

Indian Agricultural Sciences Abstracts

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C20 Extension

201. Singh, J.; Sikka, S.S. (Apollo College of Veterinary Medicine, Jaipur (India)) . Role of animal nutritionist in uplifting the economy of agrifarmers. *Indian Farming (India)*. (Dec 2005) v. 55(9) p. 37-39 KEYWORDS: FARMERS; AGRICULTURE; ANIMAL PRODUCTION; AGRICULTURAL EXTENSION; FARM INCOME.

At present there is urgent necessity to increase per farm family income by way of diversification of agriculture in the form of various kind of livestock farming on intensive commercial lines. There is great scope to increase the margin of profit under various kinds of livestock farming activities by increasing around productivity, on the one hand, and economizing on the cost of feeding, on the other, for which the counseling of animal nutritionist may prove very effective.

C30 Documentation and Information

202. Kumar, V.; Sharma, A.K.; Kumar, A. (National Research Centre on Rapeseed-Mustard, Bharatpur (India). Agriculture commodity (area, production, yield) information system. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 434-438 KEYWORDS: PRODUCTION; YIELD; MUSTARD; RAPESEED.

The use of information technology in agriculture has grown rapidly in past few years. It is increasingly being used to help the managers and researchers make better decisions. A computer based information system named as "R&M (A, P, Y) Information System" i.e. Rapeseed-Mustard (area, production and yield) Information System has been developed to assist the scientists and policy makers engaged in rapeseed-mustard crop commodity to know the crop potential in different locations. This software has incorporated the database of rapeseed-mustard (area, production and yield) of different countries, and detail data state and district wise of India for last twenty years. The system is personal computer (PC) based and has been developed using windowing environment, thus allows user to interact with the system through user friendly screens and icons.

E11 Land Economics and Policies

203. Ram, D.; Jain, A.K.; Panwar, B.S.; Sangwan, O.P.; Ahuja, R.L.; Goyal, V.P.; Kuhad, M.S.; Dahiya, S.S. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). (Dept. of soil Science)). Land capability and irrigability evaluation for land use planning of Kaithal district (Haryana) using remote sensing technique. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 181-186 KEYWORDS: LAND SUITABILITY; LAND USE; HARYANA; LAND EVALUATION; PLANNING; REMOTE SENSING; TECHNOLOGY.

The development potential of land and its utilization are governed by a set of physical and cultural factors. In the present study, soil qualities were considered one of the

paramount factors affecting land use planning. The application of remote sensing technique i. e. satellite imageries IRS-IB/ IC (1 : 50,000), Panchromatic aerial photographs (1 : 50,000) and Survey of India Toposheets (1 : 50,000) were used to evaluate land capability and soil and land irrigability classification of Kaithal district (Haryana) for agriculture. USDA and AIS and LUSO systems of land evaluation were applied. Soils were classified according to Soil Taxonomy. Seven soil series were identified which belonged to two major soil orders viz., Entisols and Inceptisol. The study area was classified into three major land capability classes (I, II and III), two soil irrigability classes (A and B) and three land capability classes (1,2 and 3). Nearly 19 percent of the study area was found very good cultivable land without any significant limitation for sustained use under irrigation. Only 13 percent area of the district suffered with 'saline and waterlogged problems. The remaining area was covered under good cultivable and moderately good cultivable land with slight to moderate limitations for sustained use under irrigation.

E50 Rural Sociology and Social Security

204. Nandal, S. (Government Post Graduate College, Hisar (India); Nandal, S.S. (Department of Sports and Youth Welfare, Haryana (India); Kaushik, R.D. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India)). Socio-economic status of women judokas in Haryana. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 253-255 KEYWORDS: SOCIO-ECONOMIC DEVELOPMENT; SPORT; SOCIAL STRUCTURE; WOMEN; ROLE OF WOMEN; HARYANA.

The present study was conducted in Haryana state to examine the role of caste, family and occupation of parents on sports performance of women judokas. The study was conducted on 102 women judokas. It was found that 60.78 percent of the respondents belonged to general caste. Maximum number of respondents belonged to nuclear type of family and maximum number of respondents belonged to agriculture occupation group.

E80 Home Economics, Industries and Crafts

205. Chaurasia, P.B.L. (Central Arid Zone Research Institute, Jodhpur (India)). Solar candle making machine: employment generation for rural people. *Indian Farming (India)*. (Dec 2005) v. 55(9) p. 24-27 KEYWORDS: RURAL POPULATION; EMPLOYMENT; SOLAR ENERGY; COTTAGE INDUSTRY; PARAFFIN.

A simple machine utilizing solar energy as fuel for candle production has been developed. This solar candle technology is a safe, convenient method of candle production and obviates any type of care or attendance during wax melting process as required in old methods based on the conventional fuels. It generates employment and is quite useful in cottage industry.

F01 Crop Husbandry

206. Singh, V.; Sharma, S.K. (Rajasthan Agricultural University, Bikaner (India). College of Agriculture). Response of mothbean (*Vigna aconitifolia*) to zinc and thiourea under dryland condition. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 313-314 KEYWORDS: VIGNA ACONITIFOLIA; ZINC; THIOUREA; ARID ZONES.

207. Sheoran, P. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy). Dry matter accumulation and partitioning of summer greengram genotypes under varying irrigation schedules. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 315-318 KEYWORDS: CROP MANAGEMENT; GENOTYPES; MUNGBEANS; IRRIGATION SCHEDULING.

208. Chaudhary, V.K.; Goswami, V.K. (Arya Samaj College, Bulandshahar (India). Dept. of Agronomy). Effect of phosphorus and sulphur fertilization on chickpea (*Cicer arietinum* L.) cultivar. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 322-323 KEYWORDS: FERTILIZATION; CICER ARIETINUM; SULPHUR; PHOSPHORUS.

209. Karki, T.B.; Kumar, A. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Productivity potential and economics of maize (*Zea mays* L.) as affected by various fertility levels. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 340-341 KEYWORDS: PRODUCTIVITY; NUTRIENT MANAGEMENT; FERTILITY; ZEA MAYHS; ECONOMICS.

210. Gautam, A.K.; Mishra, B.N.; Sarkar, N.C.; Mishra, P.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Effect of graded levels of nitrogen and plant spacing on grain yield and quality of aromatic rice. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 402-405 KEYWORDS: YIELD; QUALITY; NITROGEN; SPACING.

Field experiments conducted in split plot design with three replications to study the influence of nitrogen and plant spacing, on grain yield and quality of aromatic rice, indicated that rice hybrid PRH 10 registered significantly highest (51.5 q/ha) grain yield than in-bred aromatic rice, Pusa Sugandh 3 and Pusa Basmati 1. Wider plant spacing of 20 x 20 cm recorded 16.3 and 6.2 per cent more grain yield over the spacings of 20 x 10 and 20 x 15 cm, respectively. Highest grain (52.7 q/ha) and straw (74.05 q/ha) yields were recorded with application of 160 kg N/ha. Interaction effects revealed that transplanting of PRH 10 at wider spacing of 20 x 20 cm with 160 kg N/ha was most appropriate combination. Whereas, PS-3 and PB-1 were found better at a plant spacing of 20 x 15 cm with 160 80 kg N/ha, respectively. Hulling, milling and head rice recovery were higher at wider spacing and higher level of N application. Whereas, kernel length and breadth before and after cooking were not influenced by spacings and nitrogen application.

211. Gautam, A.K.; Mishra, B.N.; Mishra, P.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Influence of plant spacing and levels of nitrogen on grain yield and nitrogen uptake of inbred and hybrid aromatic rice. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 421-423 KEYWORDS: SPACING; HYBRIDS; NITROGEN; NITROGEN UPTAKE; YIELD.

Field experiments in split plot design with three replications were conducted to find out the appropriate plant spacing and nitrogen requirement for inbred and hybrid aromatic rice. The yield performance at a spacing of 20 x 20 cm was significant and recorded 16.1 and 16.4 per cent and 6.5 and 5.7 per cent more over the spacings of 20 x 10 and 20 x 15 cm, respectively. Application of 160 kg N/ha produced significantly highest grain (50.65 and 53.85 q/ha) and straw yield along with highest nitrogen uptake over 0 and 80 kg N/ha. Nitrogen uptake by grain significantly increased with increase in plant spacing, whereas it

was reverse for N uptake by straw. Rice hybrid PRH 10 was superior to inbred varieties Pusa Sugandh 3 and Pusa Basmati 1 in producing grain yield and utilizing nitrogen.

212. Bairwa, D.K.; Kanwat, P.M.; Kumawat, K.C. (S.K.N. College of Agriculture, Jobner (India). Dept. of Entomology). Effect of dates of sowing on the incidence of jassids, whiteflies and shoot and fruit borer of okra. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 458-459 KEYWORDS: SOWING; OKRA; ALEYRODIDAE; ABELMOSCHUS ESCULENTUS; EARIAS INSULANA.

213. Singh, R.; Asrey, R.; Kumar, S. (Central Institute of Post Harvest Engineering and Technology, Abohar (India). All India Coordinated Research Project on Application of Plastics in Agriculture). Strawberry production under row cover with different mulching in semi arid region of Punjab. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 469-475 KEYWORDS: STRAWBERRY; YIELD; GROWTH; PRODUCTION; POST HARVEST TECHNOLOGY; MULCHING; PUNJAB.

A field experiment was conducted to study the effect of row cover and different mulches on growth, yield of strawberry and soil hydrothermal parameters. Use of row covers remarkably increased averaged soil temperature during night (1.4-2.7 dc) and resulted into significant higher growth and yield attributes compared to control (without row cover). Use of row cover enhanced earliness by two weeks and produced significant higher fruit yield (22.5 t/ha) compared to control (18.9 t/ha). Higher soil temperature (2.2 dc) and greater soil moisture (23.6 percent higher) was observed with black polyethylene mulch compared to straw mulch. Black polyethylene mulch was found most suitable and produced 24.8 t/ha fruit yield compared to 19.7 and 17.6 t/ha fruit yield with clear polyethylene and straw mulch respectively. Clear/transparent polyethylene mulch improved soil temperature and moisture level appreciably but failed to control the weed emergence particularly in later stage of growth.

214. Bhasin, R.M; Singh, M.; Jha, G.K.; Sharma, D.P.; Sud, U.C. (Indian Agricultural Statistical Research Institute, New Delhi (India). A comparative study of crop cut estimates and farmers' estimates in the Bhiwani district of Haryana state. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 505-506 KEYWORDS: COTTON; PRODUCTION; HARYANA.

Estimates of crop production as obtained through crop-cutting experiments approach and the farmers' based approach are compared empirically utilizing the data collected on important crops grown in the Bhiwani district of Haryana. The crop cut estimates; as opposed to the farmers' estimates, are consistently closer to the actual production figures in respect of cotton. However, the percentage standard errors associated with farmers' estimates are comparatively smaller as compared to the crop-cut estimates. No clear cut conclusions can be drawn in respect of estimates obtained from two sources for the other crops.

215. Jakhar, P.; Singh, J.; Nanwal, R.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy). Effect of planting methods, biofertilizers and nitrogen levels on growth, yield and economics of wheat (*Triticum aestivum* L.). *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 603-605 KEYWORDS: BIOFERTILIZERS; YIELD; NITROGEN; ECONOMICS; GROWTH; TRITICUM AESTIVUM.

216. Sarkar, A.; Mukherjee, P.K. (Uttar Banga Krishi Viswavidyalaya, Coochbehar (India). Dept. of Agronomy); Dutta, S.; Bhattacharya, A. (Uttar Banga Krishi Viswavidyalaya, Coochbehar (India). Dept. of Soil Science and Agricultural Chemistry). Plant nutrient concentration in Polygonum and their removal from soil by polygonum. Annals of Agricultural Research (India). (Dec 2005) v. 26(4) p. 606-607 KEYWORDS: POLYGONUM; PLANT NUTRITION; SOIL FERTILITY.

217. Bindu, S.H. (Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry); Subramanian, S. (Sugarcane Research Station, Cuddalore (India). Influence of split application of graded levels of nitrogen on yield attributes of CORH2 hybrid rice. Annals of Agricultural Research (India). (Dec 2005) v. 26(4) p. 610-611 KEYWORDS: RICE; SOIL FERTILITY; YIELD; NITROGEN.

218. Kachroo, D.; Dixit, A.K. (Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha (India). Div. of Agronomy). Residue-management practices using fly ash and various crop residues for productivity of rice (*Oryza sativa*)-wheat (*Triticum aestivum*) cropping system under limited moisture conditions. Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 249-252 KEYWORDS: CROP RESIDUES; SEQUENTIAL CROPPING; FLY ASH; ORYZA SATIVA; TRITICUM AESTIVUM; YIELDS; YIELD COMPONENTS; NUTRIENT UPTAKE; TRICHODERMA VIRIDE.

A field experiment was conducted at the Sher-e-Kashmir University of Agricultural Sciences and Technology, R.S. Pura, Jammu, during 2001-03, to evaluate the effect of fly ash and residue incorporation on the productivity and soil health in rice (*Oryza sativa* L.) - wheat (*Triticum aestivum* L. emend. Fiori & Pao!) cropping system under limited moisture conditions. Incorporation of residues of rice in wheat and wheat in rice not only increased the yield and yield components of rice and wheat but also increased the nutrient uptake besides improving the physico-chemical and biological properties of the soil which provide better soil environment for growth. Alternatively the incorporation of fly ash and left-over stubbles of previous crops as residues were found equally effective in increasing the productivity and soil environment in rice-wheat cropping system. For quick and better decomposition the application of *Trichoderma viride* + 20 kg N/ha as starter dose influenced the yield, available nutrients, microbial population and physical properties of the soil significantly compared with no starter dose application.

219. Sharma, S.K.; Pandey, D.K.; Gangwar, K.S.; Tomar, O.K. (Project Directorate for Cropping Systems Research, Modipuram (India). Effect of crop establishment methods on performance of rice (*Oryza sativa*) cultivars and their effect on succeeding wheat (*Triticum aestivum*). Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 253-255 KEYWORDS: PLANT ESTABLISHMENT; ORYZA SATIVA; VARIETIES; TRITICUM AESTIVUM; DIRECT SOWING; SEQUENTIAL CROPPING; PUDDLING; YIELDS; CROP PERFORMANCE; ECONOMICS.

A field experiment was conducted during 1999-2000 and 2000-2001 to evaluate the performance of rice (*Oryza sativa* L.) cultivars under different crop establishment methods and their effect on succeeding wheat (*Triticum aestivum* L. emend. Fiori & Paol. at the Project Directorate for Cropping Systems Research, Modipuram, Meerut, Uttar Pradesh. Rice grown under unpuddled conditions gave higher systems productivity than rice transplanted after puddling. However, productivity of rice and wheat and system as a whole under unpuddled and transplanted conditions did not differ significantly. Similar trend was

observed in basmati rice-equivalent yield (BREY). Net returns were also not influenced significantly by crop establishment methods. Among rice varieties, 'IET 15339' gave superior performance followed by wheat variety 'PBW 226' in respect of yield and net returns.

220. Babou, C. (Pondicherry University, Pondicherry (India); Gururajan, B.; Suresh, P. (Tamil Nadu Agricultural University, Madurai (India). Dept. of Agronomy). Effect of cotton crop-residue management practices and levels of nitrogen and potassium on rice (*Oryza sativa*) and succeeding blackgram (*Phaseolus mungo*) in rice-blackgram cropping system. Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 260-264 KEYWORDS: CROP RESIDUES; INOCULATION; NUTRIENT UPTAKE; FERTILIZER APPLICATION; SEQUENTIAL CROPPING; ORYZA SATIVA; YIELDS; YIELD COMPONENTS; PHASEOLUS MUNGO; INORGANIC FERTILIZERS.

A field experiment was carried out at Agricultural College and Research Institute, Madurai, during the winter (rabi) seasons of 2000 and 2001, to study the effect of cotton (*Gossypium* sp.) crop residue management practices and levels of inorganic fertilizer Nand K on rice (*Oryza sativa* L.) and succeeding blackgram (*Phaseolus mungo* L.) in rice-blackgram cropping system. Incorporation of cotton stalks 5 tonnes/ha with *Trichoderma viride* in rice crop significantly improved the growth parameters, yield attributes and yield of rice. Maximum residual effect was observed with the incorporation of cotton stalks 5 tonnes/ha + *Trichoderma viride*, that resulted in the marked improvement in the growth, yield attributes and yield of succeeding blackgram. Similar yield trend was seen by increasing levels of Nand K fertilizers in rice and blackgram.

221. Chandra, S. (Ministry of Agriculture, Department of Agriculture and Cooperation, Jaipur (India). Directorate of Millets Development); Singh, D.P. (Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (India); Pannu, R.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy); Singh, R. (Project Directorate for Cropping Systems Research, Modipuram (India). Response of wheat (*Triticum aestivum*) genotypes to post anthesis moisture stress by chemical desiccation. Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 296-299 KEYWORDS: STRESS; SOIL WATER CONTENT; FLOWERING; DRYING; TRITICUM AESTIVUM; YIELD COMPONENTS; GENOTYPES; YIELDS; WHEATS.

A field experiment was conducted during 1997-98 and 1998-99 at Hisar, to evaluate the response of wheat (*Triticum aestivum* L. emend. Fiori & Pao!) genotypes to post-anthesis moisture stress by chemical desiccation under different environments. The growth and yield parameters, viz. dry-matter production, grains/spike and 1,000-grain weight, were significantly higher in normal irrigated environment by 27.62, 26.68 and 56.39 percentage than dry and 19.99, 47.41 and 112.11 percentage higher than 0.1 percentage potassium iodide (KI) spray on whole canopy of wheat. Wet environment recorded 23.19, 120, 22 and 48.25 percentage higher grain yield in wheat over dry, 0.1 percentage KI spray on whole canopy and vegetative parts escaping ears. Among the 4 desiccant sprayed environments, significantly higher growth, yield attributes and yield were obtained in 0.075 percentage KI spray on vegetative parts as compared to 0.1 and 0.075 percentage KI spray on whole canopy. Among genotypes, 'UP 2338' recorded 6.33, 18.06 and 33.95 percentage higher number of grains/spike over 'PBW 343', 'WH 533' and 'Lok 1'. Wheat cv. 'UP 2338' fetched more grain yield by 7.51, 20.23 and 44.63 percentage than 'PBW 343', 'WH 533' and 'Lok 1' and found to be less sensitive to post-anthesis moisture stress compared with the other genotypes.

222. Singh, I. (Punjab Agricultural University, Gurdaspur (India). Pulses Section); Sardana, V. (Punjab Agricultural University, Gurdaspur (India). Regional Research Station); Sekhon, H.S. (Punjab Agricultural University, Gurdaspur (India). Dept. of Plant Breeding, Genetics and Biotechnology). Influence of row spacing and seed rate on seed yield of lentil (*Lens culinaris*) under different sowing dates. *Indian Journal of Agronomy (India)*. (Dec 2005) v. 50(4) p. 308-310 KEYWORDS: SPACING; LENTILS; LENS CULINARIS; GROWTH; SOWING DATE; YIELDS; YIELD COMPONENTS; ECONOMICS.

A field experiment was conducted on sandy-loam soil of Gurdaspur during the winter season (rabl) of 1998-2000 to study the effect of different sowing dates, row spacings and seed rates on productivity of lentil (*Lens culinaris* Medikus). There was a significant reduction in seed yield with delay in sowing from 10 November to 10 December. Lentil sown on 10 November (14.6 q/ha) out yielded the crop sown on 25 November and 10 December by a margin of 12.8percentage and 90.1 percentage respectively. The crop sown on 10 November recorded higher net income (Rs 1,826/ha) and benefit: cost ratio (0.23) than 25 November-sown crop which in turn recorded Rs 5,797/ha higher net returns and 0.75 higher benefit: cost ratio. Row spacing of 20 cm (12.3 q/ha) resulted in 4.2percentage and 9.5percentage more seed yield than closer (17.5 cm) and wider (22.5 cm) row spacings respectively. Row spacing of 20 cm recorded Rs 680 and Rs 1,047/ha higher net returns and benefit: cost ratio to the tune of 0.10 and 0.12 over row spacings of 17.5 cm and 22.5 cm respectively. Seed rate of 37.5 kg/ha gave 8.2percentage more seed yield than 45 kg seed/ha which in turn recorded 5.4percentage more seed yield than 50 kg seed/ha. Similarly, seed rate of 37.5 kg/ha recorded higher net income and benefit: cost ratio than higher seed rates. Significantly higher mean seed yield was obtained in lentil sown on 10 November at 20 cm row spacing (15.7q/11a) and that sown on 10 November using 37.5 kg seed/ha (15.9 q/ha). Seed yield (13.6 q/ha) of lentil sown at row spacing of 20 cm using 37.5 kg seed/ha was significantly higher than all other combinations of seed rates and row spacings.

F02 Plant Propagation

223. Kumar, G.; Dhaliwal, H.S.; Aulakh, P.S.; Baidwan, R.P.S. (Zonal Research Station for Kandi Area, Balachaur (India)). Studies on the suitable time of budding in ber (*Zizyphus mauritiana* Lamk) in the lower shivaliks of Punjab. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 199-201 KEYWORDS: BUDDING; ZIZYPHUS; TIMING; PUNJAB.

The present studies were carried out at Zonal Research Station for Kandi Area, Ballawal Saunkhri of Punjab Agricultural University during the years 2003 and 2004 to find out the suitable time of budding in ber (*Zizyphus mauritiana* Lamk) cv. Sanaur No.2 under the rainfed conditions of Kandi area of Punjab. The observations were recorded on per cent bud sprout, survival of buddlings, length of scion shoot, number of leaves and stem diameter. The results showed that the maximum bud sprout (95.6-97.3 percent), survival of buddlings (86.0-89.3 percent) and length of scion sprout (27.5-29.4 cm) and number of leaves per buddling (26.3-27.0) were obtained during beginning of August and mid-August as compared to the budding done during the months of September and October. This could be because of the more favourable atmospheric temperature during the month of August.

224. Mathur, K.; Srivastava, G.C. (Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Effect of 1-MCP on malic enzyme activity and ethylene production

in mango during ripening. *Indian Journal of Plant Physiology (India)*. (July-Sept 2005) v. 10(3) p. 273-275 KEYWORDS: RIPENING; ETHYLENE; MANGIFERA INDICA; ENZYME.

1-methylcyclopropene is a novel, magic gas that has proven itself to be non-toxic and odourless inhibitor of ethylene in wide range of fruits and vegetables. The effect of 1-MCP on malic enzyme, a marker enzyme, during ripening in climacteric fruits like mango, was studied. Malic enzyme activity was found to be completely inhibited for 8 days after 1-MCP treatment, the period for which endogenous ethylene evolution was also checked. Malic enzyme activity appeared after 8 days when 1-MCP lost its control to inhibit endogenous ethylene and autocatalytic evolution started, triggering cascade of biochemical changes leading to ripening in mango cv. Amrapali. 1-MCP was found to be effective for 8 days in delaying fruit ripening in mango, suggesting the role of endogenous ethylene in regulating malic enzyme activity during ripening.

225. Kumar, V.; Bhatia, V.S.; Rani, A.; Chauhan, G.S. (National Research Centre for Soybean, Indore (India). Effect of photoperiod on fatty acid composition of oil in soybean genotypes. *Indian Journal of Plant Physiology (India)*. (July-Sept 2005) v. 10(3) p. 276-279 KEYWORDS: GLYCINE MAX; GENOTYPES; PHOTOPERIODICITY; OILS.

Eight selected soybean genotypes were grown in ambient and extended photoperiod (17). Genotypes showed variation in photosensitivity in terms of days to flower and days to maturity. Photo-insensitive genotypes did not exhibit significant changes in fatty acids under extended photoperiod. However, four soybean genotypes, which exhibited photosensitivity both in terms of days to flower and days to maturity, exhibited an increase in oleic acid content and decrease in linolenic acid content. Therefore, photosensitivity in terms of days to flowering appeared to influence the fatty acid composition of soybean.

226. Gangwar, M.P.; Dimri, D.C.; Singh, S.C. (Govind Ballabh Pant University of Agriculture and Technology, Ranichauri (India). Dept. of Horticulture, College of Forestry and Hill Agriculture). Effect of graftage method and height on the performance of pear. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 332-334 KEYWORDS: GRAFT COMPATIBILITY; PHYRIFOLIA.

227. Robinson, R.; Kumari, B. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). (Dept. of Forestry); Beniwal, V.S. (Haryana Agricultural University, Hisar (India). CRAPTC). In vitro shoot multiplication of *tecomella undulata* (SM.) Seem. - an endangered tree species. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2005) v. 10(4) (New Series) p. 372-376 KEYWORDS: HORMONES; IN VITRO CULTURE; SPECIES.

An efficient protocol for in vitro propagation of *Tecomella undulata* through multiple shoot formation from nodal segment explants has been developed. MS basal medium+ 1.5 mg l⁻¹ BAP+0.02 mg l⁻¹ IAA was found to be the most effective media for maximum (95 percent) regeneration of nodal explant at 25;:!C and 16/8 hours cycle of light (2000 lux fluorescent tubes) and dark. Nodal segment showed maximum (9) shoot induction per explant. Twenty-nine shoots per nodal segment explant were observed on MS+0.75 mg l⁻¹ BAP+0.01 mg l⁻¹ IAA within 3 weeks. The rooting percentage (66 percent) and average number of days (8) for root induction were recorded by following the two-step procedure. In the first step, a 48 hour treatment of 1/2 MS medium (liquid) + 2.5 mg l⁻¹ IBA was given to isolated shoots. In the second step these shoots were transferred to hormone free 1/2 MS

medium. Seventy-three per cent survivability of plantlets was recorded in potting mixture composed of drained soil+vermiculite (3: 1, v/v).

F03 Seed Production and Processing

228. Singh, A.K.; Ranjan, R.D. (Rajendra Agricultural University, Pusa (India). Dept. of Botany and Plant Physiology); Sharma, S.C. (Central Rice Research Institute, Cuttack (India). (Dept. of Biochemistry). Salinity induced compositional changes in germinating seeds of mustard genotypes. *Indian Journal of Plant Physiology (India)*. (July-Sept 2005) v. 10(3) p. 297-301
KEYWORDS: BRASSICA COMPESTRIS; SALINITY; GERMINATION AND SEEDS; GENOTYPES; SUGAR.

Mustard genotypes Panchali and Bhavani (tolerant), and TS-46 and PT -303 (susceptible) were subjected to varied levels of salinity stress (control, 4.0, 8.0, 12.0 dS mol) to investigate the biochemical basis of salt tolerance during germination. Increase in salt stress resulted in decrease in sugars and phospholipids, and increase in malondialdehyde and phenol content in all genotypes. However, tolerant genotypes showed higher content of sugars, lipids, phenols and lower MDA content as compared to susceptible genotypes.

229. Mohi-ud-din, G.G.; Nawchoo, I.A.; Wafai, B.A. (University of Kashmir, Srinagar (India). Dept. of Botany). Seed germination studies on *Saussurea costus* (Falc.) Lipsch- a threatened medicinal plant of N.W. Himalaya. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2005) v. 10(4) (New Series) p. 394-396
KEYWORDS: SEED; GERMINABILITY; HIMALAYA.

Germinability and seedling survival studies of the *Saussurea eostus* (Asteraceae) were carried out under ex situ conditions at 1495m. Among various treatments given to the seeds to enhance germinability, scarification/complete removal of the seed coat were found to be most effective and showed 90.0%: 4.08 percent germination against the control of 21.66%: 2.35 percent. This was primarily due to the presence of inhibitors in the seed coat. Treatment with GA, 20, 50, and 100ppm showed the percentage germination 41.66%: 6.23, 70.0%: 12.24 and 70.0%: 16.32 percent respectively and that with kinetin 20, 50 and 100ppm showed 31.66%: 6.23, 60.0%: 4.08 and 40.0%: 4.08 percent germination respectively as against the control of 21.66%: 2.35 percent.

230. Singh, K.K.; Dadlani, M. (Indian Agricultural Research Institute, New Delhi (India). Div. of Seed Science and Technology, Seed Production Unit). Effect of distillery effluent pressmud compost on seed storability of paddy (*Oryza sativa* L.) CV. Pusa Basmati-1 during ambient storage. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 495-500
KEYWORDS: SEED STORAGE; ORYZA SATIVA; COMPOSTS; FERTILIZER APPLICATION.

An experiment was conducted to study the effect of distillery based press mud compost on vigor and viability of paddy cultivar Pusa Basmati-1 seed under ambient conditions. Germination percentage, shoot length, root length, total seedling length, seedling dry weight, vigor index-I and vigor-index-II were measured at initial and six months intervals of storage. The effect of distillery compost was seen on germination of seed produced, which ranged from 77 to 81 percent in different compositions of organic and inorganic fertilizers (T-1 to T-6) at 2 months of harvest. After eight months of storage, seeds of different treatments recorded higher germination value ranging from 95. to 97 percent, which possibly was because of the release of residual dormancy. After 14 month of storage germination value revealed a decline trend from 87 to 89 percent. Seeds from T-4 (Press

mud compost 3 t/ha +25 percent NPK) recorded highest germination and seedling dry weight at 2, 8, 14 and 20 months after harvest while there were lowest in treatment T.1 (Press mud compost 1.5 t/ha). Seed from T-4 (press mud compost 3 t/ha +25 percent NPK) was found to be more vigorous, both initially and after the storage.

