

Indian Agricultural Sciences Abstracts

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A01 Agriculture – General Aspects

001. Singh, P. (Banaras Hindu University, Varansi (India). Agriculture and India today. Indian Journal of Agronomy (India). (Jun 2007) v. 52(2) p. 91-95 KEYWORDS: AGRICULTURE; INDIA.

Attainment of food security has been the major objective of India since independence. Today India is second largest producer of food in world and has all the potential of becoming world leader if the emerging problems of agriculture are addressed through technological development, appropriate policy interventions that improve farm profitability vis-a-vis agricultural sustainability. This can be done through a transition from commodity agriculture to product agriculture, that is from quantity to quality agriculture. Efforts to develop and expand new types and uses of bulk agricultural products (value addition), alternative production technology (organic and conservation agriculture) and speciality crops will create opportunities for improving economic viability of agriculture and rural communities. Value-added cooperatives that can develop new alliances with consumers (farmer-grocer contacts, internet marketing) may create new entrepreneurial opportunities in Indian agriculture. Emphasis on access to higher education and imbition of quality and relevance in education with appropriate policy intervention will pave the ways for faster and sustainable development.

E10 Agricultural Economics and Policies

002. Singh, Jitendra; Saxena, H.K. (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Agricultural Economics); Singh, G.P. (SMMTPG College, Ballia (India). Department of Agricultural Economics). An economic analysis of sugarcane based cropping system in eastern plain of Uttar Pradesh. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 1-11 KEYWORDS: ECONOMIC ANALYSIS; SUGARCANE; CROPPING SYSTEMS; UTTAR PRADESH; COST BENEFIT ANALYSIS; INCOME.

ABSTRACT: The present study was conducted in Faizabad district of U.P., during the year 2000-01, which revealed that the average size of holding was about 3.06 ha in the out-side area as compared to 2.73 ha in the command area of sugar factories. The cropping pattern in the out-side area was similar to that in the command area with a slight variation in Zaid season where maize replaced urad. The costs and returns showed that larger farm invests were more in case of sugarcane planted particularly in the command area of sugar factories. The returns from sugarcane planted were increasing with the increase in the size of farms in the command area of the sugar factories. The returns from sugarcane planted on the farms in out-side area of sugar factories were much lower than on the farms in command area. On the medium farms, average command area of sugar factories related to contribution of employment days of all the crops taken for the study was higher. Thus, the command area was more employment generating in case of all the crops on the same farm size group. In the out-side area of sugar factories the employment days were found increasing with the

increase in the size group of farms in case of all the crops except ratoon. It was also observed during study period that the generation of family labour days was higher in out-side area. The per farm analysis showed that paddy, sugarcane and wheat were such crops which generated maximum employment days on the larger farms in the command area. In out-side area, same pattern of employment generation was also noticed in all the crops under study. Agriculture sector was the prime contributor to employment days in the command area. However, in out-side area of sugar factories too, the same trend to employment generation was also there in the area under study. The present study suggests that the number of sugar factory must be installed in the area under study by the government. The extension agencies of the state government should arrange for their timely supply of seeds of suitable varieties to the concerned sugar factories.

003. Mittal, Rashi; Singh, S.P. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Agricultural Economics). Economics of Lemongrass (*Cymbopogon fluxuosus*) cultivation, value addition and its financial feasibility in the state of Uttarakhand. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 12-18 KEYWORDS: ECONOMICS; CYMBOPOGON CITRATUS; VALUE ADDED; DRUG PLANTS; FEASIBILITY STUDIES; UTTARANCHAL; UTTARAKHAND.

ABSTRACT: The present study aims at examining the economics of cultivation of Lemongrass and its value added product and to study its financial feasibility. The study revealed that the per hectare cost of cultivation of Lemongrass was Rs. 75742 during first year and Rs. 29957, Rs. 30794, Rs. 32336 and Rs. 33170 in II, III, IV and V year respectively. It indicates that the crop is highly capital intensive. The total cost of extraction of oil (cost of cultivation plus processing cost) accounted to Rs. 87482 in the I year followed by Rs. 46951, Rs. 49569, Rs. 51906, and Rs. 50246 in the II, III, IV and V year respectively. The analysis of returns revealed that in the first year the crop had negative returns of Rs. (-) 33402 per hectare over the cost of cultivation and Rs. (-) 9956 over the cost of extraction of oil. The value addition due to oil extraction over the herbage was Rs. 23446 during first year and varied within a range of Rs.32098 to Rs. 34836 in subsequent years. The results on the production of lemongrass oil indicate that the investment in lemongrass is financially feasible.

E11 Land Economics and Policies

004. Mini, V.; Patil, P.L.; Dasog, G.S. (University of Agricultural Sciences, Dharwad (India). Dept. of Soil Science and Agricultural Chemistry). Land evaluation of a pilot site in coastal agro-ecosystem of North Karnataka. Journal of the Indian Society of Soil Science (India). (Sep 2007) v. 55(3) p. 317-323 KEYWORDS: LAND EVALUATION; KARNATAKA; LAND USE; LAND SUITABILITY; SOIL CLASSIFICATION; SOIL CHEMICOPHYSICAL PROPERTIES; AGROECOSYSTEMS.

A study was carried out in Mitjan village of coastal agro-ecosystem of Karnataka to find out the potential and constraints of these soils through land capability classification and soil suitability evaluation. The mapped soils from the study area were matched with criteria for land capability classification and soil site suitability evaluation. In the land capability map, three classes have been differentiated viz., IIs, IVs and Vs. As depicted in the map, majority of the area was classified under non-arable category followed by IVs and then by IIs category. According to suitability classification, class III land was found to be suitable for

coconut, arecanut, cashew and rubber. Class IV land was moderately suitable for cultivation of paddy and cashews and marginally suitable for coconut and arecanut. Class V land was marginally suitable for plantation crops.

E14 Development Economics and Policies

005. Manas, D.; Singh, S.P. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Agricultural Economics). Value addition processes and constraints in house hold production of bamboo products. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 19-22 KEYWORDS: VALUE ADDED; CONSTRAINTS; HOUSEHOLDS; BAMBOOS; PLANT PRODUCTS; SOCIOECONOMIC DEVELOPMENT.

ABSTRACT: Kerala is a major diversity center of bamboo having 25 species spread over 57,000 hectares of area and about three lakh people depend on bamboo for their livelihood. The various value added products in the household production are baskets, winnowers, mats, stool etc. and their weaving is a traditional occupation of certain schedule caste and tribes. The study revealed that from an average sized bamboo culm with an average price of Rs. 100, five large baskets or ten winnowers or one mat or one stool can be made. The net value addition per unit occurred for big baskets, winnower, mats and stool were Rs. 8, 6, 50 and 65 respectively. It was found that the major problem being faced by bamboo weaving families was unavailability of raw material. Unorganized marketing system, high cost of raw material, labour intensiveness, lack of remuneration and low social acceptability were the other important problems. Hence, efforts need to be made for promoting intensive cultivation and application of under utilized and valuable species. Development of an organized market is also very urgent. Technology intervention should be enhanced in value addition processes to make them competitive in the market by improving quality and productivity.

E50 Rural Sociology and Social Security

006. Kumar, S.; Kumar, M. (C.R.M. Jat College, Hisar (India). Study of aggressive tendency in comparison to kabaddi and kho-kho players. Annals of Biology (India). (Jun 2007) v. 23(1) p. 87-89 KEYWORDS: AGGRESIVE BEHAVIOUR; YOUTH; SPORT; SOCIAL BEHAVIOUR; HUMAN BEHAVIOUR.

The study was undertaken during the year 2005 at Kurukshetra University, Kurukshetra (Haryana). The study showed that the mean value of aggressive behaviour of Kabaddi players was higher than that of KhoKho players at 0.05 level of significance. So, it was concluded that the players of Kabaddi games had more aggressive behaviour than that of Kho-Kho players. Tflis may be due to the more body contact of the players in Kabaddi game.

E80 Home Economics, Industries and Crafts

007. Deepa Vinay; Chaudhary, Nidhi (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Family Resource Management). Importance of Ergonomics at Household Level: A Participatory Approach. Pantnagar Journal of Research (India). (Jul-dec 2007) 5(2) p. 139-143 KEYWORDS: ERGONOMICS; HOUSEHOLDS; WOMEN'S PARTICIPATION; HOME ECONOMICS.

ABSTRACT: It is beyond doubt that kitchen activities demand a high degree of physical effort, leading to fatigue. The major causative factors responsible for this are the static muscular effort and adopting unnatural postures, mainly resulting from bad design of kitchen layout. A standardization module in the form of flap book was developed for imparting training to housewives. Concept of ergonomics, ergonomic approach to workstation design, importance and contribution of ergonomics in work station design, importance and use of anthropometry, musculo skeletal problems in standing, work surface dimension for standing kitchen and finally recommendation for different workstation designs along with right posture were included in the module. The reliability index for the same was calculated to 0.71. Results of pre-exposure of the knowledge tool revealed that most of the respondents (56.66 per cent) lie in the low level of knowledge category. They were not aware about the concept and role of ergonomics. Although all the respondents complained about musculo skeletal disorders but they were unaware about the hidden cause of musculo skeletal disorders. When they were exposed to the developed training module it was found that knowledge level of all the respondents increased and 100 per cent respondents reached high level of knowledge category. The scores of retention of knowledge after 15 days of exposure to training media showed that 86.67 per cent had a high level of retention of knowledge. A significant relationship was also found in pre and post tests score.

008. Singh, Poonam; Chaurasia, Ranjana (C.S. Azad University of Agriculture and Technology, Kanpur (India). Department of Family Resource Management). Postural profile and work stress in leather shoe industry workers engaged in moulding and stitching. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 144-147 **KEYWORDS:** MOULDING; LEATHER INDUSTRY; WORKERS; WORKING CONDITIONS; OCCUPATIONAL HAZARDS.

Postural profile and work stress of 100 workers engaged in moulding and stitching activities in a shoe-manufacturing unit of Kanpur were studied using observation technique. Workers spent a total of 8 hours 30 minutes working in the factory. Average time spent by moulding and stitching workers in a neck and shoulder posture, tense due to work, was 3 hours 50 minutes and 3 hours 40 minutes, respectively. Both the groups spent 6 hours 20 minutes with their legs in a poorly supported or unstable position. The back of the workers engaged in stitching remained in a stooped position for 5 hours 15 minutes. The position of elbow, with arms in tense or joints in an extreme position, of moulding and stitching workers, remained for 4 hours 35 minutes and 4 hours 30 minutes, respectively. Moulding involved much work above shoulder height, with the elbow(s) near/above shoulder height, just below elbow height, in the non-straight wrist position, involving standing and mechanical stresses. Stitching required much work in non-straight wrist position and involving mechanical stresses, bending and sitting. Moulding with a stress score of 47.2 proved much strenuous than stitching, having a stress score of 30.5 only. Workers' own perception of exertion too was higher under moulding.

009. Kashyap, Shewanti N.; Sharma, P. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Family Resource Management). To study the satisfaction derived by the inmates from different categories of houses of Pantnagar. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 148-152 **KEYWORDS:** ENERGY EXPENDITURE; HOUSING; UTTARAKHAND; LIVING STANDARDS; HEART RATE.

Housing providers appear to agree over the importance of accountability to tenants and users, and believe that they should adjust their strategies and day-to-day practices to take account of such measures of performance. However, there is less certainty or consensus over how to do this. The complexity of attitudes and the variety of factors involved make measuring housing satisfaction a difficult task. Hence a satisfaction scale was developed. This scale concentrates on the underlying principles of developing a scale to assess satisfaction derived by the inmates from different categories of house (i.e., one-room, two-room and three-room) in Pantnagar campus. It was observed that majority of the respondents were satisfied with different areas and parts of living room, bedroom, dining room, kitchen and bathroom. The physiological cost of activities done in using sink in the kitchen was highest followed by ventilators and windows. The energy expenditure was highest (7.02 k.cal./minute) for performing activities in sink in the kitchen, while lowest in shelves of the room (5.4 k.cal./minute).

O10. Singh, Poonam; Chaurasia, Ranjana (C.S. Azad University of Agriculture and Technology, Kanpur (India). Department of Family Resource Management). Working conditions and job satisfaction of leather shoe industry workers of Kanpur. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 153-157 KEYWORDS: UTTAR PRADESH; WORKING CONDITIONS; WORK SATISFACTION; LEATHER INDUSTRY.

ABSTRACT: A study of a leather shoe manufacturing unit at Kanpur revealed that most of the moulding workers (48 per cent) were employed on daily wages and stitching workers (64 per cent) on contract, with 24 per cent, under both the trades, on permanent basis. Working days per month ranged between 22-27 for 64 per cent of moulding and 76 per cent of stitching workers followed by 19-22 for 30 and 24 per cent workers in respective trades. Working hours per day were 8.5, with a single rest interval of 30 minutes. For most of the moulding workers (88 per cent), wages were based on duration of work and for stitching (64 per cent) quantum of work. Reverse was true for 12 per cent moulding and 35 per cent stitching workers. All the workers worked overtime Rs. 9.0 per hour and received bonus. Permanent workers had the benefit of casual, earned, and medical leave and were provided with provident fund, family pension, and group insurance. Factory premises were properly planned, kept neat, white washed annually had low humidity, sufficient light, proper ventilation, water supply and were used as work floor only. On the negative side, premises had high temperature, insufficient light for stitching, intolerable noise level, congestion and only one toilet for all the workers. Most of the moulding (60 per cent) and stitching (50 per cent) workers perceived their job as routine, with only 20 and 28 per cent, under respective trades, feeling satisfied. Most of them rated their management motivating (40 per cent moulding and 30 per cent stitching)/satisfactory (32 and 38 per cent) but found their remuneration, opportunities for promotion, treatment from the supervisors and working conditions below par or plain workable. Most of the workers (30 per cent moulding and 50 per cent stitching) perceived their colleagues as responsible and some (28 and 12 per cent under respective trades) as intelligent.

F01 Crop Husbandry

O11. Rasal, P.N.; Gadekar, D.A.; Bhoite, K.D.; Gavhane, V.N. (Agricultural Research Station, Niphad (India). NIAW 917 - new variety of bread wheat. Indian Journal of Genetics and Plant

Breeding (India). (May 2007) v. 67(2) p. 217-218 KEYWORDS: SOFT WHEAT; VARIETIES; TRITICUM AESTIVUM; YIELDS.

012. Pandey, Sunita T.; Singh, Sarnam (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Agronomy); Bist, L.D.; Rajesh Kumar (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Horticulture). Effect of planting techniques on the growth dynamics and root yield pattern of safed musli in Mollisol of Uttarakhand. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 34-35 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; DRUG PLANTS; PLANTING; ROOTS; LILIACEAE; UTTARANCHAL; UTTARAKHAND.

Planting methods affected the number, length and root yield of safed musli significantly. Maximum number of finger (10.10), length of finger (8.88 cm) and maximum yield (13.41 g/plant) was observed in the raised bed (60 cms) method of planting at 270 DAP, however, increase in root diameter remains non-significant in all the methods. Yield under various methods varied significantly and ranged from 3.28 q/ha (8.89 g/plant) in Flat bed to 4.90 q/ha (13.41 g/plant) in Raised bed (60 cms). Besides, in mollisol crop exhibited brown leaf spot and root rot.

013. Anubha Rani; Lal, R.L.; Shukla, Pavan (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Horticulture). Evaluation of litchi cultivars under Tarai conditions of Uttarakhand. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 96-99 KEYWORDS: EXPORTS; PRODUCTION POSSIBILITIES; LITCHI; GERMPLASM; UTTARAKHAND; UTTARANCHAL.

ABSTRACT: The present investigation was carried out at Horticulture Research Centre, Patharchatta, G. B. Pant University of Agriculture & Technology, Pantnagar during the year 2004-05 to find out suitable cultivars of litchi on the basis of yield and quality attributes. Ten cultivars of litchi were taken to conduct the experiment. Sex ratio was observed highest in Maharaj Singh Pasand (3.54). Fruit cracking percentage was found lowest in cultivar Culcuttia (14.50 per cent). Rose Scented is early, Calcuttia is mid season and Late Seedless is categorized as late season variety. Yield was maximum in cultivar Rose Scented (40 kg/tree). In contrast to quality characters TSS was maximum in Rose Scented (19.66 OB). Total sugars were the maximum in Late Large Green (15.39 per cent). On the basis of the study, Rose Scented, Calcuttia and Late Seedless are suitable cultivars for Tarai region. Orcharding of litchi with these three varieties will ensure the availability of fruits in the market for a longer period.

014. Ganajaxi; Hegde, Y. (University of Agricultural Sciences, Mugad (India). Agricultural Res. Stn.). Grain yield and aroma of basmati rice genotypes as influenced by N levels and time of sowing. Annals of Biology (India). (Jun 2007) v. 23(1) p. 13-15 KEYWORDS: RICE; SOWING DATE; GENOTYPES; YIELDS; NITROGEN; GRAIN.

A field experiment was conducted during wet seasons of 1999 and 2000 at Agricultural Research Station, Mugad. The treatments comprised three genotypes (Pusa Basmati-I, MGDB-I and Taroari Basmati), two dates of sowing (I FN of June and II FN of June) and four levels of N (0, 30, 60 and 90 kg N haol). Among the genotypes, Pusa Basmati and MGDB-I were on par with each other with respect to grain yield, number of panicles and mean panicle weight and they were found significantly superior over Taroari Basmati. Sowing in I FN of June recorded significantly higher yield (2369 kg haol) than sowing in II FN of June

(2157 kg ha⁻¹): Aroma of Basmati rice decreased progressively with the increase in the level of nitrogen.

015. Bakida, S.; Singh, G.; Antil, S.; Sangwan, N.; Rinwa, R.S. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy) . Comparative economics of paddy and maize cultivation in shivalik foothills of Haryana. *Annals of Biology (India)*. (Jun 2007) v. 23(1) p. 29-31 KEYWORDS: ECONOMICS; RICE; MAIZE; HIGHLANDS; HARYANA.

From the study conducted in 22 selected villages of upper and lower project areas of Shivalik foothills, it was concluded that paddy gave net returns of Rs. 4938 and 9005 per hectare in upper and lower project areas, respectively, whereas the maize cultivation was found to be less remunerative and net returns were in negative.

016. Satyajeet; Nanwal, R.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy); Yadav, V.K. (Krishi Vigyan Kendra, Rewari (India); Kumar, P. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy). Effect of integrated nutrient management on productivity and quality of pearl millet. *Annals of Biology (India)*. (Jun 2007) v. 23(1) p. 37-40 KEYWORDS: NUTRITIONAL REQUIREMENTS; PRODUCTIVITY; PEARL MILLET; PROTEIN CONTENT; GRAIN; YIELDS; ORGANIC MANURES; VARIETIES; BIOFERTILIZERS; FERTILIZER APPLICATION.

A field experiment was conducted in pearl millet during the years 2003-04 and 2004-05 at CCSHAU Regional Research Station, Bawal. The experiment was laid out in split plot design with four pearl millet varieties in main plot and eight fertility levels in sub-plots, having three replications. The objective of the experiment was to evaluate the yield and quality in relation to integrated nutrient management treatments in pearl millet. Hybrid HHB-117 recorded highest yield over rest of the varieties. The pooled grain yield was recorded highest with 100 percent RD in conjunction with vermicompost and biofertilizer (19.54 q/ha). Application of 100 percent RD and 75 percent RD+vermicompost+biofertilizer also gave comparable yields. Highest protein content and protein yield in grain and stover was obtained with 100 percent RD+vermicompost+biofertilizer. Similar trend was obtained in total protein yield.

017. Sharma, K.D.; Kumar, S.; Singh, N. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy). Dry matter accumulation and its partitioning in different mothbean [*Vigna aconitifolia* Jacq.] Marechal genotypes under moisture stress. *Annals of Biology (India)*. (Jun 2007) v. 23(1) p. 91-95 KEYWORDS: VIGNA ACONITIFOLIA; SOIL WATER CONTENT; DRY MATTER CONTENT; GENOTYPES; DROUGHT STRESS.

The present study was conducted at crop physiology research area of Agronomy Department, CCS Haryana Agricultural University, Hisar. The treatment consisted of two environments of moisture stress (water stress and irrigated control) and four genotypes viz., RMO 40, RMO 257, MB 99-1 and CZM 10. The dry weights of different plant parts (leaf, stem, root, nodules and pods) showed significant decrease under water stress in all the genotypes. Maximum dry weights of leaves and nodules were observed at flowering and thereafter declined till harvest, however, the dry weights of stem, roots and pods increased consistently upto harvest. The contribution of leaves to total biomass reduced after flowering but the per cent contributions of stem increased upto pod filling and declined thereafter. The genotype MB 99-1 possessed more biomass of leaves, roots, nodules and pods, however, stem biomass was observed highest in CZM 10.

018. Solanki, N.S.; Sahu, M.P. (Maharana Pratap University of Agriculture and Technology, Udaipur (India). Dept. of Agronomy). Productivity and P-use efficiency of clusterbean (*Cyamopsis tetragonoloba*) as influenced by bio regulators and phosphorus. *Indian Journal of Agronomy (India)*. (Jun 2007) v. 52(2) p. 143-147 KEYWORDS: PLANT GROWTH SUBSTANCES; PHOSPHATE; FERTILIZERS; CLUSTER BEANS; CYAMOPSIS PSORALIOIDES; YIELDS; NUTRIENT UPTAKE.

A field experiment was conducted at Bikaner during 1999 and 2000 on sandy soil to study the effect of bioregulators (thiourea and dimethylsulphoxide) and phosphorus on productivity and P-use efficiency of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.]. The study revealed that application of thiourea 5 kg/ha in the soil (split), thiourea 5 kg/ha + dimethylsulphoxide 2 kg/ha in the soil (split), foliar spray of 500 ppm thiourea and foliar spray of 500 ppm thiourea + 100 ppm dimethylsulphoxide proved effective in improving the growth and yield-attributing parameters over the control. The maximum seed yield of 1.988 tonnes/ha was obtained with thiourea 5 kg/ha ++ dimethylsulphoxide 2 kg/ha in the soil (split) along with 17.2 kg P/ha, which was on a par with yield obtained with application of 5 kg thiourea/ha in soil (split) and 8.6 kg P/ha, and foliar spray of 500 ppm/ha thiourea and 8.6 kg P/ha. Growth indices, viz. leaf-area index (LAI) and crop-growth rate (CGR) also improved with bio-regulators and phosphorus application. Application of phosphorus up to 17.2 kg P/ha significantly improved the LAI and CGR at 60 and 90 days after sowing (DAS), number of nodules/plant, pods/plant and pod length as well as P-use efficiency. The gum content increased significantly due to phosphorus application up to 8.6 kg P/ha. The maximum P recovery of 47.4 kg/ha was obtained with the application of 8.6 kg P/ha followed by 17.2 kg/ha (26.4 kg/ha). The highest P uptake by seed (10.72 kg/ha) was obtained with 5 kg thiourea/ha + dimethylsulphoxide 2 kg/ha in the soil (split). Soil and foliar applications of thiourea and dimethylsulphoxide recorded higher agronomic as well as physiological efficiency of the applied phosphorus.

019. Awasthi, V.; Garg, S.K. (M.J.P. Rohilkhand University, Bareilly (India). Dept. of Plant Science). Effect of salicylic acid enzymes of ammonium assimilation in maize seedling. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2007) v. 12(4) p. 393-395 KEYWORDS: MAIZE; ZEA MAYS; SALICYLIC ACIDS; ANABOLISM; AMMONIUM.

The response of salicylic acid application was studied in roots and shoot of six day old maize seedling. Glutamate dehydrogenase (GDH) activity enhanced in root and shoot at lower concentrations of salicylic acid. However, glutamine synthetase (GS) and glutamate synthase (GOGAT) activities decreased with the increase in concentration of salicylic acid. Protein and total nitrogen content showed upward trend with application of salicylic acid upto 50 JIM but further increase in its concentration resulted in lower protein and total nitrogen content.

F02 Plant Propagation

020. Kumar, V.; Chawla, H.S. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Genetics and Plant Breeding). Organogenic regeneration from different explants of patchouli (*Pogostemon cablin*). *Indian Journal of Genetics and Plant Breeding (India)*. (May 2007) v. 67(2) p. 187-189 KEYWORDS: ORGANOGENESIS; EXPLANTS;

REGENERATION; INVITRO CULTURE; PLANT PROPAGATION; INVITRO REGENERATION; POGOSTEMON CABLIN; TRANSPLANTATION.

021. Awasthi, U.D.; Singh, R.B.; Dubey, S.D. (Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Soil Conservation and Water Management). Effect of sowing date and moisture-conservation practice on growth and yield of Indian mustard (*Brassica juncea*) varieties. *Indian Journal of Agronomy* (India). (Jun 2007) v. 52(2) p. 151-153
KEYWORDS: SOWING DATE; WATER CONSERVATION; INDIAN MUSTARD; BRASSICA JUNCEA; YIELDS.

An experiment was conducted during the winter (rab/) season of 2001-02 and 2003-04 at Kanpur, Uttar Pradesh, to evaluate the effect of sowing dates (15 and 30 October) and moisture-conservation practices (control, 1 weeding and hoeing, grass mulch and paddy straw mulch) on growth and yield of 2 varieties of ('Vaibhav' and 'Urwashi') of Indian mustard [*Brassica juncea* (L.) Czernj. & Cosson] under rainfed conditions. Sowing of variety 'Vaibhav' on 15 October achieved higher seed yield and net monetary return compared to sowing on 30 October and variety 'Urwashi'. Moisture-conservation practices increased the seed yield, yield attributes and net monetary return over the control. Among moisture-conservation practices, paddy straw mulch was found most effective in reducing the weed count and enhancing yield and yield attributes markedly. From economic point of view, paddy straw mulch resulted in the highest net monetary returns of Rs 14,799/ha with a benefit: cost ratio of 2.48.

F03 Seed Production and Processing

022. Asha; Dhingra, R. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Botany and Plant Physiology). Salinity mediated changes in yield and nutritive value of chickpea (*Cicer arietinum* L.) seeds. *Indian Journal of Plant Physiology* (India). (Jul-Sep 2007) v. 12(3) p. 271-275
KEYWORDS: CHICKPEA; CICER ARIETINUM; SALINITY; YIELDS; NUTRITIVE VALUE.

An experiment was conducted on eight genotypes of chickpea, varying in their salt tolerance level, to evaluate effect of salinity on yield related parameters and the quality of seeds produced. Lower salinity (4dSm⁻¹) did not affect the number of flowers and pods per plant except in the genotypes HC-1, CSG9505 and HC-5. Higher salinities reduced the number of flowers and pods; the reduction being maximum in CSG 9505 followed by Pusa 256, HC-5 and HC-1 while HC-3 and KC-1 showed minimum reduction. Salinity also affected number and weight of the seeds per plant adversely, irrespective of the tolerance status of the genotype; reduction being more in the sensitive genotypes than the tolerant ones. Salinity also decreased starch and protein content of the seeds; the genotype KC-1 and HC-3 (salt tolerant)evinced relatively less decrease over CSG 9505 and HC-5 (salt sensitive), thereby proving that salt tolerant genotypes are neither high yielder nor produce quality seeds when compared to the control.

023. Bera, A.K. (Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India). Depot. of Plant Physiology); Pati, M.K. (Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India). Dept. of Vegetable Crops); Bera, A. (Calcutta University, Koklata (India). Institute of Agricultural Science). Electrotherapy of pre-sowing seed: a novel technique for yield improvement in

crop plants. Indian Journal of Plant Physiology (India). (Oct-Dec 2007) v. 12(4) p. 301-311
KEYWORDS: SEED TREATMENT; ELECTROTHERAPY; YIELDS.

Treating seeds with electric current (EC) improves yield over control in crop plants. EC treatment influences various physiological and biochemical activities in plants leading to higher yield. In monoecious cucurbits, it induces femaleness and reduces male: female flower ratio. Although, this technology was first applied in cucurbitaceous plants to improve yield, but now it has been extended to other crops like cereals, pulses, oilseeds etc. and the results are very much encouraging as evidenced by present review work. Hence, this technology might be considered as a reliable tool to improve yield in various crop plants.

F04 Fertilizing

024. Setia, R.K. (Punjab Agricultural University, Ludhiana (India). Punjab Remote Sensing Centre); Sharma, K.N. (Punjab Agricultural University, Ludhiana (India). Dept. of Soils). Dynamics of forms of inorganic phosphorus during wheat growth in a continuous maize-wheat cropping system. Journal of the Indian Society of Soil Science (India). (Jun 2007) v. 55(2) p. 139-146
KEYWORDS: FERTILIZER APPLICATION; NITROGEN; PHOSPHORUS; POTASSIUM; WHEATS; MAIZE; CROPPING SYSTEMS; GROWTH; NUTRIENT UPTAKE; SOIL ANALYSIS.

The transformation of added phosphorus (P) greatly depends on the physical and chemical environment of the soil. The effect of continuous application of nitrogen (N), P and potassium (K) to a maizewheat annual sequence on the changes in Olsen-P, inorganic forms of P (saloid-P, Al-P, Fe-P and Ca-P) and total P at tillering, ear initiation and wheat harvest is reported. The application of P (17.5 or 35 kg P ha⁻¹) increased all the P forms, irrespective of the growth stage whereas, N (120 and 180 kg N ha⁻¹) and K (0 and 33.2 kg K ha⁻¹) application caused decrease in the P fractions. Olsen-P in the control plot (NoPoKo) decreased from its initial status of 6.50 to 5.75 mg kg⁻¹ after 22 cycles of maize-wheat sequence. The relative abundance of inorganic P fractions was in the order of saloid-P Fe-P Al-P Ca-P. The various inorganic P fractions tended to decline with the crop age. The inorganic P forms (except saloid P) decreased after wheat harvest in comparison to their respective initial status. The increasing rate of NPK addition resulted in a significant increase in P content of plant! plant parts at all the growth stages. The P uptake by wheat significantly increased with fertilizer addition under all the treatments. The P concentration of wheat exhibited a decline whereas, the total P uptake continued to increase with the plant age. The P uptake in the partitioned plant parts at earing stage was in the order of stem ear leaves. Olsen-P showed a significant relationship with all the inorganic P forms at tillering stage but it was significantly related only with Al-P and Ca-P at the ear initiation and saloid-P and Fe-P at the harvesting stage. The correlation coefficient values between inorganic forms of P at various growth stages and P concentration in/uptake by different plant parts at the respective / subsequent stage were worked out. The saloid-P served as a good index of P availability to wheat at tillering. A sizeable amount of Al-P and Ca-P was utilized between the first (tillering) and second stages (earring) of sampling. However at the harvesting stage, saloid-P mainly contributed towards P nutrition of wheat (the contribution from other P forms at the same time cannot be ignored). Based on the physico-chemical approach to the problem of P availability, the energy required for the absorption of P by wheat from saloid-P and Fe-P is less than that required for Ca-P by 389 and 733 joules, respectively. There is a refixation of

the released P on AI-P, Fe-P and again on AI-P at tillering, ear initiation and harvesting stages of wheat, respectively.

025. Babu, M.V.S. (Acharya N.G. Ranga Agricultural University, Hyderabad (India); Reddy, C.M. (Acharya N.G. Ranga Agricultural University, Tirupati (India). Dept. of Soil Science and Agricultural Chemistry); Subramanyam, A.; Balaguravaiah, D. (Agricultural Research Station, Anantapur (India). Effect of integrated use of organic and inorganic fertilizers on soil properties and yield of sugarcane. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 161-166 KEYWORDS: FERTILIZER APPLICATION; ORGANIC FERTILIZERS; INORGANIC FERTILIZERS; SOIL CHEMICOPHYSICAL PROPERTIES; NUTRITIONAL REQUIREMENTS; SUGARCANE; YIELDS; TRACE ELEMENTS.

