correlation with caffeine in tea [(*Camellia sinensis* (L) O.Kuntze)] leaves.. *Journal of Plantation Crops (India)*. (Aug 2010) v. 38(2) p. 132-137 KEYWORDS: CAFFEINE. CAMELLIA SINENSIS. CHLOROPHYLLS. NITRATE REDUCTASE. NITROGEN. PROLINE.

Any factor which influences the chemical composition of leaf also has a great bearing on quality of made tea. The experiment was conducted to investigate the effect of certain chemicals on nitrate reductase (NR) activity and to find its correlation with the chemical constituents of leaf. A Tockali released clone TV18 was sprayed with chemicals, viz., jibika (mixture of GAJ+4+7)' IAA, cycocel, thiourea, methanol, succinic acid and sucrose including water spray as control. Sucrose application increased NR activity amongst all other chemical treatments in phase I (45.2%) and phase II (42.1%). However, the total nitrogen (N) (7.21%) and crude protein (6.39 %) were higher with succinic acid in phase I and thiourea in phase II. Further, methanol application resulted in 19.4% and 16.0% increase in caffeine content in phase I and phase II, respectively. Similarly, proline was also maximum in both the phases (32.5%, 23.9%) with methanol while total chlorophyll content was higher with jibika (37.1%) in phase I and with methanol (74.6%) in phase II. In this study, an interesting relationship between NR activity with caffeine (0.69\*\*) and proline ( $r=0.89^{**}$ ) content was observed. This study suggested that alteration in NR activity due to growth regulating chemicals had a direct influence on caffeine content of tea leaves which is one of the quality determinants of made tea.

**F62 Plant Physiology – Growth and Development**

419. Hayat, Shamsul; Aligarh Muslim University, Plant Physiology Section, Department of Botany, Aligarh (India). Mori, Masaki; National Institute of Agrobiological Sciences, Plant Disease Resistance Unit, Division of Plant Sciences, Tsukuba (Japan). Fariduddin, Qazi; Aligarh Muslim University, Plant Physiology Section, Department of Botany, Aligarh (India). Bajguz, Andrzej; University of Bialystok, Institute of Biology, Department

of Plant Biochemistry, Bialystok, (Poland). Ahmad, Aqil; Higher College of Technology, Department of Applied Sciences, Al-Khuwair (Oman). Physiological role of brassinosteroids: an update. Indian Journal of Plant Physiology (India). (Jun 2010) v.15(2) p.99-109 KEYWORDS: BRASSINOSTEROIDS. HORMONAL CONTROL. ENZYMES. GROWTH. PHOTOSYNTHESIS. YIELDS.

The entire range of the developmental processes in plants is largely regulated by the shift in the hormonal balance. Out of the recognized hormones, attention has largely been focused on auxins, gibberellins, cytokinin, abscisic acid and ethylene. Brassinosteroids (BRs) were initially assigned a position of a lesser importance than the above recognized plant growth regulators. At present BRs have evolved as essential regulators of growth and development. Much progress has been achieved in their isolation, characterization and possible mechanism of action. However, their practical applicability has lacked far behind. BRs are recognized as regulators of transcription and translation thereby changing the pattern of total proteins, enzymes, and the rate of photosynthesis and finally the seed yield, at harvest. In this review we have discussed the importance of BRs in regulating the enzyme level, enhancing photosynthetic rate and other related aspects, determining biological yield, under natural conditions.

420. Kumari, V.; Indian Agricultural Research Institute, New Delhi (India). Div. of Biochemistry). Tyagi, V.; National Bureau of Plant Genetic Resources, New Delhi (India). Ali, K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Biochemistry). Tyagi, A.; Indian Agricultural Research Institute, New Delhi (India). Div. of Biochemistry). Isolation of differentially regulated partial, cDNA with respect to water stress from rice. Indian Journal of Plant Physiology (India). (Jul - Sept 2009) v. 14(3) p. 306-309 KEYWORDS: RICE. ABA. DROUGHT STRESS. STRESS.

In the present study a partial cDNA sequence of 308 bp showing induction under water stress was isolated from rice cv. Nagina-22 (N22) and sequenced. The sequence has 150 bp 5' untranslated region and the 156bp coding sequence. Coding sequence has A TG initiation codon and encodes 52 amino acids. On homology search analysis, it was observed that the coding sequence had 100 % homology with protein phosphatase 2C gene of *Arabidopsis thaliana* and corresponds to N terminal region of the gene which has very important role in ABA signaling. Protein phosphatase 2C negatively regulates ABA response under water deficit stress.

421. Thomas, Litty; Central Plantation Crops Research Institute, Kasaragod (India). Gupta, Alka; Central Plantation Crops Research Institute, Kasaragod (India). Murali Gopal; Central Plantation Crops Research Institute, Kasaragod (India). George, Priya; Central Plantation Crops Research Institute, Kasaragod (India). Thomas, G.V.; Central Plantation Crops Research Institute, Kasaragod (India). Plant growth promoting potential of *Bacillus* spp. isolated from rhizosphere of cocoa (*Theobroma cacao* L.). Journal of Plantation Crops (India). (Aug 2010) v. 38(2) p. 97-104 KEYWORDS: THEOBROMA CACAO. BACILLUS.

A total of 185 bacilli were isolated from rhizosphere soils of cocoa from various locations in southern states of India and they were subsequently screened in vitro for plant growth promoting (PGP) traits such as production of IAA, ACC deaminase, HCN, siderophore, chitinases and antibiotics, ammonification, ability to grow on N-free media and solubilization of phosphates. It was found that 91% of the *Bacillus* spp. isolates produced ammonia; less than 20% isolates produced HCN and siderophore; IAA production was noticed in 22% isolates and 19% isolates were found to produce antibiotics. About 49% of 185 *Bacillus* isolates solubilized phosphates; 50% of isolates could grow on N-free medium and 71% of isolates showed ACC deaminase production. The isolates could exhibit upto six PGP traits, which may promote plant growth directly or indirectly or synergistically. Thirty six isolates were selected based on the in vitro plant growth promotion potential and were further screened for plant growth promotion under Environmental Plant Growth Chamber (EPGC) conditions. Thirty isolates which showed increase in seedling length in EPGC study were further screened for in vivo growth promotion in cowpea seedlings under greenhouse conditions. Out of 30 isolates

tested, 11 were found to increase seedling length and fresh and dry weight of cowpea seedlings when compared to the uninoculated control. The results of this study points to the potential of rhizospheric soil bacilli for plant growth promotion. Further studies are necessary to confirm their effectiveness and potential in the field.

## H10 Pests of Plants

422. Jana, T.; Zoological Survey of India, Kolkata (India). Nematelminthes Section. Jana, A.; Jhargram Raj College, Jhargram (India). Dept. of Zoology. Chatterjee, A.; Zoological Survey of India, Kolkata (India). Nematelminthes Section). First report of *Mononchus aquaticus* (Nematoda) from West Bengal, India with an updated key to the species under the genus *Mononchus*. Indian Journal of Nematology (India). (Jun 2009) v. 39(1) p. 46-53 KEYWORDS: NEMATODA. WEST BENGAL. SOLANUM TUBEROSUM.

*Mononchus aquaticus* Coetzee, 1968 is reported first time from West Bengal, India. The species was collected from the district South-24-Parganas (Sub division- Alipur Sadar; Block- Maheshtala), West Bengal, India in the month of October, 2006 from the potato (*Solanum tuberosum* L.) field. Four females were collected but no male was found. The present species is characterized by medium sized body (L=1.22-1.30 mm); buccal cavity measured as: 31.85-32.66 X 11.55-11.98 J.U11, large dorsal tooth occupying more than 80% of the total buccal cavity length; gonad amphidelphic; tail 4.09-4.21 anal diameter long, tail elongated, clavate at the end. Three caudal glands and spinneret opening terminal, distinct caudal papillae at the tail terminus

423. Sivaprakash, M.; Tamil Nadu Agricultural University, Coimbatore (India). Centre for Excellence in Biofuels). Balasubramanian, P.; Forest College and Research Institute, Mettupalayam (India). Rathakrishnan, P.; National Research Centre for Agro Forestry, Jhansi (India). Prabhu, S.; Tamil Nadu Agricultural University, Coimbatore (India). Dept. of Plant Nematology). Pathogenicity of lance nematode, *Hoplolaimus seinhorsti* on red sanders, *Pterocarpus santalinus* tree seedlings. Indian Journal of Nematology (India). (Jun 2009) v. 39(1) p. 54-58 KEYWORDS: PTEROCARPUS SANTALINUS. TREES. SEEDLINGS.

A pot culture experiment was conducted in a glass house to assess the pathogenicity of *Hoplolaimus seinhorsti* on Red Sanders, *Pterocarpus santalinus* in 25 x 15 cm bags idled up with steam sterilized fine river-sand mixed with red earth at the ratio of 3:1. The freshly collected seeds were presoaked continuously in normal water by changing water daily for eight days for presowing treatment. Fifteen days after germination, the plants were infested with adults and juvenile of *H. seinhorsti*, of the treated seeds at the rate of 0, 100, 200, 400 and 600 larvae pot<sup>-1</sup> around the root zone. The results revealed progressive reduction in length and weight of shoot and root significantly with the increase in the level of initial inoculum. The multiplication rate of *H. seinhorsti* was 9.3 to 100 larvae kg/soil. There was no reduction in chlorophyll contents to 100 larvae kg/soil, but significant reduction was recorded in 600 larvae kg/soil (13.2). The stomatal conductance, transpiration rate and net photosynthetic rate were significantly reduced, when the nematode population level exceeded 200 kg/soil.

424. Bhat, M.Y.; University of Kashmir, Srinagar (India). Dept. of Botany). Fazal, M.; Sinha College, Aurangabad (India). Hissamuddin; Aligarh Muslim University, Aligarh (India). Dept. of Botany). Effect of *Meloidogyne incognita* race-1 on the functioning of rhizobial nodules on black gram, *Vigna mungo*. Indian Journal of Nematology (India). (Jun 2009) v. 39(1) p. 59-64 KEYWORDS: MELOIDOGYNE INCOGNITA. BRADYRHIZOBIUM. VIGNA MUNGO. NITROGENASE. LEGHAEMOGLOBIN.

The present investigation concludes that inclusion of *Meloidogyne incognita* race-1 cause adverse effects on the growth of black gram, nodule development, nitrogen contents of root and shoot, leg haemoglobin, bacterioids and nitrogenase activity in all the treatments at any population level. In the presence of *Bradyrhizobium* damage to plant growth was significantly less, except in treatments where bacterial application followed nematode inoculations, compared to those where *Bradyrhizobium* was not

applied. Bacterial application appreciably increased the nitrogen content of root and shoot in all the treatments irrespective of the time of application. Leghaemoglobin, bacteriod and nitrogenase activities in nematode infected plants was higher in prior inclusion of Bradyrhizobium and least in treatments which were applied 10 days after nematode inoculation.

425. Khan, M.R.; Aligarh Muslim University, Aligarh (India). Dept. of Plant Protection). Khan, U.; Aligarh Muslim University, Aligarh (India). Dept. of Plant Protection. Effect of temperature regimes on the survival of *Steinernema masoodi* AMU EPN-1. Indian Journal of Nematology (India). (Jun 2009) v. 39(1) p. 65-70 KEYWORDS: TEMPERATURE. IN VITRO. STEINERNEMA.

The study was conducted to determine the survivability of *Steinernema masoodi* AMU EPN-I at different temperatures in vitro in cavity blocks and earthen tea cups and in vivo in earthen pots kept in a guava orchard. The in vitro study was conducted by incubating 2500 infective juveniles of the nematode in distilled water in cavity blocks and in soil (100g) in earthen tea cups in BOD incubators at 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50°C for 4, 6, 8 and 12 h. The nematode survival was almost 100% at 5-25°C temperature in distilled water or in soil. However, from 30°C onwards the survival decreased gradually and the mortality reached 100% at 50°C. The nematode survival in distilled water at 30, 35 and 40°C was 61-89%, 53-84% 39-59% at 4-12 hour duration respectively, and 33-45% at 45°C. The survival was 1-14% greater in the soil. The nematode survival was greatest in the pots placed under full shade and gained an increase of 54 to 61% during November-December in comparison to the initial population (September 2007). The nematode population declined by 10-96% during March to June and showed an increase in July to September. The minimum survival of nematode was recorded in June in comparison to the initial population under shaded and partially shaded environment.

426. Sundaraju, P.; National Research Centre for Banana, Tirichirapalli (India). Crop Protection Lab. Thangavelu, R.; National Research Centre for Banana, Tirichirapalli (India). Crop Protection Lab. Influence of *Pratylenchus coffeae* and *Meloidogyne incognita* on the Fusarium wilt complex of banana. Indian Journal of Nematology (India). (Jun 2009) v. 39(1) p. 71-74 KEYWORDS: BANANAS. FUSARIUM. PRATYLENCHUS COFFEA. MELOIDOGYNE INCOGNITA. WILTS.

A pot culture experiment was conducted to study the influence of *Pratylenchus coffeae* and *Meloidogyne incognita* alone and in combination on the Fusarium wilt complex of banana in cv. Rasthali. The results of the study revealed that the plants receiving inoculum of anyone of the nematodes or both inoculated first followed by the wilt fungus resulted in the early onset and increased severity of the Fusarium wilt disease. Inoculation of fungus, *Fusarium oxysporum* f. sp. *cubense* alone showed moderate effect on plant growth. However, maximum reduction of plant growth parameters was observed in plants inoculated with all the three pathogens together (*F. oxysporum* f. sp. *cubense*, *P. coffeae* and *M. incognita*) suggesting a positive interaction among the three tested pathogens.