231. Pandey, S.; Kumar, J.; Parmar, B.S. (Indian Agricultural Research Institute, New Delhi (India). Polymer seed coating on soybean and maize for seed quality enhancement and better emergence. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 509-513
KEYWORDS: MAIZE; SOYBEANS; SEEDS; QUALITY.

Pre-sowing seed treatments such as coating and pelleting can be used to increase germination to get uniform stand and higher yields. Coating and pelleting improved physical properties of the seed for ease of handling for mechanization, permitted direct application of nutrients and growth regulators, reduced pesticide dusts on seeds, provided better protection against diseases. In a joint venture with the Division of Agricultural Chemicals, IARI, New Delhi, 6 polymers namely PVC, Rosin (natural product,) Lac, Ethyl Cellulose, Thermocol and PEO were tested for their efficacy in coating maize and soybean, The study indicated that pvc, Rosin (natural product), Lac and Ethyl Cellulose were very effective in maintaining the storage quality of the soybean seeds for more than 7 months. The best polymer was Ethyl cellulose, which could retain the germination percent above 80 percent even after 7 months of storage in soybean whereas the control had only 49 percent germination. In maize also, polymer coating with Ethyl cellulose resulted in 96 percent germination after 7 months of storage, whereas it remained 89 percent in case of control. The corresponding field emergence and Vigor Index values were also higher in the seeds coated with Ethyl Cellulose.

F04 Fertilizing

232. Mann, K.K.; Brar, B.S.; Dhillon, N.S. (Punjab Agricultural University, Ludhiana (India). Dept. of Soils). Response of fertilizer N to wheat in soils under long term differential fertilizer use. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 173-180
KEYWORDS: FERTILIZER APPLICATION; FARMYARD MANURE; WHEAT; NITROGEN FERTILIZER; FIELD EXPERIMENTATION; ORGANIC FERTILIZERS; INORGANIC FERTILIZERS.

A green house experiment was conducted using wheat (cv. PBW 343) as a test crop with 10 soils (0-0.15 m depth) collected from long term fertilizer experiment on maize-wheat-cowpea (fodder) cropping sequence, which is in progress since 1971-at Punjab Agricultural University Farm, Ludhiana. Soils received four graded levels of fertilizer N (0, 50, 100 and 150 mg N kg⁻¹ soil to each soil as urea). A basal dose of phosphorus 50 mg kg⁻¹ soil as KH₂PO₄ and potassium 50 mg K kg⁻¹ soil was also supplemented as KCl. The plants were harvested after 30 days in two replications and after 84 days of sowing in the remaining two. The dry matter production and N uptake were recorded. The results showed that wheat responded significantly to both residual fertility and applied N. Dry matter yield for shoots increased from 0.44 and 3.3 g pot⁻¹ in control soils to 0.89 and 9.1 g pot⁻¹ in FYM treated soils at 30 and 84 DAS, respectively. Application of graded doses of N increased dry matter yield from 0.44 and 3.3 g pot⁻¹ to 0.62 and 10.2 g pot⁻¹ in control soils at 30 and 84 DAS, respectively. N content of wheat crop also increased both with increased application of N and soil N status in all the soils under test. Similarly, N uptake increased with N application from 21.8 and 70.8 mg pot⁻¹ to 33.4 and 426 mg pot⁻¹ in control soils at 30 and 84 DAS,

respectively. Dry matter production of roots decreased with increase in N level, but the N content of roots - increased with increasing doses of nitrogen fertilizers. There was no particular trend observed in N uptake by wheat roots.

233. Singh, S.; Aggarwal, P.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Environmental Sci.). Effect of heavy metal fertilization on growth, yield, and metal distribution in wheat. *Indian Journal of Plant Physiology (India)*. (July-Sept 2005) v. 10(3) p. 302-305 KEYWORDS: TRANSLOCATION; FERTILIZATION; GROWTH; YIELD; WHEAT.

In the present study the- effect of different heavy metal salts on the growth, yield and metal accumulation pattern of wheat (*T. aestivum*) cv. HD 2285 was examined. The studies revealed that application of heavy metals in soil before sowing caused varying extent of reduction in yields of wheat. Mercury caused maximum reduction in biological as well as economic yields followed by copper, lead and cadmium, while zinc did not affect the growth and grain yield of wheat markedly. The number of spikes/pot and grains/spike were reduced, while 1000 grain weight increased significantly by the application of copper, lead and cadmium in soil. The heavy metal stress, however did not affect the harvest index of wheat plants. The content of all the tested metals increased both in straw and grain by their application in soil, but their accumulation was much higher in vegetative shoots (straw) than in reproductive shoot (grain). However, zinc registered higher content in grain than in straw of wheat plants. The content of metals in wheat shoots was in the order of Zn Cu Cd . Pb. The larger proportion of both essential (Cu) and toxic metals (Pb and Cd) absorbed by wheat plants thus remained in straw and a small proportion of the same only transported to edible part (grains).

234. Kumar, R.; Kapoor, J.K. (Indian Agricultural Statistics Research Institute, New Delhi (India). Methodological study of composite yardsticks of additional production from the use of cultural practices at optimum levels of fertilizer nutrients for various crops. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 185-189 KEYWORDS: SEED CHARACTERISTICS; FERTILIZER APPLICATION; YIELD.

To prepare targets of additional production from the adoption of improvement measures knowledge of the output-input relationship of various developmental measures that is yardsticks is necessary and yardstick thus from an essential basis for this operation. The yardstick is a measure of the average increase of production per unit given improvement measures singly or jointly under the typical agronomic and climatic conditions of the region. This is termed as simple when inputs applied singly and composite when applied jointly. Among various inputs of the crop, fertilizer is the most important and very costly. Indian government is giving subsidy to fertilizers for farmers so that they may afford the cost of fertilizers and buy as per requirement for their crop cultivation. The cultural practices are very economic and play a significant role in production of the yield of various crops. These cultural practices include seed rate, spacing, date of sowing or planting, date of harvest, number of seeds or seedling/hill, mulching with various type of residue, method of sowing or planting, method of ploughing and cultivation etc. These cultural practices are economically cheaper than other inputs for the crop growth. An attempt has been made to study of composite yardstick of additional production from the use of cultural practices at optimum level of fertilizer nutrients for various crops. On the basis of coefficient of determination (R^2) and root mean square error (MSE), Complete Quadratic Response Surface model was found a good fit for cultural cum manurial experiments when cultural

practices are quantitative in nature. Change in the level of cultural treatment brings the change in the yardsticks of the additional production at optimum level of fertilizer. It means the yield of the particular crop changes as per various level of cultural treatment. Response of fertilizer also change as per various levels of cultural treatment.

235. Mohammad, F.; Khan, T. (Aligarh Muslim University, Aligarh (India). Dept. of Botany); Afridi, R.M. (Aligarh Muslim University, Aligarh (India). Dept. of Ilmu Advia, A.K. Tibbiya College). Fertilizer application strategies for improved yield and fatty acid composition of oil in mustard. *Indian Journal of Plant Physiology (India)*. (Oct-Dec. 2005) v. 10(4) (New Series) p. 327-332 KEYWORDS: SEED; YIELD; BRASSICA JUNCEA; OILSEEDS.

The effect of basal N and P with and without supplemental foliar N, P and S on yield characteristics and fatty acid composition of oil of *Brassica juncea* cv. Rohini was studied in a two year field experiment. The data revealed that, of the six treatments, inclusion of N, P and S in the spray, particularly in the form of commercial grade fertilizers, had a significant ameliorating effect on all yield characteristics as well as erucic acid content of the oil. This indicates the feasibility of the technique for increased productivity of the crop as well as improved quality of oil for human consumption.

236. Sarkar, R.K. (Calcutta University, Kolkata (India). Dept. of Agronomy); Saha, A. (Calcutta University, Kolkata (India). Dept. of Plant Physiology, Institute of Agricultural Sciences). Analysis of growth and productivity of sesame (*Sesamum indicum*) in relation to nitrogen, sulphur and boron. *Indian Journal of Plant Physiology (India)*. (Oct-Dec. 2005) v. 10(4) (New Series) p. 333-337 KEYWORDS: SESAMUM INDICUM; GROWTH; NITROGEN; SULPHUR; BORON; PRODUCTION.

A field experiment was conducted during summer season of 2001 and 2002 to study the effect of nitrogen (N), sulphur (S) and boron (B) on physiological parameters in relation to productivity of sesame (*Sesamum indicum*) on Gangetic alluvial land. Application of N, S and B improved the physiological parameters, viz. leaf area index (LA1), biomass production (BM), crop growth rate (CGR), relative growth rate (RGR), net assimilation rate (NAR) and increased yield attributes which eventually resulted in higher seed yield. Application of 90 kg N, 50 kg S and 1 kg B ha⁻¹ increased the seed yield of sesame by 94.2, 30.4 and 10.4 percent respectively over their respective control. Increase in level of N and S increased agronomic and physiological efficiency of respective nutrient. Among the nutrients applied, B showed the maximum agronomic and physiological efficiency.

237. Singhal, S.K.; Aggarwal, B. (Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry). Effect of inorganic and organic sources of N on okra yield, N uptake and apparent recovery. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 449-452 KEYWORDS: NITROGEN; OKRA; YIELD.

An experiment was conducted in sandy loam soil of IARI Farm to study the integrated effect of organic and inorganic source of nitrogen on yield, N uptake and recovery of okra (Prabhni -Kranti). Graded levels of N were tested in presence of nitrification inhibitors. The results showed that the integrated treatments had higher N uptake, recovery and yield of fresh fruit as compared to fertilizer alone. The yield due to fertilizer N (50 percent) integrated with organic N (FYM and oilseed cakes) and nitrification inhibitors was statistically at par with 100 percent fertilizer N alone. Thus, it is suggested that a saving of 50 percent fertilizer N would be possible by the use of organic sources of N.

238. Jat, R.L.; Dahama, A.K.; Meena, R.P. (Rajasthan Agricultural University, Bikaner (India). Dept. of Agronomy). Productivity and economics of mustard (*Brassica juncea* (L.) Czern. & Coss) as influenced by phosphorus and sulphur nutrition in association with farmyard manure. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 481-484 KEYWORDS: ECONOMICS; PRODUCTION; FARMYARD MANURE; MUSTARD; PHOSPHORUS; SULPHUR; NUTRITION.

A field experiment was conducted to study the effect of FYM, phosphorus and sulphur nutrition in association with farmyard manure on productivity and economics of mustard. Manuring of FYM 10 t/ha-l significantly improved the yield attributes viz., siliquae/plant, seeds/siliqua, length of siliqua and 1000-seed weight, seed and straw yields and net monetary return and B : C ratio of mustard. Significant improvement in yield components viz., siliqua, plant, seeds/siliqua, length of siliqua and 1000-seed weight, seed and stover yield, net monetary returns and B : C ratio was observed due to fertilization of 60 kg P₂O₅ ha-l over control and 30 kg P₂O₅ ha-l. The optimum economic dose of 72.21 and 75.59 kg P₂O₅ ha-l was observed for mustard during 2000-01 and 2001-02, respectively. Similarly, application of sulphur upto 60 kg ha-l also significantly increased yield attributes, seed and stover yields, net monetary returns and B : C ratio over control and 30 kg S ha¹. The optimum economic dose of 71.49 and 71.48 kg S ha⁻¹ was estimated for mustard during 2000-01 and 2001-02, respectively.

239. Adak, T.; Singh, S.; Sachan, R.S. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). (Dept. of Soil Science). Post-harvest micronutrient status in fenugreek as influenced by co-inoculation of *Sinorhizobium meliloti* and *Bacillus megaterium*. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 501-504 KEYWORDS: POST HARVEST PHYSIOLOGY; FYM; SINORHIZOBIUM MELILOTI; BACILLUS MEGATERIUM; TRIGONELLA FOENUMGRAECUM; MICRONUTRIENT FERTILIZERS; TRACE ELEMENTS.

Field experiments revealed that the integrated use of recommended dose of fertilizer (30:60:40 N, P₂O₅ and K₂O kg ha-l) in combination with microbial inoculants (*Sinorhizobium meliloti* and *Bacillus megaterium*) and FYM resulted in significant increase in micronutrient uptake of fenugreek' over sole application of recommended dose of fertilizer in a Mollisoi. The treatments where recommended N and P doses were adjusted with *Sinorhizobium meliloti* and *Bacillus megaterium* resulted in significant increase in micronutrient uptake as well as residual post harvest status over recommended NPK dose. The FYM application was found to increase the uptake of micronutrient cations like Zn (5.0 percent), Fe (21.00 percent), Mn (6.0 percent) and Cu (1.0 percent) by straw samples over the untreated conditions.

240. Singh, A.K.; Singh, S. (Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Horticulture). Effect of urea and zinc on growth, yield and quality of grapefruit (*Citrus paradisi* Macf.). *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 571-574 KEYWORDS: GROWTH; YIELD; QUALITY; CITRUS PARDISI.

An experiment was conducted to study the effect of Zn on grapefruit. The effect of 400gm urea (soil application) as well as foliar application (0.5 percent, 1.5 percent and 2.0 percent) were studied. Zinc was applied as foliar spray (0.5 percent) and in combination with different nitrogen treatment twice a year. Soil application of urea was applied twice in 1st week of

February and September during both the year of experimentation. The growth of plant in terms of plant height, stem girth and plant spread, yield in terms of number and weight of fruit and quality in terms of juice content acidity, total sugar and 55 per cent increased with soil application of 400gm urea over control. The parameters further increased when urea was sprayed in addition to soil application. Every increase in the percentage of urea in the solutions for spray from 0.5 to 1.5 percent increased the growth, yield and quality of fruits. However, 2 percent solutions could not increase the parameters further but it was not detrimental. The addition of 0.5 percent zinc in the spray solutions of plant further increased the growth of plant, yield and quality of fruit.

241. Pathan, A.R.K.; Kumawat, B.L.; Parihar, N.S. (S.K.N. College of Agriculture, Jobner (India). Dept. of Agricultural Chemistry and Soil Science). Interaction effect of phosphorus and sulphur on yield and nutrient uptake of taramira (*Eruca sativa* L.). *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 587-590 KEYWORDS: PHOSPHORUS; SULPHUR; YIELD; NUTRIENT UPTAKE; ERUCA SATIVA; SOIL FERTILITY.

Field experiment on interaction effect of phosphorus and sulphur on yield and nutrient uptake of taramira revealed that seed and straw yield increased significantly with increasing level of either phosphorus or sulphur. The per cent increase in seed and straw yield was 39.70 and 38.11 per cent, due to phosphorus application and 38.35 and 38.34 per cent due to sulphur application, respectively. Application of either phosphorus or sulphur increased the nitrogen, sulphur and phosphorus uptake by the crop. The effect of sulphur application was more on nitrogen and sulphur uptake as compared to phosphorus application.

242. Lalitlanmawia, L.; Singh, A.K.; Sharma, S.K. (Nagaland University, Medziphema (India). Dept. of Agricultural Chemistry and Soil Science, School of Agricultural Sciences and Rural Development). Effect of phosphorus and molybdenum nutrition on growth, yield and nutrient content of soybean in an acid alfisol of Nagaland. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 591-595 KEYWORDS: PHOSPHORUS; GROWTH; YIELD; MOLYBDENUM; SOYBEAN; NUTRIENT; NAGALAND; PLANT.

A field experiment was conducted to evaluate the effect of phosphorus and molybdenum in soybean. The application of phosphorus significantly increased the number of leaves, plant height, nodulation, plant dry weight, yield and molybdenum increased significantly the nodulation, plant dry weight and yield only. Application of phosphorus significantly increased the nitrogen and phosphorus content in stover and seed. Likewise, application of Mo increased the N content but failed to reach significant level. Maximum P content in seed and stover recorded at 1.0 kg Mo ha⁻¹ which declined sharply on 1.5 kg Mo ha⁻¹, whereas Mo increased K content in seed and stover. Application of 60 kg P₂O₅ ha⁻¹ and 1.0 kg Mo ha⁻¹ were found to be economical for better yield and quality of soybean.

243. Choudhary, A.K.; Majumdar, S.P.; Sharma, S.R.; Lakhana, R.C. (S.K.N. College of Agriculture, Jobner (India). Dept. of Soil Science and Agricultural Chemistry). Impact of nitrogen and zinc nutrition on yield attributes, yield and economics of barley (*Hordeum vulgare* L.) grown under typical ustipsamment. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 599-602 KEYWORDS: NITROGEN; ECONOMICS; ZINC; HORDEUM VULGARE; YIELD; SOIL FERTILITY.

An experiment was conducted to study the effect of nitrogen and zinc on yield attributes, yield and economics of barley with four levels of nitrogen (i.e. 0, 30, 60 and 90 kg N ha⁻¹)

and zinc (i.e. 0, 2, 4 and 6 kg Zn ha⁻¹) in randomized block design with four replications at the agronomy farm of S.K.N. College of Agriculture, Jobner. The results indicated that the application of all the levels of nitrogen and zinc significantly increased numbers of effective tillers (per meter row length) leaf area index, test weight, harvest index, grain and straw yield of barley under 90 kg N ha⁻¹ and 6 kg Zn ha⁻¹ application. However, the treatment 90 kg N ha⁻¹ and 6 kg Zn ha⁻¹ was found at par with 60 kg N ha⁻¹ and 4 kg Zn ha⁻¹ application.

244. Dixit, A.K. (Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha, Jammu (India); Singh, O.P. (Gobind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Agronomy); Kachroo, D.; Bali, A.S. (Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha, Jammu (India). Response of promising rainy-season sorghum (*Sorghum bicolor*) genotypes to nitrogen and phosphorus fertilization. *Indian Journal of Agronomy* (India). (Sep 2005) v. 50(3) p. 206-209 KEYWORDS: FERTILIZATION; NITROGEN; PHOSPHORUS; SORGHUM; SORGHUM BICOLOR; GENOTYPES; NUTRIENT UPTAKE; YIELDS; YIELD COMPONENTS.

A field investigation was conducted at Pantnagar, Uttaranchal during the rainy (kharif) seasons of 1998 and 1999, to study the pattern of growth and nutrient uptake by sorghum [*Sorghum bicolor*(L.) Moench] genotypes to varying fertility levels. Genotype 'SPH 960' proved superior in producing higher number of green leaves/plant, leaf-area index and dry-matter accumulation than other genotypes. In 'SPH 960', increase in panicle length, panicle diameter, panicle weight and grains/panicle resulted in significant increase of grain yield than rest of the genotypes. This genotype also removed more phosphorus and nitrogen from the soil. However, genotype 'SPH 792' recorded maximum stover yield, fresh fodder yield and potassium uptake. The net return and benefit: cost ratio were also highest in 'SPH 960'. Application of 80 kg N + 40 kg P/ha not only increased the growth and yield attributes but also increased the grain yield, stover yield, harvest index, fresh fodder yield, uptake of N, P and K significantly which resulted in higher net return and benefit: cost ratio.

245. Prasad, M.; Lal, K.; Prasad, R. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Effect of nitrogen and organic plant food supplements and stimulants Vegimax and mahaagrozyme on growth, yield attributes and yield of cotton (*Gossypium hirsutum*). *Indian Journal of Agronomy* (India). (Sep 2005) v. 50(3) p. 228-230 KEYWORDS: FERTILIZER APPLICATION; ORGANIC FERTILIZERS; PLANT GROWTH STIMULANTS; FARMYARD MANURE; GOSSYPIUM HIRSUTUM; YIELDS; COTTON; GROWTH; NITROGEN; YIELD COMPONENTS.

A field experiment was conducted for 3 years (2001-03) at the Indian Agricultural Research Institute, New Delhi, to study the effect of Vegimax and Mahaagrozyme, two organic plant food supplements, and stimulants on cotton (*Gossypium hirsutum* L.). The optimum levels of application were found to be 0.25 ml/litre water for Vegimax and 3 ml/litre water for Mahaagrozyme. Vegimax and Mahaagrozyme were not effective when applied/ along with fertilizer nitrogen. However, with farmyard manure both Vegimax and Mahaagrozyme were quite effective and resulted in highest seed-cotton yield.

246. Mathew, T. (Kerala Agricultural University, Thiruvalla (India). Sugarcane Research Stn.); Varughese, K. (Cropping System Research Centre, Karamana (India). Integrated nutrient management for sustainable cane production. *Indian Journal of Agronomy* (India). (Sep 2005) v. 50(3) p. 231-235 KEYWORDS: FERTILIZER APPLICATION; SUGARCANE; ORGANIC

FERTILIZERS; NUTRIENT UPTAKE; INORGANIC FERTILIZERS; YIELDS; MINERAL NUTRIENTS; YIELD COMPONENTS; NUTRITIONAL REQUIREMENTS; QUALITY.

A field experiment was conducted during the crop season of 1998-99 and 1999-2000, to study the influence of integrated use of organic sources with different levels of mineral nutrients. Integrated use of press mud at 5 tonnes/ha with NPK application 100percentage of the recommended dose influenced the yield attributes, nutrient uptake and remarkably increased the cane yield. It was comparable with conjunctive use of pressmud tonnes/ha with NPK 100percentage of the recommended dose. But the magnitude of variation in cane yield was only marginal. Hence, it was possible to save 25percentage of the recommended dose of NPK when pressmud was applied tonnes/ ha. There was a drastic decrease in cane growth and cane yield when resorted to mineral nutrition alone. The juice quality also improved when organic sources were integrated with mineral nutrients.

247. Arya, R.L. (Central Tobacco Research Institute, Cooch Behar (India). Research Stn.); Kumar, L.; Singh, K.K.; Kushwaha, B.L. (Indian Institute of Pulses Research, Kanpur (India). Effect of fertilizers and tillage management in rice (*Oryza sativa*)-chickpea (*Cicer arietinum*) cropping system under varying irrigation schedules. Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 256-259 KEYWORDS: FERTILIZATION; TILLAGE; ORYZA SATIVA; CICER ARIETINUM; CROPPING SYSTEMS; IRRIGATION SCHEDULING; WATER USE; NUTRIENT UPTAKE; SOIL CHEMICOPHYSICAL PROPERTIES; EFFICIENCY.

A field experiment was carried out during 2000-01 and 2001-02 at the Indian Institute of Pulses Research, Kanpur, to study the effect of fertilizers, tillage and irrigation management in chickpea (*Gicer arietinum* L.) raised after rice (*Oryza sativa* L.). Significantly higher growth and yield attributes of chickpea were obtained undertreatment 30:60:40 kg NPK/ha, deep ploughing with spade (23 cm deep) and cumulative pan evaporation (CPE) of 60 mm compared to 20:40:40 kg NPK/ha, normal ploughing and CPE of 80 mm. Significantly higher grain and straw yield of chickpea, chickpea-equivalent yield and monetary returns were obtained with 30:60:40 kg NPK/ha than 20:40:40 kg NPK/ha. Among the various tillage practices, deep ploughing with spade (23 cm deep) recorded significantly higher grain and straw yields of chickpea, chickpea-equivalent yield and economics than normal ploughing. Significantly higher productivity and monetary returns of chickpea was obtained at CPE of 80 mm compared to CPE of 80 mm. The NPK uptake by rice and chickpea and total uptake by the system were significantly higher under CPE of 60 mm, deep tillage and 30:60:40 kg NPK/ha than CPE of 80 mm, normal tillage and 20:40:40 kg NPK/ha. Bulk density, particle density, water-holding capacity, pore space and volume expansion of soil were greatly influenced by different tillage and nutrients management. The residual effect of nutrients management and tillage practices applied during the winter (rab/) season was also seen in the preceding crop of rice in second year.

248. Aruna, E.; Mohammad, S. (Acharya N.G.Ranga Agricultural University, Hyderabad (India). Dept. of Agronomy). Influence of conjunctive use of organic and inorganic source of nutrients in rice (*Oryza sativa*) on crop growth, yield components, yield and soil fertility in rice-sunflower (*Helianthus annuus*) sequence. Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 265-268 KEYWORDS: FERTILIZER APPLICATION; SOIL FERTILITY; SEQUENTIAL CROPPING; ORGANIC FERTILIZERS; INORGANIC FERTILIZERS; ORYZA SATIVA; HELIANTHUS ANNUS; YIELDS; YIELD COMPONENTS.

A field experiment was carried out during 2001 and 2002 at Agricultural College Farm, Rajendranagar, Hyderabad, to study the effect of conjunctive use of nutrients in rice on rice (*Oryza sativa* L.)-sunflower (*Helianthus annuus* L.) cropping system, rice fertilized with 75 percentage recommended level of 120 kg N/ha and supplemented with 25 percentage N through organic sources removed more N, P and K from the soil and gave significantly more seed yield (39.57 q/ha) than by the application of N through the fertilizer-alone. The yield was increased to 43.67 and 42.91 q/ha by substituting 25 percentage N through the bulky organic manure of FYM and vermicompost. The substitution of 25 percentage N through green leaf manures, viz. *Gliricidia* and sunnhemp, increased the production to, 41.83 and 43.90 q/ha. Plant height, capitulum diameter, filled seeds/capitulum and seed yield of sunflower were significantly reduced by reducing the level of fertilizers to 75 or 50 percentage of the recommended level of 80, 50 and 30 kg/ha NPK. The crop gave mean seed yield of 8.18 q/ha with the recommended level of 120 kg N/ha to preceding rice through the fertilizer. But the residual fertility of nutrients by the application of 75 percentage N through fertilizer and rest through FYM or vermicompost to rice significantly increased the seed yield of sunflower to 9.23 and 9.14 q/ha respectively. Substitution of 25 percentage N through *Gliricidia* Or sunnhemp to rice also significantly increased the seed yield of succeeding sunflower to 8.82 and 8.70 q/ha. The soil-available N, P and K was also more by the conjunctive source of fertilizer and organic manures applied to rice in rice-sunflower cropping system compared to the initial values.

249. Pathak, S.K.; Singh, S.B.; Jha, R.N.; Sharma, R.P. (Rajendra Agricultural University, Sabour (India). Bihar Agricultural College). Effect of nutrient management on nutrient uptake and changes in soil fertility in maize (*Zea mays*) - wheat (*Triticum aestivum*) cropping system. *Indian Journal of Agronomy* (India). (Dec 2005) v. 50(4) p. 269-273 KEYWORDS: FERTILIZER APPLICATION; ORGANIC FERTILIZERS; INORGANIC FERTILIZERS; NUTRIENT UPTAKE; FERTILIZER COMBINATIONS; CROPPING SYSTEMS; ZEA MAYS; TRITICUM AESTIVUM; SOIL FERTILITY; SOIL CHEMICO-PHYSICAL PROPERTIES.

A long-term experiment initiated in 1983 was selected during 1997-99 to study cumulative impact of organic sources (FYM, rice straw and green karanj leaves) substituting inorganic fertilizers in recommended fertilizer dose (RFD) once each by 25 percentage and 50 percentage during rainy season (kharif, in maize (*Zea mays* L.)-wheat (*Triticum aestivum* L.) cropping system. All the organic sources were instrumental in improving pH and aggregation of soils. Only rice straw in its higher substitution (50 percentage) could induce significant improvement in bulk density and water-holding capacity of soils but a constant trend of improvement was there under application of all the sources. All the 3 sources both in their higher and lower substitutions enriched the soils in organic carbon contents. Farmyard manure (FYM) and green karanj leaves in their higher substitution improved NPK levels of soils. Rice straw at this level (50 percentage substitution) could bring about significant improvement only in available K content of soils. At lower level of substitution (25 percentage) green manuring with karanj leaves induced higher available P and K in soils, but FYM at the level could bring about significant improvement only in available P level. Application of rice straw at this level of substitution (25 percentage) could not alter status of any of the NPK significantly. Substitution of inorganic fertilizers by FYM either at higher (50 percentage) or lower (25 percentage) level was helpful in increasing grain yield and uptake of NPK.

250. Kumar, A.; Thakur, K.S.; Sharma, S. (Oilseeds Research Station, Kangra (India). Integrated nutrient management in maize (*Zea mays*)-gobhi sarson (*Brassica napus* spp *olerifera* var. *annua*) cropping system under rainfed condition. Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 274-277 KEYWORDS: NUTRITIONAL REQUIREMENTS; CROPPING SYSTEMS; FERTILIZER APPLICATION; ZEA MAYS; BRASSICA NAPUS; YIELDS; YIELD COMPONENTS; NUTRIENT UPTAKE; FERTILIZER COMBINATIONS; RAINFED FARMING.

