Vol. 9, No. 1, January-June 2010 ISSN : 0973-0214

The Indian Agricultural Sciences ABSTRACTS

Indian Council of Agricultural Research
New Delhi

Vol. 9, No. 1 January-June 2010

The Indian Agricultural Sciences ABSTRACTS

Published by

Directorate of Information and Publications of Agriculture
Indian Council of Agricultural Research
Krishi Anusandhan Bhawan-I,
Pusa, New Delhi 110012

Published : July 2010

Project Director (DIPA) : Dr T.P. Trivedi

Compilation and Technical Editing : Hans Raj
Information Systems Officer
V.S. Kaushik
Technical Officer

Published by Dr T.P. Trivedi, Project Director, Directorate of Information and Publications of Agriculture, Indian Council of Agricultural Research, Krishi Anusandhan Bhawan I, Pusa, New Delhi 110012

SAMPLE ENTRY

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

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

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

A50 Agricultural Research

001. Jain, T.C.; K-12/11, DLF, Phase -II, Gurgaon (India). New paradigms in agronomic research and development. Indian Journal of Agronomy (India) v. 52(4) p. 241-244 KEYWORDS: AGRONOMY. RESEARCH. AGRICULTURAL DEVELOPMENT.

It was encouraging to see that a serious issue of new directions to agronomic research in India was deliberated at the National Symposium held at Navsari Agricultural University, Navsari, Gujaraffrom 19-21 November 2008. Perhaps it is high time to think in this direction to maintain the established reputation of agricultural scientists, especially of Agronomists. The growth in agriculture is not only declining but at times has just stagnated, and it is a difficult task to achieve its 4. growth to maintain the overall national growth of around 8. in the next 5 years. It requires a paradigm shift and there are ample signs of it. But the process of change is too slow, needing a change in overall attitude of the scientific community with enabling policy support. Research must contribute to development (short-term or long-term), and to achieve this objective, the scientists should examine much deeper to the 'quality and relevance of research'. At the same time the development efforts should make the best use of available research. As such, there is need to strengthen the linkages between agricultural research and development. This paper points out some of the changes that are required for a new approach to agricultural research in general and agronomy in particular.

002. Yadav, R.L.; Indian Institute of Sugarcane Research, Lucknow (India). My journey in changing facets of agronomic research during three decades of green revolution in India. Indian Journal of Agronomy (India) v. 52(4) p. 245-254 KEYWORDS: AGRONOMY. RESEARCH. AGRICULTURAL DEVELOPMENT. HIGH YIELDING VARIETIES.

The changing facets of agronomic research in India as observed and followed by me during the past three decades, are reviewed in this paper. Green Revolution ushered in a new paradigm of agronomic management of crops in India. Fertilizer responsiveness of dwarf wheat generated heavy demand of fertilizers and gave major boost to the Indian fertilizer industry. Thus, due to the increased availability of fertilizers in the market, sugarcane farmers also started using heavy doses of N fertilizer to improve the cane yield, but at the cost of sugar content. Therefore, determination of optimum dose of N became important. In the first decade of my research career, I worked in this direction to work out the optimum dose and time of N application in sugarcane. Later on, with the introduction of fertilizer-responsive short-duration varieties in many crops like pulses and oilseeds, multiple cropping emerged as an important concept for intensification of agriculture. Consequently, I reoriented my research activities to develop companion cropping system with sugarcane and worked out fertilizer requirement of different crop combinations. Within two decades of Green Revolution, due to expansion of irrigation facility, rice-wheat crop rotation became predominant production system in the Indo-Gangetic plains, with gradual decrease in the area under pulse cultivation. Efforts were made to introduce pulses as companion crops of sugarcane for sustaining soil fertility and providing extra income to cane growers. Within a short span of time rice-wheat system, due to heavy de¬mand of nutrients developed soil fatigue and witnessed decline in factor productivity. My research interest again changed during 1980s towards conservation of soil-organic carbon, by utilizing the organic farm waste material and crop residues. Various options of green-manuring were also tried in rice-wheat and sugarcane-based cropping systems to achieve this objective and to increase the fertilizer-use efficiency. From high-input agronomy, my research interest thus, finally changed to conservation agronomy. Conservation of soil moisture through trash mulching, in-situ decomposition of trash using bio-agents and bio-manuring to improve the soil fertility as well as nutrient-use efficiency has now become my prime concern. In sugarcane, the improvement in productivity of ratoon crop remained a major research activity throughout my career.

