

Indian Agricultural Sciences Abstracts

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C10 Education

201. Singh, J.; Kumar, K. (Punjab Agricultural University, Ludhiana (India). Dept. of Extension Education). Knowledge level of farmers of rainfed area of Punjab state regarding soil and water management practices. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 197-200
KEYWORDS: EDUCATION; EXTENSION ACTIVITIES; FARMERS; RAINFED FARMING; SOIL MANAGEMENT; WATER MANAGEMENT; PUNJAB.

The present study was conducted in rainfed (Kandi) area of Punjab state for studying the knowledge level of farmers regarding soil and water management practices. It was found that majority of the farmers had medium knowledge level with score between 13-17. It was also found that only educational level and risk bearing capacity of the farmers were positively and significantly correlated with their knowledge level. Independent variables like age, operational land holding, gross income, family size, farming experience, social participation, extension contacts and mass media exposure had a non-significant correlation with knowledge level of the farmers.

C20 Extension

202. Singh, M.; Khurana, G.S.; Dhillon, G.S. (Punjab Agricultural University, Ludhiana (India). Dept. of Extension Education). Prospects of privatization of extension services in dairy farming in Punjab. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 193-196
KEYWORDS: PRIVATIZATION; EXTENSION ACTIVITIES; PUNJAB; DAIRY FARMS.

The study was conducted to know the prospects of privatization of extension services in dairy farming in Punjab. The study was conducted on 69 dairy farmers of Punjab Kisan Club organized by Punjab Agricultural University, Ludhiana. The findings of the study showed that most (53.62 percent) of the respondents were from middle age group, 39.13 percent had education upto high school level, 52.17 percent had 7-18 acres of operational land holding, 55.07 and 56.52 percent had medium extension contact and mass media exposure, respectively. Majority of the respondents (95.65 percent) agreed to privatize the extension services in the area of artificial insemination followed by treatment against common diseases (92.75 percent) and only 10.14 percent of the respondents agreed to privatize extension services for information about maintenance of dairy records. The overall scope of privatization of extension services about dairy farming was medium (56.52 percent). Operational land holding, education and extension contacts of the respondents were positively and significantly correlated with overall scope of privatization extension services in dairy farming.

E20 Organization, Administration and Management of Agricultural Enterprises or Farms

203. Ravishankar, N.; Pramanik, S.C.; Rai, R.B.; Nawaz, S.; Biswas, T.K.; Bibi, N. (Central Agricultural Research Institute, Port Blair Andaman and Nicobar Group of Islands (India). Div.

of Natural Resource Management). Study on integrated farming system in hilly upland areas of Bay Islands. Indian Journal of Agronomy (India). (Mar 2007) v. 52(1) p. 7-10 KEYWORDS: FARMING SYSTEMS; HIGHLANDS; PRODUCTIVITY; PROFITABILITY; ISLANDS; ENERGY EXCHANGE.

Integrated farming system, comprising the components like cropping, vegetables, floriculture, fishery, poultry, duckery and cattle (bullock, cow and calf) rearing was undertaken at Calicut village of South Andaman during 2004-06, to study the productivity, profitability, employment generation, energy flow and nutrient recycling for slopy upland areas of Bay Islands. Among the components evaluated, the highest net return was obtained from crop (81.09 percent), followed by livestock (14.3 percent), poultry (4.38 percent) and fish (0.38 percent). Employment generation was 346 mandays/ha/year under the integrated farming system. The net return obtained from all components was also higher under this system, with a benefit cost ratio 3.30. To improve the productivity, economic returns and employment generation for family labour, integration of all these components could be adopted instead of cultivating the crop alone in the hilly upland situations of Andaman and Nicobar Group of Islands.

204. Singh, K; Bohra, J.S.; Singh, T.K.; Singh, J.P.; Singh, Y.; Singh, C.S. (Banaras Hindu University, Varanasi (India). Dept. of Agronomy). Productivity and economics of integrated farming system in irrigated agro-ecosystem of eastern Uttar Pradesh. Indian Journal of Agronomy (India). (Mar 2007) v. 52(1)p. 11-15 KEYWORDS: FARMING SYSTEMS; PRODUCTIVITY; UTTAR PRADESH; AGROECOSYSTEMS; ECONOMICS; YIELDS.

An experiment to identify an efficient farming system for irrigated agro-ecosystem of eastern Uttar Pradesh was carried out at Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during 2002-03 and 2003-04. Based on the 2-year study, rice (*Oryza sativa* L.)-pea (*Pisum sativum* L. var. *arvense* Poir.)-okra (*Hibiscus esculentus* L.) was selected as the most remunerative cropping sequence, with the highest rice grain-equivalent yield (170.98 q/ha) and net return (Rs 66,079/ha) among all the sequences. Dairy produced considerably higher net return (Rs 3, 17,904/ha) than poultry (Rs 39,768/ha) and fishery (Rs 21, 224/ha) but had lower benefit: cost ratio (1.28) than the fish component (1.42). The poultry component was found least profitable for every rupee invested. The farming system comprising crop component [rice-pea-okra and sorghum [*Sorghum bicolor* (L.) Moench]-berseem (*Tripliam alexandrinum* L.)-maize (*Zea mays* L.)], dairy, poultry and fishery was identified as the most suitable and efficient farming system model, giving the highest system productivity, i.e. rice grain-equivalent yield of 1,237.5 q/ha and net return under irrigated agro-ecosystem of eastern Uttar Pradesh.

E50 Rural Sociology and Social Security

205. Singh, Pratibha; Tewari, Poonam; Sunita Rani (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Home Science Extension). Socio-economic status of rural households in Kumaon region of Uttarakhand. Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 146-150 KEYWORDS: UTTARAKHAND; UTTARANCHAL; SOCIOECONOMIC SYSTEMS; RURAL DEVELOPMENT; HOUSEHOLDS.

ABSTRACT: A study was undertaken in two adjoining districts i.e. U.S. Nagar and Nainital to know the socio economic status of rural families. Out of these two districts one village was selected from hill area and four villages were from plain. The results showed that

majority of the houses were pucca and more than 50 per cent family's belonged to upper caste. Main occupation of the families was agriculture, all villages had school, temple and semi pucca roads and most of the families had electricity in their houses. Medium size families were more common in villages.

E80 Home Economics, Industries and Crafts

206. Singh, Poonam; Chaurasia, Ranjan (C.S. Azad University of Agriculture and Technology, Kanpur (India). Department of Family Resource Management). Musculo-skeletal and health problems of workers in a leather shoe manufacturing unit. *Pantnagar Journal of Research (India)*. (Jan-Jun 2007) 5(1) p. 139-142 KEYWORDS: MUSCULAR DISEASES; BONE DISEASES; HEALTH HAZARDS; LEATHER INDUSTRY; WORKING CONDITIONS; ERGONOMICS.

ABSTRACT: Musculo-skeletal and health problems of 100 workers engaged in moulding and stitching activities, in a shoe manufacturing unit, were studied using survey, observation and body map technique. Majority of the moulding workers reported severe pain in eyes, neck, shoulder joint, upper arm, lower arm and ankle/feet, whereas majority of stitching workers reported severe pain in eyes, neck, shoulder joint, lower arm, lower back, hand/wrist, buttock, upper leg/thigh and ankle/feet. Seventy-eight per cent problems in moulding and 80 per cent in stitching workers emerged during industry association. Over half of the workers engaged in both types of activities reported the problem of ruptured discs in neck and back. The reason behind these problems was found to be the number of hours spent in wrong posture. Only 40 per cent workers in moulding and 14 per cent in stitching work took medical treatment, that too on non-company cost.

207. Rana, Bindu; Shukla, Pushpa (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Foods and Nutrition); Dwivedi, Reeta (Maharaja Sayajirao University of Baroda, Baroda (India)). Sensory and nutritional evaluation of high fibre sprouted oat chapatti. *Pantnagar Journal of Research (India)*. (Jan-Jun 2007) 5(1) p. 143-145 KEYWORDS: ORGANOLEPTIC ANALYSIS; NUTRITIONAL STATE; OATS; SPROUTING; DIETARY FIBRES; NUTRITIVE VALUE.

ABSTRACT: Oat contains soluble dietary fibre. It is easy to sprout and increases nutritive value. The present study was based on development of high fibre sprouted oat flour and incorporation of sprouted oat flour in chapatti at different levels. Nutritional and sensory qualities of developed chapatti were evaluated. The nutritional analysis of chapatti revealed that soluble fibre, insoluble fibre and protein contents ranged from 12.68 to 12.88 per cent, 11.69 to 12.10 per cent and 6.78 to 8.13 per cent, respectively. Iron and calcium contents ranged from 1.51 to 1.93 and 15.63 to 15.87 mg/100g, respectively. The sensory evaluation of chapatti at different levels of incorporation of sprouted oat flour revealed that chapatti was acceptable at 25 or less than 25 per cent level and sensory scores ranged from 6.43 to 7.1.

F01 Crop Husbandry

208. Saha, S. (Central Rice Research Institute, Cuttack (India). Crop Production Div.). Comparative study on efficacy of sulfonylurea herbicides and traditional recommended herbicides in transplanted rice (*Oryza sativa*). *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 304-306 KEYWORDS: ORYZA SATIVA; HERBICIDES.

The efficacy of some potent low-dose herbicides of sulfonylurea group in conjunction with other traditional recommended herbicides for control of wide-spectrum of weed flora in transplanted rice (*Oryza sativa* L.) field was studied during the wet season of 2004 and 2005 at Cuttack, under rainfed shallow lowland. The major weeds found were *Echinochloa* spp., *Cyperus iria*, *Fimbristylis miliacea*, *Sphenochlea zeylanica*, *Ludwigia parviflora* and *Aeschynomene indica*. Triasulfuron + Pretilachlor (9 + 500 g/ha) applied 7 days after transplanting was found most effective in controlling weeds and maximizing rice-grain yield (59.3). This was at par with weedfree check. There was more than 44 percent reduction in the grain yield of rice due to competition with weeds in the weedy plots. All the new-generation herbicides showed better control of weeds (weed-control efficiency 79.995.1 percent) in comparison with the traditional recommended rice herbicides (weed-control efficiency 73.3-78 percent) and gave higher yield of rice irrespective of their dose of application.

209. Tripathi, Neeta ; Verma, R. S. (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Agronomy). Influence of late planting on physiological parameters in wheat (*Triticum aestivum* L.) varieties. *Pantnagar Journal of Research (India)*. (Jan-Jun 2007) v. 5(1) p. 6-8 KEYWORDS: PLANT PHYSIOLOGY; PLANTING DATE; PHYSIOLOGICAL FUNCTIONS; WHEATS; SOWING DATE.

210. Mahesh Kumar; Lal, R.L. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Horticulture). Canopy management by pruning under varying spacing-cum-planting systems in litchi (*Litchi chinensis* Sonn.). *Pantnagar Journal of Research (India)*. (Jan-Jun 2007) 5(1) p. 45-49 KEYWORDS: CANOPY; PRUNING; SPACING; PLANTING; LITCHI; LITCHI CHINENSIS; CROPPING SYSTEMS.

ABSTRACT: The present investigation was carried out during the year 2004-06 to observe the effect of pruning under varying spacing-cum-planting densities in litchi (*Litchi chinensis* Sonn.). The trees of cv. Rose Scented of uniform vigour and size were randomly selected for the present study. Pruning of overlapping, over crowded, dead and diseased branches in different planting systems namely square, cluster, paired, hedge row and double hedge row was done with the help of lopping shears, pruning saws and secateurs in the month of June, after harvesting the crop. The experiment was laid as per randomized block design with 5 treatments and 4 replications. Square system of planting provided to be the most effective for increasing tree volume (121.23 and 130.12 m³), canopy spread (6.40 and 6.42 m), net assimilation rate (0.313 and 0.369 mg/cm²) and fruit set (3.64 and 3.91 per cent) during both the years. The maximum tree volume, canopy spread, net assimilation rate (NAR) were recorded in square system of planting during both the years. Significantly higher yield (82.30 and 85.52 kg/tree) was obtained in square system, whereas, the maximum yield per hectare (156.73 and 158.75 q/ha) was obtained in double hedge row system of planting during both the years.

F02 Plant Propagation

211. Nikam, T.D.; Savant, R.S. (University of Pune, Pune (India). Dept. of Botany). Callus culture and micropropagation of *Ceropegia sahydrica* Ans. And Kulk. : an edible strachy tuberous rare asclepiad. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2007) v. 12(2) (New Series) p. 108-114 KEYWORDS: CALLUS; TISSUE CULTURE; MICROPROPAGATION; IN

VITRO CULTURE; PLANT PROPAGATION; PLANT GROWTH SUBSTANCES; GROWTH CONTROL; ASCLERPIADACEAE.

Micropropagation by axillary shoot multiplication of nodal explants of *Ceropegia sahyadrica* Ans. & Kulk was achieved. The highest mean number of shoots per nodal explants (6.1±0.6) was obtained on Murashige and Skoog (MS) medium supplemented with 10mM BAP. Mature indehiscent follicle was the suitable source to obtain the aseptic seedlings and explants. For morphogenetic study, 195 combinations of BAP, KN, IAA, NAA and 2,4-D in the range of 0 to 22 mM were fortified in the MS medium. Extensive callus proliferation took place on MS +1.0 mM 2, 4-D +5 0 mM BAP. The calli could be maintained on the parent medium over a period of 18 months. Rooting of shoots was favored by addition of 6.0 mg-1 spermine and 5 percent sucrose. The hardened plantlets remained stunted after transfer in the month of November to May. These stunted plantlets and fresh plantlets grew normally during the month of June to October and completed their life cycle similar to wild plants. The micropropagation protocol can be successfully utilized for conservation and domestication of the *Ceropegia sahyadrica* Ans. and Kulk.

212. Mehta, R.; Sharma, S.; Nath, A.K. (Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Biotechnology). In vitro selection and biochemical characterization of carnation (*Dianthus caryophyllus* L.) callus culture tolerant to *Alternaria dianthi*. Indian Journal of Plant Physiology (India). (Apr-Jun 2007) v. 12(2) (New Series) p. 120-126 KEYWORDS: IN VITRO SELECTION; CALLUS; ISOENZYMES; TISSUE CULTURE; PLANT DISEASE; CULTURAL CONTROL; BIOCHEMICAL ENGINEERING; ORGANOGENESIS; DISEASE RESISTANCE; DIANTHUS CARYOPHULLUS; DIANTHUS.

For the establishment of callus cultures of carnation (*Dianthus caryophyllus* L.), internodal segments were used as explants. Maximum percentage of callus induction was obtained on Murashige and Skoog (MS) medium supplemented with 2.0 mg/l naphthalene acetic acid (NAA) and 2.0 mg/l kinetin. Whereas, maximum shoot regeneration was obtained on medium supplemented with 2.0 mg/l 6-benzyladenine (BA) and 0.5 mg/l NAA. Well developed root system was obtained on liquid MS medium supplemented with 2.0 mg/l indole-3-butyric acid (IBA) and 0.2 per cent activated charcoal. Calli were subjected to different concentrations of culture filtrate of *Alternaria dianthi* and cell survival at 15 per cent selective dose of culture filtrate was 11.67 per cent. Selected calli showed significantly higher levels of biochemical constituents viz., total sugars, phenols, reducing sugars and proteins as compared to non-selected calli. Banding patterns of isozymes esterase, peroxidase and polyphenol oxidase were different in selected and non selected calli. In vitro shoot regeneration from selected calli was obtained on MS medium supplemented with 2.0 mg/l thidiazuron (TDZ).

213. Saravanan, R.; Basha, B.G.; Basha, A.; Vivekanandan, L. (Jamal Mahammed College, Tiruchirappalli (India). Dept. of Botany). Ex situ culture studies on a medicinal plant *Pedaliium murex* (Linn). Indian Journal of Plant Physiology (India). (Apr-Jun 2007) v. 12(2) (New Series) p. 178-180 KEYWORDS: IN VITRO CULTURE; PEDALIACEAE; DRUG PLANTS; CALLUS; TISSUE CULTURE; GROWTH; PLANT DEVELOPMENT STAGES.

In the present study, nodal, internodal segments of *Pedaliium murex* (Linn) were cultured on Murashige and Skoog (MS) medium supplemented with 3 mg/l 2,4-D, which was found to be most suitable for the successful callus initiation. The callus was then cultured on MS medium consisting of MS basal salts, 0.8 percent agar and 3 percent sucrose supplemented

with BAP with a concentration of 3 mg/l, which lead to the highest rate of multiple shoot bud initiation. The in vitro shootlets were cultured on different concentrations of 2, 4-0 in combination with BAP in the culture medium. For flower initiation, the highest rate of flower initiation was in the culture media supplemented with 1.5 mg/l 2,4-0 and 1.5 mg/l BAP.

F03 Seed Production and Processing

214. Atic, O.; Agar, G. (Ataturk University, Erzurum (Turkey). Dept. of Biology, Science and Letter Faculty); Battal, P. (Yuzuncu Yil University, Van (Turkey). Dept. of Biology, Science and Letter Faculty). Influence of long term storage on plant growth substance levels, germination and seedling growth in legume seeds stored for 37 years. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2007) v. 12(1) (New Series) p. 1-5 KEYWORDS: ABSCISIC ACID; SEEDLINGS; GROWTH; GERMINATION; SEED STORAGE.

The present work describes the changes that take place in plant growth substance (PGS) levels, germination and seedling growth during germination of seeds of *Medicago sativa* cv. Clover, *Trifolium repens* cv. Milka and *Trifolium pratense* cv. Bora which had been stored for 37 years. The endogenous abscisic acid (ABA), indole-3-acetic acid (IAA), gibberellic acid (GA3) and zeatin (Z) in the seeds were extracted and finally purified by high performance liquid chromatography (HPLC). Per cent germination, seedling height and the PGS levels in the germinating seeds were determined for 5 days at 23 °C. On day 5, the per cent germination values of aged seeds of *M. sativa*, *T. repens* and *T. pratense* were 37 percent, 30 percent and 17 percent, respectively. The height of seedlings derived from the stored seeds was also significantly low, compared to that of controls. ABA level was high, throughout germination, in the aged seeds studied, but the levels of IAA, GA3 and Z were low. Based on these results, it can be proposed that the reduced capability of germination and seedling vigour and growth in the aged seeds may be due to high ABA level which remained so throughout germination. This was also associated with decreased levels of GA3, IAA and Z.

F04 Fertilizing

215. Choudhary, G.R. (Rajasthan Agriculture University, Jaipur (India). Agricultural Research Stn.); Jain, N.K. (Rajasthan College of Agriculture, Udaipur (India). Dept. of Agronomy); Jat, N.L. (Rajasthan Agriculture University, Jobner (India). SKN College of Agriculture). Response of cumin (*Cuminum cyminum*) to inorganic nitrogen, farmyard manure and biofertilizer. *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 334-336 KEYWORDS: INORGANIC FERTILIZERS; FARMYARD MANURE; BIOFERTILIZER; AZOSPIRILLUM.

A field experiment was conducted on loamy sand soils of Jobner (Jaipur) during winter (rabi) seasons of 2000-01 to 2003-04, to study response of cumin (*Cuminum cyminum* L.) to inorganic N, FYM and biofertilizer. Maximum number of branches/plant (5.92), umbels/plant (21.28), umbellets/umbel (5.28), seeds/umbel (32.8) and test weight of seeds (4.50 g) were recorded with the application of inorganic N (100 percent) + Azospirillum 1.5 kg/ha + 5 tonnes FYM/ha, followed by 100 percent N through inorganic source alone and inorganic N (75 percent) + Azospirillum 1.5 kg/ha + 5 tonnes FYM/ha. Combined application of 100 percent inorganic N + Azospirillum 1.5 kg/ha + 5 tonnes FYM/ha also recorded significantly higher seed and straw yields, being 80.4 and 42.8 percent higher over the

control and the highest net returns of Rs 6,357/ha and benefit: cost ratio of 1.39 : 1. The highest uptake of N, P and K was also recorded under 100 percent inorganic N + Azospirillum 1.5 kg/ha + 5 tonnes FYM/ha.

216. Sangakkara, U.R.; Nissanka, S.P. (University of Peradeniya, Peradeniya (Sri Lanka). Faculty of Agriculture). Yield parameters of cassava (*Manihot esculenta*) as affected by method of addition of organic matter in two consecutive minor seasons of Sri Lanka. *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 337-340 KEYWORDS: YIELDS; MANIHOT ESCULENTA; SRI LANKA; GROWTH.

A study was carried out at the experimental farm, University of Peradeniya, Sri Lanka, to evaluate the influence of 2 organic materials [rice (*Oryza sativa* L.) straw and *Gliricidia* leaves, applied as a surface mulch or incorporated at planting on soil moisture, growth and yields of cassava [*Manihot esculenta* (L.) Crantz] planted in 2 dry seasons (2002 and 2003) and the rainfall-utilization efficiency by this crop. Application of straw or *Gliricidia* leaves as a mulch increased the soil-moisture contents and enhanced vegetative growth, yield components, yields, harvest indices of cassava and rainfall-use efficiency in both seasons compared to incorporation of organic matter. The mean yield increment owing to the straw mulch were 46 percent and 54 percent in the 2 seasons and 25 percent due to *Gliricidia* in both seasons respectively. Incorporation of straw and *Gliricidia* reduced yields by 14-16 percent and 8 percent, respectively, compared with surface application. The benefit of rice straw was greater owing to its ability to maintain greater soil-moisture content in the minor dry season.

217. Rani, C.; Bishnoi, S.K.; Kumar, B.; Sheoran, I.S.; Angrish, R.; Datta, K.S. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Botany and Plant Physiology). Changes in protein profile under sodium chloride and boron toxicity stress in seedlings of two wheat cultivars. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2007) v. 12(1) (New Series) p. 13-17 KEYWORDS: SODIUM; CHLORIDE; PROTEIN; BORON; SEEDLINGS; TRITICUM AESTIVUM; SALINITY; GENOTYPES.

Two genotypes of wheat (*Triticum aestivum* L.), a salt tolerant KRL 1-4 and a salt sensitive HD 2329 were subjected to stress treatments of control, 10 mM B, 120 mM NaCl and 10 mM B+ 120 mM NaCl at the seedling stage in a BOD incubator at 26:1:1 °C for 96 h. Proteins from coleoptile and radicle were resolved by SDS-PAGE. In tolerant cultivar (KRL 1-4), two proteins of 83.6 and 28.1 kDa appeared in the coleoptile and a 35 kDa protein appeared in the radicle in the seedlings treated with Band B+NaCl. Similarly, 46.6 kDa protein was observed in the radicle of KRL 1-4 only in B treated seedlings. These results clearly indicate characteristically B induced proteins. Two proteins of 74.2 and 48.8 kDa in HD 2329 coleoptile and a 64.6 kDa protein in the radical of both KRL 1-4 and HD 2329 seedlings were seen specific to salt treatment and were absent in boron treated seedlings. Likewise, a 70 kDa protein in the coleoptile profile of KRL 1-4 seedlings was expressed only with salt treatment, but was absent in boron treatment.

218. Shukla, Y.R.; Thakur, A.K.; Joshi, A. (Dr. Y.S. Parmar University of Horticulture and Forestry, Kandaghat (India). Horticultural Res. Stn.). Effect of inorganic and organic fertilizers on yield and horticultural traits in tomato (*Lycopersicon esculentum* Mill.). *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 137-141 KEYWORDS: ORGANIC FERTILIZERS; INORGANIC

FERTILIZERS; AGRONOMIC CHARACTERS; LYCOPERSICON ESCULENTUM; YIELDS; TOMATOES; FERTILIZERS APPLICATION.

The investigations were carried out at the farmers' fields at village Ded Gharat under Kandaghat block of Solan district (H. P.) during 2002-03 and 2003-04 to study the effect of inorganic and organic fertilizers in tomato (*Lycopersicon esculentum* Mill). Application of recommended doses of N, P and K together with farm yard manure and vermi compost 250 and 12.5 q per hectare, respectively, in tomato was found to be more beneficial in terms of yield/plant, yield/ha, number of fruits/plant, average fruit weight, number of fruits/cluster and TSS content. There was, however, no combined effect of N, P, K, farm yard manure and vermi compost on harvest duration and pericarp thickness. Vermicompost together with N, P and K could induce early flowering, whereas early picking resulted with the application of vermicompost and P.

219. Singh, U. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy); Ahlawat, I.P.S. (Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu (India). Regional Research Station and Faculty of Agriculture). Phosphorus management in pigeonpea (*Cajanus cajan*)-wheat (*Triticum aestivum*) cropping system. *Indian Journal of Agronomy* (India). (Mar 2007) v. 52(1) p. 21-26 KEYWORDS: FERTILIZER APPLICATION; RESIDUAL EFFECTS; PHOSPHORUS; CROPPING SYSTEMS; CAJANUS CAJAN; TRITICUM AESTIVUM.

A field experiment was conducted at New Delhi during 2002-03 and 2003-04 on sandy-loam soil with 10 kg available P/ha to optimize the P requirement in pigeon pea [*Cajanus cajan* (L.) Millsp.]-wheat [*Triticum aestivum* L. emend. Fiori & Paol.] cropping system. This study revealed that 17.2 kg P/ha to pigeon pea recorded higher mean growth (plant height, 158.7 cm; branches/plant, 22.9 leaf-area index, 2.20), yield attributes (pods/plant, 194.5; grains/pod, 4.45; 1,000-grain weight, 74.45 g) and grain yield (2.05 Mg/ha) over no P and phosphatesolubilizing bacteria (PSB) alone. Application of 17.2 kg P/ha to the preceding pigeonpea also increased the mean growth (plant height, 72.7 cm; tillers/m row length, 101.1; LAI, 3.11) and yield attributes (spikes/m row, 91.8; grains/spike, 33.4), and also grain yield of the succeeding wheat (4.55 Mg/ha) compared with no P to pigeonpea. Besides residual P, direct application of P to wheat up to 17.2 kg P/ha + PSB also increased the mean growth yield attributes and grain yield (4.85 Mg/ha) of wheat. Residual as well as direct-applied P up to 17.2 kg/P ha + PSB increased the total productivity of the cropping system in terms of pigeonpea-equivalent yield (residual, 4.48 Mg/ha; direct, 4.37 Mg/ha) over the preceding P levels. The cropping system removed the highest mean total P (26.8 kg/ha) when both the crops received 34.4 kg P/ha. The soil available P status after the cropping cycle improved over the initial status (10 kg/ha) with increasing rates of P application up to 34.4 kg/ha (18.8 kg/ha). However, negative balance of soil P (8.8 kg/ha) was noticed in the plots receiving no P.

220. Pandey, N.; Verma, A.K.; Anuraj; Tripathi, R.S. (Indira Gandhi Agricultural University, Raipur (India). Dept. of Agronomy). Integrated nutrient management in transplanted hybrid rice (*Oryza sativa*). *Indian Journal of Agronomy* (India). (Mar 2007) v. 52(1) p. 40-42 KEYWORDS: FERTILIZER APPLICATION; HYBRIDS; ORYZA SATIVA; FARMYARD MANURE; NUTRIENT UPTAKE; YIELDS; POTASSIUM; YIELD COMPONENTS.

A field experiment was conducted on clay-loam soil at research farm of Indira Gandhi Agricultural University, Raipur during rainy season 1999 and 2000, to find out suitable

nutrient-management strategies for hybrid rice (*Oryza sativa* L.). Application of inorganic fertilizer, level of 100, 60 and 40 kg/ha N, P Ps and KP along with 10 tonnes farmyard manure (FYM) gave the grain yield and B:C ratio comparable to that of 100, 60 and 40 kg/ha N, PPs and KP + FYM + 25 kg ZnSO₄/ha or 150, 75 and 60 kg/ha N, PPs and KP + FYM. The application of potassium 60 per cent as basal and 40 per cent at maximum tillering stage significantly increased the grain yield, uptake of N, P and K and the net return than its whole amount applied basal. Nitrogen treated with neem extract proved significantly better than untreated nitrogen.

221. Ghosh, A. (Central Rice Research Institute, Cuttack (India). Comparative study on combined and individual effects of farmyard manure and green-manuring with fertilizer N on growth and yield of rice (*Oryza sativa*) under submergence-prone situation. Indian Journal of Agronomy (India). (Mar 2007) v. 52(1) p. 43-45 KEYWORDS: FARMYARD MANURE; ORYZA SATIVA; GREEN MANURING; YIELD COMPONENTS; NITROGEN; WATER TOLERANCE; YIELDS.

A field experiment was conducted during 2003 and 2004 to study the combined and individual effects of using farmyard manure (FYM), green-manure (dhaincha : *Sesbania aculeata* L.) along with fertilizer N on rice (*Oryza sativa* L.) variety 'Gayatri' experiencing 10 days' complete submergence at maximum tillering stage. The crops under both the organics (FYM and green-manuring) thrived better under submergence, due to greater root development, higher critical N level in plant, higher biomass production and less tiller mortality compared with their individual application. Consequently these crops gave significantly higher grain yield (3.03 tonnes/ha). The crops under both the organics ensured higher N uptake (55.50 kg/ha), apparent N recovery (38.32 percent) and N-use efficiency (29.50 kg grain/kg N applied).

222. Raj, G.; Tiwari, S. (Central Soil Salinity Research Institute, Karnal (India). Coordination Unit (AICRP-SSW); Minhas, P.S. (Indian Council of Agricultural Research, New Delhi (India). Div. of Natural Resource Management). Response of sewage-irrigated wheat (*Triticum aestivum*) to level and timing of nitrogen application. Indian Journal of Agronomy (India). (Mar 2007) v. 52(1) p. 46-48 KEYWORDS: FERTILIZER APPLICATION; NITROGEN; TRITICUM AESTIVUM; YIELDS; SEWAGE; IRRIGATION.

A study was conducted during the winter season of 2001-02 and 2002-03 at sewage-irrigated farms in Sirsa (Haryana) for evaluating the optimal dose and time of application of nitrogenous fertilizers to wheat (*Triticum aestivum* L. emend. Fiori & Paol.). Seven fields, 0.4 ha each, were selected along the sewage drain during 200102 on the basis of variations in the build-up of organic matter (0.89-3.44 percent) vis-a-vis nitrogen (available N 191-413 kg/ha). Eight treatments consisting of different doses of fertilizer N (0, 60, 120 and 180 kg/ha) and times of application of 75 kg N/ha (50 percent of recommended N for normal soils of the area). First trial was repeated on eight other farmers' fields during 2002-03 with 1.19-3.01 per cent organic matter. The observations on wheat yield showed improvement in basic productivity of soils with accumulation of organic matter up to 2 per cent. The latter also defined the optimal doses of nitrogen, computed to be 55-119 kg/ha. Distinct possibility of producing high yield with reduced addition of N fertilizer was found in the immediate vicinity of the sewage-disposal sites. Under reduced doses, wheat responded better to a booster basal dose, followed by at crown-root initiation. Thus the recommendations to the farmers on the use of N fertilizers should be different for waste

water-irrigated soils. The reduced use of nitrogen should further help in minimizing the pollution problems by $\text{NO}_3\text{-N}$, especially with shallow ground waters.

223. Choudhary, R.S.; Gautam, R.C. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Effect of nutrient-management practices on growth and yield of pearl millet (*Pennisetum glaucum*). Indian Journal of Agronomy (India). (Mar 2007) v. 52(1) p. 64-66 KEYWORDS: FERTILIZER APPLICATION; NITROGEN; FARMYARD MANURE; PHOSPHORUS; BIOFERTILIZERS; PENNISETUM GALUCUM; YIELDS; PEARL MILLET; YIELD COMPONENTS.

An experiment was conducted for 2 years (2002 and 2003) at Dryland Research Farm of Indian Agricultural Research Institute, New Delhi, to evaluate the effect of nutrient-management practices on growth and yield of pearl millet [*Pennisetum glaucum* (L.) R. Sr. emend. Stuntz.]. Nutrient-management practices comprised the control, 30 kg N/ha + 20 kg P p/ha, 60 kg N/ha + 40 kg P p/ha, 5 tonnes FYM/ha + bio-fertilizer (Azotobacter + vesicular arbuscular mycorrhizae), 10 tonnes FYM/ha + bio-fertilizer (Azotobacter + VAM), 30 kg N/ha + 20 kg P P/ ha + 5 tonnes FYM/ha + bio-fertilizer, 30 kg N/ha + 20 kg P p/ha + 10 tonnes FYM/ha + bio-fertilizer and 60 kg N/ha + 40 kg P p/ha + 10 tonnes FYM/ha + bio-fertilizer in randomized block design with three replications. The total rainfall received during kharif season of 2002 and 2003 was 405.5 mm and 823.0 mm respectively. Application of 60+40 kg/ha of N + P Ps along with 10 t FYM/ha and biofertilizer gave significantly higher grain yield and N, P uptake by pearl millet than control and FYM (5 or 10 t/ha) + biofertilizers use.