427. John, S.; Central Tuber Crops Research Institute, Thiruvananthapuram (India). Div. of Crop Protection). Chitra, K.R.; Central Tuber Crops Research Institute, Thiruvananthapuram (India). Div. of Crop Protection). Nambisan, B.; Central Tuber Crops Research Institute, Thiruvananthapuram (India). Div. of Crop Utilization). Mohandas, C.; Central Tuber Crops Research Institute, Thiruvananthapuram (India). Div. of Crop Protection). Toxicity of cassava cyanogens to the root knot nematode, *Meloidogyne cognita* (Kofoid and White). Indian Journal of Nematology (India). (Jun 2009) v. 39(1) p. 75-79 KEYWORDS: CASSAVA. MELOIDOGYNE INCOGNITA. TOXICITY. MELOIDOGYNE. CYANIDES.

Aqueous extracts of cassava roots showed marked nematicidal activity against the root-knot nematode *Meloidogyne incognita*. These extracts contain significant amounts of cyanogenic compounds viz., linamarin and its degradation products, acetone



cyanohydrin and cyanide. In vitro studies on the effect of cassava cyanogens on second stage juveniles of *M. incognita* showed that both cyanide and acetone cyanohydrin displayed significant and similar nematicidal activity. The toxicity was related to the concentration of these compounds and the exposure time. Linamarin by itself was nontoxic but addition of linamarase released cyanide/acetone cyanohydrin, which produced toxicity. The in vitro activity of cassava root (tuber and rind) extracts was comparable to that produced by sodium cyanide and acetone cyanohydrin, with respect to concentration (cyanide equivalents) and exposure time, indicating that the presence of these compounds in the extracts is the primary factor responsible for nematicidal activity.

428. Sundaraju, P.; National Research Centre for Banana, Tiruchirapalli (India). Crop Protection Lab.). Vertical and horizontal distribution of plant parasitic nematodes associated with banana. *Indian Journal of Nematology* (India). (Jun 2009) v. 39(1) p. 80-84 KEYWORDS: BANANAS. ROTYLENCHUS. PRATYLENCHUS. HELICOTYLENCHUS MULTICINCTUS. PARASITOSSES.

An experiment was conducted at farmer's field to determine the vertical and horizontal distribution of root-lesion nematode, *Pratylenchus coffeae* and other major nematodes on banana in cv. Nendran. Periodic sampling was done from banana garden once in a month from vegetative to harvesting stages by using a 2.5 cm diameter soil auger at a distance of 25, 50 and 75 cm away from the base of the corm at different depths. The results revealed that the maximum nematode population was recorded at flowering stage followed by harvesting stage at a distance of 25 cm and 50 cm from the base of the corm with a depth of 26-50 cm. Negligible or nil population was noticed at a distance of 75 cm from the base of the corm at a depth of 51-75 cm. This clearly showed that the population build-up of major banana nematodes like *P. coffeae*, *M. incognita* and *H. multicinctus* and other nematodes would greatly vary depending on the distance, depth and availability of susceptible roots in banana plants.

429. Dhawan, S.C.; Indian Agricultural Research Institute, New Delhi (India). Div. of Nematology). Singh, S.; Indian Institute of Vegetable Research, Varanasi (India). Compatibility of *Pochonia chlamydosporia* with nematicide and neem cake against root knot nematode, *Meloidogyne incognita* infesting okra. *Indian Journal of Nematology* (India). (Jun 2009) v. 39(1) p. 85-89 KEYWORDS: OKRAS. MELOIDOGYNE INCOGNITA. MELOIDOGYNE. BIOLOGICAL CONTROL. CARBOFURAN.

The effect of antagonistic fungus, *Pochonia chlamydosporia*, a parasite of nematode eggs, neem cake and carbofuran alone and in combinations were evaluated in micro plots infested with *Meloidogyne incognita* on okra under net house condition. Plant growth parameters, fruit yield, root galling, egg production and final nematode population densities were determined after 90 days of germination. Heavy galling in the nematode alone treatment was observed resulted in highest root weight as compared to treated ones and healthy. All the treatments receiving any of the management components showed enhancement in plant growth and suppression of nematode multiplication. The effect of *P. chlamydosporia* (RCA) was recorded better than neem cake and at par with tested nematicide. The combined application of RCA with neem cake and/or carbofuran at reduced doses gave better recovery in comparison to either of the single application in terms of shoot length, shoot weight, root length and fruit yield and significantly ( $P < 0.05$ ) suppressed *M. incognita* in terms of galling, egg production, and soil population. The trio combination of *P. chlamydosporia*, carbofuran and neem cake yielded significantly not only higher fresh fruit weight with a recovery of 53 % but also recovered shoot weight up to 64% over control and suppressed root-knot disease severity in terms of galling, egg production and nematode population (89%, 90% and 81% respectively) with a marginal difference with dual application BCA and carbofuran.

430. Rao, U.; Indian Agricultural Research Institute, New Delhi (India). Div. of Nematology). Sharma, A.; Indian Agricultural Research Institute, New Delhi (India). Div. of Nematology). Rao, S.B.; Indian Agricultural Research Institute, New Delhi (India).



Div. of Nematology). RAPD-PCR analysis of genetic similarity between male and females of *Anguina tritici*. Indian Journal of Nematology (India). (Jun 2009) v. 39(1) p. 90-97  
KEYWORDS: RAPD. PCR. GENETICS. COCKLES. ANGUINA.

Sexual differentiation in *Anguina tritici* requires about two months of feeding ectoparasitically by the second stage juveniles making it a very interesting phenomenon to understand at molecular level. Understanding the molecular genetic differences between male and female nematodes of this nematode may be helpful to estimate genetic proximity between them which in turn could probably reveal number of genes involved in sex determination. Random amplification of polymorphic DNA (RAPD) was used to analyze genomic DNA from females and males of *Anguina tritici* causing ear cockle disease in wheat, with a view to identify sex-specific differences predicted by an Xx/xY system of chromosomal sex determination. 107 random primers belonging to OPA, OPB, OPC, OPD, OPE and OPG used for the RAPD analysis produced 1023 RAPD markers. UPGMA clustering based on these RAPD fragments indicated about 67% similarity between males and females of *A. tritici*. 54 primers belonging to different series of random primers have amplified about 106 male specific RAPD fragments and an average number of male specific bands produced per primer is 0.99.

431. Das, D.K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Nematology). Gaur, H.S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Nematology). Distribution and abundance of *Rotylenchulus reniformis* in cotton growing areas in North India. Indian Journal of Nematology (India). (Jun 2009) v. 39(1) p. 98-103  
KEYWORDS: ROTYLENCHULUS RENIFORMIS. MELOIDOGYNE INCOGNITA. COTTON. GOSSYPIUM. INDIA.

A random survey was undertaken to determine the distribution and abundance of *Rotylenchulus reniformis* and concomitant nematodes in cotton (*Gossypium* spp.) growing area of north India. 184 soil samples were collected from cotton field of different location of Punjab, Haryana and Uttar Pradesh. It was found that reniform nematodes are wide spread occurrence in all three states. Absolute frequency of *R. reniformis* was 56.5 in Punjab, 30.0 in Haryana and 42.3% in Uttar Pradesh. The relative frequency of *R. reniformis* in the total nematode community in Punjab, Haryana and Uttar Pradesh was 10.2, 21.8 and 16.8%, respectively. In Punjab the mean population densities indicated heavier infestation (178/200cm<sup>3</sup>) in farmer's field compared to less infestation (48/200cm<sup>3</sup>) in the research farm. Application of negative binomial distribution indicated that distribution of *R. reniformis* was highly aggregated ( $k=0.07$ ) but was relatively less aggregated in research farm ( $k=0.55$ ). This indicates that there were pocket of high infestation in farmer's field in the rural area indicating monoculture or poorly planned cropping systems with predominance of host crops. The predominant plant parasitic nematodes associated with cotton in this region were *Meloidogyne incognita*, *M. javanica*, *Pratylenchus zeae*, *P. thomei*, *Hoplolaimus indicus*, *Tylenchorhynchus* spp. and *Helicotylenchus* spp.

432. Kanwar, R.S.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Nematology). Bajaj, H.K.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Nematology). Mechanism of resistance in wheat varieties Raj MR1 and AUS 15854 to cereal cyst nematode, *Heterodera avenae* Woll. Indian Journal of Nematology (India). (Jun 2009) v. 39(1) p. 104-105  
KEYWORDS: WHEATS. CEREALS. NEMATODA. HETERODERA AVENAE. DEFENCE MECHANISMS.

433. Kumar, S.; Tamil Nadu Agricultural University, Coimbatore (India). Dept. of Nematology). Management of root knot nematode in papaya by *Pochonia chlamydosporia*. Indian Journal of Nematology (India). (Jun 2009) v. 39(1) p. 105-107  
KEYWORDS: PAPAYAS. NEMATOCIDES. FRUIT CROPS.

434. Vijay, K.; Ayya Nadar Janaki Ammal College, Sivakasi (India). Dept. of Zoology). Pavaraj, M.; Ayya Nadar Janaki Ammal College, Sivakasi (India). Dept. of Zoology). Munisamy, S.; Ayya Nadar Janaki Ammal College, Sivakasi (India). Dept. of Zoology).

Rajan, M.K.; Ayya Nadar Janaki Ammal College, Sivakasi (India). Dept. of Zoology). Effect of seed extract of *Nerium indicum* on growth parameters of black gram infected with root knot nematode. *Indian Journal of Nematology (India)*. (Jun 2009) v. 39(1) p. 107-108 KEYWORDS: VIGNA. MELOIDOGYNE. NERIUM OLEANDER.

435. Sosamma, V.K.; Central Plantation Crops Research Institute, Kayamkulam (India). Varghese, K.M.; St. Thomas College, Kozhencherry (India). Record of root knot nematode, *Meloidogyne incognita* infestation on *Plumbago rosea*, A medicinal plant. *Indian Journal of Nematology (India)*. (Jun 2009) v. 39(1) p. 109 KEYWORDS: MELOIDOGYNE INCOGNITA. MELOIDOGYNE. DRUG PLANTS. INFESTATION.

436. Kanwar, R.S.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Plant Breeding). Viability of inoculum in and pattern of juvenile emergence from cysts of *Heterodera avenae* stored in sand. *Indian Journal of Nematology (India)*. (Jun 2009) v. 39(1) p. 109-110 KEYWORDS: SAND. HETERODERA AVENAE. CYSTS. GLOBODERA.

437. Patel, H.R.; Anand Agricultural University, Anand (India). Tobacco Project). Patel, B.N.; Anand Agricultural University, Anand (India). Tobacco Project). Assessment of avoidable loss due to reniform nematode in bidi tobacco nursery. *Indian Journal of Nematology (India)*. (Jun 2009) v. 39(1) p. 111-113 KEYWORDS: NICOTIANA RUSTICA. MELOIDOGYNE.

438. Arya, R.; Tika Ram Kanya Mahavidyalaya, Aligarh (India). Botany Dept.). Saxena, S.K.; Tika Ram Kanya Mahavidyalaya, Aligarh (India). Botany Dept.). Efficacy of rhizosphere fungi against root knot nematode (*Meloidogyne incognita*) and *Rhizoctonia solani* in tomato crop. *Indian Journal of Nematology (India)*. (Jun 2009) v. 39(1) p. 113-116 KEYWORDS: TOMATOES. RHIZOCTONIA SOLANI. MELOIDOGYNE INCOGNITA. MICROBIAL FLORA.

439. Nagar, M.K.; Maharana Pratap University of Agriculture and Technology, Udaipur (India). Dept. of Nematology). Baheti, B.L.; Maharana Pratap University of Agriculture and Technology, Udaipur (India). Dept. of Nematology). Rathore, B.S.; Maharana Pratap University of Agriculture and Technology, Udaipur (India). Dept. of Nematology). Efficacy of salicylic acid and ascorbic acid against root knot nematode, *Meloidogyne incognita* on mungbean (*Vigna radiata* L.). *Indian Journal of Nematology (India)*. (Jun 2009) v. 39(1) p.116-118 KEYWORDS: SALICYLIC ACIDS. MELOIDOGYNE INCOGNITA. VIGNA RADIATA. RHIZOBIUM.

440. Annigeri, S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Nematology). Pankaj; Indian Agricultural Research Institute, New Delhi (India). Div. of Nematology). Singh, K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Nematology). In vitro mortality of root-knot nematode using different phenolic acids. *Indian Journal of Nematology (India)*. (Jun 2009) v. 39(1) p. 119-120 KEYWORDS: MORTALITY. PHENOLIC ACIDS. MELOIDOGYNE.

441. Hissamuddin; Aligarh Muslim University, Aligarh (India). Dept. of Plant Pathology and Plant Nematology). Azam, T.; Aligarh Muslim University, Aligarh (India). Dept. of Plant Pathology and Plant Nematology). Manuring of tomato (*Lycopersicon esculentum*) and management of root knot disease by *Cassia tora* L.. *Indian Journal of Nematology (India)*. (Jun 2009) v. 39(1) p. 120-122 KEYWORDS: CASSIA TORA. LYCOPERSICON ESCULENTUM. MELOIDOGYNE.

442. Joyamatidevi, L.; DMC of Science, Imphal (India). Dept. of Zoology). Pathogenicity of root knot nematode, *Meloidogyne incognita* on two different indigenous plants of Manipur. *Indian Journal of Nematology (India)*. (Jun 2009) v. 39(1) p. 122-125

KEYWORDS: ALLIUM. PATHOGENICITY. MELOIDOGYNE. MELOIDOGYNE INCOGNITA. MANIPUR.