An experiment was conducted during 1998-99 to 2000-01 to work out an integrated nutrient management schedule for maize (*Zea mays* L.)-gobhi sarson (*Brassica napus* ssp *oleifera* var *annua*) cropping system under rainfed conditions. The total grain production was higher (110.5 q/ha) when both crops in system were given 150percentage of recommended NPK and was 28 and 26percentage higher over recommended fertilizer application in maize and gobhi sarson respectively. However, an application of 150percentage of recommended NPK to maize and 100percentage NPK + 10 tonnes/ha farmyard manure (FYM) to gob hi sarson also resulted in statistically similar grain yield (108 q/ha). Application of 10 t;hnes FYM along with 100percentage NPK either to one crop or both crops increased the system productivity by 7.7percentage oVer 100percentage NPK, application only. The N,P and K uptake in system was higher when both crops in system were given 150percentage NPK, followed by 100percentage NPK + 10 tonnes FYM/ha application. Higher gross returns (Rs.75, 251) and benefit: cost ratio (2.68) were obtained when both crops in system were given 150percentage of recommended NPK. Application of recommended NPK to both crops although gave lower gross returns (Rs 56,786), the benefit: cost ratio of 2.18 was most practical under limited resources.

260. Singh, J.; Singh, K.P. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy). Effect of organic manures and herbicides on yield and yield attributing characters of wheat. Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 289-291 KEYWORDS: FERTILIZER APPLICATION; YIELDS; YIELD COMPONENTS; TRITICUM AESTIVUM; WEED CONTROL METHODS; FARMYARD MANURE; COMPOSTING; OLIGOCHAETA; HERBICIDES; METSULFURON.

In a study conducted during 1999-2000 and 2000-2001, an application of organic manures increased the number of effective tillers, grain weighVear and grain and biological yields over no organic manure in wheat (*Triticum aestivum* L. emend. Fiori & Paol. The highest yield was recorded under vermicompost at 15 tonnes/ha. Vermicompost at 10 tonnes/ha and FYM at 15 tonnes/ha gave equal yields.. Overall increase in grain yield was 29.91, 18.81, 35.44 and 45.21 percentage owing to FYM at 15 tonnes/ha and vermicompost at 7.5, 10 and 15 tonnes/ha, "respectively, over no organic manure. Different weed-control treatments significantly improved the effective tillers) and grain weighVear of wheat. Metsulfuron at 4 g/ha and 2,4-0 at 0.5 kg/ha were as effective as weed-free treatment for these parameters and for weed-control efficiency. Metsulfuron at 4 g/ha and 2,4-0 at 0.5 kg/ha gave significantly more yields than the weedy check and were at par with each other. In interaction effects, vermicompost at 15 and 10 tonnes/ha gave better results under weedy conditions than FYM.

261. Meena, R.; Gautam, R.C. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Effect of integrated nutrient management on productivity, nutrient uptake and moisture-use functions of pearl millet (*Pennisetum glaucum*). Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 305-307 KEYWORDS: FERTILIZER APPLICATION;

BIOFERTILIZERS; FARMYARD MANURE; NUTRITIONAL REQUIREMENTS; PENNISETUM GLAUCUM; WATER USE; EFFICIENCY; NUTRIENT UPTAKE; YIELDS; YIELD COMPONENTS.

A field experiment was conducted at the Indian Agricultural Research Institute, New Delhi, during the rainy seasons of 2000 and 2001 to study the effect of integrated nutrient management (INM) on productivity and nutrient uptake of pearl millet [*Pennisetum glaucum* (L.) R.Br. emend. Stuntz.] under rainfed conditions. Inoculation of seed with Azospiril/um + phosphate-solubilizing bacteria (PSB) with 20 and 15 kg Nand P Ps resulted in significantly higher yield attributes, seed yield and NPK uptake. Further, application of 20 kg N + 15 kg pp/ha + Azospiril/um + PSB resulted in higher consumptive use of water (mm), water-use efficiency (kg/ha-mm) and daily rate of water use (mm/day) over other INM treatments. The seed yield and nutrient uptake increased with organic manuring in association with summer ploughing before sowing the crop. The consumptive use of water, wateruse efficiency and daily rate of water use and yield attributes of pearl millet, yield and N, P and K uptake significantly increased with different Nganic manures and summer ploughing before sowing of crop. The FYM 10 tonnes/ha with summer ploughig before sowing of the crop registered the highest values for the above parameters compared to other organic sources of nutrients and summer ploughing.

262. Chaturvedi, S. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Directorate of Extension Stn.); Chandel, A.S. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India); Dept. of Agronomy) . Influence of organic and inorganic fertilization on soil fertility and productivity of soybean (*Glycine max*). Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 311-313 KEYWORDS: FERTILIZER APPLICATIONS; ORGANIC FERTILIZERS; INORGANIC FERTILIZERS; TRACE ELEMENTS; HARVEST INDEX; NUTRIENT UPTAKE; GLYCINE MAX; YIELDS; YIELD COMPONENTS; SOIL FERTILITY.

A field experiment was conducted at Pantnagar, during the rainy season (kharif) of 2002 and 2003, to assess the effect of various fertilizer and manurial treatments on soybean [*Glycine max* (L.) Merr]. Integrated use of rec-ommended fertilizers with supplementary nutrients increased the yield attributes and yield. Increase in yield varied from 58.7 to 124.4percentage and 61.9 to 136.9percentage during 2002 and 2003, respectively, over the control. Highest yield attributes (pods/plant, and 100-seed weight), harvest index, grain yield as well as NPK uptake was recorded with the application of 100percentage recommended dose of NPK + FYM 10 tonnes/ha. Use of organic sources helped in maintaining soil fertility in terms of available nutrients.

263. Rana, K.S.; Rana, D.S.; Gautam, R.C. (Indian Agricultural Research Institute, New Delhi (India). (Div. of Agronomy). Influence of phosphorus, sulphur and boron on growth, yield, nutrient uptake and economics of Indian mustard (*Brassica juncea*) under rainfed conditions. Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 314-316 KEYWORDS: FERTILIZER APPLICATION; SULPHUR; BRASSICA JUNCEA; PHOSPHORUS; BORON; YIELDS; NUTRIENT UPTAKE; YIELD COMPONENTS; ECONOMICS; RAINFED FARMING.

A field experiment was conducted during the winter seasons of 2001-2003 at New Delhi, on deep sandy-loam soil analyzing medium in available P and S, to study the effect of 3 levels of phosphorus (0, 25 and 50 kg pp/ha), 3 levels of sulphur (0, 20 and 40 kg S/ha) and 2 levels of boron (control and 0.2percentage spray of borax at 50percentage flowering) on rain fed Indian mustard [*Brassica juncea* (L.) Czernj. & Cosson]. Progressive increase in P and

S levels increased yield attributes and seed yield, but the increase in seed yield was significant only up to ~5 kg P p/ha and 20 kg S/ha. Indian mustard removed more S than P. Owing to P and S levels, P, Sand B uptake was significant only up to 25 kg P Ps and 20 kg S/ha. Seed-yield response to tested levels of P and S was found quadratic. Based on the response equation, optimum dose of P₂O₅' response/kg P and returns/re-investment on PPs were 45.4 kg P p/ha, 10.8 kg and Rs 4.82 respectively. Corresponding figures for S application were 30.9 kg S/ ha, 13.3 kg seed/kg Sand Rs 5.63/Re investment on S. Net returns were the maximum with 50 kg P p/ha (Rs 19,214/ha) and 40 kg S/ha (Rs 17,664/ha), whereas benefit: cost ratio was the highest with 25 kg PPs (3.30) and 20 kg S/ha (3.35). Boron application also recorded marked improvement in seed yield (10.6percentage), uptake of P_J 3 percentage), S (7.30percentage) and B (14.3percentage), and net returns (13.9percentage) and benefit: cost ratio (4.8 percentage).

264. Sharma, D.K.; Thakur, S.; Sharma, K.L. (Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur (India). Dept. of Tea Husbandry and Technology). Effect of method, time and levels of phosphorus application on yield and quality of tea (*Camellia sinensis*). Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 324-326 KEYWORDS: FERTILIZER APPLICATION; PHOSPHORUS; CAMELLIA SINENSIS; QUALITY; YIELDS.

A field experiment was carried out at Palampur during 1994-99 on 150-year-old China hybrid tea [*Camellia sinensis* (L.) O. Kuntze] to study the effect of single superphosphate on yield and quality of tea with different methods, times and levels of P application. Phosphorus application at 90 kg pp/ha with alternate-years of application registered significantly highest yield. On the contrary, the highest values for tea quality with regards to total colour and percent brightness were obtained with annual application of fertilizer 60 kg P p/ha with deep placement method. Among the interactions, the highest yield was obtained when phosphorus was applied in alternate years by broadcasting on the soil surface.

F06 Irrigation

265. Rao, G.G. (Central Soil Salinity Research Institute, Bharuch (India). Regional Res. Stn.); Patel, P.R. (Sardar Patel University, Vallabh Vidyanagar (India). Dept. of Biosciences); Bagdi, D.L.; Chinchmalatpure, R.; Nayak, A.K.; Khandelwal, M.K.; Meena, R.L. (Central Soil Salinity Research Institute, Bharuch (India). Regional Res. Stn.). Effect of saline water irrigation on growth, ion content and forage yield of halophytic grasses grown on saline black soil. Indian Journal of Plant Physiology (India). (Oct-Dec. 2005) v. 10(4) (New Series) p. 315-321 KEYWORDS: SALINE WATER; GROWTH; IRRIGATION; YIELD; ERAGROSTIS SOIL.

In a pot study, two halophytic grasses, *Eragrostis* species and *Aeluropus lagopoides* were grown using saline water of EC 10, 20, 30 and 40 dS m⁻¹. There was good establishment, growth and forage production up to EC 40 dS m⁻¹. Ion partitioning in shoots and roots of both the grasses indicated that the roots act as potential sinks for toxic ions like Na⁺ and Cl⁻. Total Na⁺ content was found less in the shoot than in the root, in both the grasses irrespective of salinity and age of the plant. Cl⁻ was found much higher in the root than in the shoot. The rate of flux of Na⁺ and Cl⁻ to the whole plant was found to increase with salinity. *Aeluropus lagopoides* was found to possess high tissue tolerance and better forage quality traits i.e., protein, proline, fibre, ash and sugar contents, compared to *Eragrostis* species. *Aeluropus lagopoides*, because of its ability to withstand high salinity, better forage

quality, ion partitioning and fast growing nature, forms an ideal forage grass for saline agriculture on saline black soil of Gujarat region.

266. Kumar, M.; Premi, O.P.; Bhogal, N.S.; Kumar, A. (National Research Centre on Rapeseed-Mustard, Bharatpur (India). Effect of saline water irrigation and phosphorus levels on seed yield and phosphorus uptake of mustard in Eastern plain zone of Rajasthan. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 431-433 KEYWORDS: IRRIGATION; PHOSPHORUS; YIELDS; MUSTARD; RAJASTHAN.

A field experiment was conducted to evaluate the effect of saline water irrigation and phosphorus levels (0, 20; 40, 60 kg P₂O₅/ha) on phosphorus content and uptake of mustard. The saline irrigation treatments in main plots consisted of four combinations of non-saline water (two irrigations with non-saline water, first non-saline and saline irrigation, first saline and second non-saline irrigation) and two irrigations with saline water. Phosphorus uptake was highest under non-saline irrigation than that of other saline irrigation. Application of 60 kg P₂O₅/ha recorded the highest total phosphorus uptake. Among mustard constituents, seed had the maximum uptake of phosphorus followed by husk and straw.

267. Mathew, T. (Kerala Agricultural University, Thiruvalla (India). Sugarcane Research Stn.); Varughese, K. (Cropping System Research Centre, Karamana (India). Irrigation management for sustainable cane production. *Indian Journal of Agronomy (India)*. (Sep 2005) v. 50(3) p. 239-242 KEYWORDS: IRRIGATION METHODS; FURROW IRRIGATION; SUGARCANE; MULCHING; YIELD COMPONENTS; YIELDS.

An experiment was conducted during 1998-99 and 1999-2000 to standardize the methods of irrigation with and without trash mulching. All furrow irrigation positively influenced all yield attributes and nutrient uptake and appreciably increased the cane yield. It was comparable with alternate furrow irrigation with trash mulching. The cane growth as well as cane production was reduced under skip furrow irrigation with or without trash mulching. Since the combination of trash mulching with all furrow and alternate furrow irrigation recorded comparable values for cane yield, it could be possible to economize the use of irrigation water to the tune of 41 percentage by following alternate furrow irrigation during the formative phase of sugarcane. It also recorded the highest water-use efficiency, energy-use efficiency and productivity, indicating the effective and efficient utilization of resources with better conservation.

F08 Cropping Patterns and Systems

268. Singh, T.; Deshmukh, P.S.; Srivastava, G.C.; Kushwaha, S.R. (Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology); Mishra, S.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). Growth rate of chickpea (*Cicer arietinum* L.) genotypes under different planting dates. *Indian Journal of Plant Physiology (India)*. (Jul-Sept 2005) v. 10(3) p. 254-259 KEYWORDS: CROP; GROWTH; GENOTYPES; TEMPERATURE; CHICKPEA; LEAF AREA INDEX.

High temperature is one of the important abiotic stresses limiting chickpea productivity. A field experiment was, therefore, conducted to study the effect of temperature on crop growth rate in six chickpea genotypes, viz., Pusa 256, Pusa 372, BGD 72 (released varieties) and DG 36, DG 46 and DG 51 (advance lines) grown under different planting dates. DG 36 showed higher leaf area index (LAI), crop growth rate (CGR) expressed on per day and per

growing degree days (GDD), compared to other genotypes. Pusa 372 showed the lowest values of these traits. The minimum requirement of GDD was recorded in the genotype DG 36. In general, the advance lines under study required less accumulated heat units as compared to the released varieties.

269. Sharma, H.L.; Kumar, R. (Chaudhury Sarwan Kumar Himachal Pradesh Krishi Vishwavidyalaya, Palampur (India). Dept. of Agronomy). Simulating phenology and yield of rice using ceres-rice model in North Western Himalayas. *Indian Journal of Plant Physiology (India)*. (July-Sept 2005) v. 10(3) p. 280-282 KEYWORDS: ORIZA SATIVA; YIELD; RICE; PHENOLOGY.

A rice crop model CERES-Rice was parameterized and validated in Himachal Pradesh using experimental results. Cultivar specific genotypic coefficients were derived for four varieties during calibration. Validation based on several independent sets of yield data, including different locations, years, nitrogen and irrigation water treatments showed good agreement ($R^2=0.7785$) between observed and simulated grain yield. The model predicted phenology of varieties reasonably well. The model, however, fails to simulate single grain weight. Significant association between simulated and observed grain yield were supported by the tests of significance for intercept and slope of the regression line ($R^2=0.7289$). Likewise harvest index was also simulated fairly well by the model. The model was used to design management practices of four varieties.

270. Dhakad, A.; Rajput, R.S.; Mishra, P.K.; Sarawgi, S.K.; Joshi, B.S. (Indira Gandhi Agricultural University, Raipur (India). Dept. of Agronomy). Effect of planting geometry and nitrogen management on growth and dry matter production on wheat+chickpea intercropping system. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 204-208 KEYWORDS: NITROGEN; YIELD; WHEAT; CHICKPEA; INTERCROPPING.

A field experiment was conducted at Instructional Farm, Indira Gandhi Agriculture University Raipur (e.G.) to find out the planting geometry and nitrogen management on growth and dry matter production of wheat + chickpea intercropping system. Results revealed that, plant height, number of tillers, dry matter accumulation of wheat were as higher under sole crop sown at 20 cm spacing with fertilizer doses 100:50:30 NPK Kg ha⁻¹ but in case of inter cropping 4:2 row ratio with 80 Kg N ha⁻¹ well performed as compared to 2:1 and 2:2 row ratio and in chickpea results revealed that plant height, number of branching, dry matter accumulation were higher under sole crop sown at 30 cm spacing with fertilizer dose of 80 Kg N ha⁻¹.

271. Meena, R.P.; Gautam, R.C.; Meena, R.P. (Indian Agricultural Research Institute, New Delhi (India). (Div. of Agronomy). Studies on cultural operations and nutrient integration on water use efficiency, yield and nutrient uptake of rainfed pearl millet (*Pennisetum glaucum* (L.) R. Br. Emend Stutz). *Annals of Agricultural Research (India)*_ (Jun 2005)_ v. 26(2) p. 297-301 KEYWORDS: PLOUGHING; BIOFERTILIZERS; ORGANIC FERTILIZERS; YIELD; NUTRIENT; PENNISETUM GLAUCUM; EFFICIENCY; WATER USE.

The field experiment was conducted on sandy clay loam soil at the Indian Agricultural Research Institute, New Delhi during the kharif seasons of 2000 and 2001 to study the cultural operations and nutrient integration on water use efficiency, yield and nutrient uptake of rainfed pearl millet. The daily rate of water use, consumptive use of water, water use efficiency, grain and stover yields and N and P uptake of pearl millet increased

considerably due to summer ploughing with FYM incorporation before sowing the crop followed by wheat straw incorporation after the harvest of preceding crop with summer ploughing as compared to unploughed field and rest of the treatments whereas K uptake increased significantly owing to wheat straw incorporation just after harvesting of the preceding crop. The highest daily rate of water use, consumptive use of water, water use efficiency, grain stover yields and uptake of N, P and K of pearl millet were recorded under 20 kg N + 15 kg P₂O₅ ha⁻¹ + PSB + Azospirillum closely followed by 40 kg N + 30 kg P₂O₅ ha⁻¹ over control and rest of the treatments.

272. Dhakadk, A.; Rajput, R.S.; Mishra, P.K.; Sarawgi, S.K. (Indira Gandhi Agricultural University, Raipur (India). Dept. of Agronomy). Effect of spatial arrangement and nitrogen scheduling on monetary advantage and economics of wheat+chickpea intercropping system. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 335-337 KEYWORDS: SPATIAL DISTRIBUTION; ECONOMICS; NITROGEN; INTERCROPPING.

273. Kar, M.; Patro, B.B.; Sahoo, C.R.; Hota, B. (Orissa University of Agriculture and Technology, Bhubaneswar (India). Dept. of Plant Physiology). Traits related to drought resistance in cotton hybrids. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2005) v. 10(4) (New Series) p. 377-380 KEYWORDS: DROUGHT RESISTANCE; HYBRIDS; COTTON.

Responses of five hybrid varieties of cotton to moisture stress were assessed in the field for their relative tolerance to drought. The study revealed that moisture deficit adversely affected the chlorophyll stability index and nitrate reductase activity, while proline accumulation enhanced irrespective of varieties. Yield and its attributes decreased conspicuously in all the varieties in response to water stress imposed at flowering stage. Amongst the cotton hybrids, PKV Hy-4 and PKV Hy-2 were noted to be relatively more drought tolerant than others on the basis of assessment of their yield performance. The flowering stage in cotton was found to be more critical to moisture stress than vegetative and ripening stages.

274. Saxena, D.K.; Kaur, H. (Bareilly College, Bareilly (India). Dept. of Botany). Effect of cadmium and nickel toxicity on the peroxidase activity and carotenoids content in *Thuidium cymbifolium*. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2005) v. 10(4) (New Series) p. 397-399 KEYWORDS: TOXICITY; CADMIUM; PEROXIDASE; CAROTENOIDS.

Effects of two heavy metals (nickel and cadmium) with different phytotoxicity were examined on the activity of peroxidase (POX) and carotenoids content in pleurocarpous moss *Thuidium cymbifolium* (Doz and Molk.). Cd treatment for 3 days caused an increase in peroxidase activity only at 0.01 M concentration from 0.464 to 0.514 $\mu\text{mol min}^{-1} \text{g}^{-1} \text{fw}$, while for Ni, peroxidase activity was higher for an concentrations in comparison to control. However, carotenoids content after 3 days treatment increased upto 51 percent for Ni only and decreased upto 5-6 percent of control for Cd. POX activity after 15 days treatment decreased 74 percent for Ni and 90 percent for Cd. Contrastingly carotenoid declined upto 65 percent for Ni and only upto 26 percent of control for Cd. Results suggest that both POX and carotenoid content could be used as bio-indicators of metal pollution. Study suggests that Cd is more phytotoxic than Ni.

275. Mahavishnan, K.; Prasad, M. (Indian Agricultural Research Institute, New Delhi (India). (Div. of Agronomy). Direct and residual effect of different sources of nitrogen on yield

attributes and yield of sunflower in cotton - sunflower system. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 416-420 KEYWORDS: NITROGEN; FARMYARD MANURE; YIELD; CROPPING SYSTEM.

A field trial was carried-out to find out the effect of conjunctive use of organic and inorganic sources of nitrogen on yield attributes and yield cotton and its residual effect on succeeding sunflower seed yield. The treatments consisted of eight treatments for cotton comprising of two levels of fertilizers viz. 50, 100 percent (60:30:30 N, P2O₅ and K₂O kg/ha), two organic sources viz. 12 t of FYM and mungbean intercrop incorporation alone and in combination along with control. The treatments for sunflower comprising two levels of fertilizers viz. 50 and 100 percent (80:40:40 N, P₂O₅ and K₂O kg/ha) along with control. The treatments were arranged in randomized block design for cotton and that of split plot Design for sunflower with three replications. The results showed and highest residual effect in terms of sunflower seed yield was recorded with the plots which received FYM either alone or in combination with other sources. Direct application of 100 percent RDF was superior in enhancing yield attributes and yield over its lower levels.

276. Singh, T.; Rana, K.S. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Productivity and water use efficiency of mustard and lentil intercropping system as influenced by moisture conservation practices and fertility levels under rainfed conditions. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 485-490 KEYWORDS: SOIL FERTILITY; PRODUCTION; MUSTARD; EFFICIENCY; WATER USE; LENTIL; YIELDS.

A field experiment was conducted to find out the suitable soil moisture conservation practices and fertility, levels for mustard paired row (30/90 cm.) + lentil (two rows) intercropping system for high productivity. The yield and yield attributes of mustard except siliqua length in 2003-04 were not affected by intercropping whereas lentil yield and yield attributes decreased significantly under intercropping system. The seed yield of mustard was found 5.4 and 7.1 percent higher than paired planting of mustard during both the years of experimentation. FYM + organic mulch + Kaolin 6 percent produced significantly higher number of siliquae per plant leading to significantly higher seed yield of mustard over no mulch. FYM + organic mulch + Kaolin 6 percent increased the seed yield of mustard by 16.6 and 10.9 percent, however, 13.3 and 16.5 percent increment with lentil. The seed yield of mustard increased significantly with successive increment in fertility levels during first season while in second season 100 percent and 50 percent RDF produced significantly higher yield of mustard over control but remained statistically at par with each other. Whereas the seed yield of lentil was significantly higher with 50 percent RDF and 100 percent RDF over control but remained statistically at par with each other. The consumptive use, moisture use rate and water use efficiency were highest under mustard paired row (30/90 cm) + lentil (two rows) intercropping system. Moisture conservation practices and fertility levels also increased the consumptive use as well as water use efficiency.

277. Singh, F.; Kumar, R.; Pal, S.; Husain, M.F.; Kumar, P.; Singh, N.B. (Chandra Shekar Azad University of Agriculture and Technology, Kanpur (India). Regional Agricultural Research Stn.). Effect of integrated nutrient management on productivity, profitability and soil fertility in wheat (*Triticum aestivum* L.) based cropping systems. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 491-494 KEYWORDS: PRODUCTION; SOIL FERTILITY; TRITICUM AESTIVUM; NUTRITION PHYSIOLOGY; NUTRIENTS.

A field experiment was conducted to find out the response of integrated nutrient management on productivity, profitability and soil fertility in wheat-based cropping systems. Green manuring insitu increased grain of wheat crop substantially. Application of FYM (10 t ha⁻¹) of vermicompost (5 t ha⁻¹) in rabi season along with reduced quantity on N fertilizer (30 kg N ha⁻¹) increased productivity of rice-wheat sequence on an average to the tune of five percent over recommended dose on N (120 kg ha⁻¹). Crop residue/haulms incorporation or inoculation of Azotobacter along with three-fourth quantity on N (90 kg ha⁻¹) yielded at par with recommended dose no N (120 kg ha⁻¹) without any adverse effect on yield of wheat indicating system productivity can be maintained over years. The highest net return was realized in soybean-wheat cropping sequence. Integrated use of chemical fertilizers along with organic manures, residue incorporation and biofertilizers improved soil fertility. Continuous application of NPK fertilizers alone in rice-wheat crop sequence showed negative impact on soil fertility.

278. Neog, P. (B.N. College of Agriculture, Sonitpur (India); Chakravarty, N.V.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Physics); Sharma, M.K. (B.N. College of Agriculture, Sonitpur (India); Bhagawati, G.; Srivastava, A.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Physics). Effect of weather on mustard dynamics under semi-arid environment. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 514-521 KEYWORDS: ENVIRONMENT; LEAF AREA INDEX; GROWTH; TEMPERATURE; WEATHER; MUSTARD.

Field experiments were carried out on sandy loam soil of Indian Agricultural Research Institute (New Delhi) farm area with mustard cultivars Pusa Jaikisan and Varuna which were grown for two consecutive rabi seasons (2000-2001 and 2002-03) at ten different dates following recommended agronomic practices. The first crop season was comparatively warmer by 3 to 5°C than the second season. In daily basis the differences of maximum and minimum temperatures in the two crop seasons were much higher of the order of 11 to 13°C. The daily bright sunshine hours were also higher in the first crop season (6.1 hrs) than the second season (4.1 hrs). The average daily bright sunshine hours were continuously below two hours during the month of January and February 2003 in second season, while the sunshine hours were ranging from 4 to 8 hours during that period in the first crop season. Leaf area index (LAI), crop growth rate (CGR) and pod growth rate (pGR) were computed at weekly interval for each cultivar in all sowings. Total above ground biomass (at maturity) and seed yields were also evaluated. Irrespective of sowing dates and crop seasons LAI, CGR, PGR, total biomass and seed yield were higher in Pusa Jaikisan than in Varuna. Values of crop growth parameters and seed yield were maximum when crop sown between 15th and 29th October in both the cultivars and seasons which might be due to crop sown in this period were exposed to the optimum thermal environment for growth and development. The value of LAI, total biomass production, CGR and PGR were higher in first crop season than the second crop season in all sowing dates in both the cultivars. A significant reduction of seed yield both in Pusa Jaikisan and Varuna in second season was probably due to prevailing cold spell coupled with low bright sunshine hours during the month of January and February, 2003 that might have caused reduction in LAI, CGR, PGR and biomass production resulting lower seed yield.

279. Sarkar, N.C.; Mishra, B.N.; Gautam, A.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Effect of neem formulations and nitrogen levels on yield

and quality of rice-mustard cropping system. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 546-549 KEYWORDS: YIELD; QUALITY; NITRGEN.

Field experiments in factorial randomized block design with three replications were conducted to find out the efficient neem formulation and optimum nitrogen level on productivity and quality of the produce in rice-mustard cropping system. Amongst the neem formulations, ARNCU proved superior in influencing higher yield of both the crop, while it had positive influence on higher hulling percentage, milling percentage and head rice recovery of rice as well as oil and protein content of mustard. Application of 120 kg N ha⁻¹ significantly increased found effective as compared to lower N levels.

280. Swaroop, K. (Central Agricultural Research Institute, Port Blair (India). (Div. of Horticulture and Forestry). Evaluation of vegetable crop rotation system for yield and net return in South Andaman. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 568-570 KEYWORDS: YIELD; CROP ROTATION; SOUTH ANDAMAN; VEGETABLES; VARIETIES; PROFIT; COST BENEFIT ANALYSIS.

A field trial was conducted to identify suitable intensive and remunerative vegetable cropping system for Andaman. The results indicated that brinjal-cowpea-radish recorded highest yield of 748.73 q/ha, gave Rs. 4,79,073/ha, net return and benefit: cost ratio (1:4:16), followed by palakbhindi-poi (701.86 q/ha, net return, Rs. 4,06,609/ha and benefit: Cost ratio, 1 : 3.38) per year respectively.

281. Kantwa, S.R.; Ahlawat, I.P.S.; Gangaiah, B. (Indian Agricultural Research Institute, New Delhi (India). (Div. of Agronomy). Effect of land configuration, post monsoon irrigation and phosphorus on performance of sole and intercropped pigeonpea (*Cajanus cajan*). *Indian Journal of Agronomy (India)*. (Dec 2005) v. 50(4) p. 278-280 KEYWORDS: LAND MANAGEMENT; SOLE CROPPING; CAJANUS CAJAN; INTERCROPPING; PHOSPHORUS; VIGNA MUNGO; IRRIGATION; YIELDS; YIELD COMPONENTS.

A field experiment was conducted during the rainy season 2001-02 to find out the effect of land configuration, post-monsoon irrigation and phosphorus fertilization on performance of pigeonpea [*Cajanus cajan* (L.) Millsp.] grown sole and intercropped with urdbean [*Vigna mungo* (L.) Hepper]. The broad-bed and furrow planting and post-monsoon irrigation at 0.4 IW : CPE ratio improved the yield attributes (pods/plant and seeds/pod) of pigeonpea over flat planting and unirrigated pigeonpea, leading to similar increase in grain yield of pigeonpea by

10percentage. An intercropping of pigeonpea with urdbean had no effect on pigeonpea yield, but the additional urdbean yield in intercropping resulted in markedly higher total productivity in terms of pigeon pea-equivalent yield. The grain yield of pigeonpea increased up to 40 kg P Ps /ha only. However, total productivity in terms of pigeonpea-equivalent yield increased with increasing rates of P up to 80 kg PPs /ha.