E11 Land Economics and Policies

003. Ramesh, V.; Central Tuber Crops Research Institute, Thiruvandhapuram (India)Bandyopadhyay, K.K.; Central Institute of Cotton Research, Coimbatore (India)Sharma, K.L.; Central Research Institute for Dryland Agriculture, Hyderabad (India). Evaluation of infiltration models under different land use and management systems in semi-arid tropical vertisols. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 154-160 KEYWORDS: INFILTRATION. TROPICAL ZONES. SOIL CRACKING. TROPICAL SOILS. LAND USE. LAND MANAGEMENT.

Effects of land use and management treatments on soil infiltration parameters were assessed in the semi-arid tropical (SAT) zone of India. An infiltration study was carried out in Vertisols at six locations under two different land uses viz., agriculture and wasteland (WL); under agriculture land use, two different levels of management viz., high management (HM) and farmer's management (FM) were considered. The performance of2 empirical infiltration models (Kostiakov 1932 and Horton 1940) and 2 process-based models (Green and Ampt 1911 and Phillip 1957) was evaluated to predict instantaneous infiltration rates in these locations. The model parameters were evaluated for efficiency and precision with respect to effects of land use and management levels. The soil series of Kasireddypalli under HM recorded higher infiltration rates. Infiltration rates were lower in wastelands than in agricultural lands. Based on coefficient of determination (R2), root I mean square error (RMS), coefficient of residual mass (CRM) and model efficiency '(ME) parameters, the Horton's (1940) model gave the best representation of the infiltration rate and time relationship in Vertisols at all the locations.

E16 Production Economics

004. Singh, G.; Narendra Deva University of Agriculture and Technology, Uttar Pradesh (India)Singh, O.P.; Narendra Deva University of Agriculture and Technology, Uttar Pradesh (India)Kumar, V.; Narendra Deva University of Agriculture and Technology, Uttar Pradesh (India)Kumar, T.; Narendra Deva University of Agriculture and Technology, Uttar Pradesh (India). Effect of methods of establishment and tillage practices on productivity of rice (oryza sativa) whet (Triticum aestivam) cropping system in lowlands. Indian Journal of Agricultural Sciences (India) v.78(2) p.63-166 KEYWORDS: ORYZA SATIVA. TRITICUM AESTIVUM.

Transplanting method of rice being at par with seeding by drum seeder and direct seeded by zero-till-drill without tillage after spray of glyphosate .5 kg ai/ha but gave significantly higher grain yield of rice over rest methods of establishment. Rice sown in puddled soil depleted significantly higher amount of nutrient as compared to unpuddled soil. Grain yield of whet was significantly lowest in rice plot established in rice plot seed as compared to unpuddled. Wheat sown in rice plot seed by zero till drill without tillage after spray of glyphosate of 0.5 kg ai/ha gave significantly highest grain yield.

005. Surekha, K.; Directorate of Rice Research, Hyderabad (India) Rao, K.V.; Directorate of Rice Research, Hyderabad (India)Sam, T.K.; Directorate of Rice Research, Hyderabad (India). Improving productivity and nitrogen use efficiency through integrated nutrient management in irrigated rice (oryza sativa). Indian Journal of Agricultural Sciences (India) v.78(2) p.173-176 KEYWORDS: ORYZA SATIVA. PRODUCTIVITY. NITROGEN.