The results of a field experiment conducted on alluvial soils to study the effect of different organic manures along with inorganic fertilizers on physical, physico-chemical and chemical properties of alluvial soil and yield of sugarcane during 1994-96 in farmers' fields of Kovur Sugar Factory area of Nellore district, Andhra Pradesh revealed that sugarcane responded to organic manures when used in integration with inorganic fertilizers. An additional cane yield of 14-27 t ha⁻¹ was realized with different organic manures + inorganic fertilizers over inorganic fertilizers alone. Among different organic sources, FYM, pressmud and poultry manure proved superior in terms of cane yield whereas pressmud followed by poultry manure proved superior in terms of sugar yield. There was a slight reduction in soil pH and increase in electrical conductivity with the application of organic manures. At the end of ratoon crop, the increase in available N and Ca was maximum (38.2 percent and 24.4 percent) with the application of FYM whereas the application of poultry manure resulted in the highest increase in available P (122.2 percent), K (23.6 percent) and magnesium (47.4 percent) over the initial soil values. Application of poultry manure along with inorganic fertilizers resulted in higher cane yield in plant crop whereas, FYM along with inorganic fertilizers resulted in the highest cane yield in ratoon crop.

026. Majumdar, B. (Central Research Institute for Jute and Allied Fibres, Kolkata (India). Div. of Crop Production); Venkatesh, M.S. (Indian Institute of Pulses Research, Kanpur (India); Kumar, K. (Central Institute for Sub-tropical Horticulture, Lucknow (India); Patiram (ICAR Research Complex for North Eastern Hill Region, Umiam (India). Div. of Soil Science). Effect of rock phosphate, superphosphate and their mixtures with FYM on soybean and soil-P pools in a typic haplundalf of Meghalaya. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 167-174 KEYWORDS: FERTILIZER APPLICATION; ROCK PHOSPHATE; SUPER PHOSPHATE; FARMYARD MANURE; SOYBEANS; NUTRIENT NUTRIENT INTERACTION; PHOSPHORUS; NUTRIENT UPTAKE; YIELDS; MEGHALAYA.

A field experiment was conducted for five consecutive years on a phosphorus-deficient Typic Hapludalf to study the efficiency of SSP (single superphosphate), RP (rock phosphate) and their mixtures along with FYM on soybean. The yield, P uptake, protein and oil content of soybean increased significantly I with P alone or with FYM irrespective of sOurces 'over, control and maximum values were recorded with SSP I 60 kg P 205 ha⁻¹ + FYM, followed by SSP + RP (1: 1) 60 kg P 205 ha⁻¹ + FYM. The organic carbon, available P and N in soil increased by 11.5 to 35.4, 23.1 to 199 and 7.5 to 15.5 percent, respectively over the initial status in various treatments after 5 years of cropping. The fate of applied P in soil indicated that total and organic P increased significantly with different sources of applied P and organic P contributed 48.9lo 53.7 percent of total P. Among inoliganic fractions, significant

increase in saloid-P, Al-P, Fe-P and Ca-P but depletion in reductantsoluble and occ1uded-P was observed. The P use efficiency was higher at lower doses of applied P with the maximum value (21.3 percent) recorded with SSP 30 kg P205ha-1 + FYM treatment. Application of 60 kg P205ha-1 through SSP alone or with FYM was most efficient dose for production of high quality soybean and forms of P build up followed by 60 kg P205ha-1 as SSP + RP (1:1) with or without FYM in acid Alfisol of Meghalaya.

027. Begum, M.; Narayanasamy, G. (Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry); Rai, R.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy); Biswas, D.R. (Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry). Influence of integrated nutrient management on nitrogen and phosphorus in soil under wheat-mungbean-maize cropping system. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 175-183 KEYWORDS: FERTILIZER APPLICATION; FARMYARD MANURE; NITROGEN FERTILIZERS; PHOSPHORUS; NITRATE; NUTRIENT NUTRIENT INTERACTION; WHEATS; MUNGBEANS; MAIZE; NUTRITIONAL REQUIREMENTS.

An investigation was carried out to assess the influence of integrated nutrient management on dynamics of nitrogen (N) and phosphorus (P) in soil under a wheat-mungbean-maize cropping system. Eight treatments viz. fertilizers applied at 50,75 and 100 percent of the recommended dose (NrZJ60Kro), N120 only, P60 only, FYM (5 t ha⁻¹) applied alone, and in combination with 50 and 75 percent recommended NPK were applied to wheat. These treatments were compared with no-fertilizer and manure control. Mungbean was grown following wheat without any fertilizer or manure application. It was allowed to grow till maturity, and after two pickings, the stover was incorporated into the soil. Zero, 50 and 75 percent of the recommended dose of fertilizer (N 120P 60Kro) were applied to maize. The treatments where higher amounts of fertilizer-N were added, registered higher contents of ammoniacal, nitrate and alkaline KMnO₄oxidisable (available) N in the soil. Similarly, higher doses of fertilizer-P resulted in higher values of Olsen-P and total inorganic P. Application of FYM 5 t ha⁻¹ along with inorganic N was found to maintain the levels of all these forms of soil N up to maize harvest. Inorganic P showed an inverse relationship with the organic P content at all the growth stages of the three crops under study.

028. Pattanayak, S.K. (Orissa University of Agriculture and Technology, Bhubaneswar (India). Dept. of Soil Science and Agricultural Chemistry); Rao, D.L.N. (Indian Institute of Soil Science, Bhopal (India); Mishra, K.N. (Orissa University of Agriculture and Technology, Bhubaneswar (India). Dept. of Soil Science and Agricultural Chemistry). Effect of biofertilizers on yield, nutrient uptake and nitrogen economy of rice-peanut cropping sequence. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 184-189 KEYWORDS: FERTILIZER APPLICATION; AZOTOBACTER; AZOLLA; BIOFERTILIZERS; AZOSPIRILLUM; NITROGEN; YIELDS; RICE; NUTRIENT UPTAKE; GROUNDNUTS.

A field experiment was conducted on a Vertic Ustochrept of Bhubaneswar to study the effect of integration of biofertilizers on yield, nutrient uptake and N economy of rice-peanut cropping sequence. The study revealed that 40 kg inorganic N (50 percent N dose) integrated with biofertilizers (Azotobacter, Azospirillum and Azolla) and 17.5 kg of P and 32 kg of K ha⁻¹ resulted in the highest grain (3.57 t ha⁻¹) and straw yield (4.32 t ha⁻¹) of rice. On its residual fertility, peanut crop produced the highest pod yield (2.38 t ha⁻¹) with seed inoculation of Rhizobium and treatment with molybdenum and addition of 17.5 kg of P and

32 kg K ha⁻¹. With this a total of 60 kg inorganic N ha⁻¹ was saved in the rice-peanut cropping sequence with apparent P and K recovery of 20 and 76 percent, respectively.

029. Jat, J.R.; Mehra, R.K. (Rajasthan College of Agriculture, Udaipur (India). Dept. of Agricultural Chemistry and Soil Science). Effect of sulphur and zinc on yield, macronutrient content in and uptake by mustard on haplustepts. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 190-195 KEYWORDS: FERTILIZER APPLICATION; NUTRIENTS; SULPHUR; ZINC; NUTRIENT AVAILABILITY; NUTRIENT UPTAKE; YIELDS; MUSTARD; BRASSICA JUNCEA.

Field experiments were conducted for two years (2001-02 and 2002-03) with mustard [*Brassica juncea* (L.) Czern and Coss.] as a test crop on Haplustepts with five doses of sulphur (0, 20, 40, 60 and 80 kg S ha⁻¹) and zinc (0, 2.5, 5.0, 7.5 and 10.0 kg Zn ha⁻¹). Seed and stover yield increased significantly up to 40 kg S and 5 kg Zn ha⁻¹ application. Application of 60 kg S ha⁻¹ and 2.5 kg Zn ha⁻¹ significantly increased the nitrogen, phosphorus, potassium and sulphur content at 30, 60 and 90 DAS and at harvest in both the years of experimentation. Nitrogen, phosphorus, potassium and sulphur uptake increased significantly up to 60 kg S and 5.0 kg Zn ha⁻¹ application except nitrogen and potassium uptake in seed where significant increase was recorded only up to 40 kg S ha⁻¹.

030. Chaube, A.K.; Ruhella, R.; Chakraborty, R.; Gangwar, M.S.; Srivastava, P.C.; Singh, S.K. (Gobind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Soil Science). Management of zinc fertilizer under pearl millet-wheat cropping system in a typical ustipsamment. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 196-202 KEYWORDS: FERTILIZER APPLICATION; PEARL MILLET; WHEATS; YIELDS; CROPPING SYSTEMS; ZINC.

Field experiments were conducted with pearl millet-wheat cropping system on a Typical Ustipsamment to assess the direct, residual and cumulative effect of Zn application on crops with or without use of organic manure. The residual effect of 10 kg Zn ha⁻¹ applied to first crop on gram yields was noted up to the sixth crop. Better yields were obtained with the application of 10 kg Zn ha⁻¹ every year or at least in alternate years. Combined application of 2.5 kg Zn + 5 t FYM ha⁻¹ in alternate years gave significantly higher concentration of Zn in flag leaf, its uptake by crops and higher content of DTPA-extractable Zn in soil at the end of three years' cycle. Apparent Zn fertilizer use efficiency under combined application of 2.5 kg Zn + 5 t FYM ha⁻¹ applied in 1st and 2nd years or 1st and 3rd years was about ten-fold higher than application of 10 kg Zn as ZnSO₄ ha⁻¹ in 1st and 2nd or in 1st and 3rd years.

031. Bhat, M.A. (Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu (India). Regional Agricultural Research Stn.); Singh, R. (Narendra Deva University of Agriculture and Technology, Faizabad (India). Dept. of Soil Science); Kohli, A. (Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu (India). Regional Agricultural Research Stn.). Effect of integrated use of farmyard manure and fertilizer nitrogen with and without sulphur on yield and quality of Indian mustard (*Brassica juncea* L.). *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 224-226 KEYWORDS: FERTILIZER APPLICATION; NITROGEN FERTILIZERS; MUSTARD; YIELDS; NUTRIENT UPTAKE; QUALITY; BRASSICA JUNCEA; FARMYARD MANURE; SULPHUR.

032. Mathakiya, H.V.; Meisheri, M.B. (Gujarat Agricultural University, Navsari (India). Dept. of Agricultural Chemistry and Soil Science). Feasibility of using some solid industrial wastes on cabbage and their effect on yield and nutrient absorption. Journal of the Indian Society of Soil Science (India). (Jun 2007) v. 55(2) p. 227-230 KEYWORDS: SOLID WASTES; INDUSTRIAL WASTES; FERTILIZER COMBINATIONS; FERTILIZER APPLICATION; YIELDS; CABBAGES; BRASSICA OLERACEA CAPITATA; ABSORPTION; NUTRIENTS; NUTRIENT UPTAKE.

033. Yesh Pal; Singh, R.P. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Agronomy); Sharma, N.L. (A.S. College Lakhaoti, Bulandshahr (India). Department of Agricultural Chemistry and Soil Science) Sachan, R.S. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Soil Science). Effect of integrated nutrient management practices on rice (*Oryza sativa* L.) in a Mollisol. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 23-28 KEYWORDS: NUTRIENT UPTAKE; SOIL FERTILITY; NUTRIENTS; RICE; ORYZA SATIVA; SOIL CHEMICAL PHYSICAL PROPERTIES.

Field experiment was conducted during Kharif season of 2002 and 2003 to study the response of rice to INM practices in Mollisol. The yield attributes and yield in rice were studied with application of FYM 5 and 10t ha⁻¹, paper mill Bagasse 5 and 10 t ha⁻¹ and inoculation with Blue green algae 10 kg ha⁻¹ in a field experiment on a Typic Hapludolls. Application of FYM, Bagasse and BGA along with the recommended, 75 and 50 per cent of recommended fertilizer doses had positive effect on yield and yield attributing parameters over recommended fertility alone. Highest values were recorded in the treatment where 10 t FYM ha⁻¹ was applied with recommended fertility levels and the average extent of increase in panicle (m²), panicle length (cm), spikelets/panicle, 1000 grain weight and grain yield was 2.16, 5.34, 4.80, 1.81 and 9.0 per cent respectively.

034. Yesh Pal; Singh, R.P. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Agronomy); Sharma, N.L. (A.S. College Lakhaoti, Bulandshahr (India). Department of Agricultural Chemistry and Soil Science) Sachan, R.S. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Soil Science). Effect of integrated nutrient management practices on yield, N, P, K uptake and economics of rice (*Oryza sativa* L.) in a Mollisol. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 29-33 KEYWORDS: NUTRIENTS; SOIL FERTILITY; SOIL CHEMICAL PHYSICAL PROPERTIES; NUTRIENT UPTAKE; NPK FERTILIZERS; ECONOMICS; RICE; ORYZA SATIVA.

ABSTRACT: An experiment was conducted during Kharif seasons of 2002-03 and 2003-04 to study the effect of various combinations of organic, inorganic and biological sources on plant nutrient contents, total nutrient uptake, grain yield, economics of different treatments and cost benefit ratio in rice crop. Significantly higher contents of nitrogen, phosphorus and potassium (in both grain and straw), total nutrient uptake, grain yield and net returns were recorded significantly higher with the application of N₁₂₀P₆₀K₄₀ + Farmyard manure 10 t ha⁻¹ and 75 per cent of N, P, K (90:45:30 kg ha⁻¹) + 10 t FYM ha⁻¹ over recommended fertility level alone. While 50 per cent of RF (N₆₀P₃₀K₂₀ kg ha⁻¹) + FYM had no significant effect over RF alone but yielded significantly higher over 50 per cent of RF alone. Inoculation with BGA 10 kg ha⁻¹ alongwith recommended fertilizer level recorded highest (1.12) cost benefit ratio during both the years.

035. Mehra, Menka; Singh, Sobaran (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of soil Science). Effect of INM on the growth, yield and

nutrient uptake by wheat under Brahmi-Wheat cropping system. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 105-107 KEYWORDS: BIOFERTILIZERS; FERTILIZERS; ORGANIC FERTILIZERS; NUTRIENTS; NUTRIENT UPTAKE; WHEATS; CROPPING SYSTEM; DRUG PLANTS; ORGANIC AGRICULTURE.

ABSTRACT: Field experiment was conducted during Rabi season of 2003-04 at Pantnagar on sandy loam soil to study the effect of INM on the growth, yield and nutrient uptake by wheat under Brahmi-Wheat cropping system. Integrated nutrient management involving the combination of FYM, green manure, crop residue and biofertilizer (Azotobacter) with inorganic sources resulted in highest plant height (98 cm), no of tillers/m² (349), grain yield (41.36 q ha⁻¹) and straw yield (82.32 q ha⁻¹) of wheat and also highest N (144.99 kg ha⁻¹), P (36.40 kg ha⁻¹) and K (145.40 kg ha⁻¹) uptake by wheat. Thus, it was concluded that integrated nutrient sources are better for sustaining growth, yield and nutrient uptake by wheat crop under Brahmi-Wheat cropping system.

036. Krishna, D.; Ram, S.; Nand Ram (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Soil Science). Response of long term use of NPK fertilizers and manure to P-fractions, soil properties and their relationship to yields of rice in rice-wheat-cowpea cropping system on a Mollisol of Tarai. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 108-113 KEYWORDS: RICE; WHEATS; COWPEAS; SOIL CHEMICOPHYSICAL PROPERTIES; CROPPING SYSTEMS; NPK FERTILIZERS; ORGANIC FERTILIZERS; PHOSPHORUS.

ABSTRACT: The study was undertaken with rice during 2002-03 in a long term fertilizer experiment, which is being carried out since 1971. The obtained results indicate that application of 100 per cent recommended NPK fertilizers + FYM 15 t ha⁻¹ produced maximum grain and straw (4.6 and 5.6 t ha⁻¹) and nutrients uptake by rice and it was followed by 100 per cent NPK+Zn. Whereas, continuous use of optimal and super optimal dose of 100 and 150 per cent NPK fertilizers without zinc gave 18.63 and 21.63 per cent lower grain yield respectively as compared to 100 per cent NPK+ FYM. However, 100 per cent phosphorus application with nitrogen and zinc shows superiority over optimal and super optimal doses of NPK fertilizers without zinc and alone nitrogen with zinc. Remarkable decrease in organic carbon from initial (1.48 per cent) to control (0.57 per cent) was observed up to 30th cycle of rice-wheat-cowpea and it was maintained with 100 per cent NPK+ FYM treatment (1.52 per cent). This shows that organic manure application 15.0 t ha⁻¹ in combination with optimal dose of NPK fertilizers retained initial soil fertility level and produced maximum yields. Highest saloid-P and Ca-P in soil was recorded with 150 per cent NPK treatment but 100 per cent NPK+FYM gave maximum available phosphorus and lowest saloid-P. Significant and positive correlation coefficients were found with Al-P and Ca-P Vs grain yield and available phosphorus was significantly correlated with all P-fractions whereas, negative correlations were recorded by saloid-P with CaCO₃ in surface and subsurface soils after rice.

037. Singh, D.; Verma, B.S. (R.B.S. College, Bichpuri (India). Dept. of Agronomy). Effect of different sources of sulphur on the yield of Indian mustard (*Brassica juncea* L.) in pearl millet-mustard cropping system. Annals of Biology (India). (Jun 2007) v. 23(1) p. 17-18 KEYWORDS: CROPPING SYSTEMS; MUSTARD; BRASSICA JUNCEA; PEARLMILLET; FERTILIZER APPLICATION; SULPHUR; GYPSUM; YIELDS; YIELD COMPONENTS; SEED.

The mean seed yield of mustard var. T-59 (Varuna) was recorded maximum (18.80 q ha⁻¹) during 1992-93 and 1993-94 under application of gypsum for 40 kg S ha⁻¹ followed by ammonium sulphate (16.99 q ha⁻¹), besides 80 kg N and 60 kg P 2 0 5 ha⁻¹ - as a recommended dose at Bichpuri Centre, Agra (U. P.). However, the other sources of sulphur viz., elemental sulphur, pyrite and single superphosphate remained inferior. The lowest yield (14.68 q ha⁻¹) could be recorded under elemental sulphur.

038. Singh, D.; Verma, B.S. (R.B.S. College, Bichpuri (India). Dept. of Agronomy). Indian mustard (*Brassica juncea*) seed yield and oil yield as affected by sulphur and nitrogen application. *Annals of Biology (India)*. (Jun 2007) v. 23(1) p. 19-21 KEYWORDS: MUSTARD; BRASSICA JUNCEA; SEED; YIELDS; FERTILIZATION; SULPHUR; NITROGEN; FERTILIZER APPLICATION; FERTILIZER COMBINATION.

A field experiment was conducted during winter (rabi) seasons of 1992-93 and 1993-94 to study the effect of graded levels of sulphur and nitrogen on Varuna Indian mustard [*Brassicajuncea* (L.) Czern & Coss], grown in pearl millet-mustard cropping system. Seed yield (16.4 q ha⁻¹) was found, however, significantly increased with S application 90 kg ha⁻¹, but application of 60 kg S ha⁻¹ appeared economically better than other levels of S. Similar increases in mean seed yield with N application 120 kg over 80, 40 and 0 kg levels was 3.8, 29.2 and 117.6 percent, respectively. A significantly positive interaction between the two nutrients (S & N) in increasing seed yield was observed, giving the highest seed yield (19.18 q ha⁻¹) due to combined application of N80S60. An improvement in oil yield was noticed significantly upto 60 kg S ha⁻¹ and appeared a reasonable level of S. Similarly, 80 kg N ha⁻¹ was noticed quite advantageous for production of oil ha⁻¹ in mustard.

039. Varshney, S.K.; Singh, B.; Kumar, A. (Rajendra Agricultural University, Muzaffarpur (India). Dept. of Seed Technology). Nutrient management in true potato seedling transplanted crops in Bihar plains. *Annals of Biology (India)*. (Jun 2007) v. 23(1) p. 97-101 KEYWORDS: TRANSPLANTING; SEED; SEEDLINGS; NUTRITIONAL REQUIREMENT; NITROGEN; POTASSIUM; FERTILIZER APPLICATION; POTATOES; BIHAR; YIELDS.

The experiment was carried out to find out the suitable dose of N, K and mustard cake in TPS transplanted crop at Dholi Research Farm of T. C. A., Dholi, Muzaffarpur-Bihar during rabi 2000-01 and 2001-02 under NATP funded project. There was non-significant-effect on seedling survival per cent, total and marketable tuber yield with the increasing dose of N and K and mustard cake over the standard doses. As such, the lower dose of N and K 100 kg/ha each gave the total and marketable tuber yield at par with recommended dose of N (150 kg/ha) and K (125 kg/ha). The interaction effect of N x K x M was significant for both total and marketable tuber yield in the first year, whereas in second year it was significant for total yield only.

040. Marathe, R.A. (National Research Centre on Pomegranate, Solapur (India); Bharambe, P.R. (Central Institute for Cotton Research, Nagpur (India). Correlation of integrated nutrient management induced changes in soil properties with yield and quality of sweet orange (*Citrus sinensis*) on udic haplustert. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 270-275 KEYWORDS: CITRUS SINENSIS; NUTRITIONAL REQUIREMENTS; INORGANIC FERTILIZERS; SOIL CHEMICO PHYSICAL PROPERTIES; YIELDS; QUALITY; SOIL FERTILITY; BIOFERTILIZERS; SWEET ORANGE; ORGANIC FERTILIZERS.

Changes in soil properties as influenced by single and combined application of organic manures, inorganic fertilizers and biofertilizers and their response on yield and quality of sweet orange (*Citrus sinensis* Osbeck) grown on Udic Haplustert were evaluated through a field experiment during 2002-04. Among soil physical properties, only hydraulic properties of soil significantly influenced both fruit yield as well as quality. The changes in available nutrients in the soil were positively correlated and possibly played a dominant role in regulating the fruit yield. Nutrient concentration in leaves was more significantly correlated with yield and quality parameters than the soil available nutrients, signifying the superiority of leaf over soil analysis.

041. Gathala, M.K.; Kanthaliya, P.C.; Verma, A.; Chahar, M.S. (Maharana Pratap University of Agriculture and Technology, Udaipur (India). Dept. of Agricultural Chemistry and Soil Science). Effect of integrated nutrient management on soil properties and humus fractions in the long term fertilizer experiments. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 360-363 KEYWORDS: FERTILIZER APPLICATION; HUMUS; NUTRIENT REQUIREMENTS; FARMYARD MANURE; SOIL CHEMICO-PHYSICAL PROPERTIES; SOIL ANALYSIS; NUTRIENT UPTAKE; FERTILIZER COMBINATIONS.

042. Agarwal, B.K.; Kumar, B.; Singh, S.; Singh, R.N.; Sinha, A.K. (Birsa Agricultural University, Ranchi (India). Dept. of Soil Science And Agricultural Chemistry). Effect of phosphorus and liming on yield, phosphorus uptake and protein content of pea upland soil of east singhbhum.. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 367-369 KEYWORDS: FERTILIZER APPLICATION; PHOSPHORUS; LIMING; NUTRIENT UPTAKE; PISUM SATIVUM; PEAS; ACID SOILS; PROTEIN CONTENT; YIELDS; HIGHLANDS.

043. Behera, B.; Sankar, G.R.M.; Mohanty, S.K.; Pal, A.K.; Chary, G.R.; Reddy, G.S.; Ramakrishna, Y.S. (Orissa University of Agriculture and Technology, Phulbani (India). All India Coordinated Research Project for Dryland Agriculture). Sustainable fertilizer practices for upland rice (*Oryza sativa*) from permanent manurial trials under subhumid alfisols. *Indian Journal of Agronomy (India)*. (Jun 2007) v. 52(2) p. 96-101 KEYWORDS: FERTILIZERS; SUSTAINABILITY; UPLAND RICE; ORYZA SATIVA; LUVISOLS; EXPERIMENTATION.

Twelve permanent manurial trials were conducted from 1994 to 2005 to develop a sustainable fertilizer application schedule for upland rice (*Oryza sativa* L.) and find out optimal fertilizer requirement for attaining maximum productivity in a moist subhumid alfisol. Nine treatments of organic N (Glyricidia, cassia and farmyard manure) and inorganic N, P and K fertilizers together with a control, were tested. The treatments differed significantly from each other in all seasons. Application of 50 percent N (FYM) + 50 percent PK of recommended dose proved superior, as evident from lowest yield decrease of 86.4 kg/year compared with a maximum of 170.9 kg/year with application of 100 percent NPK (inorganic). Regression analysis revealed that the treatment comprising 50 percent N (FYM) + 50 percent NPK was superior with a maximum yield predictability of 0.85 with a prediction error of 511 kg/ha, and a maximum sustainability yield index (0.47), maximum mean yield (1,811 kg/ha) and lowest variation (29 percent) in the study. The study indicated that an optimum application of 32, 22, 17 and 14 kg/ha organic N together with 28, 33, 39 and 47 kg/ha inorganic N could be made respectively under 500-750, 750-1,000, 1,000-1,250 and 1,500-1,750 mm of crop seasonal rainfall for attaining sustainable productivity of upland rice under rainfed conditions in moist subhumid alfisols.

044. Ramakrishna, Y.; Singh, S.; Parihar, S.S. (Indian Agricultural Research Institute, New Delhi (India). Water Technology Centre). Influence of irrigation regime and nitrogen management on productivity, nitrogen uptake and water use by rice (*Oryza sativa*). Indian Journal of Agronomy (India). (Jun 2007) v. 52(2) p. 102-106 KEYWORDS: IRRIGATION; NITROGEN; FERTILIZERS; RICE; ORYZA SATIVA; NUTRIENT UPTAKE; WATER USE.

A field experiment was conducted on deep sandy clay-loam soil (Typic Haplustepts) at New Delhi, during 2002 and 2003 to investigate the effect of irrigation regimes, viz. continuous submergence, 1-day drainage, and 3-day drainage, and integrated nutrient management, viz. the control, 75 percent N of recommended fertilizer dose (RFD), 100 percent N of RFD, 150 percent of RFD, 75 percent N of RFD out of which 25 percent N substituted by farmyard manure (FYM), 100percent N of RFD out of which 25percent N substituted by FYM, 150percent N of RFD of which 25percent substituted by FYM and 75percent N of RFD + biofertilizer, on the productivity of rice (cv. 'Pusa Sugandh 3'). Continuous water submergence increased the maximum plant height, number of tillers, leaf-area index (LAI), dry-matter accumulation, number of panicles, grains/panicle, panicle length, 1,000-grain weight, and the grain and straw yields, which were statistically superior to 3-day drainage but on a par with those of 1-day drainage. Continuous water submergence resulted in 9.617.4percent higher grain yield than 3-day drainage and 2.7-4.6percent higher than 1-day drainage. Irrigation and water requirement of rice were higher with continuous submergence, whereas irrigation, use efficiency and field water-use efficiency were higher with 3-day drainage. Among the nitrogen treatments, application of 150percent N of RFD (25percent substituted by FYM) induced the highest growth and yield attributes over other treatments and outyielded 75percent N of RFD by giving 21.7percent, 75percent N of RFD (25percent substituted by FYM) by 17.1percent, and 75percent N of RFD + biofertilizer by 14.1percent and 40.4percent more grain yield than the control in the first year and 19.8percent, 19.9percent, 12.7percent and 42.0percent in record year. Highest N uptake was recorded with 150percent of N of RFD (25percent N substituted by FYM) in biomass. Agronomic nitrogen efficiency was maximum with 1-day drainage and 100 kg N/ha applied through fertilizer. Irrigation-use efficiency and field water-use efficiency were higher with 150percent¹11 of RFD (25percent N of RFD substituted by FYM). It was concluded that under less availability of water, irrigation may be applied on the basis of 1-day drainage with 150percent N of RFD (25percent substituted by FYM).

045. Sharma, R.P.; Pathak, S.K.; Singh, R.C. (Rajendra Agricultural University, Sabour (India). Dept. of Agronomy). Effect of nitrogen and weed management in direct seeded rice (*Oryza sativa*) under upland conditions. Indian Journal of Agronomy (India). (Jun 2007) v. 52(2) p. 114-119 KEYWORDS: NITROGEN; FERTILIZERS; WEED CONTROL; DIRECT SOWING; UPLAND RICE; ORYZA SATIVA.

A field experiment was conducted during the rainy season of 2002 and 2003 at Sabour study the effect of nitrogen and weed management in direct-seeded upland rice (*Oryza sativa* L.). Grain and straw yields of rice and N, P and K uptake by rice crop and weeds increased significantly with successive increase in nitrogen up to 120 kg/ha. The splits in which basal application of nitrogen was skipped off resulted in significantly higher yield attributes, grain and straw yields and nutrient uptake by crop in comparison to splits wherein part of nitrogen was applied at sowing owing to lower weed dry weight and nutrient depletion by weeds that resulted in higher weed-control efficiency and N-use

efficiency. Among the weed-management practices, 2 hand-weedings at 20 and 40 days after sowing and pre-emergence application of butachlor at 1.5 kg/ha + 1 hand-weeding at 30 DAS were at par; they significantly reduced the density and dry weight of weeds and nutrient depletion by weeds. These treatments significantly increased the nutrient uptake by the crop, resulting in higher grain yield (4.18 and 4.16 t/ha) of 120 kg N/ ha as a result of higher weed-control efficiency (90.6 and 84.3percent), N-use efficiency (33.5 and 32.9 kg grain/kg of N applied) and production efficiency (60.4 and 60.3 kg grain/kg N applied) respectively. However, minimum nutrient uptake by crop and maximum nutrient removal by weeds were noted under weedy check.

046. Sarma, A. (Assam Agricultural University, Golaghat (India). Krishi Vigyan Kendra); Singh, H.; Nanwal, R.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy). Effect of integrated nutrient management on productivity of wheat (*Triticum aestivum*) under limited and adequate irrigation supplies. *Indian Journal of Agronomy (India)*. (Jun 2007) v. 52(2) p. 120-123 KEYWORDS: NUTRIENT UPTAKE; WHEAT; TRITICUM AESTIVUM; IRRIGATION; WATER USE.

A field experiment was conducted during the winter seasons of 2000-01 and 2001-02 at Hisar, Haryana, to find out a suitable combination of chemical and organic nutritional sources for wheat (*Triticum aestivum* L. emend. Fiori & Paol.) grown at 2 irrigation levels, viz. adequate irrigation and limited irrigation, and 10 levels of nutrients. Wheat crop under adequate irrigation one each at crown-root initiation, late tillering, late jointing, flowering and milk stages recorded better growth, yield attributes, grain and straw yields and higher consumptive use of water and nutrient uptake. Application of 187.5 kg N/ha + FYM (10 t/ha) and 150 kg N/ha + FYM (10 t/ha) + Azotobacter recorded significantly higher growth, nutrient uptake, available N and grain and straw yields of wheat. The net in-come and benefit: cost ratio and water-use efficiency were also highest with 187.5 kg N/ha + FYM (10 t/ha) + Azotobacter + followed by 187.5 kg N/ha + FYM (10 t/ha) and 150 kg N/ha + FYM (10 t/ha) + Azotobacter. Available N content also increased compared with its initial soil status under these treatments. The content of organic carbon and available phosphorus in soil increased and the bulk density and pH decreased in all the integrated nutrient-management practices involving FYM (10 t/ha). Thus on integrating FYM (10 t/ha) + Azotobacter with 187.5 and 150 kg N/ha or FYM (10 t/ha) with 187.5 kg N/ha, productivity and monetary return can be increased by maintaining or improving the residual soil-fertility status after the harvest of wheat crop.