282. Rana, N.S.; Kumar, S.; Saini, S.K. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Agronomy). Effect of irrigation scheduling on performance of summer legumes growth in association of sugarcane. *Indian Journal of Agronomy (India)*. (Dec 2005) v. 50(4) p. 281-284 KEYWORDS: IRRIGATION SCHEDULING; INTERCROPPING; SUGARCANE; LEGUMES; WATER USE; EFFICIENCY; YIELDS; YIELD COMPONENTS.

A field experiment was conducted during 2001-03 to find out an optimum irrigation schedule for intercrops grown in association with spring sugarcane, on silty clay-loam soil, having 23.4percentage moisture at field capacity and 8.6percentage at permanent wilting point (PWP). Daily evapotranspiration (ET) varied from 3.3 to 16.8 mm/day. Mungbean (*Phaseolus radiatus* L.), urdbean (*P. mungo* L.) and cowpea [*Vigna unguiculata* (L.) Walp.] gave highest yield of 4.1, 3.85 q/ha and 73.0 q/ha, respectively with irrigation at, IW : CPE ratio of 1.2 compared to 3.25, 2.75 and 6.10 q/ha with irrigations at flowering and pod-filling stage. All the intercrops reduced cane yield due to decline in number of millable canes and cane weight. Mean reduction in cane yield was 14.2percentage with cowpea, 11.5percentage with urdbean and 9.2percentage with mungbean. Irrigation at 1.2 IW : CPE ratio resulted in highest cane yield of 97.0 tonnes/ ha, being respectively 3.7, 8.1 and 13.3percentage higher than IW : CPE ratio of 1.0, 0.8, and irrigations at critical growth stages. Sugarcane + cowpea gave highest mean cane-equivalent yield (107.0 tonnes/ha), being 6.8, 10.0, and 8.7percentage more than sole sugarcane and intercropping with urdbean and mung bean respectively. Sugarcane intercropped with cowpea gave highest gross return of Rs 101,650/ha followed by sugarcane alone (Rs 95,190) as against Rs 92,435 with sugarcane + urdbean. Respective Benefit: cost ratio was 0.89, 0.90 and 0.73. Irrigation applied at 1.2 IW: CPE ratio gave significantly highest cane-equivalent yield (109.5 tonnes/ha) with benefit: cost ratio of 0.85 as against 92.4 tonnes/ha and 0.77 with irrigation at critical growth stages of intercrops.

283. Singh, A.K.; Lal, N.; Srivastava, T.K. (Indian Institute of Sugarcane Research, Lucknow (India). Enhancing productivity and sustainability of sugarcane plant - ratoon system through planting geometry, dual purpose legume intercropping and nitrogen nutrition. *Indian Journal of Agronomy* (India). (Dec 2005) v. 50(4) p. 285-288 KEYWORDS: INTERCROPPING; SUGARCANE; RATOONS; LEGUMES; GROWTH; YIELDS; QUALITY; SPACING; NITROGEN; SUSTAINABILITY.

An effect of intercropped dual-purpose legumes in spring sugarcane plant-ratoon system was studied (during 1997-98 to 1999-2000 at the Indian Institute of Sugarcane Research, Lucknow. The yield of sugarcane inter cropped with cowpea [*Vigna unguiculata* (L.) Walp.] (67.0 tonnes/ha) and greengram (*Phaseolus radiatus* L.) (68.5 tonnes/ha) was comparable to that intercropped with *Sesbania* for green-manuring (72.2 tonnes/ha). Significantly highest cane-equivalent yield (80.3 tonnes/ha), sugar-equivalent yield (9.47 tonnes/ha), net monetary returns (Rs 33,341/ha) and nitrogen addition (71.6 kg/ha) to the soil through incorporation of green biomass was recorded with sugarcane + cowpea intercropping system. Population density of 125percentage gave significantly higher number of millable canes (119,400/ha), cane yield (73.7 tonnes/ha) and cane-equivalent yield (78.7 tonnes/ha). However, normal planting was found remunerative (Rs 36,696/ha). The growth and yield parameters of sugarcane as well as monetary returns significantly increased by application of 150 kg N/ha. Sugarcane + cowpea intercropping system proved highly productive and most economical. Cropping system x N level interaction indicated that sugarcane + cowpea as well as sugarcane + greengram were equally productive at higher level of N (150 kg N/ha). There was significant increase in number of millable canes, cane yield and sugar yield of ratoon from counter part plant crop intercropped with cowpea and green gram.

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284. Katna, G.; Singh, H.B.; Sharma, J.K.; Mittal, R.K. (CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur (India). Dept. of Plant Breeding and Genetics)). Components of variation in maize (*Zea mays* L.). *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 133-136
KEYWORDS: GENETIC VARIATION; GENES; MAIZE; HERITABILITY; ZEA MAYS; YIELD COMPONENTS; HIMACHAL PRADESH.

Components of variation for yield and its related were studied in maize involving 12 x 12 half diallel set and three checks (commercial hybrids) at two locations i.e. Palampur and Bajaura. Both additive and dominance components were important with the predominance of dominance effects for majority of the traits. Non-allelic interactions were observed to be important for grain yield, harvest index, days to 75 percent silking, leaf area/plant, ear length, ear circumference, kernel rows/ear, kernels/row and 100-seed weight at both the locations; for plant height at Palampur and for ear height at Bajaura. Characters viz., kernel rows/ear, kernels/row and 100-seed weight at Palampur and ear height at Bajaura exhibiting significant regression coefficient values (b) coupled with significant values of (I-b), indicated the presence of probably complementary type of interactions. Further, majority of the traits under study exhibited unequal distribution of positive and negative genes and low heritability values, suggesting the importance of heterosis breeding in the present material.

285. Uttam Chand; Katoch, P.C.; Kumar, V. (CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur (India). Dept. of Plant Breeding and Genetics)). Variability studies in some macromutations induced by EMS and gamma rays in basmati rice T-23. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 137-141
KEYWORDS: ORYZA SATIVA; INDUCED MUTATION; EMS; GAMMA RADIATION; HERITABILITY; GENETIC VARIABILITY; GENETIC ADVANCE.

Locally adapted cultivar of Basmati rice (*Oryza sativa*), namely, T-23 was treated with ethyl methane sulphonate (EMS) and gamma rays. A number of various types of morphological macromutations were induced in M2 generation. These mutants were evaluated in M3 generation in RBD with two replications. Estimates of variability, heritability and genetic advance were worked out for the mutants. Wide range of variability was observed for grain yield/plant, effective tillers/plant, days to flowering, days to maturity, 100-seed weight and protein content. High heritability coupled with moderate genetic advance was observed for days to flowering, days to maturity and plant height.

286. Gupta, D.; Mittal, R.K. (CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur (India). Dept. of Plant Breeding and Genetics); Singh, M. (Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Fruit Breeding); Kant, A. (CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur)). Evaluation of triticale x bread wheat derivatives for agromorphological, physiological and biochemical traits in relation to drought and cold stress. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 143-147
KEYWORDS: GENETIC VARIABILITY; DROUGHT STRESS; COLD STRESS; SOFT WHEAT; TRITICOSECALE; GENOTYPES; HERITABILITY; AGRONOMIC CHARACTERS.

Twenty-two triticale x bread wheat derivatives alongwith six checks were evaluated for different plant traits in the field under irrigated environment to select drought and cold tolerant genotype(s) alongwith high yield and quality traits. The analysis of variance revealed the presence of sufficient genetic variability for grain yield and other traits. Heritability was observed moderate to high for traits like grain yield, days to heading, days to maturity, 1000-grain weight, biological yield, spikelets/spike, leaf area index, specific leaf weight and stomatal number, whereas genetic advance was moderate to high for grain

yield, 1000-grain weight, biological yield and leaf area index. None of the drought tolerant genotypes viz., RL-111 P2, RL 124-2 P2, RL 139-1 PI, RL 136-1 PI' TW-9336 and RL 122 PI was superior to or statistically at par with the best check HS-240 in grain yield. Derivative TW 9336 had fairly high grain yield and harvest index. RL III P2 and -RL 124-2 P2 were found to be cold as well as drought tolerant alongwith fairly high grain yield and harvest index.

286. Satish, Y.; Seetharamaiah, K.V. (Agriculture College, Bapla (India). Dept. of Plant Breeding)). Combining ability analysis for yield and its component characters in rice (*Oryza sativa* L.). *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 149-153 KEYWORDS: COMBINING ABILITY; YIELDS; YIELD COMPONENTS; ORYZA SATIVA; RICE.

Fifteen hybrids generated from six parents were studied alongwith parents for combining ability for number of productive tillers per hill, total chlorophyll (percent), grain yield per plot, protein content (percent), number of grains per panicle, leaf nitrogen (percent) at flowering stage, volume expansion ratio, LIB ratio, harvest index, test weight, amylose content, LAI and kernel weight. Among the parents BPT 5204, MTU 2067 and NLR 33641 were found to be good general combiners for grain yield and leaf nitrogen per cent. BPT 4358 was best general combiner for amylose content. The most promising specific combinations were ARC 5780 x BPT 1768, ARC 5780 x NLR 3364 I, BPT 5204 x BPT 1768, BPT 5204 x MTU2067, BPT 5204xBPT 4358 and NLR 33641 xBPT4358 for grain yield.

287. Kumar, R.; Sharma, S.K.; Luthra, O.P.; Sharma, S. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Plant Breeding)). Phenotypic stability of lentil genotypes under different environments. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 155-158 KEYWORDS: STABILITY; ENVIRONMENT; LENTILS; GENOTYPES; YIELDS; PHENOTYPES; YIELD COMPONENTS.

The present investigation was carried out with 44 lentil genotypes in eight environments to study their stability for yield and other relevant characters. Individual regression analysis over all the eight environments revealed that most of the genotypes exhibited predictable linear type of G x E interaction with respect to mean performance and response to changing environment for the traits. The environment VII (late sown with high dose of nitrogen) has been found to be the most favourable for the expression of seed yield and related traits. Considering the various stability parameters for different characters under study, genotypes DPL-15, DPL-55 and IPL-71 were adjudged to be promising for most of the characters.

288. Lokesh; Verma, P.K.; Sangwan, O.; Behl, R.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Plant Breeding)). Genotypic divergence analysis for different characters in rice bean (*Vigna umbellata* (Thunb.) Ohwi and Ohashi). *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 159-164 KEYWORDS: GENETIC DISTANCE; VIGNA UMBELLATA; GENOTYPES.

Genotypic divergence was carried out according to Mahalanobis D2 statistics. The 79 genotypes were grouped into 11 clusters revealing presence of wide range of genotypic variation. Intra clusters distance and cluster means for different characters were also calculated so that it can help in selecting most divergent genotypes for different characters to be used in hybridization programme of crop improvement, in order to obtain transgressive segregants of desirable types for various characters.

289. Lokesh; Verma, P.K.; Sangwan, O.; Behl, R.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Plant Breeding)). Association analysis between seed yield and its component characters in rice bean. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 165-168 KEYWORDS: GENETIC CORRELATION; PHENOTYPES; GENOTYPES; SEED; YIELDS; VIGNA UMBELLATA; YIELD COMPONENTS.

Genotypic and phenotypic correlation coefficients between different phenological characters in rice bean were carried out. Clusters per plant, pods per cluster and pods per plant showed positive and highly significant correlation with seed yield per plant; while days to flowering, days to maturity, plant height, pod length and test weight showed highly significant and negative correlations.

290. Rattan, S. (National Research Centre on Rapeseed-Mustard, Bharatpur (India); Chaudhary, B.D.; Singh, D. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Plant Breeding). A comparative study of quantitative traits under different environments in Indian mustard (*Brassica juncea* (L.) Czern and Coss) . *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 169-172 KEYWORDS: BRASSICA JUNCEA; GENOTYPES; QUANTITATIVE ANALYSIS; QUANTITATIVE GENETICS; DIALLEL ANALYSIS; ENVIRONMENT; AGRONOMIC CHARACTERS.

Mean values for all the traits under study except 1000-seed weight were reduced under terminal moisture stress. All tested genotypes were observed late in flowering and maturity under normal environment as compared to terminal moisture stress. The genotype RH 30 was the earliest for days to flowering, whereas PCR-IO took maximum days to flowering under both the environments. The genotype Rajat x PCR -10 exhibited significant superiority for their main raceme length irrespective of environments. RH 30 x BIO 902 and RH 8812 possessed significantly more number of siliquae on the main raceme as compared to other genotypes under normal and terminal moisture stress environments, respectively.

291. Pathania, N.K.; Katoch, R.; Katoch, V. (CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur (India). Dept. of Vegetable Science and Floriculture)). Correlation and path analysis for some biometric traits in brinjal (*Solanum melongena* L.). *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 193-197 KEYWORDS: GENETIC CORRELATION; STATISTICAL METHODS; SELECTION; SOLANUM MELONGENA; GENOTYPES; SELECTION RESPONSES; AGRONOMIC CHARACTERS; YIELDS.

Correlation and path analysis studies in 19 genotypes of brinjal were conducted during 1999 under humid sub-temperate conditions of north-western Himalaya. Marketable yield per plant was positively and significantly associated with number of marketable fruits, gross yield and total number of fruits per plant. Days to flowering were significantly associated with days to first picking. Path analysis revealed that purposeful and balanced selection on the basis of horticultural traits viz., fruit diameter, number of fruits (total and marketable), fruit length and days to first picking would be more rewarding for improvement of brinjal.

292. Kumar, B.; Mishra, M.N. (R.B.S. College, Agra (India). Dept. of Plant Breeding and Genetics). Correlation and path analysis in urd bean (*Vigna mungo*). *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 177-178 KEYWORDS: VIGNA MUNGO; PATH GENESIS; STATISTICAL METHODS; YIELD; CORRELATION; GENETIC.

Thirty urd bean genotypes were studied for assessing the association between yield and its component characters. Yield per plant showed high positive correlation with number of

Pods/plant and plant height, whereas number of seeds/pod showed significant negative correlation with yield. Number of pods per plant recorded the highest genotypic correlation with yield. The path coefficient analysis revealed that number of pods per plant, 100 seed weight and number of seeds/pod had high direct effect as well as indirect effects through other characters on yield per plant.

293. Reddy, A.N. (Acharya N.G. Ranga Agricultural University, Guntur (India). Regional Agricultural Res. Stn.); Satyanarayana, A. (Acharya N.G. Ranga Agricultural University, Hyderabad (India). Genetics of yield and fibre quality traits in American cotton (*Gossypium hirsutum* L.). *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 190-193
KEYWORDS: GENOTYPES; YIELD; GOSSYPIUM HIRSUTUM; GENETIC VARIABILITY; GENETIC ADVANCE; HERITABILITY.

Fifty five genotypes of American cotton (*G. hirsutum* L.) comprising of 10 parents and their 45 hybrids produced in a diallel fashion (without reciprocals) were evaluated for estimating the genetic variability, heritability and genetic advance in four different environments for yield and yield components besides fibre quality traits. The E1 - Normal sowing (15th July) irrigated was found to be the most favourable environment for majority of the characters, while E2 - Delayed-sowing (15th August)-Rainfed was considered to be poor environment. The variation in the magnitude of estimates of genetic parameters for all the characters under different environments suggests the profound influence of environment on the character expression. The PCV and GCV was high for seed cotton yield per plant. The PCV was greater than GCV for all the characters. The GCV/PCV ratio was high for 2.5% span length and bundle strength indicating that these traits were not much influenced by the environment. Heritability estimates were high for ginning percentage, 2.5% span length, bundle strength and seed cotton yield indicating the amenability of these traits in selection process. High heritability coupled with high genetic advance for ginning percentage, 2.5 % span length, bundle strength and seed cotton yield indicates the operation of additive gene action in the inheritance of these traits. Number of seeds per boll, seed index and oil percentage showed low heritability as well as low genetic advance besides narrow range of variability indicating the predominance of non additive gene action.

294. Goswami, P.K. (Assam Agricultural University, North Lakhimpur (India). Regional Agricultural Res. Stn.); Behl, R.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Plant Breeding). Genetics of seed yield and its attributes in Indian mustard. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 198-203
KEYWORDS: SEED; YIELD; MUSTARD; GENETICS; PATHOGENE.

In a line x tester analysis of Indian mustard, both gca and sca varieties were found highly significant for yield and yield attributing traits. Parents RH-30, RH-9617 and RH-9004 were good general combiner for seed yield and other 4-6 yield attributing characters. Analysis revealed significant role of non-additive gene action for all the traits. Out of 30 hybrids, seven hybrids showed significant positive sca effects and high per se performance for seed yield and yield attributes. Either non-additive or both additive and non-additive gene actions were important in the expression of the traits. The duplicate type of epistasis was observed for primary branches, siliquae on main shoot and 1000 seed weight. Population improvement programme should be explored in such situation.

295. Rai, S.K. (Indian Grassland and Fodder Research Institute, Jhansi (India); Gupta, B.R.D. (Banaras Hindu University, Varanasi (India). Dept. of Geophysics); Dhar, S. (Indian Grassland and Fodder Research Institute, Jhansi (India). Performance of cere-sorghum model in simulating forage sorghum in response to nitrogen levels in semiarid region of India. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 240-247 KEYWORDS: FORECASTING; SORGHUM; NITROGEN; YIELD.

Field experiments were conducted during spring seasons of 2002 and 2003, at IARI, New Delhi, to study the effect of integrated nutrient management on growth and yield of spring sunflower. Application of recommended dose of fertilizers (RDF) recorded highest growth and yield. Application of half RDF + vermicompost 2.5 t ha⁻¹ and half RDF + V AM being on par gave significantly higher yield than half RDF alone. Use of vermicompost 2.5 t ha⁻¹ or vermicompost 1.25 t ha⁻¹ + V AM or V AM + cowpea intercrop along with half RDF also performed better in respect of growth, seed and oil yield of sunflower. Thus use of these organic and biosources were found to economize the recommended dose of fertilizers by 20 to 28 per cent.

296. Singh, R. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics); Balyan, H.S.; Singh, P. (Chaudhary Charan Singh University, Meerut (India). Dept. of Agricultural Botany). Non-hierarchical Euclidean cluster analysis in black gram (*Vigna mungo* L. Hepper). *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 306-309 KEYWORDS: VIGNA MUNGO; GENETIC DISTANCE.

One hundred and thirty nine genotypes/accessions of black gram (*Vigna mungo* L. Hepper) were evaluated in an augmented block design. Considerable variation was observed among accession for their characters. The accession were grouped into 16 cluster based on non-hierarchical euclidean cluster analysis. Cluster II and XVI were the diverse clusters. Considerable variation in cluster means was observed for most of the characters. These observations indicate that there is ample scope of varietal improvement through hybridization between cluster II accession and cluster XVI accession to obtain high yielding, MYMV resistant segregants possessing good seed quality.

297. Singh, A.K. (Raja Balwant Singh College, Agra (India). Dept. of Horticulture). Effect of spacing and nitrogen levels on growth and yield of hybrid tomato (*Lycopersicon esculentum* Mill.). *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 329-331 KEYWORDS: SPACING; NITROGEN; GROWTH; YIELD; LYCOPERSICON ESCULENTUM.

298. Kumar, C.R.A.; Bala, K.I. (Tamil Nadu Agricultural University, Killikulam (India). Agricultural College and Research Institute). Genetic diversity studies in drought resistant cultures of rice. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 395-397 KEYWORDS: DROUGHT TOLERANCE; RICE; GENETIC DIVERSITY; HETEROSIS; GENOTYPES; YIELD; WEIGHT.

Genetic divergence analysis using D2 statistic of 24 genotypes belonging to drought resistant cultures of rice revealed, the existence of considerable diversity among the cultures. The genotypes were grouped into seven clusters. Cluster I was the largest having 12 genotypes and all the other clusters have 2 genotypes each. Highest inter cluster distance was noticed between the clusters V and VII. The biometrical traits viz., yield per plant, 100 grain weight and root volume have contributed much to genetic divergence.

Combining parents of Aruvankuruvai and IR 64 of cluster V and Ariyan and Pattambi of cluster VII would expect to result in high heterosis.

299. Singh, O.; Singh, R.K.; Singh, M.N.; Singh, U.P. (Banaras Hindu University, Varanasi (India). Dept. of Genetics and Plant Breeding). Genetics of biochemical and morphological traits for podfly resistance and yield components in long duration pigeonpea (*Cajanus cajan* (L.) Millsp.). *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 465-468
KEYWORDS: PHENOLIC COMPOUNDS; MELANAGROMYZA OBTUSA; RESISTANCE; CHEMICALS; YIELDS; CAJANUS CAJAN.

Three crosses, Bahar x PDA93-1E, Bahar x ICP8102-5~ and Bahar x SL12-3-1 involving, three podfly resistant lines viz., PDA93-1E, ICP8102-5-S1' SL12-3-1 and one highly susceptible cultivar i.e., Bahar, were under taken to know the genetics nature and magnitude of gene action, through scaling test and generation means analysis. The estimates of scaling test were significant for all the traits in all three crosses except for days to 50 percent flowering in cross Bahar x SL12-3-1 indicated presence of epistatic interactions for all the seven characters in the crosses studied. Both additive and dominance components were significant for all the traits except days to 50 percent flowering, where dominant component was significant and additive effect was non-significant in all three crosses. It is obvious that non-fixable gene effects were more important for seed yield and its components in long duration pigeonpea.

300. Singh, S.; Singh, H.P.; Singh, A.K.; Singh, R.S. (Narendra Deva University of Agriculture and Technology, Faizabad (India). Combining ability studies for salt-tolerance of salt adapted and non adapted rice during in vitro culture and seed germination. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 533-538
KEYWORDS: SALT TOLERANCE; GERMINABILITY; SEEDS.

The genetics of salt tolerance in rice was investigated both at seed germination and in seed/ seedling derived calli using six-parent dialler analysis, excluding reciprocals. Test materials involved salt tolerant (CSR-10 and CSR-5), moderately tolerant (NDR-501 and SAR-41) and sensitive (00-12860 and IET-11149) genotypes. Rate of germination (RGI), germination stress index (GSI) at seedling phase and fresh and dry weight (FW & DW) of calli and corresponding survival ratio of callus were studied for their combining ability and gene action. Analysis revealed both additive and non-additive gene effects for most traits the former being more pronounced than the latter, especially under stress medium for fresh and dry callus weight and survival under control condition, both additive and non-additive gene effects were equally important. The genotypes like additive and non-additive gene effects were equally important. The genotypes like CSR-10, CSR-5 (tolerant) and NDR-501 (moderately tolerant) were found to be the best combiners both under control (CM) and salt medium (SM). The crosses like CSR-10 X CSR-5, CSR-5 X NDR-501 X IET 12860 and NDR-501 x IET 1149 exhibited maximum SCA effects for fresh and dry weight of calli both in CM and SM and its terminal survival under CM.

301. Kumar, M. (Central Soil and Salinity Research Institute, Karnal (India); Singh, K.P. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Genetics); Singh, D. (Janta Vedic Post Graduate College, Baghpat (India); Usha (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Genetics). Genetic divergence analysis for seed yield, its parameters and oil content in Indian mustard (*Brassica juncea* L. Czern and

Coss). *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 539-541 KEYWORDS: MUSTARD; GENETIC DIVERGENCE; OIL CONTENTS; BRASSICA JUNCEA; SEED YIELD.

Genetic divergence was estimated for seed yield, oil content and several important yield contributing characters in twenty-five genotypes of Indian mustard (*Brassica juncea*). Even with the limited number of material included in the study, the results revealed considerable diversity and the 25 genotypes were grouped in to seven clusters. Only one cluster (cluster VII) had single genotype while the other remaining clusters included 3 to 6 genotypes. Cluster I included maximum number of genotypes (6). Inter cluster distance was maximum between cluster VI and VII (2852.66). Cluster VI showed the highest mean value for days to 50 percent flowering, days to maturity, seed filling period, number of secondary branches, length of main raceme and number of pods on primary branches whereas VII showed the highest mean value for number of secondary branches, length of main shoot, number of pods on primary branches, number of pods on secondary branches, 1000-seed weight and seed yield per plant. Present study indicated that crosses attempting between the genotypes belonging to cluster VI and VII to get desirable segregants to developing superior varieties (s) best suited for commercial cultivation.

302. Singh, S.; Singh, A.MAhlawat, A.K.; Deveshwar, J.J.; Mishra, B.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). Characterization of bread wheat genotypes based on high molecular weight glutenin subunits. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 550-553 KEYWORDS: GLUTENIN; GENOTYPES; SOFT WHEAT; WEIGHT; ELECTROPHORESIS; SODIUM SULPHATE.

The seed proteins of twenty of Indian bread wheat varieties released for different production zones were fractionated using Sodium Dodecyl Sulphate Polyacrylamide Gel Electrophoresis (SDS-P AGE) to determine their high molecular weight glutenin subunit (HMWGS) composition. In these varieties, three alleles were identified for the Glu-A1 locus (subunit 1, 2* and null phenotype), four alleles for the Glu-B1 (Subunit 7+8, 7+9, 17+18 and 20) and two alleles for the Glu-D1 locus (subunit 2+12 and 5+10). Based on these subunits, 12 different groups were observed. Four genotypes viz. WH 711, AKW 1071, HUW 510 and MACS 2496 had distinct pattern from the remaining genotypes. The genotypes WH 711 showed 1, 7 + 9 and 2 + 12, AKW 1071 1, 7 + 8 and 2 12, genotypes HUW 510 showed 1, 17 + 18 and 2 + 12 and MACS 2496 revealed 1, 7 + 9 and 5 + 10 subunits.

303. Rao, N.S.; Sharma, K.; Sharma, R.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Entomology). Screening for newer sources of resistance in wheat varieties against khapra beetle, *Trogoderma granarium* Everts. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 575-577 KEYWORDS: ENTOMOLOGY; TROGODERMA GRANARIUM; PEST RESISTANCE; TESTING.

Twenty-two wheat varieties were screened for grain resistance against khapra beetle, *Trogoderma granarium* Everts, through a standard no choice progeny test conducted under uniform conditions of temperature, relative humidity (r.h.) and grain moisture. The per cent weight loss and avoidable weight loss was calculated to correlate with mean progeny beetle emergence. The mean number of progeny beetles obtained from different varieties per 20 grains ranged from 10.0, 38.6 and Kalyansona, Lok Bold and WTN 283 occupied the resistant group. The varieties RNB 78 and Sonalika were graded as most susceptible group. The maximum per cent loss in weight (70.71) was recorded in RNB 78 and minimum (19.62) in

Kalyansona. Per cent weight loss and mean progeny beetle emergence was positively correlated and highly significant (0.724**).

304. Singh, P.; Kaur, N.; Mahal, G.S. (Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding, Genetics and Biotechnology). Gene effects for quality parameters in Triticum durum. Indian Journal of Genetics and Plant Breeding (India). (May 2005) v. 65(2) p. 115-116 KEYWORDS: TRITICUM DURUM; GENE; INTERSECTION; QUALITATIVE ANALYSIS.

305. Sharma, S.N.; Singh, H.; Sharma, Y. (Rajasthan Agricultural University, Jaipur (India). All India Coordinated Wheat and Barley Improvement Project). Correlation analyses of yield and related physiological variables in twelve generations of durum wheat (Triticum durum Desf.). Indian Journal of Genetics and Plant Breeding (India). (May 2005) v. 65(2) p. 117-118 KEYWORDS: WHEATS; TRITICUM DURUM; YIELDS; SELECTION RESPONSES.

306. Rosamma, C.A.; Vijayakumar, N.K. (Kerala Agricultural University, Mannuthy (India). Agricultural Research Stn.). Heterosis and combining ability in rice (Oryza sativa L.) hybrids developed for Kerala state. Indian Journal of Genetics and Plant Breeding (India). (May 2005) v. 65(2) p. 119-120 KEYWORDS: RICE; ORYZA SATIVA; HETEROSIS; COMBINING ABILITY; KERALA.

307. Gautam, R.K. (Central Soil Salinity Research Institute, Lucknow (India). Regional Research Stn.); Vir, O. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics); Bharaj, T.S. (Punjab Agricultural University, Kapurthala (India). Regional Rice Research Stn.). Breeding bacterial blight resistant rice (Oryza sativa L.) hybrids. Indian Journal of Genetics and Plant Breeding (India). (May 2005) v. 65(2) p. 121-122 KEYWORDS: RICE; ORYZA SATIVA; DISEASE RESISTANCE; BACTERIOSES; XANTHOMONAS ORYZAE.

308. Sharma, R.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics); Mani, S.C. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Genetics and Plant Breeding). Combining ability and gene action for quality characters in basmati rice (Oryza sativa L.). Indian Journal of Genetics and Plant Breeding (India). (May 2005) v. 65(2) p. 123-124 KEYWORDS: RICE; ORYZA SATIVA; COMBINING ABILITY; QUALITATIVE ANALYSIS; GENE INTERACTION.

309. Mall, C.N.; Sharma, M.K. (Narendra Dev University of Agriculture and Technology, Faizabad (India). Crop Research Stn.). Genotype x environment interaction effects on yield of rainfed lowland rice (Oryza sativa L.) varieties. Indian Journal of Genetics and Plant Breeding (India). (May 2005) v. 65(2) p. 125-126 KEYWORDS: RICE; ORYZA SATIVA; YIELDS; GENOTYPE ENVIRONMENT INTERACTION.