In a field experiment to study the influences of different organic sources on productivity and nitrogen use effciency in irrigated rice, three organic sources (paddy straw, greengram and dhaincha) were used in different combinations along with chemical fertilizers. Though the green nature, greengram only could result in signficant yield increase (by 13.) over inorganic fertilizers in the first year, all the organic sources resulted in significant grain yield increase over fertilizers alone (by 17-41.) from second year onwords.

F01 Crop Husbandry

006. Hariprasanna, K.; National Research Centre for Groundnet, Junagadh (India)Lal, Chuni; National Research Centre for Groundnet, Junagadh (India)Radhakrishnan, T.; National Research Centre for Groundnet, Junagadh (India). Relationship between flowering duration and physical-quality traits as well as pod yield in groundnet (Arachis hypogaea). Indian Journal of Agricultural Sciences (India) v.78(2) p.180-182 KEYWORDS: ARACHIS HYPOGAEA. FLOWERING. GROUNDNUTS.

An experiment was conducted during 2005 to study the relationship between duration of flowering and physical quality traits as well as pod yield in groundnut (Arachis hypogaea L.). Different duration of flowering simulated through artifical deflowering resulted in signficaunt differences for 100-kernel mass and sound mature kernels signifying that the kernel size and recovery of mature kernels. The regressions of during of flowering upon 100-kernal mass and sound mature kernels were near to unity and significant, thus implying that breeding programmes for large-seeded groundnut varieties should take into consideration the flowering duration also in the genotypes.

007. Mandal, S.K.; Krishi Vigyan kendra, Muzaffarpur (India)Jha, V.B.; Krishi Vigyan kendra, Gopalganj (India). Constraints in adoption of I.P.M. modules among farmers in Gopalganj, Bihar. Annals of Plant Protection Sciences v.16(2) p.396-398 KEYWORDS: CONSTRAINTS. CULTIVATION.

The major constraints in the adoption of IPM modules in various crop cultivation were lack of knowledge of various parameters like determing ETL of insects and diseases, about identifying the harmful and benefical insects, about recommended dose of insecticides, fungicides, weedicides, fertilizers etc., timely and appropriate transfer of technology by extension organizations, dedicated and regular extension personnel, farm literature on various crop cultivion, high cost of pesticides/bio-pesticides and bio-agents etc. The overall percentage regarding the constraints pertaining to technology was 72.2. constraints pertaining to technology, extension service, supply and marketing and transfer of technology was 74.6, 71.0 and 68.0. respectively.

008. Rajkhowa, D.J.; Assam Agricultural University, Jorhat (India). Dept. of Agronomy)Borah, D.; Assam Agricultural University, Jorhat (India). Dept. of Agronomy). Effect of rice (Oryza sativa) straw management on growth and yield of wheat (Triticum aestivum). Indian Journal of Agronomy (India) v.52(2) p.112-115 KEYWORDS: RICE. ORYZA SATIVA. RICE STRAW. TRITICUM AESTIVUM. YIELDS.

A field experiment was conducted at Jorhat, Assam during 2004-05 and 2005-06 to find out an effective practice of rice (Oryza sativa L.) straw management in wheat (Triticum aestivum L. emend. Fiori & Paol.) as a component of integrated nutrient management. Straw was incorporated 5 Vha with different decomposers, viz. starter N (one-third recommended dose of N), cellulose-decomposing microorganisms (COM), earthworms culture (EC), EC + FYM, COM + EC, FYM and starter N+ COM + EC + lime. These decomposers significantly improved the yield and yield components in wheat compared with straw removal. Incorporation of rice straw 5 Vha under dual inoculation of cellulose-decomposing microorganisms and earthworms improved the grain yield by 2.46 Vha. These also increased the nutrient uptake, available N, P, K in soil at harvest and benefit: cost ratio. Straw incorporation increased the organic C in the soil by 2-11 compared with straw removal. It also increased the microbial population in soil substantially irrespective of the decomposer used. Inoculation with COM led to build-up of microbial population in the soil. Thus, rice straw incorporation with cellulose decomposing micro-organisms and earthworms resulted in higher yield, increased nutrient uptake, improved residual soil fertility and soil microorganism status and ultimately higher benefit: cost ratio of wheat.