047. Singh, R.K. (Krishi Vigyan Kendra, Etawah (India); Singh, S.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Environmental Science); Singh, L.B. (Chandra Sekhar Azad University of agriculture and Technology, Kanpur (India). Agricultural Technology Information Centre). Integrated nitrogen management in wheat (*Triticum aestivum*). *Indian Journal of Agronomy (India)*. (Jun 2007) v. 52(2) p. 124-126 KEYWORDS: NITROGEN; FERTILIZERS; WHEAT; TRITICUM AESTIVUM.

A field experiment was conducted at Bichpuri, Agra during the winter season of 2000-01 and 2001-02 to study the effect of biofertilizers, and organic and chemical nitrogen as well as their combination on growth, yield and uptake of nitrogen by wheat (*Triticum aestivum* L. emend. Fiori & Paol.). The treatments consisted of biofertilizer (Azotobacter and Azospirillum), organics (FYM 5 Vha) and 3 levels of nitrogen (50, 100 and 150 kg N/ha), and their combinations (i.e. 50 kg N/ha + Azotobacter, 50 kg N/ha + Azospirillum + FYM 5 Vha);

one unfertilized control was also included for comparison. The integrated use of inorganic fertilizer, biofertilizer and organics enhanced the growth and yield of wheat. Higher plant height and yield attributes were recorded in 50 kg N/ha + Azospirillum + FYM 5 Vha, followed by 150 kg N/ha. Further, seed and stover yields of wheat enhanced significantly at higher levels of N and integrated use of organic and bio-fertilizers. However, the highest yield attributes were recorded at 150 kg N/ha. The uptake of total nitrogen by wheat was significantly higher at 150 kg N/ha than at 50 kg N/ha + Azospirillum + FYM 5 Vha.

048. Gupta, M.; Bali, A.S.; Sharma, B.C.; Kachroo, D.; Bharat, R. (Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha (India). Div. of Agronomy). Productivity, nutrient uptake and economics of wheat (*Triticum aestivum*) under various tillage and fertilizer management practices. *Indian Journal of Agronomy* (India). (Jun 2007) v. 52(2) p. 127-130 KEYWORDS: TILLAGE; FERTILIZER APPLICATION; WHEAT; TRITICUM AESTIVUM; NUTRIENT UPTAKE; YIELDS.

A field experiment on sandy clay-loam soil was conducted during 2003-2005 at Chatha, Jammu to study the productivity, nutrient uptake and economics of wheat (*Triticum aestivum* L. emend. Fiori & Pao!) under different (zero and conventional) tillage practices, and 3 fertility levels (75,100 and 125percent of recommended fertilizer dose) in main plots and 5 N splits (N1, 0:50:50; N2, 20:40:40; N3, 33:33:33; N4, 50:25:25; and Ns' 50:50:0) in subplots replicated thrice. Zero-tilled wheat recorded yield attributes as well as grain and straw yield similar to conventionally tilled crop. Increasing fertility level from 75 to 100percent of recommended fertilizer dose (100, 50 and 25 kg N, P and K/ ha) significantly increased the grain yield and yield-attributing characters of wheat during both the years. Further increase to 125percent of recommended fertilizer dose did not prove beneficial. Application of N in 3 splits (33:33:33, 20:40:40 and 50:25:25) recorded statistically similar but significantly higher grain and straw yields than application of N in 2 splits (0:50:50 and 50:50:0). Wheat sown under zero-tillage with 125percent recommended fertilizer dose receiving N in splits proved profitable and beneficial option than conventionally sown crop.

049. Jain, N.; Mishra, J.S. (National Research Centre for weed Science, Jabalpur (India); Kewat, M.L. (Jawahar Lal Nehru Krishi Vishwa Vidyalaya, Jabalpur (India). Dept. of Agronomy); Jain, V. (Krishi Vigyan Kendra, Bilaspur (India). Effect of tillage and herbicides on grain yield and nutrient uptake by wheat (*Triticum aestivum*) and weeds. *Indian Journal of Agronomy* (India). (Jun 2007) v. 52(2) p. 131-134 KEYWORDS: TILLAGE; HERBICIDES; TRITICUM AESTIVUM; NUTRIENT UPTAKE; WEEDS; YIELDS.

A field experiment was conducted during winter season of 2003-04 and 2004-05 on clayey soil to study the effect of different tillage practices (zero tillage, zero tillage with chemically stale seed-bed, conventional tillage and deep tillage) and herbicides (clodinafop 0.06 kg/ha followed by 2,4-D 0.5 kg/ha, isoproturon 1.0 kg/ha + 2,4-D 0.5 kg/ha and weedy check) on nutrient depletion by weeds, and the grain yield and nutrient uptake by wheat (*Triticum aestivum* L. emend. Fiori & Paol.). The depletion of N, P and K by weeds and uptake by crop were more or less the same under zero, conventional and deep tillage systems. Clodinafop 0.06 kg/ha followed by 2,4-D at 0.50 kg/ha gave 45.88-47.05 and 63.20-66.08 per cent higher grain yield than isoproturon + 2,4-D and weedy check respectively. The N, P and K uptake by wheat increased by 44.29-51.24,12.00-12.87 and 8.37-9.87 kg/ha due to application of clodinafop followed by 2,4-D, whereas isoproturon + 2,4-D increased the uptake by 10.8515.50,3.12-4.63 and 2.31-2.89 kg/ha N, P and K respectively compared with

weedy check. Maximum benefit: cost ratio was obtained with zero tillage along with application of clodinafop followed by 2,4-0.

050. Bindhani, A. (Krishi Vigyan Kendra, Bargarh (India); Barik, K.C.; Garnayak, L.M.; Mahapatra, P.K. (Orissa University of Agriculture and Technology, Bhubaneswar (India). Dept. of Agronomy). Nitrogen management in baby corn (*Zea mays*). Indian Journal of Agronomy (India). (Jun 2007) v. 52(2) p. 135-138 KEYWORDS: NITROGEN; FERTILIZERS; BABY CORN; MAIZE; ZEA MAYS.

A field experiment was conducted during the rainy season of 2002 and 2003 at Bhubaneswar, Orissa to study the effect of nitrogen levels (40, 80 and 120 kg N/ha) and timing of nitrogen application [percent basal + percent at 25 days after sowing (DAS), 1/3 basal + 2/3 at 25 DAS percent basal + percent at 25 days + percent at pre-tasselling (40 DAS) and 1/3 basal + 1/3 at 25 DAS + 1/3 at pre-tasselling] along with no-nitrogen (control) on productivity and nitrogen-use efficiency of baby corn (*Zea mays* L.). Growth, yield attributes, baby corn yield, nitrogen content and uptake, protein content and yield, net return and benefit: cost ratio increased significantly up to 120 kg N/ha. The differences between 80 and 40 kg N/ha were also significant. Nitrogen application in 3 equal splits as 1/3 basal + 1/3 at 25 DAS + 1/3 at pre-tasselling (40 DAS) resulted in significantly higher growth, yield attributes, marketable baby corn yield, green fodder yield with lowest discarded baby corn, maximizing net return, benefit: cost ratio, nitrogen content, uptake, protein content and yield than other schedules of N application. The apparent N recovery was the highest at 120 kg N/ha, whereas physiological and agronomic use efficiency progressively decreased with increasing nitrogen levels. Nitrogen applied in 3 equal splits resulted in the highest N recovery and agronomic use efficiency, while physiological efficiency of N was maximum when N was applied in 2 splits.

051. Rao, S.S.; Regar, P.L.; Jangid, B.L.; Singh, Y.V. (Central Arid Zone Research Institute, Pali-Marwar (India). Regional Research Stn.). Effect of nutrient and weed management on forage sorghum (*Sorghum bicolor*) under rainfed condition. Indian Journal of Agronomy (India). (Jun 2007) v. 52(2) p. 139-142 KEYWORDS: FERTILIZER APPLICATION; WEED CONTROL; SORGHUM; SORGHUM BICOLOR; RAINFED FARMING.

A field experiment was conducted during 2000-01 to 2003-04 at Pali-Marwar, Rajasthan to study the effect of nutrient and weed management on yield of forage sorghum [*Sorghum bicolor* (L.) Moench] under rainfed condition. The experiment was laid out in split-plot design with 3 replications. Application of 5 t FYM/ha + 50percent recommended dose of fertilizer 30 kg N and 8.75 kg P/ha significantly increased green and dry fodder yields of sorghum by 35.1 and 35.7percent over the control. This treatment also caused highest uptake of N and P by sorghum. The effect of FYM-treated plots on water-use efficiency was significantly higher over the control. Pre-emergence application of atrazine 0.5 kg/ha + 1 hoeing or interculture with peg tooth-weeder at 35 days after sowing, being on a par among themselves, caused least weed population and weed dry weight and significantly increased green and dry fodder yields of sorghum by 66-67percent. Application of 5 t FYM/ha + 50percent recommended dose of fertilizer resulted in the highest mean net return over the control. Pre-emergence application of atrazine alone or atrazine + interculture with peg tooth-weeder at 35 days after sowing gave high net returns and benefit: cost ratio.

052. Kumar, H.; Yadav, D.S. (Narendra Deva University of Agriculture and Technology, Faizabad (India). Dept. of Agronomy). Effect of phosphorus and sulphur levels on growth, yield and quality of Indian mustard (*Brassica juncea*) cultivars. *Indian Journal of Agronomy (India)*. (Jun 2007) v. 52(2) p. 154-157 KEYWORDS: PHOSPHATE; FERTILIZERS; SULPHUR FERTILIZERS; INDIAN MUSTARD; BRASSICA JUNCEA; YIELDS.

A field experiment was conducted during the two consecutive winter (rab/) seasons of 2000-01 and 2001-02 at Agronomy Research Farm of NDUAT, Faizabad to find out the optimum dose of phosphorus and sulphur for Indian mustard [*Brassica juncea* (L.) Czernj. & Cosson] cultivars. The treatment consisted of four levels of P (0, 13.1, 26.1 and 39.3 kg/ha) and four levels of sulphur (0, 15, 30 and 45 kg/ha) applied through diammonium phosphate and elemental sulphur in split-plot design replicated thrice. A significant response of crop was observed up to 26.2 kg P and 30 kg S/ha in seed and stover yields. Nutrient uptake was also highest under these treatments. The optimum dose of Sand P was computed as 47.5 and 40.2 kg, and 44.0 and 40.2 kg for the first and second years respectively. Highest net returns of Rs 12,729 and 13,734/ha were recorded with the application of 39.3 and 45 kg/ha P and S respectively. However, net returns of Rs 1.10 and 1.18/ha/Re invested were highest at 26.2 and 30 kg P and S respectively. 'NDR 8501' recorded the highest seed yield of 2.01 and 2.00 t/ha, and stover yield of 6.03 and 5.90 t/ha during 2000-01 and 2001-02 respectively, followed by 'Varuna'.

053. Singh, S.; Singh, V. (Dr. B.R. Ambedkar University, Bichpuri (India). Effect of sources and levels of sulphur on yield, quality and nutrient uptake by linseed (*Linum usitatissimum*). *Indian Journal of Agronomy (India)*. (Jun 2007) v. 52(2) p. 158-159 KEYWORDS: SULPHUR FERTILIZERS; LINSEED; LINUM USITATISSIMUM; NUTRIENT UPTAKE; YIELDS.

A field experiment was conducted during 2001-02 and 2002-03 at Bichpuri, Agra, to assess the effect of sources and levels of sulphur on productivity, sulphur content and uptake of nutrients (NPS) by linseed (*Linum usitatissimum* L.). Each successive increase in the level of sulphur up to 60 kg/ha significantly increased seed yield, oil yield and content of S as well as total uptake of N, P and S by the crop. Among sources of sulphur, gypsum proved significantly superior to other sources for seed and oil yields and uptake of nutrients. Linseed fertilized with 60 kg S/ha through gypsum was found most profitable. Sulphur-use efficiency was the highest when lowest level of S was applied.

054. Sharma, D.K.; Rana, D.S.; Joshi, H.C. (Indian Agricultural Research Institute, New Delhi (India). Div. of Environmental Sciences). Evaluation of sugarcane (*Saccharum officinarum*)-based industrial waste and litter fall of jatropha (*Jatropha curcas*) for nutrient management in oleiferous rocket salad (*Eruca sativa*). *Indian Journal of Agronomy (India)*. (Jun 2007) v. 52(2) p. 160-163 KEYWORDS: INDUSTRIAL WASTE; SUGARCANE; SACCHARUM OFFICINARUM; PLANT LITTER; JATROPHA CURCAS; NUTRIENTS; SALADS; ERUCA SATIVA.

A field study conducted for 2 years (2003-05) on sandy-loam soil at New Delhi showed that seed yield (1.80 t/ha) of oleiferous rocket salad (*Eruca sativa* Mill.) obtained with distillery pressmud-distillery effluent compost 5 t/ha + half the recommended dose of NPKS (60 kg N, 13.1 kg P, 25.0 kg K and 20 kg S/ha) was on a par with the seed yield (1.69 t/ha) recorded with the recommended dose of NPKS. The seed yield recorded with former treatment was significantly superior to that with flyash-distillery effluent mixture (1:1) 5 t/ha + half the recommended dose of NPKS by 30.4 percent and litter-fall of jatropha (*Jatropha curcas*) 5 t/ha + half the recommended dose of NPKS by 24.1 percent. On an average,

pressmud-distillery effluent compost 5 t/ha + half the recommended dose of NPKS recorded perceptible increase in the available NPK status of the soil recorded after oleiferous rocket salad harvest compared with the initial fertility status. Available nutrient status of this treatment was also higher when compared with the recommended dose of NPKS and other treatments. Application of pressmud-distillery effluent compost 5t/ha alone recorded significantly higher seed yield and residual fertility after oleiferous rocket salad harvest when compared with flyash effluent mixture and jatropa litter-fall applied at the same rate.

055. Shukla, S.K. (Indian Institute of Sugarcane Research, Lucknow (India). Productivity and economics of high sugar genotypes of sugarcane (*Saccharum officinarum* hybrid complex) in plant ratoon system under various planting seasons and fertility levels. *Indian Journal of Agronomy* (India). (Jun 2007) v. 52(2) p. 164-167 KEYWORDS: SUGARCANE; SACCHARUM OFFICINARUM; HYBRIDS; RATOONING; PLANTING DATE; FERTILIZER APPLICATION.

A field experiment was conducted during cropping seasons of 2002-03 and 2003-04 at Lucknow, to evaluate 3 sugarcane genotypes ('CoLk 9411', 'CoLk 9412' and 'CoLk 94184') under 3 levels of N, P and K (150, 19.6,37.4; 200, 26.2, 49.8; and 250, 32.8, 62.2 kg/ha) in 2 seasons (spring and summer) with plant-ratoon system. Genotype 'CoLk 94184' recorded the highest cane yield and commercial cane sugar (CCS) across the seasons as well as plant and ratoon crops. Genotype 'CoLk 94184' showed the highest brix (21.21) and pol (18.49percent) reading at 10month stage in spring-planted cane. Individual cane length and cane weight increased significantly up to 200, 26.2 and 49.8 kg N, P and K/ha. Ratoon of the genotype, 'CoLk 94184' produced the highest number of millable canes (133,900/ha), cane length (186.8 cm), cane yield (70.46 t/ha) and CCS (9.39 t/ha). The plant-ratoon system indicated that genotype 'CoLk 94184' gave the maximum net returns (Rs 98,558/ha) and benefit: cost ratio (2.99) in the spring-planted cane. Genotype CoLk 94184 gave better yield, sucrose and net profit, hence could be adopted in the region for optimizing sugar productivity and regulating crushing schedule at factory level. Fertility level of 200, 26.2 and 49.8 kg N, P and K/ha was optimum for growth and cane yield during spring as well as summer planting.

056. Shukla, S.K.; Lal, M. (Indian Institute of Sugarcane Research, Lucknow (India). Growth, quality and economics of plant and ratoon sugarcane (*Saccharum* spp. hybrid complex) as influenced by doses and sources of sulphur. *Indian Journal of Agronomy* (India). (Jun 2007) v. 52(2) p. 168-171 KEYWORDS: SUGARCANE; SACCHARUM OFFICINARUM; HYBRIDS; RATOONING; SULPHUR; FERTILIZERS.

A field-experiment was conducted during 2001-02 and 2002-03 at Lucknow with 3 S doses (40, 60 and 80 kg S/ha) and 3 sources (elemental S, gypsum and single superphosphate) for improving yield and quality of sugar-cane. Significant improvement in cane diameter (2.51 cm) and individual cane weight (1,100 g) was observed at 60 kg S/ha. This registered an increase of 9.87percent in cane yield and 8.77percent in commercial cane sugar over 40 kg S/ha. Pol percent in juice increased significantly when S dose increased from 40 to 60 kg/ha. Application of elemental sulphur resulted in significantly higher cane yield (83.5 t/ha) as well as commercial cane sugar (CCS 9.96 t/ha) over other sources. In plant-ratoon system, by taking 1 plant and 1 ratoon crop in account, maximum net return (Rs 111,032/ha) and benefit: cost ratio (3.18) were obtained at 80 kg S/ha.

057. Mehriya, M.L.; Yadav, R.S.; Jangir, R.P.; Poonia, B.L. (Rajasthan Agricultural University, Jodhpur (India). Agricultural Res. Stn.). Nutrient utilization by cumin (*Cuminum cyminum*) and weeds as influenced by different weed control methods. *Indian Journal of Agronomy (India)*. (Jun 2007) v. 52(2) p. 176-179 KEYWORDS: CUMIN; CUMINUM CYMINUM; WEEDS; WEED CONTROL; NUTRIENT UPTAKE.

A field study was conducted during the winter season of 2003-04 and 2004-05 at Mandor, Jodhpur with 15 weed-management treatments, to study the nutrient uptake by cumin (*Cuminum cyminum* L.) and depletion by associated weeds. Amongst the weed-management treatments, oxyfluorfen and oxadiargyl at 50 g/ha applied 20 days after sowing (DAS) along with 1 hand-weeding 35 DAS caused maximum reduction in weed biomass production and nutrient depletion by weeds 90 DAS and resulted in higher weed-control efficiency. These treatments also enhanced cumin yield, essential oil content in the seed and uptake of N, P and K by the crop and net monetary returns. Weeds in check plots cornered 93.5 kg N, 14.5 kg P and 142.6 kg K/ha recorded 90 DAS, which was significantly higher than in other treatments. Paraquat and glyphosate applied 7 DAS failed to check depletion of nutrients by weeds significantly. Application of oxadiargyl 50 g/ha applied 20 DAS was found better than its application 7 DAS. Early post-emergence application of oxyfluorfen and oxadiargyl 50 g/ha followed by 1 hand-weeding computed considerably higher net returns (Rs 25,595 and 24,823/ha respectively) and benefit: cost ratio (2.92 and 2.80), and lower nutrient uptake compared to other integrated weed-control treatments.

058. Savithramma, N. (Sri Venkateshwara University, Tirupati (India). Dept. of Botany); Fareeda, G. (Sri Venkateswara University, Tirupati (India). Dept. of Biochemistry); Madhavi, V. (Sri Venkateswara University, Tirupati (India). Dept. of Botany). Effect of calcium on lipids of green leafy vegetables. *Indian Journal of Plant Physiology (India)*. (Jul-Sep 2007) v. 12(3) p. 282-286 KEYWORDS: LEAF VEGETABLES; CALCIUM FERTILIZERS; LIPIDS.

The present investigation was carried out to study the effect of calcium on the lipids and lipid peroxidation of the green leafy vegetables like *Amaranthus tricolor* L., *Rumex vesicarius* L. and *Spinacea oleracea* L. The green leafy vegetables were grown in earthen pots and different concentrations of CaCl₂ (10, 50 and 100 mM) were applied to the soil (in the form of ionic solution). It was observed that application of 50 mM CaCl₂ resulted in higher levels of calcium (Ca²⁺), calmodulin (CaM), total lipids, glycolipids and phospholipids in the leaves of the three species. 50 mM CaCl₂ treatment was found to be very effective in controlling lipid peroxidation compared to 10 and 100 mM CaCl₂ treatments. *Amaranthus* responded effectively to 50 mM amended CaCl₂ compared to the other two species of GLVs.

059. Mao, A.A. (Botanical Survey of India, Shilong (India); Wetten, A. (The University of Reading, Reading (United Kingdom). Dept. of Agricultural Botany); Fay, M.F. (The Royal Botanic Gardens, Surrey (United Kingdom); Caligari, P.D.S. (The University of Reading, Reading (United Kingdom). Dept. of Agricultural Botany). Effect of nitrogen source on growth and morphogenesis in three micropropagated *Nepenthes* spp. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2007) v. 12(4) p. 317-321 KEYWORDS: NEPENTHACEAE; MICROPAGATION; NITROGEN FERTILIZING.

The effect of the two main nitrogen sources, i.e. NH₄(NO₃) and Ca(NO₃)₂, in Woody Plant Medium (WPM) on three micropropagated *Nepenthes* spp. Showed differences among three species in percentage nitrogen content in dried leaf, shoot production, shoot length and fresh plant weight. Higher number of shoots and longer shoot length were observed on

treatment with a single nitrogen source rather than a combination of the two sources. The three species showed higher uptake of nitrogen from nutrient with single source $\text{Ca}(\text{NO}_3)_2$, but in general produced lower fresh weights on treatment with higher $\text{Ca}(\text{NO}_3)_2$. Abnormality in leaf morphology was observed in *N. khasiana* and *N. pervillei* on the treatments with a single nitrogen source. The study concludes that a combination of two nitrogen sources are required rather than a single source for normal growth of the *Nepenthes* sp.

060. Paul, M.; Joshi, H.C. (Indian Agricultural Research Institute, New Delhi (India). Div. of Environmental Sciences); Sairam, R.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology). Germination behaviour and physiological response of rice to paper mill effluent application. *Indian Journal of Plant Physiology* (India). (Oct-Dec 2007) v. 12(4) p. 388-392 KEYWORDS: RICE; *ORYZA SATIVA*; GERMINATION; PULP AND PAPER INDUSTRY; WASTEWATER.

A study was conducted to examine the effect of different levels of paper mill effluent on rice var. Pusa Basmati-I (PB-I) at the germination stage. The effluent at higher concentration showed limited inhibitory effect on the germination percentage. The shoot and root length increased on application of effluent at 25 and 50 percent concentration but higher concentrations of effluent, i.e. 75 and 100 percent effluent, retarded the root and shoot length of the seedlings. RWC and MSI decreased with increase in the effluent concentration but the total sugar content increased significantly with the increase in effluent concentration. Hydrogen peroxide content increased in the seedlings under higher concentration of effluent with a corresponding increase in lipid peroxidation. At higher concentration of paper mill effluents, activity of antioxidant enzyme system, viz. superoxide dismutase (SOD), catalase and peroxidase increased significantly over the control. Thus salinity stress created by the paper mill effluent was found to be significantly higher at 75 and 100 percent paper mill effluent concentration.

F06 Irrigation

061. 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). Response of potato to irrigation and nutrition on a Mollisol under cool weather Tarai region of northern India. *Pantnagar Journal of Research* (India). (Jul-Dec 2007) 5(2) p. 114-119 KEYWORDS: TRACE ELEMENTS; INDIA; COLD ZONES; POTATOES; IRRIGATION; NUTRIENTS; SOIL CHEMICO-PHYSICAL PROPERTIES.

Field experiments were conducted during winter season of 2003-2004 and 2004-2005 to study the response of potato to irrigation and nutrition. The response of irrigation and nutrition on shoot number, leaf number, shoot length, tuber number hill-1 and tuber yield was found significant. Irrigation given at 30 and 50 days after planting (DAP) along with application of $\text{N200 P100 K100 Cu20 Mn20 Zn25 B5 kg ha}^{-1}$ significantly increased shoot and leaf numbers, shoot length and tuber yield of potato as compared to control. Tuber yield of potato had positive and significant correlation with shoot and leaf numbers hill-1, shoot length and tuber number hill-1. Highest positive and significant correlation was observed between shoot number hill-1 and tuber yield of potato.

062. Singh, P.K.; Singh, K.K.; Sharma, H.C. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Irrigation and Drainage Engineering). Water requirement of mango crop under drip irrigation in different mango growing belts of Uttarakhand. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 131-134
KEYWORDS: WATER REQUIREMENTS; MANGOES; TRICKLE IRRIGATION; UTTARAKHAND; EVAPORANSPIRATION; SEASONAL VARIATION.

Two representative stations namely Dehradun and Pantnagar, lying in two main mango-growing belts, were selected for the estimation of reference evapotranspiration under per-humid and moist sub-humid, agro-climatic regions of Uttarakhand. FAO Penman-Monteith model was used for the estimation of reference evapotranspiration on weekly meteorological data of ten years. The estimated reference evapotranspiration values were further used for the determination of water requirement of different age groups of mango crop under drip irrigation. The weekly average value of water requirement of mango crop under drip irrigation varied from 2.11 litre/day/plant to 139 litre/day/plant in per-humid and 2.45 to 197 litre/day/plant in sub humid climatic conditions of Uttarakhand. On an average, it was found that average annual value of water requirement varied from 2.11 to 197 litre/day/plant. It was also found that the water requirement of mango crop increases with the increase in the age of mango tree and becomes constant when the full canopy has been developed at the age of about 30 to 35 years of mango trees.

063. Dhandare, K.M.; Singh, K.K.; Singh, P.K.; Singh, M.P.; Bayissa, Gonfa (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Irrigation and Drainage Engineering). Response of capsicum (*Capsicum annum* L.) under cyclic irrigation in polyhouse condition. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 135-138
KEYWORDS: ENVIRONMENTAL CONTROL; GREENHOUSES; CAPSICUM ANNUUM; TRICKLE IRRIGATION; VENTILATION.

A field experiment was conducted at experimental field of Department of Irrigation and Drainage Engineering to study the response of cyclic irrigation on biometric and yield parameter of capsicum (*Capsicum annum* L.) in environmental controlled and naturally ventilated polyhouse. The treatment consists of two irrigation levels (100 per cent of water requirement and 75 per cent of water requirement) and three cycles' level (One cycle per day, three cycles per day and six cycles per day). The results revealed that the plant height, number of primary branches, number of secondary branches and canopy perimeter was higher in environmental controlled polyhouse than naturally ventilated polyhouse, also the yield and yield attributes was higher in environmental controlled polyhouse than naturally ventilated polyhouse. The irrigation treatment with three cycles per day performed better than six cycles and one cycle in both the polyhouses. The water use efficiency was high in treatment of three cycles per day with combination of 75 per cent of water requirement in both polyhouse. The cyclic irrigation increased the water-use efficiency.

064. Singh, K.; Malik, R.K.; Yadav, S.K.; Yadav, A.; Singh, S.; Sangwan, N. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy). Effect of irrigation and chlorsulfuron applied in wheat on germination and residual toxicity of succeeding crops. Annals of Biology (India). (Jun 2007) v. 23(1) p. 23-27
KEYWORDS: IRRIGATION; CHLORSULFURON; GERMINATION; RESIDUAL EFFECTS; PHYTOTOXICITY; SEQUENTIAL CROPPING; WEED CONTROL; WEEDS.

To evaluate the residual effect of irrigation and chlorsulfuron applied in wheat on succeeding crops, a field experiment was conducted during rabi and kharif seasons of 1999 and 2000 at Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar, India. Irrigation levels had no significant effect on germination as well as there was no residual phytotoxicity on cotton, rice and moongbean; however, these were higher in maize, sorghum and pearl millet under five irrigation levels. Chlorsulfuron had no effect on germination of cotton, moongbean and rice and also there was no residual phytotoxicity on rice crop. But the germination of maize, sorghum and pearl millet was significantly decreased due to chlorsulfuron at 45 and 60 q/ha applied in wheat and also there was residual toxicity on cotton and moongbean at these doses. Residual phytotoxicity on maize, sorghum and pearl millet was recorded even at lower levels of chlorsulfuron i. e. at 20 and 30 g/ha.

065. Bhise, P.M.; Challa, O.; Venugopalan, M.V. (National Bureau of Soil Survey and Land Use Planning, Nagpur (India). Div. of Land Use Planning). Effect of waste water irrigation on soil properties under different land use systems. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 254-258 KEYWORDS: IRRIGATION; SOIL CHEMICOPHYSICAL PROPERTIES; WASTE WATER; SOIL MORPHOLOGICAL FEATURES; LAND USE; SOIL ANALYSIS.

Soil properties under five land use systems viz. soybean-gram, sugarcane-paddy, paddy-wheat, vegetables and agri-horticulture, irrigated with waste water from Nag river for past 20 years were compared with unirrigated soils (control) under pigeonpea system. The soils were characterized and analyzed for morphological, physical and chemical properties, available micronutrients and heavy metals. The composition of waste water used for irrigation was also analysed. All the soils were very deep, clayey (with high moisture holding capacity), calcareous and alkaline (pH 7.9-8.5). The morphological properties of soils - colour, structure and consistence and physical properties - texture and bulk density were not altered by irrigation with waste water under different land use systems compared to unirrigated control. Irrigation using waste water improved the availability of Ca, Mg, K, Zn, Cu, Mn and Fe under all the land use systems besides improving the soil organic carbon content in soybean-gram, vegetables and sugarcane-paddy systems. Continuous irrigation using waste water had an adverse effect on EC, ESP, soluble cation (Na/K and Na/Mg) ratios and heavy metal (Pb, Cd, Co and Ni) content.

066. Sadangi, P.K. (Orissa University of Agriculture and Technology, Bhubaneswar (India). Dept. of Agronomy); Barik, K.C. (Krishi Vigyan Kendra, Bargarh (India)). Effect of weed management practices on nutrient depletion by weeds, yield and economics of winter irrigated cotton (*Gossypium hirsutum*). *Indian Journal of Agronomy (India)*. (Jun 2007) v. 52(2) p. 172-175 KEYWORDS: COTTON; GOSSYPIUM HIRSUTUM; YIELDS; IRRIGATION; WEED CONTROL.

A field experiment was conducted on sandy-loam soils during winter seasons of 2001-02 and 2002-03 at Bhubaneswar, to explore effective weed management in irrigated cotton. *Eleusine indica* L., *Dactyloctenium aegyptium* (L.) Beauv., *Digitaria sanguinalis* L., *Cynodon dactylon* L. Pers., *Cyperus rotundus* L., *Cyperus iria* L., *Ageratum conyzoides* L., *Heliotropium indicum* L. and *Gnaphalium indicum* L. were the major weed flora in the unweeded control plot. Post-emergence directed spray of paraquat dichloride 0.2 kg/ha at 30 days after sowing with follow up hand-weeding at 60 days after sowing recorded the lowest weed population, maximum weed-control efficiency, highest plant height, leaf-area index, number

of sympodia, bolls/plant and boll weight, and significantly increased seed-cotton yield, net return, benefit: cost ratio with maximum NPK uptake compared to other weed control and unweeded control due to lesser weed competition. It was followed by pre-emergence'spray of alachlor 1.0 kg/ha at 3 days after sowing with a hand-weeding at 40 days after sowing, Weeds if not controlled within 60 days after sowing, could deplete NPK to the extent of 87.1, 17.9 and 61.7 kg/ha at 90 days after sowing.