310. Kularia, R.K.; Sharma, A.K. (Rajasthan Agricultural University, Bikaner (India). Dept. of Plant Breeding and Genetics). Generation mean analysis for yield and its component traits in barley (Hordeum vulgare L.). Indian Journal of Genetics and Plant Breeding (India). (May 2005) v. 65(2) p. 129-130 KEYWORDS: BARLEY; HORDEUM VULGARE; YIELD COMPONENTS; STATISTICAL METHODS.

311. Sharma, K.C.; Verma, S. (CSK Himachal Pradesh Krishi Vishwavidyalaya, Bajaura (India). Hill Agricultural Research and Extension Centre). Stability analysis for curd yield in late group cauliflower (*Brassica oleracea* Var *Botrytis* L.). *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 254-255 KEYWORDS: STABILITY; YIELD; BRASSICA OLERACEA.

The callus induction in the genotype is the basic requirement for getting somaclonal variations. From the present investigation a wide range of variability was observed for per cent response of genotypes to callus induction according to the type of explant used for inoculation in the medium and concentration in the medium. The callus can be initiated from germinated seed as well as from coleoptile explants in the finger millet on MS and Bs media containing different 2, 4-D concentration and supplementing the media with casein hydrolysate. The callus induction depended upon genotype, type of explant used and 2, 4-D concentration in the medium.

312. Neog, P. (Assam Agricultural University, Biswanath Charaili (India). B.N. College of Agriculture); Chakravarty, N.V.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Physics). Thermal indices in Brassica grown under a semi-arid environment. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 291-296 KEYWORDS: BRASSICA; SOIL THERMAL REGION; THERMAL ANALYSIS.

Two varieties of Brassica viz., Pusa Jaikisan and Varuna were grown on the sandy loam soils of IARI New Delhi in two consecutive seasons. Both the varieties were sown on ten different dates at weekly interval starting from 1st October to 3rd December to enable the crop to get exposed to varying weather conditions during its various phenological stages. Days taken to attain six important phenological events viz., emergence, first flower appearance, 50 percent flowering, 90 percent poddingend of seed filling and maturity were noted. Corresponding growing degree-days (GOO) were worked out. It was observed that PusaJaikisan matured between 112 to 135 days in different sowings in the first season while it took; 3. t06 days more to mature. In the second season Varuna took 1 to 9 days more to mature in two crop seasons. The mean GpO accumulation from sowing to maturity was relatively higher in Varuna (1562°0) than. In Pusa Jaikisan (1508°0). The GOO to attain a given phenological stage decreased as sowing was delayed in both the cultivars and seasons. The phenothennal index (PTI) in both the cuitivars and seasons varied from 21.59 to 8.15 °0/day and 8.86 to 14.33 in vegetative and reproductive stages, respectively. The heat use efficiem;y (HUE) varied from 0.30 to 0.93 g/ m2jo0 in different cultivars. Higher coefficients of variation in HUE of the order of 20 to 27 per cent indicated the significant differences in using the l: 1eat available to the plants.

313. Desai, S.A.; Singh, R.D. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). Genetic analysis of drought tolerance in maize under laboratory conditions. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 326-328 KEYWORDS: DROUGHT RESISTANCE; CORN; LABORATORY EXPERIMENTATION.

314. Srivastava, S.C.; Verma, P.K. (Lucknow University, Lucknow (India). Botany Dept.). *Gongylanthus indicus* sp. Nov. (Hepaticae) from Nilgiri hills, India. *Indian Journal of Forestry (India)*. (Jun 2005) v. 28(2) p. 200-205 KEYWORDS: GENERA; BRYOPHYTA; CRYPTOGAMS; INDIA.

The genus *Gongylanthus* Nees (Arnellaceae) is being reported as new addition to India with *G. indicus* sp. novo as new to science. The plants grow in Naduvattam (Nilgiri hills), Tamil Nadu forming terricolous population. The genus is remarkable in having a well-defined positively geotropic cylindrical marsupium - a special protective device (shoot-calyptra) over the developing sporophyte. This species is characterized by perfectly connate and highly concave leaves, and feebly developed trigones in leaf cells and scattered rhizoids.

315. Sharma, J.R. (Botanical Survey of India, Dehra Dun (India); Lakhanpal, T.N.; Kumar, A. (Himachal Pradesh University, Shimla (India). Dept. of Biosciences). *Boletopsis leucomelaena* (Pers.) Fayod, A new record for India. *Indian Journal of Forestry* (India). (Jun 2005) v. 28(2) p. 208-209 KEYWORDS: CRYPTOGAMS; MACROPHOMINA; INDIA.

Boletopsis leucomelaena (Pers.) Fayod is described and illustrated for the first time from India.

316. Nayak, A.R.; Reddy, J.N. (Central Rice Research Institute, Cuttack (India). Seasonal influence on quality characters in scented rice (*Oryza sativa* L.). *Indian Journal of Genetics and Plant Breeding* (India). (May 2005) v. 65(2) p. 127-128 KEYWORDS: RICE; ORYZA SATIVA; QUALITY; SEASONS.

F50 Plant Structure

317. Altaher, A.F.; Singh, R.P. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics); Rana, M.K. (National Bureau of Plant Genetic Resources, New Delhi (India). National Research Centre on DNA Fingerprinting). Morphological characters and RAPD markers for diversity estimation in upland cotton (*Gossypium hirsutum* L.). *Annals of Agricultural Research* (India). (Jun 2005) v. 26(2) p. 310-312 KEYWORDS: GOSSYPIUM HIRSUTUM; DIVERSITY; RAPD; PLANT ANATOMY.

F60 Plant Physiology and Biochemistry

318. Singh, S. (C.H.E.S., Vejalpur (India); Singh, A.K. (B.A.C., Bhagalpur (India). Dept. of Horticulture). Studies on development pattern of mango CV. Prabha Shankar and Mahmood bahar under humid subtropics of Bihar. *Annals of Agricultural Research* (India). (Jun 2005) v. 26(2) p. 194-197 KEYWORDS: PHYSIOLOGICAL FEATURES; BIHAR; HUMID TROPICS; BIOCHEMICAL REACTIONS.

An experiment was carried out to study the developmental pattern and maturity standards of mango cv. Prabha Shankar and Mahmood Bahar under subtropics of Bihar during 1998 and 1999. It was observed that the fruit growth was faster initially as compared to latter stages. The specific gravity showed increasing trend during maturity, it was recorded more than 100 at the time of fruit harvest in both the cultivars. The development of stone was completed after 75 days from the date of fruit set in both the cultivars. Total soluble solids, total and reducing sugar content increased as the fruits reached towards maturity. Titrable acidity increased during initial period of fruit development then declined. In both the cultivars, vitamin C decreased at earlier stage of growth then increased and became constant till the fruits attain physiological maturity. Total carotenoid content increased as the fruits approached towards the maturity. It was observed that fruits of Prabha Shankar and Mahmood Bahar attained maximum size, weight and total soluble

solids by third week of June and that may be taken as harvest period for both the cultivars under humid sub tropics of Bihar.

F61 Plant Physiology - Nutrition

319. Pandey, R. (Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology); Singh, B.; Nair, T.V.R. (Indian Agricultural Research Institute, New Delhi (India). Nuclear Research Lab.). Phosphorus use efficiency of wheat, rye and triticale under deficient and sufficient levels of phosphorus. *Indian Journal of Plant Physiology (India)*. (July-Sept 2005) v. 10(3) p. 292-296 KEYWORDS: PHOSPHORUS; WHEAT; RYE; TRITICLES.

Low phosphorus (P) availability in soils and diminishing P reserves emphasize the need to create plants that are more efficient P users. A pot experiment was conducted to examine differences in P uptake and utilization efficiency of three cereals, viz. Triticale (Triticale octoploide cv DT -46) and its parents wheat (*Triticum aestivum* L. cv PBW-34) and rye (*Secale cereale* L. cv. R-308), under two levels of P fertilization, i.e. 0 (Po) and 60 (P60) kg P₂O₅ ha⁻¹. The number of tillers per plant was lesser at Po compared to P60 in all the three species. The reductions were 13 percent, 37 percent and 50 percent for rye, wheat and triticale, respectively. The reduction in shoot and root dry matter was in order of 40 and 36 percent at Po compared to P60 irrespective of the species. Root-to-shoot ratio at Po was higher for wheat and rye than triticale. Root, shoot and total plant P uptake under Po were 2.5, 1.5 and 1.6 fold lower, respectively compared to P 60. The amount of dry matter produced per unit P uptake was higher in rye, though the levels had no significant effect. Thus, it was observed that wheat was responsive to P application but rye was more efficient in utilization of P.

320. Subha, K.M.; Giri, G. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Studies on integrated nutrient management in spring sunflower (*Helianthus annuus* L.). 1. Effect on growth, yield and oil content of sunflower. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 248-253 KEYWORDS: NUTRITION PHYSIOLOGY; HELIANTHUS ANNUUS; GORWTH; YIELD; OIL CROPS.

Nine varieties/lines of cauliflower (*Brassica oleracea* var. botnjtis L.) viz., 'Pyramis', 'RS-119', 'EC162587', 'Agroteck', 'RSK-II', 'Grandessa', 'White Ro~k', 'PSB-1' and 'K-1' were evaluated during 1998-2001 for stability of curd yield. Pooled analysis of variance revealed significant differences amongst genotypes and substantial G x E interaction effect on 1:urd yield, Stability. analysis showed that two high yielding varieties 'Agroteck' and 'Grandessa' were found to be best suitable over the fluctuating environmental conditions.

321. Choudhary, B.R.; Keshwa, G.L.; Parihar, C.M. (SKN College of Agriculture, Jobner (India). Dept. of Agronomy). Effect of thiourea and zinc on productivity of pearl millet. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 424-427 KEYWORDS: THIOUREA; ZINC; PRODUCTION; SEED; PENNISETUM GLAUCUM.

A field experiment consisting of seven treatments of thiourea (control, seed soaking in 500 ppm and 1000 ppm, foliar spray of 500 ppm, foliar spray of 1000 ppm, seed soaking + foliar spray of 500 ppm, seed soaking + foliar spray of 1000 ppm) and three levels of zinc (0, 2.5, 5.0 kg ha⁻¹), making twenty one treatment combinations were tested in randomized block design with three replication. The seed soaking + foliar spray of 1000 ppm thiourea represented significantly higher plant height, number of tillers, dry matter, chlorophyll

content of leaves, number of effective tillers, number and weight of grain per ear, length of ear head, grain (21.5 q ha⁻¹) and stover 37.4 q ha⁻¹) yields. The seed soaking + foliar spray (1000 ppm) also recorded the highest net returns of Rs. 13234 and B.C. ratio (1.57) and proved superior to rest of the treatments. Application of zinc at 5.0 kg ha⁻¹ brought about a significant improvement in plant height, tillers, dry matter accumulation and length of ear head over preceding level. The chlorophyll content of leaves, effective tillers, number and weight of grains per ear and test weight increased significantly upto 2.5 kg Zn ha⁻¹. Whereas the grain (21.5q ha⁻¹) and stover (37.9 q ha⁻¹) yields, net return (Rs. 13543 hit⁻¹) and B : C ratio (1.63) increased.

322. Das, R.; Rabha, B.K.; Ahmed, F. (Assam Agricultural University, Jorhat (India). Dept. of Crop Physiology). Effect of some plant growth regulators and micronutrients mixture on physio-morphic characters of tomato (*Lycopersicon esculentum* Mill.). *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 476-480 KEYWORDS: MORPHOGENESIS; GROWTH; CONTROL; LYCOPERSICON ESCULENTUM; QUALITY; YIELD.

A field trial was conducted on tomato assess the effect of the growth regulators and micronutrient mixture. The ethrel (250 ppm) was superior to NAA and micronutrients mixture in respect of modifying the morphological characters as leaf number, leaf area index, number of branches and total number of inflorescences per plant. However, NAA treated plants showed higher plant height and long internodes length. Higher fruiting percentage, total number of fruit per plant, individual weight of the fruit, yield per plant and yield per hectare was higher in NAA treated plant due to significant decrease in flower drop. The dropping intensity has also reduced in case of NAA treated plants. All the chemicals showed significant increased in yield as compared to control. The fruit of NAA treated plant recorded higher flesh: placenta ratio, fruit volume, moisture content, total soluble solid and ascorbic acid and maintain good quality.

323. Singh, V.P. (Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Screening of rice (*Oryza sativa* L.) cultivars for low light irradiance. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 522-527 KEYWORDS: ORYZA SATIVA; IRRADIATION; TESTING.

Short, medium and long duration of rice (*Oryza sativa* L.) cultivars grown under normal and low light irradiance during monsoon season were studied, The time frame of total exposure from treatment (40 days after transplanting) to maturation were 70, 80 and 100 days for various duration groups, respectively, which resulted in differential physiological responses. Leaf area index, leaf weight ratio, chlorophyll and sterility were increased whereas, photosynthesis, soluble protein, specific leaf weight, shoot and panicle weight ratios, grain number and weight and yield were reduced due to low light irradiance. The treatment resulted in reduction of stem and panicle weight ratio to a greater degree in long duration group compared to the other two duration groups. On the contrary specific leaf weight and total dry matter were less affected in long duration group. The long duration group had rapid grain filling rate. The path coefficient analysis revealed that parameters such as TDM, LAI and SL W could serve better selection criteria than other parameters. In general, the treatment affect was more drastic in case of medium duration cultivars.

F62 Plant Physiology – Growth and Development

324. Awasthi, S.; Nautiyal, N. (Lucknow University, Lucknow (India). Botany Dept.). Growth response of fertilized hyacinth bean (*Dolichos lablab* L.) ovules to different culture media. *Indian Journal of Plant Physiology (India)*. July-Sept 2005 v. 10(3) p. 211-217 KEYWORDS: FERTILIZATION; HYACINTHUS; GROWTH; STARCH; CULTURE. Fertilized ovules of hyacinth bean (*Dolichos [ablah* L.) were cultured after 6, 8, 10 and 12 days of anthesis in ten different culture media devised earlier for the culture of pollinated ovaries or ovules or developing embryos in Murashige and Skoog (1962) medium with modifications. Growth response, measured after 10 days in culture, as increase in length, breadth, fresh and dry weight, concentration of sugars, starch and protein was maximum in Monnier's (1978) medium in ovules culiured at 8 days after anthesis. Ovules cultured at 6 days after anthesis aborted within 3-4 days of culture.

325. Ahire, R.K.; Kale.; Munjal, S.V.; Jamdang, B.M. (Mahatma Phule Krishi Vidyapeeth, Rahuri (India). (Dept. of Biochemistry). Induced water stress influence proline accumulation, protein profiles and DNA polymorphism in chickpea cultivars. *Indian Journal of Plant Physiology (India)*. July-Sept 2005 v. 10(3) p. 218-224 KEYWORDS: RAPD; CICER ARIETINUM; DROUGHT; STRESS; PCR; PROLINE.

Five drought susceptible and five drought tolerant chickpea cultivars were evaluated for proline accumulation in addition to separation of stress responsive proteins by PAGE in relation to imposed water stress. The PCR based RAPD technique was employed to detect polymorphism in genomic DNA with eight random primers in each of the two drought susceptible and tolerant cultivars. Higher magnitude of proline accumulation was observed in the leaves of stressed plants of tolerant cultivars except in PG-5. In tolerant cultivars, an additional protein band of -17.78 kD size was observed under water stress condition alongwith other protein bands of -16.21, 36.30, 46.77 and 85.11 kD. The primers OPD-15 and OPC-09 detected polymorphism in genomic DNA of two tolerant and two susceptible cultivars.

326. Kumar, V.; Rani, A.; Chauhan, G.S. (National Research Centre for Soybean, Indore (India). Accumulation pattern of fatty acids in indian soybean genotypes during seed development. *Indian Journal of Plant Physiology (India)*. (Jul-Sep 2005) v. 10(3) p. 231-235 KEYWORDS: GENETIC VARIABILITY; SEED PRODUCTION; ACID DEPOSITION; SOYBEAN.

In the present investigation, the accumulation pattern of major fatty acids during seed development in five Indian soybean genotypes (viz. NRC 37, Pbl, Shilajeet, JS 335 and LSbl) at various developmental stages was studied. The observations revealed intervarietal variation in accumulation of different fatty acids except linolenic acid content. Varieties with similar fatty acid composition in mature seeds exhibited different accumulation patterns. The results indicated that total variation for fatty acid composition depended largely on the degree of desaturation from oleic acid to linoleic acid. This may be attributed to the lower activity of fatty acid desaturase that converts oleic to linoleic acid. Latent genetic variation for fatty acid composition observed in developing soybean seeds of different varieties may be exploited by the plant breeders for developing varieties with desirable fatty acid composition.

327. Akula, B.; Shekh, A.M (Anand Agricultural University, Anand (India). Dept. of Agricultural Meteorology). Sensitivity analysis of infocrop to weather and non-weather

parameters. Indian Journal of Plant Physiology (India). (Jul-Sept 2005) v. 10(3) p. 236-240
KEYWORDS: LEAF AREA INDEX; SENSIBILITY; WEATHER; YIELD; GROWTH; STRESS.

Sensitivity of InfoCrop simulated grain yield under potential and stressed conditions to change in temperature indicated that with incremental unit increase in mean temperature, the simulated yields decreased and vice versa. But, the magnitude of change from the respective base yields was more to temperature under stressed conditions. This behaviour of the models was mainly ascribed to the logical function that high temperatures reduced the thermal time requirement for pre anthesis and grain filling and this fact resulted into low yields. The InfoCrop model showed linear response to inputs of TTVG (Thermal time for vegetation), potential grain weight (POTGWT), grain number (GNOCF), initial nitrogen (NSOILI) and water content at sowing (WCLI). Besides the above, InfoCrop exhibited linear response to potential growth rate (RGRPOT) and specific leaf area of variety (SLAV AR) as these governed the leaf area index (LAI), respectively in the initial and later stages.

328. Ismail, A.M.; Azooz, M.M. (South of Valley University, Qena (Egypt). Botany Dept.). Effect of zinc supply on growth and some metabolic characteristics of safflower and sunflower plants. Indian Journal of Plant Physiology (India). (Jul-Sept 2005) v. 10(3) p. 260-266
KEYWORDS: ZINC; GROWTH; SAFFLOWER; LEAF AREA INDEX; PHOTOSYNTHESIS; SUNFLOWER.

The effect of five Zn levels, viz. 0, 2.5, 5.0, 7.5 and 10.0 mg kg⁻¹ of soil (designated as Zn⁰ ; Zn^{2.5} ; Zn^{5.0} ; Zn^{7.5} ; Zn^{10.0} respectively) on the specific leaf area (SLA), dry matter production, and some re metabolic parameters of safflower (*Carthamus tinctorius* L.) and sunflower (*Helianthus annuus* L.) studied. The first visible symptoms of Zn toxicity were observed as reduction in both specific leaf (SLA) and dry matter yield especially of shoots along with decreased chlorophyll and carotenoids cor These symptoms were more expressed in safflower than in sunflower plants. Zinc toxicity in saffl was apparent above Zn 7.5' while in sunflower only at the highest level Zn10.0. Net photosynthetic decreased at higher zinc doses. In contrast, the respiration rate in both plant species incrpogressively with increasing Zn doses. Zinc content in the two tested species increased more in than in shoots with increased application of Zn. Zinc applied affected accumulation of other nutr but marked differences were noted in Fe and Mn contents of shoot and root in both plants membrane permeability increased with increasing Zn doses especially in safflower plants.

329. Kumar, K.A.; Rajkumar, R.; Haridas, V. (Tea Research Institute, Valparai, (India). UPSAI Tea Research Foundation). Influence of the subtending leaf on the growth of axillary bud and formation of banjji bud in tea. Indian Journal of Plant Physiology (India). (July-Sept 2005) v. 10(3) p. 267-272
KEYWORDS: GROWTH; TEA; BUD; LEAF.

Harvesting of tea shoots with shear produced a large number of cut leaves on the bush canopy. The number of cut leaves increased with the increased period of shear harvesting. Damaged leaves showed a low rate of assimilation and translocation but rate of respiration was more. Reduction in the area of photosynthetic machinery and alteration of leaf metabolism due to injury, affected the growth characteristics of axillary bud and general bush health.

330. Lakhana, R.C.; Gupta, A.K.; Shivran, A.C.; Shivran, R.K. (S.K.N. College of Agriculture, Jobner (India). Dept. of Agronomy). Role of thiourea in improving the dry matter partitioning, yield and quality of pearlmillet. Annals of Agricultural Research (India). (Jun

2005) v. 26(2) p. 218-223 KEYWORDS: YIELD; QUALITY; PEARLMILLET; THIOUREA; PLANT GROWTH SUBSTANCES.

In pearl millet [*Pennisetum glaucum* (L) R. Br.] seed soaking with thiourea (500 ppm) did not show significant improvement but foliar spray (1000 ppm) at vegetative stage (20 and 40 DAS) and seed soaking plus foliar spray significantly increased the growth and grain yield, and also quality of pearl millet. Since foliar spray of urea (1000 ppm) did not have any effect, the effect of thiourea are largely attributed to a function of sulphhydryl group. The application of N up to 90 kg ha⁻¹ significantly increased the plant height, dry matter accumulation, stover yield, nitrogen content in stover whereas dry matter partitioning, LAI (50 DAS), number of effective tillers per plant, weight of grain per ear head, grain yield and nitrogen content in grain increased significantly up to 60 kg N ha⁻¹.

331. Meena, H.S.; Kumar, J.; Yadav, S.S. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). Mode of inheritance seed roughness in chickpea (*Cicer arietinum* L.). *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 267-269 KEYWORDS: INHERITANCE; *CICER ARIETINUM*; TRAIT.

Inheritance of seed surface in chickpea was studied using five genotype having variability for this trait viz., BC 1006 (tuberculated), BCD 112 (smooth), DC 843 (smooth), DC 1360 (smooth) and ICC 8151 (rough). Based on the data of seed roughness, the individual plants of each F₂ population were classified with respect to seed surface. The χ^2 test was used for testing goodness of fit to the expected ratios. The existence of multiple allelism was revealed by results on inheritance of seed surface. The tuberculated surface was dominant over both smooth and rough while rough seed surface was found to be dominant over both smooth and rough while rough seed surface was found to be dominant over smooth.

332. Pandey, R.L.; Rastogi, N.K. (Indira Gandhi Krishi Vishwavidyalaya, Raipur (India). Dept. of Plant Breeding and Genetics). Step-down regression analysis for improving seed yield in relation to seed size in chickpea. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 319-321 KEYWORDS: *CICER ARIETINUM*; SEED YIELD; STATISTICAL METHODS; SEED SIZE.

333. Thakur, A.S. (Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Basic Sciences); Thakur, P.S. (Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Silviculture and Agroforestry); Mehta, R. (Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Basic Sciences). Effect of pre-sowing treatments on seed germination in *Berberis aristata*. *Indian Journal of Plant Physiology (India)*. (Oct-Dec. 2005) v. 10(4) (New Series) p. 338-343 KEYWORDS: LEACHING; *BERBERIS ARISTATA*; SEED GERMINATION; SOWING.

The seeds of *Berberis aristata* exhibit late, erratic and poor germination potential with significant loss of germination ability. Pre-sowing chilling treatments at 5, 2 and -5° C for various durations viz. 15 days, 1 month, 2 months and 3 months resulted in early and improved germination and highest (84 percent) germination was registered by seeds given 90 days of moist chilling at 2° C. Other pre-sowing seed treatments viz. water presoaking, running water leaching and acid scarification were found very effective in induction of early germination with 40-140 per cent improvement in germination and seedling vigour.

334. Fazli, I.S.; Ahmad, S.; Jamal, A.; Abdin, M.Z. (Hamdard University, New Delhi (India). Centre for Transgenic Plant Development, Dept. of Biotechnology, Faculty of Science). Changes in oil and fatty acid composition of development seeds of taramira (*Eruca sativa* Mill.) as influenced by sulphur and nitrogen nutrition. *Indian Journal of Plant Physiology (India)*. (Oct-Dec. 2005) v. 10(4) (New Series) p. 354-361 KEYWORDS: OILSEEDS; ERUCA SATIVA; SULPHUR; NITROGEN; NUTRITION; SEED.

Randomized field experiments were conducted to study the interactive effect of sulphur (S) and nitrogen (N) on oil, protein, sugar and fatty acid composition in developing seeds of taramira (*Eruca sativa* Mill.). Two combinations of Sand N (in kg ha⁻¹): So + N100 (-S+N) and S40 + N100 (+S+N) were used. In +S+N treatments, S was applied either as a single basal dose (T₂) or in two (T₁) or three splits (T₃). A rapid increase in total oil content commenced at 20 days after flowering (DAF) and continued till 40 DAF; the dry matter however, continued to accumulate until maturity. A gradual rise was found thereafter and finally the oil accumulated as storage oil. Combined application of S and N resulted increased oil accumulation in the seeds right from the initial stage. The maximum increase was observed when S and N were applied in three splits. There was a strong positive correlation between S and oil content in the seeds. Soluble protein content increased from 10 to 30 DAF, followed by a decline until maturity. Among the +S+N treatments, i.e. T₁, T₂ and T₃ the treatment T₃ resulted in maximum increase in soluble protein content of developing seeds. Total sugar content decreased from the initial stage of seed development till harvest. The fatty acid composition of the oil changed substantially during seed development. Sand N application in three splits (T₃) resulted in the increased oleic acid (18:1) content while decreased erucic acid (22:1) content over other treatments. Reduction in 22:1/18:1 fatty acid ratio in the oil resulted in improved quality of oil.

335. Kundu, M.; Sett, R. (Tropical Forest Research Institute, Jabalpur (India). Div. of Silviculture and Joint Forest Management). Development of *Aquilaria agallocha* Roxb. seeds : acquisition of germinability, desiccation sensitivity and storage response. *Indian Journal of Plant Physiology (India)*. (Oct-Dec. 2005) v. 10(4) (New Series) p. 363-366 KEYWORDS: DESICCANTS; SEED DEVELOPMENT; STORAGE; GERMINABILITY.

Studies were undertaken on the development of the recalcitrant seeds of *Aquilaria agallocha*. Continuous increase in seed dry weight was observed till the time of fruit shedding. The seed acquired germinability at 50 DAA and full germinability was attained at 59 DAA. With the progress of maturity, desiccation tolerance increased, though the tolerance to water loss was not varied so much after the attainment of full germinability. At very early stage of development (41 and 50 DAA) slight reduction in seed moisture content induced germination. Only fully matured seeds were capable to retain viability for few months, if stored at shedding moisture content.

336. Shukla, C.; Saxena, O.P. (Gujarat University, Ahmedabad (India). (Botany Dept.). Biochemical parameters of seeds of parents and hybrid of cotton. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2005) v. 10(4) (New Series) p. 367-371 KEYWORDS: PROLAMINES; BIOCHEMISTRY; SEEDS; HYBRIDS; COTTON; GLOBULINS; GLUTELINS.

The seed protein fractions, their profiles through electrophoresis, protease activity and enzyme proteins were examined in hybrid and its parents in cotton. The amounts of protein fractions were, intermediate in hybrid to its parent except prolamin and total proteins which showed maximum and minimum values respectively. The total proteins in the seeds were

maximum and prolamins were minimum. For protein profiles, no band was observed in the prolamin-like substance fraction. In other fractions, bands differed in their intensities. Qualitative analysis through electrophoresis in terms of presence and absence and differences in the intensities of the bands in different profiles of storage proteins proved to be an important parameter to differentiate parents and hybrid of cotton.

337. Ramadevi, J.; Ramarao, G. (Sri Venkateswar Agricultural College, Tirupati (India). Dept. of Plant Physiology). Effect of seed size on yield and yield components in groundnut. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2005) v. 10(4) (New Series) p. 385-388
KEYWORDS: SEED; PROPAGATION MATERIAL; YIELD; GROUNDNUT.

A field experiment was conducted during Rabi 2002 to study the effect of seed size on yield and yield components in groundnut. The experiment was conducted on sandy clay loam soils with two cultivars (JL-24 and TPT-4) and five seed sizes (Bold, medium, small, shrivelled and ungraded seed) in factorial randomized block design. The results revealed that plants from bold seed produced significantly higher flowers to peg ratio, peg to pod ratio, number of pods per plant, seed index, harvest index, pod yield, sound matured kernel percentage and shelling percentage as compared to medium, ungraded, small and shrivelled seed. The cultivars also differed significantly and the yield per hectare was higher with JL-24 (1671kg) compared to TPT-4 (1383Kg).

338. Singh, R.K. (Amar Singh Post Graduate College, Bulandshahr (India). Dept. of Agricultural Botany); Singh, O. (Banaras Hindu University, Varansi (India). Dept. of Genetics and Plant Breeding). Genetic variation for yield and quality characters in mutants of aromatic rice. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 406-410
KEYWORDS: GENETIC VARIATION; YIELD; QUALITY; AROMATIC RICE.