224. Singh, Y.P. (Banasthali Vidyapith Deemed University, Banasthali (India). Krishi Vigyan Kenra); Mann, J.S. (Central Soil and Water Research Institute, Avikanagar (India). Interaction effect of sulphur and zinc in groundnut (*Arachis hypogaea*) and their availability in Tonk district of Rajasthan. Indian Journal of Agronomy (India). (Mar 2007) v. 52(1) p. 70-73 KEYWORDS: NUTRIENT NUTRIENT INTERACTIONS; SULPHUR; ARACHIS HYPOGAEA; RAJASTHAN; GROUNDNUTS; NUTRIENTS UPTAKE; NUTRIENT AVAILABILITY; ZINC.

A field experiment was conducted during rainy (kharif) season 2001 and 2002 at research farm of Banasthali (Rajasthan), to evaluate the interaction effect of four levels each of sulphur (0, 20, 40 and 60 kg/ha) and zinc (0, 2.5, 5.0 and 7.5 kg/ha) on groundnut (*Arachis hypogaea* L.). From the groundnut-growing fields of Tonk district, 125 surface (0-15 cm) soil samples were collected randomly for estimating available Sand Zn. Total Sand Zn contents in the soil varied from 142.0 to 232.0 kg/ha and 4.0 to 26.0 mg/kg with mean values of 170.2 kg/ha and 21.3 mg/kg respectively. The availability of 0.15 per cent CaCO_3 -extractable Sand DTPA-extractable Zn was 6.1-17.8 kg/ha and 0.31-0.81 mg/kg respectively. Out of the soils studied, 59 per cent were found deficient in Sand 31 per cent in Zn. Application of 40 kg S/ha and 5 kg Zn/ha significantly increased the pod yield of groundnut. The positive and significant interaction between Sand Zn resulted in highest pod yield of groundnut (2,251 kg/ ha) at 40 kg Sand 5 kg Zn/ha. Maximum benefit: cost ratio was recorded with the application of 40 kg Sand 2.5 kg Zn/ha. The use efficiency of Sand Zn decreased with increase in the level of Sand Zn, and maximum use efficiency was recorded at lower levels of Sand Zn application.

225. Sumathi, V.; Rao, D.S.K. (Sri Venkateshwar Agricultural College, Tirupati (India). Dept. of Agronomy). Effect of organic and inorganic sources of nitrogen with different irrigation schedules on growth and yield of sunflower (*Helianthus annuus*). Indian Journal of Agronomy (India). (Mar 2007) v. 52(1) p. 77-79 KEYWORDS: IRRIGATION SCHEDULING;

NUTRIENTS UPTAKE; FARMYARD MANURE; YIELDS; FERTILIZER APPLICATIONS; HELIANTHUS ANNUUS; NITROGEN; YIELD COMPONENTS.

A field experiment was conducted during 2001 and 2002 to study the combined effect of organic and inorganic sources of nitrogen (N) with different irrigation schedules on growth and yield of sunflower (*Helianthus annuus* L.). There were three irrigation schedules (IW:CPE ratios 0.6, 0.8 and 1.0) and five N-management practices (the control, recommended dose of N through fertilizer, substitution of 25, 50 and 100 per cent recommended dose of N through FYM). Irrigation schedule at irrigation water (IW): cumulative pan evaporation (CPE) ratio 1.0 significantly improved the growth, yield, N uptake and net returns of sunflower. The supply of entire dose of N through fertilizer gave significantly higher values of all the parameters, which were on a par with those under 75 per cent N through fertilizer + 25 per cent N through FYM. The interaction of IW:CPE ratio 1.0 in combination with supply of entire dose of N through fertilizer resulted in better growth and yield.

226. Singh, B.P.; Dimri, D.C.; Singh, S.C. (College of Forestry and Hill Agriculture, Ranichauri (India). Department of Horticulture). Efficacy of NPK management through fertigation on growth characteristics of apple (*Malus domestica* Borkh.) plant. Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 50-53 KEYWORDS: NPK FERTILIZERS; FERTIGATION; GROWTH RATE; APPLES; MALUS PUMILA.

The present investigation was carried out during the year 2004-05 at experimental Block of Department of Horticulture, G.B. Pant University of Agriculture & Technology, Hill Campus, Ranichauri, Tehri Garwal, Uttarakhand. The NPK fertilizers were applied through fertigation as well as soil application in five treatment combinations to test various attributes of 3-yr-old spur type apple cv Red Chief. The investigation indicated the highest vegetative growth of plants under full dose of NPK through drip irrigation in terms of shoot length (111.43 cm), plant diameter (2.87 cm), number of leaf per plant (223.50), leaf area (43.19 cm²), fresh weight (2.33 g), and dry weight (62 per cent), while the minimum shoot length (84.48 cm), plant diameter (1.97 cm), no. of leaves per plant (178.25), leaf area (27.43 cm), fresh weight (1.10 g), and dry weight of leaves (35 per cent), were noticed under full dose of NPK applied through soil. The full dose of NPK through fertigation also resulted in maximum leaf N (2.565 per cent), P (0.282 per cent) and K (1.685 per cent), and gave maximum chlorophyll 'a' (0.51 mg/g tissue), 'b' (0.40 mg/g tissue) and total chlorophyll (0.92 mg/g tissue), while minimum leaf NPK and chlorophyll content was found under full dose of NPK applied through soil. On the basis of overall effect of fertigation on vegetative growth, leaf nutrient and soil nutrient status of apple plants, the application of full dose of NPK through fertigation was most effective in improving the plant growth as well as leaf and soil nutrient status.

227. Singh, Room; Nand Ram; Singh, Peeyush (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Soil Science). Economics of fertilizer use under continuous rice-wheat cropping in a Mollisol. Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 76-80 KEYWORDS: RICE; WHEATS; CROPPING SYSTEMS; SOIL CHEMICAL PROPERTIES; ECONOMICS; FERTILIZERS.

ABSTRACT: The present study was undertaken to compute the economics of using fertilizers and manure under continuous rice-wheat cropping for over 3-decades on an Aquic Hapludoll. Various fertilizer and manural treatments substantially increased the yields of

both crops with successive increase in the levels of NPK along with Zn. Application of 100 per cent NPK with FYM produced the highest yields as well as maximum net profit (Rs. 32477/- ha⁻¹ yr⁻¹) of nutrient application. Treatments receiving recommended level of optimal NPK with zinc fetched about 97 per cent of the maximum net profit. With the application of only recommended N with Zn and at 50 per cent NPK dose with Zn net profit was only about 77 per cent and 67 per cent, respectively. However, their value cost ratios were higher than all other treatments. These two fertilizer practices seem to be suitable options for low input farming.

228. Chander Pal; Singh, H.N.; Ram, S.; Nand Ram (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Soil Science). Response to potassium fractions and their relationship with physico-chemical properties under different nutrient management systems in long-term fertilizer experiment on a Mollisol. Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 81-87 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; POTASH FERTILIZERS; FERTILIZERS; SOIL FERTILITY; NUTRIENTS; CROPPING SYSTEMS; SEQUENTIAL CROPPING.

ABSTRACT: The present study was undertaken during 1998-99 in a long term fertilizer experiment on a Mollisol to evaluate the effect of continuous cropping system and fertilizers application on potassium fractions and physico-chemical properties of soil. The obtained results indicate that chemical fertilizers application (N, P and K) and intensive cropping had negative effect on soil pH and CaCo₃ and positive with electrical conductivity and CEC. 100 per cent NPK+FYM treatment showed superiority over all other nutrient management treatments viz; 100 per cent NPK, 100 per cent NP+Zn, 100 per cent N+Zn etc., in improvement of soil properties and potassium fractions in post harvest soils whereas intensive fertilization without manure in mono cropping deteriorated the soil properties viz; pH, EC, CEC and organic carbon. However, water soluble, exchangeable and available potassium are negatively correlated with pH and CaCo₃ in surface (0-15 cm) soils after rice in rice-wheat-cowpea cropping system under all the nutrient management treatments but non-significant correlation coefficients were found with fixed and lattice potassium. For sustaining soil health and crop productivity under such set of conditions, integrated nutrient management coupled with intensive cropping could be a better choice to the farmers.

F06 Irrigation

229. Mudgal, A. (CSWCRTI, Dehra Dun (India). Div. of H & E); Kapil (Chaudhary Charan Singh Haryana Agricultural University, Hisar Dept. of Soil and Water Engineering); Kumar, M. Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). HARSAC); Kumar, R. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Soil and Water Engineering). Evaluation of irrigation practices for safe use of saline water under shallow water table conditions. Annals of Biology (India). (Dec 2006) v. 22(2) p. 143-148 KEYWORDS: IRRIGATION; IRRIGATION METHODS; WASTE WATER IRRIGATION; SALINITY; GROUND WATER TABLE; SALINE WATER.

No country can afford to waste water or abandon ever-increasing land areas to salt. The challenge is making productive and sustainable use of salt-affected land, preferably by tapping the saline groundwater in the field. Basically there are two methods of irrigation with saline groundwater or drainable surplus viz., (i) Alternate or cyclic use of low salinity" water with saline drainage water and (ii) Mix use of "low salinity" water with saline drainage

water for irrigation. The option (i) is advocated by many researchers, but in the present study the option (ii) of irrigation was found more suitable. There was lesser salt build-up in the soil profile and also the crop yield was better with option (ii) of irrigation method.

230. Jangir, R.P.; Jat, B.L.; Rathore, M.S. (Rajasthan Agricultural University, Jodhpur (India). Agricultural Res. Stn.). Comparative efficacy of sprinkler and surface methods of irrigation in cumin (*Cuminum cyminum*) under arid western Rajasthan conditions. *Indian Journal of Agronomy* (India). (Mar 2007) v. 52(1) p. 83-85 KEYWORDS: SPRINKLER IRRIGATION; SURFACE IRRIGATION; IRRIGATION SCHEDULING; CUMINUM CYMINUM; ARID ZONES; RAJASTHAN; YIELDS; YIELD COMPONENTS.

A field study was undertaken during winter seasons of 2002-03 and 2003-04 at Mandor-Jodhpur to compare the efficacy of sprinkler method of irrigation with conventional check-basin method and to work out an appropriate irrigation schedule and the operating time for sprinklers. The pooled results revealed that application of five irrigations through sprinklers operated for 3 hr produced seed yield (411 kg/ha) on a par with that of recommended irrigation schedule applied through conventional irrigation method, but it saved water up to 41 per cent with higher WUE (0.260 kg seed/m³) and net returns (Rs 16,558/ha). Further increase in irrigation frequency (six irrigations) did not cause significant impact on cumin productivity and net returns.

231. Mondal, T.N.; Mishra, H.S. (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Soil Science); Singh, N.P. (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Vegetable Science). Effect of nutrition and irrigation on soil properties and yield of potato on a Mollisols in tarai region of Uttarakhand. *Pantnagar Journal of Research* (India). (Jan-Jun 2007) 5(1) p. 107-112 KEYWORDS: POTATOES; SOIL CHEMICO-PHYSICAL PROPERTIES; UTTARAKHAND; UTTARANCHAL; IRRIGATION; NUTRIENTS.

ABSTRACT: Field experiments were conducted during winter season of 2003-2004 and 2004-2005 to study the effect of nutrition and irrigation on soil properties and yield of potato. Irrigation given at 30 and 50 days after planting (DAP) and application of N200, P100 K100 Cu20 Mn20 Zn25 B5 Kg ha⁻¹ significantly increased the yield of potato. Effect of nutrition and irrigation treatments on pH, EC and organic carbon of soil was non-significant, but the effect was significant on N P K Zn Cu Mn B over control. Tuber yield of potato had positive and significant correlation with organic carbon, N P K Zn Cu Mn except B. Higher significant positive correlation of tuber yield was found with P ($r = 0.892^*$).

F07 Soil Cultivation

232. Kundu, D.K.; Chaudhari, S.K.; Singh, R. (Water Technology Centre for Eastern Region, Bhubanewar (India). Effect of soil puddling and potassium application on rice in a canal irrigation command of Orissa. *Journal of the Indian Society of Soil Science* (India). (Mar 2007) v. 55(1) p. 84-85 KEYWORDS: PUDDLING; CANALS; FERTILIZER APPLICATION; POTASSIUM; IRRIGATION SYSTEMS; YIELDS; ORISSA.

F08 Cropping Patterns and Systems

233. Singh, R.; Yadav, D.S. (Narendra Deva University of Agriculture and Technology, Faizabad (India). Dept. of Agronomy). Effect of rice (*Oryza sativa*) residue and nitrogen on performance of wheat (*Triticum aestivum*) under rice-wheat cropping system. *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 247-250 KEYWORDS: INTERCROPPING; NITROGEN; ORYZA SATIVA; TRITICUM AESTIVUM.

A field experiment was conducted during the winter (rabi) season of 2001-02 and 2002-03 to find out the effect of rice (*Oryza sativa* L.) residue and N levels on performance of wheat (*Triticum aestivum* L. emend. Fiori & Paol.) in rice-wheat cropping system. Highest mean grain yield of 33.6 q/ha was recorded on incorporation of residue, which was respectively 14.72 and 8.64 per cent more than when the residue was removed and retained. Residue incorporation also increased the organic carbon content in the soil by 0.37, 0.35 and 0.31 per cent in residue incorporated, retained and removed treatment respectively. It also increased the organic carbon content in the soil by 17.73 and 5.71 per cent in comparison with residue removed and retained treatment over a period of 2 years. Application of 150 kg N/ha increased the growth, yield attributes and yield of wheat. It increased the grain yield by 96.6, 65.0 and 37.3 per cent compared with N 0, 50 and 100 kg/ha. Available N in the soil also increased by 10 per cent during the 2 years.#g.

234. Lal, R.; Srivastava, S.N.L.; Chand, M. (Chaudhary Charan Singh Haryana University, Karnal (India). Regional Research Stn.). Integrated weed management for sugarcane (*Saccharum officinarum*) plant-ratoon cropping system. *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 251-255 KEYWORDS: CROPPING SYSTEMS; WEED CONTROL; SACHARUM OFFICINARUM.

A field experiment was conducted during 2000-03 and 2001-04 to evolve suitable and economical integrated weed-management technologies for sugarcane (*Saccharum officinarum*) plant and ratoon crops. The treatments comprised four different weed-management practices for plant (chemical, integrated, interculture and weedy check) and ratoon (integrated, trash mulching, interculture and weedy check). In plant crop the integrated method (one hoeing after first irrigation followed by spraying of atrazine 2 kg/ha after second irrigation in moist soil) and in ratoon crop the integrated method (one hoeing followed by spraying of atrazine 2 kg/ha in moist soil at ratoon-initiation stage) or trash mulching were observed to be better weed-management technologies for cane production, involving less costs. Rice-mustard-sugarcane (plant)-ratoon-wheat cropping system was found more economical than rice-wheat-sugarcane (plant)-ratoon-wheat cropping system.

235. Paikaray, R.K.; Mahantqa, D.; Swain, S.K. (Orissa University of Agriculture and Technology, Kendrapara (India). Jute Research Stn.). Effect of nutrient management in white jute (*Corchorus capsularis*)-rice (*Oryza sativa*) cropping system under rainfed condition. *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 256-258 KEYWORDS: NUTRIENT SOLUTIONS; CROPPING SYSTEMS; NUTRIENT UPTAKE.

A field experiment was carried out during 2000-01 to 2002-03, at Kendrapara, to study the effect of nutrient management on yield, nutrient uptake and economics of white jute (*Corchorus capsularis* L.)-rice (*Oryza sativa* L.) cropping system in rainfed medium land. Application of 60 kg N, 30 kg PPs and 30 kg Kp/ha (recommended dose for white jute) along with MgSO₄. 7Hp 10 kg/ha + lime (0.5 lime requirement) to jute crop recorded the highest fibre yield (2.28 tonnes/ha), and maximum grain yield (3.89 tonnes/ha) of succeeding rice crop were obtained with a fertilizer dose of 60 kg N, 30 kg PPs and 30 kg Kp/ha in the

system. This resulted in an increased yield of 26.7 percent in jute fibre and 10.2 percent of rice grain over the recommended fertilizer dose in both the crops. The nutrient uptake (N,P,K, Ca, Mg and S) of individual crop and the system increased owing to NPK + 10 kg MgSO₄. 7 H₂O + lime (0.5 lime requirement) in jute, followed by rice with only recommended fertilizer dose in comparison to other treatments. The maximum net returns (Rs 22,628/ha) and the highest benefit: cost ratio (1.71) were recorded with the recommended NPK to both crops along with MgSO₄ and lime to jute only in jute-rice cropping system under rainfed condition.

236. Kumar, A.; Thakur, K.S. (CSK Himachal Pradesh Krishi Vishwa Vidyalaya, Kangra (India). Shivalik Agricultural Research and Extension Centre). Effect of Brassica spp. and their sowing proportions on productivity, competition and economics of wheat (*Triticum aestivum*) + Brassica mixed cropping system under rainfed conditions of Himachal Pradesh. *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 259-262 KEYWORDS: CROPPING SYSTEMS; RAINFED FARMING; BRASSICA; TRITICUM AESTIVUM; SOWING.

An experiment was conducted during winter (rabi) season of 2003 and 2004 to identify the suitable Brassica spp. and their optimum sowing proportion for wheat (*Triticum aestivum* L. emend. Fiori & Pao!) + Brassica mixed cropping system. Brown sarson (Local) was more competitive than mustard ('Ree 4') in all the mixed cropping patterns, decreasing the total productivity by 4.9 and 6.1 percent respectively. Mixed cropping of wheat + mustard ('Ree 4') in 100 percent + 10 percent and 100 percent + 20 percent seeding proportion gave significantly higher wheat yield, total productivity and net returns compared with sole wheat and farmer's practice of wheat + brown sarson (100 percent + 50 percent), followed by wheat + brown sarson (Local) in 100 percent + 20 percent seeding proportion. These treatments gave 4.49-9.9 percent and 15.0-21.1 percent higher productivity over sole wheat and farmer's mixed cropping practice. The competitive ratio, aggressivity and LER of the main crop wheat were maximum when the mixed cropping of wheat + mustard or wheat + brown sarson was followed in 100 percent + 20 percent seeding proportion, followed by that of wheat + mustard (100 percent + 10 percent). In all other sowing patterns the wheat crop was dominant.

237. Tatarwal, J.P.; Rana, K.S. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Impact of cropping system, fertility, level and moisture-conservation practice on productivity, nutrient uptake, water use and profitability of pearl millet (*Pennisetum glaucum*) under rainfed conditions. *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 263-266 KEYWORDS: CROPPING SYSTEM; NUTRIENT UPTAKE; FERTILITY; RAINFED FARMING; PENNISETUM GLAUCUM.

A field experiment was conducted on a sandy loam soil at Indian Agricultural Research Institute, New Delhi during rainy (kharif) season of 2003 and 2004. The treatment combinations comprised two cropping systems [pearlmillet sole (50 cm row spacing) and pearl millet paired row (30/70 cm row spacing) + one row of mothbean] and three fertility levels (control, 40 kg N + 20 kg P/ha and 80 kg N + 40 kg P/ha) in main plots; and four moisture-conservation practices (no mulch, dust mulch + straw mulch, kaolin + straw mulch and farmyard manure (FYM) 5 t/ha + dust mulch + straw mulch) in subplots. Split-plot design was followed with three replications. The planting of one row of mothbean between paired rows of pearl millet proved superior to sole pearl millet in respect of pearl millet-equivalent yield (29.60 q/ha), water use and economics. Application of 80 kg N + 40 kg P

p/ha as also FYM 5 t/ha + dust mulch + straw mulch recorded significantly higher pearl millet equivalent yield, nutrient uptake, water use and economics compared with the rest of the treatments.

238. Singh, T.; Rana, K.S. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Effect of moisture conservation and fertility of Indian mustard (*Brassica juncea*) and lentil (*Lens culinaris*) intercropping system under rainfed conditions. *Indian Journal of Agronomy* (India). (Dec 2006) v. 51(4) p. 267-270 KEYWORDS: MOISTURE CONTENT; FERTILITY; RAINFED FARMING; INTERCROPPING.

A field experiment was conducted in the winter season of 2003-04 and 2004-05 to study the effect of intercropping, moisture-conservation practices and fertility levels on the growth, yield and N and P uptake of rainfed 'Pusa Barani' Indian mustard [*Brassica juncea* (L.) Czernj. & Cosson] and 'L 7473' lentil (*Lens culinaris* Medikus). Indian mustard paired row (30/90 cm) + lentil (2 rows) intercropping system proved more productive, as it gave 3.7 q/ha extra seed yield of lentil without reducing significantly dry-matter accumulation, yield attributes and the seed yield of Indian mustard. Moisture-conservation practices increased the growth parameters and total N and P uptake. FYM + organic mulch + kaolin spray (6 percent) increased the seed yield of Indian mustard and lentil by 14.0 / and 14.3 percent respectively. Dry-matter accumulation and yield attributes of Indian mustard and lentil and leaf-area index were recorded significantly higher with 50 percent and 100 percent recommended dose of fertilizer (RDF). The N and P uptake of Indian mustard and lentil increased significantly with the application of 50 percent RDF and 100 percent RDF. The maximum increment in seed yield of Indian mustard and lentil was recorded with 100 percent fertility level and it was 19.9 and 25. percent higher over the control respectively. The moisture-conservation practice of FYM + organic mulch + kaolin spray (6 percent) recorded highest water-use efficiency (10.1 kg/ha-mm) over the control.

239. Kumar, S. (Krishi Vigyan Kendra, Dehradun (India); Rana, N.S. (Sardar Ballabh Bhai Patel University of Agriculture and Technology, Meerut (India). Dept. of Agronomy); Singh, R.; Singh, A. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Agronomy). Production potential of spring sugarcane as influenced by intercropping of dual-purpose legumes under tarai conditions of Uttarakhand. *Indian Journal of Agronomy* (India). (Dec 2006) v. 51(4) p. 271-273 KEYWORDS: INTERCROPPING; YIELD; SUGARCANE; LEGUMES.

A field experiment was conducted during 2000-02 at the Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, to study the effect of dual-purpose legume intercropping with spring sugarcane under different NPK levels. All intercrops, except *Sesbania* reduced the cane yield significantly. The reduction in cane yield was 14.0, 8.9 and 11.4 percent with cowpea [*Vigna unguiculata* (L.) Walp.], mungbean (*Vigna radiata*) and urdbean (*Vigna mungo*) intercropping respectively. Sugarcane intercropped with *Sesbania* (GM) yielded similar to that of sole sugarcane. Different fertility levels did not show significant effect on cane yield. Sugarcane + cowpea gave 17.2, 15.8, 19.0 and 26.5 percent higher mean cane-equivalent yield (118.4 tonnes/ha) than sole sugarcane, sugarcane + mungbean, sugarcane + urdbean and sugarcane + *Sesbania* intercropping respectively. A dose of 100 percent of recommended NPK resulted in 5.0 percent higher cane-equivalent yield than 75 percent dose and was on a par with 125 percent of NPK dose. Sugarcane + cowpea also gave the highest net return of Rs 57,772 compared to Rs 41,449 with urdbean

and Rs 48,330 with sole sugarcane. Respective benefit: cost ratio was 2.06, 1.78 and 2.01. A dose of 125 percent of the recommended NPK gave highest monetary return and benefit: cost ratio with maintaining the residual soil-fertility status after harvest of sugarcane.

240. Porwal, M.K.; Agarwal, S.K.; Khokhar, A.K. (Maharana Pratap University of Agriculture and Technology, Udaipur (India). Dept. of Agronomy). Effect of planting methods and intercrops on productivity and economics of castor (*Ricinus communis*)-based intercropping systems. *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 274-277 KEYWORDS: PLANT PRODUCTION; INTERCROPPING; BEAVERS.

An experiment was conducted during the rainy season of 2001 and 2002 at Udaipur, to evaluate productivity and economics from intercropping greengram (*Vigna radiata* L.), blackgram (*Vigna mungo* L.), clusterbean [*Cymopsis tetragonoloba* (L.) Taub.] and sesame (*Sesamum indicum* L.) with castor (*Ricinus communis* L.) in uniform and paired rows systems of planting. Paired row planting (60/120 cm) gave the maximum seed yield (41.84 q/ha), castor-equivalent yield (47.50 q/ha), land-equivalent ratio (1.52) and monetary advantage, followed by paired row planting at 80/160 cm and uniform row planting at 90 cm x 60 cm. Castor intercropped with greengram recorded higher values of yield attributes and yielded maximum castor-equivalent yield, land-equivalent ratio, net returns and benefit: cost ratio over sole castor, castor + sesame and castor + clusterbean intercropping systems, but remained at par with castor + blackgram intercropping system.

241. Walia, S.S.; Kler, D.S.; Khurana, M.P.S. (Punjab Agricultural University, Ludhiana (India). Dept. of Agronomy, Agrometeorology and Forestry). Heavy concentration in grains and soils as influenced by organic, integrated and chemical source of nutrition in maize-wheat system. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2007) v. 12(2) (New Series) p. 212-214 KEYWORDS: CROPPING SYSTEMS; SEQUENTIAL CROPPING; FARMING SYSTEMS; ORGANIC AGRICULTURE; HEAVY METALS; FERTILIZER APPLICATION; FARM YARD MANURE; CHEMICAL COMPOSITION; NUTRIENTS; NUTRIENT UPTAKE.

The long-term experiment with maize-wheat sequence was initiated during 1996-97 at the experimental farm of the department of Agronomy, Agrometeorology and Forestry, Punjab Agricultural University, Ludhiana. On the same field the investigation was expanded to organic (pure), integrated (partial) and chemical farming systems during Kharif and rabi 2002-03. The application of farmyard manure, green manure and crop residues decrease heavy metal (lead, nickel and cadmium) concentration in grains of maize and wheat as well as in soils and uptake of heavy metal by maize and wheat grains as compared to use of chemical fertilizers alone as a source of nutrients.

242. Thakur, P.S.; Dutt, V.; Lal, C.; Singh, S. (University of Horticulture and Forestry, Solan (India). Dept. of Silviculture and Agroforestry). Management of agroforestry systems for better production ability and diversification. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2007) v. 12(1) (New Series) p. 41-49 KEYWORDS: FODDER; FUEL; SUSTAINABILITY; AGROFORESTRY; DIVERSIFICATION; PRODUCTION.

Diversification and sustainability in production are the two main goals to be achieved through short and long term strategies. Management of agroforestry systems in general and tree component in particular, exert strong influence on the performance and production ability of associated components. Our studies over the last 8 years on location-specific agroforestry models developed for upland terraces as well as silvi-pastoral models for

sloping, degraded land in the northwestern Himalayas indicate that suitable tree-crop combinations, followed by proper tree canopy management are the deciding factors for making upland temperate agroforestry a viable and profitable landuse system. Proper tree crown management has been found to regulate belowground and aboveground biological interactions for critical resources between the components of the systems, and also maintains vigour and biomass production ability for prolonged duration. Various canopy management practices - maintenance of tree components as hedgerows at different spacings, retention of canopies by the cutting of stems to different heights, and removal of crown to 25, 50 and 75 percent - have been found to strongly influence performance, production abilities, and physiological status of associated agricultural crops to a large extent. The findings suggest an additional advantage of suitable management approaches in improving production and monetary gains to the hill farming community.

243. Tripathi, M.K.; Saini, B.C.; Chaturvedi, S. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Growth and yield of intercropped wheat under *Salix-Dalbergia* agroforestry system. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 189-191
KEYWORDS: INTER CROPPING; MIXED CROPPING; CROPPING SYSTEMS; WHEATS; AGROFORESTRY; YIELDS; DALBERGIA; SALIX; GROWTH.

A field experiment was conducted to study the response of late sown wheat cv. UP 2425 under different combinations of mixed *Salix-Dalbergia* agroforestry system viz., control (TJ), 100 percent *Salix* (T2), 100% *Dalbergia* (T), 66 : 34 *Dalbergia* : *Salix* (T.), 34 : 66 *Dalbergia* : *Salix* (Ts) and 50 : 50 *Dalbergia* : *Salix* (TO) at the G. B. Pant University of Agriculture & Technology, Pantnagar, during rabi season of 2000-01. Yield attributes and grain yield of intercropped wheat under 50 : 50 *Dalbergia* : *Salix* treatment were at par with sole wheat crop.

244. Pillai, P.S.; Geethakumari, V.L.; Issac, S.R. (Kerala Agricultural University, Thiruvananthapuram (India). Dept. of Agronomy). Balance-sheet of soil nitrogen in rice (*Oryza sativa*)-based cropping systems under integrated nutrient management. *Indian Journal of Agronomy (India)*. (Mar 2007) v. 52(1) p. 16-20
KEYWORDS: CROPPING SYSTEMS; SOIL FERTILITY; NUTRIENT REQUIREMENTS; *ORYZA SATIVA*; NUTRIENTS.

A field experiment was conducted at Rice Research Station, Kayamkulam, Alappuzha in Kerala to assess the impact of L.) showed a positive nitrogen balance in the soil, the maximum being after rice-rice-groundnut crop sequence. The integrated nutrient management (INM) on four rice (*Oryza sativa* L.)-based cropping systems, comprising rice during the rainy (kharif) and winter (rabi) seasons; and four different crops during the summer season, in terms of their productivity, effect on the organic carbon of soil and nitrogen balance. Inclusion of legumes in the cropping system and integrated nutrient management improved the organic carbon status of the soil. The crop sequences rice-rice-cowpea [*Vigna unguiculata* (L.) Walp.] and rice-rice-groundnut (*Arachis hypogaea* crop sequences rice-rice-sesame (*Sesamum indicum* L.) and rice-rice-okra (*Abelmoschus esculentus* L.) reduced the available nitrogen status of the soil. Integration of nutrient sources made the predominant rice-ricesesame cropping sequence more productive in the sandy-loam soil. Inclusion of groundnut and cowpea in rice-based crop sequences increased the yield of the succeeding crop of rice.

245. Bharati, V.; Nandan, R.; Kumar, V.; Pandey, I.B. (Rajendra Agricultural University, Pusa (India). Dept. of Agronomy). Effect of irrigation levels on yield, water use efficiency and economics of winter maize (*Zea mays*)-based intercropping systems. *Indian Journal of Agronomy (India)*. (Mar 2007) v. 52(1) p. 27-30 KEYWORDS: INTERCROPPING SYSTEMS; IRRIGATION; WATER USE; ECONOMICS; EFFICIENCY; ZEA MAYS; YIELDS.

A field experiment was conducted during winter season of 2002-03 and 2003-04 at Pusa in Bihar to study the effect of four irrigation levels, based on Irrigation water (IW): cumulative pan evaporation (CPE) ratio and four in-tercropping systems. The plant height, leaf-area index, yield attributes except number of cobs/plant and grain yield of maize increased significantly with increase in IW:CPE ratio. Application of five irrigations each of 6 cm depth gave the maximum maize-equivalent yield, and net return/Re of investment. Intercropping of maize (*Zea mays* L.) reduced the maize yield but significant reduction was recorded only in french bean (*Phaseolus vulgaris* L.) and toria (*Brassica campestris* L. var. toria) intercropping system. However, water-use efficiency (WUE) decreased with increase in IW:CPE ratio and was maximum at IW:CPE 0.6. Among the intercrops, maximum WUE (on the basis of maize-equivalent yield) was obtained with maize + potato (*Solanum tuberosum* L.) (561.89 kg/ ha-cm) and minimum with maize + toria (256.0 kg/ha-cm). All the intercrops with maize recorded significantly higher maize-equivalent yield than sole cropping of maize. Maize + potato recorded the highest (123.48 and 140.07 q/ha) maize-equivalent yield and net return, whereas, sole cropping of maize recorded the maximum net return per rupee of investment. Among intercropping systems, maize+potato generated the highest net return (Rs 28,781 and 35,661), followed by maize + rajmash.

246. Kumar, A.; Rana, K.S. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Performance of pigeonpea (*Cajanus cajan*)+greengram (*Phaseolus radiatus*) intercropping system as influenced by moisture-conservation practice and fertility level under rainfed conditions. *Indian Journal of Agronomy (India)*. (Mar 2007) v. 52(1) p. 31-35 KEYWORDS: INTERCROPPING; PHASEOLUS RADIATUS; CAJANUS CAJAN; DRY MULCHES; EFFICIENCY; RAINFED FARMING; WATER USE; SOIL WATER CONTENT; SOIL FERTILITY; NUTRIENT UPTAKE.

A field experiment was conducted on moisture conservation and nutrient-management practices in pigeonpea [*Cajanus cajan* (L.) Millsp.]-greengram [(*Phaseolus radiatus* (L.) Wilczek)] intercropping system under rainfed conditions on sandy-loam soil at New Delhi in rainy season 2004 and 2005. The planting of one row of greengram between paired rows (30.70 cm) of pigeon pea proved superior to the sole pigeon pea in terms of pigeonpea-equivalent yield, water use and economics. Application of soil mulch + farmyard manure 5 tonnes/ha + Kaolin 6 per cent spray was found the best moisture-conservation practice by recording the maximum values of pigeonpea-equivalent yield, nutrient uptake and water-use efficiency. Application of 40 kg P p/ha + 25 kg S / ha + phosphate-sutibilizing bacteria (PSB) recorded the maximum values of pigeonpea-equivalent yield, nutrient uptake, watar-use efficiency and net returns.