443. Ram, L.; Maharana Pratap University of Agriculture and Technology, Udaipur (India). Dept. of Nematology). Siddiqui, A.U.; Maharana Pratap University of Agriculture and Technology, Udaipur (India). Dept. of Nematology). Parihar, A.; Maharana Pratap University of Agriculture and Technology, Udaipur (India). Dept. of Nematology). Management of root knot nematode, *Meloidogyne incognita* infecting okra using oil cakes. *Indian Journal of Nematology* (India). (Jun 2009) v. 39(1) p. 125-127  
KEYWORDS: MELOIDOGYNE INCOGNITA. VEGETABLE CROPS. OKRAS. OILSEED CAKES. MELOIDOGYNE.

444. Sharma, D.R.; Punjab Agricultural University, Department of Horticulture. Ludhiana (India). Arora, P.K.; Punjab Agricultural University, Department of Horticulture. Ludhiana (India). Insect and mite pests infesting citrus in Punjab. *Journal of Research Punjab Agricultural University* (India). (Mar & Jun 2009) v.46(1-2) p.34-36  
KEYWORDS: CITRUS. INSECTA. ACARINA. PUNJAB.

The studies on the occurrence of insect and mite species showed that currently there are 27 insect and mite species on citrus under Punjab conditions. Prior to 1999, only 11 species were present but due to improvement in production technology or changes in climatic conditions, 16 more species were added to the existing list of this important crop, which showed about 145 per cent increase in pest problems since 1999. The crucial periods of pest activities are February-June and August-October. The categorization of pests showed that 8 species were very serious (50% damage), 5 species were serious (15-25% damage), 5 species of low intensity (5-15% damage), 6 species were of very low intensity (5% damage) and 3 species were in traces. The findings of study clearly indicated that fruit fly, aphids, mealy bugs, thrips, mites and termites are the emerging problems of citrus in the state.

445. Chadda, R; Punjab Agricultural University, Department of Horticulture, Ludhiana (India). Sharma, D.R.; Punjab Agricultural University, Department of Horticulture, Ludhiana (India). Dhaliwal, H.S.; Punjab Agricultural University, Department of Horticulture, Ludhiana (India). Efficacy of neonicotinoids against leaf miner, *Phyllocnistis citrella* infesting nursery of rough lemon. *Journal of Research Punjab Agricultural University* (India). (Mar & Jun 2009) v.46(1-2) p.37-40  
KEYWORDS: PHYLLOCNISTIS CITRELLA. CITRUS JAMBHIRI. CITRUS. ROOTSTOCKS.

446. Kaur, Harjit; Departmental of Zoology, Punjab Agricultural University, Ludhiana (India). Chhabra, Esha; Departmental of Zoology, Punjab Agricultural University, Ludhiana (India). Impact of environmental factors on the population of Gastropods in commercial ornamental plant nurseries at Ludhiana, Punjab. *Journal of Research Punjab Agricultural University* (India). (Mar & Jun 2009) v.46(1-2) p.60-67  
KEYWORDS: GASTROPODA. SNAILS. ENVIRONMENTAL FACTORS. ENVIRONMENTAL IMPACT. POLLUTION. ORNAMENTAL PLANTS. PUNJAB. SLUGS.

Survey of gastropods (snails and slugs) at commercial plant nurseries at Ludhiana revealed that two biotypes of slug species, *Filicaulis alte* (brown slug with black spots and creamish yellow with black anterior and posterior ends, wrinkled body with irregular polygonal network of brown lines on its dorsal surface i.e. caterpillar like) and two snail species *Macrochlamys indica* and *Macrochlamys cassida* were infesting ornamental plants. *M. indica* snail density varied from  $1.05 \pm 0.47$  to  $1.13 \pm 0.34$  snails m<sup>-2</sup> at 26.5°C air temperature, 23°C soil temperature and 27.6% soil moisture in the months of March-April and September-October. *F. alte* brown slug with black spots slug density varied from  $0.65 \pm 0.06$  to  $0.72 \pm 0.09$  slugs m<sup>-2</sup> at 87-96 relative humidity, 26.5-30°C air temperature and 21-25.5°C soil temperature in the months of March-April and September-October. It was found that gastropods preferred sandy loam, alkaline soil, medium in organic matter, nitrogen and high in phosphorous and potassium. This study revealed a positive correlation between population of surface active gastropods

with air and soil temperature and relative humidity(RH) minimum and a negative correlation with RH maximum and soil temperature.

447. Jacob, T.K.; Indian Institute of Spices Research, Calicut (India). Devasahayam, S.; Indian Institute of Spices Research, Calicut (India). Incidence of Erythrina gall wasp (*Quadrastichus erythrinae* Kim), an invasive insect pest on Erythrina spp., in major black pepper (*Piper nigrum* L.) areas of Kerala and Karnataka, India. *Journal of Plantation Crops (India)*. (Aug 2010) v. 38(2) p. 161-164 KEYWORDS: PEPPER. PIPER NIGRUM.

448. Daniel, Mariamma; Central Plantation Crops Research Institute, Vittal (India). Regional Station. Bionomics of the marmorated bug, *Halyomorpha marmorea* Fab. (Hemiptera: Pentatomidae) in arecanut plantation ecosystem. *Journal of Plantation Crops (India)*. (Apr 2010) v. 38(1) p. 78-81 KEYWORDS: PLANTATIONS. ECOLOGY. HEMIPTERA. PENTATOMIDAE. ARECA CATECHU.

449. Venugopal, S.; N.S.S. College, Pandalam (India). P.G. Dept. of Botany. Chandra Mohan, R.; Central Plantation Crops Research Institute, Kasaragod (India). Epidemiological studies of rotting and immature nutfall of eriophyid mite infested coconut caused by *Lasiodiplodia theobromae*. *Journal of Plantation Crops (India)*. (Apr 2010) v. 38(1) p. 1-6 KEYWORDS: ACERIA GUERRERONIS. COCOS NUCIFERA. EPIDEMIOLOGY. BOTRYODIPLODIA THEOBROMAE.

The intensity of rotting and immature nutfall of Coconut caused by *Lasiodiplodia theobromae* was recorded from a 20-year-old coconut garden in Kerala State, India during June, 2003 to May, 2005 and correlated with climatic factors. A significant correlation coefficient was obtained between disease incidence and relative humidity and minimum temperature. There was a positive correlation between disease incidence and rainfall and number of rainy days. Rotting of eriophyid mite (*Aceria guerreronis*) infested coconuts caused by *L. theobromae* increased with increase in rain. The percentage of disease incidence was high during south-west monsoon period (April-October) in both the years, whereas, it was comparatively low during post-monsoon period. During post--monsoon period the incidence of mite infestation was also the lowest. In both the years, the intensity of *L. theobromae* infection of coconuts increased with rainfall (April onwards),attained peak during July to October and gradually decreased as the temperature rose from November. Identification of critical period of rotting and immature nutfall ofcoconut will be helpful in formulating proper disease management strategies.

450. Raviprasad, T.N.; Directorate of Cashew Research, Puttur (India). Shivarama Bhat, P.; Directorate of Cashew Research, Puttur (India). Age estimation technique for field collected grubs of cashew stem and root borer (*Plocaederus ferrugineus* Linn.). *Journal of Plantation Crops (India)*. (Apr 2010) v.38(1) p.36-41 KEYWORDS: POPULATION DYNAMICS. CASHEWS. SHOOTS. ROOTS. LARVAE. The age estimation technique for cashew stem and root borers (CSRB) was evaluated using prothoracic shield (PIS) width and body length as indicator. The age grouping of field collected CSRB grubs was standardized using PIS width. Based on the backdating of the field collected grubs, it was observed that the maximum egg laying had occurred during December to June. The maximum percentage of younger CSRB grubs (96.89) out of the total young grubs encountered in a year were found to occur between February to June. This period coincides with the nut collection period in most of the cashew growing tracts. Hence, this will be the optimal period to adopt grub removal, for reducing bark damage to infested trees and minimizing subsequent reinfestation by this pest.

## H20 Plant Diseases

451. Khilari, J.M.; Maharashtra Rajya Draksh Bagaitdar Sangh, Pune (India). Shelke, T.S.; Maharashtra Rajya Draksh Bagaitdar Sangh, Pune (India). Evaluation of Different Fungicides against downy mildew (*Plasmopara viticola*) of Grapes in maharashtra.

Journal of Maharashtra Agricultural Universities (India). (May 2010) v.35(2) p.255-257  
KEYWORDS: MILDEWS. FUNGICIDES. GRAPES. MAHARASHTRA.

The downy mildew on grapes was significantly reduced by systemic fungicides like Metalaxyl 35 WS 2.5 g l<sup>-1</sup> and fosetyl 80 WP 2.0 g l<sup>-1</sup> which resulted into the higher yield of 15.04 kg and 14.29 kg vine<sup>-1</sup> respectively.

452. Bhuvaneshwari, V.; Horticulture Research Station, Pandirimamidi (India). Venkata Ramana, K.T.; Horticulture Research Station, Pandirimamidi (India). Bhagavan, B.V.K.; Horticulture Research Station, Pandirimamidi (India). Nega Lakshmi, R.; Horticulture Research Station, Pandirimamidi (India). Srinivasulu, B.; Horticulture Research Station, Pandirimamidi (India). In vitro studies on management of leaf blight disease of palmyrah caused by *Pestalotiopsis palmarum* (Cooke) Stey. Journal of Plantation Crops (India). (Aug 2010) v.38(2) p.165-167 KEYWORDS: BORASSUS FLABELLIFER.

453. Sasikala, M.; Central Plantation Crops Research Institute, Kayangulam (India). Regional Station. Rajeev, G.; Central Plantation Crops Research Institute, Kayangulam (India). Regional Station. Prakash, V.R.; Central Plantation Crops Research Institute, Kayangulam (India). Regional Station. Amith, S.; Central Plantation Crops Research Institute, Kayangulam (India). Regional Station. Modified protocol of ELISA for rapid detection of coconut root(wilt) disease. Journal of Plantation Crops (India). (Apr 2010) v.38(1) p.16-19 KEYWORDS: COCONUTS. ELISA. PHYTOPLASMAS.

Root (wilt) disease of coconut is a phytoplasmal malady causing heavy economic loss to the coconut farmers in Kerala and Tamil Nadu. The disease is generally recognized based on foliar symptoms. But the development of foliar symptoms in coconut palms is very slow and there is a time lag between infection and symptom expression. To identify such latent infected palms, Direct Antigen Coated (DAC) indirect ELISA had been standardized earlier. But this ELISA system was not rapid. Though subsequently it was refined, 24 h was required for the completion of the test. Hence, a modified protocol was developed using leaf disc as test antigen. The modified protocol is simple, rapid and results could be obtained within 7h. The test yielded very high sensitivity of 98% with respect to visual observations. The modified protocol is being used for the routine screening of coconut palms for selection of disease-free mother palms for developing root (Wilt) resistant/tolerant varieties. Besides this, the test is being used for confirmation of root (wilt) disease in coconut palms seen in mildly disease affected and disease outbreaks in new areas.

454. Hareesh, P.S.; Indian Institute of Spices Research, Calicut (India). Bhat, A.I.; Indian Institute of Spices Research, Calicut (India). Seed transmission of Piper yellow mottle virus in black pepper (*Piper nigrum* L). Journal of Plantation Crops (India). (Apr 2010) v.38(1) p.62-65 KEYWORDS: PEPPER. SYMPTOMS. PIPER. VIRUSES. SEEDS. TRANSMISSIONS.

The study demonstrated the occurrence of true seed transmission of Piper yellow mottle virus (PYMoV) in black pepper (*Piper nigrum*) based on symptoms and polymerase chain reaction (PCR) tests of seedlings. The presence of PYMoV virions in berries and seedlings were confirmed by immunocapture (IC) PCR. This is the first report of occurrence of seed transmission of PYMoV.

## **H60 Weeds and Weed Control**

455. Aulakh, C.S.; Punjab Agricultural University, Department of Agronomy, Ludhiana (India). Mehra, S.P.; Punjab Agricultural University, Department of Agronomy, Ludhiana (India). Effect of herbicides and submergence period on red Sprangletop [*Leptochloa chinensis* (L.) Nees] in transplanted rice. Journal of Research Punjab Agricultural University (India). (Mar & Jun 2009) v.46(1-2) p.1-5 KEYWORDS: HERBICIDES. WATER TOLERANCE. PLANTING. RICE. WEEDS.

A field experiment was conducted to evaluate the effect of herbicides and submergence period on the growth behaviour of emerging weed Red Sprangletop



[*Leptochloa chinensis* (L.) Nees] in transplanted rice on a loamy sand soil during kharif 2003 and 2004 at Punjab Agricultural University, Ludhiana in a split plot design with three submergence periods (one, two and three week after transplanting of rice) in the main plots and four herbicides (butachlor 1.5 kg, anilofos 0.375 kg, pretilachlor 0.75 kg and pyrazosulfuron 0.015 kg ha<sup>-1</sup>) along with an unweeded control in the sub plots. The two and three week submergence, though statistically at par, were significantly better than one-week submergence in registering better control of *Leptochloa chinensis* by reducing its emergence, plant height, LAI and dry matter accumulation leading to higher grain yield of rice. The submergence of two and three week registered 46.7 and 48.1 per cent increase in grain yield of rice over the one week submergence, respectively. All the herbicides were statistically at par but were significantly better than the unweeded control in respect of growth parameters of *L. chinensis* and grain yield of rice. The growth of *L. chinensis* was not adversely affected by herbicides under one week submergence.

456. Yadav, D.B.; Chaudhary Charan Singh Haryana Agricultural University, Karnal (India). Regional Research Stn.). Punia, S.S.; Chaudhary Charan Singh Haryana Agricultural University, Karnal (India). Regional Research Stn.). Yadav, A.; Chaudhary Charan Singh Haryana Agricultural University, Karnal (India). Regional Research Stn.). Singh, S.; Chaudhary Charan Singh Haryana Agricultural University, Karnal (India). Regional Research Stn.). Lal, R.; Chaudhary Charan Singh Haryana Agricultural University, Karnal (India). Regional Research Stn.). Pinoxaden: an alternate herbicide against little seed canary grass (*Phalaris minor*) in wheat (*Triticum aestivum*). Indian Journal of Agronomy (India). (Dec 2009) v. 54(4) p. 433-437 KEYWORDS: TRITICUM AESTIVUM. HERBICIDES. ECONOMICS. ORYZA SATIVA. PHALARIS.