009. Kumar, A.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Productivity, economics and nitrogen-use efficiency of speciality corn (Zea

mays) as influenced by planting density and nitrogen fertilization. Indian Journal of Agronomy (India) v. 52(4) p. 306-309 KEYWORDS: ZEA MAYS. PLANT POPULATION. NITROGEN FERTILIZERS. PRODUCTION. ECONOMICS.

A field experiment to study the effect of planting density and N level on pop corn and sweet corn (Zea mays L.) was conducted during rainy season 2005 and 2006 at New Delhi. An increase in planting density recorded taller plants with reduced values of yield attributes of both pop corn and sweet corn. However, in sweet corn the number of cobs/ha increased with the increase in planting density. The planting density of 66,666 and 83,333 plants/ha re¬corded 23.5 and 40.0. higher grain yield of pop corn compared with that of 55,555 plants/ha respectively. The cob and kernel yields of sweet corn however, improved significantly by 19.4 and 15.2. at a planting density of 83,333 over that of 66,666 plants/ha respectively, but further increase in planting density to 1,11,111 plants/ha decreased both the cob and the kernel yields in comparison with 83,333 plants/ha. The net returns, net returns/Re invested, N uptake and N-use efficiency also showed a similar trend. The increase in N level up to 120 kg/ha resulted in taller plants with higher values of yield attributes of pop corn as well as sweet corn, which consequently resulted in higher yields and returns. The highest N uptake and residual soil N content were recorded at 120 kg N/ ha level. The N-use efficiency was the highest at 40 kg N/ha, and an increase in N level reduced the N-use efficiency. The results show that for getting higher yield and net return, pop corn and sweet corn should be planted at 83,333 plants/ha planting density and fertilized with 120 kg N/ha.

010. Lal, K.; Himachal Pradesh PWD, Sirmaur (India)Rawat, G.S.; Wildlife Institute of India, Dehra Dun (India). Additions to the flora of Himachal Pradesh from Sirmaur district. Indian Journal of Forestry (India) v. 31(1) p. 113-115 KEYWORDS: FLORA. WILD PLANTS. HIMACHAL PRADESH.

011. Jain, S.C.; University of Rajasthan, Jaipur (India). Medicinal Plants and Biotechnology Research Lab)Jain, R.; University of Rajasthan, Jaipur (India). Dept. of Chemistry. Biopotentialities of Verbesina encelioides cell cultures. Indian Journal of Plant Physiology (India) v. 13(3) p. 224-230 KEYWORDS: ANTIMICROBIALS. ANTIOXIDANTS. ORNAMENTAL PLANTS. PHYTOTOXINS.

Verbesina encelioides (Cav.) Benth. & Hook. fil ex Gray is regarded as ornamental garden plant and there are many reports of its use in folk medicine as analgesic, emetic, febrifuge, insecticide and anti-inflammatory. It is even used to treat cancer, gastrointestinal disturbance, skin ailments, and snake bite. The aim of present investigation is to evaluate the biosynthetic and bioefficacy potentials of the cell cultures of V. encelioides. For this purpose, cell cultures were established from seeds -on MS basal m'edium in the absence or presence of IAA, NAA, Kn and BAP singly or in various combinations. Initiation of callus was observed after 20 days of inoculation and callus was successfully established on MS medium supplemented with 10 mgIL NAA and 0.4 mgIL Kn. The callus was whitish brown in colour and friable in nature. Various compounds viz. friedelin, epifriedelin, lupeol, a-, P- amyrin, stigmasterol, betulin and P-sitosterol have been isolated and identified using spectral studies. Different bioefficacies like antibacterial, antifungal followed by disc diffusion method and antioxidant using 2,2-Diphenyl-1-picrylhydrazyl (DPPH) were studied and compared with in vivo system. J.