247. Singh, J.K. (Sher-e-Kashmir University of Agricultural Sciences and Technology, Wadura (India). Faculty of Agriculture). Response of sunflower (*Helianthus annuus*) and french bean (*Phaseolus vulgaris*) intercropping to different row ratios and nitrogen levels under rainfed conditions of temperate Kashmir. *Indian Journal of Agronomy (India)*. (Mar 2007) v. 52(1) p.

36-39 KEYWORDS: INTERCROPPING; HELIANTHUS ANNUUS; SPACING; NUTRIENT UPTAKE; PHASEOLUS VULGARIS; ECONOMICS; YIELDS; RAINFED FARMING; JAMMU AND KASHMIR.

A field experiment was conducted at the research farm of Faculty of Agriculture, SKUAST-K Regional Research Station, Wadura in Kashmir during rainy (kharif) season 2002 and 2003, to study the response of sunflower (*Helianthus annuus* L.) and french bean (*Phaseolus vulgaris* L.) intercropping to different row ratios (1:1 and 2:2) and nitrogen levels (0, 40, 80 and 120 kg/ha) under rainfed conditions. Intercropping reduced the values of growth parameters, yield attributes and seed yield of both sunflower and french bean compared with their sole crops. Both the intercrops recorded significantly higher sunflower-equivalent yield (SEY), net income and benefit: cost ratio than their sole stands. Intercropping of sunflower + french bean under 2:2 row ratio recorded significantly higher SEY (1,231 kg/ha), land-equivalent ratio (1.25), net income (Rs 13,138/ha) and benefit: cost ratio (1.95), and also indicated a modest competitive ratio (2.10:0.48), followed by sunflower + french bean in 1:1 ratio. Both sunflower and french bean in sole and intercropping responded favourably up to 80 kg N/ha only for leaf-area index, dry-matter accumulation, yield attributes, seed yield, N uptake, net income and benefit: cost ratio. The interaction effects of the factors showed that mean SEY responded to N application up to 80 kg/ha in 2:2 row ratio of sunflower+ french bean.

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248. Rana, D.S.; Giri, G.; Pachauri, D.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Evaluation of castor (*Ricinus communis*) genotypes for productivity, economics, litter fall and changes in soil properties under different levels of inter row spacing and nitrogen. *Indian Journal of Agronomy* (India). (Dec 2006) v. 51(4) p. 318-322 KEYWORDS: GENOTYPES; RICINUS COMMUNIS; NITROGEN; SOIL GENESIS.

A fixed plot field experiment was conducted during the rainy (kharif) seasons of 2002 and 2003 at New Delhi, to find out the effect of 3 inter-row spacings (60, 75 and 90 cm) and 3 levels of N (0, 60 and 120 kg N/ha) on performance of 2 genotypes ('DCH 177' and 'DCS 9') of castor (*Ricinus communis* L.) and physico-chemical properties of soil. The mean performance indicated significant superiority of 'DCH 177' to 'DCS 9' in terms of yield attributes, seed yield (27.7 and 23.9 q/ha), harvest index (9.59 and 8.92 percent) and net return (Rs 24,072 and 20,656/ha). The optimum N dose was worked out to be 121.6 and 100.9 kg N/ha for 'DCH 177' and 'DCS 9' respectively. Castor genotypes responded to inter-row spacing significantly. The maximum seed yield (26.5 q/ha), harvest index (9.72 percent) and net return (Rs 23,420/ha) were recorded with 90 cm inter-row spacing. Low temperature during December to February induced considerable fruits drop. The treatments under test also caused perceptible variation in fruits drop. Mean litter fall of 9 to 10 tonnes/ha per season was recorded. Litter fall exhibited marked increase due to decrease in inter-row spacing and increase in N levels. At the end of 2 years experimentation on the same site, physico-chemical properties like bulk density and pH recorded perceptible decrease from initial values, while soil organic carbon content and available N exhibited marked improvement over initial values.

249. Kumar, V.; Singh, G.; Sharma, R. (Rajasthan Agricultural University, Bikaner (India). Dept. of Biotechnology); Sharma, S.N. (Agricultural Research Station, Jaipur (India). Seed Technology Research). Rapid and protein profiles of cotton varieties. *Indian Journal of Plant*

Physiology (India). (Apr-Jun 2007) v. 12(2) (New Series) p. 115-119 KEYWORDS: GENETIC VARIATION; RAPD; GOSSYPIUM HIRSUTUM; VARIETIES; GENETIC MARKERS; TETRAPLOIDY; DIPLOIDY; SEED; PROTEIN CONTENT; GOSSYPIUM ARBOREUM.

RAPD and SDS-PAGE techniques were employed for identification and genetic diversity - estimation of six tetraploid (*Gossypium hirsutum*) and two diploid (*G. arboreum*) cotton cultivars. 17 RAPD primers produced 86 amplicons, out of which 55 were polymorphic having 63.95 percent polymorphism and 8 primers produced variety specific bands. The maximum discriminating power was obtained from Primers OPA'7 and OPA-19. SDS-PAGE of seed storage proteins resolved into 30 bands. Out of 30 bands, only one variety specific band was found, while 12 bands were species specific and appeared only in one of the species. The discrimination power of seed protein profile was 0.53, which was less than the discriminatory power of most of the RAPD profiles generated for individual primers. Cluster analysis of both RAPD and SDS-PAGE data produced two clusters, separating diploid with tetraploid cultivars. RAPD was found to be more efficient for cultivar identification and genetic diversity estimation.

250. Bhandari, A.P.; Sukanya, D.H. (Indian Grassland and Fodder Research Institute, Dharwad (India). Regional Res. Stn.). Fingerprinting napier grass (*Pennisetum purpureum*) germplasm with biochemical markers. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 101-106 KEYWORDS: PENNISETUM PURPUREUM; GERMPLASM; GENETIC MARKERS; ISOENZYMES; VARIETIES.

Sixty-four genotypes of napier grass (*Pennisetum purpureum* Schum) were analysed for total proteins and isozymes viz., malate dehydrogenase (MDH) E. C. 1.1.1.37, glutamate oxaloacetate transaminase (GOT) E.-C. 2.6.1.1 and peroxidase (POX) E. C. 1.11.1.7. The analysis was carried out by native polyacrylamide gel electrophoresis. The napier grass accession exhibited substantial isozyme diversity as described by isozyme polymorphism data of three isozyme systems and total proteins. Among isozymes, peroxidase produced unique fingerprints for 24 cultivars. Though MDH and GOT could show distinct pattern for only two and five accessions, respectively, all the three enzymes viz., MDH, GOT and POX together could differentiate as many as 56 germplasm lines and the remaining eight accessions that showed identical profiles could be differentiated using total proteins. Wherever total protein and peroxidase could not distinguish accessions, other enzymes contributed for differentiation. Thus, all the 64 accessions could be differentiated using isozyme specific profile/fingerprint data using three isozyme systems and total protein.

251. Vamadevaiah, H.M.; Katageri, I.S.; Anita, B.; Thippeswamy, S.; Soregaon, C.D. (University of Agricultural Sciences, Dharwad (India). Agricultural Res. Stn.). Identification of RAPD markers in genetic purity test of DHH-11 intra *Hirsutum* hybrid. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 107-111 KEYWORDS: GENETIC MARKERS; HYBRIDS; PURITY; QUALITY CONTROLS; RAPD; IDENTIFICATION.

To distinguish and identify DHH-II from their parents PCR based DNA marker has been identified which is useful in genetic purity test of this hybrid. After screening 120 primers, it was found that 11 primers viz., OPA 02, OPA II, OPA 07, OPC 11, OPC 17, CPP 08, OPY 04, OPY 15, OPY 18, OPZ 05 and OPZ 10 were able to differentiate CPD-420 male parent and CPD-423 female parent of DHH-II. Among these 12, OPC 17 had amplified 700 bp locus in DHH-II. As it is male parent specific, stable and repeatable marker, it can be used to differentiate between female parent and DHH-11 hybrid and would therefore be utilized as -

marker to test genetic purity of DHH-II in place of time consuming, laborious and cumbersome test like grow-out-test.

252. Kumar, A.; Sharma, S.C.; Meenakshi (Chaudhary Sawarn Kumar Himachal Pradesh Krishi Viswavidyalaya, Bajaura (India). HAREC). Genetics of total sugars and proline content associated with drought tolerance in bread wheat. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 115-117 KEYWORDS: GENETIC VARIATION; TRITICUM AESTIVUM; DROUGHT RESISTANCE; GENE INTERACTION; REPLICATION; SUGAR; PROLINE.

Gene effects were analyzed using mean value of total sugars and proline content through generation mean analysis under rainfed (E1) and irrigated (E2) environments. Both additive-dominance model and digenic epistatic model were found to be inadequate in all the crosses under both the environments to explain genetic variation among the generation means for both the characters. Additive gene effects were more pronounced than dominance gene effects and epistatic effects, particularly dominance x dominance (I) type of interaction was more predominant for both the characters. Duplicate type of epistasis was observed in the crosses S 4/HPW 89 and VL 421/HS 240 for both the characters and for VL 421/PBW 175 for only proline content under both the environments.

253. Das, P. (Jawaharlal Nehru Krishi Viswa Vidyalaya, Chhindwara (India). Zonal Agricultural Res. Stn.). Correlation of yield components in segregating population of wheat. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 119-121 KEYWORDS: GENETIC CORRELATION; YIELD COMPONENTS; SEGREGATION; WHEATS; GENETIC POPULATION; GENOTYPES; PHENOTYPES.

Study of genetic association in six diverse parents of wheat, F1, F2 and F3 generations and their 15 crosses in wheat revealed that selection for the improvement of spikes/plant, kernels/spike and spikelets/spike will lead, to improvement in the yield. Other characters were positively associated except 1000-kernel weight which had negative correlation with other characters including yield.

254. Khatri, M.; Singh, S.; Rana, O.P.S. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Genetics); Lokesh (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Plant Breeding). Influence of genotype and explant on callus induction and regeneration in wheat (*Triticum aestivum*). *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 123-129 KEYWORDS: EXPLANTS; GENOTYPES; REGENERATION; TRITICUM AESTIVUM; CALLUS; WHEATS.

Three explants (shoot tip, leaf base and immature embryo) from six genotypes of wheat, namely, Tordo, PBW 343, WH 533, 8948A and Norin 10 and Oleson were used for callus induction and regeneration on MS medium supplemented with different hormonal combinations. Genotypic differences were observed for callus induction from shoot tip and leaf base but not from immature embryo on all the concentrations of 2, 4, 10 (1-4 mg/l). Genotypic differences were also present for regeneration. Tordo was the most responsive genotype for plant regeneration irrespective of the explant used. The size of the shoot tip (1.2 mm) and age of the mother seedling (4 days old) were the crucial factors for callus induction and regeneration. The genotype Oleson was recalcitrant to regeneration from any of the explants used.

255. Singh, S. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Genetics); Lokesh (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India).

Dept. of Plant Breeding). Study on compatible solutes under sodium chloride stress in some wheat genotypes. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 131-136 KEYWORDS: GENOTYPES; TRITICUM AESTIVUM; WHEATS; SALT TOLERANCE; OSMOTIC STRESS; IN VITRO CULTURE; PROLINE; SOLUTES; FREE AMINO ACIDS.

The calli raised from embryos of three wheat genotypes (HP 2009, WH 157 and KH 65), representing sensitive, moderately tolerant and tolerant to salt stress, respectively, and their F1's were challenged on MS medium with 0.5, 1.0 and 1.5 percent sodium chloride. The salt stress increased the amount of proline, soluble carbohydrates and free amino acids in both tolerant and sensitive genotypes whereas the amount of protein decreased in all the genotypes. The salt tolerant genotypes KH 375 and WH 157 had less decrease in callus dry weight. It appears that accumulation of compatible organic solutes alone may not be the sole criterion of salt tolerance in wheat.

256. Sidhu, D.S.; Dhillon, G.P.S.; Singh, A. (Punjab Agricultural University, Ludhiana (India). Dept. of Forestry and Natural Resources). Genetic variation among progenies of plus trees of *Dalbergia sissoo* Roxb. at nursery stage. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 165-167 KEYWORDS: GENETIC VARIATION; PROGENY; HERITABILITY; DELBERGIA SISSOO; DEVELOPMENTAL STAGES.

The study was conducted at Punjab Agricultural University, Ludhiana by raising 13 progenies of *Dalbergia sissoo* Roxb. (shisham) under conditions following randomized block design for two consecutive years. The differences among progenies for collar diameter and plant height were found to be statistically significant. The phenotypic coefficients were moderate (10.21 to 27.12 percent) and high heritability (67.21 to 80.62 percent) was noticed.

257. Jhang, T. (Indian Agricultural Research Institute, New Delhi (India). National Research Centre on Plant Biotechnology); Vikal, Y.; Singh, K.; Sidhu, J.S. (Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding, Genetics and Biotechnology); Dhaliwal, H.S. (Indian Institute of Technology, Roorkee (India). Dept. of Plant Biotechnology). Introgression and molecular identification of quantitative trait loci for yield components in rice (*Oryza sativa* L.) variety Basmati 370. *Indian Journal of the Genetics and Plant Breeding (India)*. (Feb 2007) v. 67(1) p. 1-6 KEYWORDS: ORYZA SATIVA; SEGREGATION; YIELD COMPONENTS; LOCI; INTROGRESSION; GENETIC MARKERS; RICE; AGRONOMIC CHARACTERS; VARIETIES.

To improve yield potential of export quality traditional Basmati rice (*Oryza sativa* L.) variety Basmati 370, QTL for yield components were introgressed from a high yielding tropical japonica cultivar Palawan through marker assisted selection in BC2F2 population. Transgressive segregants were observed for all traits. Enhancement over recurrent parent for panicle weight (155.5 percent), panicle number (141.5 percent), grains per panicle (35.7 percent), 10 D-grain weight (35 percent), panicle length (20 percent) and for overall grain yield was 168.7 percent. A set of 201 SSR markers was used to identify and tag a total of 19 putative QTL by bulked segregant analysis. Six putative QTL for panicle number were tagged on chromosome 1, 2, 7, 8, and 12, five for panicle weight on chromosome 1, 5, 7, 9 and 12, three QTL for 100 grain weight 1, 6 and 7 and five QTL for grain yield per plant on chromosome 1, 2, 7, 8 and 12 were detected. The QTL identified in this study will be useful in molecular breeding of Basmati for improvement of yield.

258. Datta, D. (Indian Institute of Vegetable Research, Varanasi (India); Prashar, M.; Bhardwaj, S.C. (Directorate of Wheat Research, Shimla (India). Regional Stn.). Validation and incorporation of leaf rust resistance genes Lr9, Lr19, Lr24 and Lr26 through molecular markers in wheat (*Triticum aestivum* L.). *Indian Journal of the Genetics and Plant Breeding* (India). (Feb 2007) v. 67(1) p. 7-11 KEYWORDS: GENETIC MARKERS; RUSTS; GENES; LEAVES; PLANT DISEASES; DISEASE RESISTANCE; WHEATS; TRITICUM AESTIVUM.

Molecular markers for the leaf rust resistance genes Lr9, Lr19, Lr24, rye specific chromatin (1 BL.1 RS translocation, Lr26), and Lr28 were validated in the parental lines of wheat (*Triticum aestivum* L.). The markers for Lr9, Lr19 and Lr26 were able to discriminate the lines with specific genes/chromatin from the lines that did not carry these genes. The Lr24 marker showed polymorphism between positive and negative controls but in white grained genotypes the amplified band was faint and inconsistent as compared to red seeded lines. The marker used for detecting Lr28 was not polymorphic among the tested carrier and non-carrier lines. The markers of Lr19 and Lr24 were utilized for authenticating the presence of specific genes in the advanced breeding lines, whereas rye-chromatin specific marker was used for marker assisted selection of Lr26. Genetic stocks with combined resistance genes Lr19 + Lr26 + 5r25 + 5r31 + Yr9 + Yr27 and Lr24 + Lr26 + 5r24 + 5r31 + Yr9 + Yr27 were developed in the background of PBW 343 with the aid of pedigree information, host-pathogen interaction and molecular marker.

259. Faseela, K.V.; Joseph, S. (Kerala Agricultural University, Thrissur (India). Dept. of Olericulture). Molecular characterization of amaranth landraces and assessment of interspecific relationships among *Amaranthus* spp. (L.) using RAPD markers. *Indian Journal of the Genetics and Plant Breeding* (India). (Feb 2007) v. 67(1) p. 12-17 KEYWORDS: AMARANTHUS; GENETIC MARKERS; RAPD; GENETIC DIVERSITY; GENOTYPES; GERMPLASM.

Amaranth landraces belonging to three species namely *Amaranthus tricolor*, *A. dubius* and *A. hypochondriacus* were studied for assessing genetic diversity and interspecific relationship using RAPD markers. Eighteen primers used for the study showed a very high level of polymorphism. Out of the total 376 bands detected, 89 percent were polymorphic. Genetic similarity indices ranged from 0.252 to 0.942 indicating a very high level of diversity within land race collection which is mainly attributed to interspecific diversity. Three species distinctly formed three different groups on clustering. Clustering was influenced by morphological characters like leaf colour, but no geographical trends were clear. RAPD markers specific to each species were identified which can be utilized in future as SCARs. *A. dubius* and *A. hypochondriacus* were observed to be genetically closer than *A. tricolor*.

260. Santhoshlal, P.S. (University of Calicut, Kollam (India). Dept. of Botany); Pavithran, K. (University of Calicut, Calicut (India). Div. of Genetics). Transformation of genetical ratios in crosses involving X-ray irradiated pollen grains in rice (*Oryza sativa* L.). *Indian Journal of the Genetics and Plant Breeding* (India). (Feb 2007) v. 67(1) p. 18-22 KEYWORDS: XRAY IRRADIATION; POLLEN; RICE; ORYZA SATIVA; GENETIC TRANSFORMATION; HYBRIDIZATION.

Early reports on radiation dependant-genetical transformation indicated that sublethal levels of irradiated pollen grains allow development of normal hybrid progeny but in subsequent generations they occasionally express paternal characters due to differential inheritance of donor genes. However, detailed genetic analysis has not yet been followed up for confirmatory analysis of genetic transformation especially in rice (*Oryza sativa* L.). Presently different crosses of (normal and treated) Cherumodan (green) x Japan Violet

(purple) were effected by using X-ray irradiated pollen grains of the male parent in the treated crosses. The crosses were studied up to F₃ of the control and M₃F₃ of the treated generations for inheritance/differential inheritance for fourteen morphological characters. The results showed transformation of genetical ratios in respect of ten morphological characters in the M₂F₂ populations when compared to the control. Observations recorded in the F₁M₂F₂ are duly confirmed by the results obtained from the F₁M₃F₃ generations. It could be concluded that irradiation might have caused allelic differences as to transform genetical ratios concerned as discussed.

261. Rosamma, C.A.; Vijaykumar, N.K. (Kerala Agricultural University, Thrissur (India). Agricultural Research Stn.). Variation in quantitative characters and heterosis in F₁ rice (*Oryza sativa* L.) hybrids as affected by male sterile cytoplasm. Indian Journal of Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 23-27 KEYWORDS: CYTOPLASMIC MALE STERILITY; ORYZA SATIVA; GENETIC VARIATION; RICE; HYBRIDS; HETEROSIS; QUANTITATIVE ANALYSIS; AGRONOMIC CHARACTERS.

In hybrid breeding programme based on cytoplasmic-genic male sterility, the effect of sterility inducing cytoplasm on agronomic traits is of considerable importance. In rice (*Oryza sativa* L.) there are reports showing that sterile cytoplasm reduced the productive capacity of hybrids compared with normal cytoplasm of the maintainers. Forty eight hybrid combinations including 24 AIR hybrids and their reciprocals were evaluated and mean values for 15 different characters were compared. It was found that there is significant difference between direct hybrids and their reciprocals for almost all characters except ways to flowering, total dry matter production, panicle length and 100 seed weight. This difference in performance of these two sets of hybrids can be attributed to cytoplasmic effect. Even though these are the average performances of the two groups of hybrids, when different cross combinations are compared, it can be seen that these are cross specific and each cross differs in their performance. Evaluation of heterosis expressed by different hybrids revealed that number of reciprocal hybrids expressing positive and significant heterosis for grain yield was high compared to direct hybrids. All these explain the possible negative influence of sterile cytoplasm on quantitative characters.

262. Vaishali, M.G.; Girish, T.N.; Nagabhushan, K.; Biradar, H.; Hittalmani, S. (University of Agricultural Sciences, Bangalore (India). Dept. of Genetics and Plant Breeding). Novel method for simultaneously estimating yield parameters and disease incidence for neck blast using half-plant panicles inoculation approach in rice (*Oryza sativa* L.). Indian Journal of Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 28-30 KEYWORDS: ORYZA SATIVA; GENOTYPES; RICE; MORBIDITY; INOCULATION; INFLORESCENCES; YIELDS; YIELD FACTORS.

A new procedure is described to screen neck blast disease and simultaneously evaluate for grain yield within the same plant and estimate yield losses if any. Taking the example for neck blast resistance, fourteen rice (*Oryza sativa* L.) genotypes were evaluated for neck blast using the "half-plant panicles inoculation approach to check the possibility of simultaneous screening for both yield parameters and neck blast resistance, thus avoiding losing the valuable genetic material. In this approach half the number of panicles in each of the five selected plants of each genotype were inoculated with mixed blast isolates and the other half of the panicles of a plants were used as uninoculated control. The results from this approach were then compared with two other treatments where in all the panicles in the selected five plants were inoculated with the mixed isolate spores and untreated as control

plants, respectively. The results indicated that no significant difference in the yield loss between the whole plant inoculated and whole plant uninoculated control and yield loss between the inoculated and uninoculated panicles of the same plant (half the number of panicles inoculated and rest was untreated control). This approach serves as a valuable method to simultaneously estimate yield parameters as well as neck blast incidence within the same plant and, thus helps to avoid having several treatments and progeny testing in segregating generations.

263. Prakash, V. (Agricultural Research Station, Jaipur (India). Dept. of Plant Breeding and Genetics). Screening of wheat (*Triticum aestivum* L.) genotypes under limited moisture and heat stress environments. *Indian Journal of Genetics and Plant Breeding* (India). (Feb 2007) v. 67(1) p. 31-33 KEYWORDS: SELECTION; HEAT STRESS; GENOTYPES; MOISTURE CONTENT; TRITICUM AESTIVUM; WHEATS; DROUGHT RESISTANCE; ENVIRONMENTAL IMPACT.

Moisture and high temperature stress are major constraints in wheat (*Triticum aestivum* L.) productivity. To generate information on the effect of high temperature and moisture stress on various traits which contribute for yield would be helpful in developing tolerant wheat genotypes. An experiment was conducted on a set of 27 diverse wheat genotypes, including three released cultivars for late sown and limited moisture conditions. The experiment was conducted under normal sown, with limited (one irrigation) moisture and under late sown (six irrigation) conditions. The results revealed that days to flowering, biomass yield and 1000-grain weight were less affected by the stress conditions. The genotypes WR-626, WR-631, WR-642 and PBW 373 showed better performance under both the (high temperature & low moisture) stresses with less reduction in grain yield. The characters HSI and DSI could be taken as important criteria for breeding wheat genotypes suitable for stress environments.

264. Narain, V.; Singh, P.K. (Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Project Coordinating Unit, Linseed); Kumar, N.; Singh, V.S. (Chandra Sekhar Azad University of Agriculture and Technology, Jhansi (India). Crop Research Farm). Gene effects for grain yield and related traits in sorghum (*Sorghum bicolor* (L.) Moench). *Indian Journal of Genetics and Plant Breeding* (India). (Feb 2007) v. 67(1) p. 34-36 KEYWORDS: SELECTION; GENETIC ENGINEERING; YIELDS; SORGHUM; GENETIC CORRELATION; RECURRENT SELECTION; GENOTYPES; GRAINS; SORGHUM BICOLOR.

Generation mean analysis was carried out to estimate the nature and magnitude of gene effects in sorghum [*Sorghum bicolor* (L.) Moench]. Inadequacy of simple additive-dominance model reflected the presence of epistatic interaction. All the four traits in majority of crosses were under the influence of dominance gene effects. Higher magnitude of dominance and dominance x dominance gene interactions could not be exploited in the crosses with duplicate epistasis as it minimizes the expression of heterosis. Reciprocal recurrent selection and/or biparental mating in early segregating generations can prove to be an effective approach for development of high yielding sorghum varieties.

265. Arulselvi, S.; Mohanasundaram, K.; Selvi, B. (Tamil Nadu Agricultural University, Coimbatore (India). Centre for Plant Breeding and Genetics); Malarvizhi, P. (Tamil Nadu Agricultural University, Coimbatore (India). Soil Science and Agricultural Chemistry). Genetic variability studies and interrelationships among nutritional quality characters, phytate phosphorus and grain yield in the seeds of pearl millet (*Pennisetum glaucum* (L.) R. Br.).

Indian Journal of Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 37-40
 KEYWORDS: GENETIC VARIATION; GENETIC CORRELATION; NUTRITIVE VALUE; PENNISETUM GLAUCUM; PEARLMILLET; YIELDS; GRAIN; CHEMICAL COMPOSITION; PHYTATES; PHOSPHORUS.

The data on chemical constitution of pearl millet [*Pennisetum glaucum* (L.) R. Sr.] grain and grain yield were recorded for sixty three hybrids and their sixteen parents during post rainy season of 2004. Significant differences were observed for all the characters studied. More or less equal magnitude of both genotypic and phenotypic coefficient of variation was observed for all the characters. Heritability in broad sense and genetic advance were found to be high to moderate for recorded characters. Highly significant negative correlation was observed between grain yield and protein. Phytate phosphorus is positively associated with phosphorus and negatively associated with iron and zinc. This study suggested that simultaneous improvement of both grain quality characters and grain yield is difficult.

266. Kumar, A. (Nodai Seeds India Private Limited, Hyderabad (India); Mishra, M.N. (R.B.S. College, Agra (India). Dept. of Plant Breeding and Genetics); Kharkwal, M. C. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). Induced mutagenesis in blackgram (*Vigna mungo* (L.) Hepper). Indian Journal of Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 41-46
 KEYWORDS: MUTAGENS; INDUCED MUTATION; URD; VIGNA MUNGO; MUTAGENECITY; MUTATION.

A wide range of chlorophyll and viable morphological mutations affecting almost all the parts of the plant and seed characteristics were isolated in M2 generation of blackgram [*Vigna mungo* (L.) Hepper] variety Type-9 treated with gamma rays doses 50 to 500 Gy. The comparative study of frequency and spectrum of chlorophyll and viable mutations and the mutagenic effectiveness and efficiency of gamma rays on blackgram included two treatment conditions: 1. Irradiation of dry seeds with 50 to 500 Gy with an interval of 50 Gy, 2. Soaking of seeds in water for 6 hours before irradiation- with 50 to 500 Gy again with the same interval of 50 Gy. Mutation rate indicated that 400 Gy dry treatment was most potent in inducing chlorophyll and viable mutations. The frequency and spectrum of the induced chlorophyll mutations was in the order of - Chimera, chlorina, albina. and xantha. Higher doses of gamma rays treatment 500, 450 and 400 Gy showed high lethality under both the treatment conditions - dry and soaked. The treatment of 400 Gy gamma rays under dry condition showed highest mutagenic efficiency in inducing mutations in blackgram. However, lower doses of gamma rays i.e., 250 Gy under dry condition and 150 Gy under soaked condition were also quite effective and efficient.

267. Sharma, A.K.; Singh, G.; Sharma, S.; Sood, S. (Chaudhary Swarn Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur (India). Dept. of Vegetable Science and Floriculture). Combining ability and heterosis for pod yield and its related horticultural traits in garden pea (*Pisum sativum* L.) under mid-hill sub-temperate and high-hill dry-temperate conditions of Himachal Pradesh. Indian Journal of Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 47-50
 KEYWORDS: COMBINING ABILITY; PISUM SATIVUM; HETEROSIS; PEAS; ARID ZONES; TEMPERATE ZONES; YIELDS; AGRONOMIC CHARACTERISTICS; HIMACHAL PRADESH; HIGHLANDS.

A line x tester analysis involving 10 promising lines and 2 testers having wider genetic base were carried out for pod yield and related horticultural traits in garden pea (*Pisum sativum* L.) in diverse environments at Kukumseri (dry-temperate) and Palampur (sub-

temperate) during summer 2004 and winter 2004-05, respectively. Among the parents, Green Pearl, Azad P 1, DPP 9418-06 and DPP 9411 were observed as good general combiners for pod yield/plant and majority of the component traits. The cross combinations Green Pearl x DPP 9411 and Azad P 1 x Sugar Giant showed high heterosis and sea effects for pod yield and related horticultural traits. The cross Green Pearl x Sugar Giant was the most promising for early flowering and green pod picking. For powdery mildew incidence, the cross VRPMR 10 x Sugar Giant where both parents revealed high negative gene effects also showed significant negative gene effect and heterosis. For most of the traits including pod yield/plant, both additive and non-additive gene actions were of prime importance.

268. Manjaya, J.G.; Gopalakrishna, T.; Pawar, S.E.; Bapat, V.A. (Bhabha Atomic Research Centre, Mumbai (India). Nuclear Agriculture and Biotechnology Div.). Genetic variability for trypsin inhibitor content in soybean (*Glycine max* (L.) Merrill) and its correlation with oil and protein. *Indian Journal of Genetics and Plant Breeding* (India). (Feb 2007) v. 67(1) p. 51-55
KEYWORDS: GENETIC VARIATION; SOYBEANS; GLYCINE MAX; GENETIC CORRELATION; TRYPSIN INHIBITORS; STATISTICAL METHODS; LIPID CONTENT; PROTEIN CONTENT.

Trypsin inhibitors are one of the most important antinutritional factors in soybean [*Glycine max* (L.) Merrill.]. They decrease the digestibility of protein and cause pancreatic hypertrophy. Fifty-five soybean genotypes including Indian cultivars were analysed for trypsin inhibitor activity (TIA). Mean TIA ranged from 14.49 mg g⁻¹ seed meal to 29.05 mg g⁻¹ seed meal. Genotypes PK.1042 (14.49) and EC-389178 (22.20) showed lower TIA mg g⁻¹ seed meal. The studies showed no correlation of TIA with days to maturity, oil content, protein content and seed yield. Based on multivariate analysis, TIA showed maximum contribution to D2 value indicating scope for selection of parents in a breeding programme.

269. Soregaon, C.D.; Veereshgowda, R.P.; Katageri, I.S. (Agricultural Research Station, Dharwad (India); Khadi, B.M. (Central Institute of Cotton Research, Nagpur (India). Introgression of fiber traits of *Gossypium barbadense* L. into *Gossypium hirsutum* L.. *Indian Journal of Genetics and Plant Breeding* (India). (Feb 2007) v. 67(1) p. 56-61
KEYWORDS: INTROGRESSION; GOSSYPIUM BARBADENSE; COTTON; GOSSYPIUM HIRSUTUM; INTERSPECIFIC HYBRIDIZATION; AGRONOMIC CHARACTERS.

F2 of cotton hybrid DCH-32 was forwarded to F3 as a tmlk by taking 10 seeds per plant similarly two seeds from each F3 plants were taken to constitute F4 generation. Selection in F4 generation was carried out. Measurement of halo length was used as base for selection of plants. As many as 184 plants were selected. On detail investigation of fibre traits, plants with 23 g/tex fibre strength, 30 mm fibre length (2.5 percent SL) and around 4 micronaire value have been isolated. Selected plants were tested in F5 generation in plant to row progeny, plants with higher fibre strength (23 g/tex) have been recovered; however micronaire of these plants was around 2.8. Finally the selected plants tested in F5 have been recorded for seed cotton yield, ginning outturn and fibre properties. Desirable plants having higher seed cotton yield than DS-28 (38 g/plant) with high fibre strength (23 wtex) have been recovered, however, the micronaire of these plants is around 2.8.

270. Singh, M. (Central Institute of Medicinal and Aromatic Plants, Lucknow (India); Srivastava, A. (University Nebraska Medical Centre, Omaha (United States of America). Dept. of Biochem. and Molecular Biology); Singh, A.P. (Lucknow University, Lucknow (India). Botany Dept.); Singh, V.; Srivastava, A.; Sharma, S.; Uniyal, G.C.; Dwivedi, S. (Central Institute

of Medicinal and Aromatic Plants, Lucknow (India). Genetic analysis of important morpho-economic traits in periwinkle (*Catharanthus roseus* (L.) G. Don.). *Indian Journal of Genetics and Plant Breeding* (India). (Feb 2007) v. 67(1) p. 62-65 KEYWORDS: DIALLEL ANALYSIS; CATHARANTHUS ROSEUS; COMBINING ABILITY; GENETIC CORRELATION; GENETIC VARIATION.