Two field experiments were conducted at Karnal, Haryana during rabi 2005-06 and 2006-07 to evaluate the efficacy of pinoxaden against *Phalaris minor* in wheat. Pinoxaden 10 EC 40g/ha+adjuvant 2,000ml/ha and pinoxaden 5 EC (with built-in adjuvant) 50g/ha reduced the dry weight of *Phalaris minor* to the extent of 92-99 and 89-98%, respectively, and were at par with weed free checks during both the years. Consequently, Pinoxaden 5 EC 50g/ha and Pinoxaden 10 EC 40g/ha+adjuvant 2,000ml/ha being at par with weed free checks produced grain yield of wheat to the tune of 6.1-6.2 and 5.7-6.1 t/ha. Efficacy of pinoxaden 10 EC against *P. minor* increased by about 70% with addition of adjuvant indicating that adjuvant is must with this formulation. Pinoxaden 5 EC 50 g/ha was superior to lower doses, fenoxaprop and sulfosulfuron, however, it was at par with clodinafop during both the years. Both formulations of pinoxaden were ineffective against broad-leaved weeds. Maximum net returns (Rs 14,400-19,500/ha) and benefit: cost ratio (0.74-0.91) was obtained under pinoxaden 5 EC 50g/ha. There was no phytotoxicity on wheat and no residual toxicity on the succeeding rice crop.

## **J10 Handling, Transport, Storage and Protection of Agricultural Products**

457. Nagamaniammai, G.; Arumugham, C.; Venugopal, V.V.; Gangopadhyay, Hiranmoy. Quality optimization for membrane concentrated tender coconut water.. Journal of Plantation Crops (India). (Aug 2010) v. 38(2) p. 111-117 KEYWORDS: REVERSE OSMOSIS. COCONUT WATER. COCOS NUCIFERA.

Tender coconut water is the most nutritious wholesome beverage, which will get deteriorated within 6-8h at normal atmospheric conditions. A study was undertaken to improve the shelf life with minimum change to its nutritional and other sensory attributes. Reverse osmosis technique was used as a preservation method to concentrate the tender coconut water. Trials were made for dummy solution and coconut water to optimize the processing conditions based on their chemical compositions and sensory attributes. The total soluble solid content of concentrated juice was increased from 4.5 to 14.0%. Apart from this, other nutrients also increased 2-2.5 times of its original content. Storage studies were carried out for membrane concentrated tender coconut water, 25 and 50% upgraded tender coconut water concentrate as control, tender coconut water

packed in sterile container and with chemical preservative (500 ppm of sodium benzoate). The samples were stored at  $30\pm 2^{\circ}\text{C}$  and at  $12^{\circ}\text{C}$ . No changes were observed in the samples kept at  $12^{\circ}\text{C}$  up to 43 days. At the same time, increase in the acidity, decrease in reducing sugar content and pH were noticed in the samples kept at  $30\pm 2^{\circ}\text{C}$  within 22 days. Out of all these samples, 14% membrane concentrated tender coconut water and 25% upgraded tender coconut water without preservative in the sterile container at  $12^{\circ}\text{C}$  with minimum changes in chemical composition was accepted by panelists.

### **J11 Handling, Transport, Storage and Protection of Plant Products**

458. Reghu, C.P.; Rubber Research Institute of India, Kottayam (India). Thomas, Jimmy; Rubber Research Institute of India, Kottayam (India). Marattukalam, Joseph G.; Rubber Research Institute of India, Kottayam (India). Annamma, Varghese Y.; Rubber Research Institute of India, Kottayam (India). Variation in strength properties of wood of ten selected clones of *Hevea brasiliensis*. Journal of Plantation Crops (India). (Apr 2010) v.38(1) p.7-10 KEYWORDS: HEVEA BRASILIENSIS. RUBBER.

Variation in certain strength properties of wood such as static bending, tensile strength, compressive strength, shearing strength, and hardness in mature trees of ten clones of *Hevea brasiliensis* viz, RRII 44, RRII 45, RRII 105, PB 235, PB 260, PB 310, PB 311, PR 255, PR 261 and RRIM 600 were studied. It was found that the modulus of rupture of the timber under static bending was significantly higher in the clone RRII 105 than that of PB 260, PB 311, PR 255, PR 261, RRIM 600, RRII 44 and RRII 45. The modulus of elasticity was significantly higher in PB 235 than that of all other clones except RRII 105. The timber of RRII 105 also showed superiority over all other nine clones for other static bending parameters such as maximum load, fibre stress at limit of proportionality, horizontal stress at limit of proportionality and horizontal stress at maximum load. The variation in the tensile strength and shearing strength properties between clones were not statistically significant. The maximum load bearing capacity under compressive strength was significantly higher in RRII 105 than PB 311, PR 255, PR 261, RRII 44 and RRII 45. The wood hardness test at various planes (radial, tangential and end) also indicated significant clonal variation. The hardness of wood at radial and tangential planes was significantly higher in RRII 105 than that of PB 260 and RRII 44. The present study revealed significant clonal variability in strength properties of different clones of rubber wood. The study also revealed that the timber quality of the popular clone RRII 105 is superior to majority of the clones studied in terms of static bending, compressive strength and hardness.

459. Prasad, J.V.N.S.; Central Research Institute for Dryland Agriculture, Hyderabad (India). Gangaiyah, B.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Kundu, S.; Central Research Institute for Dryland Agriculture, Hyderabad (India). Korwar, G.R.; Central Research Institute for Dryland Agriculture, Hyderabad (India). Venkateswarlu, B.; Central Research Institute for Dryland Agriculture, Hyderabad (India). Singh, V.P.; ICRAF South Asia Regional Office, New Delhi (India). National Agricultural Research Science Complex). Potential of short rotation woody crops for pulp fiber production from arable lands in India. Indian Journal of Agronomy (India). (Dec 2009) v. 54(4) p. 380-394 KEYWORDS: AGROFORESTRY. POPULUS DELTOIDES. EUCALYPTUS. RAINFED FARMING.

Wood fiber is used for the manufacture of various kinds of paper, packaging material, tissues, paperboard etc. The conventional soft woods and hard woods used as raw materials by pulp, paper and cellulose based industries are depleting day by day and the wood imports are draining country's foreign exchange. Short rotation industrial agroforestry plantations with the fast growing tree species are potential sources to fill this gap and to make the nation self reliant in pulpwood supply. Poplar, eucalyptus, leucaena and bamboo are the ideal species that can be grown commercially in private lands for meeting the wood requirements and has the potential to produce a biomass of 18 to 49t/ha per year. The pulp yield from these species ranges from 40 to 49% of the

wood biomass produced. With the expansion of wood markets, high biomass yields and amenability for harvesting in short rotations, short rotation woody crops can be one of the profitable options for fiber production on lands which are not suitable for intensive arable cropping. Some of the important fiber supplying species which are grown under Indian conditions and their agroforestry systems and profitability aspects are discussed in the paper.

## **N20 Agricultural Machinery and Equipment**

460. Verma, Aseem; Punjab Agricultural University, Department of Farm Machinery and Power Engineering, Ludhiana (India). Singh, Manjeet; Punjab Agricultural University, Department of Farm Machinery and Power Engineering, Ludhiana (India). Sidhu, H.S.; Punjab Agricultural University, Department of Farm Machinery and Power Engineering, Ludhiana (India). Performance of combine mounted straw managing system during rice crop harvesting. *Journal of Research Punjab Agricultural University (India)*. (Mar & Jun 2009) v.46(1-2) p.72-78 **KEYWORDS: RESIDUES. MANAGEMENT.**

The major problem during sowing under conservation tillage in combine harvested paddy fields is the frequent choking of conservation tillage machines due to long loose straw, lying in the windrows. Effective residue management requires both straw and chaff to be finely chopped and evenly spread over the entire cutting width of combine. The study was undertaken to evaluate the performance of straw managing system (SMS), developed as an attachment for the existing combine, affected by various independent parameters. Three levels of number of rows of stationary blades (one, two & three rows), three levels of rotor speed index (30, 35 & 40) and two levels of deflector angle (20° & 30° with horizontal) were selected for the study. Optimal combination of different independent parameters was selected on the basis of uniformity of straw thrown (C.V. basis). Uniformity of straw thrown improved significantly when number of rows of stationary blades was increased from one to three. Similar pattern was observed when rotor speed index was increased from 30 to 40. Deflector angle had nonsignificant effect on uniformity of straw thrown. Optimal combination, at which there was maximum uniformity of straw thrown i.e. C.V. 15.25%, was observed at combination of three rows of stationary blades, rotor speed index of 40 and deflector angle of 20°. Sowing performance of spatially modified no-till drill while harvesting paddy crop at optimal settings of straw managing system was almost same as the performance of conventional no-till drill operated in clean field.

461. Dogra, Ritu; Punjab Agricultural University, Department of Farm Machinery and Power Engineering, Ludhiana (India). Dogra, Baldev; Punjab Agricultural University, Department of Farm Machinery and Power Engineering, Ludhiana (India). Virk, M.S.; Punjab Agricultural University, Department of Farm Machinery and Power Engineering, Ludhiana (India). Dhaliwal, I.S.; Punjab Agricultural University, Department of Farm Machinery and Power Engineering, Ludhiana (India). Performance of modified thresher for mustard. *Journal of Research Punjab Agricultural University (India)*. (Mar & Jun 2009) v.46(1-2) p.83-89 **KEYWORDS: THRESHERS. MUSTARD.**

Effect of feed rate (F) and peripheral speed (PS) on threshing efficiency, cleaning efficiency, grain damage, losses from various outlets of a modified spike tooth cylinder type multicrop thresher was studied. Cylinder concave clearance was kept 25 mm. Number of spikes used was 12 (two/row in helical pattern) instead of 36 spikes used in wheat thresher. Three feed rates of 4.3, 5.0 & 5.8 q/h and four peripheral speeds 13.4, 16.4, 17.5 & 20.1 m/s were selected. The straw grain ratio was 4.02. Threshing efficiency was more than 99.5 per cent and statistically comparable for the studied range of feed rates and peripheral speeds. Cleaning efficiency varied from 97.62 to 99.26 per cent. Cleaning efficiencies were slightly lower at lower peripheral speeds and higher feed-rates. However, these were statistically comparable for all the treatment combinations. Grain breakage varied from 0.2 to 0.3% for different feed rates and peripheral speeds except for peripheral speed PS4 (0.79). Per cent broken grains were minimum for treatment combination F2PS1 and these were statistically comparable with

F3PS1. Total noncollectable losses varied from 0.04 to 0.11 per cent for different feed rates and peripheral speeds of threshing cylinder except for PS4. Percent non collectable losses were statistically comparable for all peripheral speeds except PS4. These were statistically lower for federates F2 and F3 as compared to F1. Therefore thresher can be operated at peripheral speed PS1 (13.4 m/s) at feed-rates F2 (5.0 q/h) and F3 (5.8 q/h).

### **P01 Nature Conservation and Land Resources**

462. Acharya, Somen; Indian Agricultural Reserch Institute, Division of Environmental Science, New Delhi (India). Adak, Tarun; Indian Agricultural Reserch Institute, Division of Agricultural Physics, New Delhi (India). Wetland management for sustainable development. Journal of Soil and Water Conservation (India). (Oct 2009) v.8(4) p.25-30  
KEYWORDS: BIODIVERSITY. LEGISLATION. MANAGEMENT.

Wetlands ecosystems are a natural resource of local, regional and global significance. Historically, their high level of plant and animal (especially bird) diversity is perhaps the major reason why wetland protection has become a high priority worldwide, supported by international agreements, such as Ramsar Convention and the International Convention of Biological Diversity. More recently, a number of goods and services provided specially by wetland ecosystems have been identified that may even outweigh biodiversity in terms of their importance for human welfare and sustainable natural resource management. Wetlands, as transitional zones between land and water, provide a natural protection against extreme floods and storm surges. They may also store freshwater to be used for drinking water preparation or for irrigation. Wetlands bordering streams, rivers and lakes have a water quality enhancement function that is increasingly recognized. As natural habitats for fish, riverside wetlands, shallow lakes and coastal wetlands have the potential to produce large fish stocks, which are exploited commercially in some regions, but could be enhanced by restoring wetlands in degraded areas. Because wetlands often provide spawning habitats, their importance as a source of juvenile fish for large aquatic lakes and river channels should not be underestimated. In addition to these local and regional benefits, wetlands as a global resource provide a net sink of carbon dioxide. However, in recent years wetlands are a threatened part of our natural ecosystem. Centuries of draining have ensured the destruction of many of our wetlands. Declining area and quality of wetlands in recent times have had serious consequences for wildlife. Remaining areas of wetland habitats are increasingly small and isolated and their decline continues. Having clear goals along with a site specific plan is the key to successful wetland management. Construction, grading, fertilization and other changes to the land surrounding wetlands may increase the flow of water and pollutants to wetlands, overwhelming their ability to function and remain healthy. Therefore, immediate steps are to be undertaken as a part of policy matter for conserving, restoring and sustaining the existing wetlands ecosystems.

463. Prasad, Rajendra; Central Arid Zone Research Institute, Jaisalmer (India). Mertia, R.S.; Central Arid Zone Research Institute, Jaisalmer (India). Tree windbreaks and their shelter benefits on farmland in arid region of western rajasthan. Journal of Soil and Water Conservation (India). (Oct 2009) v.8(4) p.46-50  
KEYWORDS: ARID ZONES. REDUCTION. WINDBREAKS. TREES. FARMLAND.