F07 Soil Cultivation

067. Singh, Shailendra; Singh, Govindra (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Agronomy). Evaluation of different methods of establishment in wheat (*Triticum aestivum*) after different methods of rice (*Oryza sativa*) establishment. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 36-40
KEYWORDS: ZERO TILLAGE; WHEATS; RICE; CROPPING SYSTEMS; SOIL CHEMICOPHYSICAL PROPERTIES.

Zero tilled wheat (ZTW) had definite advantage (10-15 days) of early crop establishment resulting into higher yield (2.5 per cent) than conventionally tilled wheat (CTW) after direct seeded rice (DSR) because of its early maturity, which facilitated timely planting of wheat. It also saved water during first irrigation (ZTW-322560 liters ha⁻¹ as compared to CTW-381120 liters ha⁻¹), due to reduced infiltration rate (1.09 mm h⁻¹) with higher bulk density (1.52 Mg m⁻³ and 1.68 Mg m⁻³ in 0-7.5 cm and 12-19 cm, respectively) in ZT as compared CT with higher infiltration rate (2.39 mm h⁻¹) with lower bulk density (1.46 Mg m⁻³, 1.66 Mg m⁻³ in 0-7.5 cm and 12-19 cm, respectively).

068. Phogat, S.B.; Solanki, Y.P.S.; Sangwan, N.; Dahiya, I.S. (Chaudhary Charan Singh Haryana Agricultural University, Rohtak (India). Res. Stn.). Comparison of zero tillage and conventional methods of wheat sowing under critical (0-1.5 m), moderate 1.5-3.0 m) and safe (3.0 m) water table depths. Annals of Biology (India). (Jun 2007) v. 23(1) p. 41-44
KEYWORDS: ZERO TILLAGE; DEPTH; WHEATS; SOWING DEPTH; GROUND WATER TABLE; CONVENTIONAL TILLAGE; YIELDS; YIELD COMPONENTS; WATER LOGGING.

From the field trials conducted at different locations during 2001-03 on the comparison of zero-till and conventional method of sowing on wheat crop under critical, moderate and safe water table depth revealed that yield and growth attributes (germination, plant height, tillering, ear length, grains per ear, 1 000-grain weight and grain yield) were better under zero-tillage sowing practice than under conventional practice. The values of seven attributes under zero-tillage were, respectively, 19.0,4.2, 14.7,3.2, 12.2,6.7 and 6.0 percent higher than those under conventional practices.

F08 Cropping Patterns and Systems

069. Singh, D. (Project Directorate for Cropping Systems Research, Modipuram (India); Kumar, D. (Central Potato Research Institute, Modipuram (India); Pandey, R. (Project Directorate for Cropping Systems Research, Modipuram (India); Malik, K. (Central Potato Research Institute, Modipuram (India); Kumar, V. (Project Directorate for Cropping Systems Research, Modipuram (India) . Inclusion of potato for intensification of cotton-wheat cropping system in northwestern plains: a physiological study. Indian Journal of Plant Physiology (India). (Jul-Sep 2007) v. 12(3) p. 298-300
KEYWORDS: POTATOES; SOLANUM

TUBERASUM; INTENSIFICATION; COTTON; GOSSYPIMUM; WHEAT; TRITICUM AESTIVUM; MIXED CROPPING.

A Field experiment was conducted during 2005-06 to test the suitability and adaptability of cotton, potato and wheat genotypes for cotton based system. Highest seed-cotton yield was recorded in LHH 144 (2.3-2.6 t ha⁻¹) followed by Ankur 651 (2.2 t ha⁻¹) and lowest in CNH 36 (1.9 t ha⁻¹). This was associated with boll weight, which was significantly higher in LHH 144. Among potato genotypes, Kufri Pukhraj had significantly higher tuber yield and total biomass productivity than Kufri Surya, largely due to higher LAI in Kufri Pukhraj. However, tuber dry matter (percent) and photosynthesis rate were invariably higher in Kufri Surya - 19 percent and 20.6 J.1mol CO₂ m⁻² s⁻¹, respectively) than in Kufri Pukhraj (- 16 percent and 19.4 J.1mol CO₂ m⁻² s⁻¹). In wheat, grain yield was significantly reduced in PBW 343 (13 percent) under late sowing (40 days) after the harvest of potato as compared with the normal sowing. This was mainly due to reduction in biomass and leaf area. The results indicate that early maturing cotton genotypes (Ankur 651 and LHH 144) and potato genotypes (Kufri Pukhraj and Kufri Surya) could provide opportunities for the intensification of cotton-wheat system by inclusion of potato in northwestern plains in system mode.

F30 Plant Genetics and Breeding

070. Kumar, A.; Tripathi, V.; Pushapangadan, P. (National Botanical Research Institute, Lucknow (India). Plant Genomics Laboratory, Molecular Biology and Genetic Engineering Div.). DNA marker - based genetic variation in *Cassia fistula* L.. Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 173-176 KEYWORDS: CASSIA FISTULA; RAPD; GENETIC VARIATION; GENETIC MARKERS; DNA; IDENTIFICATION; PCR.

071. Mondal, S.; Badigannavar, A.M.; Kale, D.M.; Murty, G.S.S. (Bhabha Atomic Research Centre, Mumbai (India). Nuclear Agriculture and Biotechnology Div.). An induced dominant seed coat colour mutation in groundnut. Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 177-179 KEYWORDS: MUTATION; INDUCED MUTATION; ARACHIS HYPOGAEA; TESTA; SEED PELLETING; PIGMENTATION; GROUNDNUTS; MUTANTS.

072. Singh, B. (Orissa University of Agriculture and Technology, Bhubaneswar (India). Dept. of Plant Breeding and Genetics). Induced leaf and inflorescence mutations in *Vigna radiata* (L.) Wilczek. Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 180-182 KEYWORDS: MUTATION; VIGNA RADIATA; LEAVES; INDUCED MUTATIONS; INFLORESCENCES; MUTANTS; VARIETIES.

073. Kumar, S.; Srivastava, S.B.L. (Chander Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Genetics and Plant Breeding). Heterosis and combining ability for yield related traits and protein content in lentil (*Lens culinaris* Medik.). Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 190-192 KEYWORDS: COMBINING ABILITY; LENTILS; PROTEIN CONTENT; GENETIC VARIANCE; YIELDS; YIELD COMPONENTS; HETEROSIS; LENS CULINARIS.

074. Singh, J.; Garg, D.K. (Rajasthan Agricultural University, Bikaner (India). Dept. of Plant Breeding and Genetics); Raje, R.S. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). Combining ability and gene action for grain yield and its components

under high temperature environment in bread wheat [*Triticum aestivum* (L.) Lem. Thell]. Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 193-195
KEYWORDS: COMBINING ABILITY; TRITICUM AESTIVUM; GENOTYPES; GENETIC INTERACTION; IDENTIFICATION; GENOTYPE ENVIRONMENT INTERACTION; HEAT; YIELDS; YIELD COMPONENTS; GENETIC VARIATION.

075. Ghosh, M.K.; Chowdhuri, S.R.; Nath, S.; Ghosh, P.K.; Debnath, P.K.; Roy, I.; Ghosh, P.L. (Central Sericultural Research and Training Institute, Berhampore (India). Harvest index and biological yield as selection criteria for mulberry (*Morus* spp.). Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 196-197
KEYWORDS: SELECTION CRITERIA; YIELDS; HARVEST INDEX; GENOTYPES; BIOLOGICAL PRODUCTION; MULBERRIES; MORUS; GENETIC VARIATION.

076. Rajkumar; Fakrudin, B.; Kuruvina Shetti, M.S. (University of Agricultural Sciences, Dharwad (India). Institute of Agri-Biotechnology). Variability and correlation studies for charcoal rot (stalk rot) and yield components in recombinant inbred lines of sorghum. Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 198-199
KEYWORDS: SORGHUM; GENETIC CORRELATION; GENETIC VARIABILITY; RECOMBINATION; INBRED LINES; PLANT DISEASE; GENOTYPES; YIELD COMPONENTS; MACROPHOMINA; PHENOTYPES.

077. Devi, B.; Barua, N.S.; Barua, P.K.; Talukdar, P. (Assam Agricultural University, Jorhat (India). Dept. of Plant Breeding and Genetics). Analysis of midparent heterosis in a variety diallel in rainfed maize. Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 200-202
KEYWORDS: DIALLEL ANALYSIS; RAINFED FARMING; MAIZE; HETEROSIS; VARIETIES; GENETIC VARIATION; COMBINING ABILITY.

078. Suthamathi, P.; Geetha, K.; Sumathi, P. (Tamil Nadu Agricultural University, Paiyur (India). Regional Research Stn.). Combining ability studies on quality characters in Cumbu napier hybrids. Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 203-205
KEYWORDS: COMBINING ABILITY; GENOTYPES; PEARLMILLET; PENNISETUM GLAUCUM; PENNISETUM PURPUREUM; HYBRIDS; QUALITATIVE ANALYSIS.

079. Maloo, S.R.; Sharma, S.C. (Maharana Pratap University of Agriculture and Technology, Udaipur (India). Dept. of Plant Breeding and Genetics). Combining ability for oil and protein content in soybean [*Glycine max* (L.) Merrill]. Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 206-208
KEYWORDS: COMBINING ABILITY; SOYABEANS; LIPID CONTENT; GENETIC VARIATION; GENOTYPES; GLYCINE MAX; PROTEIN CONTENT.

080. Bandyopadhyay, B.B.; Mishra, A.C.; Negi, Y.K.; Srivastava, R.K.; Kumar, J. (Govind Ballabh Pant University of Agriculture and Technology, Ranichauri (India). Hill Campus). Genetic variation in seed proteins of improved cultivars and local land races of finger millet from Garhwal Himalayas. Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 209-210
KEYWORDS: GENETIC VARIATION; VARIETIES; ELEUSINE CORACANA; LAND RACES; FINGER MILLET; HIMALAYAN REGIONS; GENOTYPES; PROTEIN CONTENT.

081. Nehvi, F.A.; Wani, S.A.; Dar, Z.A. (Sher-e-Kashmir University of Agricultural Sciences and Technology of Karhmir, Kashmir (India). K.D. Research Stn.). Triple test cross analysis of

forage yield components in oats (*Avena sativa* L.). *Indian Journal of Genetics and Plant Breeding* (India). (May 2007) v. 67(2) p. 211-212 KEYWORDS: HYBRIDIZATION; AVENA SATIVA; GENOTYPES; OATS; GENETIC VARIATION; STATISTICAL METHODS; GENETIC ENVIRONMENT INTERACTION; YIELD COMPONENTS; VARIETIES; GENE INTERACTION.

082. Abraham, M. (College of Agriculture, Thiruvananthapuram (India). Dept. of Plant Breeding and Genetics); Mathew, J. (Kerala Agricultural University, Thrissur (India). Cashew Research Stn.). Genetic divergence in cashew (*Anacardium occidentale* L.). *Indian Journal of Genetics and Plant Breeding* (India). (May 2007) v. 67(2) p. 213-214 KEYWORDS: GENETIC DISTANCE; ANACARDIUM OCCIDENTALE; CASHEWS; SELECTION; IDENTIFICATION; HYBRIDS; GENETIC VARIATION.

083. Singh, J.; Garg, D.K. (Rajasthan Agricultural University, Bikaner (India). Dept. of Plant Breeding and Genetics); Raje, R.S. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). Heterosis for yield and associated traits in bread wheat [*Triticum aestivum* (L.) em. Thell.]. *Indian Journal of Genetics and Plant Breeding* (India). (May 2007) v. 67(2) p. 215-216 KEYWORDS: HETEROSIS; SOFT WHEAT; TRITICUM AESTIVUM; GENETIC DISTANCE; GENOTYPES; DIALLEL ANALYSIS; YIELD COMPONENTS; GENETIC VARIATION.

084. Madheshia, S.K.; Pandey, I.D.; Mani, S.C.; Bajpai, G.C. (G.B. Pant University of Agriculture and Technology (India). Department of Genetics and Plant Breeding). Characterization of cowpea [*Vigna unguiculata* (L.) Walp.] genotypes using protein markers. *Pantnagar Journal of Research* (India). (Jun-Dec 2007) 5(2) p. 62-64 KEYWORDS: ELECTROPHORESIS; PROTEIN CONTENT; COWPEAS; GENOTYPES; GERMPLASM; VIGNA UNGUICULATA.

085. Singh, Arti; Pandey, M.P. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Genetics and Plant Breeding). Evaluation of NILs and pyramiding bacterial leaf blight and blast resistance genes into an elite cultivar of indica rice (*Oryza sativa* L.) through marker assisted selection. *Pantnagar Journal of Research* (India). (Jun-Dec 2007) 5(2) p. 65-69 KEYWORDS: BACTERIOSES; BLIGHT; DISEASE RESISTANCE; LEAVES; XANTHOMONAS ORYZAE; PYRICULARIA ORYZAE; RICE; SELECTION; ORYZA SATIVA.

NILs were screened for bacterial leaf blight (BB) (*Xanthomonas oryzae* pv *oryzae*) and blast (BL) (*Pyricularia oryzae*) diseases of rice. The results revealed NILs, IRBB-52 and C101A51 to be good donors in the gene pyramiding programme. The banding pattern of parental lines and BC1F2 progenies of cross IRBB52/C101 A51//Pant Sugandh Dhan-17 after PCR amplification with STS primers revealed the homozygosity of Xa 4, Xa 21 and Pi-2 by marker alleles in seven, six and eight progenies. Two progenies viz., PSD 17 BC1F 2-672 and PSD 17 BC1F 2-701 revealed two gene pyramids Xa4 + Pi-2 and Xa21 + Pi-2, respectively. The results of BC1F2 plants explicitly show the wider and higher level of resistance exhibited by Xa 21 gene.

086. Narayan, Ashish; Shrotria, P.K. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Genetics and Plant Breeding). Genetic divergence over environments in sorghum [*Sorghum bicolor* (L.) Moench]. *Pantnagar Journal of Research* (India). (Jun-Dec 2007) 5(2) p. 70-74 KEYWORDS: SORGHUM; GENETIC DISTANCE; GENOTYPE ENVIRONMENT INTERACTION; SORGHUM BICOLOR; GENOTYPES.

Twenty-four sorghum genotypes were studied in three environments, viz., early sowing (E1), timely sowing (E2) and late sowing (E3), to know the influence of Genotype x Environment (G x E) interaction over genetic diversity. Considerable genetic diversity was recorded in the material. The environment influenced clustering pattern of the genotypes. The mean values for different traits varied from environment to environment, which indicated the impact of different environments on the gene expression and ultimate effect on phenotypic expression for producing diversity among the genotypes. The intra and inter cluster distances also varied in magnitude with different environments. Average was higher in E1 (early sown) and E2 (timely sown) as compared to E3 (late sown) environment. Some genotypes were found to be occupying consistently the same cluster in two different environments indicating their stability. It is revealed that for better understanding of genetic diversity present among the genotypes, they should be tested in variable environments.

087. Sachan, J.N.; Singh, Dharendra; Singh, A.K.; Singh, S.P.; Pant, D.P. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Genetics and Plant Breeding). Inheritance of flower colour in Brassica rapa var. yellow sarson. Pantnagar Journal of Research (India). (Jun-Dec 2007) 5(2) p. 75-76 KEYWORDS: BRASSICA CAMPESTRIS; FLOWERS; PLANT MORPHOLOGY; BREEDING METHODS; ERUCIC ACID; SELECTION.

088. Narayan, Ashish; Verma, Sitar Singh (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Genetics and Plant Breeding). Phenotypic stability for yield and other characters in quality protein maize (*Zea mays* L.). Pantnagar Journal of Research (India). (Jun-Dec 2007) 5(2) p. 77-81 KEYWORDS: GENOTYPE ENVIRONMENT INTERACTION; PHENOTYPES; STABILITY; PROTEIN QUALITY; MAIZE; ZEA MAYS.

The main objective of any maize breeding programme is to develop high yielding varieties/hybrids with better degree of stability over a wide range of environments. A set of ten quality protein maize (QPM) parental lines with their forty-five single crosses and two standard checks were evaluated in three different environments, viz., Pantnagar (E1), Gorakhpur (E2) and Kashipur (E3) in order to examine their yield stability across changing environmental conditions. Results indicated significant G x E interaction mean squares for all the traits suggesting impact of variable environments on the performance of the genotypes. Crosses having desired stability for grain yield may be released as hybrids.

089. Sachan, J.N.; Singh, Basudeo; Singh, S.P.; Pant, D.P.; Singh, Dharendra; Singh, A.K. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Genetics and Plant Breeding). PRQ 2005-1 (INGR No. 06013) as a source of low erucic acid with yellow seed in Indian mustard [*Brassica juncea* (L.) Czern & Coss]. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 82-84 KEYWORDS: BRASSICA JUNCEA; ERUCIC ACID; PLANT OILS; HIGH YIELDING VARIETIES; OIL CROPS.

090. Saxena, Payal; Rawat, R.S.; Verma, R.S.; Meena, B.K. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Genetics and Plant Breeding). Variability and association analysis for yield and quality traits in wheat. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 85-92 KEYWORDS: GENETIC GAIN; GENETIC DIVERGENCE; GENETIC CORRELATION; YIELD COMPONENTS; WHEATS; STATISTICAL METHODS.

Analysis of variance revealed highly significant genetic differences among the genotypes for all the characters under study. The GCV, PCV were estimated as high in comparison to ECV, which indicated that variability was influenced by the environment. High heritability (75 per cent) was estimated for biological yield per plant, grain yield per plant, harvest index, plant height, number of grains per ear, tillers per plant, 1000-kernel weight, days to maturity and protein content and it was moderate (50 to 75) for total number of spikelets per ear, wet gluten and days to heading and low heritable character observed as spike length and zeleny. Genetic advance was also highest for the character biological yield per plant. Low genetic advance was shown by zeleny, days to maturity, wet gluten, days to heading, total number of spikelets per ear, spike length and protein content. Biological yield per plant, tillers per plant, harvest index, days to heading had strong positive and significant correlation with grain yield per plant. Protein content, wet gluten and zeleny showed positive correlation among themselves and these three traits had significant negative correlation with 1000-kernel weight and spike length. Wet gluten exhibited a highly significant positive correlation with protein content. Positive direct effects of biological yield per plant, number of grains per ear, tillers per plant, 1000-kernel weight, days to heading and days to maturity on grain yield was observed.

091. Pankaj Kumar (V.C.S.G. College of Horticulture, Bharsar (India). Krishi Vigyan Kendra); Dimri, D.C.; Petwal, Anita (College of Forestry and Hill Agriculture, Hill Campus, Ranichauri (India).. Varietal variation in vegetative growth, leaf senescence and pollen behaviour among spur and colour mutant cultivars of apple (*Malus domestica* Borkh.). Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 93-95 KEYWORDS: VEGETATIVE PROPAGATION; LEAVES; SENESCENCE; POLLEN; SHURS; MALUS PUMILA; MUTANTS; APPLES.

092. Shashi Kamal; Raghav, M.; Singh, Y.V.; Singh, N.P. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Vegetable Science); Rajkumar (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Horticulture). Correlation and path analysis of yield determinants in potato (*Solanum tuberosum* L.) hybrids. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 120-124 KEYWORDS: GENETIC CORRELATION; STATISTICAL METHODS; POTATOES; HYBRIDS; YIELD COMPONENTS; SOLANUM TUBEROSUM.

The study on phenotypic and genotypic correlation and path coefficient analysis was conducted in twenty-five hybrids of potato during Rabi 2003-04 and 2004-05. Pooled analysis for the correlation coefficients among the various traits revealed that maximum and significantly positive genotypic and phenotypic correlation of tuber yield was recorded with average tuber weight and number of tubers per hill. Negative correlation of significant value with tuber yield was exhibited by shoot girth. Protein content showed negative correlation with all growth and quality characters except number of tubers per hill. Path coefficient analysis revealed that tuber weight, plant height, number of tubers per hill, number of stolon per hill, number of leaves per haulms and number of haulms per hill have positive effect on tuber yield. Keeping in view high negative direct effect on tuber yield of total soluble solids, phosphorus content, specific gravity of tuber and total chlorophyll content, it is suggested that important yield determining traits viz., tuber weight, plant height and number of tubers per hill should be given due importance during selection for improvement of yield in potato.

093. Tyagi, K.; Kumar, U.; Prasad, L.C.; Nandan, R. (Banaras Hindu University, Varanasi (India). Dept. of Genetics and Plant Breeding); Chand, R. (Banaras Hindu University, Varanasi (India). Dept. of Mycology and Plant Breeding); Joshi, A.K. (Banaras Hindu University, Varanasi (India). Dept. of Genetics and Plant Breeding). Inheritance and identification of RAPD markers for resistance to spot blotch of barley caused by *Cochliobolus sativus* L. Indian Journal of Genetics and Plant Breeding (India). (Nov 2007) v. 67(4) p. 309-314
 KEYWORDS: BARLEY; HORDEUM VULGARE; DISEASE RESISTANCE; BLOTCHES; COCHLIOBOLUS SATIVUS; RAPD; GENETIC MARKERS.

Spot blotch of barley caused by *Cochliobolus sativus* is an important foliar disease of barley causing considerable yield loss every year. The present study was undertaken to identify molecular markers for the locus controlling spot blotch resistance in the accession IBON 18, using a set of 110 recombinant inbred lines (RILs). The screening of individual RILs using an isolate highly virulent on the popular Indian cultivar 'RD 2508 revealed the presence of a major locus for spot blotch resistance in IBON 18. Based on the screening of 360 RAPD primers employing Bulk Segregant Analysis (BSA), 75 (20.83percent) primers gave polymorphic bands in between parents. Out of these, two RAPD markers OPM04 625 and OPB01520 were found to be linked to the spot blotch resistance locus with a map distance of 6.5 and 10.9 eM, respectively. The linked markers appear to be useful in incorporating spot blotch resistance gene into barley breeding lines.

094. Hossain, F.; Prasanna, B.M.; Kumar, R. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics); Singh, S.B.; Singh, R.; Prakash, O. (Indian Agricultural Research Institute, New Delhi (India). Directorate of Maize); Warsi, M.Z.K. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Genetics and Plant Breeding). Genetic analysis of grain yield and endosperm protein quality in the quality protein maize (QPM) lines. Indian Journal of Genetics and Plant Breeding (India). (Nov 2007) v. 67(4) p. 315-322
 KEYWORDS: MAIZE; ZEA MAYS; ENDOSPERM; PROTEIN QUALITY; YIELDS; GENOTYPES.

To evaluate the performance of Quality Protein Maize (QPM) lines with respect to grain yield and endosperm protein quality, a set of 14 lines developed in India (DMRQPM series) and three exotic testers (from CIMMYT, Mexico) were involved in a Line x Tester mating design. The resultant experimental hybrids along with the parental lines were evaluated at two locations (Delhi and Pantnagar) during Kharif2003, and biochemical analysis for estimation of endosperm protein content and per cent tryptophan in endosperm protein was undertaken on the harvested material (control-pollinated). DMRQPM-65 and CML 189 at Delhi and DMRQPM-28-5, CML166 and CML189 at pantnagar were found to be the best general combiners for grain yield, while DMRQPM-401, DMRQPM-28-5 and DMRQPM-65 exhibited best GCA effects for most of the characters at both the locations. DMRQPM-45 x CML 189 and DMRQPM-404 x CML 189 displayed highest SCA effects for grain yield at Delhi and Pantnagar, respectively. The study revealed preponderance of variance due to dominance effects over that due to additive effects for most of the characters at both Delhi and Pantnagar. The present investigation identified DMRQPM-404 x CML 189 as the best heterotic combination at both locations. DMRQPM-28-5 (0.99percent) and CML189 (0.98percent) among the inbred lines and DMRQPM-56 x CML 189 (1.03percent) among the crosses recorded the highest per cent tryptophan content in the endosperm protein. CML 189 was found to be the best donor for endosperm quality traits. Taking into account the combining ability effects for grain yield and endosperm protein quality, besides heterosis,

095. Soregaon, C.D.; Ravikumar, R.L.; Thippeswamy, S. (University of Agricultural Sciences, Dharwad (India); Dept. of Genetics and Plant Breeding). Identification of DNA markers linked to H2 locus of fusarium wilt resistance in chickpea (*Cicer arietinum* L.). *Indian Journal of Genetics and Plant Breeding* (India). (Nov 2007) v. 67(4) p. 323-328 KEYWORDS: CHICKPEAS; CICER ARIETINUM; DISEASE RESISTANCE; WILTS; FUSARIUM OXYSPORUM; GENETIC MARKERS.

Resistance to chickpea wilt caused by *Fusarium oxysporum* f.sp. *ciceris* race 1 is governed by two to three genes. The DNA marker linked to H, locus is already available. In order to identify DNA marker linked to H2 locus of wilt resistance, the recombinant inbred lines derived from the cross K 850 (late wilting) x WR315 (resistant), segregating for only H2 locus were utilized. The recombinant inbred lines showed 1:1 segregation for late wilting and resistance. Seventynine random oligonucleotide primers of 10 to 11 base pairs were used to study the polymorphism in parents. The primer A07C amplifies an extra band of 417 bp in susceptible parent and co-segregate in susceptible bulk. The DNA marker A07C 417 showed monogenic segregation ratio of 1:1 in the recombinant inbred lines. The linkage analysis indicated that the A07C4,7 marker. is linked to H2 locus and susceptibility and were separated by 21.7 centi Morgan (cM). The RILs of another cross JG-62 x WR-315 segregate for both H, and H2 loci; consequently the DNA markers linked to H, and H2 also showed independent segregation in the RILs of a cross JG-62 x WR-315. The A07C417 marker was also found linked to H2 locus of wilt susceptibility in different genotypes tested. The DNA marker A07C 47 showed linkage with H2 locus across genetic backgrounds. The identification of DNA markers linked to both H, and H2 of wilt resistance will facilitate marker-assisted selection and pyramiding of resistance genes to susceptible varieties.

096. Qadir, S.A.; Datta, S.; Singh, N.P.; Kumar, S. (Indian Institute of Pulses Research, Kanpur (India). Div. of Crop Improvement). Development of highly polymorphic SSR markers for chickpea (*Cicer arietinum* L.) and their use in parental polymorphism. *Indian Journal of Genetics and Plant Breeding* (India) . (Nov 2007) v. 67(4) p. 329-333 KEYWORDS: CHICKPEAS; CICER ARIETINUM; GENETIC MARKERS; POLYMORPHISM.

Simple sequence repeat (SSR) or microsatellite marker is currently the most preferred molecular marker system owing to their highly desirable properties viz., abundance, hyper-variability, and suitability for highthroughput analysis. Development of SSR markers using molecular methods is time consuming, laborious, and expensive. Use of computational approaches to mine ever-increasing sequences such as expressed sequence tags (ESTs) and genomic DNA sequences available in public databases permits rapid and economical discovery of SSRs. Because the number of SSR markers currently available in chickpea is very limited, the aim of this study was to develop and characterize more SSR markers. Twenty one hundred DNA sequences of chickpea were searched for SSRs and analyzed for the design of PCR primers amplifying the SSR reach regions. Di-nucleotide repeats were found to be the most abundant followed by tri- or mononucleotide repeats. The motifs Aft, GA/AGICT/ACITCI CA/TA, and CAAfTCT/AGA/CAGITTG/ATT were the predominant mono-, diM, and tri-nucleotide SSRs, respectively. A subset of 64 primer pairs flanking SSR loci was used for screening polymorphism between two chickpea cultivars BG 256 and WR 315, which are parents of a *Fusarium* wilt mapping populations. Of them, 45 SSR markers (70.3percent) were polymorphic between these two parents.

097. Jabeen, N.; Ahmed, N.; Khan, S.H.; Chattoo, M.A.; Sofi, P.A. (Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Olericulture). Inheritance of resistance to fusarium wilt [*Fusarium pallidoroseum* (Cooke) Saac.] in chilli (*Capsicum annum* L.). Indian Journal of Genetics and Plant Breeding (India). (Nov 2007) v. 67(4) p. 334-336 KEYWORDS: CHILLIES; CAPSICUM ANNUM; DISEASE RESISTANCE; WILTS; FUSARIUM PALLIDOROSEUM.

The present study was undertaken to investigate the inheritance pattern of resistance to Fusarium wilt. Arka Lohit which showed resistance to Fusarium wilt under field conditions as well as artificial epiphytotics was crossed to susceptible but well adapted and high yielding parental lines like Kashmir Long-1 (having moderate to susceptible reaction), SH-C-101 and Local Pampori (both showing highly susceptible reaction to the disease). Resistance to Fusarium wilt was inherited as a monogenic dominant trait.

098. Soregaon, C.D.; Ravikumar, R.L.; Satish, D. (University of Agricultural Sciences, Dharwad (India). Dept. of Genetics and Plant Breeding). Molecular diversity in *Carthamus* species and species identification using RAPD markers. Indian Journal of Genetics and Plant Breeding (India). (Nov 2007) v. 67(4) p. 347-351 KEYWORDS: CARTHAMUS; GENETIC VARIATION; GENETIC MARKERS; IDENTIFICATION.

The molecular genetic relationship between four *Carthamus* species and the cultivated variety A-1 was determined using 44 RAPD primers. The RAPD primers produced a large number of markers. On an average 11.65 bands per primer were produced. Totally 83.75 percent of the markers were polymorphic. The polymorphic markers were also used to assess the inter-relationships of the species and to estimate the overall genetic variation in the species. The *Carthamus oxyacantha* and *Carthamus palaestinus* were more closely related to the cultivated species supporting the previous taxonomic studies based on cytogenetics. These two species were reported to be the progenitors of cultivated *Carthamus tinctorius* L. The *Carthamus glaucus* L., which has a chromosome number of $n = 10$; as against $n = 12$ of the cultivated species, formed a distinct solitary cluster and showed least similarity with cultivated species and its progenitors. The *Carthamus* species (unidentified) was distinct from all the other *Carthamus* species studied and formed a solitary cluster. The study revealed the significant genetic differences in the genome of *Carthamus* species and species specific markers were identified. The cultivated varieties A-1 and A-2 were crossed to different *Carthamus* species and interspecific hybrids were produced. The species specific markers were useful in identifying true interspecific hybrid plants.

099. Mohapatra, K.P.; Sehgal, R.N. (Central Soil and Water Conservation Research and Training Institute, Agra (India); Sharma, R.K.; Mohapatra, T. (Indian Agricultural Research Institute, New Delhi (India). National Research Center on Plant Biotechnology). Population genetic structure of the endangered tree species *Taxus wallichiana* Zucc. in the Western Himalayas. Indian Journal of Genetics and Plant Breeding (India). (Nov 2007) v. 67(4) p. 352-357 KEYWORDS: TAXUS; POPULATION GENETICS; HIMALAYAN REGION.

Taxus wallichiana Zucco (Taxaceae), commonly known as Himalayan yew, is a long-lived, dioecious tree species distributed sparsely in the higher elevations of the Himalayan ranges. The species has become endangered and listed in the threat category of IUCN and Convention on International Trade on Endangered Species of Wild Flora and Fauna (CITES). Random Amplified Polymorphic DNA (RAPD) was used to study the genetic structure of

severely restricted populations of this species, which would be useful in devising suitable conservation strategy. Analysis of molecular variance (AMOVA) revealed 89.95 per cent within population and 10.05 per cent between population components of variation. The Wright's fixation index (F_{st}) or its analogue and migration rate (N_m) based on different methods revealed similar results. Rate of migration (N_m) varying from 1.00 to 1.30, indicated exchange of genetic material among the populations. However, F_{ST} that ranged from 0.16 to 0.21, suggested existence of genetic structuring. UPGMA dendrogram based on pair-wise F_{ST} values and Mantel's correlation ($r = 0.47$, $P = 0.01$) showed that genetic structure followed spatial distribution.