The experiment was conducted with six diverse genotypes including one 0.5 percent EMS induced mutant and one released white with cream center cultivar 'Nirmal' and one recently released white petal with pink center cultivar 'Prabal' of periwinkle (*Catharanthus roseus* (L.) G. Don.] to seek the genetic information on leaf alkaloid yield by using diallel analysis. Analysis of variance -6 x 6 diallel cross. progenies revealed highly significant differences among treatments (inclusive of direct and reciprocal F1S and the parents) for all the traits. This study revealed that medium x medium and medium x high performing parents provided the best cross combination for the production of high leaf alkaloid yielding lines. Based on three analyses, namely graphical, variance component and combining ability, both additive and non-additive genetic variances were found important in the inheritance of alkaloid yield and other yield contributing characters although non-additive component was higher than the additive component for most of the characters except for leaf-stem ratio.

271. Wani, A.M.; Chauhan, K.C. (Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Tree Improvement and Genetic Resources). Genetic divergence between half-sib families under different environments in Kachnar (*Bauhinia variegata* L.). *Indian Journal of Genetics and Plant Breeding* (India). (Feb 2007) v. 67(1) p. 66-69 KEYWORDS: GENETIC DISTANCE; ENVIRONMENT; BAUHINIA VARIEGATA; GENETIC RESOURCES.

Thirty-two half sib progenies of Kachnar (*Bauhinia variegata* L.) belonging to different geographic regions of Himachal Pradesh, Haryana, and Jammu & Kashmir were sown in glasshouse and field condition during 2004 with a view to assess the impact of two different environments on the expression of genetic diversity using non-hierarchical Euclidean cluster analysis. Superior tree progenies were grouped into ten and eight clusters in glasshouse, and field atmosphere, respectively. Families of plus tree T5 and T6 formed one cluster both under glasshouse and field background. Whereas, T3 and T9; T19 and T2; T17 and T18; T15 and T22; T15 and T18; T30 and T31 formed same group but different clusters. Intra cluster distance only under glasshouse condition was zero for cluster II, VI and X. The highest inter cluster distance was found between cluster X and III (12.293, under glasshouse), cluster IV and I (7.325, under field situation). Seedling height contributed maximum to the total divergence and played a predominant role in creating the genetic diversity.

272. Gupta, S. (ICAR Research Complex for North Eastern Hill Region, Barapani (India); Khanna, V.K. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Genetics and Plant Breeding); Chowdhury, V.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Biotechnology and Molecular Biology). Use of amino acids and silicon carbide fibers for improving in vitro plant regeneration and Agrobacterium mediated genetic transformation in Sudan grass [(*Sorghum sudanense* (Piper)]. *Indian Journal of Genetics and Plant Breeding* (India). (Feb 2007) v. 67(1) p. 70-72 KEYWORDS: GENETIC TRANSFORMATION; INVITRO CULTURE; SORGHUM ARUNDINACCUM; INVITRO REGENERATION; AMINO ACIDS; AGROBACTERIUM; SILICON.

273. Singh, B.; Vinod; Tomar, S.M.S. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). Genetics of crinkled leaf in *Triticum aestivum* L. and hairy peduncle in triticale. *Indian Journal of Genetics and Plant Breeding (India)*. (Feb 2007) v. 67(1) p. 73-74
KEYWORDS: GENETIC VARIATIONS; GENETICS; TRITICUM AESTIVUM; TRITICOSECALE; GENOTYPES.

274. Bala, R.; Goel, R.K.; Singh, K.; Das, A. (Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding, Genetics and Biotechnology). Sources of resistance to brown leaf spot [*Drechslera oryzae* (Breda de Haan) Subram. & Jain] in some wild *Oryza* spp.. *Indian Journal of Genetics and Plant Breeding (India)*. (Feb 2007) v. 67(1) p. 75-76
KEYWORDS: GENETIC RESOURCES; ORYZA SATIVA; SPOTS; GENOMES; DISEASE RESISTANCE; COCHLIOBOLUS MIYABEANUS.

275. Kumar, J. (Indian Institute of Pulses Research, Kanpur (India). Div. of Crop Improvement); Gadag, R.N; Singh, B.B. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). Combining ability studies among the inbred lines of sweet corn (*Zea mays* L. *saccharata*). *Indian Journal of Genetics and Plant Breeding (India)*. (Feb 2007) v. 67(1) p. 77-78
KEYWORDS: COMBINING ABILITY; SWEET CORN; ZEA MAYS; INBRED LINES; YIELD COMPONENTS; GENETIC VARIATION; YIELDS.

276. Lukose, S.; Godawat, S.L. (Maharana Pratap University of Agriculture and Technology, Udaipur (India). Dept. of Plant Breeding and Genetics). Combining ability for grain yield and drought related morpho-physiological traits in maize (*Zea mays* L.) under late sown conditions. *Indian Journal of Genetics and Plant Breeding (India)*. (Feb 2007) v. 67(1) p. 79-80
KEYWORDS: COMBINING ABILITY; ZEA MAYS; GENOTYPES; PHYSIOLOGICAL FEATURES; SOWING DATE; DROUGHT STRESS; ENVIRONMENT; YIELDS; DROUGHT RESISTANCE; MAIZE.

277. Ali, G.; Ishfaq, A. (Sher-e-Kashmir University of agriculture Science and Technology, Srinagar (India). Div. of Plant Breeding and Genetics); Rather, A.G. (High Altitude Maize Research Station, Pahalgam (India); Wani, S.A.; Zaffar, G.; Makhdoomi, M.I. (Sher-e-Kashmir University of Agricultural Science and Technology, Srinagar (India). Div. of Plant Breeding and Genetics). Heterosis and combining ability for grain yield and its components in high altitude maize inbreds (*Zea mays* L.). *Indian Journal of Genetics and Plant Breeding (India)*. (Feb 2007) v. 67(1) p. 81-82
KEYWORDS: COMBINING ABILITY; INBRED LINES; HETEROSIS; ZEA MAYS; MAIZE; YIELD COMPONENTS; YIELDS; ATITUDE; GENETIC VARIATION; HYBRIDS.

278. Kumar, P. (Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology); Mahajan, V.; Shukla, S.K. (Vivekananda Parvitiya Krishi Anusandhan Sansthan (ICAR), Almora (India). Crop Improvement Division). Identification of cold tolerant chickpea (*Cicer arietinum* L.) genotypes suitable for mid-hills of northern India. *Indian Journal of Genetics and Plant Breeding (India)*. (Feb 2007) v. 67(1) p. 83-84
KEYWORDS: IDENTIFICATION; CHICKPEAS; COLD TOLERANCE; GENOTYPES; CICER ARIETINUM; HIGHLANDS; INDIA.

279. Talukdar, D.; Biswas, A.K. (University of Kalyani, Nadia (India). Dept. of Botany). Long pedicelled mutant and its inheritance in grasspea (*Lathyrus sativus* L.). *Indian Journal of*

Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 85-86 KEYWORDS: MUTANTS; LATHYRUS SATIVUS; GENETIC INHERITANCE; INDUCED MUTATION.

280. Kumar, R. (Birsa Agricultural University, Ranchi (India). Dept. of Genetics and Plant Breeding); Sinha Mahapatra, S.P.; Maity, S. (Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India). Dept. of Genetics and Plant Breeding). Inheritance of vegetative and reproductive growth period in Indian mustard (*Brassica juncea* Czern and Coss.) over environments. Indian Journal of Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 87-88 KEYWORDS: COMBINING ABILITY; VEGETATIVE PERIOD; GENETIC INHERITANCE; BRASSICA JUNCEA; GENOTYPES; GENETIC VARIATION; ENVIRONMENT.

281. Kumhar, J.P.; Sharma, K.C.; Sastry, E.V.D. (Rajasthan Agriculture University, Jobner (India). Dept. of Plant Breeding and Genetics). Heterosis in taramira [*Eruca sativa* (Mill.)] for seed yield and oil content. Indian Journal of Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 89-90 KEYWORDS: HETEROSIS; LIPID CONTENT; ERUCA SATIVA; HETEROSIS BREEDING; STATISTICAL ANALYSIS; YIELDS.

282. Kale, V.P. (Bejo Seetal Seeds Private Limited, Jalna (India). Plant Tissue Culture Laboratory); Kothekar, V.S. (Dr. Balasaheb Ambedkar Marathawada University, Aurangabad (India). Dept. of Botany). Studies on in vitro germplasm conservation in potato (*Solanum tuberosum* L.). Indian Journal of Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 91-92 KEYWORDS: GERMPLASM CONSERVATION; IN VITRO CULTURE; SOLANUM TUBEROSUM; INOCULATION.

283. Ram, K.; Singh, P. (Chander Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Genetics and Plant Breeding). Combining ability and gene effect for yield and quality characters in brinjal (*Solanum melongena* L.). Indian Journal of Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 93-94 KEYWORDS: COMBINING ABILITY; GENETIC VARIATION; GENES; AUBERGINES; SOLANUM MELONGENA; GENOTYPES; YIELDS; QUALITY; GENE INTERACTION.

284. Sood, S.; Bindal, A.; Sharma, A. (Chander Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Vegetable Science and Floriculture). Genetical study for quality traits in bell pepper [*Capsicum annuum* (L.) var. *grossum* Sendt.]. Indian Journal of Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 95-96 KEYWORDS: GENOTYPES; PHENOTYPES; QUALITY; GENETIC GAIN; SWEET PEPPERS; CAPSICUM ANNUUM; GENETIC CORRELATION; GENETIC VARIATION.

285. Prasath, D. (Indian Institute of Spices Research Centre, Medikeri (India); Ponnuswami, V.; Muralidharan, V. (Tamil Nadu Agricultural University, Coimbatore (India). Horticulture College and Research Institute). Evaluation of chilli (*Capsicum* spp.) germplasm for extractable colour and pungency. Indian Journal of Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 97-98 KEYWORDS: GERMPLASM; CAPSICUM; QUALITY; YIELDS; CHILLIES; GENETIC VARIATION; GENOTYPES.

286. Ghosh, A.; Datta, A.K. (Kalyani University, Kalyani (India). Dept. of Botany, Cytogenetics and Plant Breeding Section). Induced autotetraploids in Love-in-a-mist (*Nigella damascena*

L.). Indian Journal of Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 99-100
KEYWORDS: INDUCED POLYPLOIDY; TETRAPLOIDY; NIGELLA.

287. Agnihotri, D.K.; Singh, N.; Chauhan, S.V.S. (Dr. B.R. Ambedkar University, Agra (India). Dept. of Botany). Evaluation of surf excel-A detergent as chemical hybridizing agent in radish (*Raphanus sativus* L.). Indian Journal of Genetics and Plant Breeding (India). (Feb 2007) v. 67(1) p. 101-102 KEYWORDS: POLLINATION; POLLEN; FOLIAR APPLICATION; RAPHANUS SATIVUS; YIELDS; CHEMICALS.

288. Birader, H. (University of Agricultural Sciences, Bangalore (India). Dept. of Genetics and Plant Breeding); Bhargavi, M.V. (University of Agricultural Sciences, Bangalore (India). Dept. of Agricultural Chemistry and Soil Sciences); Sasalwad, R.; Parama, R.; Hittalmani, S. (University of Agricultural Sciences, Bangalore (India). Dept. of Agricultural Chemistry and Soil Sciences). Identification of QTL associated with silicon and zinc content in rice (*Oryza sativa* L.) and their role in blast disease resistance. Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 105-109 KEYWORDS: QUANTITATIVE GENETICS; IDENTIFICATION; TRACE ELEMENTS; QUANTITATIVE ANALYSIS; SILICON; ZINC; LOCI; ORYZA SATIVA; DISEASE RESISTANCE; BLIGHT.

QTL associated with zinc (Zn) and silicon (Si) content in rice were identified and mapped on different rice chromosomes. Based on interval mapping, a OTL was detected for silicon content on chromosome three and this OTL showed positive additive effect of 0.054 and explained 12.9 percent phenotypic variation. Additionally, single marker analysis results identified eighteen OTL for silicon content on different chromosomes. Similarly, a total of six OTL were identified for zinc content in rice seeds using single marker analysis and mapped one each on chromosome number 1, 4, 5, 8, 9 and 11. These OTL individually explained 4.4 percent to 9.5 percent phenotypic variation. The identified OTL were mapped on chromosome regions having blast resistance OTL and candidate genes for blast resistance. The overlapping of silicon and zinc OTL and disease resistance loci on same chromosome regions suggested their positive role in blast disease resistance.

289. Arya, S.; Toky, O.P. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Forestry). Isozyme variation in progenies of plus trees of *Acacia nilotica* (L.) ex. Del. ssp. *indica* (Benth.) Brenen from north-western India. Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 110-114 KEYWORDS: GENETIC VARIATION; PROGENY; ACACIA NILOTICA; PLUS TREES; PREROXIDASE; ESTERESSES; GENETIC DISTANCE; ISOENZYMES; INDIA.

Acacia nilotica ssp. *indica* (babul) is an extremely important agroforestry species in semi-arid regions of Indian sub-continent. Genetic variation among 30 progenies of 'plus' trees of this species collected from 3 states of India, were assessed by esterase and peroxidase isozyme profiles. Rf value in peroxidase isozyme ranged from 0.02 to 0.12 with 4 bands; while it ranged from 0.05 to 0.32 with 10 bands in esterase. The range of similarity index varied from 0.214 to 1.000 for the two enzymes. In general, lesser genetic diversity was observed in the ~progenies of plus trees from Gujarat, medium in Uttar Pradesh and higher in that of Haryana, and there were also some similarities between certain progenies of the 3 states. The dendrogram revealed the co-efficient level of 0.53 and three clusters, i.e. A, Band C with 6, 8 and 16 progenies, respectively. The study is important for analysis of

genetic diversity between progenies and its further use in establishment of seed orchards of *Acacia nilotica* ssp. *Indica*.

290. Marinkovic, R.; Atalgic, J. (Institute of Field and Vegetable Crops, Novi Sad (Serbia and Montenegro). Analysis of wild *Helianthus annuus* and *H. petiolaris* populations for presence of Rf genes for PET-1 cytoplasm. *Indian Journal of Genetics and Plant Breeding (India)*. (May 2007) v. 67(2) p. 115-117 KEYWORDS: GENES; CYTOPLASMIC MALE STERILITY; HELIANTHUS ANNUS; POPULATION GENETICS; DOMINANT GENES.

Presence of genes for restoration of male sterile PET-1 cytoplasm and mode of their action have been determined in 8 populations of wild *Helianthus annuus* and one *H. petiolaris* ssp. *petiolaris* Nutt. population. One dominant gene was found to be present in three wild *H. annuus* populations (ANN-2159, ANN -221 3 and ANN-2226) and the populations of *Helianthus petiolaris* ssp. *Petiolaris* Nutt. (PET-2167). The remaining 5 p.opulations (ANN-2143, ANN-2172, ANN-2173, ANN-2199 and ANN-2229) had two complementary dominant genes.

291. Padmavathi, G.; Krishnaiah, N.V.; Prasad, G.S.V.; Rao, Y.K. (Directorate of Rice Research, Hyderabad (India). Identification of green leafhopper [(*Nephotettix virescens* (Distant.))] resistance genes in rice. *Indian Journal of Genetics and Plant Breeding (India)*. (May 2007) v. 67(2) p. 118-120 KEYWORDS: GENETIC RESISTANCE; NEPHOTETTIX VIRESCENS; IDENTIFICATION; RICE; PEST RESISTANCE; INSECTA; GENETIC INHERITANCE.

The genetics of resistance to green leafhopper, [*Nephotettix virescens* (Distant.))] was studied in four pre-release green leafhopper resistant rice varieties viz., IET 12356 (RP 243298-6-3), IET 13268 (HKR 91-102), IET 15359 (BPT 6858), IET 1"5120 (CRM 47). The parental lines, F1s and F2 populations derived from the crosses of resistant varieties with the susceptible variety, TN1 or Phalguna or Sona and inter crosses among resistant varieties were screened against Indian population of green leafhopper in greenhouse at Directorate of Rice Research, Hyderabad. The inheritance of resistance suggested that two dominant complementary genes governed resistance in IET 13268, a single recessive gene in IET 15359, two recessive genes in IET 15120 and a single dominant gene in IET 12356. The single dominant gene of IET 12356 was allelic to Glh 6 in IR 64.

292. Devanshi (Bundelkhand University, Jhansi (India). Dept. of Biotechnology); Singh, A.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Fruits and Horticultural Technology); Sharma, P. (National Research Centre on Plant Biotechnology, New Delhi (India); Singh, B. (Bundelkhand University, Jhansi (India). Dept. of Biotechnology); Singh, R.; Singh, N.K. (National Research Center on Plant Biotechnology, New Delhi (India) . Molecular profiling and genetic relationship among ber (*Ziziphus* sp.) genotypes using RAPD markers. *Indian Journal of the Genetics and Plant Breeding (India)*. (May 2007) v. 67(2) p. 121-127 KEYWORDS: GENETIC VARIATION; GENOTYPES; ZIZIPHUS; RAPD; GENETIC MARKERS; GENETIC POLYMORPHISM.

Genetic relationship study was performed with RAPD markers among 50 ber genotypes representing *Z. mauritiana*, *Z. nummularia* and *Z. spina-christi*. Out of 120 primers initially tested, 46 were highly reproducible and generated 368 RAPD markers with 86.2 percent polymorphism (316 polymorphic bands). The number of amplification product per primer ranged from 2 (OPF-9) to 17 (OPD-3)' with an average of 8 bands per priiner. The resolving' power (Rp) for different primers ranged from 0.48 (OPE4) to 9.37 (OPD-3) and polymorphic

information content (PIC) ranged from 0.12 (OPD-20) to 0.82 (OPE-9). Nineteen primers distinguished at least one genotype that would prove to be highly useful for identification of genotype and designing future breeding strategy. Genetic relationships between the accessions were established based on Jacquard's similarity coefficient and it ranged from 26.3 percent to -78.9 percent suggesting that the *Ziziphus* germplasm is genetically diverse. UPGMA cluster analysis generated dendrogram with six clusters separating two wild genotypes, *Z. nummularia* (collection 1) and *Z. spina-christi* from rest of the genotypes. Cluster-I and II comprised of two genotypes each, whereas, the biggest cluster, cluster VI comprised of 20 out of remaining 44 genotypes. In cluster II to cluster-VI, genotypes were separated from each other at different similarity levels in successive branching. The present study has proved that ber genotype earlier reported to be similar based on morphology are genetically different. The degree of genetic variation detected in *Ziziphus* species with RAPD analysis in the present study suggests that it is an efficient marker technology for delineating genetic relationships among genotypes and estimating genetic diversity, thereby enabling the formulation of appropriate strategy for conservation and improvement programmes.

293. Vanaja, T. (Kerala Agricultural University, Kannur (India). Pepper Research Stn.); Randhawa, G.J.; Singh, R. (National Bureau of Plant Genetic Resources, New Delhi (India). National Res. Centre for DNA Fingerprinting); Mahapatra, T. (Indian Agricultural Research Institute, New Delhi (India). National Research Centre for Plant Biotechnology). Analysis of molecular diversity and differentiation of photoperiod sensitive and insensitive rice varieties. *Indian Journal of the Genetics and Plant Breeding (India)*. (May 2007) v. 67(2) p. 128-134 KEYWORDS: GENETIC VARIATION; RICE; VARIETIES; GENETIC POLYMORPHISM; RAPD; GENETIC MARKERS; PHOTOPERIODICITY.

A study was undertaken to differentiate photoperiod sensitive and photoperiod insensitive rice varieties and to identify putative RAPD marker (s) associated with the trait. The genetic diversity analysis among photoperiod sensitive and photoperiod insensitive rice varieties using different DNA amplicons, grouped 40 varieties into two major clusters and nine sub-clusters. Sixty five per cent of photo sensitive varieties and 60 percent photo insensitive varieties were grouped in distinct clusters. The result indicated that response to photoperiod had played a major role in the pattern of clustering. The most distant pairs of rice varieties revealed from genetic distance are Bhagya and Ptb 12, Bhagya and Ptb 7, Sagara and Bhagya, and Dhanya and Bhagya. These distant varieties can be utilized in future breeding programmes as parents to get promising recombinants.

294. Singh, R.A.; Yadav, R.; Pahuja, S.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Forage Research Section). Evaluation of Egyptian clover germplasm using multivariate analyses. *Indian Journal of the Genetics and Plant Breeding (India)*. (May 2007) v. 67(2) p. 135-139 KEYWORDS: TRIFOLIUM ALEXANDRINUM; GERMPLASM; GENOTYPES; GENETIC VARIABILITY; STATISTICAL METHODS.

Principal factor and cluster analyses were carried out with 15 fodder and seed traits in 190 accessions of Egyptian' clover (*Trifolium alexandrinum* L.). Principal factor analysis identified four Principal Components which explained about 69 percent variability. 'Varimax rotation' enabled loading of similar type of variables on a common Principal Component permitting to designate them as fodder yield and seed yield factors. Genotypes GP 3, 19, 27, 28 and 29 were found to be better performers on the basis of principal factor scores with

regard to fodder yield and seed traits when both the principal factors were considered together. These genotypes may further be utilized in breeding programmes for improving fodder and seed yield. Hierarchical cluster analysis resulted into ten clusters containing one to sixty two genotypes. The best clusters with regard to fodder and seed characters were C II, VII and IX. The results of cluster and principal factor analyses were in agreement.

295. Tomer, A.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics); Tyagi, K.; Lal, J.P. (Banaras Hindu University, Varanasi (India). Dept. of Genetics and Plant Breeding). Selection of promising drought tolerant mutant lines in lentil (*Lens culinaris* Medik.). Indian Journal of the Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 140-144 KEYWORDS: SELECTION; DROUGHT RESISTANCE; LENTILS; LENS CULINARIS; INDUCED MUTATION; MUTANTS; GENETIC VARIABILITY.

Four lentil varieties of small seeded group (PL-639 and PL-406) and bold seeded group (K-75 and L-4076) mutagenised through gamma rays (10, 20 and 30 kR), EMS (0.04 M), sodium azide (0.05 M) and their combinations were evaluated for induced genetic variability and to identify the drought tolerant mutant lines and the trait(s) responsible for enhancing grain yield under rainfed condition. The findings suggest that materials ought to be tested in both moisture stress and moisture non-stress conditions so that the favourable alleles under drought can be maintained as well as the selection response under favorable condition can be maximized. Yield under drought (Y d)' yield potential' (Y p)' drought susceptibility index (S) and geometric mean (GM) were considered as the potential indicators for assessing drought resistance of a mutant line. Correlation coefficients between these parameters revealed that GM was positively and significantly correlated with both Y d and Y p' There was significant but negative correlation between Sand Y d' while no significant correlation between Sand Y p was observed. It was very clear from the correlation studies that for the enhancement of yield potential under both the conditions selection should be based on GM rather than on S, because S is a better measure of drought tolerance than a measure of performance under stress. Further, selected mutant lines were evaluated for different physiological parameters (nitrate reductase activity, wax content and protein content) In M4 generation and most of them showed higher values for NR activity and wax content. NR activity and wax content may be used as the more reliable parameters to form the basis of selection under rainfed conditions.

296. Singh, G.P.; Chaudhary, H.B. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). Stability of wheat genotypes for yield and moisture stress tolerance traits. Indian Journal of the Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 145-148 KEYWORDS: WHEATS; STABILITY; AGRONOMIC CHARACTERS; GENOTYPES; DROUGHT STRESS; YIELDS; GENOTYPE ENVIRONMENT INTERACTION; GENETIC VARIATION.

Forty genotypes of wheat were evaluated over six environments under different moisture regimes for their yield performance. Genotype x environment interaction was found significant for plant height, peduncle length, grain yield, biological yield, LPHIPH index, PULPH index PUPH index, ear length, tillers per meter and harvest index. On partitioning it into linear and non-linear components, both were responsible for expression of the traits. However, the linear component was found larger in magnitude than the non-linear component suggesting that the variation in the performance of different cultivars could be predicted. The genotypes RR 49 and IB2K1-37 were found to be stable across environments for grain yield, while genotypes RR 888, RR 49, IB2K1-66, RS 897, RR 24 and IB2K1-37 were

found to be stable across environments for yield components like 1000 grain weight, biological yield and tillers per meter. Genotypes DL 153-2, DL 788-2 and RR 19 were found to be having stable performance for plant height and component characters under stress environments. Thus these genotypes could be included in the hybridization programme to converge the stability characteristics of seed yield for development of a stable variety adapted to wider range of environments.

297. Nagarajan, S. (Indian Agricultural Research Institute, New Delhi (India). Nuclear Research Laboratory); Tripathi, S.; Singh, G.P.; Chaudhary, H.B. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). Effect of genotype and environment on quality traits and grain yield of wheat. Indian Journal of the Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 149-152 KEYWORDS: WHEATS; YIELDS; QUALITY; TRITICUM AESTIVUM; GENETIC VARIATION; GENOTYPES; GENOTYPE ENVIRONMENT INTERACTION.

Field experiments with 20 bread wheat and durum varieties of different origin were conducted in seven environments during 2005-06. Data on 5 quality traits (grain protein content, sedimentation value, test weight, thousand kernel weight, and grain density) and grain yield per plot were used to investigate the effects of G, E and G x E on these traits. Highly significant differences were detected among the environments and varieties for each of the quality variable. Both variety (V) and environment (E) had a significant effect on the quality traits and grain yield. Significant V ; E interaction indicated that quality trait evaluation must be undertaken for different environments. Highly significant positive 'correlation were observed for grain density and yield per plot, thousand kernel weight and yield per plot, grain density and thousand kernel weight, grain density and test weight (kg/hl), test weight and thousand kernel weight. Significant negative association was observed between grain protein content and thousand kernel weight. High heritability (broad sense) was observed for all the six traits under consideration with a moderate genetic advance and moderate to high genotypic and phenotypic coefficient of variation. These findings suggests that quality parameters could be greatly enhanced through genetic improvement for the targeted, well characterized production environments.

298. Kishore, N.; Dogra, R.K.; Thakur, S.R.; Chahota, R.K. (Chaudhary Swaran Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur (India). Dept. of Plant Breeding and Genetics). Stability analysis for seed yield and component traits in amaranthus [Amaranthus hypochondriacus L.] in the high altitude dry temperate regions. Indian Journal of the Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 153-155 KEYWORDS: STABILITY; GENOTYPES; GENOTYPE ENVIRONMENT INTERACTION; YIELDS; AMARANTHUS HYPOCHONDRIACUS; YIELD COMPONENTS; GENETIC VARIATION; ALTITUDE; TEMPERATE ZONES; ARID ZONES.

Joint regression analysis over eight environments in 8 genetically diverse amaranth genotypes during kharif seasons of 2001-2004 at Sangla (Distt. Kinnaur) and Salooni (Distt. Chamba) indicated the presence of genotype x environment interaction for all the traits studied. Significant pooled deviations for all the traits indicated predominance of the nonlinear component. Estimates of stability parameters revealed that no genotype was stable for the traits studied. Based on the mean performance (x), genotypes Annapurna, Suvarna and PRA-1 showed significantly higher seed yield than the Local check. Suvarna was significantly early in flowering (54 days) and maturity (107 days) than the other genotypes, whereas PRA-1 showed maximum mean plant height and inflorescence length. Significant

linear regression coefficient value for seed yield indicated above average (b1) stability for the genotype Annapurna i.e. suitability for the input responsive environment, whereas for plant height the genotype was significantly least responsive i.e. exhibited below average (b1) stability showing fitness for the low yielding environment. PRA-1 was also found to be significantly responsive for plant height in comparison to the Local check. Genotypes PRA-2 and the Local check exhibited least responsiveness for days to 50 percent flowering. Considering the stability parameters in general, genotype Suvarna is by far the best genotype followed by Annapurna and PRA-1 for cultivation in the higher regions of Himachal Pradesh.

299. Sarial, A.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics); Sarial, S.S. (Directorate of Wheat Research, Karnal (India); Singh, V.P. (Seeds and Agri-Business Division, KRBL Limited, New Delhi (India). Combining ability of new basmati fertility restorers for grain yield and its components in rice (*Oryza sativa* L.). Indian Journal of the Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 156-160 KEYWORDS: RICE; COMBINING ABILITY; INBRED LINES; ORYZA SATIVA; FERTILITY; YIELDS; YIELD COMPONENTS; HYBRIDS.

A line x tester (L x T) analysis was carried out in rice to characterize the newly identified fertility restorers of basmati type and their hybrids for general (gea) and specific (sea) combining ability. Twenty-one fertility restorers including 11 basmati type were selected after screening 45 improved germ plasm collections with 4 cyto sterile lines. The restorers and their hybrids were evaluated for grain yield and its component traits in a randomized block design (RBD). Of the 11 basmati type 5 were identified to be effective restorers. Restorer Basmati 385 and HKR 241 were found to be good general combiners for grain yield/plant, biomass yield/plant, 1000 grain weight and number of primaries/panicle, P1031 for 1000 grain weight and effective tillers/plant while, Karnal Local for biomass yield/plant and 1000 grain weight. Among CMS lines IR 58025A and PMS 3A were characterized as good general combiners for grain yield and other traits. The specific cross combinations characterized with high significant sea effects were IR 58025A x Basmati 385, IR 62829A x Basmati 385, IR 62829A x HKR 241 and PMS 3A x P1031-8-5-1 for grain yield/plant, biomass yield/plant and effective tillers/plant. IR 62829A x Karnal Local for 1000 grain weight, PMS 10A x SAP Khalsa 7 for days to 50 percent flowering and PMS 3A x HKR 241 for primaries/panicle. The gca effects of the parents were not reflected in the sea effects of the crosses in all traits studied. No generalized order of nicking among the parents to produce desirable combination was observed. Any sort of combination among the parents gave hybrid vigour over the parents which might be due to favorable dominant genes, over dominance or epistatic action of the genes.

300. Rao, A.R.; Prabhakaran, V.T. (Indian Agricultural Statistics Research Institute, New Delhi (India). Simultaneous selection of cultivars for yield and stability in crop improvement trials. Indian Journal of the Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 161-165 KEYWORDS: SELECTION; STABILITY; GENOTYPE ENVIRONMENT INTERACTION; YIELDS; VARIETIES; SELECTION INDEX; GENTIC VARIATION.

Assessment of cultivar performance in trials conducted across a range of locations and over years is often difficult because of the presence of significant location x year interaction. Methods for separation of environmental (location x year) variation into predictable and unpredictable components are available in literature. In the present paper an index, based

on cultivar yield and the predictable component of environmental variance, $MS(Y/L)$, is proposed for selecting cultivars simultaneously for high yield and stability. Two sets of rice data from All India Coordinated Rice Improvement Program, Directorate of Rice Research, Hyderabad, are used to illustrate the superior performance of the index method vis-a-vis the procedure advocated by Un and Binns [2]. A user-friendly computer programme written in 'c' for judging promising cultivars is developed and available on request.

301. Yadav, H.K.; Shukla, S.; Rastogi, A.; Singh, M.P.; Singh, S.P. (National Botanical Research Institute, Lucknow (India). Div. of Genetics and Plant Breeding). Genotype-environmental interactions and phenotypic stability analyses of opium poppy (*Papaver somniferum* L.) for seed, opium and morphine content. *Indian Journal of the Genetics and Plant Breeding (India)*. (May 2007) v. 67(2) p. 166-168 KEYWORDS: PAPAVER SONIFERUM; GENOTYPE ENVIRONMENT INTERACTION; STABILITY; PHENOTYPES; MORPHINE; OPIUM; SEEDS; GENETIC VARIATION; YIELDS.

302. Jaiswal, S.K. (Allahabad Agricultural Institute, Allahabad (India). Dept. of Genetics and Plant Breeding); Prasad, L.C.; Kumar, U.; Tyagi, K. (Banaras Hindu University, Varanasi (India). Dept. of Genetics and Plant Breeding, Institute of Agricultural Sciences); Verma, R.P.S. (Directorate of Wheat Research, Karnal (India); Joshi, A.K. (Banaras Hindu University, Varanasi (India). Dept. of Genetics and Plant Breeding). Characterization of genetic diversity in barley (*Hordeum vulgare* L.) through DNA fingerprinting. *Indian Journal of the Genetics and Plant Breeding (India)*. (May 2007) v. 67(2) p. 169-170 KEYWORDS: GENETIC VARIATION; IDENTIFICATION; BARLEY; HORDEUM VULGARE; DNA FINGERPRINTING; RAPD; GENETIC MARKERS.