The crops in the shivaliks of Punjab usually suffer water stress under limited and erratic water supply condition. A field experiment was conducted on a sandy loam soils during 2004-05 and 2005-06 to study the effect of tillage and nitrogen management on grain yield, water expense and soil physical properties in maize-wheat cropping sequence under rainfed conditions. The soil of the experimental site is classified as a fine loamy fluventic ustochrept. The treatments of conventional tillage and reduced tillage along with chemical weed control were at par with respect to grain yield of maize. The tillage had no significant effect on grain yield of wheat. 100% inorganic fertilization gave significantly higher maize grain yield over other treatments, while the treatments of 100% inorganic fertilization, and 50% through organic source and 50% through inorganic source were at par with respect to grain yield of wheat. The water expense



efficiency was higher under conventionally tilled plots in maize, while in wheat, it was higher in reduced tilled plots with chemical weed control. The infiltration rate, bulk density and nitrogen uptake were significantly affected by different tillage and nitrogen management.

### **P10 Water Resources and Management**

464. Sherring, Arpan; Allahabad Agricultural Institute, Allahabad (India). Dept. of Soil, Water, Land Engg. and Management. Amin, Hafizishtiyag; Allahabad Agricultural Institute, Dept. of Soil, Water, Land Engg. and Management, Allahabad (India). Mishra, A.K.; Allahabad Agricultural Institute, Dept. of Soil, Water, Land Engg. and Management, Allahabad (India). Mohd, A. Alam; Allahabad Agricultural Institute, Dept. of Soil, Water, Land Engg. and Management, Allahabad (India). Stochastic time series modeling for prediction of rainfall and runoff in lidder catchment of South Kashmir. *Journal of Soil and Water Conservation (India)*. (Oct 2009) v.8(4) p.11-15 KEYWORDS: RAIN. RUNOFF.

A study was conducted to develop a stochastic time series model for prediction of annual rainfall and runoff for Lidder catchment of Lidder river. The study area is one of the macro watershed of lidder river and has an area of 1,243 km<sup>2</sup>. The developed model is based on 15 years (1993-2007) annual rainfall and runoff data collected by Indian Metrological Department, Srinagar, and Civil Investigation and Design Division, Anantnag, Jammu and Kashmir, India. Autoregressive(AR) model of order 0, 1 and 2 proposed by Kottegoda and Horder (1980) were tried. The goodness of fit and adequacy of model was tested by Box-Pierce Portmonteau test, Akai information criterion (AIC) and various statistical characteristics, viz. Mean Forecast Error (MFE), Mean Absolute Error (MAE), Mean Relative Error (MRE), Root Mean Square Error (RMSE) and Integral Square Error (ISE). Based on the results, it was concluded that AR(I) model can be effectively used for prediction of rainfall and runoff for Lidder catchment of Lidder river in south Kashmir.

465. Pendke, M.S.; Marathwada Agricultural University, College of Agricultural Engineering and Technology, Dept. of Soil and Water Conservation Engineering, Parbhani (India). Relative efficacy of rain water conservation techniques and organic sources under rainfed condition. *Journal of Soil and Water Conservation (India)*. (Oct 2009) v.8(4) p.16-19 KEYWORDS: RAINWATER. STORAGE. DRY FARMING. ORGANIC AGRICULTURE.

Rain water conservation techniques, like large compartmental bunding and furrow opening in between the crop rows in combination with organic sources like FYM (5 tonnes/ha), Glyricidia (6 tonnes/ha), Neem powder (1 tonne/ha) and Vermicompost (3 tonnes/ha) were evaluated for their impact on increasing the productivity of cotton + soybean intercropping system. The highest productivity of soybean 765.67 kg/ha and cotton 657.34 kg/ha were recorded due to application of FYM followed by Neem powder, Glyricidia and Vermicompost. All the organic sources were tested in combination with rain water management techniques. The highest moisture use (320 mm) was recorded in the treatment of application of Glyricidia with moisture use efficiency of Rs.63.65/kg yield, per unit rainfall (mm) and per hectare. The monetary return of Rs.20,365/ha was recorded in the treatment of application of Glyricidia with rainwater conservation techniques. Organic sources improved the bulk density of soil as well as infiltration rate of soil. The rainwater conservation techniques with Glyricidia reduced the runoff and soil loss from the intercrop of cotton+soybean. Approximately, 48.1% more water was conserved due to above treatment combination. Similarly 37.47% soil was arrested in the field itself due to combined effect of rainwater conservation with organic sources.

### **P30 Soil Science and Management**

466. Saha, R.; Indian Institute of Horticultural Research, Bhubaneswar (India). Central Horticultural Experiment Stn.). Mishra, V.K.; Central Soil Salinity Research Institute, Lucknow (India). Regional Research Stn.. Khan, S.K.; Visva Bharati, Sriniketan (India).



ASEPAN). Evaluation and development of pedo-transfer functions for prediction of soil water retention characteristics of modified land use systems under hilly agro-ecosystem of North-eastern India. *Journal of the Indian Society of Soil Science (India)*. (Sep 2009) 56(3) p. 254-259 KEYWORDS: WATER MANAGEMENT. HILL SOILS. SOIL WATER RETENTION. LAND VARIETIES.

Soil water retention characteristics under various modified land use systems of Meghalaya, have been determined from commonly and easily measured soil properties such as soil texture, bulk density and organic carbon content based on multivariate linear pedo-transfer functions (PTFs). The predicted soil water contents at field capacity (FC) and permanent wilting point (PWP) from regression model were in good agreement with those obtained by laboratory analysis. Few other selected PTFs were also evaluated on large independent soil datasets under present study. Tomasella and Hodnett (1998) model was found to be satisfactory for prediction of soil moisture characteristics under present condition. Results from the present study revealed that PTFs based on soil texture, bulk density and organic carbon content perform better for soil moisture prediction under hilly agro-ecosystems of North-eastern India.

467. Bandyopadhyay, K.K.; Central Institute for Cotton Research, Coimbatore (India). Regional Stn. Misra, A.K.; Indian Institute of Soil Science, Bhopal (India). Ghosh, P.K.; Indian Institute of Soil Science, Bhopal (India). Hati, K.M.; Indian Institute of Soil Science, Bhopal (India). Mohanty, M.; Indian Institute of Soil Science, Bhopal (India). Singh, R.K.; Indian Institute of Soil Science, Bhopal (India). Assessment of critical soil water potential for emergence of wheat, chickpea and linseed seedlings in relation to water stress in a vertisol. *Journal of the Indian Society of Soil Science (India)*. (Sep 2009) 56(3) p. 267-275 KEYWORDS: SOIL WATER POTENTIAL. WHEATS. CHICKPEAS. LINSEED. VERTISOLS. CHEMICOPHYSICAL PROPERTIES.

Seedling emergence influences the initial plant population and hence the yield of any annual crop. Among the soil physical properties, soil water potential is the most critical factor influencing the seedling emergence. The narrow range of soil water for sowing operation and limited availability of irrigation water are the major constraints for seedling emergence and productivity of the dry season crops in Vertisols. A field experiment was carried out on a deep Vertisol at the Indian Institute of Soil Science, Bhopal to find out the critical soil water potential for the emergence of wheat, chickpea and linseed seedlings and to assess the amount of presowing irrigation required and the optimum time of sowing following the presowing irrigation for achieving the desired emergence of seedlings. Wheat, chickpea and linseed were sown after 1 to 9 days of drainage following application of six levels of presowing irrigation viz., 0, 2, 4, 6, 8, and 10 cm. The results showed that the critical matric potential for the initiation of emergence of wheat, chickpea and linseed was -72.60, -68.65 and -72.76 kPa, respectively and the corresponding critical volumetric water content at the time of sowing was 0.17, 0.19 and 0.18 cm<sup>3</sup> cm<sup>-3</sup>, respectively. It was estimated that for achieving 50% emergence, wheat, chickpea and linseed might be sown respectively at 4, 3 and 1 days after drainage of 8 or 10 cm presowing irrigation. The emergence rate index decreased significantly with the increase of matric suction of the seed zone caused by application of less amount of presowing irrigation or delay in sowing after application of a given amount of presowing irrigation. The logistic growth model successfully predicted the relative emergence of wheat, chickpea and linseed.

468. Radder, B.M.; University of Agricultural Sciences, Dharwad (India). All India Coordinated Research Project on Water Management). Patil, P.L.; University of Agricultural Sciences, Dharwad (India). All India Coordinated Research Project on Water Management). Aladakatti, Y.R.; University of Agricultural Sciences, Dharwad (India). All India Coordinated Research Project on Water Management). Patil, S.G.; University of Agricultural Sciences, Dharwad (India). All India Coordinated Research Project on Water Management). Response of okra (*Abelmoschus esculentus* L.) to moisture regimes and micronutrients in vertisols of Malaprabha command, Karnataka. *Journal of the Indian*

Society of Soil Science (India). (Sep 2009) 56(3) p. 276-280 KEYWORDS: VERTISOLS. NUTRIENTS. KARNATAKA. ABELMOSCHUS ESCULENTUS.

A field experiment was conducted on a Vertisol of Malaprabha right bank command (MRBC) of Karnataka for three years (2004-05 to 2006-07) to study the effect of moisture regimes and micronutrient application on okra (*Abelmoschus esculentus* L.) yield, water use efficiency (WUE), nutrient uptake and economics. Response of okra was significant due to both irrigation levels as well as micronutrient application. Highest fresh okra yield of 9.3 t ha<sup>-1</sup> was realized when crop received irrigation at 12 moisture regime (1.0 IW/CPE). Application of micronutrients increased the yield of okra. The N, P, K, Zn and Fe uptake by the crop was significant due to moisture levels and micronutrient application. Interaction effect indicated that crop receiving irrigation level of 1.0 IW/CPE with application of ZnSO<sub>4</sub> and FeSO<sub>4</sub> each 20 kg ha<sup>-1</sup> recorded significantly higher okra yield (9.3 t ha<sup>-1</sup>), WUE (30.27 kg ha<sup>-1</sup>) and B:C ratio (5.07).

469. Rao, K.J.; Acharya N.G. Ranga Agricultural University, Hyderabad (India). Dept. of Soil Science and Agricultural Chemistry). Lakshmi, Ch.S.R.; Acharya N.G. Ranga Agricultural University, Hyderabad (India). Dept. of Soil Science and Agricultural Chemistry). Raju, A.S.; Acharya N.G. Ranga Agricultural University, Hyderabad (India). Dept. of Soil Science and Agricultural Chemistry). Evaluation of manurial value of urban and agricultural waste composts. Journal of the Indian Society of Soil Science (India). (Sep 2009) v.56(3) p.295-299 KEYWORDS: SOLID WASTES. COMPOSTS. WASTE MANAGEMENT.

The hygienic disposal of organic wastes by composting is an environmentally-sound and economically-viable technology resulting in the production of organic fertilizer which is a basic and valuable input in organic farming. Methods of composting for the production of organic manures of high quality were standardized. Composting methods with enrichment techniques were adopted with 2 methods (aerobic and anaerobic) and 7 treatments in each method. The samples of the aerobic compost were drawn after 30,60,90 and 120 days after composting and in anaerobic compost samples were drawn after 150 days of composting. Effect of bio-inoculum (*Pleurotus scljorcaju*), chemical amendments (0.88% P and 1% N) and method of composting on organic carbon (OC), chemical oxygen demand (COD), cation exchange capacity (CEC), C/N ratio, pH, EC and total nutrient status during composting was determined in aerobic and anaerobic composts. The OC, COD, C/N ratio decreased significantly during maturation of the compost irrespective of treatments and method of composting. High organic carbon was recorded in 100% urban solid waste (USW) compost in both the methods. It ranged from 20.15 to 24.0% in aerobic matured compost and from 21.5% to 23.25% in anaerobic matured compost. The 100% agricultural waste (AW) compost had lower C:N ratio (18.65 and 17.47 in aerobic and anaerobic composts, respectively) than 100% USW compost (19.20 to 18.02 in aerobic and anaerobic compost, respectively). Nitrogen content increased from 0.78 to 1.29% in 100% urban waste compost and from 0.75 to 1.23% in 100% agricultural compost. Rock phosphate treated composts in both the methods enhanced the total P content with maximum of 0.89% in both aerobic and anaerobic composts. There was a gradual increase in total K content from the initial status of 0.44 to 0.64%.

470. Singh, P.K.; Nagaland University, Nagaland (India). Dept. of Agricultural Chemistry and Soil Science). Biswas, A.K.; Indian Institute of Soil Science, Bhopal (India). Determining the potassium releasing power of the acid soils of Nagaland. Journal of the Indian Society of Soil Science (India). (Sep 2009) v.56(3) p. 305-308 KEYWORDS: ACID SOILS. POTASSIUM. SOIL CHEMISTRY. NAGALAND.

471. Kour, S.; Sher-e-Kashmir University of Agriculture and Technology, Jammu (India). Div. of Soil Science and Agricultural Chemistry). Jalali, V.K.; Sher-e-Kashmir University of Agriculture and Technology, Jammu (India). Div. of Soil Science and Agricultural Chemistry). Forms of sulphur and their relationships in soils of different agro-climatic

zones of Jammu region. *Journal of the Indian Society of Soil Science (India)*. (Sep 2009) v.56(3) p. 309-312 KEYWORDS: SULPHUR. SOIL TYPES. JAMMU AND KASHMIR.

472. Sunitha, S.; Directorate of Oil Palm Research, Regional Station, Trivandrum (India). Varghese, P.T.; Directorate of Oil Palm Research, Regional Station, Trivandrum (India). Babu, Kochu; Directorate of Oil Palm Research, Regional Station, Trivandrum (India). Fertilizer requirement of under planted oil palm during pre-bearing stage.. *Journal of Plantation Crops (India)*. (Aug 2010) v. 38(2) p. 148-150 KEYWORDS: OIL PALMS. UNDERPLANTING. FERTILIZERS.