100. Yadav, O.P. (Central Arid Zone Research Institute, Jodhpur (India). Genetic diversification of landrace-based populations of pearl millet (*Pennisetum glaucum* L. R. Br.) to enhance productivity and adaptation to arid zone environments. *Indian Journal of Genetics and Plant Breeding (India)*. (Nov 2007) v. 67(4) p. 358-364 KEYWORDS: PEARL MILLET; PENNISETUM GLAUCUM; GENETIC DISTANCE; ADAPATATION; ARID CLIMATE.

In the present investigation, 20 crosses of pearl millet (*Pennisetum glaucum* L. R. Br.) and their nine parental combinations consisting of four landrace-based and five elite exotic populations were evaluated in four contrasting seasons within arid ecosystem in order to study their response pattern to a wide range of environmental conditions. In most severe drought year, the landrace-based populations outyielded other two groups by a margin of 33-72percent. In favourable conditions, exotic elite populations provided significantly higher grain yield than land races with average degree of superiority being 25-45percent across two seasons. The hybridization between land race-based and elite populations resulted into enhanced adaptation range of crosses, beyond that of their parents. Individual landraces and elite populations differed significantly in their general combining ability (gca) effects though landraces had, in general, more pronounced gca effects than elite populations. Landrace Jakharana and elite population ESRC provided their crosses both adaptation to stress conditions and also higher potential productivity. On the contrary, BarPop was established as an appropriate parent for producing cultivars with general adaptation giving high stover yield but with a significant penalty for grain yield. ERajPop appeared more suitable for producing grain type materials while WRajPop emerged suitable to produce dual-purpose materials. The elite populations MC and EC had effects for specific adaptation to drought conditions for grain yield productivity. The populations BSEC established as promising parent for grain yield but not for stover yield across environments. Results demonstrated that there are exploitable differences among landraces and elite populations for their ability to produce genetic material with a variety of combinations for grain and stover productivity and with differential adaptation pattern. Implication of these findings in pearl millet breeding for arid zone conditions is discussed.

101. Tiwari, V. (Rajendra Agricultural University, Bhagalpur (India). Dept. of Plant Breeding). Grain filling duration as a means for increasing yield in spring wheat. *Indian Journal of Genetics and Plant Breeding (India)*. (Nov 2007) v. 67(4) p. 365-368 KEYWORDS: WHEAT; TRITICUM AESTIVUM; SEED FILLING.

Grain filling duration, the period between heading date and physiological maturity, plays an important role in determining the final grain yield in spring wheat. The variability for grain filling duration and selected agronomic traits was studied in 72 spring wheat

genotypes. There was wide genetic variation in the genotypes for the traits examined. It was observed that earlier heading lines tended to have longer grain filling duration as compared to later heading genotypes. Genotypes having shorter grain filling duration were identified for further utilization. The grain filling duration was significantly correlated with grain yield and its components, kernels per spike and kernel mass. The results suggest that increasing grain yield in spring wheat was possible through breeding for grain filling parameters.

102. Kumar, S.; Singh, J.; Singh, P.K.; Pandey, D.K. (Indian Institute of Sugarcane Research, Lucknow (India). Div. of Crop Improvement). Nonparametric measures of phenotypic stability for commercial cane sugar yield in sugarcane. *Indian Journal of Genetics and Plant Breeding (India)*. (Nov 2007) v. 67(4) p. 369-373 KEYWORDS: SUGARCANE; YIELDS; STABILITY; PHENOTYPES.

Nine sugarcane genotypes evaluated for commercial cane sugar yield under six environments. The objective of this investigation was to identify sugarcane genotypes with good phenotypic stability for sugar yield over the environments using non parametric measures. Further, the relationship among non parametric as well as some classical parametric measures of stability were also studied. Based on estimates 5(1) and 5(2) from uncorrected data, Co 1148 had shown maximum stability with low sugar yield, however, Colk 9710 was most stable with high sugar yield based on 5(?) measure. On the other hand, the values of 5(1) and 5(2) obtained from transformed data indicating that C05 97264 had maximum stability. However, the estimate of 5/3) from transformed data, reflected the maximum stability in Colk 9606 for CC5 yield. Based on the rank correlation among different measures of stability, 5/1) and 5/2) were nearly perfectly associated with high significant positive value indicating that two measures were similar in classifying the genotypes according to their stability over the environmental conditions. The statistic 5/3) may be utilized for simultaneous selection for yield and stability.

103. Roshandel, P. (Shahrekord University, Shahrekord (Iran). Botany Dept.). The possible involvement of MYB, WAK and RIM2 proteins in salt tolerance in rice. *Indian Journal of Plant Physiology (India)*. (Jul-Sep 2007) v. 12(3) p. 215-221 KEYWORDS: RICE; ORYZA SATIVA; SOIL TOLERANCE; GENE EXPRESSION; PROTEINS.

Salinity in plants has two major components: osmotic effects (phase 1) and ionic effects (phase 2). In this research the effects of phase 1 on gene expression in two rice varieties differing in salt tolerance (IR4630 and IR15324) was studied using a modified eDNA-amplified fragment length polymorphism (AFLP) technique. To separate osmotic from ionic effects of salt, mannitol was applied as a non-ionic osmoticum at the equivalent osmotic potential to 50 mM NaCl. mRNA was sampled at 0.5, 6, 24, 48 and 192 hours after salinisation. Several products (AFLP-bands) were detected, which were upregulated in the response to ionic effects of salt in the tolerant line (IR4630) and not expressed in the sensitive line (IR15324) at both phase 1 and 2 of salinisation. Bioinformatic analysis indicated these AFLP-bands to be: 1) a gene (OsMYB) encoding a Myb-related protein (for an isolated AFLP-band belonged to saltstressed shoots of IR4630 at 0.5 h after salinisation); 2) a gene (OsWAK) encoding a putative wall-associated protein kinase (for an isolated AFLP-band belonged to salt-stressed shoots of IR4630 at 24 h after salinisation) and 3) a gene (OsRim2) encoding a Rim 2 protein (for an isolated AFLP-band belonged to salt-stressed shoots of IR4630 at 192 h after salinisation). The possible roles of the products of candidate genes are discussed.

104. Ban, Y.G. (All India Coordinated Research Project on Niger, Igatpuri (India). Zonal Agricultural Research Stn); Jadhav, B.B.; Shinder, A.K.; Jamdar, V.T. (Dr. B.S.K.K. Krishi Vidyapeeth, Dapoli (India). Dept. of Agricultural Botany). Rice variety identification by electrophoretic variants of salt soluble seed proteins and seed morphology. Indian Journal of Plant Physiology (India). (Jul-Sep 2007) v. 12(3) p. 222-227 KEYWORDS: RICE; ORYZA SATIVA; IDENTIFICATION; ELECTROPHORESIS; SEEDS.

Efficacy of certain physico-chemical characters of grain and electrophoretic method (SDS-PAGE) was tested in rice varietal identification. SDS-PAGE of rice varieties resulted in scoring of twenty polymorphic bands. Out of these distinct presence/absence was exhibited by band no. 2 (Rm 0.23), 3 (Rm 0.26), 5 (Rm 0.30), 6 (Rm 0.32), 7 (Rm 0.34), 8 (Rm 0.35), 12 (Rm 0.44) and 23 (Rm 0.97). The varieties were distinguishable from each other by determining the presence and/or absence of specific protein bands and their intensity in electrophoregrams. Polypeptide polymorphism along with 'seed keys' may be used for differentiation and identification of rice cultivars and for utilization in a rice varietal improvement programme.

105. Vashistha, R.K.; Prasad, P.; Nautiyal, B.P.; Nautiyal, M.C. (Hemwati Nandan Bhauguna Garhwal University, Srinagar (India). High Altitude Plant Physiology Research Centre). Biochemical and electrophoretic variability at population level in two *Angelica* species from Garhwal Himalaya. Indian Journal of Plant Physiology (India). (Jul-Sep 2007) v. 12(3) p. 246-252 KEYWORDS: ANGELICA; MOLECULAR GENETICS; ELECTROPHORESIS; VARIABILITY; HIMALAYAN REGION.

Biochemical and isoenzyme patterns, in rhizomes of *Angelica glauca* Edgew. and *Angelica archangelica* Linn. were studied in different populations collected from Garhwal Himalaya. In general both species showed much variation in soluble protein, carbohydrate and total free amino acid content. Isoenzyme pattern for different enzymes also varied greatly among different populations of both *Angelica* species. In *Angelica glauca* populations such as VF, KN, RN and GH showed dark intensity bands while in *Angelica archangelica*, RN and PK populations showed dark intensity bands in all the enzymes studied.

106. Sudhakar, P.; Latha, P.; Babitha, M.; Reddy, P.V.; Naidu, P.H. (Acharya N.G. Ranga Agricultural University, Tirupati (India). Regional Agricultural Research Stn.). Relationship of drought tolerance traits with aflatoxin contamination in groundnut. Indian Journal of Plant Physiology (India). (Jul-Sep 2007) v. 12(3) p. 261-265 KEYWORDS: GROUNDNUTS; ARACHIS HYPOGAEA; DROUGHT RESISTANCE; AFLATOXINS.

Fifty groundnut (*Arachis hypogaea* L.) genotypes were screened for low aflatoxin contamination under field conditions with two main treatments i.e., irrigated and simulated drought conditions. A severe strain of *A.flavus* was isolated by collecting native strains from different parts of Chittoor district in Andhra Pradesh and a suck plot was developed utilizing this strain. *A.flavus* inoculum was applied 2.5 g per meter row length and sufficient spore load was maintained till harvest. Mean aflatoxin content was higher under imposed moisture stress conditions compared to irrigated treatment. The genotypes differed in tolerance to aflatoxin in irrigated and simulated drought conditions. Among the fifty groundnut genotypes screened ICGV 86590, 89104, 94350, 99029, IC 48 and ICGS 76 had low aflatoxin levels (5 ppb) in both irrigated and simulated drought treatments. No consistent relationship was observed between seed colonization and aflatoxin production.

The results indicate that aflatoxin production in groundnut is negatively related with relative water content (RWC), pod wall integrity and pod wall moisture content at harvest.

107. Sabale, A.; Kale, P.B. (Shivaji University, Kolhapur (India). Dept. of Botany). Response and recovery of *Coriandrum sativum* L. variety indoori exposed to soil moisture stress. *Indian Journal of Plant Physiology (India)*. (Jul-Sep 2007) v. 12(3) p. 266-270 KEYWORDS: CORIANDRUM SATIVUM; SOIL WATER CONTENT; DROUGHT STRESS.

Influence of soil moisture stress was investigated in *Coriandrum sativum* L. var. Indoori subjected to soil moisture stress (SMS) for four and eight days. The study revealed a decline in relative water content (RWC) with an increase in leaf water potential (L WP) up to 2.1 MPa. A decrease in total chlorophylls upto 34 percent and a minor reduction in chlorophyll stability index (CSI) was visible. Significant accumulation of free proline, free amino acids, ascorbic acid and total flavanoids was evident in plants facing eight days SMS. Lipid peroxidation and superoxide dismutase activity enhanced, but proline oxidase activity declined due to water deficit. Upon rewatering, RWC increased and amount of proline and ascorbic acid decreased. Lipid peroxidation decreased and enzyme activities recovered upon rewatering. The variety is susceptible to SMS but can be 'recovered from stress within five days after rewatering. Accumulation of antioxidants such as ascorbic acid and flavanoids may help the plant to face oxidative stress.

108. Dalvi, U.S.; Chavan, U.D.; Kachare, D.P.; Naik, R.M. (Mahatma Phule Krishi Krishi Vidyapeeth, Rahuri (India). Dept. of Biochemistry). Proline metabolism in sorghum and chickpea cultivars during water stress. *Indian Journal of Plant Physiology (India)*. (Jul-Sep 2007) v. 12(3) p. 287-289 KEYWORDS: SORGHUM; SORGHUM BICOLOR; CHICKPEAS; CICER ARIETINUM; DROUGHT STRESS; PROLINE.

Drought tolerant and susceptible cultivars of both sorghum and chickpea were evaluated for proline accumulation, Pyrroline 5-carboxylate synthetase (P5CS) activity and soluble proteins in relation to imposed water stress. The result in the present study revealed that an increase of proline content from 14.58 to 70.75 $\mu\text{mol g}^{-1}$ fr.wt in sorghum and 11.74 to 131.30 $\mu\text{mol g}^{-1}$ fr.wt in chickpea with concomitant increase in P5CS activity and soluble proteins. The significant differences were recorded in free proline content of drought tolerant and susceptible genotypes of both sorghum and chickpea that could be attributed to increased P5CS activity and the loss of feedback inhibition of P5CS by proline during moisture stress.

109. Datta, D. (Indian Institute of Vegetables Research, Varanasi (India); Bhardwaj, S.C.; Prashar, M. (Directorate of Wheat Research, Shimla (India). Regional Stn.). Genetic basis of rust resistance of a high yielding wheat line from northern hills zone. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 221-224 KEYWORDS: WHEAT; TRITICUM AESTIVUM; HIGH YIELDING; VARIETIES; GENETIC RESISTANCE; RUSTS.

Genetic basis of rust resistance was investigated in a bread wheat line HS424 which is bred for Northern Hills Zone 01 India. The study showed that HS424 is resistant to leaf rust and stem rust pathotypes prevalent in India. At seedling stage it was resistant to stripe rust pathotypes except 46S119. However, at adult plant stage, HS424 showed only moderate susceptibility to pathotype 46S119. Low terminal disease against pL 46S119 must be due to additional adult plant resistance factors in HS424. At least two resistance genes were involved in the resistance against leaf rust pathotypes wherein resistance to pathotypes 77-

5 and 77-2 was governed by single dominant gene and two independent dominant genes, respectively. Stem rust resistance was governed by three genes. Resistance to pL 40A was due to two independent dominant genes whereas single dominant gene imparted resistance to pt. 40-1. Adult plant resistance gene Sr2 was also postulated in HS424. Based on infection type data, inheritance study, morphological -marker, genetic linkage and molecular marker analyses It is concluded that HS424 carries genes L24+Lr26+Sr2+Sr24+Sr31+Yr9.

110. Shivani, D.; Viraktamath, B.C.; Rani, N.S. (Directorate of Rice Research, Hyderabad (India). Effect of nucleo-cytoplasmic interactions on the expression of quality characters in rice (*Oryza sativa* L.) hybrids. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 225-228 KEYWORDS: RICE; ORYZA SATIVA; GENETIC INTERACTION; NUCLEUS; CYTOPLASM; QUALITY.

To study the effects of nucleo-cytoplasmic interactions on the expression of quality characteristics, critical comparisons were made between 11 CMS lines and their respective maintainers and between 30 A x R hybrids and 30 B x R hybrids for 14 quality traits. Since A and B lines are isogenic, the differences observed could be attributed to nucleo-cytoplasmic Interactions. Hulling, milling and head rice recovery percentages were lower in A lines and A x R crosses as compared to their corresponding maintainers and B x R crosses. The negative effects of the male sterility inducing cytoplasm were also observed for kernel length, IJB ratio, kernel length after cooking and water uptake. Elongation ratio was found to be positively influenced by the sterility inducing cytoplasm. Nucleo-cytoplasmic effects for gelatinization temperature were cross specific. For gel consistency, the cytoplasmic effects were negligible. Most significant effect of the sterility inducing cytoplasm was the reduction in amylose content of A lines and A x R hybrids. The amylose content of those lines was 1-2 percent less than their corresponding B lines and B x R hybrids. Male sterility inducing cytoplasm had no effects on aroma.

111. Ram, B. (Sugarcane Breeding Institute, Karnal (India). Regional Centre); Nair, N.V.; Radhakrishnan, C.M. (Sugarcane Breeding Institute, Coimbatore (India); Singh, N.; Sahi, B.K. (Sugarcane Breeding Institute, Karnal (India). Effect of cytoplasmic diversity on performance of sugarcane hybrids. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 229-231 KEYWORDS: SUGARCANE; SACCHARUM; GENETIC VARIATION; CYTOPLASMIC INHERITANCE.

Selected clones of *S. spontaneum*, *S. barberi* and *S. sinense* were used as pistil parents and *S. officinarum*, Co and allied hybrids as pollen parents with the objective to introduce cytoplasmic diversity from *S. spontaneum*, *S. barleri* and *S. sinense*. The ultimate aim of the programme was to select elite donors for stalk yield and juice quality traits as well as for red rot resistance. Difference in means of *S. barberi* x commercial hybrids (F₁,sb) progenies and (*S. spontaneum* x *S. officinarum* | commercial hybrid) x commercial hybrid (BCI-Ss) progenies was significant only for red rot disease index. Mean performance of these two progeny groups was better than F₁ progenies of *S. spontaneum* x *S. officinarum* | commercial hybrid (FrS₁,) for all the traits, except number of millable stalks (NMS) and stalk length. These results did not indicate any significant contribution (on the traits studied) of diverse cytoplasm from species other than *S. officinarum*.

112. Muduli, K.C.; Misra, R.C. (Orissa University of Agriculture and Technology, Bhubaneswar (India). Dept. of Plant Breeding and Genetics). Efficacy of mutagenic treatments in

producing useful mutants in finger millet (*Eleusine coracana* Gaertn.). *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 232-237 KEYWORDS: FINGER MILLET; ELEUSINE CORACANA; INDUCED MUTATION.

A mutation breeding project was initiated with finger millet varieties, VR 708 and GPU 26 using three doses each of gamma rays (150, 300 and 450 Gy), ethyl methane sulphonate (0.15, 0.30 and 0.45 percent) and nitroso guanidine (0.015, 0.030 and 0.045 percent) coupled with combination treatments 01 300 Gy gamma rays with 0.30 percent EMS or 0.030 percent NG. Fifteen selected M2 plant progenies from each of the eleven mutagenic treatments along with the parental variety were evaluated in M3 generation. Four high yielding M3 progenies from each treatment along with the parental variety were evaluated for yield and eight component traits in M₃ generation. In M3 generation, of the 165 progenies, 61 in VR 708 and 65 in GPU 26 produced significantly higher yield than the parent and EMS treatments produced more of such high yielding progenies. In M4' out of 44 progenies in each of VR 708 and GPU 26, 8 and 9 progenies showed superiority over the parental variety in one or more traits, respectively. High frequency of positive mutations was observed for 1000-grain weight, finger length and fingers/ear in case of VR 708 and fingers/ear and finger length in case of GPU 26. Moreover, EMS treatments produced more superior mutants (28.93 percent in VR 708 and 39.13 percent in GPU 26) in different traits than the other mutagenic treatments. Among the mutagenic treatments, the frequency of high yielding progenies in M3 and M₄ generations were higher in 0.30 percent and 0.45 percent EMS, 0.030 percent NG and combination treatment 01 300 Gy gamma rays + 0.30 percent EMS.

113. Garg, A.; Prasanna, B.M. (Indian Agricultural Research Institute, New Delhi (India)). Div. of Genetics; Chauhan, S.V.S. (B.R. Ambedkar University, Agra (India)). Simple sequence repeat (SSR) polymorphism in the tropical Asian maize inbred lines differing in resistance to banded leaf and sheath blight (*Rhizoctonia solani* f. sp. *sasakii*). *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 238-242 KEYWORDS: POLYMORPHISM; MAIZE; ZEA MAYS; DISEASE RESISTANCE; RHIZOCTONIA SOLANI; ASIA; BLIGHT.

A set of 23 tropical maize inbred lines, including 18 from the CIMMYT, Asian Regional Maize Program (CIMMYT-ARMP) and 5 inbred lines developed under the All-India Coordinated Maize Improvement Project (AICMIP), were selected for this study. These lines, with distinct differences in responses to Banded Leaf and Sheath Blight (BLSB; *Rhizoctonia solani* f. sp. *sasakii*) at different locations in India (Delhi, Pantnagar and Udaipur), were analyzed using 49 polymorphic simple sequence repeat (SSR) markers (179 SSR alleles). The study aided in genotype differentiation as well as analysis of genetic diversity among the lines. Besides revealing high genetic diversity among the tropical/sub-tropical inbred lines, cluster analysis using SSR dataset clearly demonstrated the genetic distinctness of the CIMMYT-ARMP lines vis-a-vis maize inbreds developed in India. The study also aided in identifying suitable lines with phenotypic contrast (BLSB resistance) and genetic divergence. The information would be helpful in undertaking detailed genetic and molecular analyses of BLSB resistance, besides planned utilization of promising genotypes in breeding for BLSB resistance in the tropical maize germplasm.

114. Ram, S.; Tyagi, B.S.; Mishra, B. (Directorate of Wheat Research, Karnal (India)). Evaluation and utility of synthetic hexaploids in the improvement of wheat grain quality.

Indian Journal of Genetics and Plant Breeding (India). (Aug 2007) v. 67(3) p. 243-247
KEYWORDS: WHEAT; TRITICUM AESTIVUM; BREEDING METHODS; HEXAPLOIDY.

A set of 75 synthetic hexaploid lines, derived from the hybridization of tetraploid (*T. turgidum* spp. *Durum*) and diploid (*Ae. fausonii*) -wheats, was evaluated for grain quality traits. Since synthetic hexaploids have been developed using wild progenitors, the utility of synthetics in widening genetic base and improving wheat quality has been explored. Wide ranges of quality traits were exhibited in the synthetic hexaploids studied. There was higher protein content (14 percent) in 14 lines along with higher grain weight (50 mg). This is important for the improvement of protein content without decreasing the grain weight. Super soft grained lines were identified with having low hardness index (20.0), such low values are rarely available in hexaploid wheats. Some of the very soft grained hexaploids had very low sedimentation value (5.0 ml; 1 g test) also. This trait has utility in improvement of biscuit making quality of wheat. Similarly, synthetic lines with stronger gluten and hard texture were also identified. These can be used for improving bread and chapati quality. Since grain hardness and SDS sedimentation volumes are highly heritable, the criteria can be used for selecting desirable segregants among early generation progeny. Overall data demonstrated the availability of useful traits in synthetic hexaploids and their utility in the improvement of quality of wheats and widening their genetic base.

115. Hemaprabha, G.; Singh, N.K. (Sugarcane Breeding Institute, Coimbatore (India). Div. of Crop Improvement). Evaluation of parental value of selfs in sugarcane (*Saccharum* spp.) breeding. Indian Journal of Genetics and Plant Breeding (India). (Aug 2007) v. 67(3) p. 248-253
KEYWORDS: SUGARCANE; SACCHARUM; PLANT BREEDING; SELFS; PARENTS.

Use of selfs as parents in breeding programme was assessed. Genetic divergence estimated among eighteen selfs, six each derived from three proven parents viz., Co 7201, Co 775 and Co 1148 using twenty three sugarcane specific STMS primers revealed high within-parental group genetic similarity (0.86 in Co 7201 group, 0.84 in Co 1148 group and 0.85 in Co 775 group) and moderate genetic similarity among the groups. Sixteen more divergent (SI50.60) combinations were identified, which were not used in breeding programme. These diverse crosses could be used to exploit heterosis in sugarcane. Progenies from crosses effected involving diverse selfs of Co 1148 and Co 775 and between the original parents were evaluated. For Brix, the progenies from the selfs of Co 775 as female parent showed a marginal improvement (0.72 percent) over those of Co 775 x Co 1148 cross, indicating that selfs of Co 775 were not better for improving Brix, unlike selfs of Co 1148 that showed mean improvement of 5.17 percent over Co 1148 x Co 775. The magnitude of improvement in NMC and cane height was more in the selfs of Co 775 over that of Co 775 when used as female parent, whereas the selfs of Co 1148 were better as parents for juice quality, cane diameter, cane length and single cane weight. Use of diverse selfs of Co 775 and Co 1148 selected with maximum expression of the desired trait could be successfully utilized as parents in genetic improvement programmes and demanded more studies on the appropriate use of selfs to improve the accuracy of sugarcane breeding. The results of the study also assume significance in light of practical application of molecular tools at field situations in the complex crop of sugarcane.

116. Hossain, F.; Hossain, M. (Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India). Dept. of Seed Science and Technology). Breeding for photo-period insensitive Tossa jute (*Corchorus olitorius* L.) with high fibre yield. Indian Journal of Genetics and Plant Breeding

(India). (Aug 2007) v. 67(3) p. 254-256 KEYWORDS: CORCHORUS OLITORIUS; PLANT BREEDING; PHOTOPERIODICITY; FIBRES.

The reported photo-period insensitive Olitorius mutant (Gennan, maturing in 35-40 days after sowing) was crossed with photo-period sensitive standard variety, JRO 7835 and two selections (named as seo 100 and seo t20) were isolated from segregating F2 generation based on flowering in 90 and 110 days respectively after sowing. Pedigree selection continued up to 8th generation when the flowering character became stable. These two selections and the standard JRO 7835 were sown every month throughout the year to test their sensitivity to photoperiod under varied day length in different months. The two selections flowered in almost 90 and 110 days throughout the year whereas the standard had variable days to flowering. The two selections (SeO 100 and seo 120) along with three standard varieties (JRO 524, JRO 7835, JRO 878) were put to yield trial twice - on 1st April and 1st June. In case of the 1st sowing all entries were harvested at 100 days when only seo 100 had flowering on 90 days. Here the yield of seo 100 and seo 120 significantly exceeded that in the standards. In case of the second sowing seo 100 was also harvested on 100 days (flowering in 90 days) while others including seo 120 were harvested at 120 days when all were in flowering stage as the critical photo-period prevailed on and around 15th September. Here the fibre yield of seo 120 significantly exceeded all entries including seo 100. However, the fibre yield of seo 100 was at par with the standards though numerically slightly less. The yield trials and the sowing throughout the year conclusively proved the photoperiod insensitiveness of seo 100 and seo 120 and yield of seo 120 had better yield as compared to that in the standard while seo 100 had advantage of 20 days over the entries with equal fibre yield.

117. Sarode, S.B.; Singh, M.N.; Singh, U.P. (Banaras Hindu University, Varanasi (India). Dept. of Genetics and Plant Breeding). Genetics of waterlogging tolerance in pigeonpea [*Cajanus cajan* (L.) Millsp.]. Indian Journal of Genetics and Plant Breeding (India). (Aug 2007) v. 67(3) p. 264-265 KEYWORDS: PIGEANPEAS; CAJANUS CAJAN; WATER TOLERANCE; GENETIC RESISTANCE.

118. Badigannavar, A.M. (Bhabha Atomic Research Centre, Mumbai (India). Nuclear Agriculture and Biotechnology Div.). Inheritance of flower colour mutant in groundnut. Indian Journal of Genetics and Plant Breeding (India). (Aug 2007) v. 67(3) p. 266-267 KEYWORDS: GROUNDNUTS; ARACHIS HYPOGAEA; GENETIC INHERITANCE.

119. Pushpam, R.; Raveendran, T.S. (Tamil Nadu Agricultural University, Coimbatore (India). Centre for Plant Breeding and Genetics). Assessment of ploidy behaviour in doubled diploid wild species of *Gossypium*. Indian Journal of Genetics and Plant Breeding (India). (Aug 2007) v. 67(3) p. 268-269 KEYWORDS: COTTON; GOSSYPIUM; DIPLOIDY; POLYPLOIDY.

120. Sharma, A.K. (Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut (India). Directorate of Research); Singh, V.P.; Sarma, M.K. (Banaras Hindu University, Varanasi (India). Dept. of Genetics and Plant Breeding). Induced seed and pod colour mutations in urdbean [*Vigna mungo* (L.) Hepper]. Indian Journal of Genetics and Plant Breeding (India). (Aug 2007) v. 67(3) p. 270-271 KEYWORDS: URD; VIGNA MUNGO; INDUCED MUTATION; COLOUR.

121. Souframanien, J.; Gupta, S.K.; Gopalakrishna, T. (Bhabha Atomic Research Centre, Mumbai (India). Nuclear Agriculture and Biotechnology Div.). Segregation distortion in recombinant inbred lines of blackgram [*Vigna mungo* (L.) Hepper] detected by inter simple sequence repeat (ISSR) markers. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 272-274 KEYWORDS: URD; VIGNA MUNGO; INBREEDING; SEGREGATION; GENETIC MARKERS.
122. Kumar, S.; Skngh, H.B.; Sharma, J.K. (Choudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur (India). Dept. of Plant Breeding and Genetics). Gene action for grain yield, its components and quality traits in hill rice (*Oryza sativa* L.) varieties. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 275-277 KEYWORDS: RICE; ORYZA SATIVA; GENETIC VARIATION; YIELDS; QUALITY.
123. Sharma, M.K. (Assam Agricultural University, Sonitput (India). B.N. College of Agriculture); Sharma, A.K. (Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut (India). Directorate of Research); Agrawal, R.K.; Richharia, A.K. (Banaras Hindu University, Varanasi (India). Dept. of Genetics and Plant Breeding). Combining ability and gene action for yield and quality traits in Ahu rices of Assam. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 278-280 KEYWORDS: RICE; ORYZA SATIVA; GENETIC VARIATION; YIELDS; QUALITY.
124. Rani, K.J.; Rana, B.S.; Kaul, S.; Rao, S.S.; Ganesh, M. (Maize Research Centre, Hyderabad (India). Genetic analysis of certain morpho-physiological characters in rabi sorghum. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 281-283 KEYWORDS: SORGHUM; GENETIC PARAMETERS.
125. Nwauzoma, A.B. (National Research Centre for Banana, Thiruchirapalli (India); Daniel-Kalio, L.A. (Rivers State University of Science and Technology, Port Harcourt (Nigeria). Dept. of Applied and Environmental Biology). Correlation and principal component analyses in plantain (*Musa* spp., AAB group) somaclonal variants. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 284-286 KEYWORDS: BANANA; PLANTAIN; MUSA; GENETIC PARAMETERS; GENETIC CORRELATION.
126. Tahsildhar, N.; Hanchinal, R.R.; Vijayakumar, A.G. (University of Agricultural Sciences, Dharwad (India). Main Agricultural Research Stn.); Desai, S.A. (University of Delhi, South Campus, New Delhi (India). Dept. of Plant Molecular Biology); Lohitaswa, H.C.; Nadaf, H.L. (University of Agricultural Sciences, Dharwad (India). Main Agricultural Research Stn.). Quantifying diversity in wheat using D2 technique and molecular profiling. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 287-289 KEYWORDS: WHEAT; TRITICUM AESTIVUM; QUANTITATIVE ANALYSIS.
127. Yadav, R. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics); Prashar, M.; Shoran, J.; Kumar, J.; Bhardwaj, S.C. (Directorate of Wheat Research, Karnal (India). Rust resistance in newly bred lines of wheat (*Triticum aestivum* L.). *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 200-202 KEYWORDS: WHEAT; TRITICUM AESTIVUM; DISEASE RESISTANCE; RUSTS; PUCCINIA TRITICINA.

128. Singh, G.; Singh, D.P.; Chatrath, R.; Tyagi, B.S. (Directorate of Wheat Research, Karnal (India); Singh, G.P. (Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics); Singh, S.K.; Shoran, J. (Directorate of Wheat Research, Karnal (India). Combating leaf blight in wheat through resistance breeding. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 293-296 KEYWORDS: WHEAT; TRITICUM AESTIVUM; DISEASE RESISTANCE; BLIGHT; HELMINTHOSPORIUM.