012. Kumar, V.; Rajendra Agricultural University, Samastipur (India). Dept. of Soil Science)Prasad, R.K.; Rajendra Agricultural University, Samastipur (India). Dept. of Soil Science). Integrated effect of mineral fertilizers and green manure on crop yield and nutrient availability under rice-wheat cropping system in calciorthents. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 209-214 KEYWORDS: NUTRIENT AVAILABILITY. FERTILIZERS. INORGANIC FERTILIZERS. CROP YIELD. CROPPING SYSTEMS. INTEGRATED CONTROL. GREEN MANURES.

A field experiment conducted on Calciorthents revealed that average biomass production of green gram [Vigna radiata (L.) Wikzek] at initiation of flowering was 1.12 t ha-1 whereas residual yield of green gram was 1.20 t ha-1 after picking pods at full

maturity stage. On an average, green gram yielded 0.55 t grain ha-1. The direct and residual effects of75. NPK + green manure on grain yield of rice and wheat were more than those through addition of 100. NPK, which indicates that green manure could easily substitute 25. NPK to each of rice and wheat crop (equivalent to 25 kg N, 6.67 kg P and 8.3 kg K ha-1 in rice-wheat cropping system). Green manuring and green gram residue incorporation enhanced the uptake of N, P and K by rice and wheat. The direct and residual effect of green gram residues incorporation was inferior to green manuring because of high C/N ratio of the crop residue (34.3). Significant build up of organic carbon, available N, P and K in soils was recorded under graded levels of fertilizers and also with green manure and green gram straw incorporation after the picking of pods. This study suggests that a short duration pulse crop like green gram can give dual profit by way of providing grain for sale/consumption by the farmer's family and straw as the green manure.

013. Sarangthem, I.; Central Agricultural University, Imphal (India). Dept. of Soil Science and Agricultural Chemistry)Singh, L.S.; Central Agricultural University, Imphal (India). Dept. of Soil Science and Agricultural Chemistry)Singh, N.G.; Central Agricultural University, Imphal (India). Dept. of Soil Science and Agricultural Chemistry)Sarkar, A.K.; Central Agricultural University, Imphal (India). Dept. of Soil Science and Agricultural Chemistry). Response of rapeseed to nitrogen and sulphur. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 222-224 KEYWORDS: RAPESEED. NITROGEN. SULPHUR. LIPID CONTENT. YIELDS. NUTRIENT UPTAKE.

An experiment was conducted to investigate the response of rapeseed to nitrogen and sulphur at the Research Farm ofthe College of Agriculture, Central Agricultural University, Imphal during raM seasons of 1990-2000 and 2000-2001 on a clayey soil. Treatments consisted of three levels of nitrogen (0, 40 and 60 kg ha-I) and three levels of sulphur through gypsum (0, 20, 40 kg ha-I). Application of 60 kg N ha-I produced the highest seed (1.18 t ha-I) and straw (1.69 t ha-I) yield of rapeseed. Oil content in seed increased significantly with the addition of nitrogen (60 kg ha-I) and sulphur (40 kg ha-I). Total N uptake by rapeseed progressively increased from 39.6 to 72.6 kg ha-I with the increase in N levels. The uptake of sulphur increased with sulphur application up to 40 kg S ha-I. Uptake of P and K by rapeseed increased with graded levels of-nitrogen and sulphur. .