303. Ali, M.N.; Chattopadhyay, K.; Sarkar, H.K.; Mandal, N.; Bhattacharyya, S. (Bidhan Chandra Krishi Viswavidyalaya, Nadia (India). Crop Research Unit, Genetics and Biotechnology). Diversity among selected blackgram accessions on the basis of RAPD and ISSR markers. *Indian Journal of Genetics and Plant Breeding (India)*. (May 2007) v. 67(2) p. 171-172 KEYWORDS: VIGNA MUNGO; GENETIC VARIATION IDENTIFICATION; URD; SELECTION; RAPD; GENETIC MARKERS.

304. Singh, Seema K.; Mishra, D.P.; Joshi, Pankaj K.; Saxena, S.C. (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Biochemistry); Arora, Sandeep (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Molecular Biology and Genetic Engineering). An efficient protocol for regeneration in Indian mustard *Brassica juncea* (L.) Czern and Coss. *Pantnagar Journal of Research (India)*. (Jan-Jun 2007) v. 5(1) p. 9-13 KEYWORDS: ORGANOGENESIS; BRASSICA JUNCEA; PROTOCOLS; REGENERATION.

An efficient protocol for plant regeneration from hypocotyls explants has been developed in two *Brassica juncea* cultivars, namely Pusa Jai Kisan and Varuna. The two cultivars are among the top ten cultivars used in India. Different combinations of NAA and BAP were used to obtain optimal regeneration response. The cultivars showed a varied shoot regeneration response. Regeneration frequency was slightly higher in the Pusa Jai Kisan (85.71 per cent) than Varuna (83.3 per cent). Ninety per cent of the regenerated plantlets showed rooting response and 65 per cent of the rooted plantlets were successfully transferred to pots.

305. Singh, Satendra; Sachan, J.N. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Genetics and Plant Breeding). Line x Tester analysis over planting dates for seed yield and its component traits in low erucic lines of Indian mustard (*Brassica juncea* (L.) Czern & Coss). Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 33-37 KEYWORDS: SELECTION; PLANTING DATE; SEED PRODUCTION; YIELD COMPONENTS; ERUCIC ACID; HIGH YIELDING VARIETIES; BRASSICA JUNCEA; COMBINING ABILITY.

Fimbristylis miliacea was most dominant weed in zero tilled condition with average contribution 55.3 per cent at 60 days stage. Higher dry weight was observed during the second year of experiment. Anilofos 0.4 kg ha⁻¹ as early post emergence application followed by 2, 4-D at 0.5 kg ha⁻¹ reduced density and total dry weight of weeds at 60 days stage resulting in highest weed control efficiency (91.5 and 55.1 per cent respectively during 2001 and 2002) among herbicidal treatments. Weeds caused complete destruction of rice crop in weedy check plots. Owing to better control of weeds pendimethalin at 1.0 kg ha⁻¹ followed by 2, 4-D at 0.5 kg ha⁻¹ and anilofos 0.4 kg ha⁻¹ as early post emergence application followed by 2,4-D at 0.5 kg ha⁻¹ recorded significantly higher number of panicles m⁻² and thus grain yield.

306. Sharma, B.; Pandey, M.P. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Genetics and Plant Breeding). Screening of NILs and inheritance of resistance to bacterial blight in rice, *Oryza sativa* (L.). Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 38-42 KEYWORDS: GENETIC INHERITANCE; DISEASE RESISTANCE; BACTERIOSES; GERMPLASM; BLIGHT; RICE; INSECT PESTS; XANTHOMONAS ORYZAE.

Screening of 80 lines comprising elite breeding lines, landraces, cultivars, wild species and some near-isogenic lines for bacterial blight resistance against four isolates viz., Dx020 (DRR1), Dx0025 (CHN-A2), Dx001 (PNT-A) and Dx002 (FZB) in screen house under epiphytotic conditions at DRR, Hyderabad indicated eight lines with resistant reaction against at least two isolates including PNT-A (Pantnagar) isolate. Resistant reaction of five NILs (IRBB13, IRBB51, IRBB53, IRBB56 and IRBB60) indicate major genes Xa4, xa5, xa13 and Xa21 responsible for highly resistant reaction against PNT-A isolate. Reaction of NILs indicated that lines possessing xa13 gene either in single or in combination with xa5, xa5+Xa4, xa5 + Xa4 + Xa21 give highly resistant score. The resistant lines were UPR 2869-98-121 (P1), BBL 180-5-1-4-1 (P2), UPR 2442-28-4-2 (P3), UPR 2393-5-2 (P4), RP 2151-224-4 (P5), UPR 2508-6-3-3 (P6), UPR 2508-9-4-1 (P7) and IR 4442-46-3-3-3 (P8). Inheritance study using parental, F1, F2 and both the backcross generations of crosses with susceptible T(N)1 revealed resistance of P4 was digenic in nature with inhibitory gene interaction. In case of P1, P2, P3, P5, P6 and P7 inheritance was monogenic in nature with dominance of susceptibility over resistance, while in P8 resistance was conferred by single dominant gene. These genes are independently inherited and are being exploited in breeding programme to develop varieties with durable resistance against bacterial blight.

307. Sharma, B.; Singh, B.V.; Singh, Kamendra; Pushpendra; Gupta, M.K. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Genetics and Plant Breeding). Selection criteria for improvement of grain yield in soybean (*Glycine max* (L.) Merrill). Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 43-44 KEYWORDS:

SELECTION CRITERIA; BREEDING METHODS; SOYBEANS; GLYCINE MAX; HERITABILITY; GENETIC VARIATION.

308. Shashi Kamal; Singh, N.P. (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Vegetable Science). Assessment of potato genotypes for quality traits under tarai conditions of Uttarakhand. Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 99-103 KEYWORDS: POTATOES; GENOTYPES; BREEDING METHODS; UTTARANCHAL; UTTARAKHAND; GENETIC ENGINEERING.

ABSTRACT: The quality performance of twenty-five genotypes was evaluated over a period of two years. The pooled data for various traits indicated that tuber of MS/91-1326 exhibited maximum tuber protein and nitrogen content (1.91 per cent and 304.67 mg/100 fresh wt., respectively); dry matter and potassium content by Kufri Chipsona -2 (23.54 per cent and 270.17 mg/100 fresh wt., respectively). The maximal value for specific gravity of tuber was recorded in J/93-139 (1.078 g/cm³) whereas, highest total soluble solids were observed in J/92-159 (7.390B). The genotypes Kufri Bahar showed maximum ascorbic acid content (27.18 mg/100 fresh wt.) while J/93-86 showed highest vitamin A (48.69 I.U.).

309. Bhushan, K.B.; Singh, B.P.; Dubey, R.K.; Hari Har Ram (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Vegetable Science). Correlation analysis for seed yield in French bean (*Phaseolus vulgaris* L.). Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 104-106 KEYWORDS: GENETIC CORRELATION; SEED PRODUCTION; PHASEOLUS VULGARIS; VEGETABLES; SELECTION CRITERIA; YIELD COMPONENTS.

Simple correlation coefficient was calculated for seven characters in four hundred and forty one exotic genotypes of french bean (*Phaseolus vulgaris* L.) during January-March 2004. Seed yield per plant showed positive and significant correlation with number of pods per plant, pod length and 100-seed weight. However, number of pods per plant exhibited positive and significant correlations with pod length, days to maturity and plant height. Days to maturity showed positive and significant correlation with plant height.

310. Upadhyay, Megha; Hari Har Ram (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Vegetable Science). Hybrid vs pureline breeding in bottle gourd [*Lagenaria siceraria* (Mol) Stand]. Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 113-118 KEYWORDS: HETEROSIS; HYBRIDIZATION; LAGENARIA SICERARIA; GERMPLASM; VEGETABLES.

ABSTRACT: Ten purelines and ten F1 hybrids of bottle gourd were evaluated at Vegetable Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar. Standard heterosis (per cent) was worked out using Pusa Naveen as check. It was found that none of the hybrids showed significant negative heterosis for flowering characters. For fruit length, in kharif PBOG 113 X Pusa Naveen (26.7 per cent) showed significant positive heterosis. While in summer season, PSPL X PBOG 61 and PBOG 22 X PBOG 40 showed positive and significant heterosis of 16.5 and 14.9 per cent, respectively. For fruit diameter, PBOG 74 X PSPL (33.2 and 20.7 per cent) showed a highly significant and positive heterosis over check parent for both the seasons. For total yield, none of the ten F1 hybrids could out perform the check parent Pusa Naveen that had the total yield of 238.1 q/ha and 825.1 q/ha in kharif and summer season, respectively.

311. Pandey, S.; Rai, M. (Indian Institute of Vegetable Research, Varanasi (India). Inheritance of yield and its components in pumpkin (*Cucurbita moschata* Duch. ex Poir). Indian Journal of Genetics and Plant Breeding (India). (Nov 2006) v. 66(4) p. 355-356 KEYWORDS: PUMPKIN; CUCURBITA MOSCHATA; GENETIC INHERITANCE; YIELD COMPONENTS.

312. Sharma, A.; Sharma, S. (Chaudhary Swaran Kumar Himachal Krishi Vishvavidyalaya, Palampur (India). Dept. of Vegetable Science and Floriculture) . Variation studies for bell pepper [*Capsicum annum* (L.) Sendt. var *grossum*] improvement under cold desert conditions of North-Western Himalayas. Indian Journal of Genetics and Plant Breeding (India). (Nov 2006) v. 66(4) p. 357-358 KEYWORDS: SWEET PEPPERS; CAPSICUM ANNUM; GENETIC VARIATION; ARID CLIMATE; HIMALAYAS.

313. Rahman, M.S.; Doss, S.G.; Debnath, S.; Chowdhury, S.R.; Ghosh, P.L.; Sarkar, A. (Central Sericultural Research and Training Institute, Berthampore (India). Mulberry Breeding and Genetic Stn.). Genetic variability and correlation studies of leaf characters in some mulberry (*Morus* spp.) germplasm accessions. Indian Journal of Genetics and Plant Breeding (India). (Nov 2006) v. 66(4) p. 359-360 KEYWORDS: MULBERRY; MORUS; GENETIC VARIATION; LEAVES.

314. Mishra, M.; Patil, R.; Chandra, R. (Central Institute for Subtropical Horticulture, Lucknow (India). Biotechnology Lab.); Kole, C. (Pennsylvania State University, Pennsylvania (United States of America). Dept. of Horticulture). Clonal micropropagation of Indian gooseberry (*Embllica officinalis* Gaertn.). Indian Journal of Genetics and Plant Breeding (India). (Nov 2006) v. 66(4) p. 361-362 KEYWORDS: GOOSEBERRY; EMBLICA OFFICINALIS; MICROPROPAGATION; CLONES.

315. Singh, H.; Sharma, S.N.; Bhatnagar, S.M. (Rajasthan Agricultural University, Jaipur (India). All India Wheat and Barley Improvement Project). Development and validation of a new wheat (*Triticum aestivum* L.) variety – Raj 4037 to sustain maximum production in peninsular zone of India. Indian Journal of Genetics and Plant Breeding (India). (Nov 2006) v. 66(4) p. 363-364 KEYWORDS: WHEAT; TRITICUM AESTIVUM; HIGH YIELDING VARIETIES; INDIA.

316. Talukdar, D.; Biswas, A.K. (University of Kalyani, Nadia (India). Dept. of Botany). An induced mutant with different flower colour and stipule morphology in grass pea (*Lathyrus sativus* L.). Indian Journal of Genetics and Plant Breeding (India). (Nov 2006) v. 66(4) p. 364-367 KEYWORDS: PEAS; LATHYRUS SATIVUS; INDUCED MUTATION.

F50 Plant Structure

317. Prakash, M.; Suganthi, S.; Gokulakrishnan, J.; Sabesan, T. (Annamalai University, Annamalainagar (India). Dept. of Agricultural Botany). Effect of 28-homobrassinolide on morphophysiological and yield parameters of sesame. Indian Journal of Plant Physiology (India). (Jan-Mar 2007) v. 12(1) (New Series) p. 91-94 KEYWORDS: YIELD; SESAMUM INDICUM; PLANT ANATOMY; MORPHOGENESIS.

An investigation was carried out to study the influence of 28 - homobrassinolide on morphological, growth, biochemical and yield parameters of sesame (*Sesamum indicum* L.).

The plants were sprayed with 0.5 mg/J homobrassinolide on 30, 45 and 60 DAS. Among the treatments, the plants treated with homobrassinolide thrice recorded higher values for all the parameters. The total chlorophyll, soluble protein, sugars and catalase activity were found to be maximum in the HBR treated plants. The application of HBR enhanced the total dry matter production, number of capsules per plant, number of seeds per capsule, capsule weight and 1000 seed weight.

F60 Plant Physiology and Biochemistry

318. Khan, F.U.; Khan, F.A.; Hayat, N.; Bhat, S.A. (Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Floriculture, Medicinal and Aromatic Plants). Influence of certain chemicals on vase life of cut tulip. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2007) v. 12(2) (New Series) p. 127-132 KEYWORDS: TULIP; SUCROSE; CHEMICALS; KEEPING QUALITY; PLANT WATER RELATION; WATER CONTENT; WATER BALANCE; CUT FLOWERS.

An experiment was undertaken in two consecutive seasons of 2003-04 and 2004-05 to understand the physiological and biochemical events leading to senescence and the role of chemicals in advancing the longevity of cut tulip. Standard grade of tulip bulbs cv. 'Apeldoorn' were grown in the open field conditions following the recommended package and practices. Tulip scapes were harvested at bud colour break stage and placed in conical flasks (250 ml) containing vase solution comprised of sucrose (Suc) 2.0 per cent and 4.0 per cent plus aluminum sulphate (AS) 200 and 300 ppm, and citric acid (CA) 1000 and 2000 ppm. Distilled water without any chemical was served as control. The flasks were kept in the laboratory at a room temperature of 20 ± 2 °C with a relative humidity of 70 ± 5 percent under cool light of 2000 lux (12 h). Floral preservatives significantly influenced the different physiological attributes and, improved the quality and vase life of cut tulip by about 4 days. Holding solutions comprised of Suc 4 percent + AS 200 ppm resulted in maximum fresh weight gain of scapes (30.22 percent), leaf chlorophyll content (0.41 mg g⁻¹ f.w.), leaf and petal relative water content (RWC) (64.5 percent and 58.7 percent), petal membrane stability index (MSI) (53.7 percent) and leaf and petal sugar (29.35 mg g⁻¹ d. w. and 38.3 mg g⁻¹ d. w.) and protein (18.55 mg g⁻¹ d. w. and 28.9 mg g⁻¹ d. w.). Similar treatment also recorded the highest scape length (29.80 cm), tepal diameter (8.96 cm) and vase life (11.66 day).

319. Sharma, K.D.; Pannu, R.K.; Tyagi, P.K.; Chaudhary, B.D.; Singh, D.P. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy). Water use efficiency and yield of chickpea genotypes as influenced by soil moisture availability. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2007) v. 12(2) (New Series) p. 168-172 KEYWORDS: CHICKPEAS; WATER USE; CICER ARIETINUM; EFFICIENCY; PLANT WATER RELATIONS; PLANT SOIL RELATIONS; YIELDS; SOIL WATER CONTENT; DROUGHT STRESS.

Six chickpea (*Cicer arietinum* L) genotypes were evaluated under soil moisture stress for morpho physiological characteristics conferring resistance to drought. The increased moisture stress reduced the maturity duration by 15 and 19 days under mild and severe stress, respectively over irrigated control. The shorter maturity duration resulted in reduced reproductive phase duration. The water use efficiency was higher under irrigated control as compared to both the stress conditions. The plant water status reduced significantly at full bloom stage (110 DAS) under moisture stress. The moisture stress significantly reduced the

plant height, number of, effective pods per plant, 100 seed weight, seed yield, biological yield and harvest index over irrigated control. The longer maturity duration ($r=0.93$) has significant positive association with seed yield. The plant water status parameters have significant positive associations with seed yield. Among the yield attributes, pod density has highest significant positive association ($r=0.89$) with seed yield followed by 100 seed weight ($r = 0.78$). The genotypes, ICCV 10, BG 364 and C 214 have relatively higher plant water status and maintained their canopy cooler at full bloom and yielded highest as compared to other tested genotypes.

320. Yadav, N.; Yadav, V.K.; Yadava, C.P.S. (Rajasthan Agricultural University, Jaipur (India). Agric. Res. Stn.). Influence of simulated white grub damage of roots on water relation parameters in groundnut. Indian Journal of Plant Physiology (India). (Apr-Jun 2007) v. 12(2) (New Series) p. 173-177 KEYWORDS: GROUNDNUTS; PLANT WATER RELATIONS; PLANT WATER CONTENT; PROLINE; TRANSPIRATION; DROUGHT STRESS; LARVAE.

White grubs (larval scarabaeids) are important pest of groundnut in many parts of the world. These larvae damage the root system of the plants. A method of simulated white grub damage to plants was developed to assess influence of feeding activity of these insects on plant growth. Seeds of groundnut variety Chitra were sown in polythene bags and allowed to grow in a net house. One set was grown under normal water supply and the other set under water stress. Simulated white grub damage was created by cutting the roots of plants at 10, 20 and 30 cm from the top soil surface at 30 days after sowing in one set and at 60 days after sowing (DAS) in the other set under both the conditions. Plant leaves were taken at 5, 15 and 25 days after the root cut from both the sets for estimation of proline, peroxidase / activity, transpiration rate and relative water content. Simulated white grub damage reduced relative water content as well as transpiration and the reduction was highest in plants with roots cut at 1.0 cm and the lowest in plants with roots cut at 30 cm. Proline content and peroxidase activity increased with the increase in the per cent root cut. The magnitude of increase in proline and peroxidase was almost 2-3 times of the control, in plants whose roots were cut at 30 or 60 days after sowing. Seed yield was also reduced due to simulated white grub damage at both the stages. The roots damaged at 60 DAS reduced the seed yield to a greater extent than the roots damaged at 30 DAS.

321. Reddy, M.A.; Shankhdhar, D.; Shankhdhar, S.C. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Plant Physiology). Physiological characterization of rice genotypes under periodic water stress. Indian Journal of Plant Physiology (India). (Apr-Jun 2007) v. 12(2) (New Series) p. 189-193 KEYWORDS: AEROBIC STRESS; RICE; DROUGHT STRESS; PROLINE; PROTEINS; YIELDS; WATER BALANCE; PLANT WATER RELATIONS; YIELDS.

A field experiment was conducted with six indica rice genotypes to evaluate the suitability under periodic water stress or aerobic conditions. Genotypes were characterized by various physiological and biochemical parameters at various growth stages. Amongst the genotypes DRRH-I had maximum RWC (percent) with maximum grain yield under periodic water stress. The total protein content decreased in almost all the six genotypes under periodic water stress. Jaya had maximum protein & proline content. The total chlorophyll content decreased in almost all the genotypes under periodic water stress and higher chlorophyll stability index was recorded in Pant Dhan 4. The maximum photosynthetic efficiency (Fv/Fm) was found in Kasturi which indicates minimum photosynthetic damage in

these genotypes. Amongst these genotypes DRRH-I showed very mild effect of stress on yield potential, however, Jaya exhibited good proline & RWC content with poor yield under stress condition. Therefore, DRRH -1 might be recommended for aerobic cultivation.

322. Shrepa, A.; Pradhan, P.; Sarkar, A.K.; Sinha, A.C. (Uttar Banga Krishi Viswavidyalaya, Cooch Behar (India). Dept. of Agronomy). Growth and yield of wheat as influenced by evapotranspiration control measures and levels of fertilizer under rainfed condition. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2007) v. 12(2) (New Series) p. 194-198
KEYWORDS: EVAPOTRANSPIRATION; LEAF AREA INDEX; FERTILIZER APPLICATION; STRAW MULCHES; TRITICUM AESTIVUM; GROWTH FACTORS; YIELDS; RAINFED FARMING; GROWTH RATE.

An experiment was carried out to study the growth and productivity of wheat (*Triticum aestivum* L.) as influenced by different levels of evapotranspiration control measures and different levels of fertilizer under rainfed condition. The combined application of straw mulch 6 t ha⁻¹ + kaolin spray 6.0 percent with significantly influenced leaf area index (LAI), dry matter accumulation (DMA), crop growth rate (CGR), net assimilation rate (NAR) and yield during both the years of 2000-2001 and 2001-2002. Similar effects on growth parameters and yield were observed due to increased levels of fertilizer up to 120: 60: 60 kg ha⁻¹ of N, P₂O₅ and K₂O respectively.

323. Khan, M.H (Assam University, Silchar (India). Plant Biochemistry Lab.); Patra, H.K. (Utkal University, Bhubaneswar (India). Dept. of Botany). Sodium chloride and cadmium induced oxidative stress and antioxidant response in *Calamus tenuis* leaves. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2007) v. 12(1) (New Series) p. 34-40
KEYWORDS: CALAMUS; CADMIUM; GROWTH; SALINITY; OXIDANTS; SODIUM CHLORIDE.

The effects of NaCl (0-300 mM), CdCl₂ (0-10 mM) and NaCl (300 mM) + CdCl₂ (10 mM) induced oxidative stress in *Calamus tenuis* Roxb. leaves were studied. Alterations in the activated oxygen metabolism was detected as evidenced by the increased peroxide content and lipid peroxidation due to the accumulation of thiobarbituric acid reactive substances (TBARS) with the increasing NaCl and Cd concentrations. Superoxide dismutase (SOD) and peroxidase (POX) decreased, while catalase (CAT) and glutathione reductase (GR) activities increased during NaCl treatments. Cd treatment decreased SOD and CAT activities, while POX and GR activities increased. NaCl + Cd treatment decreased all enzyme activities except GR. Ascorbate and glutathione content increased in response to NaCl and Cd treatments, whereas, NaCl + Cd treatment decreased ascorbate and increased glutathione content. The cadmium uptake increased up to 10 times in 10 mM treatment as compared to lower concentrations. Enhanced levels in some of the antioxidants observed in the investigation suggest that a better antioxidant defense is required for higher NaCl and cadmium tolerance.

324. Chandra, K.; Das, M.R. (Assam Agricultural University, Jorhat (India). Dept. of Crop Physiology). Effect of KNO₃, vitamin B₆ and salicylic acid on growth, False silique formation and seed yield in toria. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2007) v. 12(1) (New Series) p. 78-82
KEYWORDS: SILIQUA; GROWTH; BRASSICA CAMPESTRIS; YIELD; SEED; SALICYLIC ACID.

In a field trial, the effects of foliar spray of KNO₃ (5000, 10000, 15000 and 20000 ppm), vitamin B₆ (0.05, 0.10, 0.15 and 0.20 ppm) and salicylic acid (10, 100, 500 and 1000 ppm)

were assessed on growth, false siliqua formation and yield components in toria (*Brassica campestris* L.). Application of all chemicals, influenced plant height, branching, days to flower initiation, days to 50 percent flowering, days to maturity and percentage of false siliqua formation. Among all treatments, 15000 ppm of KN_3 , was found superior over rest of the treatments in improving the morphological traits, yield components and yield potential.

325. Anaytullah; Bose, B.; Yadav, R.S. (Chandra Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Plant Physiology). Peg induced moisture stress : screening for drought tolerance in rice. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2007) v. 12(1) (New Series) p. 88-90 KEYWORDS: DROUGHT STRESS; RICE; NITRATE REDUCTASE; PROLINE.

A lab experiment was carried out to assess the effect of PEG-6000 induced short term moisture stress on drought tolerance of ten rice genotypes, on the basis of change in some important physico - chemical parameters like proline content, RWC and NR activity in germinating seedlings, -Proline contents of seedlings increased with increasing stress; at highest level of imposing stress, i.e. at -10.0 bars of water potential the percentage increment in respect to control represented an order like IET -11120 < CSAR. 13 < CSAR-77. Maximum relative water content (RWC) was found in the genotypes CSAR-13 < CSAR77 < IET-11120 at -10.0 bars of water potential and minimum percentage reduction of nitrate reductase activity in respect to their controls observed in the variety CSAR-77 and followed by IET-11120 < CSAR. 27. Hence, the rest of the genotypes were found more sensitive towards increasing stress.

326. Kewat, R.N.; Singh, R. P.; Abidi, A.B. (N.D. University of Agriculture and Technology, Faizabad (India). Department of Biochemistry). Screening of pointed gourd (*Trichosanthes dioica* Roxb.) varieties and strains for sweet making. *Pantnagar Journal of Research (India)*. (Jan-Jun 2007) v. 5(1) p. 14-16 KEYWORDS: ORGANOLEPTIC ANALYSIS; CRUDE FIBRE; TRICHOSANTHES; HIGH YIELDING VARIETIES; VEGETABLES; BIOCHEMISTRY.

ABSTRACT: The present investigation was undertaken with a view to screen the pointed gourd fruits for the preparation of sweets on the basis of physical and biochemical observations. Sixteen varieties/strains of pointed gourd viz., FP-4 < FP-118, FP-152, FP-206, FP-207, FP-216, FP-229, FP-260, FP-270, FP-304, FP-305, FP-306, FP-307, FP-308, FP-313 and, FP-316 were used as experimental material and analyzed for physical and biochemical characters namely shape, weight, seed, thickness, fruit length, diameter, fruiting behaviour, weight of flesh, TSS, total sugar, crude fibre and organoleptic evaluation. The sweets prepared from various pointed gourd strain/varieties were judged by a panel of professors and students for organoleptic evaluation. Best performance of parwal sweets were noticed in strains FP-4, FP-152, FP-260, FP-304, FP-305 and FP-316 and rated superior in organoleptic taste and recommended for making of sweets.

F61 Plant Physiology - Nutrition

327. Singh, P. (Maharana Pratap University of Agriculture and Technology, Kota (India). Agricultural Research Stn.); Nepalia, V. (Maharana Pratap University of Agriculture and Technology, Udaipur (India). Rajasthan College of Agriculture); Tomar, S.S. (Maharana Pratap University of Agriculture and Technology, Kota (India). Krishi Vigyan Kendra). Effect

of weed control and nutrient management on soybean (*Glycine max*) productivity. *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 314-317 KEYWORDS: NUTRITION PHYSIOLOGY; WEED CONTROL; NUTRIENT UPTAKE.

A field experiment was conducted at Kota during rainy season of 2002 and 2003 to evaluate the effect of herbicides and their mixtures and of fertility levels on the extent of weed control and productivity of soybean [*Glycine max* (L.) Merr]. Two hand-weedings at 30 and 45 days after sowing (DAS), alachlor applied pre-emergence 2 kg/ha + hand-weeding (HW) at 30 DAS and tank mixture of chlorimuron ethyl + fenoxaprop-p-ethyl (9+70 and 6+50 g/ha) as post-emergence reduced the weed density and dry matter at 50 and 70 DAS. These treatments also recorded significantly higher pods/plant, 1000-seed weight, seed yield and net return of soybean crop. Lowest NPK uptake by weeds was recorded by two hand-weedings and the maximum NPK uptake by the crop under alachlor 2 kg/ha + HW at 30 DAS, two hand weeding and chlorimuron ethyl + fenoxaprop-p-ethyl (9+70 g/ha) treatments. Fertility levels did not influence the weed density, but a decrease in fertilizer application to 75 percent of recommended dose of fertilizer (RDF) reduced the dry matter of weeds. The yield and net returns decreased on reducing the rate of fertilizer application. No significant influence on NPK uptake by weeds was registered by applying 125 percent RDF, but nutrient uptake by crop increased significantly.

328. Jat, N.L. (Rajasthan Agriculture University, Jobner (India). Dept. of Agronomy); Jain, N.K. (Rajasthan College of Agriculture, Udaipur (India). Dept. of Agronomy); Choudhary, G.R. (Rajasthan Agriculture University, Jaipur (India). Agricultural Research Stn.). Integrated nutrient management in fenugreek (*Trigonella foenum-graecum*). *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 331-333 KEYWORDS: INTEGRATED CONTROL; TRIGONELLA FOENUM GAECUM; NUTRIENT PHYSIOLOGY.

A field experiment was conducted on loamy sand soils of Jobner (Jaipur) during winter (rabi) seasons of 2000-01 to 2003-04, to study integrated nutrient management in fenugreek (*Trigonella foenum-graecum* L.). Plant height, branches/plant, pods/plant and seeds/pod were higher in the plots receiving 100 percent inorganic N + Rhizobium 1.5 kg/ha + 5 tonnes FYM/ha. The highest seed yield, net returns, benefit: cost ratio and N and P uptake by seed were recorded in 100 percent inorganic N alone, followed by 100 percent inorganic N + Rhizobium 1.5 kg/ha + 5 tonnes FYM/ha, while the highest straw yield, N and P uptake by straw were recorded in 100 percent inorganic N + Rhizobium 1.5 kg/ha + 5 tonnes FYM/ha.

329. Jain, V.; Singla, N.; Jain, S.; Sawhney, S.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Biochemistry). Nitrogen metabolism in the leaves of *Pennisetum glaucum* (L.) as affected by water stress. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2007) v. 12(2) (New Series) p. 101-107 KEYWORDS: NITROGEN; PENNISETUM ;GLAUCUM; GLUTAMATE DEHYDROGENASE; GLUTAMATE AMMONIA LIGASE; NITROGEN REDUCTASE; NITRATE REDUCTASE; DROUGHT STRESS; METABOLISMS; ENZYME ACTIVITY.

Activities of nitrate reductase (NR, both in vitro and in vivo), nitrite reductase (NiR), glutamine synthetase (GS1 and GS2) and glutamate dehydrogenase (GDH) in the leaves of *Pennisetum glaucum* (Bajra) declined following water stress imposed by withholding irrigation for different duration (24-60 h). Both the catalytic activities of nitrate reductase, viz. terminal nitrate reductase and NADH-nitrate reductase (total NR activity) got impeded

in water stressed seedlings. Though the enzymes of ammonia assimilation were also affected by water withholding, but the level of reduction was less than that of nitrate assimilation. The isoforms of GS were differently affected by drought stress. GSI activity declined more (54-63 percent) as compared to GS2 (21-31 percent) at 36 and 48 h of water withholding. The enzyme activities were recovered upon supply of water to 36 h-stressed plants. However, the plants subjected to longer period of water withholding (48 and 60 h) could show only the partial recovery of enzymes upon rewatering. The fast response of enzymes to change in water status of the plants could be due to posttranscriptional modification or inactivation of the enzyme(s).

330. Singh, A.L.; Chaudhari, V. (National Research Centre for Groundnut, Junagadh (India). Macronutrient requirement of groundnut : effects on uptake of macronutrients. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2007) v. 12(1) (New Series) p. 72-77
KEYWORDS: GROUNDNUT; UPTAKE; NUTRIENTS; SAND.

A series of sand culture pot experiments were conducted to find-out the required concentrations of macronutrients in the nutrient solution, for growing groundnut. The groundnut variety JL 24 was grown at 2, 5, 10, 20, 50, 100, 150 and 200 ppm levels of each of N, P, K, Ca and S, separately. The uptake of these macronutrients by groundnut were determined. The study revealed that increasing levels of N, P, K, Ca and S upto 100, 50, 100, 200, and 20 ppm, respectively of these macronutrients, in the nutrient solution, increased their uptake. There was an interaction among macronutrient absorption. Increasing N level increased P, K, Ca and Mg, increasing K level decreased Ca and Mg and increasing Ca level decreased K and Mg concentrations in plant tissues and their uptake. The P and S, however, did not show any interaction effects with other macronutrients. The crop received balanced nutrition and showed best growth at 50, 20, 50, 50, and 20 ppm, levels of N, P, K, Ca and S, respectively.

331. Panwar, Rashmi; Singh, C.P. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Horticulture). Effect of preharvest foliar spray of micronutrients on chemical properties of mango fruit cv. Langra. *Pantnagar Journal of Research (India)*. (Jan-Jun 2007) 5(1) p. 56-61
KEYWORDS: PREHARVEST APPLICATION; FOLIAR APPLICATION; TRACE ELEMENTS; CHEMICAL PROPERTIES; MANGOES.

ABSTRACT: The present investigation was carried out to study the effect of preharvest foliar spray of micronutrients on chemical attributes on mango cv. Langra. It was found that combined application of boron, zinc, iron and copper increased the total soluble solids, total sugar, β -carotene and vitamin A content while decreased the total titrable acidity of fruits.

F62 Plant Physiology – Growth and Development

332. Gill, M.S.; Kumar, P.; Kumar, A. (Punjab Agricultural University, Ludhiana (India). Dept. of Agronomy and Agrometeorology). Growth and yield of direct seeded rice (*Oryza sativa*) as influenced by seeding technique and seed rate under irrigated conditions. *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 283-287
KEYWORDS: GROWTH; YIELD; ORYZA SATIVA; SEED PRODUCTION.