129. Bidinger, F.R.; Hash, C.T. (International Crops Research Institute for the Semi-Arid Tropics, Patancheru (India). Selection for improved seed set in a Rajasthan pearl millet [*Pennisetum glaucum* (L.) R. Br.] landrace population. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 297-298 KEYWORDS: PEARL MILLET; PENNISETUM GLAUCUM; SELECTION; SEED SET; RAJASTHAN.

130. Madhusudhana, R.; Padmaja, P.O.; Satish, K.; Mohan, S.M.; Srinivas, G.; Reddy, R.N. (National Research Centre for Sorghum, Hyderabad (India). Heterosis for shoot fly [*Atherigona soccata* (Rondani)] resistance in sorghum. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 299-300 KEYWORDS: SORGHUM; HETEROSIS; DISEASE RESISTANCE; ANTHERIGONA SOCCATA.

131. Manivel, P. (National Research Centre for Medicinal and Aromatic Plants, Anand (India); Pandey, S.K.; Gopal, J.; Kumar, V. (Central Potato Research Institute, Shimla (India). Comparison of hybridization in-situ and on decapitation in glasshouse in potato. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 301-303 KEYWORDS: POTATOES; SOLANUM TUBEROSUM; HYBRIDIZATION.

132. Singh, G.; Guru, S.K. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Plant Physiology). Multiple shoot induction in intact shoot tip, excised shoot tip and nodal segment explants of *Rauwolfia serpentina*. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2007) v. 12(4) p. 360-365 KEYWORDS: RAUWOLFIA SERPENTINA; INDUCED MUTATION; SHOOTS; PLANT GROWTH SUBSTANCES.

The effect of different plant growth regulators alone or in combination on multiple shoots production from different explants of *Rauwolfia serpentina* L. was studied. Multiple shoots were obtained from intact or excised shoot tip, and nodal segment in MS medium supplemented with RAP (2.0 mg l⁻¹) and NAA (0.5 mg l⁻¹). Maximum number of shoots (16-24 per explant) was obtained from the excised shoot tips.

F50 Plant Structure

133. Kulkarni, M. (Vidya Pratishthan, Baramati (India). School of Biotechnology); Deshpande, U. (SRTMU, Nandad (India). School of Life Sciences). Root anatomical and morphological basis for drought resistance in tomato (*Solanum lycopersicon*). *Indian Journal of Genetics and Plant Breeding (India)*. (May 2007) v. 67(2) p. 185-186 KEYWORDS: GENETIC RESISTANCE; GENOTYPES; XYLEM; DROUGHT RESISTANCE; TOMATOES; LYCOPERSICON ESCULENTUM; PLANT ANATOMY.

F60 Plant Physiology and Biochemistry

134. Rathod, Z.; Saxena, O.P. (Gujarat University, Ahmedabad (India). Biotechnology Lab.). Biochemical profile of in vivo and in vitro produced *Bougainvillea spectabilis* L.. Indian Journal of Plant Physiology (India). (Jul-Sep 2007) v. 12(3) p. 234-238 KEYWORDS: BOULGAINVILLEA; BIOCHEMICAL REACTIONS; METABOLISM.

Bougainvillea spectabilis rosea (Bougainvillea) is an important medicinal plant used in the treatment of Diabetes mellitus. Plant tissue culture approach has been found to be advantageous as it provides a continuous and reliable source of natural product year round without the destruction of the entire plant. Biochemical profile of in vivo and in vitro produced metabolites of *B. spectabilis* was studied. The results revealed that the amount of sugar was notably less in in vitro while proteins, starch, amino acids, phenols, DNA and RNA did not show a significant variation. Enzymatic activities like peroxidase, invertase, IAA oxidase, polyphenol oxidase were higher in in vitro callus.

135. Kumar, P.; Mahajan, V. (Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora (India). Crop Improvement Div.). Effect of low temperature stress on photosynthesis, total soluble sugars, grain filling rate and yield in rice (*Oryza sativa* L.). Indian Journal of Plant Physiology (India). (Jul-Sep 2007) v. 12(3) p. 253-260 KEYWORDS: RICE; ORYZA SATIVA; TEMPERATURE; PHOTOSYNTHESIS; PLANT PHYSIOLOGY; CARBOHYDRATE CONTENT; SEED FILLING; YIELDS.

A field experiment with 15 rice (*Oryza sativa* L.) genotypes was conducted during kharif (rainy) season of 2001 to understand the photosynthetic basis of productivity under low temperature conditions in hills. Exposure of rice genotypes to low temperature conditions (mean temperature 18°C and minimum temperature 12°C) during reproductive phase was made by altering the dates of planting i.e. normal planting (transplanting date 25th June) and late planting (transplanting date 25th July). It was observed that the rates of photosynthesis and canopy photosynthesis showed significant positive association with grain yield during grain tilling stage (15 days after anthesis) under normal planting and poor association under late planting. A significant reduction in rates of photosynthesis, canopy photosynthesis, and level of total chlorophyll was observed at grain filling stage under low temperature condition. Besides, a reduction in the grain-filling rate under late planting was also seen among rice genotypes. A significant enhancement in the level of total soluble sugars (TSS) in the flag leaf (L) while slight reduction in soluble sugars in panicle peduncle (P) was noted among rice genotypes exposed to low temperature condition. The total soluble sugars in the leaf showed significant negative association with photosynthesis rate. Moreover, highly significant positive association of harvest index (HI) with grain yield ($r = 80$ percent).

136. Kavita (National Research Centre for Groundnuts, Junagadh (India); Singh, R.A.; Kumar, V. (Rajendra Agricultural University, Samastipur (India). Dept. of Botany and Plant Physiology). Physiological behaviour of chickpea genotypes growth in zinc deficient calcareous soils. Indian Journal of Plant Physiology (India). (Jul-Sep 2007) v. 12(3) p. 290-292 KEYWORDS: CHICKPEAS; CICER ARIETINUM; MINERAL DEFICIENCIES; ZINC; CALCAREOUS SOILS.

Field experiments were conducted on zinc deficient calcareous soil with eight chickpea (*Cicer arietinum* L.) genotypes. Tolerant genotypes (FG 897, BG 1084, PBG 126) recorded higher content of zinc, total chlorophylls, carotenoids, soluble protein and the activities of enzymes superoxide dismutase, catalase, peroxidase, carbonic anhydrase as compared to

moderately tolerant (CSJ 128, CSG 9505) and susceptible (BG 372, BG 256, BGM 535) genotypes. However, total free amino acids content was found to be higher in susceptible genotypes.

F61 Plant Physiology - Nutrition

137. Singh, V.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Environmental Sciences); Agrawal, H.P. (Banaras Hindu University, Varanasi (India). Dept. of Soil Science and Agricultural Chemistry). Development of DRIS norms for evaluating nitrogen, phosphorus, potassium and sulphur requirements of rice crop. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 294-303 KEYWORDS: TISSUE ANALYSIS; NUTRIENTS AVAILABILITY; LEAVES; SOIL FERTILITY; NUTRIENT UPTAKE; PLANT NUTRITION; RICE; NUTRITIONAL REQUIREMENTS.

A crop nutrition survey was conducted in five development blocks covering 125 rice fields in district Ghazipur of D.P. for developing DRIS foliar diagnostic norms for N, P, K and S. The sample population was divided into low (3.9 Mg ha⁻¹ with 63 observations) and high yield groups (3.9 Mg ha¹ with 62 observations) for developing the DRIS foliar diagnostic norms. Leaf samples were obtained at tillering and booting stages and analyzed for N, P, K and S content. Crop yields were calculated by harvesting 100 m² of the cropped area in each field. The degree of nutrient imbalances in the rice plant expressed in terms of DRIS indices indicated the extent to which a particular nutrient deviated from the established norms. The advantage of DRIS system in predicting nutrient imbalances when the nutrient concentration in rice plant was below or above critical level range was observed. It was also noticed that these DRIS norms were different from those established elsewhere. The results indicate that local calibration of DRIS norms are required and the published DRIS norms developed in a different climatic location for a crop may not be universally applicable. Critical nutrient concentration (CNC) and DRIS norms were not found compatible. The DRIS approach appeared to be better than CNC for predicting nutrient requirements for higher yields.

138. Bindhmadhava, H.; Prasad, T.G. (University of Agricultural Sciences, Bangalore (India). Dept. of Crop Physiology); Joshi, M.K. (Hindustan Lever Research Centre, Bangalore (India); Sharma, N. (Indian Tobacco Company Limited, Hyderabad (India). ITC Research and Development Centre). Gibberellin induced differences in intrinsic water use, carboxylation and photochemical efficiencies in a tea (*Camellia sinensis* L.) accession. *Indian Journal of Plant Physiology (India)*. (Jul-Sep 2007) v. 12(3) p. 293-297 KEYWORDS: TEA; CAMELLIA SINENSIS; GIBBERELIC ACID; WATER USE; PHOTOSYNTHESIS.

We demonstrate the plausible utility of gas exchange and fluorescence approaches for exploiting the variability in physiological traits such as water use, carboxylation and photochemical efficiencies in a tea accession (SA6) treated with different concentrations of gibberellin (GA3).

F62 Plant Physiology – Growth and Development

139. Pandey, Sunita T.; Singh, Sarnam; Chilana, Kishor (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Agronomy); Bisht, L.D.; Rajesh Kumar (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of

Horticulture); Gaur, A.K. (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Biochemistry). Impact of various nutritional packages on seed and oil yield of European dill (*Anethum graveolens*) in subtropical belt of Uttarakhand. Pantnagar Journal of Research (India). (Jun-Dec 2007) 5(2) p. 41-43 KEYWORDS: NUTRIENTS; SEED PRODUCTION; DILL; ANETHUM GRAVEOLENS; UTTARAKHAND; SUBTROPICAL ZONES; DRUG PLANTS; ORGANIC FERTILIZERS.

ABSTRACT: Investigation was carried out to standardize the nutritional package for getting maximum seed/oil yield of European dill in split plot design with three planting distances (30, 45 and 60 cm) as main plot treatments and eight treatments of different organic and inorganic sources of nutrients and their combinations as sub plot treatments with four replications. Plant height, number of branches/plant, number of umbels/plant, seed and oil yield were not influenced significantly by planting distance alone, however, fresh and dry weight of plants increased significantly with increase in planting distance. Applied nutrients significantly influenced the seed and oil yield. Maximum seed/oil yield was found in N75P40K30 treatment at 45 cm row spacing while minimum was recorded under control treatment.

140. Nag, S. (Rampurhat College, Rampurbhat Birbhum (India). Botany Dept.); Choudhuri, M.A. (University of Burdwan, Burdwan (India). Dept. of Botany). Role of endogenous auxin and polyamines in adventitious root formation in mungbean cuttings. Indian Journal of Plant Physiology (India). (Jul-Sep 2007) v. 12(3) p. 228-233 KEYWORDS: MUNGBEAN; VIGNA RADIATA; AUXINS; POLYAMINES; PLANT GROWTH SUBSTANCES; ROOTING.

Exogenous application of putrescine (10-4 M) markedly improved the number of second order root and second order root length per cutting, whereas, spermidine (10-9 M) and spermine (10-5 M) had no significant effect on adventitious root formation in mungbean cuttings. fflA (10-5 M) was more effective than putrescine in rooting performance. Three phases of adventitious root formation process could be identified namely, induction (0-24h), initiation (24-72h) and expression phase (after 72h). High levels of free IAA, Putrescine (PUT) and low peroxidase (POX) activity were observed during the induction phase. IBA (10-5 M) treated cuttings showed higher levels of IAA and PUT as well as POX activity than control cuttings. In short-term estimation (0-24h), the free IAA peak (6h) which preceded the PUT peak (12h), might be the reason of initiation of the induction phase of rooting. Experimenting with the inhibitors of polyamine biosynthesis, DFMO, (104M, (X-difluoromethyl ornithine) and DFMA (10-4 M, (X-difluoromethyl arginine) it was observed that DFMO was more inhibitory than DFMA in adventitious root formation and hence ODC (ornithine decarboxylase) pathway might be the preferred pathway for putrescine biosynthesis during adventitious root formation in mungbean. AG (amino guanidine), which inhibits the conversion of putrescine to fl- pyrroline and then to GABA (1- aminobutyric acid), inhibited rooting. CHA (cyclohexylamine), which inhibits the conversion of putrescine to spermidine, on the contrary, favoured rooting. Further, exogenous application of GABA also promoted rooting. The results thus point to the involvement of putrescine and its degradation product GABA in adventitious root formation in mungbean cuttings.

141. Kumar, N. (Indian Agricultural Research Institute, New Delhi (India); Dixit, K. (Choudhary Charan Singh Haryana Agricultural University, Hisar (India); Singh, A.; Srivastava, G.C. (Indian Agricultural Research Institute, New Delhi (India). Physiological changes during

flower bud opening in rose (*Rosa hybrida* L.). *Indian Journal of Plant Physiology (India)*. (Jul-Sep 2007) v. 12(3) p. 239-245 KEYWORDS: ROSA; BUDS; FLOWERING.

The present study was undertaken to understand the physiological basis of flower bud opening in rose (*Rosa Hybrida* L.). Flower stems of two cultivars of rose 'Grandgala' and 'First Red' were harvested at six developmental stages (stage 1 to stage 6). The flower stems were kept in water contained in plugged water bottles and water uptake by stems was recorded after 72 hrs. Petals were separated from seven different petal whorls in flowers (outermost to innermost) of both the cultivars at all developmental stages and their fresh weight, turgid weight, RWC & dry weight determined. It was observed that during the opening of flower bud in vase, water uptake was found to be maximum at stage 4 and thereafter, a significant decline was observed with the visible sign of petal rolling and flower wilting. A striking behavior of petal RWC was noticed throughout the flower bud opening. After a peak at stage 4 petal RWC decreased with time and reached to a lowest level (55 percent) at stage 6. Water potential of flower head followed a parallel increase with flower bud opening. A general increase in fresh weight of petals was recorded during first three phases of flower bud opening followed by a declining trend at later stages. The initial development of flower bud was accompanied by the substantial increase in the dry matter of petals up to stage 3, when the flower bud was attached to the plant. During further opening in vase, the dry matter of the petals tended to fall with the expansion of petals in different whorls.

142. Gholamian, F. (Research Centre of Natural Resources and Agriculture of Bushehr Province, Bushehr (Iran); Gholamian, F. (Malek Ashtar University, Tehran (India). University Complex of Materials and Production Technology). Germination and growth parameters of *Raphanus sativus* L. and *Triticum sativum* L. plants exposed to TNT and HMX explosives. *Indian Journal of Plant Physiology (India)*. (Jul-Sep 2007) v. 12(3) p. 276-281 KEYWORDS: RAPHANUS SATIVUS; TRITICUM SATIVUM; EXPLOSIVES; GERMINATION; GROWTH.

Differences in the degree of expressed phytotoxicity due to various 2,4,6-trinitrotoluene (TNT) and hexahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazine (HMX) TNT and HMX-concentrations were established. Effects of TNT and HMX on germination, seedling development and some basic growth components include relative growth rate (RGR), leaf area ratio (LAR) and specific leaf area (SLA), ear and root tuber fresh weight of *Raphanus sativus* L. and *Triticum sativum* L. plants were characterized. Growth analysis of TNT and HMX-treated plants showed inhibiting effect of TNT on *Raphanus sativus* L., *Triticum sativum* L. and HMX on *Raphanus sativus* L., while HMX cause increasing growth parameters to *Triticum sativum* L. up to 37.5 percent relative to control samples. Results indicate *Raphanus sativus* L. is less tolerant to TNT and HMX than *Triticum sativum* L.

F63 Plant Physiology - Reproduction

143. Chandel, P.; Geetha, K.A.; Maiti, S. (National Research Centre for Medicinal and Aromatic Plants, Boriavi (India). Reproductive biology of *Convolvulus microphyllus* (Convolvulaceae) - A memory stimulating drug plant of Ayurveda. *Indian Journal of Genetics and Plant Breeding (India)*. (Aug 2007) v. 67(3) p. 257-263 KEYWORDS: CONVOLVULACEAE; REPRODUCTION; DRUG PLANTS.

Convolvulus microphyllus Sieb.ex Spreng is a reputed memory improving drug of 'Ayurveda'. The present paper reports some aspects of reproductive biology of the species. Atmospheric temperature and relative humidity played an important role in anthesis

pattern in the species. Flower longevity was about 4-6 hours in all the months studied and insects belonging to *Apis* spp. Played an important role in pollen transfer. Maximum pollen germination was found in pollen collected after about 1 hour of anther dehiscence initiation. Stigma was not receptive in *C. microphyllus* in a freshly opened flower and peak receptivity was at about two to four hours after anthesis. However, stigma retained receptivity till flower closure (4 hours). Pollination experiments clearly revealed The predominance of cross pollination in the species. The information gathered by the present study could be effectively utilized in planning the breeding programmes in the species.

144. Karami, O. (Bu-Ali Sina University, Hamadan (Iran). Dept. of Biotechnology); Kordestani, G.K. (Zanjan Islamic Azad University, Zanjan (Iran). Dept. of Microbiology); Mohamadi, M. (Bu-Ali Sina University, Hamadan (Iran). Dept. of Irrigation). Direct somatic embryogenesis and plant regeneration in strawberry (*Fragaria ananassa*). *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2007) v. 12(4) p. 322-326 KEYWORDS: STRAWBERRY; FRAGARIA ANANASSA; SOMATIC EMBRYO; REGENERATION.

This is the first report for optimal culture conditions to induce direct somatic embryogenesis in two strawberry cultivars (Selva and Comarosa) Somatic embryos were directly formed from leaf explants plated on Murashige and Skoog (MS) medium containing picloram. Maximum embryogenesis was obtained with 2 mg/l picloram. Globular shape embryos were developed into cotyledonary-shaped embryos when they were transferred to hormone-free media containing different concentrations of sucrose. Increasing sucrose concentrations in culture media enhanced somatic embryos development. Cotyledonary somatic embryos were converted into plantlets when they were transferred on MS medium containing GA₃. Maximum germination was obtained with 1 and 2 mg/l GA₃. Plantlets were also continued to grow under greenhouse condition.

H10 Pests of Plants

145. Maurya, Ravi Prakash; Khan, M.A. (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Biological Control Laboratory, Department of Entomology). Development of cartap hydrochloride tolerant strain of egg parasitoid, *Trichogramma chilonis* Ishii through artificial selection. *Pantnagar Journal of Research (India)*. (Jun-Dec 2007) 5(2) p. 44-52 KEYWORDS: TRICHOGRAMMA CHILONIS; BIOLOGICAL CONTROL; CARTAP; INSECTICIDES; PARASITIDS; SELECTION; INSECT PESTS; EGGS.

ABSTRACT: Development of cartap hydrochloride tolerant strain of *Trichogramma chilonis* was conducted in Biocontrol Laboratory, G. B. Pant University of Agriculture and Technology, Pantnagar. For the cartap hydrochloride tolerance, superior native strain of *T. chilonis* was subjected to selection pressure. Laboratory selection was started from the 1/10th of field recommended dose and ended with 1/4th of field dose of cartap hydrochloride. *T. chilonis* took eight generations to develop tolerance against 1/10th of field dose, thirteen generations against 1/8th, twenty-one generations against 1/6th of field dose and twenty-four generations against 1/4th of field recommended dose. Parasitoid population took 66 generations to develop tolerance against 1/4th of field recommended dose of cartap hydrochloride with 80.34 per cent parasitisation and 79.66 per cent emergence from the eggs of *Corcyra cephalonica*. At each 5th generation strain was tested for consistency and at F65 per cent parasitization and per cent emergence by tolerant strain were increased up to 82.34 per cent and 81.34 per cent, respectively, whereas 16.33 per

cent and 19.67 per cent parasitization and adult emergence were given by susceptible strain at 1/4th of the field dose of cartap hydrochloride. Only 65.67 per cent parasitization and 52.00 per cent emergence were recorded by tolerant strain as compare with 15.33 per cent parasitization and 19.00 per cent emergence by susceptible strain at 5th generation at 1/10th of field recommended dose of cartap hydrochloride.

146. Tiwari, Ruchira; Sehgal, V.K. (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Entomology). Field efficacy of some insecticides and Bt against *Helicoverpa armigera* on chickpea. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 53-58 KEYWORDS: BOTANICAL INSECTICIDES; BIOLOGICAL CONTROL; FIELD EXPERIMENTATION; INSECTICIDES; BACILLUS THURINGIENSIS; CHICKPEAS; INSECT PESTS.

ABSTRACT: The field efficacy of insecticides (endosulfan, monocrotophos, cypermethrin, deltamethrin and fenvalerate) individually and in combination with *Bacillus thuringiensis* var *kurstaki* (Bt) Berliner was evaluated on *Helicoverpa armigera* (Hubner) in chickpea under field conditions during 1998-99 and 1999-2000 rabi crop seasons. The chickpea crop was sprayed twice in both the years with the respective insecticides when pest population exceeded the economic threshold level. Among the tested chemicals, cypermethrin + Bt var *kurstaki*, cypermethrin, deltamethrin + Bt var *kurstaki* and Bt var *kurstaki* were found significantly superior over rest of the treatments and two years data clearly showed that insecticides in combination with Bt var *kurstaki* were found highly effective in increase in grain yield and in reducing larval population and pod borer damage.

147. Arora, Manisha; Kanaujia, Sudha (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Chemistry); Mall, Pramod (G. B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Entomology) Department of Chemistry, College of Basic Sciences and Humanities, G.B. Pant University of Agriculture and Technology, Pantnagar-263 145 (U.S. Nagar, Uttarakhand). Fumigant action of different volatile chemicals used as grain protectants against pulse beetle (*Callosobruchus chinensis* L.) in increasing storability of pigeon pea. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 59-61 KEYWORDS: PIGEON PEAS; STORED PRODUCTS PEST CONTROL; INSECT PESTS; FUMIGATION; VOLATILE COMPOUNDS; CHEMICALS; GRAIN LEGUMES; CALLOSOBRUCHUS CHINENSIS.

Studies were carried out to evaluate the efficacy of six volatile fumigants viz., Benzene, chloroform, ethanol, methanol, acetic acid, acetone 10, 5, 1 and 0.1 ml of each chemical per 100 gram grain. Cotton was soaked with chemicals separately and used as protectants in pigeon pea against pulse beetle (*Callosobruchus chinensis* L.). Mortality in the adult insects was recorded after 24 hrs. Out of all the chemicals, acetic acid was found to be most effective in all the concentrations followed by benzene, chloroform and acetone. Acetic acid being a part of vinegar and ethyl alcohol used in medicines are not highly toxic, hence could be effectively used to control the insect pests of storage grain.

148. Purwar, J.P.; Agrawal, Anjali; Vishwanath (G.B. Pant University of Agriculture and Technology, Majhera (India). Agriculture Research Station). Evaluation of host preference of *Spodoptera litura* (Fabricius) among pulses grown in Uttarakhand hills. Pantnagar Journal of Research (India). (Jul-Dec 2007) 5(2) p. 100-102 KEYWORDS: INSECT PESTS; GRAIN LEGUMES; HOST PLANTS; GRAIN LEGUMES; UTTARAKHAND; SPOLOPTERA LITURA; UTTARANCHAL.

Of the six pulses like soybean, pigeonpea, blackgram, horsegram, rajmah, cowpea, rice bean grown in Uttarakhand hills, blackgram (*Vigna mungo*) was found to be the best preferred host of tobacco caterpillar, *Spodoptera litura* (Fab.), followed by cowpea (*Vigna sinensis*) on the basis of preference index and consumed leaf area. Horsegram (*Macrotyloma uniflorum*) was more preferred by *S. litura* than soybean (*Glycine max*), rajmah (*Phaseolus vulgaris*) and rice bean (*Vigna umbelata*). Least food consumption was recorded in soybean and pigeon pea when castor and soybean were standard hosts plants, respectively.

149. Dhingra, H.; Chaudhary, K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Biotechnology and Molecular Biology). Effect of different nitrogen sources on production of *Bacillus thuringiensis* biomass. *Annals of Biology (India)*. (Jun 2007) v. 23(1) p. 1-4 KEYWORDS: BACILLUS THURINGIENSIS; NITROGEN; BIOMASS; PRODUCTION; AGROINDUSTRIAL SECTOR; MICROBIAL INSECTICIDES.

The overuse and negative impacts of chemical pesticides on soil, water, human health, wildlife and ecological balance have led to the use of microbial insecticides against insect-pests of order Lepidoptera, Coleoptera, Diptera and Hemiptera. An attempt has been made to develop low cost Bt formulations for the management of *Helicoverpa armigera*. Agro-industrial residues and their byproducts can be used for large scale production of *B. thuringiensis* biomass. Different low cost agro-industrial based nitrogen sources such as cotton seed meal: soya meal, sunflower meal, urea, ammonium sulfate and potassium nitrate were evaluated for Bt biomass production. Among the different nitrogen sources evaluated, maximum biomass of *B. thuringiensis* isolates was achieved in the medium containing 1.0 percent cotton seed meal in basal medium. The biomass production in this medium was equivalent to that achieved in LB medium after 48 h of growth.

H20 Plant Diseases

150. Ray, Anjana; Kumar, P. (G.B. Pant University of Agriculture and Technology, Pantnagar (India). Department of Plant Pathology). Effect of culture filtrate of *Rhizoctonia solani* Kuhn on germinated seedlings of soybean. *Pantnagar Journal of Research (India)*. (Jul-Dec 2007) 5(2) p. 103-104 KEYWORDS: PHYTOTOXICITY; GLYCINE MAX; RHIZOCTONIA SOLANI; FUNGAL DISEASES; SEEDLINGS; GERMINATION; SOYBEANS.

151. Kumar, R.; Jalali, B.L.; Mehta, S.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Plant Pathology). Management of root rot (*Rhizoctonia bataticola*) by mycorrhiza (*Glomus fasciculatum*) in mungbean. *Annals of Biology (India)*. (Jun 2007) v. 23(1) p. 45-48 KEYWORDS: PLANT DISEASES; ROOT ROTS; MUNGBEANS; VIGNA RADIATA; CONTROL METHODS; MACROPHONIA; PHASEOLINA; MYCORRHIZAE; GLOMUS FASCICULATUM; DISEASE CONTROL.

A pot culture experiment was conducted to test the efficacy of mycorrhizal fungus (*Glomus fasciculatum*) for the control of root rot of mung bean. Dual inoculation of *G. fasciculatum* and *Rhizoctonia bataticola* increased the seed germination, yield/plant and biomass production as compared to the inoculation with *R. bataticola* alone. Mycorrhizal inoculation suppressed the incidence of root rot by 52 percent and resulted in better colonization of roots with VA-mycorrhiza thereby causing reduction in root rot as compared

to inoculation with *R. bataticola* alone. Mycorrhizal inoculated plants also exhibited significant increase in the uptake of nutrients (N, P, K and Zn).

152. Kunkaliker, S.; Byadgi, A.S.; Kulkarni, V.R. (University of Agricultural Sciences, Dharwad (India). Dept. of Plant Pathology); Reddy, M.K. (Indian Institute of Horticultural Research, Bangalore (India). Div. of Plant Pathology). Study of papain in papaya ring spot affected papaya. *Annals of Biology (India)*. (Jun 2007) v. 23(1) p. 49-51 KEYWORDS: PLANT DISEASES; PAPAYAS; PAPAINE; VIROSES; SPOTS.

Papaya ring spot virus (PRSV) disease has threatened papaya cultivation in the world. It causes up to 100 percent loss in severe conditions. The papain content depends on size and healthy condition of fruit. Plants infected with PRSV produced smaller fruits (1.667 cm length x 2.514 cm girth) and yielded less (0.670 g/fruit) papain as compared to bigger (Plate 45) fruits (13.827 cm length and 2.86 cm girth) and more papain (0.948 g/fruit) in healthy plants. The decrease in papain content in diseased fruits was 29.324 percent.

H50 Miscellaneous Plant Disorders

153. Kumari, R.; Kumari, B.; Punia, S.S. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy). High performance liquid chromatographic method for estimation of oxadiargyl residues in paddy grains, straw and soil. *Annals of Biology (India)*. (Jun 2007) v. 23(1) p. 33-36 KEYWORDS: HPLC; HERBICIDES; WEED CONTROL; RESIDUES; RICE; STRAW; SOILS.

A field experiment was conducted at CCSHAU Regional Research Station, Kamal during kharif 2005 to evaluate the effectivity of a pre-emergence herbicide, oxadiargyl (Top Star) applied 0 and 200 g a.i./ ha to keep the field weed-free for the whole season. The soil of the experimental field was clay loam in texture and slightly alkaline with pH 8.2. Residues were estimated in paddy grains, straw and soil at harvest by HPLC. The per cent recoveries at the fortification levels of 0.25, 0.50 and 1.0 $\mu\text{g g}^{-1}$ in soil, paddy grains and straw were found in the range of 85-90, 81-85 and 83-86, respectively, with the detection limit of 0.05 $\mu\text{g g}^{-1}$. No detectable residues were found in grain, straw and soil samples at harvest.

154. Nagarajan, V.K.; Ebbs, S.D. (Southern Illinois University, Carbondale (United States of America). Dept. of Plant Biology). Transport of arsenite by the arsenic hyperaccumulating brake fern *Pteris vittata* is inhibited by monovalent silver. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2007) v. 12(4) p. 312-316 KEYWORDS: ARSENIC COMPOUND; TOXICITY; PTERIS VITTATA; INHIBITION; SILVER.

The capacity of silver (Ag^+) to inhibit the transport of arsenite by the arsenic (As) hyperaccumulating fern *Pteris vittata* was investigated. The hydroponic growth medium was supplemented with 200 μM arsenite and 1, 10, or 100 μM Ag^+ , with roots and pinnae harvested intermittently following treatment. Treatment with Ag^+ significantly reduced transpiration and prevented the hyperaccumulation of As. A study of competitive uptake between arsenite and its analog antimonite showed that arsenite significantly reduced the concentration of antimonite in *P. vittata*, but antimonite had no effect on As accumulation. The results collectively suggest that uptake of arsenite by *Pteris vittata* is mediated by membrane transporters sensitive to Ag^+ inhibition that may also mediate antimonite transport, such as members of the major intrinsic protein family.

H60 Weeds and Weed Control

155. Rajkhowa, D.J.; Deka, N.C.; Borah, N.; Barua, I.C. (Assam Agricultural University, Jorhat (India). Dept. of Agronomy). Effect of herbicides with or without paddy weeder on weeds in transplanted summer rice (*Oryza sativa*). Indian Journal of Agronomy (India). (Jun 2007) v. 52(2) p. 107-110 KEYWORDS: HERBICIDES; WEED CONTROL EQUIPMENT; RICE; ORYZA SATIVA.

A field investigation was carried out during the winter (rabl) season of 2003-04 and 2004-05 at Jorhat, with herbicides, viz. butachlor, oxadiargyl, pyrazosulfuron ethyl, pretilachlor, chlorimuron + metsulfuron methyl, fenoxaprop-p-ethyl applied alone or followed by paddy weeder to test their efficiency in controlling weeds in transplanted summer rice. All the weed-control treatments increased the grain yield of rice significantly over unweeded check and decreased the population and dry weight of weeds significantly. Uncontrolled growth of weeds caused 49percent reduction in crop yield. Treatment of pretilachlor 0.75 kg/ha (pre-emergence) + paddy weeder, resulted in the highest grain yield, maximum weed-control efficiency (88percent) and monetary returns (Rs 8,300/ha). Herbicides alone were inferior to their use with paddy weeder.