473. Syamala, V.K.; Rubber Research Institute of India, Kottayam (India). George, Sherin; Rubber Research Institute of India, Kottayam (India). Joseph, Kochuthressiamma; Rubber Research Institute of India, Kottayam (India). Nair, A.N. Sasidharan; Rubber Research Institute of India, Kottayam (India). Nair, Usha N.; Rubber Research Institute of India, Kottayam (India). Effect of inorganic and organic sources of fertilizers on growth of rubber (*Hevea brasiliensis*) seedlings. *Journal of Plantation Crops (India)*. (Aug 2010) v.38(2) p.151-153 KEYWORDS: GROWTH. INORGANIC FERTILIZERS.

474. Jessy, M.D.; Rubber Research Institute of India, Kottayam (India). Prasannakumari, P.; Rubber Research Institute of India, Kottayam (India). Nair, R.B.; Rubber Research Institute of India, Kottayam (India). Vijayakumar, K.R.; Rubber Research Institute of India, Kottayam (India). Nair, Usha N.; Rubber Research Institute of India, Kottayam (India). Influence of soil moisture and nutrient status on fine root dynamics of rubber trees (*Hevea brasiliensis*). *Journal of Plantation Crops (India)*. (Aug 2010) v. 38(2) p. 92-90 KEYWORDS: STRESS. NUTRITIONAL STATUS. RUBBER CROPS.

Fine roots are important for water and nutrient acquisition and their dynamics have profound influence on the below ground resource capture efficiency of trees. The present investigation was taken up to study the effect of environmental variables viz., soil moisture and soil nutrient status on the fine root dynamics of rubber trees, and to find out the period of highest fine root density to optimize the timing of pre-monsoon fertilizer application. The study was conducted at two locations, Kottayam and Chethackal with distinct variation in soil nutrient status, comparatively lower status at Kottayam and higher at Chethackal. Root observations were recorded during 2006 and 2007. Soil moisture stress during summer season was less during 2006 compared to 2007. At both the locations, the clone was RR11 105 and trees were 17 years old. Fine root density in the surface layer (0-7.5 cm) was quantified during summer season and after the onset of rains till the root density stabilized or declined. Soil moisture was recorded periodically. With the onset of rains, fine roots began to develop and the highest root density was observed after a period of 35 to 45 days at both the locations during both the years. After this period, the root density declined. The fine root density was nearly twofold at the low fertility site (Kottayam) compared to the other site (Chethackal). The intensity of soil moisture stress during preceding summer season influenced the time taken for fine root development after the onset of rains and the biomass allocated for fine root production at the low fertility site. When the soil moisture stress was low, there was gradual increase in fine root density, whereas, when the soil moisture stress was more, the time lag for initiating root proliferation was longer. The data indicate the necessity of a more precise timing of fertilizer application to maximize uptake of applied nutrients.

475. Dash, D.K.; OUAT, Bhubaneswar (India). Pattanayak, S.K.; OUAT, Bhubaneswar (India). Samal, P.P.; OUAT, Bhubaneswar (India). Root distribution pattern of coconut and its influence on nutrient uptake in littoral sandy soil of coastal Orissa. *Journal of Plantation Crops (India)*. (Apr 2010) v.38(1) p.32-33 KEYWORDS: COCONUTS. ROOTS.

The performance of two hybrids and their parents considering the good and poor bearing characters of coconut were evaluated at AICRP on Palms, Konark, Orissa to find out the effective root zone and its influence on nutrient uptake and yield. The effective feeder root zone was found within the radius of 0-200 cm and at depth of 0-60 cm from

the trunk. The yielding behavior of palms had a direct relation to the number of roots, nutritional status of root and the leaf. The bearing palms showed higher level leaf and root N, P, K and root CEC than the poor bearing palms. The N, P and K content of root and root CEC were higher at the surface soil and gradually decreased with increase in depth of the profile.

476. Senthurpandian, Y.K.; Anna University, Tiruchirapalli (India). Jayaganesh, S.; UPASI Tea Research Foundation, Valparai (India). Enzyme activities of tea soils as influenced by heavy metal contamination. *Journal of Plantation Crops (India)*. (Apr 2010) v.38(1) p.42-46 KEYWORDS: ACID PHOSPHATASE. ALKALINE PHOSPHATASE. HEAVY METALS. UREASE.

Heavy metal contamination has been reported to influence the activities of soil enzymes. The main objective of the current work was to find out the effect of Cd, Ni, Pb and Hg at 25 and 75  $\mu\text{mole}$  concentrations on acid phosphatase, alkaline phosphatase, aryl sulfatase and urease activities in tea soils of south India. Soil samples were collected from four different zones and contaminated with equimolar concentrations (25 and 75  $\mu\text{mole}$ ) of the above mentioned heavy metals. When there was no contamination, the acid phosphatase activity was prominently higher than alkaline phosphatase activity. Similarly the aryl sulfatase and urease activities were found maximum in soils of Munnar and Nilgiris, respectively. In a few cases the inhibition was almost double due to higher concentration than lower concentration. While presence of Cd resulted in an increase in the percentage of inhibition of the acid phosphatase activities in soils of Anamalais and Munnar, Pb caused maximum inhibition in soils of Nilgiris and Ni caused maximum inhibition in soils of Vandiperiyar. In the case of alkaline phosphatase activities in Anamalais, maximum inhibition was noticed in the presence of Cd. Ni produced an increase in the percentage of inhibition of the alkaline phosphatase activities in Munnar and Nilgiris and Pb caused maximum inhibition in soils of Vandiperiyar. The inhibiting power of Ni and Pb was maximum towards the enzyme aryl sulfatase, which is responsible for breaking the non-available ester compounds of sulphur into available fraction like sulphate in soils. The concentration of heavy metals had positive influence on their inhibiting nature on enzyme activities. Among the various elements added, Hg resulted in maximum inhibition of aryl sulfatase at 75  $\mu\text{mole}$  (87%) when compared to control in the soils of Nilgiris.

### **P31 Soil Surveys and Mapping**

477. Taywade, S.S.; National Bureau of Soil Survey and Land Use Planning (ICAR), Nagpur (India). Prasad, J.; National Bureau of Soil Survey and Land Use Planning (ICAR), Nagpur (India). Characterization of sewage-water-irrigated and non-irrigated soils in Nag river ecosystem of Nagpur, Maharashtra. *Journal of the Indian Society of Soil Science (India)*. (Sep 2009) v.56(3) p. 247-253 KEYWORDS: HEAVY METALS. IRRIGATION. SOIL TYPES. SOIL ANALYSIS. TAXONOMY.

The sewage-water-irrigated and adjoining non-irrigated soils (three pedons in each group) along Nag river of Nagpur district, Maharashtra were studied for their morphological, physical and chemical (including heavy metals) as well as microbial characteristics. The surface horizons of sewage-water-irrigated soils were darker than non-irrigated ones. The sewage-water-irrigated soils, in general, had higher pH, organic carbon and  $\text{CaCO}_3$ . Surface horizons of soils (irrigated/non-irrigated) had higher concentrations of DTPA-extractable Fe, Mn, Cu and Zn and these exhibited a decrease with depth. In general, sewage-water-irrigated soils are associated with relatively higher concentration of DTPA-Fe, Mn, Cu, Zn, Pb, Cr and Cd as compared to the corresponding non-irrigated soils but reverse was the trend observed in case of microbial counts (bacteria, actinomycetes, Azotobacter and fungi barring few exceptions).

478. Sarade, S.D.; National Bureau of Soil Survey and Land Use Planning (ICAR), Nagpur (India). Prasad, J.; National Bureau of Soil Survey and Land Use Planning (ICAR), Nagpur (India). Characteristics and classification of guava-growing soils of Bhandara district,



Maharashtra. Journal of the Indian Society of Soil Science (India). (Sep 2009) v.56(3) p. 300-304 KEYWORDS: GUAVAS. SOIL CLASSIFICATION. MAHARASHTRA.

479. Surya, J.N.; National Bureau of Soil Survey and Land Use Planning, New Delhi (India). Gaikwad, S.T.; National Bureau of Soil Survey and Land Use Planning (ICAR), Nagpur (India). Gajbhiye, K.S.; National Bureau of Soil Survey and Land Use Planning (ICAR), Nagpur (India). Thayalan, S.; National Bureau of Soil Survey and Land Use Planning (ICAR), Nagpur (India). Gawande, S.N.; Shri Shivaji Agricultural College, Amravati (India). Evaluation of land quality indicators for soybean cultivation in Eastern part of Maharashtra. Journal of the Indian Society of Soil Science (India). (Sep 2009) v.56(3) p.313-315 KEYWORDS: LAND CLASSIFICATION. SOYBEANS. SOIL SURVEYS. CULTIVATION. MAHARASHTRA.

### **P33 Soil Chemistry and Physics**

480. Pandey, P.K.; North Eastern Regional Institute of Science and Technology, Dept. of Agricultural Engineering, Itanagar (India). Darbal, P.P.; North Eastern Regional Institute of Science and Technology, Dept. of Agricultural Engineering, Itanagar (India). Kumar, Ashish; North Eastern Regional Institute of Science and Technology, Dept. of Agricultural Engineering, Itanagar (India). Kumar, Nikhil; North Eastern Regional Institute of Science and Technology, Dept. of Agricultural Engineering, Itanagar (India). Determination of physical, water retention and transmission properties of soil of paddy fields in the vicinity of Nirjuli (Arunachal Pradesh). Journal of Soil and Water Conservation (India). (Oct 2009) v.8(4) p.3-10 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES. PERMEABILITY. CHEMICOPHYSICAL PROPERTIES. RICE. HYGROSCOPICITY.

This study shows the importance of physical, water retention and transmission properties of soils in relation to water management/hydrological studies of paddy fields in the vicinity of Nirjuli (Arunachal Pradesh). Soil samples were collected at various depths (0-15, 15-30, 30-45 and 45-60 cm) at Nirjuli village, Modern village, Doimukh and Banderdewa. The mechanical composition of the soils at all sites reveals that soils were sandy in texture at all depths. The value of dry density, specific gravity and porosity increased for 0-45 cm depths for most of the sites. For Modern village (15-30 cm depth), Doimukh (15-30 cm, 30-45 cm depth) and Banderdewa (30-45 cm, 45-60 cm depth) coefficient of uniformity ( $C_u < 2$ ) which indicated that soil was uniformly graded. Except Doimukh, at all other sites and soil depths the value of  $C_c$  was lying in the range of 1 to 3 which indicated that soil was well graded. Generally soil moisture available to plants varies in between 1/3 bar to 15 bar. At 1/3 bar pressure, the moisture content in the paddy fields of D-sector, Modern Village, Doimukh and Banderdewa varied 28.2-35.1%, 19.0-29.2%, 19.0-28.3%, 12.5-28.4% at 0-15 cm, 15-30 cm, 30-45 cm, 45-60 cm soil depths respectively. At 15 bar pressure the moisture content in the paddy fields of D-sector, Modern Village, Doimukh and Banderdewa varied 10.4-22.2%, 10.0-18.8%, 6.9-17.0%, 3.9-14.6% at 0-15 cm, 15-30 cm, 30-45 cm, 45-60 cm soil depths respectively. As the soil depth increased, the moisture content also decreased at 1 and 15 bar levels at all sites. For Doimukh and Banderdewa sites the value of hydraulic conductivity are  $1.831 \times 10^{-7}$ - $1.831 \times 10^{-4}$  cm sec<sup>-1</sup> and  $1.721 \times 10^{-7}$ - $1.721 \times 10^{-4}$  cm sec<sup>-1</sup> respectively. The value of hydraulic conductivity decreased as the soil depth increased for both the sites. For D-sector the value of hydraulic conductivity varied between  $7.20 \times 10^{-5}$ - $7.43 \times 10^{-4}$  cm sec<sup>-1</sup>. In this site the value of hydraulic conductivity increased as the soil depth increased.

481. Choudhary, K.K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Physics). Aggarwal, P.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Physics). Singh, A.K.; Indian Council of Agricultural Research, New Delhi (India). Variation of least limiting water range with compaction for divergent textured soils. Journal of the Indian Society of Soil Science (India). (Sep 2009) v.56(3) p.260-266 KEYWORDS: SOIL TEXTURE. SOIL COMPACTION. SOIL STRUCTURE.

Least limiting water range (LL WR), an indicator of soil structural quality is dynamic in nature and varies inversely with bulk density (BD) changes; its effects are further modified by variation in soil texture. Hence, in order to relate LL WR with compaction and soil type, a column study was carried out with three soil types i.e. sandy loam (SL), loamy sand (LS) and clay loam (CL), five soil water contents (Sw) (5, 10, 15, 20 and 25% by weight) and three compaction levels (10, 20 and 30 blows). Components of LLWR i.e. soil water content at soil penetration resistance (PR) of 2MPa (S2MPa) were obtained by drawing soil resistance curve (SRC) and also soil water contents at field capacity (Sf), permanent wilting point (Spwp) and at 10% aeration porosity (Sap) determined by drawing soil water release curve (SWC). The SRC showed that as compared to higher BD, at lower BD the magnitude of PR was low and its reduction with increase in Sw was appreciable. Computed S2MPa from SRC was higher for CL than for LS and SL. Among all four parameters of LL WR, Sfc and qpWP did not vary much, whereas Sap reduced significantly and S2MPa increased appreciably with increase in BD. Trends of LL WR-BD curve showed that LL WR was more than 20% ( $m^3m^{-3}$ ) at lower BD, which is indication of good structural condition and decreased with increase in BD. At  $BD > 1.75 Mg m^{-3}$  for LS and SL and at  $BD > 1.68 Mg m^{-3}$  for CL the value of LL WR became less than 10% ( $m^3m^{-3}$ ) which indicated poor structural conditions. For all soil types, available water capacity (A WC) did not vary appreciably with BD, whereas LLWR decreased appreciably with increase in BD, which indicated that LLWR was a true indicator of soil structural condition.