A field experiment was conducted during rainy season (kharif) 2002 and 2003 at Ludhiana, to find out the suitable seeding technique and optimum seed rate for realizing high yield of direct-seeded rice (*Oryza sativa*). The dry-matter accumulation in direct-seeded

rice under compaction and puddle condition was 115.7-139.1 q/ ha in 2002 (drought year) and 178.5-197.5 q/ha in 2003 (normal year) compared with 104.1 q/ha under transplanting 25 days after sowing (DAS). The seed rate of 50 kg/ha produced the maximum dry-matter accumulation. The maximum leaf-area index was (4.37-4.97 in 2002 and 5.24-6.06 in 2003) recorded under direct seeding. The maximum grain yield (57.8 q/ha and 179.3 q/ha during first and second years respectively) was recorded under transplanting at 25 DAS (on the day of sowing) which was found on a par with direct seeding done after puddling and compaction at seed rate 50 and 75 kg/ha. It was mainly due to significantly more effective tillers/m² (201 and 218 in 2002 and 276.2 and 283.3 in 2003) compared with 25 kg/ha seed rate (166 in 2002 and 267.6 in 2003). The water productivity (kg grain/m³ of irrigation water applied) in direct-seeded rice in 2002 was 0.35 and in 2003 was 0.76 compared with that of transplanted rice being 0.31 and 0.57 kg grain/m³ of irrigation water, clearly indicating better water-use efficiency under direct seeding.

333. Singh, R.K.; Singh, C.V. (Central Rainfed Upland Rice Research Station, Hazaribag (India)). Effect of phosphorus on drought mitigation and productivity of rainfed upland rice (*Oryza sativa*). *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 293-296
KEYWORDS: CROP YIELD; PHOSPHORUS; DROUGHT RESISTANCE; ORYZA SATIVA; CROP MANAGEMENT.

The effect of phosphorus application at varying rates, viz. 0, 12, 24, 48 and 96 kg/ha, was studied on drought mitigation and productivity of two upland rice (*Oryza sativa* L.) varieties ('Vandana' and 'Annada') during 1999, 2000 and 2001 under rainfed upland condition at Hazaribag in Jharkhand. Phosphorus was applied basal through single superphosphate along with common doses of N, K, Zn and Mg. The effects of P rates, and interaction effects between P rates and varieties were significant in the drought year only (2000). Reduction in grain yield due to drought in no-P plots was 27.4 percent in 'Vandana' and 58.4 percent in 'Annada' in comparison with normal rainfall year (1999). The grain yield of 'Annada' and 'Vandana' decreased by 11.7 and 25.4 at 24 kg P/ha, and by 2.5 and 5.2 at 48 kg P/ha respectively. Maximum P-use efficiency was achieved at 24 kg P/ha in both the varieties. Concentration of P in grain and straw was also reduced due to drought in 2000 at low P application compared with that in 1999. Differences in agronomic P-use efficiency were apparent due to varieties. Agronomic P-use efficiency was 38.1 kg grain/kg P in 'Annada' compared with 15.5 kg grain/kg applied P in 'Vandana'. However, differences due to varieties in relative effect of drought stress (RDS) and available soil P were marginal. It was concluded that the application of P 24 kg/ha helped in reducing the effect of drought as well as in increasing the rice productivity and P-use efficiency of rainfed upland rice.

334. Saxena, D.C.; Abbas, S.; Sairam, R.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Effect of ethrel on reproductive efficiency in chickpea. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2007) v. 12(2) (New Series) p. 162-167
KEYWORDS: CHICKPEAS; CICIER ARIETINUM; REPRODUCTIVE PERFORMANCE; ETHEPHON; FLOWERING; FOLIAR; SPRAYING; FOLIAR APPLICATION.

An experiment was conducted with chickpea (*Cicer arietinum* L.) cultivar BG 209 to study the effect of ethrel applied as foliar spray at low (250 ppm), medium (500 ppm) and high (1000 ppm) concentrations at pre flowering (65 DAS: S1) mid-flowering (94 DAS: S2) and post-flowering (125 DAS: S3) stages. The low and medium concentrations resulted in increase in dry matter over the control plants, though medium concentration was less

effective than lower concentration at all the stages. Maximum leaf area was observed at lowest ethrel concentration at all stages and there was decline in leaf area with increasing ethrel concentration. Low concentration increased the pod number at S1 (17 percent) and S2 stages (11 percent), while at S3 stage, a 22 percent reduction in pod number was observed. The medium concentration was slightly better than lower concentration when applied at S1 stage, while at S2 and S3 stages it was inferior to lower concentration. High concentration at all the stages reduced pod number by 4, 8 and 27 percent, respectively. At higher concentrations, number of seeds decreased by 10, 18 and 46 percent at S1 and S3 stages, respectively. High concentration again decreased pod set from 3 to 24 percent depending upon stage of application, maximum decrease being at S3 stage. High concentration reduced biomass production from 1 to 31 percent depending upon stage. At stage S1 and S2 low concentration increased yield by 11 and 14 percent respectively while medium concentration increased it by 14 and 2 percent at S1 and S2 stages, respectively. The percentage of flowers and pods shed in treated plants in comparison to control was more when plants were sprayed at post-flowering stage than pre-flowering and mid-flowering stages. The total number of pods formed at pre-flowering and mid-flowering stages show substantial increase over control with low and medium concentration, while high concentration registered a decrease.

335. Sangeeta; Seth, P.; Sharma, V.; Khandelwal, S. (Rajasthan College of Agriculture, Udaipur (India). Dept. of Molecular Biology and Biotechnology). Effect of salinity on antioxidant enzymes in wheat. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2007) v. 12(2) (New Series) p. 186-188 KEYWORDS: ANTIOXIDANTS; TRITICUM AESTIVUM; ENZYMES; SALINITY; SEEDLINGS.

The effect of salinity on antioxidant metabolites and antioxidant enzymes activity was studied in two wheat (*Triticum aestivum* L.) genotypes GW-322 (salt susceptible) and Raj-3077 (salt tolerant) grown for 10 days under the influence of 100 mM salinity. Seeds were primed with 50 ppm ascorbic acid, 50 ppm gibberellic acid and 100 PPJP. salicylic acid for 4 h followed by germination in 100 mM of sodium chloride. Contents of proline, ascorbic acid and activities of catalase and superoxide dismutase were examined in the seedlings at the end of experiment. Salinity increased the proline content, catalase and superoxide dismutase activity and decreased the ascorbic acid content. Deleterious effect of salinity was counteracted by ascorbic acid, gibberellic acid and salicylic acid.

336. Dutta, P.; Bera, A.K. (Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India). Dept. of Plant Physiology). Oxidative stress and the activity of antioxidant enzymes in mungbean seedling subjected to water stress. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2007) v. 12(2) (New Series) p. 199-202 KEYWORDS: ANTIOXIDANTS; ENZYMES; SEEDLINGS; DROUGHT STRESS; OXIDATION; STRESS; MUNGBEANS; VIGNA RADIATA.

The effect of PEG induced moisture stress during seedling development on oxidative stress and antioxidant enzymes activities were studied in mungbean (*Vigna radiata* L. Wilczek) using two cultivars namely tolerant K 851 and susceptible PDM 84-139 respectively. Water stress increased H₂O₂ content and TBARS content (lipid peroxidation) as well as superoxide dismutase and peroxidase activities in both the cultivars compared to control. However, catalase activity decreased under water stress in both the cultivars tested. Tolerant genotype K 851 showed lower H₂O₂ and TBARS content and higher activity

of antioxidant enzymes like SOD, peroxidase and catalase than susceptible PDM 84-139 in response to water stress.

337. Verma, V.; Kasera, P.K. (Jai Narain Vyas University, Jodhpur (India). Dept. of Botany). Variations in secondary metabolites in some arid zone medicinal plants in relation to season and plant growth. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2007) v. 12(2) (New Series) p. 203-206 KEYWORDS: DRUG PLANTS; ASPARAGUS; ALKALOIDS; PHENOLIC COMPOUNDS; MALVACEAE; PLANT DEVELOPMENT STAGES; SEASONS; ARID ZONES; MYCTAGINACEAE.

In the present investigation, attempt has been made to find out variations in total alkaloids and phenols due to different seasons and plant growth stages in *Asparagus racemosus*, *Boerhavia diffusa* and *Sida cordifolia*. Results revealed that maximum accumulation of alkaloids and phenols occurred in summer season in all the three plant species. Peak concentrations of alkaloids and phenols were observed in flowering -stage in all the plants except in *A. racemosus* that showed maximal accumulation of phenols in the vegetative stage. Interestingly, no alkaloids or phenols accumulated in the seedling stage.

338. Hayat, S.; Ali, B.; Hasan, S.; Hayat, Q.; Ahmad, A. (Aligarh Muslim University, Aligarh (India). Dept. of Botany). Effect of 28 homobrassinolide on salinity induced changes in growth, ethylene and seed yield of mustard. *Indian Journal of Plant Physiology (India)*. (Apr-Jun 2007) v. 12(2) (New Series) p. 207-211 KEYWORDS: BRASSINOSTEROIDS; PLANT GROWTH SUBSTANCES; ETHYLENE; SALINITY; BRASSICA JUNCEA; YIELDS; MUSTARD.

The seeds of *Brassica juncea* were soaked for 6 hours, in water, 50, 100 or 150 mM of NaCl and sown in pots. The plants were sprayed with water, 10⁻¹⁰, 10⁻⁸ or 10⁻⁶ M aqueous solution of 28homobrassinolide (HBL) at 15, 30 or 45 day after sowing (DAS) to the foliage of the plants. Sodium chloride retarded growth of root and shoot observed at day 60 (post-flowering) and lowered seed yield, at harvest (140 DAS). However, spray of HBL at 15, 30 or 45 DAS increased the values significantly for the above characteristics. 30th day sowing was best among them. Moreover, the plants released more ethylene, under NaCl stress or HBL treatments. The ill effect of the lowest concentration (50 mM) of the salt was completely overcome by the spray of HBL (10⁻⁸M) at 30 day stage.

339. Kumar, R.; Kishore, K.; Sinha, S.K.; Gupta, N.C.; Dubey, N.; Sachdev, A. (Indian Agricultural Research Institute, New Delhi (India). Div. of Biochemistry). Isolation and characterization of fad2-1 cDNA sequence from *Glycine max* L. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2007) v. 12(1) (New Series) p. 6-12 KEYWORDS: GLYCINE MAX; DNA; NUCLEOTIDE SEQUENCE; ISOLATION.

Microsomal 0-6 desaturase encoded by fad2-1 gene catalyzes the production of polyunsaturated fatty acids in seed storage lipids. A cDNA library was constructed in a TriplEx2 vector using poly (A) RNA isolated from developing seeds (19-26 OAF) of *Glycine max* L. The putative clones from library screening were converted into plasmid clones following in vivo excision and analyzed for insert size by restriction digestion. A positive clone PR2 with largest insert size spanning a total of 1139 bp revealed a 3' UTR region of 184 bp specific to fad2-1. Conceptual translation indicated an open reading frame of 955bp encoding a 317 amino acid protein with a predicted molecular weight of 37kD. A high degree of sequence identity was found with *Glycine max* cDNA for co-6-desaturase and with fad2-1 of *Arachis hypogea*. PR2 was also used as a labelled probe to analyse the expression

of *fad2-1* transcripts by northern blotting. High levels of *fad2-1* mRNA transcripts were detected at the mid maturation stages of seed development (19-26 OAF).

340. Mathew, D. (Kerala Agricultural University, Tavanur (India). Krishi Vigyan Kendra); Prasad, M.C. (University of Agricultural Sciences, Bangalore (India). Div. of Horticulture). Multiple shoot and plant regeneration from immature leaflets of in vitro origin in curryleaf (*Murraya koenigii* Spreng). Indian Journal of Plant Physiology (India). (Jan-Mar 2007) v. 12(1) (New Series) p. 18-22 KEYWORDS: REGENERATION; LEAVES; MICRO PROPAGATION; CTYOKININS; TISSUE CULTURE; MURRAYA KOENIGII; SHOOTS.

High frequency shoot regeneration protocol from in vitro raised young leaves of *Murraya koenigii* Spreng was standardized. A combination of 6.6 pM 6-benzyl amino purine (BAP) and 2.9 pM indole 3acetic acid (IAA) has induced significantly (p<0.05) more number of shoots per explant (21.5). Maximum length (2.72 cm) of regenerated shoots (8 weeks after initial culture) was observed on Murashige and Skoog (MS) medium with 5.5 pM BAP and 2.9 pM IAA and on medium with 4.4 pM BAP and 2.9 pM IAA (2.69) which also gave maximum number of leaves per shoot (13.4). Maximum number of roots (recorded 6 and 8 weeks after initial culture) from cut end of induced shoots was obtained on MS medium supplemented with 26.9 or 37.6 pM α -naphthalene acetic acid (NAA). Percentage seedling establishment and whole plant fresh and dry weight were best on hardening medium containing peat, perlite and sand at 1: 1: 2 ratios.

341. Banu, G.S. (Muthayammal College of Arts and Science, Namakkal (India). Centre for Biotechnology); Kumar (G. (Selvamm Arts and Science College, Namakkal (India). Faculty in Biochemistry); Pandian, M.R. (Muthayammal College of Arts and Science, Namakkal (India). Centre for Biotechnology). Establishment of shoot cultures and plant regeneration of *Passiflora edulis* Sims. Indian Journal of Plant Physiology (India). (Jan-Mar 2007) v. 12(1) (New Series) p. 23-27 KEYWORDS: REGENERATION; MICROPROPAGATION; PASSIFLORA EDULIS.

Passiflora edulis Sims, a woody climber belonging to the family passifloraceae has been micropropagated successfully by culturing nodal and internodal segments. The explants were cultured in Murashige and Skoog (MS) basal medium augmented with 6-benzylaminopurine. Maximum percentage of shoot proliferation was achieved in MS basal medium fortified with 6-benzylaminopurine (4.44 mM). The maximum percentage of callus formation was achieved on MS medium augmented with 2, 4dichlorophenoxyacetic acid (4.52 mM). Maximum percentage of shoot proliferation from the internodal derived calli was achieved on MS medium supplemented with 6-benzylaminopurine (2.22 JIM and 4.44 mM). The in vitro raised shootlets were transferred to MS medium fortified with indole butyric acid (IBA) and highest percentage of rooting was observed in IBA-4.90 mM.

342. Srivastava, J.P.; Gangey, S.K. (Banaras Hindu University, Varanasi (India). Dept. of Plant Physiology); Shahi, J.P. (Banaras Hindu University, Varanasi (India). Dept. of Genetics and Plant Breeding). Waterlogging resistance in maize in relation to growth, mineral compositions and some biochemical parameters. Indian Journal of Plant Physiology (India). (Jan-Mar 2007) v. 12(1) (New Series) p. 28-33 KEYWORDS: MAIZE; LEAF CONDUCTANCE; MINERAL CONTENT; SUPEROXIDE DISMUTASE; GROWTH; GENOTYPES; WATERLOGGING.

Nine genotypes of maize were grown in polythene bags containing 1.50 kg of garden soil. Plants were subjected to waterlogging stress after 14 days of sowing. Observations

pertaining to dry matter accumulation, leaf area, leaf rolling, leaf conductance, chlorophyll content, soluble protein content and superoxide dismutase (SOD) activity in leaves, and nitrogen, phosphorus, and potassium contents in various plant parts were determined in normal and waterlogged plants between 22 to 25 days of waterlogging treatment. Genotype CML-49 registered minimum reduction in dry matter accumulation and CML-80 the maximum. Accordingly they were classified as resistant and susceptible to water logging stress, respectively. The resistant genotypes registered lesser reduction in leaf area, chlorophyll content and leaf conductance under waterlogged condition compared to susceptible ones. SOD activity, nitrogen and potassium contents decreased but phosphorus and sodium contents increased under waterlogging condition. Resistant genotype maintained lesser reduction in SOD, N and K contents. It is suggested that high level of K, in resistant genotype is advantageous in maintaining plant water relation and leaf conductance, while relatively higher level of SOD prevents oxidative damages. It is observed that genotype which require low level of N for normal growth, tolerates waterlogging stress.

343. Tiwari, O.N. (Ministry of Science and Technology, New Delhi (India). Dept. of Biotechnology); Chauhan, U.K. (A.P.S. University, Rewa (India). School of Environmental Biology). Seed germination studies in *Rhododendron maddenii* Hook. F. and *Rhododendron niveum* Hook. F.. Indian Journal of Plant Physiology (India). (Jan-Mar 2007) v. 12(1) (New Series) p. 50-56 KEYWORDS: SEED GERMINATION; PLANT GROWTH; SUBSTANCES; RHODODENDRON.

The genus *Rhododendron* constitutes a very important dominant combination in temperate, sub-alpine and alpine region of the Sikkim Himalaya. The present investigation was undertaken to examine the effect of various physical and chemical agents and plant growth regulators for enhancing uniform seed germination. Among the various plant growth regulators and chemicals tried, only a few could significantly influence seed germination over control. Seeds of *Rhododendron maddenii*, *R. niveum* in MS medium treated with GA₃ (250 11M) recorded maximum germination. The BAP did not enhance the seed germination in *R. maddenii*; BAP (250 11M) was in fact inhibitory. On the other hand, in *R. niveum*, BAP enhanced seed germination. The combined treatments of gibberellins and BAP resulted in reduced germination in *R. maddenii* and enhanced germination in *R. niveum*. Among nitrogenous compounds, KNO₃ decreased germination in *R. maddenii*, and increased in *R. niveum*. However KOH solution was found to be beneficial in both concentrations. Seed germination percentage and seed vigour were decreased with the increase of storage time.

344. Menaria, B.L.; Maliwal, P.L. (Maharana Pratap University of Agriculture and Technology, Udaipur (India). Quality of fennel as influenced by plant density, fertilization and plant growth regulators. Indian Journal of Plant Physiology (India). (Jan-Mar 2007) v. 12(1) (New Series) p. 57-62 KEYWORDS: PLANT POPULATIONS; FERTILIZATION; PLANT GROWTH SUBSTANCES; FENNEL; NAA; BA.

A field experiment was conducted during the year 2002-03 and 2003-04 at Instructional Farm, Rajasthan College of Agriculture, Udaipur. The results revealed that planting of fennel at a density of 27.77 thousand plants ha⁻¹ produced seeds which were superior in chlorophyll content, appearance and total soluble sugars over the seed obtained from the densities of 55.55 and 83.33 thousand plant ha⁻¹. Application of 90 kg N + 40 kg P, + 20 K, O + 20 kg S + 5 kg Zn ha⁻¹ (NPKZnS) produced seeds, superior in all quality parameters over the NPK, NPKS and NPKZn treatments. Application of NAA at 100 ppm and BA at 10 ppm

significantly improved total chlorophyll content, total soluble sugars, protein content and volatile oil content of fennel seeds over water sprays.

245. Warriar, K.C.S.; Ganesan, M.; Venkataraman, K.S. (Indian Council of Forestry Research and Education, Coimbatore (India). Institute of Forest Genetics and Tree Breeding). Gas exchange characteristics in *Casuarina* clones. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2007) v. 12(1) (New Series) p. 83-87 KEYWORDS: CASUARINA; GAS EXCHANGE; CLONAL VARIATION; EFFICIENCY; WATER USE.

Casuarina equisetifolia Forst. is extensively grown in India like a cash crop by farmers in southern peninsula due to its multiple utility values. However, this species is reported to show tremendous variation in tree form, growth parameters, tolerance to environmental stresses and adaptability to degraded lands. Studies conducted at the Institute of Forest Genetics and Tree Breeding, Coimbatore revealed considerable variation with respect to physiological parameters including water use efficiency in 33 *casuarina* clones. Seven clones with superior growth performance and favourable physiological characteristics including high photosynthesis, carboxylation efficiency and water use efficiency were found.

346. Sinhal, V.K.; Gupta, S.K.; Srivastava, A.; Singh, U.; Singh, V.P. (M.J.P. Rohilkhand University, Bareilly (India). Dept. of Plant Science). Effect of zinc on growth and NR activity in black gram antagonized by magnesium and sucrose. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2007) v. 12(1) (New Series) p. 95-99 KEYWORDS: ZINC; ANTAGONISM; GROWTH; VIGNA MUNGO; MAGNESIUM; SUCROSE.

The present investigation was designed to evaluate the effects of different doses of zinc (5.3, 6.3, 7.3, 8.3 & 9.3 mg lit.l) and combined effect of zinc with magnesium and sucrose on growth of two cultivars (PU-35 & T-9) of black gram (*Vigna mungo* L. Hepper). A concentration dependent decrease in plant height, fresh weight, chlorophyll, carbohydrate and protein content as well as NR activity was observed in both the cultivars. However, proline content increased with increase in doses of zinc. All the doses of combined treatments (zinc with magnesium and sucrose) were able to alleviate reduction caused by zinc but the alleviation was more pronounced with magnesium supplementation than sucrose.

347. Javed, M.A. (Kobe University, Kobe (Japan). Graduate School of Science and Technology); Ishii, T.; Kamijima, O.; Misao, S. (Kobe University, Kobe (Japan). Faculty of Agriculture). Discrepancy of two ecotypes of *Oryza sativa* L. salinity at germination and seedling stages. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 201-211 KEYWORDS: ECOTYPES; ORYZA SATIVA; VARIETIES; GERMINATION; SEEDLINGS; SALINITY; SALT TOLERANCE; CHEMICAL COMPOSITION; DEVELOPMENTAL STAGES; ELECTRICAL CONDUCTIVITY.

Screening of rice germplasm to salinity stress appropriately is a prerequisite to run the breeding programme. These studies were carried out to evaluate salt tolerance potential of rice cultivars, using four indica rice cultivars (Pokkali, Nona Bokra, Pak 221 and IR 9 NIAB) and two japonica rice cultivars (Koshihikari and Nipponbare), at germination and seedling stages in successive salinity levels. At germination stage, indica and japonica cultivars were found tolerant for germination frequency, compared to germination rate and production of green shoots. However, production of green shoots reflected the most sensitive germination index in this study. Nona Bokra, a tolerant cultivar, performed poorly at

germination stage. At seedling stage, the salt injury score revealed that Pokkali possessed maximum tolerance and Pak 221 was rated as the most sensitive cultivar. An increase in salinity level reduced the seedling height, fresh biomass and dry biomass in all cultivars. Chemical analysis showed an increase in Na^+ contents and reduction in K^+ contents in shoot with each increment in salinity, irrespective of cultivars. A rapid increase in the $\text{Na} : \text{K}$ ratio in shoots was due to the high accumulation of Na^+ in all cultivars but a severe reduction in potassium contents was another cause in japonica cultivars, particularly. The indica salt tolerant rice cultivars, Pokkali and Nona Bokra, exhibited a low accumulation of Na^+ contents and high accumulation of K^+ contents, compared to the other four cultivars in a saline environment. The salt injury score (SIS) showed significant correlation with all seedling stage traits. However, SIS exhibited a highly significant correlation (0.996) with Na^+ contents in shoots. The results revealed that rice screening for salinity tolerance should be carried out at several growth stages to understand the response of particular cultivar, as Nona Bokra exhibited a high tolerance at seedling stage but performed poorly for germination indexes. Production of green shoot and a highly significant correlation between SIS and Na^+ contents in shoots could be important criteria in the rice screening programmes for salt tolerance at germination and seedling stages, respectively. Moreover, the selectivity of K^+ over Na^+ appeared to be an important salt tolerant determinant at seedling stage, as exhibited by salt tolerant indica rice cultivars.

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348. Singh, A. (Navsari Agricultural University, Navsari (India); Singh, J. (Chaudhary Charan Singh University, Meerut (India). Dept. of Horticulture); Kumar, P. (Chaudhary Charan Singh University, Meerut (India). Dept. of Botany); Singh, V.P. (Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Membrane stability and post harvest keeping quality of gladiolus cut spikes as influenced by certain chemicals with sucrose in vase solution. *Indian Journal of Plant Physiology (India)*. (Jan-Mar 2007) v. 12(1) (New Series) p. 63-71 KEYWORDS: POST HARVEST CONTROL; STABILITY; QUALITY; SUCROSE; GLADIOLUS; MEMBRANE; CAROTENOIDS; COROLLA; ANTHOCYANINS.

Influence of silver nitrate (AgNO_3), silver thiosulphate (STS), 8-Hydroxy Quinoline (8-HQ) and sucrose as vase solution on the post harvest keeping quality of gladiolus cut spikes, was studied. The treatment of antimicrobial agent, 8-HQ (200 and 300ppm) with sucrose (5 percent) improved the keeping quality of the cut spikes. The treatment of 300 ppm 8-HQ with 5 percent sucrose significantly enhanced the per cent gain in fresh and dry weight of the cut spikes as well as recorded higher reducing, non-reducing sugar content, Carotenes and anthocyanin pigments in the petals of the cut spikes on 4th day after treatment (DAT). The vase solution treatment 300 ppm 8-HQ + 5 percent sucrose maintained higher activities of antioxidant enzymes, superoxide dismutase (SOD) and glutathione reductase (GR), reduced lipoxygenase (LOX) activity and lipid peroxidation (TBARS) in the petals of the cut spikes on 5th DAT. All these factors contributed towards better membrane integrity exhibited as high MSI, which delayed the petal senescence and significantly doubled the vase life and improved the flower quality of gladiolus cut spikes.

H10 Pests of Plants

349. Srihari, B.; Patnaik, N.C. (Orissa University of Agriculture and Technology, Bhubaneswar (India). Dept. of Entomology). Use of new insecticides against *Maruca vitrata* (Geyer) in blackgram. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 169-172 KEYWORDS: MARUCA VIRATA; INSECTICIDES; VIGNA MUNGO; INSECT CONTROL.

Field experiment was conducted to study the efficacy of thiodicarb, spinosad, novaluron, indoxacarb, profenofos, B. t. k. and chlorpyrifos against *Maruca vitrata* (Geyer) on blackgram. Field studies indicated that the new insecticide indoxacarb 0.0145 percent was most effective in suppressing the larval population of *M. vitrata* followed by spinosad (0.015 percent) and thiodicarb (0.075 percent). The next best treatments in reducing the larval population were profenofos and chlorpyrifos. The eco-friendly insecticides viz., novaluron, B. t. k. and neem were found to be least effective. Higher yields were obtained in the plots treated with indoxacarb (15.09 q/ha).

350. Hitendra Kumar; Singh, Gajendra (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Entomology). Biology of litchi bug, *Tessarotoma javanica* Thunberg (Hemiptera: Pentatomidae) on litchi. *Pantnagar Journal of Research (India)*. (Jan-Jun 2007) v. 5(1) p. 17-20 KEYWORDS: INSECT PESTS; BIOLOGY; LITCHI; TESSAROTOMA; PENTATOMIDAE; LIFE CYCLE.

A detailed study on biology of the litchi bug, *Tessarotoma javanica* Thunberg was undertaken. Insect laid globular and off pink eggs, mostly in bunch of fourteen on lower surface of leaves. The insect passed through five instars, which were sub rectangular and dark brick red except first instar, which was nearly subrectangular. Newly emerged adult was dirty white and soft bodied insect but colour changed to yellow red after few days. The average duration of male and female adults was 43.2 ± 7.7 and 47.2 ± 9.5 days, respectively. Both adults and nymph fed mostly on tender plant parts such as growing buds, leaf petioles, fruit stalks and tender branches of litchi tree. Excessive feeding caused drying of growing buds, tender shoots and ultimately fruit drop.

351. Ahmad, Tariq; Mumtaz, Rashid; Suneel Kumar; Maurya, R.P.; Khan, M.A. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Entomology). Ecological studies on *Choreodocus illustris* Walker (Orthoptera: Acrididae) with special reference to suspected gregariousness in hoppers. *Pantnagar Journal of Research (India)*. (Jan-Jun 2007) 5(1) p. 21-23 KEYWORDS: ECOLOGY; ACRIDIDAE; INSECT PESTS; LIFE CYCLE; SUGARCANE.

Fimbristylis miliacea was most dominant weed in zero tilled condition with average contribution 55.3 per cent at 60 days stage. Higher dry weight was observed during the second year of experiment. Anilofos 0.4 kg ha⁻¹ as early post emergence application followed by 2, 4-D at 0.5 kg ha⁻¹ reduced density and total dry weight of weeds at 60 days stage resulting in highest weed control efficiency (91.5 and 55.1 per cent respectively during 2001 and 2002) among herbicidal treatments. Weeds caused complete destruction of rice crop in weedy check plots. Owing to better control of weeds pendimethalin at 1.0 kg ha⁻¹ followed by 2, 4-D at 0.5 kg ha⁻¹ and anilofos 0.4 kg ha⁻¹ as early post emergence application followed by 2,4-D at 0.5 kg ha⁻¹ recorded significantly higher number of panicles m⁻² and thus grain yield.

352. Thakur, Seema Singh; Karnatak, A. K.; Karnatak, D.C. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Entomology). Effect of a carbamate

insecticide, Carbosulfan on the foraging behaviour of *Apis mellifera* L. foragers. Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 24-26 KEYWORDS: CARBAMATES; INSECTICIDES; CARBOSULFAN; FORAGING; APIS MELLIFERA; REPELLENTS.

Investigations were done to observe the effect of a carbamate insecticide, carbosulfan on the foraging activity of *Apis mellifera* L. The experiment consisted of two sets. In the first set the bees were allowed to come in direct contact of insecticide treated surface while in the second set a wire net was kept over the treated surface so that only odour repelled the bees. Carbosulfan was found to repel the bees only through its contact action while its odour was found ineffective to repel the bees at all concentrations. When comparison was made between contact and odour action with control, for all the 3 concentrations, in combination then also the results were found to be significant. There was found significant difference in the number of bees visiting the petriplates (contact, odour and control) during different time intervals. When interaction was observed between concentrations and the effects (control, odour and contact), it was significant.

353. Karnatak, A. K.; Karnataka, D. C.; Thakur, Seema Singh; Shukla, Awdhesh (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Entomology). Impact of commonly used pesticides on the population of beneficial soil inhabitants (enchytraeids) and yield in the rice crop ecosystem. Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 27-29 KEYWORDS: PESTICIDES; INSECT PESTS; ENCHYTRAEIDS; ECOSYSTEMS; RICE; SOIL BIOLOGY.

ABSTRACT: A study was conducted during Kharif season to observe the effect of some common pesticides and their combinations in rice ecosystem on the enchytraeid population and consequently on yield of rice crop. Samples from soil were collected before and after 24 hours of the pesticide application during transplanting, 30 days after transplanting (DAT), panicle initiation stage and harvesting stage of the crop. The maximum population of enchytraeid (2666.67 per m²) was observed at the time of transplanting in control plots. The minimum population (133.33 per m²) was recorded in the plots where phorate, butachlor and quinalphos were applied in combination after 24 hours of pesticide application at 30 DAT. Maximum number of tillers (15.66), maximum ear length (24.66 cm), maximum 1000 grain weight (31.20g) and Maximum yield (4926.33 kg/ha) were obtained in the plots where combination of phorate, butachlor and quinalphos were applied. Minimum number of tillers (13.66), minimum ear length (22.03 cm), minimum 1000 grain weight (28.09g) and minimum yield (4390.33 kg/ha) were recorded from control plots. Among all pesticides, caldan (cartap hydrochloride) was found to be economically sound and safest ecologically. Application of caldan in rice crop do not disturb the ecosystem as enchytraeid population was found adequately high in caldan treated plots than with other pesticides treated plots and moreover, yield was also high (4852.00 kg/ha). Application of pesticides imposed serious hazards on enchytraeid population. Combine application of more than one pesticide in the field was found to be lethal in comparison to the application of single pesticide. The pesticides used in combinations significantly increase the yield of rice crop.

354. Thakur, Seema Singh; Kanaujia, Sudha; Karnatak, D. C. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Entomology),. Influence of day hours, temperature and relative humidity on bee-visitation in calendula, *Calendula officinalis* L. and justicia, *Justicia gendarussa* L.. Pantnagar Journal of Research (India). (Jan-

Jun 2007) 5(1) p. 30-32 KEYWORDS: PHOTOPERIODICITY; TEMPERATURE; RELATIVE HUMIDITY; CALENDULA; JUSTICIA; HONEY BEES.

Studies were undertaken to observe the influence of day hours, temperature and relative humidity on bee-visitations in calendula, *Calendula officinalis* L. and justicia, *Justicia gendarussa* L. The number of *Apis* species was counted for 3 minutes on randomly selected flowers/panicles from 09:00 to 17:00h at hourly interval. Temperature and relative humidity were simultaneously noted down on 2002 *Apis dorsata* and *Apis mellifera* were found to be visiting calendula flowers plant. During the period of observation the air temperature varied from 19°C to 28°C and relative humidity 65 to 85 per cent. In justicia the major *Apis* foragers included *Apis dorsata*, *Apis mellifera* and *Apis cerana indica*. During the period of observation, the air temperature varied from 28°C to 36°C and relative humidity from 57 per cent to 72 per cent. *A. florea* did not visit the flowers throughout the day.

H20 Plant Diseases

355. Vamadevaiah, H.M.; Chattannavar, S.N.; Bhandari, A.; Sharmila, A.S.; Khadi, B.M. (University of Agricultural Sciences, Dharwad (India). Agricultural Res. Stn.). Peroxidase isozyme pattern of different groups of *Ramularia areole*. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 113-114 KEYWORDS: PEROXIDASES; RAMULARIA; ISOENZYMES; ENZYME ACTIVITY.