Twenty promising mutants of Pusa Basmati-I were studied for genetic parameters in respect to different yield and quality characters. The mutants showed significant variation for all the characters studied. The maximum phenotypic and genotypic variances were recorded for gel consistency, head rice recovery, plants height, grains panicle-1 and water uptake number. The high values of GCV and rev for chalkiness of endosperm, head rice recovery, aroma, alkali digestion value and gel consistency suggest that there is a possibility of improving these characters through direct selection. Most of the yield and quality characters showed higher heritability indicating better scope for selection. The high heritability with high genetic advance as percent of mean is more useful than heritability alone for predicting the gain in selection. In the present investigation, characters viz., chalkiness of endosperm, head rice recovery, alkali digestion value, gel consistency, number of panicles-1 and 100-grain weight exhibited high heritability with high genetic advance indicating the preponderance of additive gene action, and such characters could be improved through selection.

339. Sardana, V. (Punjab Agricultural University, Saunhri (India). Zonal Research Station for Kandi Area); Singh, R.P.; Gupta, S.K. (Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding); Chakraborty, D. (Punjab Agricultural University, Gurdaspur (India). Regional Research Station). Influence of sowing time and nitrogen on productivity and quality of durum wheat (*Triticum aestivum* Desf.). *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 411-415
KEYWORDS: TRITICUM DURUM; QUALITY; SOWING; NITROGEN; PRODUCTION.

An investigation was conducted to study the effect of planting time and nitrogen application on the yield and quality of durum wheat cultivars. The study revealed significant reduction in grain yield to the extent of 3.2 qjha with delay in sowing from 4 November to 19 November. Each successive increment of nitrogen produced significantly higher grain yield mainly through increase in number of earheads/m² over its lower level. Increase in straw yield with 180 kg Njha over 150 kg was also significant. Nitrogen application also resulted in significant improvement in grain appearance score and hectoliter weight: Cultivars differed significantly for grain yield with PDW 233 producing the highest yield. PDW 233 also produced kernels having significantly higher protein content, sedimentation value and beta carotene content than other cultivars whereas 1000-kernel weight was the highest in cultivar PBW 34. Interaction of nitrogen levels and cultivars for grain yield was significant. PBW 34 at 120 Njha produced the lowest yield (25.0 qjha) and PDW 233 with 180 kg Nj ha produced significantly highest yield (42.0 qjha).

340. Singh, R. (Central Institute of Post Harvest Engineering and Technology, Abohar (India). Krishi Vigyan Kendra). Performance of Indian mustard (*Brassica juncea*) genotypes in relation to sulphur fertilization. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 428-430 KEYWORDS: BRASSICA JUNCEA; GENOTYPES; YIELD; SULPHUR; ECONOMICS.

A field experiment was conducted to study the performance of Indian mustard (*Brassica juncea*) genotypes viz., 'RH 8814', 'RH-30', 'Bio 902' and 'PBR91' in relation to sulphur levels (0, 20, 40 and 60 kg/ha). Among different genotypes, 'RH 8814' produced highest seed in yield (1810 kg/ha) being 5.2, 17.6 and 14.5 percent more yield than 'Bio 902', 'RH-30' and 'PBR-91' respectively. Application of sulphur in mustard 20 and 40 kg/ha significantly increased seed yield and its attributes viz., siliqua/plant, seed/siliqua and test weight. Oil content and its production were also increased significantly with the application of sulphur levels over the control. The highest net returns were obtained with 'RH 8814' genotype fertilized with 40 kg sulphur per hectare.

341. Pawar, A.; Agrawal, S.P. (N.R.E.C. College, Khurja (India). Dept. of Botany). Effect of automobile exhaust on microphorphology of *Ricinus*. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 447-448 KEYWORDS: RICINUS; PLANT ANATOMY; STOMATA; CELL STRUCTURE.

The paper deals with the effect of automobile exhaust on micromorphology of *Ricinus communis*. The attributes studied were-number of epidermal cells, stomatal frequency, stomatal index and stomatal dimensions. The leaf samples collected from polluted area exhibited increase in the number of epidermal cells in both the surface of leaves (upper and lower surface), however decrease was recorded in stomatal frequency, stomatal index and stomatal dimensions in the same area.

342. Sharma, B.B. (Indira Gandhi Agricultural University, Raipur (India). Dept. of Plant Pathology). Effect of colours of light on radial growth and dry mycelia weight of *Pleurotus djamor* in Chhattisgarh region of Madhya Pradesh. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 460-461 KEYWORDS: PLEUROTUS OSTTEATUS; GROWTH; WEIGHT; MADHYA PRADESH; LIGHT.

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343. Beena, M.R.; Jami, S.K; Srinivasan, T.; Anuradha, T.S.; Padmaja, G.; Kirti, P.B. (University of Hyderabad, Hyderabad (India). Dept. of Plant Sciences). Efficient direct shoot regeneration from cotyledonary node explants of peanut (*Arachis hypogaea* L. cv. JL-24). Indian Journal of Plant Physiology (India). July-Sept 2005 v. 10(3) p. 205-210 KEYWORDS: PETIOLES; PEANUT; COTYLEDON; PLANT REGENERATION.

The shoot regeneration response from different explants, viz. cotyledon, cotyledonary node and petiole, of the most popular Indian cultivar, JL-24 of peanut (*Arachis hypogaea* L.), was evaluated by culturing on Murashige and Skoog medium containing B5 vitamins supplemented with different growth regulators. Shoot bud initiation, proliferation and subsequent development into shoots were found to be superior from cotyledonary node explants in comparison to other explants. High frequency (69 percent) direct shoot regeneration from cotyledonary node was observed on MS medium with 4.0 mg P BAP and 0.2 mg 1⁻¹ NAA. The shoots elongated upon transfer to MS medium with lower concentrations of BAP. Elongated shoots could be continuously harvested at 15 days interval for a period of 75 to 90 days. The regenerated shoots were rooted at a high frequency of 84.5 percent on MS medium containing 1.0 mg 1⁻¹ NAA. The regenerated plantlets survived to maturity in greenhouse, flowered, set pods and seed normally. This protocol could be very efficiently used for transformation studies.

344. Satisha, J.; Prakash, G.S. (National Research Centre for Grapes, Pune (India). Div. of Fruit Crops); Murti, G.S.R.; Upreti, KK. (Indian Institute of Horticultural Research, Bangalore (India). Div. of Plant Physiology). Response of grape genotypes to water deficit : root, shoot growth and endogenous hormones. Indian Journal of Plant Physiology (India). (Jul-Sept 2005) v. 10(3) p. 225-230 KEYWORDS: ABA; STOMATA; SOIL WATER CONTENT; GENOTYPES; GROWTH; CYTOKININS.

Grape varieties respond to decrease in soil water status by stomatal closure and reduced shoot growth with simultaneous increase in root growth. Most of the water deficit responses are known to be regulated by endogenous hormonal contents like abscisic acid (ABA) and cytokinins. To determine how these endogenous hormones are related to changes in shoot and root morphology, four grape genotypes were grown in pots and subjected to different levels of soil moisture stress for 14 days. None of the genotypes could survive beyond 4 days under 100 percent stress conditions. There was an increased accumulation of ABA and corresponding decrease in cytokinins at 50 percent stress compared to control (100 percent irrigation). Among the genotypes tested Flame Seedless had highest ABA and lowest cytokinin levels and it also had highest root to shoot length ratio and root to shoot dry weight ratio. It is presumed that the reduction in shoot growth and stomatal conductance observed may be due to their ability to synthesize and accumulate ABA with the onset of soil moisture stress.

345. Kamble, M.S.; Dhinukshe, B.L.; Kashid, N.V.; Shirpurkar, G.N. (Agriculture Research Station, Nashik (India). Callus induction in vitro in finger millet (*Eleusine coracana* (L.) Gaertn.). Annals of Agricultural Research (India). (Jun 2005) v. 26(2) p. 256-262 KEYWORDS: GENOTYPES; CALLUS; FINGERMILLET.

Field experiments were carried-out during 1995-2000 in the vertisol to study the performance of soybean during kharif in wheat-soybean cropping system. The varying level of nutrients (organic, inorganic, organic + inorganic and bio-fertiliser) were applied to wheat crop alone in rabi season and soybean was grown in the residual fertility of the previous

wheat crop. The bio-logical yield of soybean due to the residual effect of treatments were significant, however, the grain yield due to these treatments were non-significant over the years. The fertility treatments which produced higher grain yield of wheat could induce higher bio-logical yield of soybean but could not influence the grain yield similarly.

346. De, D.K.; Pal, S.K.; Ghosh, M.; Pal, A.K. (Bidhan Chandra Krishi Viswavidyalaya, Cooch Behar (India). North Bengal Campus). Correlation and path analysis in aromatic rice. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 398-401 KEYWORDS: CORRELATION; YIELD; AROMATIC RICE; PATH ANALYSIS.

Correlation and path analysis studies for ten characters on 14 diverse aromatic rice cultivars during wet seasons of 2000 and 2001 following normal agronomic practices revealed that only number of panicles hill⁻¹ had significant (P<0.01) positive correlation with grain yield plant⁻¹ via the indirect effect of kernel length and 100D-grain weight, because its direct effect was very low. Good positive direct effect of kernel breadth and protein content on yield was evidently nullified by high negative indirect effect of kernel length and plant height, respectively. Number of panicles hill⁻¹, duration of crop, protein content as well as aroma has been indicated as important characters for designing ideotype.

F70 Plant Taxonomy and Geograpy

347. Choudhury, M.D.; Shil, S. (Assam University, Silchar (India). (Dept. of Life Science). Antibacterial activity of some ethnomedicinal plants. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 187-192 KEYWORDS: ETHNOBOTANY; ANTIMICROBIAL PROPERTIES; DRUG PLANTS.

Antibacterial activity of *Alpinia nigra* (Gaertn.) Burtt., *Curculigo capitulate* L., *Oroxylum indicum* (L.) Vent. and *Tournefortia montana* Lour. var. *griffithi* (Cl) Johnston was tested against *Streptococcus* sp. and *Staphylococcus* sp. It was found that *Curculigo capitulata* L. is active against *Streptococcus* sp. only, whereas other three plants were active against both the test organisms. Antibiotic sensitivity of the test organisms was tested using some known antibiotic discs to have a comparative conclusion.

H10 Pests of Plants

348. Kumar, S.; Kumar, S.; Singh, P.K. (R.B.S. College, Bichpuri, Agra (India). Dept. of Agricultural Zoology and Entomology)). Toxicity of malathion against cabbage butterfly *Pieris brassicae* Linn. (Lepidoptera : Pieridae) on cabbage. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 207-208 KEYWORDS: MALATHION; BRASSICA OLERACEA CAPITATA; CABBAGES; PIERIS BRASSICAE; TOXICITY; LEPIDOPTERA.

Different concentrations of malathion 0.5, 0.2, 0.1 and 0.05 percent were tested for their efficacy against larvae of *Pieris brassicae* L. in cabbage crop by spray application. Four sprays of insecticide were made with Knapsack sprayer at fortnightly intervals. Among the different concentrations tested, 0.25 percent recorded the lowest per cent head infestation (U24 percent) and yield as compared to other concentrations tested.

349. Goel, S.R. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Nematology). Reaction of certain cowpea genotypes to root-knot nematode,

Meloidogyne javanica. Annals of Agricultural Research (India). (Jun 2005) v. 26(2) p. 338-339 KEYWORDS: GENOTYPES; MELOIDOGYNE JAVANICA; VIGNA UNGUICULATA.

350. Dhawan, S.; Bhandari, R.S.; Singh, R.B. (Forest Research Institute, Dehra Dun (India). Behavioural studies of alates and colony foundation under laboratory conditions in *Odontotermes distans* Holmgren & Holmgren (Isoptera : Macrotermitinae). Indian Journal of Forestry (India). (Jun 2005) v. 28(2) p. 195-199 KEYWORDS: ODONTOTERMES; ISOPTERA; MACROTERMES; SEXUAL BEHAVIOUR; SWARMING.

The present paper deals with the swarming of alates, their associated activities (sexual dimorphism, dealation, calling attitude and tandem behaviour) and colony formation by the termite *Odontotermes distans* Holmgren & Holmgren in laboratory conditions. The female of *O. distans* initially lays about 25 - 28 comma shaped eggs, which hatches out after 48 - 52 days. The first batch of workers became active after 40 - 45 days. It takes 124 days from the date of swarming to the first gallery formation by the workers.

351. Mishra, S.K.; Kanwat, P.M.; Singh, S.P. (Rajasthan Agricultural University, Jobner (India). Dept. of Agricultural Zoology and Entomology). Bionomics of *Coccinella septempunctata* Linn. (Coccinellidae: Coleoptera) - a potential predator of mustard aphid. Annals of Agricultural Research (India). (Sep 2005) v. 26(3) p. 453-457 KEYWORDS: COCCINELLA SEPTEMPUNCTATA; PREDATORS; MUSTARD.

The laboratory study on bionomics indicated that eggs of *C. septempunctata* hatched in 3 days with 86.6 per cent hatchability, pre-oviposition, oviposition and post-oviposition periods were found 6.7, 13.4 and 3.3 days, respectively. Female laid about 657.7 eggs during her life span. The grub passed through four instars were in 9.27 days. An average pupal period was 6.52 days. The average longevity of the male was 21.08 days while that of the female was 25.50 days.

352. Anand, M.; Sharma, K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Entomology). Toxic effect of boric acid-borax bait mixture on fruitfly, *Bactrocera cucurbitae* (Coquilett). Annals of Agricultural Research (India). (Dec 2005) v. 26(4) p. 578-580 KEYWORDS: ENTOMOLOGY; COQUILETT; BORIC ACID; TEPHRITIDAE.

The toxic bait mixture containing boric acid - borax (3:1) as toxicant and yeast autolysate 4 percent as attractant in water, when fed to 5 day old adults of *Bactrocera cucurbitae* (coquilett) with different concentration (1 to 12 percent) of the toxicant through cotton swabs in petridishes kept in rearing jars in the laboratory caused mortality of 41.6 to 98.3 per cent after 36 hours of exposure. The bait mixture remained effective for 15 days with 50 percent toxicity reduced.

353. Sharma, R.K.; Bajracharya, A.S.R. (Indian Agricultural Research Institute, New Delhi (India). Div. of Entomology). Population growth of *Rhizopertha dominica* (F.) in speciality maize varieties. Annals of Agricultural Research (India). (Dec 2005) v. 26(4) p. 581-586 KEYWORDS: GROWTH; RHIZOPERTHA DOMINICA; ENTOMOLOGY; MAIZE; RESISTANCE.

Varietal evaluation under no choice test with *Rhizopertha dominica* (Fabr.) in six speciality maize varieties was studied at uniform condition of temperature and humidity under unrenewed medium conditions. Variety Win pop com remained the least susceptible throughout the experimental period, whereas, Madhuri as the most susceptible. Varieties on the basis of population of *R. dominica* could be arranged as: MadhuriPriyaBasi

10calEBRShaktiman-IWin pop corn and as: MadhuriShaktiman-IPriyaBasi 10calEBRWin pop com for one and three pair inoculated experiments, respectively. Three times initial increase in insect inoculation did not show proportionate increase in population at each census count over one pair inoculated experiment except in varieties Shaktiman-I and Madhuri which recorded 4.52 and 2.36 times increase in population, respectively in three pair inoculated experiment as compared to one pair inoculated experiment.

354. Biswas, C.; Gupta, J.P. (Indian Agricultural Research Institute, New Delhi (India). Nuclear Research Laboratory). Efficacy of different *Trichoderma* spp. In managing charcoal rot (*Macrophomina phaseolina*) of Soybean. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 596-598 KEYWORDS: SOYBEAN; MACROPHOMINA PHASEOLINA; CHARCOAL.

The experiments were conducted to assess the efficacy of four *Trichoderma* species namely *T. harzianum*, *T. viride*, *T. Koningii* and *T. hamatum* against the charcoal rot pathogen of soybean, *Macrophomina phaseolina* for its management. *Trichoderma viride* was found most effective in inhibiting the growth of the pathogen in vitro as well as in reducing the disease incidence and sclerotial population in soil with concomitant increase in percentage of seedling emergence in vivo.

H20 Plant Diseases

355. Verma, P.K.; Hegde, Y.R.; Kulkarni, S.; Kalappanavar, I.K. (University of Agricultural Sciences, Dharwad (India). Dept. of Plant Pathology)). Variability in *Helminthosporium sativum* with respect to morphology and symptomatology. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 209-212 KEYWORDS: HELINTHOSPORIUM SATIVUM; SYMTOMS; PATHOLOGY; PATHOGEN; BIOLOGICAL DEVELOPMENT; VARIETIES; WHEATS.

Foliar blight symptoms recorded from different localities on various wheat cultivars showed marked variation. The symptoms incited by *Helminthosporium sativum* Parmel, King and Bakke on wheat cultivars varied from irregular grayish brown leaf blotches to small elongated grayish spots with blackish centers. Ten hyphal tip isolates of *H. sativum* were tested for their cultural variability. The maximum radial growth (90 mm) was recorded in isolates SHS, KAHS and KLHS followed by UHS (87.6), DHS (85.3), ALHS (82.6), NDHS (81.3), KHS (77.6), ARHS (72.3) and KUHS (66.3) grown on potato dextrose agar for 10 days. The shape of the colony of different isolates varied from irregular with aerial mycelium to circular with abundant aerial mycelium. Average conidial length was maximum in isolate SHS (58.4 / μ m) followed by isolate ARHS, KUHS, ALHS, KAHS, KLHS, KHS, NDHS, DHS and UHS (40.73 / μ m). The maximum average width of conidia was associated with isolate DHS (25.76 / μ m) followed by ARHS, KAHS, KUHS, KLHS, UHS, KHS, ALHS, NDHS and SHS (16.41 / μ m). The number of pseudosepta also varied among the isolates (2 to 9).

356. Gupta, D. (Apple Scab Monitoring and Research Laboratory, Shimla (India); Thakur, P.D. (Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Mycology and Plant Pathology); Sharma, P. (Sher-e-Kashmir University of Agriculture Science and Technology, Jammu (India). Agricultural Research Stn.)). Influence of planting time on the incidence of leaf curl virus disease of tomato. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 213-215 KEYWORDS: PLANTING DATE; VIRUSES; TOMATOES; LEAF CURL; PLANT DISEASES; LYCOPERSICON ESCULENTUM; MORBIDITY; FIELD EXPERIMENTATION.

Field experiments carried out for two consecutive years i. e. 1998 and 1999 on the incidence of leaf curl virus disease of tomato revealed that minimum disease incidence was recorded in the crop planted on 14 April. However, the incidence increased significantly with each subsequent planting date in both the years of experimentation. The highest incidence of 63.55 percent (52.83) and 68.75 percent (55.98) was recorded during 1998 and 1999, respectively, when the crop was planted on 15 May, the last sowing date.

357. Sagar, S.; Hegde, Y.; Kulkarni, S.; Rao, M.S.L. (University of Agricultural Science, Dharwad (India). Dept. of Plant Pathology)). Biocontrol of seed mycoflora of rice. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 217-220 KEYWORDS: SEEDS; FUNGI; SEED TREATMENT; BIOLOGICAL CONTROL; MICROBIAL FLORA; VIGOUR; RICE.

Rice seeds may be infected by various fungi causing discolouration. Different bio-control agents viz., *Pseudomonas fluorescens*, *Trichoderma harzianum* and *Trichoderma viride* were used as seed dresser at concentrations of 0.4, 0.6, and 0.8 percent. Results clearly indicated that talc formulation of *P. fluorescens* 0.8 percent was most effective in reducing the seed mycoflora, increasing the germination and seedling vigour.

358. Bhaskar, A.V. (Acharya N.G. Ranga Agricultural University, Hyderabad (India); Rao, K.C.S.; Rahman, M.A. (College of Agriculture, Hyderabad (India). Dept. of Plant Pathology)). Occurrence and management of dry corm rot disease (*Fusarium solani*) in colocasia. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 221-230 KEYWORDS: COLOCASIA; MANAGEMENT; FUSARIUM SOLANI; ROTS; PLANT DISEASES; PATHOGEN; CORMS.

Corm rots have become an impediment in the successful cultivation of colocasia. These are reported to be caused by a number of fungal pathogens. Among which *Fusarium solani* is the major one in Andhra Pradesh (India). Considerable losses have been reported during storage and marketing due to decay caused by fungal pathogens. Adequate attention has not been paid to combat the problem. Among the different storage methods, the maximum disease score and weight loss were recorded in pit method. On the other hand, the disease score and PWL were lowest in gunny bag method because of proper aeration and optimum temperature. Further studies were conducted with an aim to evaluate the different storage methods for the management of dry corm rot disease in colocasia. The control of dry corm rot disease of colocasia (*F. solani*) was investigated using contact and systemic fungicides. Four fungicides with different concentrations were tested by pre-inoculation corm dip method. Among the contact fungicides, mancozeb 2500 ppm and copper oxychloride (COE) 3000 ppm were recorded effective, whereas in the systemic fungicides carbendazim (1000 ppm) and metalaxyl (2000 ppm) were found effective individually for reducing the disease. The per cent weight loss was recorded lowest with mancozeb and COE (3000 ppm individually) among the contact fungicides, whereas in case of systemic fungicides carbendazim and metalaxyl (2000 ppm individually) were found effective. Management of the disease using botanicals was investigated using three leaf extracts viz., neem (NLE), *Pongamia glabra* (PGLE) and *Annona squamosa* (ASLE), seed kernel extract of neem (NSKE) and bulb extract of garlic (GBE) with concentrations of 25, 50, 75 and 100 g/l; proneem (PN) (20, 30 and 40 ml/l) and neemgold (NG) (10, 20 and 30 ml/l). The botanical extracts have reduced the per cent disease incidence (PDI) significantly. NLE 100 g/l, PGLE 100 g/l, ASLE 100 g/l, GBE 100 g/l and NSKE 50 g/l were recorded with low disease incidence and NSKE 50 g/l was found most effective. Similarly, PN 30 ml/l and NG 20 ml/l were also recorded effective among which NG 20 ml/l was found most effective. All the tested

botanicals were also found effective in reducing the per cent weight loss (PWL) of the corms when kept for 30 days after inoculation. Hence, the botanical, namely, NSKE 50 gli or NG 20 mill can be advised to the farmers as a part of package for the management of the dry corm rot of colocasia.

359. Bhaskar, A.V. (Acharya N.G. Ranga Agricultural University, Hyderabad (India); Rahman, M.A.; Rao, K.C.S. (College of Agriculture, Hyderabad (India). (Dept. of Plant Pathology). Occurrence and management of dry corm rot disease (*Rhizoctonia solani*) in *Amorphophallus*. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 231-240 KEYWORDS: RHIZOCTONIA SOLANI; PLANT DISEASES; CORMS; ROTS; MANAGEMENT; AMORPHOPHALLUS; PATHOGEN; FUNGICIDES.

Corm rots have become an impediment in the successful cultivation of *amorphophallus*. These are reported to be caused by a number of fungal pathogens. Among which *Rhizoctonia solani* is the major one in the Andhra Pradesh. Considerable losses have been reported during storage and marketing due to decay caused by fungal pathogens. Adequate attention has not been paid to combat the problem. Among the different storage methods, the maximum disease score and weight loss were recorded in pit method. On the other hand, the disease score and PWL were lowest in gunny bag method because of proper aeration and optimum temperature. Further studies were conducted with an aim to evaluate the different storage methods for the management of dry corm rot disease in *amorphophallus*: The control of dry corm rot disease of *amorphophallus* was investigated using contact and systemic fungicides. Four fungicides with different concentrations were tested by pre-inoculation corm dip method. Among the contact fungicides mancozeb 2500 ppm and copper oxychloride (Cae) 3000 ppm were effective, whereas in the systemic fungicides carbendazim (1000 ppm) and metalaxyl (2000 ppm) were found effective individually for reducing the disease. When per cent weight loss was calculated lowest loss was recorded with mancozeb and COC (3000 ppm individually) in case of contact fungicides and in case of systemic fungicides carbendazim and metalaxyl (2000 ppm individually) were found effective. Management of the disease using botanicals was investigated using three leaf extracts viz., neem (NLE), *Pongamia glabra* (PGLE) and *Annona squamosa* (ASLE), seed kernel extract of neem (NSKE) and bulb extract of garlic (GBE) with concentrations of 25, 50, 75 and 100 gli, proneem (PN)(20, 30 and 40 mill) and neemgold (NG) (10, 20 and 30 mill). The botanical extracts have reduced the per cent disease incidence (PDI) significantly: NLE 100 gli, PGLE 100 gli, ASLE 100 gli, GBE 100 gli and NSKE 50 gli were recorded with low disease incidence and NSKE 50 gli was found most effective. Similarly, PN30 mill and NG 20 mill were also recorded effective among which NG 20 mill was found most effective. All the tested botanicals were also found effective in reducing the per cent weight loss (PWL) of the corms when kept for 30 days after inoculation. Hence, the botanical, namely, NSKE 50 gli or NG 20 mill can be advised to farmers as a part of package for the management of the dry corm rot disease of *amorphophallus*.

360. Singh, B.; Lakra, B.S.; Niwas, R.; Singh, M. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). (Dept. of Plant Pathology)). Influence of depth of planting on development of black scurf of potato (*Rhizoctonia solani*). *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 241-244 KEYWORDS: RHIZOCTONIA SOLANI; TUBER TRUFFLES; PLANTING; DEPTH; FIELD EXPERIMENTATION; POTATOES.

A field experiment was conducted to study the effect of soil depth on black scurf development of potato at Research Farm of Department of Vegetable Crops, CCS Haryana Agricultural University, Hisar during rabi 1996-97. Seed tubers (both healthy and diseased) were planted on 15 October 1996 in 3 x 5 m² plots at 5, 10, 15 and 20 cm soil depth in randomized block design. Black scurf incidence was significantly influenced by depth of planting. Shallow planting of 5 cm soil depth recorded as low as 18.4 and 13.79 percent in comparison with a highest of 39.42 and 63.48 percent necrotic stems and disease intensity, respectively, when diseased seed tubers were planted at 20 cm soil depth. Black scurf development was linearly and negatively related with the soil temperature. Soil temperature explained upto 93 to 98 percent variability in black scurf development.

361. Singh, B.; Lakra, B.S.; Niwas, R.; Singh, M. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Plant Pathology). Effect of planting time on black scurf development in potato. *Annals of Biology (India)*. (Jul-Dec 2005) v. 21(2) p. 245-248 KEYWORDS: PLANTING DATE; RHIZOCTONIA SOLANI; TUBER TRUFFLES; POTATOES; FIELD EXPERIMENTATION.

An experiment was conducted to study the influence of planting time on black scurf development of potato at the Research Farm Area of Department of Vegetable Crops, CCSHAU, Hisar during rabi 1996-97. Seed tubers (both healthy and diseased) were planted on 1 October, 15 October, 1 November, 15 November and 1 December in randomized block design. The number of stems/plant was decreased and per cent necrotic stems were increased with delay in planting time upto 1 December. Maximum yields and low disease incidence were recorded in crop planted before 15 October. With delay in planting, disease incidence was increased significantly, which resulted in maximum yield loss (47.9 percent) in 1 December planted crop. A linear and inverse relationship was observed between black scurf development and soil temperatures. The soil temperature explained upto 88-96 variability in black scurf development of potato.

362. Sharma, B.B. (Indira Gandhi Agricultural University, Raipur (India). (Dept. of Plant Pathology). Effect of different carbon sources on radial growth and dry mycelial weight of *Pleurotus* spp. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 324-325 KEYWORDS: BASIDIOMYCETES; GROWTH; PLEUROTUS; CARBON; DRYOMYZIDAE; FUNGAL MORPHOLOGY.

H50 Miscellaneous Plant Disorders

363. Sharma, G. (Indira Gandhi Agricultural University, Raipur (India). Dept. of Horticulture); Srivastava, R. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). (Dept. of Horticulture). Combinations and concentrations of growth regulators for somatic embryogenesis in gerbera. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 214-217 KEYWORDS: GERBERA; GROWTH CONTROL; SOMATIC EMBRYOGENESIS; CALLUS; TISSUE CULTURE.

Somatic embryogenesis has been achieved from callus cultures derived from leaf disc explants of *Gerbera jamesonii* cv. Alsmeara. Callus cultures were obtained from leaf disc pieces and petioles (1-2 cm) on MS medium supplemented with varied combinations and concentrations of auxins and cytokinins. High frequency (92.78 percent) for callus induction was achieved from leaf explant obtained on MS medium supplemented with BAP (1 mg/l)

and 2, 4-D (2.5 mg/l). Maximum percentage response for somatic embryos induction (64.56 percent) from callus clumps was obtained on MS medium amended with BAP (0.5 mg/l) and NAA (1 mg/l). Histological studies confirmed the presence of somatic embryos in different developmental stages viz. globular and heart shaped.

364. Singh, R.; Singh, J.N.; Meena, P.K.P. (Indian Agricultural Research Institute, New Delhi (India). (Div. of Genetics). Combining ability studies for harvest index and other yield, contributing characters in Indian mustard (*Brassica juncea* Czern. and Coss). *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 281-285 KEYWORDS: YIELD; BRASSICA JUNCEA; COMBINING ABILITY; HARVEST INDEX; GENOTYPES; GENETIC CORRELATION.