156. Halder, J. (Orissa University of Agriculture and Technology, Bhubaneswar (India). All India Coordinated Research Project on Agroforestry, Dept. of Forestry). Effect of chemical weed control methods on productivity of transplanted rice (*Oryza sativa*). Indian Journal of Agronomy (India). (Jun 2007) v. 52(2) p. 111-113 KEYWORDS: HERBICIDES; WEED CONTROL METHODS; RICE; ORYZA SATIVA.

A field experiment was conducted during the rainy seasons of 2000 and 2001 on transplanted rice (*Oryza sativa* L.) at Chiplima, Orissa, to evaluate the efficiency of different herbicides and herbicide mixtures. Application of almix 0.004 kg tank-mixed with butachlor (1.0 kg/ha) 3 days after transplanting (4.80 t grains/ha) or application of butachlor (1.0 kg) at 3 days after transplanting (DAT) followed by sequential application of almix 0.004 kg/ha at 25 DAT (4.69 t grains/ha) was as good as hand-weeding twice at 20 and 40 DAT (4.84 t grains/ha) in controlling weeds and achieving grain yield. Application of almix 0.004 kg + butachlor 1.0 kg/ha and butachlor 1.0 kg, followed by almix 0.004 kg/ha increased the grain yield by 36.8 and 33.6percent, respectively, over the unweeded check. There was a negative linear relationship between weed dry weight and grain yield ($r=-0.74$).

K10 Forestry Production

157. Ghildiyal, S.K.; Sharma, C.M. (Hemwati Nandan Bhagauna Garhwal University, Sringer (India). Dept. of Forestry). Heat affected cone bursting in various provenances of *Pinus roxburghii* from Garhwal Himalaya. Indian Journal of Genetics and Plant Breeding (India). (May 2007) v. 67(2) p. 183-184 KEYWORDS: PINUS ROXBURGHII; HEAT TOLERANCE; HIMALAYAN REGION; SEEDS; GERMINATION.

P10 Water Resources and Management

158. Samanta, S.; Chandra, K.; Manna, S.K.; Saha, K. (Central Inland Fisheries Research Institute, Kolkata (India). Sediment status of the Hooghly and Haldi estuaries at Haldia Industrial area with special reference to trace metals. Journal of the Indian Society of Soil

Science (India). (Sep 2007) v. 55(3) p. 349-359 KEYWORDS: ESTUARIES; WATER ANALYSIS; WASTE WATER; TRACE ELEMENTS; SOIL ANALYSIS; SOIL CHEMICAL PHYSICAL PROPERTIES; WEST BENGAL; STATISTICAL METHODS.

Sediment quality of Hooghly and Haldi estuaries at Haldia industrial area, West Bengal was studied in the present investigation. The trace metal (Cd, Cu, Mn, Pb and Zn) content in sediment phase and the possible impact due to anthropogenic activities in the zone were also evaluated. The seasonal influences were prominent on sediment specific conductance, CaCO₃, primary particles distribution, available nitrogen and also on the content of the trace metals viz., Cu, Mn and Zn. Specific conductance was basically related with headwater discharge and tidal influence. The industrial effluents significantly increased the level of organic carbon. Higher levels of specific conductance, available nitrogen and trace metals (Cu, Mn and Zn) were also recorded in the area influenced by township, although the increase was not statistically significant. Relatively more variations were noticed in the content of Mn and Cu in the out-fall zone due to industrial effluents. Correlation studies revealed that organic carbon and available phosphate were positively correlated with clay ($r = 0.24$, $p=0.04$). Among the trace metals, Zn and Pb also exhibited good correlation with clay ($r = 0.33$, $p=0.004$ and $r = 0.27$, $p=0.025$, respectively). Organic carbon showed positive correlation with Cu ($r = 0.31$, $p=0.007$). Factor analysis technique yielded 4 factors expressing 96 PERCENT variability of the observed parameters. Levels of Cd (sampling site averages 1.69 to 2.09 mg kg⁻¹) and Cu (sampling site averages 16.75 to 36.56 mg kg⁻¹) observed in the present study were higher than the previous reports on river Ganga. At the same time, the observed levels of Cu and Mn were found to be much lower than those reported for the other river systems of India. The study would be of immense help in sequencing of trace metals in similar Indian estuarine sediments.

159. Kumari, A.; Pandey, O.P. (Rajendra Agricultural University, Pusa (India). Dept. of Biochemistry). Effect of waterlogging on metabolic constituents in maize. Indian Journal of Plant Physiology (India). (Oct-Dec 2007) v. 12(4) p. 366-372 KEYWORDS: MAIZE; ZEA MAYS; METABOLITES; WATERLOGGING.

Thirty days old seedlings of four varieties of maize (*Zea mays* L.), viz. Laxmi, Suwan, Desla Yellow and Desla Brown were subjected to waterlogging treatment for 24 and 72 h with a view to assess, the metabolic modification. Post-hypoxic studies were also made after placing the waterlogged plants to normal condition for 48 and 96 h. The results obtained on different parameters like chlorophyll, carotenoids, free aminoacids, pyruvate, glycolic acid, reducing sugar and inorganic phosphorous contents revealed that Suwan and Desla Brown were more tolerant to waterlogging than Laxmi and Desla Yellow.

P31 Soil Surveys and Mapping

160. Rao, D.V.K.N.; Punnoose, K.I.; Karthikakuttyamma, M. (Rubber Research Institute of India, Kottayam (India). Agronomy/Soils Div.). Interpretation of survey of data of soil under rubber: use of multivariate statistics. Journal of the Indian Society of Soil Science (India). (Jun 2007) v. 55(2) p. 99-104 KEYWORDS: SOIL SURVEYS; DATA COLLECTION; STATISTICAL METHODS; RUBBER; SOIL CLASSIFICATION.

Report is available on the rubber-growing soils in traditional region of India after surveying and mapping in 1:50000 scale and a total of 62 soil series have been identified."Further handling or data is needed to extract information for practical purposes:

Weighted means of sand, silt, clay, coarse fragments, LipH, effective cation exchange capacity (ECEC), available water capacity (A WC) and depth were considered for the analysis. Factor analysis extracted three factors namely, reactive surfaces, available water capacity and surface charge which explained 73 percent of the variability. Cluster analysis identified eight clusters that could be used as the basis for evolving management practices. In all the analyses it was inferred that coarse fragments and depth had significant role on the A WC and thus the availability of water to plants. Future experimentation in these soils, either for testing or developing recommendations, could certainly be based on these inferences and clusters.

161. Sidhu, G.S.; Rana, K.P.C.; Lal, T.; Mahapatra, S.K.; Verma, T.P.; Rao, R.V.S.; Ram, J.; Singh, S.K.; Singh, S.P. (National Bureau of Soil Survey and Land Use Planning, New Delhi (India). Delhi Regional Centre). Soils of Himachal Pradesh : inventory for land use planning. Journal of the Indian Society of Soil Science (India). (Jun 2007) v. 55(2) p. 203-208
KEYWORDS: SOIL SURVEY; SOIL MORPHOLOGICAL FEATURES; SOIL CLASSIFICATION; SOIL CHEMICOPHYSICAL PROPERTIES; HIMACHAL PRADESH; HIMALAYAN REGION.

P32 Soil Classification and Genesis

162. Uppal, H.S.; Sawhney, J.S.; Sharma, B.D. (Punjab Agricultural University, Ludhiana (India). Dept. of Soils). Sedimentation pattern of piedmont alluvial fan in sub-mountainous Siwalik hill tract of Punjab. Journal of the Indian Society of Soil Science (India). (Jun 2007) v. 55(2) p. 105-111
KEYWORDS: SOIL PROFILES; SOIL GENESIS; HIGHLANDS; ALLUVIAL SOILS; PIEDMONT; PUNJAB; HIMALAYAN REGIONS; SEDIMENTATION; SOIL MORPHOLOGICAL FEATURES.

The piedmont zone, located between the foot hills of lower Siwalik Himalayas and the plains in northwest of Punjab is elongated from north east to south east and its average height varies from 250 to 350 m above mean sea level. Based on the interpretation of satellite imageries along with topo sheets of the area, in conjunction with ground truth checking i.e. relief, slope and drainage characteristics, the study area was divided into three physiographic units viz., fan head, middle fan arid toe fan. The varying distribution patterns of sediments from different units of the alluvial fan in the piedmont plain of lower Siwalik hills were studied and it has been observed that alluvium was heterogeneous in constitution (sand to boulders). The size of sedimentary particles decreased from the fan head or apex towards the fan tailer toe. The total sand content was maximum in fan head soils with weighted mean (WM) = 89.8 percent followed by middle fan soils (WM = 88.5 percent) and toe fan soils (WM = 83.2 percent). The coarse sand content and fine sand content followed the opposite trend, whereas medium sand content did not show any uniform trend. Coarse sand content decreased from fan head soils (WM = 48.2 percent) to toe fan soils (WM = 34.8 percent) and fine sand content increased from fan head soils (WM = 20.5 percent) to toe fan soils (WM = 39.3 percent). The silt content also showed an increasing trend from fan head soils (WM = 1.9 percent) to toe fan soils (WM = 6.4 percent). The clay content was almost similar in fan head (WM = 8.3 percent) and middle fan (WM = 8:1 percent) soils and increased in toe fan soils (WM = 10.5 percent). The soils of the fan. Head contained medium to very coarse sized abundant gravels and stones (46.8 percent) in surface horizon. The content of gravels and stones decreased drastically both in the surface as well as sub-surface horizons of middle fan and toe fan soils. The studied pedons from different units of

the alluvial fan did not show development of any surface or sub-surface diagnostic horizons and had A-C profiles only and as such qualified for Typic Ustifluvents according to Soil Taxonomy.

163. Arora, S. (Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu (India). Div. of Soil Science and Agricultural Chemistry); Chahal, D.S. (Punjab Agricultural University, Ludhiana, (India). Dept. of Soils). Profile distribution of different forms of boron in typic heplustalfs of Punjab. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 248-253 KEYWORDS: SOIL PROFILES; BORON; PUNJAB; SOIL CHEMICOPHYSICAL PROPERTIES.

Profile as well as surface samples were collected from Typic Haplustalfs (Gurdaspur series) of Punjab for determination of different forms of boron. Surface soils were loam in texture with organic carbon content varying from 0.30 to 1.02 percent. Water soluble B ranged from 0.14 to 0.28 mg kg⁻¹; hot water soluble boron from 0.20 to 0.72 mg kg⁻¹; and leachable B from 0.26 to 0.84 mg kg⁻¹. The total boron content in these soils varied from 18.16 to 28.54 mg kg⁻¹. Available boron content was positively and significantly correlated with clay ($r=0.656^{**}$), silt ($r=0.462^*$) and CEC ($r=0.592^{**}$) and was negatively correlated with sand content ($r=-0.585^{**}$). About 54 percent of the overall samples tested were low to medium in available boron.

164. Sidhu, G.S.; Rana, K.P.C.; Lal, T.; Mahapatra, S.K.; Verma, T.P.; Rao, R.V.S. (National Bureau of Soil Survey and Land Use Planning, New Delhi (India) . Soils of Himachal Pradesh : Land capability classification and assessment of soil degradation status for suggested land use. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 335-339 KEYWORDS: SOIL CLASSIFICATION; LAND SUITABILITY; SOIL DEGRADATION; HIMACHAL PRADESH; LAND USE.

Studies pertaining to land capability classification and soil degradation status of Himachal Pradesh were undertaken for perspective land use. About 78.3 percent area belongs to land capability classes VI, VII and VIII which are non-arable lands and not suited for agriculture but suitable for forest, orchards, pasture and recreational purposes. Class III and IV lands covering an area of 21.4 percent are moderately to marginally suitable for growing climatically adopted crops. Class-II lands occupy negligible area and there being no class-I lands. The degree and extent of soil degradation as well as severity of soil degradation have been assessed. About 53.8 percent area of the state is affected by water erosion. Stoniness is the next main problem, mostly common with areas of water erosion and found to be occupy 23.1 percent area. Flooding affects only 0.3 percent area. About 22.8 percent area is under rock outcrops, glaciers, ice caps (part of class VIII lands) and unfit for agriculture. The ameliorative measures along with suggested land use have been suggested to arrest further degradation of soils and for sustained agricultural as well as non-agricultural uses.

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165. Saha, R. (Indian Council of Agricultural Research Research Complex for North Eastern Hill Region, Umiam (India). Div. of Water Management); Mishra, V.K. (Central Soil Survey Research Institute, Lucknow (India). Regional Station). Long-term effect of various land use systems on physical properties of silty clay loam soil of N-E hills. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 112-118 KEYWORDS: SOIL HYDRAULIC

PROPERTIES; HIGHLANDS; SILTY SOILS; CLAY SOILS; SOIL CHEMICOPHYSICAL PROPERTIES; SOIL TPEYS; LOAM SOILS; ECOSYSTEMS.

The shifting cultivation, predominant in N-E hills of India, has become unsustainable today primarily due to reduced huming cycle (2-3 years) leading to soil degradation and ecological imbalance. An investigation was undertaken to evaluate the long-term effects of different land use systems viz. agriculture, agri-horti-silvi-pastoral, forestry, livestock based land use, natural fallow and shifting cultivation on some soil physical properties with an objective to recommend the most suitable alternative land use system for maintenance of soil physical health. There was a general increase in bulk density values with increasing soil depth in all the systems. Adoption of modified land use system like agri-horti-silvi-pastoral system significantly increased the mean weight diameter (29.4 percent) and decreased the dispersion ratio (52.9 percent) over the shifting cultivation. With respect to the available water content under modified systems, it increased by 24.036.5 percent over the shifting cultivation. The unsaturated hydraulic conductivity $[K(8)]$, and soil water diffusivity $[D(8)]$, varied from 0.50×10^{-6} to 11.16 cm hr^{-1} and 0.28×10^{-7} to $0.72 \times 10^{-3} \text{ m}^2 \text{ s}^{-1}$, respectively, among the various land use systems. These attributes decreased with decrease in soil water content. The periodical monitoring of soil moisture regime indicated that the agri-horti-silvi-pastoral, agriculture, and livestock based land use systems conserve higher soil moisture throughout the year as compared to other systems. On the basis of the parameters investigated, agri-horti-silvi-pastoral system appeared to be most suitable for improving the soil hydro-physical conditions and conserving soil moisture as well in the hilly agro-ecosystems of Meghalaya.

166. Lal, K.; Mongia, A.D. (Central Soil Salinity Research Institute, Karnal (India); Kumar, R. (Punjab Agricultural University, Ludhiana (India). Dept. of Soils); Swarup, A. (Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry). Kind and amount of ions released and sodium hazard in an alkali soil under saline/sodic irrigation waters. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 119-126 KEYWORDS: SOIL ANALYSIS; SOIL SOLUTION; ION EXCHANGE CAPACITY; ELECTROLYTES; ADSORPTION; SODIUM; WASTE WATER; ALKALINE SOILS; WATER QUALITY; SOIL CHEMICOPHYSICAL PROPERTIES.

The kind and amount of ions released from soil and consequent changes in composition of applied waters were estimated in sandy loam alkali soil of pHs 9.2, sodium adsorption ratio (SAR) 31.9 and electrical conductivity (ECe) 3.2 dS m^{-1} . The soils were equilibrated with waters having three levels of total electrolyte concentration (TEC) (TEC: 10, 20 and 40 m.e. VI), four levels of SAR (10, 20, 30 and 40) and two levels of residual sodium carbonate (RSC: 0 and 5 m.e. t-l). The analysis of effluent collected at equilibrium showed that Na followed by Ca+Mg were the major cations and CO_3 and HCO_3 were the major anions released, as a result of which total salt concentration increased by 4.0 to 7.0 m.e. l-l compared to applied waters. Owing to the proportionately higher release of Ca+Mg, effluent SAR was drastically reduced by 6 to 72 percent, particularly where initial total electrolyte concentration of water was low and SAR was high. Higher release of $\text{CO}_3 + \text{HCO}_3$ than Ca+Mg increased RSC of the effluent by 0.2 to 1.7 m.e. l-l. To find out the ions released from mineral weathering, previously equilibrated soil columns were again leached uniformly with pore volumes of good quality water having SAR 1.5 and TEC 6.1 m.e. VI at biweekly intervals till the steady composition of coming out solution was achieved. Here also a continuous released Na varied from 3.9 to 6.8 m.e. VI and that of Ca+Mg varied from 0.8 to 1.2 m.e. l-l in the

displaced soil solution at steady state. From break-through curves, it was found that the relative release of Na in soil solution from soil, saturated with waters of different SAR and TEC, both of RSC and non-RSC, was higher and continued for longer duration than Ca+Mg. Though more Na was released than Ca+Mg but ratio of Na:Ca+Mg ions released into the soil solution varied only from 3.5 to 6.8 which would reduce the sodic hazards (SAR) of irrigation waters having SAR 9.6. The release of Ca+Mg reduced sodic hazards of high SAR irrigation water, which will not be as high as suggested by their chemical composition.

167. Borkotoki, B. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Soil Science); Das, K.N. (Assam Agricultural University, Jorhat (India). Sulphate sorption and buffering capacity in some soils of Assam. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 127-133 KEYWORDS: BUFFERING CAPACITY; SOIL TYPES; SOIL ANALYSIS; SORPTION; SULPHATES; SOIL CHEMICOPHYSICAL PROPERTIES; ASSAM; SULPHUR.

A study was undertaken to relate the sulphate sorption characteristics and buffering capacities in some soils with soil properties covering three major soil orders viz., Entisols, Inceptisols and Alfisols of Assam. Both sorption and maximum sulphur buffering capacity (MSBC) of these soils varied widely among the soils. Alfisols, in general, showed maximum sulphate sorption capacity ranging from 91.6 to 1300 Jlg g-l along with highest MSBC (35.6 to 418 mL g-l). Among the soil orders, Entisols, in general, showed lowest MSBC with 19.2 to 32.8 mL g-l and lowest sulphate sorption capacity varying from 58.2 to 399 Jlg g-l. Such differences in sulphate sorption and MSBC were attributed to differences in their soil pH, amount of amorphous and crystalline oxides of Fe and Al, organic carbon content and available sulphate pools of these soils.

168. Patton, S.; Sharma, S.K.; Singh, P.K. (SASRD Nagaland University, Medziphema (India). Dept. of Agricultural Chemistry and Soil Science). Characterization of the acidity of soils under different land use pattern in Nagaland. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 134-138 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; CATIONS; SOIL PH; LIMING; NAGALAND; SOIL ANALYSIS; ION EXCHANGE CAPACITY.

An experiment was conducted to characterise the acidity component in seventeen soils under different land use patterns in Nagaland state. The physico-chemical properties such as pH, organic carbon, CEC, exchangeable Ca²⁺, exchangeable Mg²⁺, and texture were studied. The acidity components like, huexchangeable AP⁺, exchangeable acidity, pH-dependent acidity and extractable acidity of soils were also, determined. Significant correlation was found between acidity component, and physico-chemical properties' of soils. Each form of acidity viz., exchangeable acidity, extractable acidity, non-exchangeable acidity and pH-dependent acidity had contributed to total acidity pool in varying proportions. The pH-dependent acidity : was the dominant form of acidity and its contribution towards total acidity was more than 75 percent, which was I followed by extractable acidity. The mean value of total potential acidity was quite high, resulting in severe' acidity problem in these soils. Liming is essential in overcoming such problems and increasing productivity.

169. Jagtap, P.B. (National Agricultural Research Project (Plan Zone), Pune (India); Patil, J.D.; Nimbalkar, C.A.; Kadlag, A.D. (Mahatma Phule Krishi Vidyapeeth, Rahuri (India). Dept. of Agricultural Chemistry and Soil Science). Influence of integrated nutrient management on

soil properties and release of nutrients in a saline-sodic soil. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 147-156 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; NUTRIENT AVAILABILITY; FERTILIZER APPLICATION; FARMYARD MANURE; BIOFERTILIZERS; NITROGEN FERTILIZERS; PHOSPHORUS; NUTRITION REQUIREMENTS; ZINC.

Periodical changes in soil pH, electrical conductivity, ammoniacal nitrogen, nitrate nitrogen and available phosphorus in a saline-sodie soil ynder integrated nutrient management were studied in incubation studies at ambient condition iii the laboratory. The soil used for incubation belonged to Sawargaon soil series of Vertic Ustropept. The addition of FYM along with chemical fertilizers helped in reducing the soil pH and increased the electrical conductivity of soil under incubation. The release of ammoniacal nitrogen was higher wherein nutrients had been applied with FYM. The ammoniacal nitrogen was higher with integration of more than one nutrients. The integration effects of nutrients with FYM rendered beneficial effects in releasing the nitrate nitrogen. The integration of urea, SSP, FeS04 + ZnS04, biofertilizers and FYM was found to be beneficial for release of phosphorus; DTP A-extractable zinc and iron.

170. Yadav, V.; Chand, T.; Tomar, N.K. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Soil Science). Effect of long term irrigation with sodic waters on soil properties and phosphate fractions. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 157-160 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; IRRIGATION WATER; SALINE WATER; NUTRIENT AVAILABILITY; PHOSPHATES; WATER QUALITY.

The effect of irrigation with sodic waters of varying composition [EC 0.75-2.30 dS mol, SAR 3.7-19.5 (mmole L⁻¹)^{1/2} and RSC 0.4-10.8 me L⁻¹] for 8 years was evaluated in terms of soil properties, inorganic phosphate fractions and availability of phosphorus (P). Analysis of 46 surface (0-0.15 m) samples showed that the tubewell-irrigated soils had higher pH, ESP, CaCO₃, EC, total P, saloid-P, Al-P, Ca-P and available P but lower organic carbon (OC) and Fe-P content as compared to the poorly irrigated and unirrigated soils. The Ca-P and total P were significantly correlated ($r = 0.72$ and 0.75 , respectively) with CaCO₃ content of the soils. The total P content of the soils was positively and significantly correlated with pH ($r = 0.35$). The saloid-P, Al-P, Fe-P and available P were not correlated significantly with any of the soil properties studied. Total P was positively and significantly correlated with Al-P ($r = 0.41$) and Ca-P ($r = 0.94$) but not with saloid-P, Fe-P and available P. The Ca-P was positively and significantly correlated with Al-P ($r = 0.47$), while it was non-significantly correlated with other phosphate fractions. Individually, none of the inorganic P fractions was significantly corelated to the available P. Soil properties (pH, EC, OC, CaCO₃ and clay) jointly contributed to 11.8 percent variation in saloid-P, 27.0 percent in Al-P, 18.5 percent in Fe-P, 61.3 percent in Ca-P, 64.3 percent in total P and 11.8 percent in available P.

171. Singh, G.; Sharma, K.N. (Punjab Agricultural University, Ludhiana (India). Dept. of Soils. Characterization of inorganic soil P forms in soils representing different agro-ecological zones of Punjab. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 209-211 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; SOIL TYPES; PUNJAB; AGROCLIMATIC ZONES; SOIL ANALYSIS; PHOSPHORUS.

172. Chandrasekharao, C.; Krishnamurthy, V. (Central Tobacco Research Institute, Rajamundry (India). Div. of Crop Chemistry and Soil Science). Quantity - intensity

relationships of potassium in flue-cured virginia tobacco soils of Khammam district, Andhra Pradesh. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 212-214
 KEYWORDS: SOIL ANALYSIS; SOIL TEXTURE; TOBACCO; ANDHRA PRADESH; SOIL CHEMICOPHYSICAL PROPERTIES; BUFFERING CAPACITY; POTASSIUM; SOIL SOLUTION.

173. Sharma, B.K.; Sarma, H.K.; Tiwari, S.C. (North Eastern Regional Institute of Science and Technology, Itanagar (India). Dept. of Forestry). Variation in physico-chemical properties of soils under natural stands of seabuckthorn in Sikkim. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 215-217
 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; HIPPOPHAE; SIKKIM; HIMALAYAN REGION; SOIL WATER CONTENT.

174. Jha, P. (Central Soil and Water Conservation Research and Training Institute Research Centre, Agra (India); Rattan, R.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry). Mineralization of carbon and phosphorus in soil as affected by soil moisture regime and incorporation of crop residues. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 218-221
 KEYWORDS: SOIL AMENDMENTS; CARBON; PHOSPHORUS; SOIL WATER CONTENT; MINERALIZATION; CROP RESIDUES; SESBANIA BISPINOSA; MUNGBEANS; WHEAT STRAW.

175. Singh, G.; Sharma, K.N.; Kumar, D. (Punjab Agricultural University, Ludhiana (India). Dept. of Soils). Phosphorus sorption as affected by P sources in soils varying in organic matter content. *Annals of Biology (India)*. (Jun 2007) v. 23(1) p. 5-11
 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; ORGANIC MATTER; SORPTION; DESORPTION; PHOSPHORUS; ADSORPTION.

The effect of four phosphatic fertilizer materials viz., diammonium phosphate (DAP), single super phosphate (SSP), ammonium nitrophosphate (ANP) and narmadaphos (NP) on the adsorption and desorption behaviour of four soil samples exhibiting variation in organic carbon was studied in a laboratory incubation experiment. There existed a wide variability in the amount of P to be added through different sources to obtain a specific equilibrium P concentration in soils varying in organic carbon. Langmuir adsorption maxima (*a*) values decreased with increasing organic carbon content of soils, irrespective of the source of P addition. On the other hand, bonding energy values (*b*) exhibited a reverse trend irrespective of the soil and P source. Computation of '*a*' and '*n*' values pertaining to Freundlich isotherms and supply parameter constants (*k_i* and *k₂*) also exhibited more or less the similar trend. A decrease in *D_m* values occurred with increase in organic carbon content. Among the P carrier, *D_m* values followed the following trend-DAPSSPANPNP. Likewise, *K_d* values exhibited an increase with an increase in organic carbon content. In a low organic carbon soil, upto 15 days reaction time, dicalcium phosphate (DCP) was the main P compound. Later on, it was found to be octacalcium phosphate (OCP) upto 60 days beyond which conversion of tricalcium phosphate (TCP) and hydroxyapatite (HA) was observed at 120 and 180 days equilibration time. Application of P through different P sources to a low OC soil changed these to dicalcium phosphate dihydrate (DCPD) within 24 h reaction period, which continued to persist till seven days of incubation. In high OC status soil, DCPD was the main P compound after 24 h of equilibration time. This compound continued to exist at 60 days reaction time and got converted to OCP afterwards (upto 180 days).

176. Dahiya, R.; Jhorar, B.S.; Malik, R.S. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Soil Science); Ingwersen, J.; Streck, T. (University of Hohenheim, Stuttgart (Germany). Institute of Soil Science and Land Evaluation). Simulation of water and heat transport in drip-irrigated sandy soil under mulched conditions. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 233-240 KEYWORDS: STRAIN MULCHES; WHEAT STRAW; SIMULATION; SOIL WATER CONTENT; SOIL TEMPERATURE; SOIL HYDRAULIC PROPERTIES.

Extremely high temperatures during summer and limited water availability are characteristics of arid and semi-arid regions. Drip irrigation offers a great potential for getting high water use efficiency under such situations. Therefore, a field experiment was carried out to quantify the effects of wheat straw mulch on soil water and thermal regime in the drip-irrigated sandy soil under uncropped condition at Regional Research Station Balsamand (29° 07'N, 75° 28'E, 225 m elevation) of CCS Haryana Agricultural University, Hisar. The field experiment consisted of two treatments, namely 1) control (no mulch), and 2) wheat straw mulch. Twodimensional Hydrus-2D numerical model was used to estimate hydraulic parameters using inverse modeling for simulating water and heat transport under control and mulch field conditions. Soil water content and hourly temperature were measured at different depths. Wheat straw mulch increased the soil water storage by 1.9 L m⁻² compared to control. The mulch decreased the daily soil temperature amplitude and average temperatures measured at 0.05, 0.10 and 0.20 m depths than those in control. Hydrus-2D model performed well for simulating water flow in control with RMSE values ranging from 0.008 to 0.012 m³ m⁻³, and in mulch with RMSE values of 0.010 to 0.012 m³ m⁻³. The model predicted that soil water storage decreased and evaporation increased by increasing the drip irrigation frequency under both the treatments. The Hydrus-2D also simulated diurnal soil temperatures reasonably well under control and mulch treatments with RMSE values ranging from 0.8 to 1.9 °C. Thus, mulching is beneficial in conserving soil moisture and moderating soil temperature in arid regions. The Hydrus-2D model was found to be a useful tool for simulating water and heat flow in the drip-irrigated sandy soil under field conditions.

177. Gangwar, R.K.; Hundal, H.S.; Raj-Kumar (Punjab Agricultural University, Ludhiana (India). Dept. of Soils). The rate and activation energy relationships of potassium release from the soils of sub-humid and arid regions of Punjab. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 241-247 KEYWORDS: SOIL ANALYSIS; SOIL CHEMICOPHYSICAL PROPERTIES; SOIL TYPES; POTASSIUM; ARID ZONES; ARID SOILS; PUNJAB; SUBHUMID ZONES.

The rate and energy relationship of potassium release upon their interaction with Hydronium ion (H⁺) was studied. The rate of potassium release was measured from sub-humid and arid region soils and their fractions in 0.1 M HCl and 0.1 M HNO₃ acid solution at 25 and 35°C for various time intervals up to 264 hours. Activation energy of potassium release from soil and their fractions were calculated by fitting the values of rate constant at two different temperatures (25°C and 35°C) to the Arrhenius equation. Potassium release from both the soils and their respective fractions was best described by Elovich equation. The rate constant of potassium release was higher for the arid region soil than that for the sub-humid region soil. The rate constant of potassium for soil fractions in both the soils was in order of claysilt sand, while reverse was the order recorded for heat of activation in the fractions of both the soils. Activation energy of the subhumid and arid soils were 11.98 and

6.09 kcal mol⁻¹, respectively in 0.1 M HNO₃ solution and 10.92 and 5.76 kcal mole⁻¹, respectively in 0.1 M HCl solution. The higher magnitude of activation energy of K release for the sub-humid soil relative to the arid soil describes the slow rate of K release in former. Release of K in aqueous solutions was controlled by the film-diffusion process. Activation energy was low in the arid region soil due to the presence of higher amounts of easily weatherable trioctahedral mica. Soil of sub-humid region was rich in dioctahedral mica, which has relatively more stability to weathering. The atomic bonding energy of potassium-bearing minerals present in soils controlled the characteristic rate of potassium release.

178. Rudramurthy, H.V. (University of Agricultural Sciences, Bangalore (India). Zonal Agricultural Research Station); Puttaiah, E.T. (Kuvempu University, Shimoga (India). Dept. of Environmental Sciences); Vageesh, T.S. (University of Agricultural Sciences, Bangalore (India). Zonal Agricultural Research Stn.). Chemical properties of soils under different land use systems in Shimoga district of Karnataka. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 259-264 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; SOIL TYPES; CROPPING SYSTEMS; FERTILIZER APPLICATION; ALLUVIAL SOILS; NUTRIENTS; RICE.

Studies on chemical properties of soils under different land use systems indicated that both the soil reaction and lime potential (3.6 and 3.0, respectively) were the lowest, while the exchangeable aluminium was the highest [0.27 cmol(p+)kg⁻¹] in the soil under tobacco land use system. Soil under mixed forest land use system recorded the highest total potential acidity [18.7 cmol(p+)kg⁻¹] and buffering capacity [0.76 cmol(p+)kg⁻¹]. In the upper solum of the soil under mixed forest land use system, cation exchange capacity was the highest [48.5 cmol(p+)kg⁻¹] while the base saturation was the lowest [25.8 cmol(p+)kg⁻¹] and reverse was true in the upper solum of the soils under cultivated land use systems. Soil under mixed forest land use system recorded higher fixation of both potassium and phosphorus than the soils under cultivated land use systems.