The four different isolates representing four separate groups of *Ramularia areole* collected from different places of the country viz., Mathura, Coimbatore, Nagpur and Dharwad were subjected to peroxidase isozyme activity. The Coimbatore isolate exhibited two additional bands followed by Nagpur but both bands had different J.Vn values. However, there was no change in Dharwad and Kumbapur isolates which got single band that has been observed in all isolates.

356. Ashoka, S.; Hegde, Y.R.; Kulkarni, S.; Kulkarni, M.S. (University of Agricultural Sciences, Dharwad (India). Dept. of Plant Pathology). Survey for the incidence of fungal diseases of Vanilla in Karnataka. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 173-177 KEYWORDS: FUNGAL DISEASES; VANILA PLANI FOLIA; SURVEYS; DISEASE SURVEYS; KARNATAKA; MORBIDITY.

During fixed plot survey in 2004-05 in Karnataka, incidence of *Colletotrichum gloeosporioides* causing leaf spot or rot was highest in Uttar Kannada district (29.38 percent) followed by Shimoga district (20.05 percent). Highest incidence of *Fusarium oxysporum* was in Shimoga district (14.34 percent) followed by Uttar Kannada. Incidence of *Sclerotium rolfsii* and *Rhizoctonia bataticola* was observed only in Uttar Kannada and Shimoga districts, respectively. Higher incidence of *C. gloeosporioides* (18.15 percent), *F. oxysporum* (6.46 percent), *S. rolfsii* (0.4 percent) and *R. bataticola* (03.8 percent) was observed under natural field condition. *Sclerotium* rot and *Rhizoctonia* rot were completely absent in vanilla grown under shade net condition.

357. Kunkaliker, S.; Kunkaliker, R.; Byadgi, A.S.; Kulkarni, V.R. (University of Agricultural Sciences, Dharwad (India). Dept. of Plant Pathology). Histochemical analysis of powdery mildew affected greengram. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 179-183 KEYWORDS: MILDEWS; VIGNA RADIATA; CHEMICAL COMPOSITION; NUTRITIVE VALUE; DEVELOPMENTAL STAGES.

Greengram is popular for its nutritional value and suitability for multiple cropping systems. It is susceptible to powdery mildew disease caused by *Erysiphe poygoni*. The total phenols content at 35 days with disease reaction of grade 1 in resistant variety was more (0.5860 mg) as compared to susceptible variety (0.3712 mg): In resistant genotype Black greengram, there was less amino acid content (0.4163 mg) as compared to susceptible ganotype Pusa 103 (0.75 mg) and with disease reaction of grade 0 and 1, respectively. The total sugar content, on an average, remained the same in early stages of crop growth when disease was 0 percent. Later in advanced stages of crop growth, when disease was severe, the total sugar content increased. The percentage of potassium in initial growth stages of Pus a Baisaki was ,high, but at later stages it decreased gradually till the harvesting time. There was an increase in phosphorus content in the leaves till the flowering period, which gradually decreased after flowering till harvest.

358. Kunkaliker, S.; Kunkaliker, R.; Byadgi, A.S.; Kulkarni, V.R. (University of Agricultural Sciences, Dharwad (India). Dept. of Plant Pathology). In vitro evaluation of fungicides against powdery mildew of greengram. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 185-187
KEYWORDS: MILDEWS; PLANT DISEASES; FUNGICIDES; IN VITRO CULTURE; DEVELOPMENTAL STAGES; VIGNA RADIATA; ERYSIPIHE POLYGUNI.

Greengram is an important pulse crop widely cultivated in India in multiple cropping system. It is susceptible to powdery mildew disease caused by *Erysiphe polygوني*. It was observed that among six fungicides tested tridemorph was most effective followed by carbendazim. Copper oxychloride even at 0.30 percent concentration could not totally inhibit germination percentage.

359. Akhtar, Jameel (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Plant Pathology). Bioefficacy of fungicides and sensitivity of the isolates of *Phomopsis vexans*. *Pantnagar Journal of Research (India)*. (Jan-Jun 2007) 5(1) p. 62-65
KEYWORDS: BIOLOGICAL CONTROL; FUNGICIDES; ISOLATION; DIAPORTHE; FUNGAL DISEASES; AUBERGINES; PHOMOPSIS.

360. Vishwanath; Vineeta (G. B. Pant University of Agriculture and Technology, Majhera (India). Agriculture Research Station)Agriculture Research Station, G. B. Pant University of Agriculture and Technology, Majhera, Nainital- 263 135 (Uttarakhand). Systemic resistance induction against alternaria leaf blight through avirulent strain of *Alternaria brassicae* in mustard. *Pantnagar Journal of Research (India)*. (Jan-Jun 2007) 5(1) p. 66-69
KEYWORDS: INDUCED RESISTANCE; FUNGAL DISEASES; DISEASE RESISTANCE; ALTERNARIA BRASSICEA; MUSTARD; LEAVES; INOCULATION.

Alternaria leaf blight caused by *Alternaria brassicae* (Berk.) Sacc., is one of the most important diseases of the rapeseed-mustard crop. The present study deals with induced resistance in mustard using avirulent isolate of *A. Brassicae* against the two other virulent isolates of the same pathogen. The full leaf was pre inoculated with *Alternaria alternata* and challenge inoculated with *Alternaria brassicae* isolates A (aba) or *Alternaria brassicae* isolate C (abc). The *Alternaria brassicae* isolate A (aba) Challenged Inoculation (CI) showed maximum disease severity followed by Challenged Inoculation (CI) with *Alternaria brassicae* isolate C (abc) in comparison with *Alternaria alternata*-Water (Aa-W) check treatment which did not produce any spots on the leaf. The disease severity due to *Alternaria alternata* - *Alternaria brassicae* isolate A (Aa-aba) and *Alternaria alternata* – *Alternaria brassicae* isolate

C (Aa-abc) treatments were comparable to *Alternaria brassicae* isolate A-Water (aba -W) and or *Alternaria brassicae* isolate C-Water (abc -W) treatments respectively. Similar results in terms of induced inoculation with *Alternaria alternata* (Aa) or *Alternaria brassicae* isolate D (abd) and challenged inoculation (CI) with or *Alternaria brassicae* isolate A (aba) and or *Alternaria brassicae* isolate C (abc) were recorded on the detached leaf. But the degree of increase in disease severity in the case of *Alternaria alternata* - *Alternaria brassicae* isolate A (Aa-aba) and *Alternaria alternata* - *Alternaria brassicae* isolate C (Aa-abc) was slightly more than on the attached leaf surface.

H60 Weeds and Weed Control

361. Singh, P.; Singh, S.S. (Allahabad Agricultural Institute-Deemed University, Allahabad (India). Dept. of Agronomy). Effect of establishment method, fertility level and weed management practices on aromatic rice (*Oryza sativa*). *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 288-292 KEYWORDS: WEED CONTROL; FERTILITY; ORYZA SATIVA.

An experiment was conducted during rainy season of 2003 and 2004 at Agronomy Research Farm, Allahabad Agricultural Institute-Deemed University to assess the effect of establishment method, fertility level and weed-management practice on rice (*Oryza sativa* L.). The experiment was laid out in factorial randomized block design, comprising two establishment methods (direct wet seeding and transplanting); three levels of N, PPs and KP, viz. 80 : 40 : 40; 100 : 50 : 50 and 120 : 60 : 60 kg/ha; and four weed-management practices, viz. anilofos 0.4 kg a i/ha, butachor 1.5 kg a i/ha, two hand-weedings (at 30 and 60 DAB) and a weedy check. These 24 treatments, were replicated thrice. Transplanting method recorded higher grain yield than direct seeding. The yield increased with the increase in fertility level and reached maximum with 120 : 60 : 60 kg/h[~] f;l, PPs and Kp/ha. Two hand-weedings registered higher grain and straw yields with respect to weed-management practices. Amongst all the interactions, the maximum grain yield was observed in direct seeded and transplanted plots treated with two hand-weedings and higher fertilizer dose of 120 : 60 : 60 kg/ha N, PPs and KP, and were at par. However, higher net profit and benefit: cost ratio (BCR) were observed in transplanted plots treated with 120 : 60 : 60 kg/ha N, P Ps and KP and anilofos 0.4 kg ai/ha. The maximum weed-control efficiency was observed in transplanted rice, low fertility and anilofos 0.4 kg ai/ha treatments. The maximum weed index was observed in weedy check plots.

362. Yadav, V.; Singh, B. (Narendra Deva University of Agriculture and Technology, Faizabad (India). Dept. of Agronomy). Effect of crop establishment method and weed management practice on rice (*Oryza sativa*) and associated weeds . *Indian Journal of Agronomy (India)*. (Dec 2006) v. 51(4) p. 301-303 KEYWORDS: WEED CONTROL; ORYZA SATIVA; ZERO TILLAGE.

An experiment was conducted during rainy (kharif) season of 2003 and 2004 to find out the best weed-control practice and crop-establishment method of rice (*Oryza saiva* L.). Mean plant height was highest (83 cm) in zero tillage. Highest value of leaf-area index (3.28) was recorded in transplanting, as well as the highest mean grain yield (55 q/ha), the latter being 45.5, 4.5, 26.7 per cent more than that in dry seeding, drum seeding and zero tillage respectively. Among weed-management practices, herbicide + two hand-weedings gave the highest grain yield (60.96 q/ha), and transplanting and herbicide + two hand-weedings gave the highest straw yield. The population as well as dry weight of weeds were higher in dry seeding and zero tillage. The highest weed-control efficiency (70.80 percent) was recorded

in herbicide + two hand-weedings, followed by two hand-weedings, the highest net profit (Rs 22,344/ha) was obtained from the combination of drum seeding with herbicide + two handweedings. However, the highest value of benefit: cost ratio (1.66) was recorded in the treatment with drum seeding with two hand-weedings.

363. Mishra, J.S. (National Research for Weed Science, Jabalpur (India)). Efficacy of herbicides in wheat (*Triticum aestivum* with special reference to wild oat (*Avena sterilis ludoviciana*) in vertisols. Indian Journal of Agronomy (India). (Dec 2006) v. 51(4) p. 307-309
KEYWORDS: HERBICIDES; TRITICUM AESTIVUM; VERTISOLS; AVENA STERILLIS LUDOVICIANA.

A field experiment was conducted during winter season of 2004-05 and 2005-06 at Jabalpur to assess the efficacy of clodinafop-propargyl, sulfosulfuron and isoproturon as post-emergence in wheat (*Triticum aestivum* L. emend. Fiori & Paol.). Clodinafop 60 g/ha significantly reduced the density and dry matter of wild oat (*Avena sterilis* ssp. *ludoviciana* Dur.), but could not combat the problem of broad-leaved weeds, viz., *Medicago hispida* Gaertn., *Lathyrus aphaca* L., *Chenopodium album* L. and *Vicia sativa* L. Sulfosulfuron 25 g/ha provided effective control of both wild oat and broad-leaved weeds. Isoproturon 1,000 g/ha did not cause significant reduction in the population and dry matter of wild oat, but significantly reduced the problem of broad-leaved weeds. Infestation of weed throughout the crop-growth period caused 48.8 percent reduction in grain yield of wheat. Higher yield attributes and maximum grain yield (47.6 q/ha) of wheat were recorded from two hand-weedings at 30 and 60 days after / sowing (DAS). Amongst herbicidal treatments, application of sulfosulfuron 25 g/ha (43.6 q/ha), being on a par with that of clodinafop 60 g/ha (41.5 q/ha), 120 g/ha (43.4 q/ha) and 240 g/ha (44.5 q/ha), significantly increased the grain yield of wheat and recorded the maximum net return (Rs 11,940/ha).

364. Dhar, S.; Das, S.K.; Kumar, S.; Tripathi, S.B. (Indian Grassland and Fodder Research Institute, Jhansi (India). Crop Production Div.. Response of fodder sorghum (*Sorghum bicolor*) to different weed management techniques and nitrogen levels. Indian Journal of Agronomy (India). (Dec 2006) v. 51(4) p. 310-313
KEYWORDS: SORGHUM BICOLOR; NITROGEN; WEED CONTROL.

A field experiment was conducted during rainy (kharif) seasons of 2000-02 at Jhansi to know the response of fodder sorghum [*Sorghum bicolor* (L.) Moench] to nitrogen levels and weed-control techniques. Significant increase in green-fodder, dry-matter and crude-protein yields was recorded with successive increase in nitrogen up to 60 kg/ha. N at 60 kg/ha gave significantly higher green-fodder (45.2 t/ha), dry-matter (8.26 t/ha) and crudeprotein yields (646.7 kg/ha) as well as nitrogen uptake (104.2 kg/ha), but at higher level showed no significant differences. However, 90 kg N/ha gave the highest net profit (Rs 15,850/ha) and benefit: cost (B:C) ratio (1.55) compared with the remaining levels. Among weed-control techniques, broadcast sowing of cowpea (*Vigna unguiculata* (L.) Walp.) and application of atrazine 0.5 kg/ha were at par and gave significantly higher greenfodder (52.1 and 49.1 t/ha) and dry-matter (8.9 and 9.06 t/ha) yields than other techniques. Broadcast sowing of cowpea gave higher net. profit (Rs 13,800/ha), B:C ratio (1.45) and significantly higher crude-protein yield (800 kg/ha) as well as nitrogen uptake (126.2 kg/ha) than others methods. Atrazine 0.5 kg/ha gave significantly lower weed density (25.6/m²), dry weight of weeds (0.30 t/ha) and nitrogen uptake by weeds (4.0 kg/ha) than other techniques. This was closely followed by broadcast sowing of cowpea, registering 104.5/m², 1.93 t/ha and 16.3 kg/ha respectively. Interaction effects of nitrogen levels and weed-control techniques for

green-fodder, dry-matter, crude-protein yields and nitrogen uptake of sorghum were also significant.

365. Kumar, G.P.; Chinnusamy, C. (Tamil Nadu Agricultural University, Coimbatore (India). Dept. of Agronomy); Shanmugasundaram, R. (Tamil Nadu Agricultural University, Veppankulam (India). Coconut Research Stn.); Kandasamy, O.S. (Tamil Nadu Agricultural University, Coimbatore (India). Dept. of Agronomy). Effect of early post-emergence herbicide for control of weeds in winter irrigated upland cotton (*Gossypium hirsutum*). Indian Journal of Agronomy (India). (Dec 2006) v. 51(4) p. 323-326 KEYWORDS: WEED CONTROL; HERBICIDES; GOSSYPIUM HIRSUTUM.

A study was carried out to evaluate the effect of trifloxysulfuron with and without adjuvant against weeds in upland cotton (*Gossypium hirsutum* L.) during the winter seasons of 2003-04 and 2004-05 at the Tamil Nadu Agricultural University, Coimbatore. Weeds, viz. *Trianthema portulacastrum* L., *Chloris inflata* Link; syn. *C. barbata* Sw. and *Cyperus rotundus* L., were the dominant weeds of the experimental field. Trifloxysulfuron effectively controlled *T. portulacastrum* and *C. rotundus*. Trifloxysulfuron 10 and 20 g/ha with and without adjuvant provided 85 to 91 percent weed-control efficiency compared to unweeded control. Among the treatments, the maximum cotton yield of 16.89 and 17.96 q/ha was observed in trifloxysulfuron 10 g/ha + adjuvant during the winter season of 2003-04 and 2004-05 respectively. Minimum seed-cotton yield of 8.97 and 8.76 q/ha was obtained in unweeded control in first and second year.

366. Sharma, K.C.; Chander, S. (Central Sheep and Wool Research Institute, Bikaner (India). Arid Region Campus). Effect of cultural and chemical weed control on productivity of fodder oat (*Avena sativa*) in arid Rajasthan. Indian Journal of Agronomy (India). (Dec 2006) v. 51(4) p. 327-330 KEYWORDS: WEED CONTROL; AVENA SATIVA; RAJASTHAN.

A field experiment was conducted during winter (rabi) season of 2002-03 and 2003-04 to find out the effective and economical weed-control measure in fodder oats (*Avena sativa* L.). The different weed-control treatments significantly controlled the weed flora and recorded 69.2 to 97.6 percent weed-control efficiency (WCE) at 45 days after sowing (DAS) and 59.3 to 98.0 per cent at 50 percent flowering stage. However, post-emergence application of 2,4-D proved phytotoxic by stunting the crop growth and narrowing the leaf area. Among weed-control treatments, weed-free treatment proved superior and produced highest fodder yields (GFY 42.9 t/ha DFY 11.05 t/ha), followed by post-emergence application of metsulfuron methyl 0.008 kg/ha + 1 hand-weeding. Economical analysis showed that application of metsulfuron methyl 0.008 kg/ha gave the maximum net returns (Rs 14,647) and benefit: cost ratio (1.79), followed by metsulfuron methyl 0.012 kg/ha+1 hand-weeding. Computation of energy relationship revealed that weed-free treatment was more energy efficient, recording highest energy ratio (9.46) and energy productivity (525.7 g/MJ), followed by post-emergence application of metsulfuron methyl 0.012 kg/ha (9.42 and 523.3 g/MJ).

367. Punia, S.S.; Sharma, S.D.; Yadav, A.; Sangwan, N. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy). Efficacy of pinoxaden 10 EC against grassy weeds in wheat. Annals of Biology (India). (Dec 2006) v. 22(2) p. 149-151 KEYWORDS: WEEDS; WEED CONTROL; CONTROL METHODS; HERBICIDES; WHEATS; YIELDS; PHALARIS.

On the basis of two years' study, it is inferred that pinoxaden (NOVA 407855 10 EC) at 27.5 g ha⁻¹ can safely be used to control *Phalaris minor* in wheat crop.

368. Yadav, A.; Malik, R.K.; Hasija, R.C. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy). Efficacy of metsulfuron and isoproturon alone and in combination against complex flora of weeds in wheat. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 153-159 KEYWORDS: WEEDS; WEED CONTROL; CONTROL METHODS; HERBICIDES; METSULFURON; ISOPROTURON; WHEATS; TRITICUM AESTIVUM; FLORA; YIELDS.

Based on the results of three field experiments, it was found that metsulfuron+isoproturon at 4+750 or 4+ 1000 g ha⁻¹ being superior to their Alone applications produced the grain yield of wheat statistically similar to weedfree plots by reducing the dry weight of grassy and broadleaf weeds to the extent of 90-97 and 66-86 percent, respectively. Combinations of 2; 4-0 Na at 500 g ha⁻¹ with isoproturon at 750 or 1000 g ha⁻¹ also resulted equally effective against complex flora of weeds but due to inclusion of 2, 4-0 Na sensitive wheat variety (WH 283), these treatments could not raise the grain yield to the level of plots kept weed-free. The performance of tank mix and ready mix applications of metsulfuron+isoproturon in the ratio of 1 : 250 each at 500, 750 and 1000 g ha⁻¹ against mixed flora of weeds was similar at respective doses, however, these could produce grain yield statistically similar to weed-free treatment only at highest dose (1000 g ha⁻¹). Metsulfuron at 4 g ha⁻¹ being superior to its lower doses and at par with higher doses was safe for the crop and reduced the density and dry weight of broad leaf weeds to the extent of 79-96 percent under different experiments. But it was ineffective against grassy weeds. The weed control efficacy of 2, 4-0 Na at 500 g ha⁻¹ against broadleafweeds was also similar to metsulfuron at 4 g ha⁻¹ and it was also not effective against grassy weeds. Crop phytotoxicity and malformation in wheat variety WH 283 was also noticed in the plots treated with 2, 4-0 Na at 500 g ha⁻¹ and above either used alone or as tank mixture. Compared to metsulfuron alone 4 g ha⁻¹, there was no additional gain in weed control and grain yield of wheat with the use of either tank mix or ready mix of 2, 4-0 Na and metsulfuron particularly at higher doses. However, at lower doses, there was an improvement in their efficacy when used as tank mixed with each other and/or in their efficacy when used as tank mixed with each other and/or in combination with surfactant. Isoproturon 1000 g ha⁻¹ was significantly better than its lower doses (500 and 750 g ha⁻¹) and controlled grassy and broad leaf weeds in wheat to the extent of 77-84 and 61-70 percent, respectively. Tralkoxydim proved ineffective against broadleafweeds.

369. Kumar, A.; Malik, R.K.; Sirohi, R.M.; Hasija, R.C. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy). Performance of new herbicides at two doses and spray volumes against resistant *Phalaris minor* in wheat at farmers' fields. *Annals of Biology (India)*. (Dec 2006) v. 22(2) p. 161-164 KEYWORDS: WEEDS; WEED CONTROL; CONTROL METHODS; PHALARIS; VANUATU; WHEATS; TRITICUM AESTIVUM; YIELDS.

Clodinafop at 60 g, fenoxaprop at 120 g and sulfosulfuron at 25 g ha⁻¹ each sprayed in two volumes (250 or 500 l ha⁻¹) provided 92-93, 83-84 and 89-91 percent control of *P minor*, respectively. These herbicides at recommended dose sprayed in either of two volumes could raise the grain yield of wheat to the extent of 21-29 percent compared to weedy check. Whereas at lower than the recommended dose of clodinafop, fenoxaprop and

sulfosulfuron irrespective of spray volumes, the WCE was reduced to the extent of 10, 18 and 9 percent, respectively. Almost similar effects were reflected in terms of grain yield of wheat. There was more pronounced effect of doses as compared to spray volumes for each of the three herbicides both in terms of weed control and grain yield of wheat. Different volumes of spray at respective doses did not influence the efficacy of any herbicide and consequently the yield differences were negligible particularly at higher doses of each herbicide.

370. Pandey, I.B.; Dwivedi, D.K.; Pandey, R.K. (Rajendra Agricultural University, Pusa (India). Dept. of Agronomy). Efficacy of herbicides and fertilizer management on weed dynamics in wheat (*Triticum aestivum*). Indian Journal of Agronomy (India). (Mar 2007) v. 52(1) p. 49-52
KEYWORDS: WEED CONTROL; TRITICUM AESTIVUM; EFFICIENCY; HERBICIDES; FERTILIZER APPLICATIONS.

A field experiment was conducted during winter (rabl) season of 2002-03 and 2003-04 to study the efficacy of herbicides and fertilizer management on weed dynamics of wheat (*Triticum aestivum* L. emend. Fiori & Paol). The intensity of weeds as well as total weed count were unaffected by the method and level of fertilizer application, but side placement of fertilizer significantly reduced the total dry biomass of weeds, NPK depletion by weeds that improved the NPK uptake by the crop and produced 13.5 per cent higher grain yield than broadcast method of fertilizer application. Application of 125 per cent of the recommended dose of fertilizer (ROF) although recorded significantly higher dry biomass of weeds and NPK depletion by weeds than 75 per cent of the ROF, it increased the NPK uptake by crop and grain yield. Weed-control treatments significantly reduced the intensity of broad-leaf weeds, annual and perennial grasses, total weed count, dry biomass of weeds and NPK depletion by weeds, and increased the NPK uptake by the crop. These treatments increased the grain yield by 26.3-35.9 per cent than the weedy check. Among the weed-control treatments, sulfosulfuron proved the most effective herbicide against broad-leaf weeds and annual grasses, reducing their intensity as well as that of total weeds than the mixture of 2,4-0 + isoproturon and hand-weeding but had no adverse effect on perennial grasses and sedges. However, hand-weeding significantly reduced the intensity of perennial grasses and sedges. Sulfosulfuron also recorded significantly lower total dry biomass of weeds and NPK depletion by weeds than the mixture of 2,4-0 + isoproturon and showed the highest weed-control efficiency.

371. Bharat, R.; Kachroo, D. (Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu (India). Div. of Agronomy). Bio-efficacy of various herbicides and their mixtures on weeds and yield of wheat (*Triticum aestivum*) under subtropical agro-ecosystem. Indian Journal of Agronomy (India). (Mar 2007) v. 52(1) p. 53-59
KEYWORDS: WEEDS; TRITICUM AESTIVUM; YIELDS; HERBICIDES; AGRO ECOSYSTEMS; SUBTROPICAL ZONES; NUTRIENT UPTAKE; ECONOMICS.

A field experiment was conducted during the winter (rabl) season of 2004-05 and 2005-06 to study the effect of various herbicides and their mixtures on weed growth, yield attribute and yield of wheat (*Triticum aestivum* L. emend. Fiori & Paol.) under irrigated conditions of subtropical agro-ecosystem of Jammu region. The weed flora observed at site were *Anagallis arvensis*, *Poa annua*, *Phalaris minor*, *Trachyspermum* and *Euphorbia helioscopia*, of which the relative density of individual weed species out of total weeds corresponds to 1.11 to 4.69 per cent on application of fenoxaprop+metribuzin (120+100 g

ai/ha) at 60 days after sowing (OAS). Among the weed-control treatments, fenoxaprop+metribuzin (120+100 g ai/ha), though on a par with either tank mix application of sulfosulfuron + 2,4-D (25+500 g ai/ha), clodinafop + metsulfuron (60+2 g ai/ha), isoproturon+2,4-D (750+500 g ai/ha) or alone application of sulfosulfuron (25 g ai/ha), metribuzin (175 or 200 g ai/ha) and isoproturon (1,000 g ai/ha), reduced the dry weight of weeds significantly than weedy check and other herbicide treatments. It led to significant increase in the yield attributes, viz. effective tillers/m, grains/ear and 1,000-grain weight, and the yield of wheat than the rest of the treatments, during both the years of experimentation. Maximum grain yield and yield attributes were recorded in weed-free plots, and reduction of 42.29 and 38.27 per cent in yield was observed in weedy check plots during 2004-05 and 2005-06 respectively.

372. Nadeem, M.A.; Tanveer, A.; Ali, A.; Ayub, M.; Tahir, M. (University of agriculture, Faisalabad (Pakistan). Dept. of Agronomy). Effect of weed-control practice and irrigation levels on weeds and yield of wheat (*Triticum aestivum*). *Indian Journal of Agronomy (India)*. (Mar 2007) v. 52(1) p. 60-63 KEYWORDS: WEED CONTROL; WEEDS; TRITICUM AESTIVUM; HERBICIDES; YIELDS; YIELD COMPONENTS.

A field experiment was conducted to study the effect of different weed-control practices and irrigation levels on weeds and yield of wheat (*Triticum aestivum* L. emend. Fiori & Paol.) in winter 2002-03 and 2003-04 in Pakistan. The experiment comprised four weed-control practices, viz. weedy check, pre-emergence application of pendimethalin, post-emergence application of isoproturon + carfentrazone ethyl and manual weed control (two hoeings), and four irrigation levels, viz. 0.50, 0.75, 1.00 and 1.25 irrigation water (IW): cumulative pan evaporation (CPE). The manual hoeing resulted in minimum weed density and dry weight of weeds, and gave maximum grain yield of 62.46 and 61.45 q/ha due to more spike-bearing tillers, 1,000-grain weight and number of grains/ spike, but was statistically similar to post-emergence application of isoproturon + carfentrazone ethyl. The effect of irrigation levels on weed density and dry weight of weeds was non-significant in 2002-03 but was significant in 2003-04. The maximum grain yield was obtained at 1.25 IW:CPE.

373. Prajapati, B.L.; Upadhyay, V.B.; Singh, R.P. (All India Coordinated Research Project on Small Millets, Rewa (India). College of Agriculture). Integrated weed management in rainfed kodo millet (*Paspalum scrobiculatum*). *Indian Journal of Agronomy (India)*. (Mar 2007) v. 52(1) p. 67-69 KEYWORDS: WEED MANAGEMENT; RAINFED FARMING; PASPALUM SCROBICULATUM; ISOPROTURON; YIELDS.

A field experiment was conducted during the rainy (kharif) season of 2002, 2003 and 2004 to study integrated weed management in rainfed kodo millet (*Paspalum scrobiculatum* L.). Application of isoproturon (0.50 kg ai/ha) as pre-emergence + one intercultivation (20 days after sowing) + one hand-weeding (40 DAS) appreciably lowered the weed population (16.7/m²) and dry weight of weeds (56 g/m²). It increased the weed-control efficiency by 50.21 per cent compared with pre-emergence application of isoproturon 0.50 kg/ha. It was followed by intercultivation (20 DAS) and hand-weeding (40 DAS), which gave the highest grain yield (18.42 q/ha) and fetched higher net monetary return (Rs 5,698/ha) in all weed-control measures.

374. Tiwari, D.K.; Kewat, M.L.; Khan, J.A.; Khamparia, N.K. (Jawaharlal Nehru Krishi Vishwa Vidyalyaya, Jabalpur (India). Dept. of Agronomy). Evaluation of efficacy of post emergence

herbicides in soybean (*Glycine max*). *Indian Journal of Agronomy (India)*. (Mar 2007) v. 52(1) p. 74-76 KEYWORDS: WEED CONTROL; POSTEMERGENCE APPLICATION; GLYCINE MAX; ROOT NODULATION; ECONOMICS; HERBICIDES; SOYABEANS.

A field experiment was conducted at the research farm of the university during rainy (kharif) season 2001 and 2002 to evaluate the efficacy of post-emergence herbicides against weeds in soybean [*Glycine max* (L.) Merr.]: Among the weeds, the grassy weeds were preamoinant (69 percent) in the experimental fie1d compared with broadleafweeds (31 percent). Post-emergence application of haloxyfop ethoxy-ethyl at 50 g/ha or higher rates (75 and 100 g/ha) gave effective control of grassy weeds onlY. Imazethapyr at 75 g/ha controlled only broad-leaf weeds. Haloxyfop ethoxy-ethyl (50 g/ha) controlled grassy weeds' better and gave yield-attributing traits and yield comparable to those of hand-weeding and proved more remunerative than imazethapyr 75 g/ha as well as hand-weeding treatment.

375. Chopra, N.; Chopra, N.K. (Indian Agricultural Research Institute, Karnal (India). Regional Stn.). Production of weed-free mother bulb of onion (*Allium capa*) through integrationn of herbicides and weeding. *Indian Journal of Agronomy (India)*. (Mar 2007) v. 52(1) p. 80-82 KEYWORDS: WEED MANAGEMENT; HERBICIDES; ONIONS; WEEDING; ALLIUM CEPA; YIELDS; ECONOMICS.

A field experiment was carried out during winter season of 2004 and 2005 to find out the appropriate and economic weed-management practice for production of weed-free mother bulb of onion (*Allium cepa* L.) rejuired subsequently for seed' production. There was reduction in the bulb yield (64.8 percent) and bulb diameter 24.8 percent) due to uncontrolled weed growth in the weedy check. Pre-emergence application of oxyfluorfen inteJrated with one hand-weeding at 35 days after transplanting (OAT) was significantly superior to pendimethalin, luchloralin and alachlor when applied alone and also when supplemented with one hand-weeding at 35 OAT. All the weed-control treatments significantly reduced the weed density and dry weight of weeds, and in turn increased the bulb yield compared with the weedy check. Significantly lower bulb yield was recorded with alachlor 1.5 kg/ha) compared with pendimethalin, tluchloralin and oxyfluorfen at higher doses due to its inability to conrol broad-leaf weeds, which had the maximum density in the experimental field. Maximum additional monetary 'eturns (Rs 42,990 and 36,850 ha) and net monetary returns (Rs 37,350 and 31,750/ha) were recorded by oxyflyrofen 0.15 kg/ha integrated with one hand weeding at 30 DAT and oxyflourfen 0.30 kg/ha, respectively.

376. Pratap Singh, V.; Singh, G.; Pandey, P.C.; Singh, R.K. ; Dhyani, V.C.; Singh, S.P.; Sharma, G.; Kumar, A.; Singh, M.K (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Agronomy). Efficacy of different herbicides alone and with follow up application of 2,4-D with regard to weeds and yield of zero tillage direct seeded rice. *Pantnagar Journal of Research (India)*. (Jan-Jun 2007) 5(1) p. 1-5 KEYWORDS: HERBICIDES; 2-4, D; WEED CONTROL; RICE; ZERO TILLAGE; DIRECT SOWING.

ABSTRACT: *Fimbristylis miliacea* was most dominant weed in zero tilled condition with average contribution 55.3 per cent at 60 days stage. Higher dry weight was observed during the second year of experiment. Anilofos 0.4 kg ha⁻¹ as early post emergence application followed by 2, 4-D at 0.5 kg ha⁻¹ reduced density and total dry weight of weeds at 60 days stage resulting in highest weed control efficiency (91.5 and 55.1 per cent respectively during 2001 and 2002) among herbicidal treatments. Weeds caused complete destruction of rice crop in weedy check plots. Owing to better control of weeds pendimethalin at 1.0 kg ha⁻¹

followed by 2, 4-D at 0.5 kg ha⁻¹ and anilofos 0.4 kg ha⁻¹ as early post emergence application followed by 2,4-D at 0.5 kg ha⁻¹ recorded significantly higher number of panicles m⁻² and thus grain yield.