Combining ability studies and pattern of association was made in a 11 x 11 diallel set of *Brassica juncea* for biological yield, seed yield, harvest index, oil content and other ancillary characters Prakash was the best general combiner for biological yield, seed yield, harvest index, 10aO-seed weight and other ancillary characters except for oil content. It was interesting to note that none of the other parents showed desirable gca for biological yield, seed yield and harvest index simultaneously. Additive genetic variance was high for plant height and biological yield, for other characters non-additive genetic variance was predominant. Genotypic correlation studies revealed that seed and biological yield were positively correlated with 50 percent flowering, number of primary branches, secondary branches, length of main axis and number of siliquae on main axis except for length of main axis in latter case. Harvest index was positively correlated with length of main axis, number of siliquae on main axis and seed yield. Length of main axis was positively correlated with 10aO-seed weight and oil content.

H60 Weeds and Weed Control

365. Sannigrahi, A.K. (Ministry of Defence, Balasore (India). Proof and Experimental Establishment). Management of some aquatic weeds through vermicomposting. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 439-440 KEYWORDS: AQUATIC WEEDS; COMPOSTING; EICHHORNIA CRASSIPES; MANAGEMENT; PISTIA STRATIOTES; TYPHA ANGUSTATA.

The experiment showed that noxious aquatic weeds like water hyacinth (*Eichhornia crassipes*), water lettuce (*Pistia stratiotes*) and cattail (*Typha angustata*) could be managed beneficially by converting easily in to good quality vermicompost within 2 to 3 months using *Peryonix excavatus* earthworms. These composts recorded 0.71 - 1.36 percent total nitrogen, 0.38 - 0.75 percent total phosphorus and 0.86 - 1.44 percent total potassium, indicating its good quality as organic fertilizer. Control of these weeds by large-scale utilization for making marketable vermicompost is a beneficial technique, better than expensive chemical and biological control techniques.

366. Sarkar, A.; Mukherjee, P.K. (Uttar Banga Krishi Viswavidyalaya, Coochbehar (India). (Dept. of Agronomy). Ecology of *Polygonum*: A predominant weed in terai agro-climatic region of West Bengal. *Annals of Agricultural Research (India)*. (Sep 2005) v. 26(3) p. 462-463 KEYWORDS: WEST BENGAL; WEED.

367. Kumar, M.; Singh, D.; Tomar, P.K. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Agronomy). Nutrient uptake (N, P and K) by crop,

weeds and grain yield influenced by integrated weed management in wheat. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 608-609 KEYWORDS: PLANT NUTRITION; WEED CONTROL; TRITICUM AESTIVUM; YIELD; NITROGEN; PHOSPHORUS; POTASSIUM.

368. Ram, B.; Chaudhary, G.R.; Jat, A.S.; Jat, M.L. (Rajasthan Agricultural University, Jobner (India). (Dept. of Agronomy). Effect of integrated weed management and intercropping systems on growth and yield of pearl millet (*Pennisetum glaucum*). *Indian Journal of Agronomy (India)*. (Sep 2005) v. 50(3) p. 210-213 KEYWORDS: WEED CONTROL; INTERCROPPING; YIELDS; GROWTH; PEARLMILLET; PENNISETUM GLAUCUM; YIELD COMPONENTS.

An experiment was conducted during the rainy season (kharif) of 1999 and 2000 at College of Agriculture, Jobner (Jaipur), on a loamy sand soil, to evaluate the effect of integrated weed management and intercropping systems on growth and yield of pearl millet [*Pennisetum glaucum* (L.) R.Br. emend. Stuntz. Lowest weed population (117/m²) and dry weight (975 kg/ha) were recorded under pearl millet + cowpea [*Vigna unguiculata* (L.) Walp.] followed by pearl millet + greengram (*Phaseolus radiatus* L.) while maximum under sole pearl millet at harvest. The sole pearl millet recorded significantly higher tillers/plant than all the 3 intercropping systems. Maximum plant height was recorded under sole pearl millet, being at par with pearl millet + clusterbean [*Cyamopsis tetragonoloba* (L.) Taubert]. Sole pearl millet gave significantly more ear length, grain (20.8 q/ha) and stover (54.9 q/ha) than rest of the intercropping systems whereas highest pearl millet-grain-equivalent yield was recorded under pearl millet + clusterbean (39.2 q/ha) closely followed by pearl millet + greengram. Hand-weeding twice at 30 and 45 DAS remained at par with pendimethalin and oxadiazon each at 1.0 kg/ha supplemented with hand weeding once at 45 DAS significantly reduced the weed population (77/m²) and dry-matter production (625 kg/ha) compared to rest of the weed-management practices. The plant height, tillers/plant, ears/plant and ear length increased significantly under all the weed-control measures compared to unweeded control with maximum values under hand-weeding twice. Similarly, maximum values were obtained under hand-weeding twice (22.9 q/ha grain, 61.5 q/ha stover and 41.4 q/ha pearl millet grain-equivalent yields) followed by pendimethalin and oxadiazon each at 1.0 kg/ha + hand-weeding once at 45 days after sowing over weedy check.

369. Pandya, N. (National Research Centre for Soybean, Indore (India); Chouhan, G.S.; Nepalia, V. (Rajasthan College of Agriculture, Udaipur (India). Dept. of Agronomy). Effect of varieties, crop geometries and weed management on nutrient uptake by soybean (*Glycine max*) and associated weeds. *Indian Journal of Agronomy (India)*. (Sep 2005) v. 50(3) p. 218-220 KEYWORDS: GLYCINE MAX; WEED CONTROL; SPACING; VARIETIES; CLOMAZONE; YIELDS; WEEDING; WEEDS; CONTROL METHODS; NUTRIENT UPTAKE.

A field experiment carried out during the rainy season of 2001 and 2002 on clay loam alkaline soil at Udaipur (Rajasthan) showed that soybean [*Glycine max* (L.) Merr.] variety 'JS 335' out yielded 'NRC 37' and 'JS 71-05' in terms of N and P uptake. Crop geometries (30 cm x 10 cm and 20 cm x 15 cm) did not show any significant variation for N and P uptake by crop and associated weeds. All the weed-management treatments significantly reduced removal of N and P by weeds and enhanced uptake of these nutrients by soybean compared to weedy check. Two hand-weedings at 20 and 40 days after sowing and pre-emergence application of clomazone at 1.0 kg/ha + hand-weeding at 40 days were at par and resulted in

significant reduction in uptake of N and P by weeds and increase in uptake of these nutrients by soybean compared to all other methods of weed control. Seed and straw yields of soybean were also increased significantly owing to these 2 methods of weed control compared to rest of the methods.

370. Behera, U.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy); Singh, U.; Singh, Y.V. (Indian Agricultural Research Institute, Indore (India). Regional Stn.). Influence of weed control method on productivity of rainfed soybean (*Glycine max*) in vertisol of central India. *Indian Journal of Agronomy* (India). (Sep 2005) v. 50(3) p. 221-224 KEYWORDS: WEED CONTROL; EFFICIENCY; RAINFED FARMING; WEEDS; CONTROL METHODS; MADHYA PRADESH; YIELDS; YIELD COMPONENTS; GLYCINE MAX; HERBICIDES.

A field experiment was carried out during the rainy season of 1998 and 1999 to study the effect of different herbicides on growth and yield of 'JS 335' soybean [*Glycine max* (L.) Merr.] grown on clay-loam soil of Indore, Madhya Pradesh. The conventional practice of weed control involving *dara* (a small *bakhar* shape implement, drawn by a pair of bullocks between the rows of the crop) and 1 hand-weeding 30 days after sowing the crop, was effective in controlling the weeds and giving higher grain yield. The pre-emergence application of herbicides-metolachlor 1.0 kg/ha, chlorimuron ethyl 0.009 kg/ha and combined use of chlorimuron ethyl and metolachlor 0.009 kg and 1.0 kg/ha, respectively, were equally effective in controlling the weeds and influencing soybean yield favourably.

371. Kushwah, S.S. (Jawaharlal Nehru Krishi Vishwa Vidyalaya, Rajgarh (India). Krishi Vigyan Kendra); Vyas, M.D. (Jawaharlal Nehru Krishi Vishwa Vidyalaya, Sehore (India). Herbicidal weed control in soybean (*Glycine max*). *Indian Journal of Agronomy* (India). (Sep 2005) v. 50(3) p. 225-227 KEYWORDS: WEED CONTROL; HERBICIDES; CONTROL METHODS; GLYCINE MAX; SOYBEAN; YIELDS; WEEDS; YIELD COMPONENTS; EFFICIENCY.

A field experiment was conducted during the rainy season of 2001 and 2002 at Sehore, to study the effect of herbicidal weed control on growth, yield and economics of soybean [*Glycine max* (L.) Merr.]. Application of imazethapyr 10 percentage 75 g/ha was found most effective in reducing weed biomass and resulting higher weedcontrol efficiency over other pre- and post-emergence herbicides. Quizalofop ethyl 5 EC 50 g/ha was also found effective with fairly low weed shoot biomass during both the years and controlled particularly the monocot weeds effectively. Treatment of 2 hand-weedings recorded higher values for growth, yield attributes, harvest index and yield followed by post-emergence application of imazethapyr 10percentage 75 glha.

372. Singh, R.; Sen, D.; Singh, V.K.; Rana, N.S.; Kumar, S. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). (Dept. of Agronomy). Effect of weed management practices on spring-planted sugarcane. *Indian Journal of Agronomy* (India). (Sep 2005) v. 50(3) p. 236-238 KEYWORDS: WEED CONTROL; CONTROL METHODS; SUGARCANE; HERBICIDES; EFFICIENCY; YIELD COMPONENTS; YIELDS.

A field experiment was conducted during 1997-98 and 1998-99 to study the effect of weed-management practices on spring-planted sugarcane and associated weeds. Significantly lower density of *Echinochloa* spp. was recorded with the pre-emergence application of thiozopyr at 0.36 kg/ha than all other treatments, except it was at par with pre-emergence application of thiozopyr at 0.48 kg/ha, atrazine at 2.0 kg/ha applied just

after hoeing and 2 hoeings at 50 and 80 days after planting. *Brachiaria mutica* was completely controlled by the application of thiozopyr at all the rates. Pre-emergence application of metribuzin at 1 kg/ha, atrazine at 2.0 kg/ha alone or atrazine at 1.5 kg/ha and 2.0 kg/ha just after hoeing caused complete control of *Parthenium hysterophorus*. Uncontrolled weeds on an average caused 65.3 percentage reduction in the cane yield compared to weed-free treatments. Pre-emergence application of thiozopyr at 0.48 kg/ha gave significantly higher cane yield than its lower doses and was at par with thiozopyr at 0.36 kg/ha, metribuzin at 1.0 kg/ha and atrazine at 1.0 kg/ha just after hoeing. Atrazine at 1.5 kg/ha and 2.0 kg/ha applied after hoeing and 2 hoeings at 50 and 80 days after planting resulted in cane yield at par with weed-free condition.

373. Dhar, S. (Indian Agricultural Research Institute, New Delhi (India). (Div. of Agronomy); Gupta, S.D.; Das, S.K. (Indian Grassland and Fodder Research Institute, Jhansi (India). Crop Production Div.). Productivity and plant stand of perennial lucerne (*Medicago sativa*) under different weed control measures during establishment year. *Indian Journal of Agronomy* (India). (Sep 2005) v. 50(3) p. 243-246 KEYWORDS: WEED CONTROL; HERBICIDES; YIELDS; CONTROL METHODS; WEEDS; PRODUCTION; PERENNIAL WEEDS; LUCERNE; MEDICAGO SATIVA; FORAGE.

A field experiment was conducted during 1998-99 to 2000-01 at the Indian Grassland and Fodder Research Institute, Jhansi, using different weed-control measures in perennial lucerne (*Medicago sativa* L.). Pre-emergence application of pendimethalin at 0.5 kg/ha with hand-weeding at 6-week-crop stage was found superior to other measures for lower weed dry matter (2.5 tonnes/ha) and weed intensity (72 weeds/m²), and higher weed control efficiency (77.2 percentage) without phytotoxic effect on lucerne crop. Moreover, it also produced higher green fodder (60.7 tonnes/ha), dry matter (13.2 tonnes/ha), crude protein (2,192 kg/ha) yields and plant stand (70 plants/m²) during first growing season. Imazapyr and metribuzin with and without hand-weeding were found phytotoxic to the lucerne and resulted in lower yields due to poor initial and final plant stand despite, very good in controlling weeds. Combination of herbicides and hand-weeding resulted in more yields than chemical, mechanical and manual measure alone.

374. Singh, I.; Rathore, M.S.; Chandawat, M.S. (Rajasthan Agricultural University, Jodhpur (India). Agricultural Research Stn.); Yadav, R.S. (College of Agriculture, Bikaner (India); Lal, M. (Rajasthan Agricultural University, Bikaner (India). Directorate of Research). Herbicidal weed control in blond psyllium (*Plantago ovata*) grown on aridisols under irrigated condition. *Indian Journal of Agronomy* (India). (Sep 2005) v. 50(3) p. 247-248 KEYWORDS: WEED CONTROL; CONTROL METHODS; HERBICIDES; PLANTAGO OVATA; YIELDS; YIELD COMPONENTS; ECONOMICS.

A field study was conducted on the Aridisols during the winter seasons (rabi) of 2001-02 and 2002-03 to evaluate suitable herbicide for management of weeds in blond psyllium (*Plantago ovata* Forsk.). Application of oxadirygl 50 g/ha 15 days after sowing (DAB) recorded maximum seed yield (1,833 kg/ha) and net returns (Rs 25,244/ha) closely followed by pre-emergence application of isoproturon 600 g/ha which gave seed yield of 1,729 kg/ha and net returns of Rs 23,1220/ha. Due to phytotoxic effect on the crop, oxyfluorfen applied 50 or 75 g/ha 15 DAB remained inferior to oxadirygl 50 g/ha applied 15 DAB.

375. Mukherjee, D.; Singh, R.P. (Banaras Hindu University, Varanasi (India). Dept. of Agronomy). Effect of micro-herbicides on weed dynamics, yield and economics of transplanted rice (*Oryza sativa*). Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 292-295 KEYWORDS: WEED CONTROL; ORYZA SATIVA; WEEDS; HERBICIDES; RICE; YIELDS; TRANSPLANTING; CONTROL METHODS; EFFICIENCY.

The efficacy of some potent micro-herbicides in conjunction with other herbicide for control of various weed floras in transplanted rice (*Oryza sativa* L.) was studied during the rainy season of 2001 and 2002 at Varanasi, Uttar Pradesh. The major weeds found were *Echinochloa crus-galli* L., *Echinochloa crus-galli* Beauv. *Cyperus rotundus* L., *Cyperus difformis* L., *Fimbristylis millacea* (L.) Vahl and *Ludwigia parviflora* Roxb. Almix + 2, 4-DEE (15 + 500 g/ha) applied 8 days after transplanting was found most effective in controlling weeds and maximizing rice grain yield (58.3 q/ha). This was on a par with hand-weeding done thrice at 20, 40 and 60 days stage. This treatment recorded highest net return (Rs 46,392) and benefit: cost ratio (3.9). Hand-weeding treatments though significantly reduced the weed biomass and improved the grain yield, - owing to higher labour cost reduced the benefit: cost ratio.

376. Singh, R.P.; Mukherjee, D.; Singh, R.K. (Banaras Hindu University, Varanasi (India). Dept. of Agronomy). Efficacy of oryzalin on weeds and yield of wheat (*Triticum aestivum*). Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 300-302 KEYWORDS: WEED CONTROL; HERBICIDES; WHEATS; CONTROL METHODS; TRITICUM AESTIVUM; YIELDS; YIELD COMPONENTS; WEEDS; EFFICIENCY.

A field experiment was conducted during the winter (rabi) season of 2000-01 and 2001-02 to assess the efficacy of oryzalin, trisulfuron and pendimethalin as pre-emergence, and dicamba as post-emergence in late-sown wheat (*Triticum aestivum* L. emend. Fiori & Paol.) All herbicidal treatments reduced the density and dry weight of both narrow and broad-leaf weeds significantly from weedy check. Pre-emergence application of oryzalin at 1.25 kg/ha had minimum population and dry weight of weeds than other herbicides and doses. Dicamba at 0.025 kg/ha was the most effective against broad-leaf weeds. Trisulfuron at 0.020 kg/ha proved more effective than its lower dose (0.015 kg/ha) and controlled both narrow and broad-leaf weeds. Negative correlation ($r = -0.82$) was observed between weed biomass and grain yield of wheat. Oryzalin 1.25 kg/ha was most effective in enhancing yield attributes and had maximum grain (27.48 q/ha) and straw yields (49.21q/ha). Amongst the weed-control treatments, an application of oryzalin at 1.25 kg/ha recorded the maximum net returns (Rs 27,713) and benefit:cost ratio (2.7).

377. Sinha, S.P.; Prasad, S.M.; Singh, S.J. (Rajendra Agricultural University, Samastipur (India). (Dept. of Agronomy). Nutrient utilization by winter maize (*Zea mays*) and weeds as influenced by integrated weed management. Indian Journal of Agronomy (India). (Dec 2005) v. 50(4) p. 303-304 KEYWORDS: WEED CONTROL; YIELDS; WEEDS; NUTRITIONAL LOSSES; ZEA MAYS; NUTRIENT UPTAKE; NUTRITIONAL REQUIREMENTS; YIELD COMPONENTS.

An experiment was carried out during the winter seasons of 1998-98 and 1999-2000 at Pusa with 14 weed-management practices to study the nutrient-depletion patterns by winter maize (*Zea mays* L.) and associated weeds. Amongst the weed-management practices, nutrient depletion by weeds was minimum under hand-weeding and maximum (22.97 kg N, 4.87 kg PPs and 27.57 kg \sim O/ha) in weedy condition, whereas total nutrient uptake by winter maize was maximum (169.41 kg N, 55.67 kg PPs and 60.77 kg Kp/ha)

under the treatment alachlor + French bean (*Phaseolus vulgaris*L.) as another crop followed by hand-weeding (137.70 kg N, 44.15 kg P and 106.22 kg K/ha). The nutrient uptake by crop in weedy condition was least. Chemical weeding checked nutrient drain by weeds significantly compared with weedy check.

378. Tomar, P.K.; Prakash, O.; Singh, D. (Chaudhary Charan Singh University, Baraut (India). (Dept. of Agronomy). Weed management in late planted sugarcane. *Indian Journal of Agronomy* (India). (Dec 2005) v. 50(4) p. 317-319 KEYWORDS: WEED CONTROL; HERBICIDES; SUGARCANE; CONTROL METHODS; WEEDS; METRIBUZIN; SOWING DATE; YIELDS.

An experiment conducted during 2001-2002 and 2002-2003 showed 43.4 percentage and 43.9 percentage reduction in cane yield due to weeds. Highest cane yield (84.6 tonnes/ha and 80.6 tonnes/ha) was recorded under weed-free conditions, which was at par with 3 hoeings (30, 60 and 90 days after planting) during both the years. Significant improvement in cane yield was reported under treatments comprising herbicide spray followed by hoeing over that of herbicide spray alone. Highest net return of Rs 31,296/ha and 27,989/ha was recorded in weed-free treatment during 2001-2002 and 2002-2003 respectively. However, highest benefit: cost ratio of 1 :0.58 during 2001-2002 and of 1 :0.55 during 2002-2003 was observed in 3 hoeings (30, 60 and 90 days after planting).

J10 Handling, Transport, Storage and Protection of Agricultural Products

379. Paul, V. (Central Potato Research Institute, Modipuram (India); Kumar, D. (Central Potato Research Institute, Shimla (India); Ezekiel, R. (Indian Agricultural Research Institute, New Delhi (India). (Div. of Plant Physiology). Effect of crop maturity and on-farm storage on sugar content and chip colour of potato (*Solanum tuberosum* L.) tubers. *Indian Journal of Plant Physiology* (India). (July-Sept 2005) v. 10(3) p. 287-291 KEYWORDS: DRY MATTER CONTENTS; SOLANUM TUBEROSUM; TUBERS; CARBOHYDRATE; STORAGE.

Dry matter content and sugar levels were determined in the tubers of three potato (*Solanum tuberosum* L.) cultivars at four harvest dates, i.e. 60, 75, 90 and 105 days after planting and also before and after the on-farm storage. The reducing sugar content was found to be unacceptable for chip colour in tubers of Kufri Bahar at all harvest dates. It was high in Kufri Jyoti but within the acceptable limits for Kufri Chandramukhi at full maturity. At the time of on-farm storage, reducing sugar level and chip colour score in tubers of Kufri Jyoti were 2.2 mg g⁻¹ fw and 4.9 respectively. These values for reducing sugars level and chip colour score decreased to 1.32 mg g⁻¹ fw and 2.6 in heap, 1.16 mg g⁻¹ fw and 1.7 in katcha pit and 1.37 mg g⁻¹ fw and 3.3 in pucca pit respectively after 90 days of storage. Thus indicating the benefit of on-farm storage, especially the katcha pit method, for improving the processing quality of potato tubers.

J11 Handling, Transport, Storage and Protection of Plant Products

380. Singh, N.; Kanwar, J.S. (Punjab Agricultural University, Ludhiana (India). Dept. of Horticulture)). Effect of transportation and packaging on physico-chemical characteristics of sub-tropical peach. *Annals of Biology* (India). (Jul-Dec 2005) v. 21(2) p. 203-206 KEYWORDS: PEACHES; CHEMICAL PROPERTIES; PACKAGING; TRANSPORT; TROPICAL FRUITS.

Peach fruits cannot be distant market due to its poor keeping quality at ambient conditions, improper packaging and high cost of transportation. Thus, its cultivation

remained confined to meet the demand of near home markets. In the present studies, the fruits were transported to 50, 100 and 300 km "distance from the farm site to study the impact of transportation. Two different packing materials i. e. bamboo baskets and 3-ply cardboard boxes were used so as to contain 5 and 10 kg in each cardboard box and 6 kg in each bamboo basket. Results of this study showed that Shan-i-Punjab peach fruits can be transported by road to 300 km distance without serious deterioration. Fruits remained in good condition for 24 h after transportation. The 5 kg packing size in 3-ply cardboard boxes was better than the 3-ply 10 kg capacity cardboard boxes and 6 kg capacity bamboo baskets.

381. Grover, J.K. Punjab Agricultural University, Ludhiana (India). (Dept. of Processing and Food Engineering); Singh, K. (Punjab Agricultural University, Ludhiana (India). Dept. of Floriculture and Landscaping); Gupta, A.K.; Kumar, A. (Punjab Agricultural University, Ludhiana (India). Dept. of Processing and Food Engineering). Effect of pre-storage pulsing treatment on storage of gladiolus spikes under modified atmosphere. *Indian Journal of Plant Physiology (India)*. (Jul-Sept 2005) v. 10(3) p. 248-253 KEYWORDS: GLADIOLUS; GRAIN LEGUMES; ATMOSPHERE.

Studies were conducted on the effect of pre-storage pulsing of gladiolus spikes with sucrose (20 percent)+Al₂(SO₄)₃.16H₂O (400 pp^m), on storage in polypropylene (PP) sleeves of 100 gauge (25 ll) thickness. PP packages maintained modified atmospheres with low levels of O₂ and high levels of CO₂ throughout the duration of the storage. Pre-storage pulsing treatment significantly improved post-storage vase life of the spikes, per cent opening of florets, floret size and number of florets opening at one time and also decreased per cent loss of weight of spikes in storage. The utility of dry refrigerated storage of spikes on long-term shipment has been discussed.

K10 Forestry Production

382. Dhillon, R.S.; Hooda, M.S. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Forestry). Breeding system and graft compatibility in *Prosopis cineraria* and *Prosopis juliflora*. *Indian Journal of Forestry (India)*. (Jun 2005) v. 28(2) p. 105-107 KEYWORDS: FORESTRY PRODUCTION; PROSOPIS CINERARIA; PROSOPIS JULIFLORA; GRAFT COMPATIBILITY; PLANT BREEDING; PLANT PROPAGATION.

The noral buds began to appear in mid March and started to open from first week of April in *Prosopis cineraria*. From mid April to mid May was the peak period of no we ring. In *P. juliflora*, on the other hand, noral buds began to appear in early March and began to open by end of March. Pollen viability of fresh pollen was more than 85 per cent in both the species. Observations on breeding behaviour found predominance of cross fertilization, the degree of selfing was far below 1 per cent (in muslin cloth bags). Reciprocal crosses showed poor success, ranging from 0.08 per cent in *P. juliflora* as female parent to 0.62 per cent on *P. cineraria* as seed parent. Reciprocal grafting using *P. juliflora* as scion showed cleft method somewhat better (16.1 percent successful), while T-budding was the poorest. However, grafts failed to sprout using *P. cineraria* as scion.

383. Singh, S.; Kumar, P.; Ansari, S.A. (Tropical Forest Research Institute, Jabalpur (India). Clonal propagation of teak (*Tectona grandis*) by composite treatment of auxin with thiamine. *Indian Journal of Forestry (India)*. (Jun 2005) v. 28(2) p. 108-111 KEYWORDS: FORESTRY

PRODUCTION; TECTONA GRANDIS; PLANT GROWTH SUBSTANCE; CLONAL VARIATION; THIAMINE.

A pilot study was conducted in order to evaluate efficacy and economy of large-scale production of clonal plantlets of Teak. Semi-hardwood shoot cuttings taken from vegetative multiplication garden were treated with low doses of composite auxins (IAA, IBA and NAA) in combination with thiamine. Strong synergistic interaction between thiamine and auxins was observed for adventitious rhizogenesis, as the resultant increment in adventitious rhizogenesis due to combined auxin and thiamine application was several folds greater than from the independent application of auxins and thiamine alone. Treatment of 1200/ 800 ppm thiamine with a combined dose of auxins (250 ppm IBA, 125 ppm 1AA and 125 ppm NAA) proved to be the most effective for rooting with increment of 4.85 and 4.79 times, respectively over the control. These treatments have been recommended for production of clonal planting stock of Teak on mass scale in open non-misting conditions.

384. Sekar, K.C.; Srivastava, S.K. (Botanical Survey of India, Dehra Dun (India). *Oxytropis immersa* (Baker Exaitch.) Bunge Ex Fedtsch. (Fabaceae) - a new record for India from pin valley National Park, Himachal Pradesh. *Indian Journal of Forestry (India)*. (Jun 2005) v. 28(2) p. 206-207 KEYWORDS: OXYTROPIS; LEGUMINOSAE; GENERA; HIMACHAL PRADESH.

Oxytropis immersa (Baker ex. Aitch.) Bunge ex Fedtsch. (Fabaceae) is described as a new record for India from Pin Valley National Park, Lahaul-Spiti in Himachal Pradesh.

P01 Nature Conservation and Land Resources

385. Bhat, K.G. (Poornaprajna College, Udupi (India). Dept. of Botany). *Combretum razianum* (Combretaceae), a new species from Karnataka, India. *Indian Journal of Forestry (India)*. (Jun 2005) v. 28(2) p. 210-212 KEYWORDS: COMBRETUM; GENERA; KARNATAKA; COMBRETACEAE.

Combretum razianum, a new species of Combretaceae is described and illustrated.

P10 Water Resources and Management

386. Gupta, K.; Jain, V.; Bhardwaj, S. (Haryana Agricultural University, Hisar (India). Dept. of Biochemistry). Effect of chromium (VI) on growth and lipid components in developing seeds of *Brassica juncea*. *Indian Journal of Plant Physiology (India)*. (Jul-Sept 2005) v. 10(3) p. 241-247 KEYWORDS: CHROMIUM; GROWTH; BRASSICA JUNCEA; SEED PRODUCTION; LIPIDS.

The present investigation was aimed at studying the effect of chromium (Cr) (vi) on plant growth and lipid profile in *Brassicajuncea* (cv. RH-30). *Brassicajuncea* plants when grown in sandy soil treated with different concentration of Cr (viz. 0.5, 1.0, 2.0, 4.0, 5.0, 7.5 and 10.0 ppm), there was delayed germination and flowering of plants. At 7.5 and 10.0 ppm concentrations, plants could not survive and died within a week. With the increasing concentration of Cr from 0.5 -5.0 ppm, there was continuous inhibition in plant height (4.2-24.6 percent), number of siliqua plant (23.7-54.9 percent), number of seeds Isiliqua (1.0-10.9 percent), seed yield lplant (9.8-62.3 percent) except at 0.5 ppm. The lowest concentration (0.5ppm) of Cr was found to be stimulatory. Oil yield and lipid profile (non-polar, polar, phospholipid and glycolipid) was inhibited at higher concentration of Cr. During early stages of seed development (15 days after flowering, DAF) there was no erucic acid content in seeds. At all the stages of seed development, with the increasing concentration

of Cr (vi) application, oleic, linoleic and linolenic acid contents of lipid decreased, while, erucic content increased. Cr application caused the deterioration of oil quality i.e. increased in erucic acid contents with increasing concentration of Cr Application.