179. Singh, K.; Bansal, S.K.; Moinuddin (Potash Research Institute of India, Gurgaon (India). Effect of continuous cropping for twenty years on some properties of the intensively cultivated alluvial soils and nutrient indexing of rice. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 265-269 KEYWORDS: SOIL CHEMICOPHYSICAL PROPERTIES; SOIL SERIES; CROPPING SYSTEMS; FERTILIZER APPLICATION; ALLUVIAL SOILS; NUTRIENTS; RICE.

Soil samples were collected after wheat harvest from a rice-wheat cropping system of an intensively cultivated Nabha soil series in Punjab, while leaf-samples were taken from rice during crop season of year 2003 in order to monitor changes in pH, electrical conductivity, organic carbon, available P and K status of soil and create nutrient indexing of rice crop growing in the area. These samples were taken from the same 100 benchmark fanners' fields from two villages, which had earlier been sampled during 1983. Continuous cultivation of high yielding varieties of rice and wheat for 20 years without K fertilizer application depleted NH₄OAc-K in soil to a level of 60:18 mg kg⁻¹ (2003) from its initial (1983) level of 108:66 mg kg⁻¹. Rice leaf samples showed 65 percent K deficiency against 49 percent fields deficient in NH₄OAc-K (available K). Water-soluble K decreased to 13.6:9.4 mg kg⁻¹ from the initial value of 35.7:35.2 mg kg⁻¹; boiling INHNO₃-K remained more or less unchanged, indicating the substantial release of structural K due to weathering of K- minerals as a result of cropping for 20 years. Application of heavy doses of P to wheat for 20 years increased the

Olsen-P to 34.1:10.5 from a level of 8.7:4.1 mg kg⁻¹. Thirty-seven per cent rice leaf samples were found to be high and 63 percent sufficient in P. Twenty-six per cent of soil samples were found to be deficient in CaCl₂ extractable S, while rice leaf-samples showed 32 percent S deficiency. Organic carbon upgraded in medium category from its low status recorded in 1983. Long-term applications of chemical fertilizers to rice and wheat crops along with good quality of irrigation water did not deteriorate pH and electrical conductivity (in terms of acidity/sodicity and salinity) of Nabha-soil.

180. Biswas, H. (Central Soil and Water Conservation Research and Training Institute, Datta (India). Res. Centre); Rattan, R.K. (Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry); Singh, A.K. (Indian Council of Agricultural Research, New Delhi (India). Effect of soil manipulation and resource management on carbon and nitrogen turnover under rice-wheat cropping system. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 276-284 KEYWORDS: SOIL MANAGEMENT; NITROGEN CYCLE; CARBON CYCLE; MINERALIZATION; NUTRITIONAL REQUIREMENTS; FERTILIZER APPLICATION; BIOMASS; SOIL MICROORGANISM; ORGANIC FERTILIZERS; INORGANIC FERTILIZERS.

Field and laboratory studies were carried out at the IARI Farm, New Delhi to evaluate the impact of tillage factors, viz. tillage, water and integrated nutrient management (INM) on some biological indicators of soil quality under rice-wheat system. The objective was to monitor the carbon and nitrogen mineralization kinetics induced by soil microbial biomass under influence of different soil management practices. Two tillage practices, three water regimes and six nutrient treatments were applied to the rice-wheat system in a split-split plot design. The field experiment revealed that the most sensitive indicator, i.e. microbial biomass carbon (MBC), and soil organic carbon (SOC) responded positively to application of organics (farmyard manure, *Leucaena leucocephala* and rice residues) in conjunction with inorganics to the soil. Both SOC and MBC contents were higher where higher amount of irrigation water was applied to both rice and wheat. Carbon and nitrogen mineralization studies also revealed that application of FYM and *Leucaena* along with inorganics were better in terms of both carbon build-up and sustained release of nitrogen to the crops.

181. Priya, P.; Sureshkumar, P.; Mariam, K.A. (Kerala Agricultural University, Thrissur (India). Dept. of Soil Science and Agricultural Chemistry). Net ionic equilibrium in soil plant system - a better index of soil fertility in an ultisol. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 285-288 KEYWORDS: NUTRIENT SOLUTIONS; ION EXCHANGE; SOIL FERTILITY; ACRISOLS; ION EXCHANGE CAPACITY; YIELDS; SOIL SOLUTION; CATIONS; LEAF AREA INDEX; NUTRIENT UPTAKE.

The rhizosphere soil samples, the soil solution extracted from these samples at saturated moisture status and index leaf samples of fifty coconut palms in a homogeneous coconut plantation grown under an Ultisol (Vellanikkara III series), in the main campus of Kerala Agricultural University, were critically studied with respect to the nutrient status and the mutual interaction of nutrient ions, and influence of these parameters on the nut yield. Exchangeable ions extracted by 0.1 M BaCl₂ as well as the net ionic equilibrium (NIE) ratios were found to be significantly related one another and also with the yield. NIE was found to be a better index of yield.

182. Pareek, N. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Soil Science). Soil mineralizable sulphur : a sulphur availability index. Journal of the Indian Society of Soil Science (India). (Sep 2007) v. 55(3) p. 289-293 KEYWORDS: SOIL ANALYSIS; SOIL CHEMICOPHYSICAL PROPERTIES; SULPHUR; MINERALIZATION.

Forms of sulphur (S) and S supplying capacity of Mollisols of low, medium and high category of available S, were investigated from tarai region. One hundred and twenty surface-soil samples were collected, and grouped into low (A), medium (B) and high (C) available S content. Among 120 samples, 10 representative soils were selected and analyzed for their physico-chemical properties. The soils were neutral in reaction; EC ranged from 0.43 to 1.26 dSm l; and organic carbon content ranged between 7.2 and 36.1 g kg⁻¹. Available S in soil ranged from 6.25 to 36.25 mg gl; organic-S and inorganic-S ranged from 362 to 538 mg kg⁻¹ and 278 to 1178 mg kg⁻¹, respectively. Sulphur mineralization study indicated that mineralization increased up to the 10th week and then declined. Highest amount of mineralizable -S content was obtained at the 8th week in all the three groups of soils. Order of S-mineralization was found as group C group B group A. The maximum cumulative S-mineralization was noticed in group B soil. Group C soil did not show a consistent pattern.

183. Pandey, R.N. (Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry); Girish, B.H. (International Potato Center, New Delhi (India). Extractants and critical limits of available soil sulphur for maize (*Zea mays* L.). Journal of the Indian Society of Soil Science (India). (Sep 2007) v. 55(3) p. 304-312 KEYWORDS: SOIL ANALYSIS; MAIZE; ZEA MAYS; SULPHUR.

Pot experiments were conducted for two years using twenty-four soils, representing major soil orders of India to assess the suitability of fourteen extractants for establishing critical limits of deficiency of available soil sulphur for maize (*Zea mays* L.). The soils were extracted with 0.15 percent CaCl₂.2H₂O, 500 mg P L-l Ca (H₂P₀₄)₂.H₂O, Wolf, Mehlich-2, Mehlich-3, Mehlich-3 + charcoal, modified calcium chloride (0.15 percent CaCl₂.2H₂O + 0.5M CH₃COONH₄ + 0.5M CH₃COOH), 0.25MKCl at 40°C, 0.25MKCl at 50°C, 0.25MKCl at 50°C + charcoal, 0.25MKCl at 60°C, 0.25MKCl at 60°C + charcoal, 500 mg P L-l KH₂P₀₄ and 0.125MKCl + 0.075 percent CaCl₂.2H₂O at 50°C extractants. The extractable/available soil sulphur content of soils studied varied widely by different extraction methods. The results showed that soil sulphur contents extracted by 0.15 percent CaCl₂.2H₂O, 0.25MKCl 13hr 40°C, 0.25MKCl 3hr 50°C and 0.25MKCl 13hr 50°C + charcoal was correlated significantly with most of the plant parameters of maize. The soil sulphur content extracted by 500 mg P VI Ca(H₂P₀₄)₂.H₂O, Wolf, Mehlich-2, Mehlich-3, Mehlich-3 + charcoal, modified CaCl₂.2H₂O, 500 mg P VI KH₂P₀₄ and 0.125M KCl + 0.075 percent CaCl₂.2H₂O 3hr 50°C provided non-significant correlation with most of the biological indices of maize, indicating that these extractants are not suitable for the prediction of sulphur availability to maize. The critical limits of extractable/available soil sulphur for maize by promising extractants namely, 0.15 percent CaCl₂.2H₂O, 0.25MKCl at 50°C, 0.25 MKCl at 50°C + charcoal and 0.25MKCl at 40°C, were found to be 8.33, 9.14, 7.73 and 13.30 mg S kg⁻¹ soil, respectively. The critical tissue sulphur concentration in maize plant was found to be 1120 mg kg⁻¹ (0.112 percent) on dry weight basis. For the maize 0.15 percent CaCl₂.2H₂O, 0.25MKCl at 50°C and 0.25MKCl at 50°C + charcoal could be recommended as more suitable soil sulphur extractants followed by 0.25 percent KCl at 40°C.

184. Mathew, J.; Thampatti, K.C.M. (College of Agriculture, Thiruvananthapuram (India). Dept. of Soil Science and Agricultural Chemistry). Suitability of phosphogypsum as an ameliorant for soil acidity in laterite soil. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 313-316 KEYWORDS: SOIL AMENDMENT; PHOSPHATE FERTILIZERS; GYPSUM; SOIL PH; FERRASOLS; LIMING; SOIL CHEMICOPHYSICAL PROPERTIES; YIELDS; YIELD COMPONENTS; COWPEAS.

Phosphogypsum (PG), a by-product of phosphatic fertilizer industry, is used as an ameliorant in acid soils that are rich in Fe and Al. It is also a source rich in Ca and S. A field experiment was carried out in a Typic Kandiudult to study the acid neutralizing ability of phosphogypsum and its influence on crop growth and yield of cowpea. The treatments include absolute control, package of practices recommendation of Kerala Agricultural University -200 kg ha⁻¹ (POP), lime/PG full lime requirement (1 LR) and half LR, respectively and two combination treatments of both lime and PG each at 1/2 and 1/4 LR, respectively. Application of PG had significant influence on the acidity components except exchangeable hydrogen. The lowest values for both exchangeable acidity and Al were recorded under PG at full LR and were significantly superior to rest of the treatments. But lime was more efficient in reducing the exchangeable hydrogen content of soil and improving soil pH, compared to PG. Phosphogypsum had significant influence on the grain yield of cowpea with PG 1 LR recording the highest grain yield followed by the combination treatment of lime and PG each 1/4 LR which was on par with the former. Application of PG significantly increased the uptake of N, P, K, Ca and S and the highest values were recorded under 1 LR of PG. The residual crop also followed the same trend. But Mg uptake was highest in the treatment which had received lime half LR and application of PG at 1 LR recorded a very low value.

185. Yaduvanshi, N.P.S.; Sharma, D.R. (Central Soil Salinity Research Institute, Karnal (India). Use of wheat residue and manures to enhance nutrient availability and rice-wheat yields in sodic soil under sodic water irrigation. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 330-334 KEYWORDS: RESIDUES; GREEN MANURING; SULPHITATION; YIELDS; NUTRIENT AVAILABILITY; CROP RESIDUES; SALINE WATER; WHEATS; ABSORPTION; RICE.

A field experiment was conducted during 2001-02 and 2002-03 at Bhaini Majra experimental farm of Central Soil Salinity Research Institute, Karnal (Haryana) to evaluate the effect of management of wheat residue with Sesbania green manuring and sulphitation pressmud (SPM) on soil properties and yield of rice and wheat crops irrigated with sodic water [residual sodium carbonate (RSC) 8.5 m.e. i.-l, and sodium absorption ratio (SAR) 8.8 mmo1li..1f2)]. The increase in grain yields due to the application of recommended dose of fertilizer N120 P26 kg ha⁻¹ with wheat residue burning (WRB) or wheat residue ploughing (WRP) or WRP + green manure (GM) or WRP + sulphitation pressmud (SPM) were 6.2, 24.6, 25.6 and 27.4 percent for rice and 1.0, 9.5, 16.9 and 16.2 percent for wheat, respectively over that recommended dose of fertilizer N120P26 kg ha⁻¹. The yield trends for both crops followed the sequence: WRP + SPM > WRP + GM > WRP > WRB. The integrated use of fertilizer and organic materials also improved the organic carbon, P, K, Zn status and decreased the soil pH. The results suggest that incorporation of wheat residue 50 days before rice transplanting with green manuring or with sulphitation pressmud along with the recommended dose of fertilizer is necessary to improve and sustain the productivity of rice-

wheat system in areas having sodic water. The commonly adopted practice of burning of WR proved to be the least beneficial.

186. Regar, P.L.; Rao, S.S.; Joshi, N.L. (Central Arid Zone Research Institute, Pali-Marwar (India). Regional Research Stn.). Effect of in-situ moisture-conservation practices on productivity of rainfed Indian mustard (*Brassica juncea*). *Indian Journal of Agronomy (India)*. (Jun 2007) v. 52(2) p. 148-150 KEYWORDS: SOIL WATER CONTENT; WATER CONSERVATION; INDIAN MUSTARD; BRASSICA JUNCEA; RAINFED FARMING.

A field experiment was conducted at Pali-Marwar, Rajasthan, during winter season (rabi) of 1997-98 to 2001-02 to find out the effect of field bunding and deep tillage during preceding rainy (kharif) season and straw mulch on Indian mustard [*Brassica juncea* (L.) Czernj. & Cosson] productivity. Field bunding significantly increased mean mustard seed yield by 14.4 percent and biological yield by 15.3 percent over no bunding because of increased availability of soil moisture. Water-use efficiency also increased by 9.7 kg/ha-mm. Deep tillage during monsoon significantly increased the seed yield by 45.5 and 11.1 percent over pre-monsoon deep tillage in 1999-00 and 2001-02. Straw mulching at 5 tonnes/ha significantly increased mean seed yield by 17.7 percent over no mulch, with water-use efficiency of 8.3 kg/ha-mm.

P35 Soil Fertility

187. Tripathi, D.; Patial, K.S.; Verma, J.R.; Singh, K. (Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Soil Science and Water Management). Soil fertility status of kiar-nagali micro-watershed in solan district of Himachal Pradesh. *Journal of the Indian Society of Soil Science (India)*. (Jun 2007) v. 55(2) p. 222-223 KEYWORDS: SOIL FERTILITY; SOIL TYPES; SOIL ANALYSIS; HIMACHAL PRADESH; HILL SOILS; NUTRITIVE VALUE; HIMALAYAN REGION.

188. Yadav, K.K. (Maharana Pratap University of Agriculture and Technology, Udaipur (India). Dept. of Soil and Water Engineering); Chhipa, B.R. (S.K.N. College of Agriculture, Jobner (India). Dept. of Soil Science and Agricultural Chemistry). Effect of FYM, gypsum and iron pyrites on fertility status of soil and yield of wheat irrigated with high RSC water. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 324-329 KEYWORDS: SOIL FERTILITY; GYPSUM; IRON; IRRIGATION; FARMYARD MANURE; PYRITE; SALINE WATER; TRITICUM AESTIVUM; YIELDS.

A field experiment was conducted for two consecutive rabi seasons of 2001-02 and 2002-03 taking wheat (*Triticum aestivum* L.) as a test crop to study the effect of farmyard manure, gypsum and iron pyrite on fertility status of the post-harvest soil. Four levels of FYM as main plot treatments and three levels of gypsum and pyrites each as sub-plot treatments were surface-mixed and irrigated with high RSC water. The application of farmyard manure 20 t ha⁻¹ showed significant increase in available P and K content of the soil. The perceptible improvement in available N, S and Fe content of soil, grain and straw yields was recorded up to 30 t FYM ha⁻¹. The gypsum 50 percent GR recorded significant increase in available N, P, K, S and Fe content of soil, grain and straw yield over control whereas pyrite 50 percent GR brought about significant increase in the available P, S and Fe content of soil, grain and straw yield over control. Higher grain and straw yield observed under combined application of 20 t FYM ha⁻¹ + gypsum 50 percent GR while available S content of post harvest soil was

higher under 30 t FYM ha⁻¹ + gypsum 1 pyrite 50 percent GR. Interactive effect of FYM and pyrite showed higher grain and straw yield and highest available S content of soil was observed under application of 30 t FYM ha⁻¹ + pyrite 50 percent GR. Combined application of gypsum and pyrite both at 50 percent GR exhibited significantly higher available S content in the soil.

189. Radder, B.M.; Patil, P.L.; Patil, S.G.; Khot, A.B.; Aladakatti, Y.R.; Meti, C.B. (University of Agricultural Sciences, Dharwad (India). All India Coordinated Research Project on Water Management). Calibration of inductive electromagnetic probe for assessing soil salinity in vertisols of Malaprabha Command, Karnataka. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 367-369 KEYWORDS: SOIL SALINITY; STANDARDIZING; VERTISOLS; ELECTROMAGNETIC FIELD; KARNATAKA; SOIL HYDRAULIC PROPERTIES.

190. Radder, B.M.; Patil, P.L.; Patil, S.G.; Khot, A.B.; Aladakatti, Y.R.; Meti, C.B. (University of Agricultural Sciences (India) AICRP on water management). *Journal of the Indian Society of Soil Science (India)*. Sep 2007 v 55(3) p.367-369 KEYWORDS: SOIL SALINITY; STANDARDIZING; VERTISOLS; ELECTROMAGNETIC FIELD; KARNATAKA; SOIL HYDRAULIC PROPERTIES.

191. Murugan, K.; Mohan, T.C.K. (University College, Trivandrum (India). Dept. of Botany). Ameliorative mechanisms of sodium chloride stress in *Sesbania sesban* (L.) Merr.. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2007) v. 12(4) p. 373-377 KEYWORDS: SESBANIA SESBAN; OSMOTIC STRESS; ANTIOXIDANTS.

Salinity leads to primary and secondary stresses which includes membrane damage, metabolic disturbance and osmotic stress. Physiological and biochemical responses are induced in plants to ameliorate such stresses: The objective of this study was to obtain a better understanding on salt tolerance mechanism of *Sesbania sesban* to NaCl. Rate of germination was not affected by the NaCl treatment with 50, 100, 150 and 200 mM. Fresh and dry weights were decreased with increasing NaCl concentration. Greater reduction of chlorophyll b content than chlorophyll a suggested that chlorophyll b is more susceptible to salt stress than chlorophyll a. Accumulation of Na⁺ and Cl⁻ in the old leaves appears to be part of the mechanism to alleviate the salt toxicity. The higher accumulation of proline with increasing NaCl was found in the roots and shoots. *Sesbania* was found to have a greater tolerance to NaCl that could resist NaCl up to 200 mM is probably related with its ability to restrict Na⁺ and Cl⁻ content in roots and translocate higher amount of the ions to shoots. The young and old leaves had a higher constitutive level of SOD, APX, CAT and GR activities with increasing NaCl concentrations. These findings indicated that *S. sesban* has higher levels of antioxidative enzymes both constitutive and induced resulting in greater resistance to oxidative damage caused by NaCl stress.

192. Asha; Dhingra, H.R. (Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Botany and Plant Physiology). An integrated approach for screening of chickpea genotypes for salinity tolerance. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2007) v. 12(4) p. 378-382 KEYWORDS: CHICKPEAS; CICER ARIETINUM; SALT TOLERANCE; VARIETY TRIALS.

An experiment was conducted with eight genotypes of chickpea to provide useful parameters for screening against salinity stress, Plants were raised under 0, 4, 6 and 8dSm⁻¹ of chloride predominant salinity, Salinity affected membrane injury, chlorophyll stability

index (CSI) and KINa ratio of fully expanded leaves of 8 week old plants and yield adversely and the extent of reduction was found to vary with the genotype, Computation of the results on the basis of double ranking system i.e 'absolute value rank' and 'per cent change rank' revealed the tolerance of chickpea genotypes in the decreasing order; KC-IHC-3C235IPC94-94Pusa256HC-ICSG9505HC. 5. Spearman's rank correlation (rs) and coefficient of concordance of these parameters with yield (w) has revealed positive and significant results on the basis of 'per cent change rank' than 'absolute value rank'.

P36 Soil Erosion, Conservation and Reclamation

193. Singh, M.J.; Khera, K.L. (Punjab Agricultural University, Ludhiana (India). Dept. of Soils). Soil erodibility in relation to physical and physico-chemical characteristics of some submontane soils of Punjab. *Journal of the Indian Society of Soil Science (India)*. (Sep 2007) v. 55(3) p. 340-348 KEYWORDS: EROSION; SOIL CHEMICOPHYSICAL PROPERTIES; SOIL TYPES; RAIN; SIMULATION; STATISTICAL METHODS; SOIL ANALYSIS; PUNJAB.

A field experiment under natural and simulated rainfall conditions was planned to estimate soil erodibility from easily measurable soil properties in the submontaneous tract of Punjab. The study was conducted at two locations under natural rainfall conditions and at four locations under simulated rainfall conditions with four land uses viz. barren, cultivated, grassland and forest land use at each location. Clay content, water stable aggregates (WSA), mean weight diameter (MWD), geometric mean weight diameter (GMD) and organic carbon (OC) were observed to be negatively correlated with soil loss and soil erodibility (K) values. However, exchangeable sodium percentage (ESP) was found to be positively correlated with soil loss and K values both under natural and simulated rainfall conditions. Multiple correlation analysis involving clay content, OC, ESP and WSA explained 93 and 66 per cent variability under natural and simulated rainfall conditions, respectively.

P40 Meteorology and Climatology

194. Pathak, P.K. (Assam Agricultural University, Jorhat (India). Dept. of Plant Breeding and Genetics); Zhu, J. (Zhejiang University, Hangzhou (Republic of China). Dept. of Agronomy). QTLs for response to low temperature stress during seedling growth in rice. *Indian Journal of Genetics and Plant Breeding (India)*. (Nov 2007) v. 67(4) p. 337-346 KEYWORDS: RICE; ORYZA SATIVA; SEEDLINGS; LOW TEMPERATURE; STRESS.

QTLs associated with growth of rice seedling under favourable and low temperature affected environments were mapped using a DH population derived from a cross between lowland indica variety, IR64 and upland japonica variety, Azucena. A dynamic approach to conventional mapping technique was employed in conjunction with a novel mapping technique termed as 'conditional mapping' using age-specific measures for seedling height, seedling weight and root depth. Among 15, 12 and 17 aTLs detected for seedling height, seedling weight and root depth, respectively, only 7, 6 and 2 QTLs for the respective traits were common to favourable temperature and low temperature affected environments indicating that, while a set of aTLs could hold the key to growth irrespective of growing environments, few aTLs with situation-specific expression might determine the differential response of the genotypes to environmental stress. The study also indicated that the difference in time of expression of some of the aTLs detected across growing environments might be additional feature of differential response of genotypes to varied growing

environments. The conditional mapping technique allowed detection of 4 aTLs for seedling height and 6 QTLs each for seedling weight and root depth- which remained undetected by the conventional mapping technique indicating temporal pattern of gene expression and suggesting the importance of this technique in QTL analysis for developmental traits.

195. Sharma-Natu, P. (Indian Agricultural Research Institute, New Delhi (India). Div. of Plant Physiology); Savitha, M.; Babu, S.; Udayakumar, M. (University of Agricultural Sciences, Bangalore (India). Dept. of Crop Physiology). Heat shock response of wheat cultivars differing in thermotolerance. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2007) v. 12(4) p. 327-336 KEYWORDS: WHEAT; TRITICUM AESTIVUM; HEAT TOLERANCE; HEAT STRESS.

In the present study an attempt was made to assess whether genetic variability in thermotolerance in wheat (*Triticum aestivum* L.) was associated with the differential accumulation and expression of high molecular weight (HMW) and low molecular weight (LMW) heat shock proteins (HSPs). Seedlings of wheat cvs. HD 2285 and UP 2338 (temperature tolerant) and cvs. HD 2428 and HD 2329 (temperature susceptible) were subjected to a gradual temperature induction (30.C,1h'.33.C,1h""37.C,2h) followed by a severe lethal temperature stress (46.C,3h). The seedlings were allowed to recover for 68 hrs and growth during recovery was taken as a measure to quantify the relative thermotolerance of these cultivars. The temperature induced seedlings of thermotolerant cultivars showed higher recovery growth and greater ability to acquire thermotolerance as revealed by 2,3,5-triphenyl tetrazolium chloride (TTC) test. The higher recovery growth of temperature induced seedlings of tolerant cultivars was associated with the enhanced accumulation and expression of both HMW as well as LMW HSPs. However, unlike the HMW HSPs which showed constitutive expression even under non stress conditions, LMW HSPs were observed to be induced only under high temperature stress.

196. Bhattacharjee, S. (Hooghly Mohsin College West Bengal Education Service, Chinsurah (India). Post Graduate Dept. of Botany). Involvement of calcium and calmodulin in the acquisition of thermotolerance in *Amaranthus lividus* L. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2007) v. 12(4) p. 337-343 KEYWORDS: AMARANTHUS LIVIDUS; HEAT TOLERANCE; HEAT STRESS; CALCIUM; CALMODULIN.

Heat caused reduction in membrane protein thiol level and increased accumulation of thiobarbituric acid reactive substances in 72 hour old germinating tissues thereby reducing germination and early growth performances. Calcium chelator (EGTA), calcium channel blocker (LaCl₃) and calmodulin inhibitor (trifluoperazine) aggravated the effects of heating and added calcium reversed them, implying that protection against heat induced oxidative damage and improvement of germination in *Amaranthus* requires calcium and calmodulin. Imposition of heat stress during early germination also causes accumulation of reactive oxygen species (ROS) like O₂⁻ and H₂O₂. Calcium treatment significantly reduced the accumulation of both the toxic ROS, while EGTA, LaCl₃, and TFP treatment enhanced the accumulation. Activities of anti oxidative enzymes catalase (CAT), ascorbate peroxidase (AP) and glutathione reductase (GR) and total thiol content decreased under heat stress in germinating *Amaranthus* seedlings. Seedlings raised with Ca²⁺ treatment under heat stress exhibit higher activities of CAT, GR and AP and total thiol level than the untreated plants. EGTA, LaCl₃, & TFP treatment, on the other hand significantly reduce the activities of all anti-oxidative enzymes and total thiol level. The work supports the view that Ca²⁺-signalling

pathway plays significant role in limiting heat induced oxidative injury during recovery phase of post germination event in *Amaranthus lividus*.

197. Rai, R.K.; Singh, P.; Shrivastava, A.K.; Shukla, S.P.; Arya, N.; Singh, R.K.; Srivastava, M.K.; Tewari, P.; Sawnani, A.; Khare, A.K.; Darash, R.; Kishore, R. (Indian Institute of Sugarcane Research, Lucknow (India). Div. of Plant Physiology). Biochemical alterations in bud and root band zone of sugarcane setts due to chilling temperature. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2007) v. 12(4) p. 344-352 KEYWORDS: SUGARCANE; SACCHARUM; COLD STRESS; PLANT DEVELOPMENT STAGES; BUDS; ROOTS.

The effect of chilling temperatures (0, 5 and 10°C) on the sugarcane bud sprouting were compared with 25°C (normal). At the chilling temperatures, in the buds and the root band zones of the single bud sugarcane sett, the reducing sugars, specific activities of acid invertase (AI), IAA (indole acetic acid) oxidase and ATPase were decreased whereas the sucrose and IAA contents were increased as compared with 25°C. However, there was no change in sucrose content at the chilling temperatures but it markedly decreased at 25°C. Sucrose immobilization caused by the suppression of the acid invertase, hence decreased content of reducing sugars and accumulation of IAA might affected the sprouting at chilling temperatures.

198. Bedi, S.; Dhingra, M. (Punjab Agricultural University, Ludhiana (India). Dept. of Botany). Emergence and seedling establishment in maize under low temperature stress and its amelioration with salicylic acid. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2007) v. 12(4) p. 383-387 KEYWORDS: COLD STRESS; MAIZE; ZEA MAYS; SEEDLINGS; ANTIOXIDANTS; SALICYCLIC ACIDS.

Emergence experiments were carried out under laboratory conditions at optimum (25°C) and suboptimum (15°C) temperatures at PPFD 450-500 pmol m⁻² s⁻¹ and photoperiod (h) of 16:8 (L:D) in two maize cultivars, viz. Sheetal and Paras (recommended for rabi and main season respectively). Suboptimum temperature had no adverse effect on emergence percentage, while days to emergence were deleteriously affected. Biochemical parameters, viz. root metabolic activity, chlorophyll content, Hill reaction activity and catalase activity (estimated from 3rd leaf of seedling) decreased while total sugars, sucrose, proline content and peroxidase activity increased at 15°C in both the cultivars. Salicylic acid (SA) (10, 20 and 50 µg ml⁻¹) used as seed soaking pre-treatment improved per cent emergence, root metabolic activity, total sugars and sucrose at both 25°C and 15°C in the two cultivars. In the cultivar Sheetal, chlorophyll content and Hill reaction activity decreased at 25°C but increased at 15°C. While in Paras, there was non-significant difference in chlorophyll content and Hill reaction activity at 25°C but increased at 15°C. Proline content increased at 15°C in both the cultivars. SA increased peroxidase but decreased catalase activity in the two cultivars at both the temperatures. SA (20 µg ml⁻¹) was most effective in ameliorating chilling tolerance.

T01 Pollution

199. Khan, M.H. (Assam University, Silcher (India). Plant Biochemistry Lab.). Induction of oxidative stress and antioxidant metabolism in *Calamus tenuis* leaves under chromium and zinc toxicity. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2007) v. 12(4) p. 353-359 KEYWORDS: OXIDATION; STRESS; CALAMUS; METABOLISM; CHROMIUM; ZINC; TOXICITY.

The possible role of Cr (VI) and Zn as catalytic inducers of free radicals and antioxidant metabolism in *Calamus tenuis* leaves was investigated. Total peroxide and lipid peroxidation measured in terms of thiobarbituric acid reactive substances showed uniform increase under metal treatment. The activity of the antioxidative enzymes superoxide dismutase decreased, whereas, catalase, peroxidase and glutathione reductase increased except higher Cr (VI) treatments decreased catalase activity. Nonenzymic antioxidants ascorbate and glutathione content increased uniformly. At higher concentration both Cr (VI) and Zn decreased the dry mass and the uptake of Cr and Zn increased with the increase in the concentrations of the heavy metals.

200. Anuradha, S.; Rao, S.S.R. (Osmania University, Hyderabad (India). Dept. of Botany). Effect of 24-Epibrassinolide on the growth and antioxidant enzyme activities in radish seedlings under lead toxicity. *Indian Journal of Plant Physiology (India)*. (Oct-Dec 2007) v. 12(4) p. 396-400 KEYWORDS: PALNT GROWTH; SUBSTANCES; BRASSINOSTEROIDS; RADISH; RAPHANUS SATIVUS; ENZYMES ACTIVITY; TOXICITY; HEAVY METALS.

The supplementation of 24-epibrassinolide reduced lead (Pb) toxicity and enhanced the growth in radish (*Raphanus sativus* L.) seedlings. The activity of antioxidant enzymes like catalase, ascorbate peroxidase, guaiacol peroxidase, superoxide dismutase showed an increase in brassinosteroid treated Pb-stressed seedlings when compared to control as well as lead alone treated seedlings. Supplementation of 24-epibrassinolide to Pb stress treatments was also associated with reduced peroxidase activity and increase in the total glutathione content. The studies demonstrated the ameliorating ability of 24-epibrassinolide in scavenging the reactive oxygen species thereby reducing the oxidative stress induced by Pb in radish seedlings.