N01 Agricultural Engineering

377. Goyal, S.K. (S. V. B. Patel University of Agriculture and Technology, Meerut (India). Department of Agricultural Engineering and Food Technology). Work performance of tractor-implement system and fuel economy in different soil conditions. Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 125-128 KEYWORDS: TRACTORS; CULTIVATORS; DISC HARROWS; FIELD CAPACITY; EQUIPMENT; FUELS; ECONOMIC ASPECTS.

The experiments were conducted to evaluate tractor-implement system performance with disc harrow and cultivator in sandy loam soil. Three soil cover conditions viz. unploughed soil, stubble soil and tilled irrigated soil surfaces were taken to determine the better performance of tractor-implement system and fuel economy. Three tractors were used of 41, 26 and 22.5 kW, at three speed control setting of the tractors, viz. 1/3rd(5000 rpm), 2/3rd (1300 rpm) and full lever (1900 rpm) positions. The disc and cultivator combination were found most economical to be operated at 2/3rd speed control position. Maximum fuel consumption of 4.1 l/h in tilled irrigated soil with cultivator and 3.6 l/h with disc harrow at 2/3rd throttle position was observed because of increased depth of operation. Almost in all soil cover conditions, cultivator gave maximum field capacity. Fuel consumption for disc harrow was lesser than cultivator due to lesser depth of cut.

P32 Soil Classification and Genesis

378. Verma, K.S.; Saxena, R.K. (National Bureau of Soil Survey and Land Use Planning, Nagpur (India); Bhargava, G.P. (Central Soil Salinity Research Institute, Karnal (India). Anomalies in classification of the salt-affected soils under USDA soil taxonomy. Journal of the Indian Society of Soil Science (India). (Mar 2007) v. 55(1) p. 1-9 KEYWORDS: SOIL CLASSIFICATION; SOIL TYPES; SOIL CHEMICOPHYSICAL PROPERTIES; SALIN SOILS.

Out of 47 Mha of Indo-Gangetic semi-arid plain, an area of 2.37 Mha has turned into saltaffected soils. These are grouped into saline, saline-alkali and alkali soils. In Soil Taxonomy, the soils of recent alluvial plain are classified under Aquepts and Ustepts great groups of Inceptisols order. The salt-affected soils as well as normal productive soils Of the region are also classified in the same great groups. Such placement of soils without referring its potential or limitation do not properly reflect their management needs and thus indicate anomalies in the Soil Taxonomy System. The Typic Haplustepts and Typic Calcustepts sub-groups of recent alluvial plain under the proposed revision qualify under Sodic Haplustepts and Sodie Calcustepts whereas the classification of normal soils will remain unchanged. In case of Petrocalcic Calcustepts and Fluventic Calcustepts where ESP is more than 15, an intergrade showing sodic properties needs to be introduced. The ESP 15 limit for clayey soils is too high ind as such it may be narrowed down. Moreover ESP 15-98 kept in one class also needs modification. The salt-affected soils of active alluvial plain under the available provisions are classified in Typic Ustorthents and Typic Ustifluvents but since the soils depict ESP 15 there is a need to introduce salic and sodic classes at the sub-group levels for their meaningful interpretation considering their management.

379. Balpande, H.S.; Chilla, O.; Prasad, J. (National Bureau of Soil Survey and Land Use Planning, Nagpur (India). Div. of Land Use Planning). Characterization and classification of grape-growing in Nasik district, Maharashtra. *Journal of the Indian Society of Soil Science (India)*. (Mar 2007) v. 55(1) p. 80-83 KEYWORDS: SOIL CLASSIFICATION; GRAPES; SOIL TYPES; VITIS VINIFERA; MAHARASHTRA; SOIL CHEMICOPHYSICAL PROPERTIES.

P33 Soil Chemistry and Physics

380. Das, M. (Water Technology Centre for Eastern Region, Bhubaneswar (India). Spatial variability analysis of soil hydraulic conductivity in an irrigation command. *Journal of the Indian Society of Soil Science (India)*. (Mar 2007) v. 55(1) p. 10-13 KEYWORDS: SOIL ANALYSIS; SOIL HYDRAULIC PROPERTIES; STATISTICAL ANALYSIS; IRRIGATION; ORISSA.

Variability analysis of saturated hydraulic conductivity (Ks.) of 129 soil samples collected from 0-0.20 m depth, and representing Deras irrigation command in Orissa, was carried out. Fractal analysis indicated that the Ks. Was normally distributed over space ranging from 0.025 to 1.35 cm min⁻¹ with moderate degree of dispersion (CV = 40.41 percent. Estimation of sample size for determining Ks. varied from 2 to 8 with different levels of confidence and error per cent. But for precise measurement the numbers. varied from 6 to 8 with 5 percent error limit. Analysis of semi-variance revealed that it enhanced from south to north direction and best fitted to linear models. It would help to predict the soil Ks. through kriging at unsampled location and in turn would reduce the cost and labour involve in sample collection and analysis of soil.

381. Srinivasarao, Ch (International Crops Research Institute for the Semi-Arid Tropics, Patancheru (India). Global Theme-Agroecosystem); Vittal, K.P.R. (Central Research Institute for Dryland Agriculture, Hyderabad (India); Tiwari, K.N. (Potash and Phosphate Institute of Canada-India Program, Gurgaon (India); Gajbhiye, P.N.; Kundu, S. (Central Research Institute for Dryland Agriculture, Hyderabad (India); Pharande, A.L. (Mahatma Phule Krishi Viswavidyalaya, Solapur (India). All India Coordinated Research Project for Dryland Agriculture); Reddy, T.Y. (Agricultural Research Station, Anantpur (India). All India Coordinated Research Project for Dryland Agriculture); Shankar, M.A. (University of Agricultural Sciences, Bangalore (India). All India Coordinated Research Project for Dryland Agriculture). Potassium supplying characteristics of twenty-one soil profiles under diverse rainfed production systems. *Journal of the Indian Society of Soil Science (India)*. (Mar 2007) v. 55(1) p. 14-22 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; SOIL PROFILES; SOIL ANALYSIS; SOIL TYPES; FARMING SYSTEMS; RAINFED FARMING; POTASSIUM.

Twenty one profiles representing wide variety of soils and rainfed production systems were characterized for potassium supplying characteristics such as step K, constant rate K and cumulative K using boiling 1 N HNO₃ as an extractant. Among production systems, groundnut and finger millet system showed extremely low level of profile mean step K below 500 mg kg⁻¹. Among other production systems some locations under pearl millet and maize also showed relatively lower step and cumulative K release. Among soil types, Alfisols at Bangalore and Anantapur, Vertisols at Akola and Aridisols at S.K. Nagar showed lower K release parameters. Clay and CEC showed positive correlation in most of the soils while pH showed mainly positive relation in Alfisols and Inceptisols.

382. Paikary, N.K. (CSWCR&TI Research Centre, Koraput (India); Singh, A.K. (Indian Agricultural Research Institute, New Delhi (India). Water Technology Centre); Saharan, N. (Central Institute of Fisheries Education, Mumbai (India); Rattan, R.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry). Effect of soil physical properties on movement of ³⁵S-tagged sulphate. Journal of the Indian Society of Soil Science (India). (Mar 2007) v. 55(1) p. 23-29 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; SOIL MOVEMENT; SOIL ANALYSIS; SOIL TEXTURE; POTASSIUM SULPHATE; GYPSUM; SOIL WATER CONTENT.

The distribution pattern of sulphur after infiltration and redistribution (10 days after infiltration) under varying soil texture, initial soil water content and bulk density was studied using ³⁵S- labeled potassium sulphate (K₂S₂O₈) and gypsum (CaSO₄·2H₂O) in soil columns. In sandy loam and silty clay loam soils, movement of the labeled sulphur was recorded up to a depth of 20-24 and 16-22 cm in infiltration studies, and 27-30 and 22-28 cm in redistribution studies, respectively. Compared to the sandy loam soil, initial soil water content had a more pronounced effect in silty clay loam soil. However, the effect of bulk density was influenced largely by soil texture, initial soil moisture content, and source of sulphur. Sources exhibited a differential movement of labeled sulphur. Gypsum had two concentration peaks (the primary one being at the surface), whereas K₂S₂O₈ exhibited only one concentration peak well below the surface. About 55-90 percent of the applied gypsum and only 11-40 percent of the applied K₂S₂O₈ was retained in 15 cm soil layer.

383. Chand, T.; Tomar, N.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Soil Science). Effect of soil properties on the kinetics of phosphate desorption in some arid, semi-arid and dry sub-humid soils of North-West India. Journal of the Indian Society of Soil Science (India). (Mar 2007) v. 55(1) p. 30-35 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; ADSORPTION; SOIL TYPES; ARID SOILS; DESORPTION; ALKALINE SOILS; CALCAREOUS SOILS; PHOSPHATES; INDIA.

Kinetics of P desorption was studied in ten alkaline- calcareous soils belonging to arid, semi-arid and dry sub-humid regions of North-west India and varying in texture, CaCO₃, organic carbon and extractable Al and Fe (IN NH₄Ac pH 7.0). Desorption of P was investigated in soil samples treated with 200 µg P g⁻¹ soil and incubated at 25±2 °C and 60 percent water holding capacity for 8 weeks. The amount of P desorbed by the distilled water at water-to-soil ratio of 40: 1, on an end-over-end shaker for 5 to 180 minutes, was determined. Individually, none of the soil properties significantly affected the amount of P desorbed. However, a significant exponential regression was obtained between clay/organic carbon (OC) ratio and amount of P desorbed during three hours reaction period. The rate of soil P desorption was satisfactorily described by the modified Elovich equation [$P_d = (V_a) \ln(ab) + (V_a) \ln t$] and the equation of Sharpley et al. ($P_d = K P_o t^{1/2} W^{-1}$). The constants (a and b) decreased with increasing CaCO₃ and CaCO₃/OC ratio and a increased with CaCO₃ content, whereas 'a' increased and constants (a and K) decreased with clay/OC ratio. The results evidenced that clay, and CaCO₃/OC ratios could not be universally used to predict the P desorption and restricted only to the soils of similar pedological origin.

384. Mondal, G.K. (A.B.N. Seal College, Cooch Behar (India). Dept. of Chemistry); Pal, S.K. (Uttar Banga Krishi Viswavidyalaya, Pundari (India). Dept. of Agricultural Chemistry and Soil Science); Roy, A. (North Bengal University, Darjeeling (India). Dept. of Chemistry).

Phosphorus availability indices of soils under various land uses in Tarai zone of West Bengal. *Journal of the Indian Society of Soil Science (India)*. (Mar 2007) v. 55(1) p. 36-39 KEYWORDS: SOIL TESTING; PHOSPHORUS; SOIL FERTILITY; WEST BENGAL; SOIL CHEMICOPHYSICAL PROPERTIES; LAND USE; NUTRIENT AVAILABILITY.

Five extractants were tried viz., Bray-1, Bray-2, Olsen, MeWich-1 and AB-DTPA to assess the available P status in the soils of four land uses namely; tea garden, orchard, cultivated land and forest in tarai region of West Bengal. Biological availability of P was estimated by growing wheat in Neubauer seedling technique. In the soils of all land uses the highest amount of soil P was extracted by Bray-2 extractant. The extracting power of different extractants was not in the same order for all the soils. The extracted amount of P by various extracts, its was correlated with inorganic P fractions. Except Bray-2, all the soil tests had highly significant positive correlation with Fe-P and Al-P. Bray-IP explained the highest variation in P uptake by wheat in orchard (86 percent) and cultivated land soils (87 percent) while Bray-2-P explained the maximum variation in P uptake for tea garden (75 percent) and forest (83 percent) soils. Bray reagents were found to be the most efficient extractants for these land use soils under acidic tarai agro-climatic region of West Bengal.

385. Sharma, J.C.; Chaudhary, S.K. (Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Soil Science and Water Management). Vertical distribution of micronutrient cations in relation to soil characteristics in lower Shiwaliks of Solan district in North-West Himalayas. *Journal of the Indian Society of Soil Science (India)*. (Mar 2007) v. 55(1) p. 40-44 KEYWORDS: SOIL ANALYSIS; SOIL CHEMICOPHYSICAL PROPERTIES; TRACE ELEMENTS; NUTRIENT AVAILABILITY; SOIL PROFILES; HIMACHAL PRADESH; HIMALAYAN REGIONS.

Vertical distribution of available micronutrient cations (Zn, Cu, Fe and Mn) and their relationship with different soil properties were studied in thirty two profiles of eight tentative soil series (Johranpur, Mandhala I, Mapdhala II, Mandhala III, Mandhala IV, Majri, Dhaular and Haripur) of Mandhala watershed representing lower Shiwaliks of Solan district in Himachal Pradesh. The contents of available Zn, Cu, Fe and Mn were higher in surface horizons and decreased with depth in most of the soil series and ranged from 0.31 to 4.7, 0.30 to 2.80, 8.2 to 50.2 and 2.7 to 56.4 mg kg⁻¹, respectively. Available Zn was found deficient in 15.2, marginal in 23.7 and sufficient in 61.1 percent of the studied samples, while Cu, Fe and Mn were sufficient in all the soils. Multiple regression analysis indicated that available Zn, Cu, Fe and Mn were influenced by silt, clay, pH, OC, CEC, BSP and EC to the level of 70.22, 66.00, 75.15 and 85.72 percent, respectively. However, only BSP, OC, EC, clay and silt contributed significantly towards these micronutrients.

386. Hazarika, S.; Talukdar, N.C.; Borah, K.; Barman, N.; Medhi, B.K.; Thakuria, D.; Barooah, A.K. (Assam Agricultural University, Jorhat (India). Dept. of Agricultural Engineering). Long-term effect of pulp and paper mill effluent on chemical and biological properties of a heavy textured acidic soil in Assam. *Journal of the Indian Society of Soil Science (India)*. (Mar 2007) v. 55(1) p. 45-51 KEYWORDS: WASTE WATER; ION EXCHANGE CAPACITY; SOIL TEXTURE; IRRIGATION; SOIL CHEMICOPHYSICAL PROPERTIES; SOIL RESPIRATION; MICROBIAL PROPERTIES; SALINITY; ACIDIC SOILS; CATIONS.

Properties of the effluent of Nagaon paper mill at Jagiroad, Assam and typical acid soils receiving either this effluent or shallow tube well (STW) irrigation for 17 years were analyzed. The effluent was alkaline in reaction (pH 7.6, EC 2.5 dS mol) and contained high

levels of dissolved salts, bases and chloride. The pH of the effluent irrigated soil was observed to be 1.3 units higher due to effluent irrigation. Soil salinity (EC) was increased by more than three times. Similarly, CEC, base saturation, total and water soluble basic cations, ESP and SAR were significantly more in the effluent irrigated soil. The chloride concentration of the effluent irrigated soil was 197 mg kg⁻¹ against 43 mg kg⁻¹ observed in the STW irrigated soil. Although, rise in soil pH, CEC and base saturation are desirable for biological activity in acidic soils, the effluent irrigated soils showed rather very low value of microbial biomass carbon content. Overall, the effluent altered the soil characteristics that are not typical of add soils of this region.

387. Pagaria, P.; Totawat, K.L. (Maharana Pratap University of Agriculture and Technology, Udaipur (India). Dept. of Agricultural Chemistry and Soil Science, Rajasthan College of Agriculture). Effects of pressmud and spentwash in integration with phosphogypsum on metallic cations build-up in the calcareous sodic soil. *Journal of the Indian Society of Soil Science (India)*. (Mar 2007) v. 55(1) p. 52-57 KEYWORDS: SOIL AMENDMENTS; CATIONS; INDUSTRIAL WASTES; GYPSUM; SOIL RECLAMATION; SODIC SOILS; METALIC ELEMENTS; CALCAREOUS SOILS.

A field experiment to reclaim a calcareous sodic soil having sandy clay loam texture, pH 9.2, SAR 13.7, ESP 35, CaCO₃ 9.5 percent and medium in metallic cations (Fe, Mn, Zn and Cu) status. was carried out for two consecutive years, 2001-2002 and 2002-2003 at Livestock Research Station, Vallabh Nagar (Udaipur, Rajasthan). The treatments comprised of one time application of four levels of pressmud (0, 5, 10 and 15 t ha⁻¹) or spentwash (0.25, 0.5 and 0.75 million L ha⁻¹) in integration with three levels of phosphogypsum (0, 25 and 50 percent G.R.) in a randomized block design replicating each treatment thrice. The result of investigation indicated that the metallic cations (Fe, Mn, Zn, Cu, Ni, Cd and Pb) status increased as a consequence of incorporation of either pressmud or spentwash in integration with phosphogypsum during both the years of investigation. The highest value of metallic cations status of soil under study was recorded under the treatment receiving pressmud at 15 t ha⁻¹ or spentwash at 0.75 million L ha⁻¹ in integration with phosphogypsum at 50 percent GR. However, the status of these metallic cations in soil was within the permissible limit indicating that one time use of pressmud or spentwash as soil amendment is not hazardous for soil health and crop production.

388. Singh, A.K. (North Eastern Regional Institute of Water and Land Management, Tezpur (India). Evaluation of soil quality under integrated nutrient management. *Journal of the Indian Society of Soil Science (India)*. (Mar 2007) v. 55(1) p. 58-61 KEYWORDS: SOIL ANALYSIS; SOIL CHEMICOPHYSICAL PROPERTIES; NUTRIENT AVAILABILITY; ACID SOILS; SOIL FERTILITY.

To illustrate the effect of Integrated Nutrient Management (INM) on soil quality changes over time, an experiment was conducted in the farmer's field and Research Farm of NERIW ALM during 2001-2003. A comparison between the performance of INM and the FP (Farmers' Practice) was also done. Based on the changes in relative soil quality index (RSQI), soil quality changes were evaluated. Soil quality in INM trial was increased by 12-19 units as compared to 7-9 units in farmers' practice. The soil quality in terms of CEC, pH, N, P, K, organic matter, soil texture, etc., increased up to 58 per cent. The combination of a soil change database has proved an effective method for evaluating changes in soil quality at small scales.

389. Chander, G.; Verma, T.S.; Sharma, S. (Chaudhary Swarn Kumar Himachal Pradesh Krishi Vishwavidyalaya, Palampur (India). Dept. of Soil Science). Influence of boron and farmyard manure on available boron and exchangeable calcium and their removal by cauliflower in the boron-deficient soils of Himachal Pradesh. *Journal of the Indian Society of Soil Science (India)*. (Mar 2007) v. 55(1) p. 62-66 KEYWORDS: SOIL DEFICIENCIES; FERTILIZER APPLICATION; BORON; NUTRIENT UPTAKE; CAULIFLOWERS; SOIL ANALYSIS; FARMYARD MANURE; CALCIUM; SOIL FERTILITY; HIMACHAL PRADESH.

In laboratory-incubation and greenhouse experiments on two boron (B)-deficient soils of Bajaura (loam) and Junga (sandy loam), the application of B maintained significantly higher amounts of available B throughout the study period, while the contents of exchangeable Ca were not affected. The incorporation of FYM in the experimental soils, however, maintained a higher availability of both available B as well as exchangeable Ca. The corresponding contents of available B and exchangeable Ca were, in general, more in greenhouse study in contrast to those in laboratory-incubation. The contents of available B decreased with time in experimental soils both in laboratory-incubation and greenhouse study. The exchangeable Ca, however, increased with time in both the soils, but decreased at harvest stage in case of greenhouse study. The application of B as well as FYM recorded a significantly enhanced removal of both B and Ca in parts of cauliflower.

390. Kar, D. (Bidhan Chandra Krishi Vishwavidyalaya, Nadia (India). Dept. of Agricultural Chemistry and Soil Science); Ghosh, D.; Srivastava, P.C. (Gobind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Soil Science). Efficacy evaluation of different zinc-organic complexes in supplying zinc to maize (*Zea mays* L.) plant. *Journal of the Indian Society of Soil Science (India)*. (Mar 2007) v. 55(1) p. 67-72 KEYWORDS: SOIL ANALYSIS; ZINC; MAIZE; ZEA MAYS; SOIL SOLUTION; FARMYARD MANURE; NUTRIENT UPTAKE.

The humic and fulvic acid fractions of humic substances were extracted from well decomposed FYM and there after isolated, purified, lyophilized and complexed with zinc. The efficacy of Zn-organo complexes in supplying zinc was evaluated in a glasshouse experiment with maize as the test crop. Zinc concentration in plant' increased with increasing Zn level and the highest Zn concentration was observed when Zn was applied as Zn-fulvate at the level of 10 mg Zn kg⁻¹ soil. Dry matter production was increased with increasing Zn level until the attainment of critical zinc concentration of the plant. The highest dry matter was produced when critical Zn concentration in plant reached 39 mg kg⁻¹ which was attained by the application of 10.0 mg Zn as ZnSO₄, 5.0 mg Zn as Zn-humate, 2.5 mg Zn as Zn-humate-fulvate and 1.0 mg Zn as Zn-fulvate kg⁻¹ soil. Irrespective of zinc sources, zinc recovery was as follows: 0.25 mg Zn kg⁻¹ 0.5 mg Zn kg⁻¹ 1.0 mg Zn kg⁻¹ 2.5 mg Zn kg⁻¹ 5.0 mg Zn kg⁻¹ 10.0 mg Zn kg⁻¹ soil and irrespective of levels, the average zinc recovery by plant from different sources was as follows: Zn-FA Zn-HA-FA Zn-HA ZnSO₄. Thus, zinc-fulvate was found as the most efficient in respect of supplying zinc, increasing plant height and total dry matter production followed by zinc-humate-fulvate, zinc-humate and ZnSO₄.

391. Pandey, R.N. (Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry); Girish, B.H. (International Potato Centre, New Delhi (India). Improved turbidimetric method for the estimation of sulphur in soil extracts. *Journal*

of the Indian Society of Soil Science (India). (Mar 2007) v. 55(1) p. 73-79 KEYWORDS: SOIL ANALYSIS; SOIL SOLUTION; SULPHUR; TURBIDIMETRY; ANALYTICAL METHODS; SOIL CHEMICOPHYSICAL PROPERTIES.

An improved manual turbidimetric method for the estimation of extractable soil sulphur was developed, which has higher sensitivity and rapidity over other manual turbidimetric methods evaluated. It involves destruction of extracted organic colloids and colour by using sodium peroxide and acetic acid, and gelatin as a stabilizing agent. The extractable soil sulphur contents measured by the proposed method were found to be more or less of similar magnitude as obtained from the ion chromatographic method. Gelatin used as stabilizing agent provided better stability to the barium sulphate colloidal system and higher sensitivity to the turbidimetric method of sulphur estimation at 420 nm wavelength as compared to Tween-80 (Polyoxyethylene sorbitan mono-oleate), glycerol, PVP (Polyvinylpyrrolidone) and gum acacia. Irrespective of sulphur content and amount of stabilizing agent (Tween-80), consistently higher absorbance was recorded at 420 nm as compared to 600 nm wavelength. H_2O_2 or Na_2O_2 treatment for removal of organic matter through oxidation resulted into recovery of higher sulphur contents. The proposed method gives quantitative recovery of added sulphur to soil extracts. The modified method can be easily adopted in the soil testing laboratories.

392. Datta, S.P.; Rattan, R.K.; Chandra, S. (Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry). Influence of different amendments on the availability of cadmium to crops in the sewage irrigated soil. Journal of the Indian Society of Soil Science (India). (Mar 2007) v. 55(1) p. 86-89 KEYWORDS: SOIL AMENDMENTS; SEWAGE; SUPERPHOSPHATE; RADISHES; HELIANTHUS ANNUUS; MUSTARD; CADMIUM; IRRIGATION; FARMYARD MANURE.

393. Agarwal, Mina; Mishra, Vineeta (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Soil Science). Studies on effect of moisture and thermal regimes on mineralization of organic carbon in Mollisol. Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 88-91 KEYWORDS: MINERALIZATION; ORGANIC FERTILIZERS; CARBON; SOIL CHEMICOPHYSICAL PROPERTIES; SOIL WATER CONTROL; TEMPERATURE.

ABSTRACT: A laboratory experiment was conducted to study the effect of moisture and thermal regimes on mineralization of organic carbon with eight treatments viz. control, starter nitrogen, wheat straw, FYM, wheat straw +N, FYM+N, rice straw and rice straw +N, three replications of each treatment. Rice straw, wheat straw and FYM are applied at the rate of 5t /ha---, 5t /ha, and 15 t/ ha respectively with or without starter dose of nitrogen (for straw 20 kg N/ ha and for FYM 90 kg N /ha). These treatments were incubated at two moisture levels under two temperatures for 90 days. The mineralization of carbon was measured quantitatively following alkali trap method. Carbon mineralization at 200C temperature was greater than at 50C temperature for all the days of incubation. Carbon mineralization was more at field capacity moisture condition as compared to saturated soil moisture condition in all the treatments under both these temperatures. The amount of carbon mineralized from the soil was maximum with the rice straw. Thus, increase in temperature and field capacity moisture condition accelerated the process of mineralization.

P34 Soil Biology

394. Ram, S.N.; Kumar, S.; Roy, M.M.; Roy, M.M.; Baig, M.J. (Indian Grassland and Fodder Research Institute, Jhansi (India). Grassland and Silvopasture Management Div.). Effect of legumes and fertility levels on buffel grass (*Cenchrus ciliaris*) and annona (*Annona squamosa*) grown under horti-pasture system. Indian Journal of Agronomy (India). (Dec 2006) v. 51(4) p. 278-282 KEYWORDS: CENCHRUS CILIARIS; INTERCROPPING; LEGUMES; FERTILITY.

A field experiment was conducted during 2002-05 on sandy-loam soil to study the effect of legumes (*Stylosanthes hamata* L. Taub. and *S. scabra* Vogel) and fertility levels (P Ps and KP 0 and 0, 20 and 15, 40 and 30, and 60 and 45 kg/ha) on buffel grass + annona horti-pasture system. An intercropping of *S. hamata* with buffel grass under annona trees resulted in significantly higher total dry forage (5.07, 6.15 and 6.63 tonnes/ha) and crude protein yield (436.1, 526.8 and 547.3 kg/ha) than *S. scabra* in the first, second and third years respectively. Dry forage yield and fruit quality of annona was significantly improved with the application of 40 kg PPs + 30 kg Kp/ha compared with the control treatment. However, crude protein yield and fruit yield were significantly increased up to 60 kg PPs + 45 kg Kp/ha. Application of phosphorus and potash also had a positive effect on maintenance of legumes population. Persistence of legumes were 91.8 and 84.3 percent in the treatment where fertilizer (phosphorus and potash) was applied 60 + 45 kg/ha compared to the control treatment (78.3 and 67.2 percent) during the second and third years respectively. Maximum net returns and benefit: cost ratio were obtained by the intercropping of *S. hamata* along with application of 60 kg P/ha and 45 kg Kp/ha in buffel grass under annona trees during all the 3 years.

395. Saxena, S.; Singh, B.V.; Tiwari, S.; Dhar, D.W. (Indian Agricultural Research Institute, New Delhi (India). Centre for Conservation and Utilisation of Blue Green Algae). Physiological characterization of cyanobacterial isolates from Orissa and West Bengal. Indian Journal of Plant Physiology (India). (Apr-Jun 2007) v. 12(2) (New Series) p. 181-185 KEYWORDS: CYANOBACTERIA; GROWTH; PIGMENTS; NITROGEN FIXATION; SOIL MORPHOLOGICAL FEATURES; ORISSA; WEST BENGAL; CARBOHYDRATES; PROTEINS.

A total of 34 cyanobacterial isolates from soils of Orissa and West Bengal were purified and identified based upon morphological parameters and these were submitted in the germplasm of Centre for Conservation and Utilisation of Blue Green Algae, Indian Agricultural Research Institute, New Delhi. Physiological characterization exhibited distinct variability amongst these isolates with respect to growth (dry weight), pigments, total soluble proteins, carbohydrates and nitrogen fixing potential.

396. Srivastava, Ranjan ; Vishen, Vizender Singh; Satish Chand (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Horticulture). Effect of Azotobacter and organic manures on post harvest characteristics of tuberose (*Polianthes tuberosa* L.) cv. Double. Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 54-55 KEYWORDS: POSTHARVEST LOSSES; POLIANTHES; AZOTOBACTER; ORGANIC FERTILIZERS; ORGANIC AGRICULTURE; ECOSYSTEMS.

P35 Soil Fertility

397. Singh, Y.; Singh, C.S.; Singh, T.K.; Singh, J.P. (Banaras Hindu University, Varanasi (India). Dept. of Agronomy). Effect of fortified and unfortified rice - straw compost with NPK fertilizers on productivity, nutrient uptake and economics of rice (*Oryza sativa*). Indian Journal of Agronomy (India) . (Dec 2006) v. 51(4) p. 297-300 KEYWORDS: ECONOMIC ANALYSIS; NPK FERTILIZERS; ORYZA SATIVA; NUTRIENT UPTAKE.

A field experiment was conducted during the rainy seasons (kharif) of 2002 and 2003 at the Research Farm of the institute at Varanasi to study the effect of superimposition of fortified and unfortified rice-straw compost 6 t/ha over recommended NPK (120 kg N, 60 kg P Ps' 60 kg Kp/ha) on growth, yield and nutrient uptake by rice (*Oryza sativa*. L.). Among the different cellulo-azoto-bacterio compost treatments, rice-straw compost 6 t/ha inoculated with *Azotobacter* + phosphous solublizing bacteria (PSB) along with NPK registered significantly higher plant height, leaf-area index and yield attributes (panicles, panicle length, grains/panicle and test weight), and gave 21.17 percent increase in grain and 15.36 percent in straw yields compared with NPK (120 kg N, 60 kg P Ps' 60 kg Kp/ha). This treatment also gave the highest net returns (Rs 18,946/ha). Application of rice-straw compost inoculated with cellulolytic fungi + *Azotobacter* + PSB along with NPK was also equally effective as rice-straw compost inoculated with *Azotobacter* + PSB (cellulo-azoto-bacterio ,compost) along with NPK in terms of leaf-area index, number of panicles, grains/panicle, test weight and K uptake by rice. Fortified compost with *Azotobacter* and PSB + NPK also maintained soil fertility, as indicated by higher contents of organic carbon, available nitrogen, phosphorus and potassium. However, values of these parameters showed declining trend with recommended level of NPK (control).

398. Mishra, Peeyush; Singh, S.K.; Srivastava, P. C. ; Singh, Sobaran (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Soil Science). Availability of NPKS in some Inceptisols and Mollisols as related with soil characteristics. Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 70-75 KEYWORDS: NUTRIENT AVAILABILITY; NPK FERTILIZERS; SULPHUR FERTILIZERS; SOIL CHEMICOPHYSICAL PROPERTIES.

Distribution of available N, P, K and S in soils was studied in relation to soil properties. Results showed that soil pH ranged from 5.61 to 8.28, EC 0.18 to 2.08 dSm⁻¹, CaCO₃ 0.20 to 0.80 per cent, CEC 8.03 to 21.80 c mol (p+) kg⁻¹ and organic carbon 0.39 to 1.65 per cent. Available N, P, K and S contents ranged from 84 to 438, 21 to 113, 102 to 210 and 19 to 113 kg ha⁻¹, respectively. Maximum concentration was recorded in surface soil and in general it decreased with depth. Soil pH showed significant negative correlation with available N and P while it was positively correlated with available K and S. Organic carbon was significantly and positively correlated with available N, P, K and S. Cation exchange capacity showed a significant positive correlation with available N, K and S. Thus, a definite role of soil properties in supplying plant nutrients is indicated.

399. Mishra, Peeyush; Singh, S.K.; Srivastava, P.C.; Singh, Sobaran (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Soil Science). Vertical distribution of DTPA-extractable Zn, Cu, Mn and Fe in some soils of Tarai and Rohilkhand plains in relation to soil properties. Pantnagar Journal of Research (India). (Jan-Jun 2007) 5(1) p. 92-98 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; TRACE ELEMENTS; ZINC; COPPER; MANGANESE; IRON; NUTRIENT AVAILABILITY; UTTAR PRADESH; UTTARANCHAL; UTTARAKHAND.

Depthwise distribution of available Zn, Cu, Mn and Fe in soils extracted by DTPA was studied in relation to some physical and chemical properties. Results showed that soil pH ranged from 6.42 to 8.02, EC 0.31 to 0.59 dSm⁻¹, CaCO₃ 0.40 to 0.86 per cent, CEC 8.09 to 18.20 c mol (P+) kg⁻¹ and organic carbon 0.26 to 1.32 per cent. The DTPA-extractable Zn, Cu, Mn and Fe contents ranged from 0.18 to 2.08, 0.57 to 2.48, 1.32 to 45.63 and 3.07 to 21.35 mg kg⁻¹, respectively. Maximum concentration was recorded in surface soil and in general it decreases with depth. Soil pH showed a significant negative correlation while organic carbon, CEC and clay content was significantly and positively correlated with DTPA-Zn. The CaCO₃ showed a significant negative correlation whereas clay content showed significant positive correlation with DTPA- Mn and Fe. Thus, soil properties have a major role to play in supplying plant nutrients from soil.