387. Rajput, A.M. (Jawaharlal Nehru Krishi Vishwa Vidyalaya, Indore (India). Dept. of Agricultural Economics and Farm Management); Verma, A.R. (Jawaharlal Nehru Krishi Vishwa Vidyalaya, College of Veterinary Science and Animal Husbandry, Mhow (India). Dept. of Agricultural Economics and Farm Management). Impact of watershed development programme in Tikamgarh district of Madhya Pradesh. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 224-227 KEYWORDS: WATER MANAGEMENT; YIELD; CROP DEVELOPMENT; MADHYA PRADESH.

The paper attempts to examine the impact of watershed development programme in Tikamgarh district of Madhya Pradesh. The specific objectives were to study the cropping pattern, cropping intensity, production, cost and returns and input-output ratio on the farms of different sizes in watershed development programme (WDP) and non-WDP areas. A multi-stage random sampling technique was used. A sample of two villages each from WDP and non-WDP areas was selected from Baldevgarh block of Tikamgarh district. The farmers were grouped under three size groups, viz., small (less than 2 ha.), medium (2.1 to 4 ha.) and large (4.1 ha and above) farms. The sample consisting of 50 farmers from each of the categories of WDP areas in the Watershed Development Programme (WDP) was selected randomly making a total of 100 farmers. The study showed that the average yields per hectare of paddy, urd, wheat and gram were calculated to 16.30, 6.00, 17.80 and 8.20 quintals, respectively in WDP as compared to 12.50, 4.30, 14.20 and 6.00 quintals in non-WDP. The average input-output ratio of paddy, urd, wheat and gram was estimated at 1:1.57, 1:2.00, 1:1.77 and 1:1.96, respectively in WDP as compared to 1:1.47, 1:1.64 and 1:1.70 in non-WDP areas. The return on per rupee of investment of these crops was also higher in WDP than in non-WDP. The input-output ratios on small, medium and large farms were also higher in WDP compared to their counterparts in non-WDP areas.

388. Latha, P.; Reddy, P.V. (Regional Agricultural Research Station, Tirupati (India). Determination of water use efficiency in groundnut by gravimetric method and its association with physiological parameters. *Indian Journal of Plant Physiology (India)*. (Oct-Dec. 2005) v. 10(4) (New Series) p. 322-326 KEYWORDS: GRAVIMETRY; WATER USE; ARACHIS HYPOGAEA.

Water use efficiency (WUE) and associated physiological parameters were measured in fifteen genotypes of groundnut (*Arachis hypogaea* L) grown in pots. Accurate measurement of WUE is possible by gravimetric approach. In this study there was an inverse relationship between mean transpiration rate (MTR) and WUE. A positive association between net assimilation rate (NAR) and WUE and total dry matter (TDM) and WUE indicated the possibility of identifying genotypes with WUE under mesophyll control. There was a strong correlation between TDM and LAD suggesting the role of leaf surface area in determining the biomass production. WUE was also estimated in field trials utilizing specific leaf area (SLA) values. The results show that, the WUE in the pot culture experiment was significantly correlated with the WUE estimated under field conditions. Among the genotypes, Tir 16 recorded highest WUE compared to all other genotypes.

389. Patil, H.E.; Mahatma, M.K.; Patel, N.J.; Bhatnagar, R.; Jadeja, G.C. (Anand Agricultural University, Anand (India). (Dept. of Biochemistry and Biotechnology). Differential response of pearl millet hybrids to water stress in relation to antioxidant enzymes and proline. *Indian Journal of Plant Physiology (India)*. (Oct-Dec. 2005) v. 10(4) (New Series) p. 344-348
KEYWORDS: PENNISETUM GLAUCUM; ANTIOXIDANTS; DROUGHT STRESS; ENZYMES.

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is an important crop of semi-arid tropics. Due to erratic rainfall, the crop is generally exposed to water stress at different stages, which decreases growth and yield of plants in many ways. In the present study the female parent ICMA 94555 was crossed with eight inbred male lines in summer, 2004. Hybrids were evaluated under terminal drought condition at three different stages, each at 10 days interval (i.e. at 60, 70 and 80 DAS) in Kharif, 2004 to assess the antioxidant enzymes activity and proline content. Terminal drought condition was created by withdrawing irrigation at 50 days after sowing. Among the eight hybrids tested, four hybrids viz., ICMA 94555 x J 2340, ICMA 94555 x J 2405, ICMA 94555 x J 108 and ICMA 94555 x J 2290 showed increased activities of superoxide dismutase (SOD) and non specific peroxidase (POX) at second and third stage, while catalase (CAT) and ascorbate peroxidase (A POX) activity increased only at second stage. The CAT and APOX activity in these four hybrids recorded 2-3 folds increase as compared to first stage. The results suggested that moisture stress affected the activity of antioxidant enzymes involved in detoxification of activated oxygen species and H₂O₂ differently. Proline content increased in all hybrids at second and third stage but these four hybrids showed 2-3 fold higher proline level as compared to first stage. Thus, these four hybrids indicated biochemical adaptability to tolerate water stress condition.

390. Vardhini, B.V.; Rao, S.S.R. (Osmania University, Hyderabad (India). (Dept. of Botany). Influence of brassinosteroids on germination and seedlings growth of sorghum under water stress. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2005) v. 10(4) (New Series) p. 381-384
KEYWORDS: BRASSINOSTEROIDS; DROUGHT STRESS; GERMINABILITY; SORGHUM; GROWTH; SEED DEVELOPMENT.

The effect of 28-homobrassinolide and 24-epibrassinolide on germination and seedling growth of *Sorghum vulgare* pers var. CSH-15 R (susceptible to water stress) was studied under water stress. Both the brassinosteroids were very effective in ameliorating the impact of water stress on seed germination and seedling growth. The stress alleviation by brassinosteroids was associated with enhanced levels of soluble proteins and free proline. Brassinosteroids treatment were found to enhance the activity of catalase and reduce the activity of peroxidase.

P11 Drainage

391. Ghorai, A.K.; Bhattacharjee, A.K.; Saha, S.; Rao, P.V.; Bandopadhyay, A.K. (Central Research Institute for Jute and Allied Fibres, Barackpore (India). Impact of waterlogging on yield and quality of tossa jute (*Corchorus olitorius*). *Indian Journal of Agronomy (India)*. (Dec 2005) v. 50(4) p. 320-323
KEYWORDS: WATERLOGGING; SOIL WATER BALANCE; QUALITY; DRAINAGE; SOIL FERTILITY; YIELDS; CORCHORUS OLITORUS; NUTRIENT UPTAKE; SOIL MICROORGANISMS.

In rainy season, many jute-growing zones of India remain waterlogged affecting its yield and quality. An experiment was conducted during 1998 and 1999 under controlled conditions to evaluate the impact of waterlogging and drainage [0, 5, 10, 15, 20, 25 and 30

cm water heads with a well-drained condition (40 cm) as control] on 'JRO 524' (a jute *Corchorus olitorius* L.). Jute plants lodged within a week, survived for 20 to 30 days at 10 to 30 cm water head, exhibited premature leaf senescence and poor growth (up to 40, 41, 80 and 56% reduction in plant height, basal diameter, tap root dry weight and photosynthetic rate respectively). Waterlogging increased the stomatal resistance of jute leaves. It reduced nutrient uptake by jute plants and microbial population of soil. Waterlogging reduced the fibre yield from 20 to 60% and its strength from 12 to 55%. Waterlogging resulted in inferior quality jute fibre. In medium lands, drainage in *C. olitorius* jute will augment its fibre yield from 20 to 60% consistent with quality.

P33 Soil Chemistry and Physics

392. Kumari, S.R.; Subbaramamma, P.; Reddy, A.N. (Regional Agricultural Research Station, Guntur (India). Screening of cotton (*Gossypium hirsutum* L.) genotypes for drought tolerance under rainfed conditions in black cotton soils. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 270-274 KEYWORDS: GOSSYPIMUM HIRSUTUM; GENOTYPES; DROUGHT TOLERANCE; YIELD.

Field studies were conducted in black cotton soils under rainfed conditions revealed that out of the 20 entries tested for drought tolerance. The entries viz., L 762, GSHV 97/612 and RAH 30 showed better drought tolerance and associated with high specific leaf weight (SLW), relative water content (RWC) and chlorophyll stability index (CSI) in addition to the yield and yield attributing characters (viz., more number of bolls/plant and higher biomass production/plant).

393. Singh, R.K. (Indian Agricultural Research Institute, New Delhi (India). (Div. of Agricultural Physics); Sharma, D.K. (CCR College, Muzaffarnagar (India); Chakraborty, D. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Physics). Studies on adsorption behaviour of thiophanate methyl on soils. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 286-290 KEYWORDS: ADSORPTION; THIOPHANATE METHYL; SOILS.

The problem of pesticide residue in soils and plants is becoming more and more acute because of their application in large quantities and subsequent slow breakdown. The paper deals with a study on the adsorption behaviour of thiophanate-methyl on some soils of V.P. The adsorption ranges of thiophanate-methyl were 2.6 to 15.5, 2.08 to 13.17 and 1.56 to 12.36 $\mu\text{mol/g}$ for silty clay loam, sandy clay loam and sandy loam soils, respectively. All the adsorption isotherms were 'S' shaped. The study indicates that the adsorption gradient with concentration depends both on the quantity of thiophanate-methyl already adsorbed on the soil and its concentration. The rapid adsorption following initial low rate of adsorption might be attributed to the displacement of solvent molecules from the soil surface by the molecules of thiophanate-methyl. This implies possibility of multilayer adsorption until saturation is reached.

394. Sarawgi, S.K.; Rajput, R.S. (Indira Gandhi Agricultural University, Raipur (India). (Dept. of Agronomy). Effect of phosphorus, zinc and PSM on growth and yield of soybean (*Glycine max* L. Merrill) in vertisols of Chhatisgarh plain. *Annals of Agricultural Research (India)*. (Jun

2005)_ v. 26(2) p. 302-306 KEYWORDS: PHOSPHORUS; ZINC; GROWTH; YIELD; GLYCINE MAX; VERTISOLS.

A field experiment was conducted to study the effect of phosphorus, PSM and zinc on yield of soybean in vertisols of Chhattisgarh plain. Grain and straw yield and yield attributes of soybean increased with increasing levels of phosphorus. All these characters were further increased with the inoculation of PSM (Phosphate solubilizing microbes) over their respective levels of phosphorus. Application of zinc sulphate further enhanced the grain yield upto the lower level of phosphorus (i.e., 30 kg P₂O₅ ha⁻¹) over no phosphorus but grain yield was decreased with 60 kg phosphorus alongwith PSM; Maximum per cent increase in grain yield of soybean over control was recorded under 60 kg P₂O₅ ha⁻¹ + PSM 47.8 percent followed by (30 kg P₂O₅ ha⁻¹ + PSM + 25 kg ZnSO₄ ha⁻¹). Maximum impact of PSM and ZnSO₄ (22.9 percent) was observed with no phosphorus and it decreased with increasing the levels of phosphorus.

395. Deshmukh, R.N. (New Arts, Commerce and Science College, Ahmednagar (India); Dhupal, K.N. (University of Pune, Pune, (India). (Dept. of Botany). Enzymatic studies in sorghum cultivars under peg induced water stress. Indian Journal of Plant Physiology (India). (Oct-Dec. 2005) v. 10(4) (New Series) p. 349-353 KEYWORDS: SORGHUM; DROUGHT STRESS; ENZYME; NITRATE REDUCTASE; CATECHOL OXIDASE.

The sorghum (*Sorghum bicolor*) cultivars M 35-1, Phule Maulee (RSLG-262), Phule Yashoda, Sel-3, Swati 108 and diH-15 R were screened for drought tolerance under PEG-6000 induced water stress from -2 to -8 bars, on the basis of activities of nitrate reductase, peroxidase and polyphenol oxidase. It was noted that the cultivars CSH-15 and RSLG-262 were drought tolerant as compared to Phule Yashoda and Swati 108. Among the cultivars studied, Sel-3 and M 35-1 were found to be susceptible to water stress at seedling stage. The study indicated that enzymes like peroxidase and polyphenol oxidase along with nitrate reductase may serve as the indicators for testing the water stress tolerance and may be useful for sorghum breeders to evolve drought tolerant cultivars.

P34 Soil Biology

396. Tomar, R.K. (Indian Agricultural Research Institute, New Delhi (India). (Div. of Agricultural Physics); Singh, R.K.; Singh, C.V. (Central Rainfed Upland Rice Research Station, Hazaribag (India); Garg, R.N. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Physics); Dwivedi, B.S. (Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry); Gupta, V.K.; Sahoo, R.N.; Chakraborty, D. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Physics). Evaluation of mulching materials for soil moisture conservation growth and productivity of bunded upland rice in rainfed ecosystem. Annals of Agricultural Research (India). (Jun 2005) v. 26(2) p. 179-184 KEYWORDS: SOIL CHEMICO-PHYSICAL PROPERTIES; MULCHING; GROWTH; RICE; PRODUCTIVITY; ECOSYSTEMS.

Field studies were conducted at CRURRS, Hazaribag, Jharkhand during two rainy seasons for finding out the suitability of mulching materials viz., FYM and rice straw-chaffed and their rates i.e., 2, 4 and 6 t ha⁻¹ (on dry weight basis) for enhancing the productivity of bunded rain fed upland rice. Considerably higher (32.1 percent) infiltration rate was found with application of rice straw 6 t ha⁻¹ compared to bare plot (0.155 cm hr⁻¹). Crop and weed growth and soil moisture content in the profile was appreciably higher and yield attributes

were also found to be superior by applying rice straw 6 t ha⁻¹ compared to control. Significantly higher grain (2.35 t ha⁻¹) and straw (2.54 t ha⁻¹) yield was obtained with the application of rice straw 6 t ha⁻¹.

397. Basu, M.; Datta, A.; Basu, T.K. (Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India). (Dept. of Agronomy). Effect of cobalt, rhizobium and phosphobacterium inoculations on growth attributes, yield, quality and nutrient uptake of summer groundnut (*Arachis hypogaea* Linn). *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 209-213
KEYWORDS: COBALT; GROTH; YIELD; QUALITY; ARACHIS HYPOGAEA; RHIZOBIUM.

A field experiment was carried-out on the neutral soil of Student's Instructional Farm, Barajaguli, B.C.K.V., Nadia, West Bengal with groundnut during pre-kharif season (Feb.-June) of 2001. It revealed that in increasing plant height (cm), No. of branches per plant, leaf area index (LAI), dry matter accumulation (gm per m²) and No. and dry weight (gm) of nodules per plant at different dates of observation, Rhizobium was more effective than phosphobacterium. Again it was found that Rhizobium was more effective than phosphobacterium for higher pod yield, shelling percent, oil and protein content. Regarding nutrient concentration Rhizobium had better performance in N and K concentration but phosphobacterium gave better result in P concentration though the uptake of all the three nutrients was higher in Rhizobium inoculation. Cobalt 0.21 kg per ha gave best result in all the abovementioned parameters.

398. Ajay; Ramesh, P.; Reddy, K.S.; Ramana, S.; Maji, B. (Indian Institute of Soil Science, Bhopal (India). Div. of Environmental Soil Science). Effect of nitrogen and farm yard manure on physiological parameters in ashwagandha (*Withania somnifera*) under fertisol soil type. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2005) v. 10(4) (New Series) p. 389-393
KEYWORDS: NITROGEN; FARMYARD MANURE; WITHANIA SOMNIFERA; VERTISOLS; SOILS.

An experiment was conducted to study the effect of nitrogen and farm yard manure (FYM) on some physiological, biochemical parameters and quality of root of medicinal plant ashwagandha at pre-flowering and post-flowering stages. Significant differences in pigment content (chlorophyll and carotenoids) were observed in both pre and post-flowering stages. The total phenol and ortho-dihydric phenol content decreased with the application of nitrogen in pre-flowering stage, but increased with the application of nitrogen at post-flowering stage. The activity of polyphenol oxidase (PPO) showed an increasing trend with the application of nitrogen in pre-flowering stage and mixed trend in post-flowering stage. The highest grade of roots B, C and D were formed at all applied nitrogen levels. The quality of root based on the: alkaloid content was found to be better at low nitrogen level (N₀ and N₁) and FYM. However, the root.

P35 Soil Fertility

399. Behera, U.K. (Indian Agricultural Research Institute, New Delhi (India). (Div. of Agronomy). Influence of varying levels of soil fertility on performance of kharif soybean (*Glycine max*) under wheat-soybean cropping system in the vertisols of Central India. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 263-266
KEYWORDS: SOIL FERTILITY; GLYCINE MAX; VERTISOLS; INDIA.

Field experiments were carried-out during 1995-2000 in the vertisol to study the performance of soybean during kharif in wheat-soybean cropping system. The varying level

of nutrients (organic, inorganic, organic + inorganic and bio-fertiliser) were applied to wheat crop alone in rabi season and soybean was grown in the residual fertility of the previous wheat crop. The bio-logical yield of soybean due to the residual effect of treatments were significant, however, the grain yield due to these treatments were non-significant over the years. The fertility treatments which produced higher grain yield of wheat could induce higher bio-logical yield of soybean but could not influence the grain yield similarly.

400. Desingh, R. (Annamalai University, Annamalainagar (India). (Dept. of Botany); Reddy, A.R. (Pondicherry University, Pondicherry (India). School of Life Sciences). Differential responses to salinity stress in seedlings of three Eucalyptus species. Indian Journal of Plant Physiology (India). (Oct-Dec. 2005) v. 10(4) (New Series) p. 307-314 KEYWORDS: ASCORBIC ACID; ANTIOXIDANTS; EUCALYPTUS; SALINITY CONTROL; ABA.

Ascorbate and foliar contents of proline, glycine betaine and abscisic acid (ABA) along with lipid peroxidation rates, electrolytic leakage were determined in three different Eucalyptus species, viz. *E. camaldulensis* Dehn., *E. citriodora* Hook., *E. tereticornis* Sm., subjected to salinity stress (Mixed salts: NaCl, MgSO₄, and CaCl₂) of different concentrations (0, 50, 100, 150mM). Sampling was done after 35 days of treatments in leaves. The contents of ascorbate and monodehydroascorbate in the leaf extracts of all Eucalyptus species showed variations to salinity stressed conditions. Lower rates of membrane lipid peroxidation and electrolytic leakage were noticed in the leaves of *E. camaldulensis* under salinity stress. Quantitative differences were also noticed in foliar proline, glycine betaine and ABA contents among Eucalyptus species in response to salinity. The leaves of *E. camaldulensis* accumulated more proline, glycine betaine and ABA under salinity stress compared to *E. tereticornis* and *E. citriodora*. Our data demonstrate that *E. camaldulensis* have efficient antioxidative characteristics and ABA accumulation which could provide better protection against oxidative stress in leaves under salinity stress conditions.

401. Sharma, M.P.; Habib, A. (Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha (India). (Div. of Soil Science and Agricultural Chemistry). Decomposition rate of crop residues and their nutrient release pattern under different nitrogen levels in inceptisol. Annals of Agricultural Research (India). (Sep 2005) v. 26(3) p. 441-446 KEYWORDS: DEGRADATION; SOIL SALINITY; NITROGEN; CROP RESIDUES; NUTRIENT AVAILABILITY.

The results revealed that CO₂ evolution increased significantly with increasing N levels in all the cases except blackgram straw treated soil where results at 10 and 20 kg/ha were found significantly at par. In the treatment with solitary incorporation of crop residues, the CO₂ evolution followed the order blackgram treated soil paddy straw treated soil maize stover treated soil wheat straw treated soil. The release of various nutrient viz., NH₄ +N, NO₃-N, and available P, K, S in case of incorporation of crop residues alone was highest in black gram straw and lowest in wheat straw. The increasing levels of nitrogen enhanced the accumulation of these nutrients significantly in all the cases of residue treated soil except in case of black gram straw treated soil. The highest values of pH and CEC were recorded in black gram straw treated soil and the lowest in wheat straw treated soil. Organic content, however, was found to be highest in maize stover and lowest in black gram straw.

402. Damodaran, T. (Central Agricultural Research Institute, Port Blair (India); Kumar, N.; Jeyakumar, K. (Tamil Nadu Agricultural University, Coimbatore (India). Screening of open

pollinated clones in mango as rootstocks for salt tolerance. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 528-532 KEYWORDS: TESTING; SALINITY; MANGIFERA INDICA; SALT TOLERANCE; CLINES; ROOTSTOCKS.

The present investigation was undertaken with the objective of exploitation of interclonal variability available in the mango cultivars. Seeds of three local open pollinated clones of mango namely Neelum, Sakem Gundu and Nadu Solai were collected and screened for salt tolerance in seedling stage at varied levels of salt water irrigation. This resulted in identification of two seedlings i.e. seedling no.7 of Salem Gundu and Seedling no.5 of Neelum which exhibited tolerance to the level of Sdsm-1 and dsm-1. The tolerance to various levels of salinity increased with the corresponding increase in various physiological parameters like chlorophyll content, protein and carotenoids.

403. Sepat, R.N.; Singh, R.K.; Kantwa, S.R. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Effect of varieties and nitrogen management on growth and yield of mustard under rainfed conditions. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 542-545 KEYWORDS: MUSTARD; GROWTH; YIELD.

A field experiment, comprising three varieties of mustard was conducted in Factorial randomized block design, replicated three times at Research Farm, Division of Agronomy, IARI, New Delhi during rabi 2002-03 on sandy loam soil. Results showed that Pusa Barani and Pusa Agrani recorded significantly taller plants, more dry matter accumulation, leaf area, number of branches per plant, number of siliquae per plant and test weight as compared to Pusa Gold, whereas length of siliqua, and number of seeds per siliqua were significantly higher in Pusa Gold. Pusa Agrani (21.41 q/ha) and Pusa Barani (19.83 q/ha) recorded significantly higher seed yield over Pusa Gold (10.41 q/ha). Results also revealed that nitrogen application up to 90 kg/ha showed remarkable effect on growth parameters. Number of branches per plant were increased up to 60 kg N/ha whereas increase in number of siliquae per plant, length of siliqua and number of seeds per siliqua was recorded upto 90 kg/ha. Application of N partly through urea and partly through FYM (30+ 30 or 60+30) recorded significantly higher seed and stover yield.

404. Yadav, K.K.; Chhipa, B.R. (S.K.N. College of Agriculture, Jobner (India). Dept. of Soil Science and Agricultural Chemistry). Growth, yield attributes, yield and net returns of wheat (*Triticum aestivum* L.) as influenced by soil applied FYM, gypsum and iron pyrite under irrigation with poor quality water. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 554-560 KEYWORDS: GROWTH; YIELD; FYM; IRRIGATION; WATER; QUALITY; TRITICUM AESTIVUM.

A field experiment was conducted for evaluating the response of wheat to soil applied farmyard manure, gypsum and iron pyrite. The soil applied farmyard manure showed the significant increase in plant height, total tillers, test weight and net returns upto 20 t FYM ha⁻¹ and effective tillers, grain and straw yield upto 30t FYM ha⁻¹. The substantial improvement in plant height, total tillers, effective tillers, test weight, grain and straw yield and net returns observed under 50 percent GR either applied through gypsum or through pyrite except that total number of tillers and net returns, in case of pyrite application increased significantly upto 25 percent GR through pyrite. The combined application of 20t FYM and gypsum 50 percent GR recorded significantly higher number of effective tillers and grain and straw yield of wheat and net returns as compared to other treatments. The number of effective tillers and grain and straw yield of wheat increased significantly under

combined application of 30t FYM + pyrite 25 percent GR but the net returns recorded significantly highest under 20t FYM + pyrite 25 percent GR.

405. Singh, P.K. (Nagaland University, Meiphema (India). Dept. of Agricultural Chemistry and Soil Science); Bhardwaj, V. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Agricultural Chemistry and Soil Science); Sharma, S.K. (Nagaland University, Meiphema (India). Dept. of Agricultural Chemistry and Soil Science). Nutrients requirement for optimum yield of hybrid rice in mollisols. *Annals of Agricultural Research (India)*. (Dec 2005) v. 26(4) p. 561-567 KEYWORDS: YIELD; RICE; VARIETIES; SOIL FERTILITY; NUTRIENTS.

A field study was conducted to assess the nutrient requirement of hybrid rice (PSD-1) in a mollisols. The mean of two years data showed that the yield of hybrid rice was higher. (+48 percent) than the line (Saket-4). Fifteen treatments comparing of varying levels of (0, 100, 150, 200 and 250 kgha-l), three levels of P (0, 17.2 & 34.4 kgha-l) and three levels of K (0.33.3, 66.6 kgha-l) with and without Zn 0 & 10 kgha-l were applied. Among the various treatment levels, minimum yield, content and uptake were recorded in control plot, whereas, maximum by the treatment T13 (N200P34.4K66.6Zn10 kgha-l).

406. Govindan, K. (Gandhigram Rural Institute, Gandhigram (India). Faculty of Agriculture and AH); Thirumurugan, V. (Agricultural College and Research Institute, Madurai (India). Dept. of Agronomy). Synergistic association of Rhizobium with phosphate-solubilizing bacteria under different sources of nutrient supply on productivity and soil fertility in soybean (*Glycine max*). *Indian Journal of Agronomy (India)*. (Sep 2005) v. 50(3) p. 214-217 KEYWORDS: SYNERGISM; FERTILIZER APPLICATION; BIOFERTILIZERS; INORGANIC FERTILIZERS; GLYCINE MAX; SOIL FERTILITY; NUTRIENT UPTAKE; YIELDS; PHOSPHATE; ORGANIC FERTILIZERS.

A field experiment was conducted during the summer and rainy seasons of 1999 and 2000 to study the effect of Rhizobium and phosphate-solubilizing bacteria (PSB) on growth, yield, nutrient uptake and soil fertility of soybean [*Glycine max* (L.) Merr. under different sources of nutrient supply (vermicompost, pressmud and composted coir pith, each at 75 and 100percentage N substitution and inorganic fertilizers. Association between Rhizobium and phosphate-solubilizing bacteria was synergistic and their dual inoculation improved the seed yield of soybean significantly (30.9 and 33.6percentage) over untreated control during summer and rainy seasons respectively. Significant increase in NPK uptake and post-harvest soil N and P levels was observed under combined inoculation of biofertilizers. Among the sources of nutrient supply, vermicompost at 75percentage N substitution excelled all others in improving the growth and seed yield of soybean. Organic manures tried at 75percentage N substitution gave higher seed yield than 100percentage N substitution. Application of organic manures resulted in desirable post-harvest soil status with more N and P.

Q04 Food Composition

407. Kamthe, P.V.; Masalakar, S.D.; Kashid, N.V.; Kamble, M.S.; Marbhal, S.K. (Mahatma Phule Krishi Vidyapeeth, Rahuri (India). Effect of various chemicals and packaging materials on shelf life, organoleptic evaluation and pathological studies of custard apple at different storage conditions. *Annals of Agricultural Research (India)*. (Jun 2005) v. 26(2) p. 275-280

KEYWORDS: KEEPING QUALITY; ANNONA SQUAMOSA; SHELF LIFE; ORGANOLEPTIC ANALYSIS; STORAGE.

From the present investigation, it is concluded that the shelf life and organoleptic scores inore in custard apple fruits under same treatment combinations i.e. waxol + individual wrapping polyfilm (T10, waxol + KMnO₄ + individual wrapping polyfilm (TIS)' waxol + NAA + individual wrapping polyfilm (TIS) can be extended upto 11 days in Cc. It is interesting to note that fruits treated with - waxol + NAA and waxol + KMnO₄' packed in individual wrapping polyfilm (TIS and TIS) showed less infection of pathogens followed by waxol treated fruits packed in individual wrapping polyfilm (T12).

Q60 Processing of Non-food or Non-feed Agricultural Products

408. Mehta, R.; Jain, S.; Garg, M.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). (Dept. of Agricultural Processing and Energy). Mathematical modelling of thin layer open sun drying of liquorice (*Glycyrrhiza glabra*). Annals of Biology (India). (Jul-Dec 2005) v. 21(2) p. 249-252 KEYWORDS: DRYING; LIQUORICE; NATURAL DRYING; GLYCYRRHIZA GLABRA; MATHEMATICAL MODELS.

Open sun drying (OSD) is still the most common method used for drying of agricultural products, medicinal plants in most of the tropical and sub-tropical parts of the world. Despite several disadvantages, it is widely practiced because of its easy way of drying. It is well known that the task of-modelling of open sun drying is a complex phenomenon. In the present study, liquorice roots were harvested and cut into small pieces of approximately 5 cm each. Roots were dried in open sun upto moisture content of 10:12 percent (safe moisture content for storage). Initial moisture content of liquorice roots was 72.40 percent db, and it took 64 h to reach upto 11 level of 1.67 percent db. Five different thin layer mathematical models, namely, Newton, Page, Modified-Page, Henderson and Pabis Geometric were linearised and fitted with drying time and moisture ratio. The results were compared according to their coefficient of determination to estimate the solar drying. According to results, Henderson and Pabis regression model could satisfactorily describe the open sun drying of liquorices with the coefficient of correlation (r) of 0.9968 and standard error (e) 0.04808.