### **P34 Soil Biology**

482. Radhakrishnan, B.; UPASI Tea Research Foundation, Coonoor (India). Regional Centre. Mahendran, P.; UPASI Tea Research Foundation, Coonoor (India). Regional Centre. Studies on the effect of vermicompost and vermiwash on growth and development of tea (*Camellia sinensis*). *Journal of Plantation Crops (India)*. (Apr 2010) v.38(1) p. 27-31 KEYWORDS: BENEFICIAL ORGANISMS. NUTRITIONAL STATUS.

A simple and cost effective technique was developed for vermicomposting and collection of vermiwash and the technique was evaluated for its commercial use. The preacidified raw materials were processed using a mixed population of common earthworms viz., *Eisenia foetida*, *Eisenia andrei* and *Eudrilus ellgeniae*. After one hundred days, 100 kg of the bedding materials was flushed with 50 litres of water and vermiwash was collected. The vermicompost and vermiwash samples were analysed for physico-chemical and biological properties. The analysis revealed its good nutrient status in respect to nutrients like N, P, K, Na, Mg, Zn and Fe. It also contained beneficial microorganisms like *Azospirillum*, Phosphate solubilising bacteria (PSB), *Pseudomonas*, yeast, moulds and actinomycetes in varying numbers. The analysis of vermicompost showed a slight decrease in the nutrient status after collecting the vermiwash. Addition of 250g of vermicompost to the soil and foliar application of vermiwash diluted 1:10 at fortnightly interval after centering to the potted tea plants showed significant increase in plant height, stem thickness, root length, number of leaves and branches. Significant increase in fresh and dry weights of shoot and root were also observed in the treated plants. The study conclusively proved that the application of vermiwash and vermicompost hastened the growth of plants, thereby reducing the period of their retention in the nursery from 12 months to nine months.

### **P35 Soil Fertility**

483. Swarp, Anand; Indian Agricultural Research Institute, Division of Soil Science and Agricultural Chemistry, New Delhi (India). Nutrient losses from soil and their management for sustaining crop production. *Journal of Soil and Water Conservation (India)*. (Oct 2009) v.8(4) p.31-34 KEYWORDS: NUTRIENT UPTAKE. PLANT PRODUCTION. SOIL MANAGEMENT.

484. Lal, K.; Central Soil Salinity Research Institute, Karnal (India). Minhas, P.S.; Punjab Agricultural University, Ludhiana (India). Chaturvedi, R.K.; Central Soil Salinity Research Institute, Karnal (India). Yadav, R.K.; Central Soil Salinity Research Institute, Karnal (India). Cadmium uptake and tolerance of three aromatic grasses on the Cd-rich soil. *Journal of the Indian Society of Soil Science (India)*. (Sep 2009) v.56(3) p. 290-294  
KEYWORDS: SOIL TYPES. GRASSES. CADMIUM. SOIL TOXICITY. BIOREMEDIATION.

Performance and phyto-remediation capacity of three aromatic grasses viz., palmarosa (*Cymbopogon martinii*), lemon grass (*Cymbopogon flexuosus*) and vetiver (*Vetiveria zizanioides*) were evaluated during 2003-04 in lysimeters filled-in with a sandy loam soil. Variable levels of cadmium (Cd) were created through the application of CdCl<sub>2</sub> at the rate of 0 (control), 5, 10, 20, 50, 100, 150 and 200 mg Cd kg<sup>-1</sup> soil. Growth, biomass productivity and the oil yields of all the grasses decreased with increased Cd levels. The relative tolerance followed the order: Vetiver palmarosa lemon grass. Significant reductions in the biomass of palmarosa and lemon grass were monitored at 20 mg Cd kg<sup>-1</sup> soil, whereas the productivity of vetiver could be sustained up to -50 mg Cd kg<sup>-1</sup>. The Cd content of foliage increased with its concentration in soil but most of it was retained in the roots itself e.g. root Cd contents were 33 times the shoot Cd content in vetiver. Amongst the three grasses, Cd content in foliage of palmarosa was three times its content in shoots of lemon grass and vetiver. Considering the overall higher tolerance and removal of Cd by vetiver, it seems to be the most suitable candidate for detoxification of the Cd-contaminated soils and avoiding the entry of heavy metals in food chain.

485. Pandey, S.K.; Banaras Hindu University, Varanasi (India). Dept. of Plant Physiology. Bahuguna, R.N.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology. Pal, M.; Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology. Trivedi, A.K.; Banaras Hindu University, Varanasi (India). Dept. of Plant Physiology. Hemantaranjan, A.; Banaras Hindu University, Varanasi (India). Dept. of Plant Physiology. Srivastava, J.P.; Banaras Hindu University, Varanasi (India). Dept. of Plant Physiology. Effects of pre-treatment and foliar application of zinc on growth and yield components of mungbean (*Vigna radiata* L.) under induced salinity. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2010) v.15(2) p. 164-167  
KEYWORDS: ZINC. SALINITY. YIELDS. FOLIAR APPLICATION. GROWTH. VIGNA RADIATA.

Mungbean (*Vigna radiata* L.) is an excellent source of high quality proteins. In sprouted mungbean, high level of ascorbic acid (Vitamin C), riboflavin and thiamine is found. But the production of mungbean is threatened by salinity. In the present study observations were made for two consecutive years regarding growth parameters and yield attributes of mungbean under induced salinity condition. Results from the present study revealed that under salinity condition growth and yield attributes were adversely affected while application of zinc as zinc sulphate minimized the adverse effect under salinity.

### **P36 Soil Erosion, Conservation and Reclamation**

486. Raina, A.K.; Punjab Agricultural University, Soil Water Engineering, Ludhiana (India). Lubana, P.P.S; Punjab Agricultural University, Soil Water Engineering, Ludhiana (India). Singh, A.K.; Punjab Agricultural University, Soil Water Engineering, Ludhiana (India). Bhat, V.K.; Punjab Agricultural University, Soil Water Engineering, Ludhiana (India). Application of modified Soil Conservation Service Curve Number (SCS-CN) method for estimation-cum-comparison of moisture storage values of untreated and treated Shivalik micro-watersheds. *Journal of Soil and Water Conservation (India)*. (Oct 2009) v.8(4) p.20-24  
KEYWORDS: WATER BALANCE. RUNOFF. WATER STORAGE.

Computer based programming models are useful analysis tools to understand the watershed planning cum management problem and to find solutions through the best management practices (BMPs) and bio-engineering measures. In the present study, the dynamic initial abstraction, '1.' (not usual I. =0.2S) or the amount of water required

before runoff starts is equal to air-filled pore space per unit area for the shallowest soil was used. To accomplish this computer based daily water balance for (11) years with effect from 1998 to 2008 is computed using Thornthwaite-Mather procedure, based on daily water storage pattern  $S$  (mm) and effective rainfall/initiation of runoff pattern  $P_e$  (mm). The event based water storage pattern for each of the year during the study period for untreated  $wmI$  and treated  $wm2$  micro watersheds at Mansadevi-watershed falling within Shivalik region of India was estimated and compared. The results show definite but non-uniform percentage increase of potential average water storage of treated was over untreated  $wmI$  micro-watershed. A good agreement of estimated/predicted runoff with the observed runoff for modified SCS curve number method called (CN- VSA) method when compared with traditional SCS-CN method was determined. The modified SCS curve number method (distributed CN-VSA) approach provides a physically based method that is simple enough to be incorporated into watershed models and is easy to use for field applications.

487. Meiaraj, C.; Government College of Technology, Coimbatore (India). Sundarajan, R.; Government College of Technology, Coimbatore (India). Soil erosion studies of Alanthurai watershed located in Coimbatore district of Tamil Nadu using USLE model. *Journal of Soil and Water Conservation (India)*. (Oct 2009) v.8(4) p.56-61 KEYWORDS: EROSION. GEOGRAPHICAL INFORMATION SYSTEMS. WATERSHEDS.

A field study was conducted at the Alanthurai watershed in order to estimate the soil erosion status using GIS and USLE. The annual soil loss values estimated from the USLE is represented pictorially using Arc view 3.2a version of GIS software. From the thematic map it was found that around 25% of the land areas along the watershed are subjected to high and very high erosion. From the soil erosion study, it has been suggested that to adopt a suitable agronomical and engineering measure in order to arrest the further erosion of soil along the watershed region.

#### **P40 Meteorology and Climatology**

488. Kumar, Ashok; Sardar Vallabh Bhai Patel University of Agriculture and Technology, Dept of Soil Science, Meerut (India). Dhyani, B.P.; Sardar Vallabh Bhai Patel University of Agriculture and Technology, Dept of Soil Science, Meerut (India). Shahi, U.P.; Sardar Vallabh Bhai Patel University of Agriculture and Technology, Dept of Soil Science, Meerut (India). Satya Prakash; Sardar Vallabh Bhai Patel University of Agriculture and Technology, Dept of Soil Science, Meerut (India). Singh, R.R.; Sardar Vallabh Bhai Patel University of Agriculture and Technology, Dept of Soil Science, Meerut (India). Kumar, Vinod; Sardar Vallabh Bhai Patel University of Agriculture and Technology, Dept of Soil Science, Meerut (India). Singh, S.P.; Sardar Vallabh Bhai Patel University of Agriculture and Technology, Dept of Soil Science, Meerut (India). Kumar, Yogesh; Sardar Vallabh Bhai Patel University of Agriculture and Technology, Dept of Soil Science, Meerut (India). Analysis of rainfall during 1998-2007 for planning of rice cultivation at Meerut district of western Uttar Pradesh. *Journal of Soil and Water Conservation (India)*. (Oct 2009) v.8(4) p.62-66 KEYWORDS: RAIN. RICE. CULTIVATION.

Rainfall received during past ten years, i.e. from 1998 to 2007 at Meerut was analyzed to plan the rice cultivation in the region. Analysis of data reveal that out of 10 years only one year was as drought year on the basis of annual rainfall while drought was more frequent on summer basis as compared to winter basis. This indicates that distribution of rainfall was erratic. Rice yield was affected by received rainfall during monsoon season and lower average yield (23.65 q/ha) was recorded in the years receiving higher rainfall. On the basis of average rainfall pattern 17.48, 33.96, 33.14 and 15.41 per cent, during monsoon months, i.e. from June to September a planning for rice cultivation can be formulated so that received rain can be used judiciously.

489. Kundu, C.; University of Calcutta, Kolkata (India). Dept. of Agronomy. Sarkar, R.K.; University of Calcutta, Kolkata (India). Dept. of Agronomy. Effect of foliar application of potassium nitrate and calcium nitrate on performance of rainfed lowland rice (*Oryza*



sativa) . Indian Journal of Agronomy (India). (Dec 2009) v.54(4) p.428-432 KEYWORDS: RICE. ORYZA SATIVA. CALCIUM. NITRATES. YIELDS. POTASSIUM. LOWLAND.

A field experiment was conducted during rainy (kharif) season of 2005 and 2006 at Baruipur to evaluate the effect of foliar nutrition of potassium nitrate (KNO) and calcium nitrate, Ca(NO<sub>3</sub>)<sub>2</sub> on growth and yield of rice (*Oryza sativa* L.) in Gangetic alluvial land. Foliar application of 0.406% Ca(NO<sub>3</sub>)<sub>2</sub> followed by 0.50% KN<sub>3</sub> during 50% flowering stage increased the growth parameters and yield attributes which ultimately resulted in higher grain yield than foliar spray of 0.25 and 1.00% KN<sub>3</sub> and 0.203 and 0.812% Ca(NO<sub>3</sub>)<sub>2</sub> and water spray. Foliar spray of 0.406% Ca(NO<sub>3</sub>)<sub>2</sub> resulted in maximum grain yield (5.47 t/ha), net returns (Rs 14,733/ha) and benefit cost ratio (1.38). Hence foliar spray of 0.406% Ca(NO<sub>3</sub>)<sub>2</sub> should be practised to obtain maximum grain yield and net monetary returns from rainfed lowland rice in West Bengal.

490. Narayan, D.; Central Soil and Water Conservation Research and Training Institute, Datia (India). Research Centre. Lal, B.; Indian Institute of Soil Science, Bhopal (India). Rainwater conservation and yield of sorghum (*Sorghum bicolor*) as influenced by tillage and cover management practices in red soils. Indian Journal of Agronomy (India) . (Dec 2009) v.54(4) p.438-443 KEYWORDS: RAINWATER. MULCHING. LUVISOLS. SORGHUM BICOLOR. CONSERVATION TILLAGE.

A field experiment was conducted during kharif of 2002 to 2003 at 2% slope in red soils at Datia, Madhya Pradesh to evolve a suitable tillage and surface mulching practice for higher rainwater conservation for augmenting the crop growth and yield of sorghum [*Sorghum bicolor* (L.) Monech.] under rainfed conditions. Nine treatment combinations [T<sup>0</sup> zero tillage (no crop); T<sub>2</sub><sup>1</sup> TI + sorghum; T<sub>3</sub><sup>1</sup> T 2 + in situ surface mulching; T<sub>4</sub><sup>1</sup> traditional tillage (no crop); T<sub>5</sub><sup>1</sup> T 4 + sorghum; T<sub>6</sub><sup>1</sup> T 5 + in situ surface mulching; T<sub>7</sub><sup>1</sup> improved tillage (no crop); T<sub>7</sub><sup>1</sup> T 7 + sorghum and T<sub>g</sub>, T s + in situ surface mulching] were evaluated under randomized block design with 3 replications. Maximum infiltration rate (5.6 cm/hr), pore space (47.9%), water holding capacity (37.1 cm of 0-:36 cm soil layer) and water stable aggregates (48.11 and 49.92 of 0-15 and 15-30 cm soil layer, respectively) and lowest bulk density (1.38 Mg/m<sup>3</sup>) were recorded under improved tillage + sorghum + in situ surface mulching (T<sub>g</sub>). Bulk density was maximum (1.54 Mg/m<sup>3</sup>) under zero tillage (T<sub>1</sub>). Owing to higher rainwater conservation (78.9% mean of 2 years) growth, yield attributes and yield of sorghum increased significantly under increasing tillage depths and in situ surface mulching. Thus highest grain (3.31 t/ha) and stover (9.98 t/ha) yield and moisture use efficiency (7.84 kg/ha-mm) were recorded under T<sub>g</sub>. The results indicated that improved tillage coupled with in situ surface mulching of sunn hemp was helpful for higher rain water conservation and increasing the yield of sorghum.

491. Blaise, D.; Indian Institute of Soil Science, Bhopal (India). Singh, J.V.; Central Institute for Cotton Research, Nagpur (India). Bonde, A.N.; Central Institute for Cotton Research, Nagpur (India). Response of rainfed cotton (*Gossypium hirsutum*) to foliar application of potassium. Indian Journal of Agronomy (India). (Dec 2009) v.54(4) p.444-448 KEYWORDS: FIBRES. GOSSYPIUM HIRSUTUM. VERTISOLS. POTASSIUM.

Field studies were conducted (2002-03 to 2004-05) in Nagpur, Maharashtra under rainfed conditions to evaluate the response of upland cotton (*Gossypium hirsutum* L.) to foliar application of potassium (K). Treatments included a control (without K), soil application, soil application along with one foliar spray of K at either early boll or peak boll and two sprays at early and peak boll stages. Averaged across years, yield of the K applied plots were similar (0.97 to 1.07 tonne/ha) and were significantly greater than the control (0.81 tonne/ha). Yield differences were owing to more bolls in the K applied (40.8 to 53.3/m<sup>2</sup>) than control plots (33.6/m<sup>2</sup>). Year x treatment interaction was highly significant. In 2002-03 and 2004-05, rainfall was lesser than average and the K applied plots had significantly greater seed cotton yield (0.84 to 1.30 tonne/ha) than the control (0.71 to 0.75 tonne/ha). In 2004-05, treatment with 2 foliar sprays produced 392 kg/ha more seed cotton than soil application and was significantly superior to 1 spray. Total K uptake was greater in the K applied plots (61.3 to 68.8 kg/ha) than the control (39.1

kg/ha). Regardless of treatments, K balance (input uptake) was negative (-37.1 to -43.8 kg/ha). In general, K application did not impact fibre quality. It was found that K application may be advantageous in years with low rainfall.

492. Kubsad, V.S.; University of Agricultural Sciences, Dharwad (India). Dept. of Agronomy). Palled, Y.B.; University of Agricultural Sciences, Dharwad (India). Dept. of Agronomy). Mansur, C.P.; University of Agricultural Sciences, Dharwad (India). Dept. of Agronomy). Productivity, quality and economics of rainfed ashwagandha (*Withania somnifera*) as influenced by spacing and fertilizer levels. *Indian Journal of Agronomy* (India). (Dec 2009) v.54(4) p.449-453 KEYWORDS: ECONOMICS. FERTILIZERS. VERTISOLS. WITHANIA SOMNIFERA. PESTS. SPACING.

A field experiment was conducted at Annigeri (Karnataka) during rabi 2004-05 and 2005-06 to study the effect of 4 spacings (15 cm x 5 cm, 15 cm x 10 cm, 30 cm x 10 cm and 45 cm x 10 cm) and 4 N-P fertilizer levels (control, 12-10.6, 18-15.9 and 24-21.2 kg/ha) on performance of ashwagandha (*Withania somnifera* Dunal). The results indicated that dry root yield, nutrient uptake and total withanolide content were significantly higher at a spacing of 15 cm x 10 cm when compared with other spacings. At 15 cm x 10 cm spacing, the increase in dry root yield was 10.2, 54.9 and 107.4% over 15 cm x 5 cm, 30 cm x 10 cm and 45 cm x 10 cm respectively. Significant increase in dry root yield, nutrient uptake and total withanolide content was noticed with increase in fertilizer levels from control to 24-21.2 kg N-P/ha. Application of 24-21.2 and 18-15.9 kg N-P/ha, being comparable recorded significantly higher dry root yield, N and P uptake and total withanolide content than control and 12-10.6 kg N-P/ha. At 24-21.2 kg N-P/ha, the increase in dry root yield, N, P uptake and total withanolide content was 22.1, 51.5, 43.6 and 13.5% over control respectively. Further, there was remarkable improvement in root length, root diameter and dry root weight of ashwagandha which resulted in increase in dry root yield. Maximum dry root yield (1.55 t/ha), net returns (Rs 50,141/ha) and total withanolide content (0.62%) accrued when the crop was sown at 15 cm x 10 cm spacing along with fertilizer doze of 24-21.2 kg N-P/ha. Consequently, a spacing of 15 cm x 10 cm spacing along with fertilizer application of 24-21.2 kg N-P/ha was found optimum for ashwagandha in vertisols of Northern dry zone of Karnataka.

## **Q80 Packaging**

493. Gupta, Satish Kumar; Punjab Agricultural University, Department of Processing and Food Engineering, Ludhiana (India). Singh, Jarnail; Punjab Agricultural University, Ludhiana (India). Department of Processing and Food Engineering. Kumar, Ashok; Punjab Agricultural University, Ludhiana (India). Department of Processing and Food Engineering. Quality characteristics of dehydrated onions as affected by storage conditions and packaging material. *Journal of Research Punjab Agricultural University* (India). (Mar & Jun 2009) v.46(1-2) p.79-82 KEYWORDS: ONIONS. STORAGE. PACKAGING MATERIALS.

The study was conducted on three varieties of onions to find out the varietal effect on the quality characteristics of the dehydrated onions during storage in different conditions and different packaging materials. The quality characteristics studied were pyruvic acid concentration, colour and moisture content for each of the three varieties i.e. PBW-1, Punjab Naroya and PRO-6. The dehydrated onions obtained after drying at constant temperature of 60°C were stored for a period of 10 months. Two types of packaging material i.e. laminated aluminum foil (LAF) and high density polyethylene (HDPE) of thickness 50 mm were used for packaging the dehydrated onions. The samples under study were stored under the following two conditions i.e. ambient temperature (room temperature) and refrigerated conditions (5 to 7°C). The pungency retention per cent was the highest in variety PRO-6 followed by variety PBW-1 and it was more in refrigerated condition as compared to ambient conditions. Also the pungency retention per cent was more in the samples packed in laminated aluminium foil as compared to those packed in HDPE. The total colour difference values were lower in samples stored

under refrigerated conditions. The quality in respect of colour change was better in laminated foil packaging than HDPE bags.

### **S01 Human Nutrition – General Aspects**

494. Bisht, Soni; Punjab Agricultural University, Ludhiana (India). Department of Food and Nutrition. Chawla, Paramjit; Punjab Agricultural University, Ludhiana (India). Department of Food and Nutrition. Sachdeva, Rajbir; Punjab Agricultural University, Ludhiana (India). Department of Food and Nutrition. Effect of sprouted fenugreek seeds on non insulin dependent diabetics. Journal of Research Punjab Agricultural University (India). (Mar & Jun 2009) v.46(1-2) p.90-93 KEYWORDS: TRIGONELLA FOENUM GRAECUM. SPROUTING. SEEDS.

Present study is an endeavour to examine the effect of supplementation of sprouted fenugreek seeds on blood glucose, lipid profile and blood pressure of non insulin dependent diabetic males. A group of 60 male Non Insulin Dependent Diabetes Mellitus (NIDDM) patients in the age group of 40-60 years free from serious complications of diabetes were selected from Punjab Agricultural University Hospital, Ludhiana. Subjects were divided into 2 groups i.e. experimental (E) and control (C) group consisting of 30 subjects in each group. Subjects of E group were supplied 25 g sprouted fenugreek seeds per day for two months while no supplementation was given to the C group. The results revealed that mean age of onset of diabetes was 45 and 47 years in E and C group, respectively. Supplementation of sprouted fenugreek seeds resulted in a significant (P 0.01) decrease in fasting blood glucose level (20.34%) and post prandial glucose level (15.1%). Lipid profile of the subjects also showed percentage decrease of 10.1, 23, 12.4 and 23 per cent in total cholesterol (TC), triglycerides (TG), Low density lipoprotein cholesterol (LDL-C) and very low density lipoprotein cholesterol (VLDL-C) respectively in experimental group. Further TC:HDL and LDL:HDL ratios were also decreased 18.3 and 21.1% respectively. However, 11% increase was observed in HDL-C. Regarding the blood pressure of the subjects, Systolic blood pressure was decreased significantly (P 0.01) from 132 to 128mmHg and Diastolic blood pressure (P 0.05) from 84 to 81 mmHg after the supplementation, thus helping in retarding the secondary complications of diabetes.

495. Nahar, Savita; Punjab Agricultural University, Ludhiana (India). Department of Food and Nutrition. Grover, Kiran; Punjab Agricultural University, Ludhiana (India). Department of Food and Nutrition. Chawla, Paramjit; Punjab Agricultural University, Ludhiana (India). Department of Food and Nutrition. Nutritional status of rural school children in central zone of Punjab. Journal of Research Punjab Agricultural University (India). (Mar & Jun 2009) v.46(1-2) p.94-98 KEYWORDS: BIOMETRY. NUTRITIVE VALUE. NUTRITIONAL STATUS. PUNJAB.

A sample of 120 school children in the age group of 7-9 year was selected from rural areas of two districts namely Jalandhar and Kapurthala of central zone of Punjab. General information, food and nutrient intake and anthropometric measurements of rural school children were recorded to assess their nutritional status. The data on dietary adequacy revealed lower intake of cereals, pulses, milk and milk products and green leafy vegetables. The per cent adequacy of energy and protein intake was found to be nearly half (50 and 54%) of the Recommended Dietary Allowances. The intake of vitamins and minerals -  $\beta$ -carotene, thiamine, riboflavin, niacin, vitamin B12, vitamin C, calcium and iron was also lower. The mean height of children was comparable with national and international standards of Indian Council of Medical Research (ICMR) and National Centre for Health and Statistics (NCHS), USA. However, the mean weight was lower than these standards. Twenty two per cent of rural school children were underweight. The percentage of underweight girls (24.6) was found to be higher than boys (17.7). Low purchasing power and ignorance were mainly responsible for dietary inadequacy. Hence, empowering the mothers in terms of nutritional knowledge and skill can go a long way to improve the nutritional status of the children.

496. Agarwal, Vyoma; Punjab Agricultural University, Ludhiana (India). Department of Food and Nutrition. Kochhar, Anita; Punjab Agricultural University, Ludhiana (India). Department of Food and Nutrition. Sangha, Jaswinder; Punjab Agricultural University, Ludhiana (India). Department of Food and Nutrition. Impact of nutrition counselling regarding stevia on non-insulin dependent diabetics. *Journal of Research Punjab Agricultural University (India)*. (Mar & Jun 2009) v.46(1-2) p.99-103 KEYWORDS: HUMAN BEHAVIOUR. BLOOD PROTEIN CONCENTRATE.

Fifty Non-Insulin Dependent Diabetic subjects, 25 males and 25 females were selected from posh areas of Ludhiana city to study the impact of nutrition counseling regarding Stevia, on its usage and consequent knowledge, attitude, practices and blood profile of diabetics. Nutrition education related to etiology, complications, management of diabetes, health benefits of stevia, its cooking qualities and knowledge regarding recipes developed using stevia was imparted to the diabetic subjects for a period of 3 months. Pre and post testing of knowledge, attitude and practices of subject was done using questionnaire technique. The blood parameters of the subjects were also recorded after imparting nutrition counseling. The finding indicated that stevia as sweetener was used only by 4 per cent subjects before nutrition counseling which increased to 64 per cent in males and 68 per cent in females after nutrition counseling. The percent decrease in fasting blood glucose level and post prandial blood glucose level in males was 8.56 per cent and 6.51 per cent and in females it was 7.09 per cent and 5.29 per cent after nutrition counseling. The percent decrease in total cholesterol and triglyceride in case of male subjects was 2.34 per cent and 2.48 per cent and in females was 2.76 per cent and 2.09 per cent after nutrition counseling. The percent gain in knowledge, attitude and practices scores of the subject was 101.33 per cent, 59.43 per cent and 84.32 per cent respectively, while the overall gain in knowledge, attitude and practices score of the subject was 84.69 per cent after nutrition counseling. It was concluded that diabetics should be encouraged to use stevia as it is natural, safe and has other therapeutic benefits.



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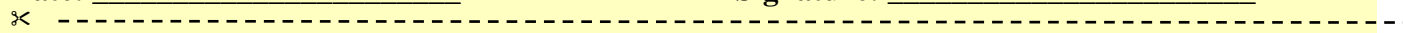
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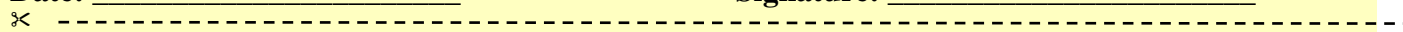
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32. National Bureau of Animal Genetic Resources  
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33. National Bureau of Plant Genetic Resources  
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34. National Centre for Integrated Pest Management  
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35. National Dairy Research Institute  
Karnal-132001, Haryana
36. National Research Centre on Camel  
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37. Directorate of Groundnut Research  
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38. National Research Centre on Mithun  
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