014. Karthikeyan, K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry) Shukla, L.M.; Indian Agricultural Research Institute, New Delhi (India). Div. of Soil Science and Agricultural Chemistry). Effect of boron-sulphur interaction on their uptake and quality parameters of mustard (Brassica juncdea L.) and sunflower (Helianthus annuus L.). Journal of the Indian Society of Soil Science (India) v. 56(2) p. 225-230 KEYWORDS: MUSTARD. BRASSICA JUNCEA. HELIANTHUS ANNUUS. BORON. SULPHUR.

Greenhouse experiment was conducted with a soil (Typic Haplustalf) deficient in boron and sulphur to study the effect of interaction between B and S on their uptake and quality parameters of mustard (Brassicajuncea L.) and sunflower (Helianthus annuus L.). The interaction effect between boron and sulphur significantly and synergistically influenced the dry matter and seed yields of both the crops, which were observed the highest at 60 mg kg -1 of S in conjunction with 2 mg kg -1 of boron. The oil and protein contents of sunflower and mustard were significantly and synergistically improved by the application of both sulphur and boron.

F02 Plant Propagation

015. Dhilllon, W.S.; Punjab Agricultural University, Ludhiana (India). Dept. of Horticulture)Pannu, B.K.; Punjab Agricultural University, Ludhiana (India). Dept. of Horticulture)Gill, P.P.S.; Punjab Agricultural University, Ludhiana (India). Dept. of Horticulture). Influence of rootstock and inter-stock combination on pre-bearing

behaviour of pear cv. Punjab beauty. Indian Journal of Plant Physiology (India) v. l13(3) p. 251-257 KEYWORDS: PEARS. SCIONS. GRAFT COMPATIBILITY. PUNJAB.

Effect of Shiara, Kainth large fruited, Kainth small fruited, Patharnakh cuttings and Sucker rootstocks along with inter-stock were evaluated for their effect on various vegetative characteristics of pear cv. Punjab Beauty. The overall minimum rootstock, inter-stock and scion girth was in Patharnakh cutting! Patharnakh ! Punjab Beauty treatment among the triple combinations, while Sucker! Punjab Beauty recorded the lowest values both for rootstock and scion girth among double combinations. Combination of Patharnakh cutting! Punjab Beauty recorded maximum plant height, plant spread and tree volume. Leaf size and number of stomata were maximum in Sucker! Sucker! Punjab Beauty combination. The combinations of Shiara! Patharnakhl Punjab Beauty; Shiaral Punjab Beauty; Kainth large fruited! Patharnakh! Punjab Beauty; Kainth large fruited! Punjab Beauty; Patharnakh cutting! Patharnakhl Punjab Beauty and Patharnakh cutting! Punjab Beauty resulted into a smooth graft union. The results show great variability among different combinations. The combinations of Sucker! Sucker! Punjab Beauty and Sucker! Punjab Beauty have produced dwarf plants. These combinations will be further critically examined for their flowering and fruiting behaviour.

016. Ramana, S.; Indian Institute of Soil Science, Bhopal (India) Biswas, A.K.; Indian Institute of Soil Science, Bhopal (India)Ajay; Indian Institute of Soil Science, Bhopal (India)Rao, A.S.; Indian Institute of Soil Science, Bhopal (India). Phytoextraction of lead by marigold and chrysanthemum. Indian Journal of Plant Physiology (India) v. 13(3) p. 297-299 KEYWORDS: LEAD. CHRYSANTHEMUM. BIOREMEDIATION. SOIL BIOLOGY.

Chrysanthemum and marigold were grown in the pots at five levels of lead (0,100,150,200,250 and 500 ppm). At lower levels, the applied Pb promoted growth of the plants but at the highest level suppressed the growth. The concentration of Pb in the tissues followed the order: rootstemleafflower. Chrysanthemum recorded higher concentration of Pb in root (649 Jlg got dw) at 500 ppm of applied Pb than marigold (587 g-1DW) at the same level of Pb. Marigold because of its high biomass recorded higher total Pb uptake than chrysanthemum. Therefore, marigold could have a great prospective as a phyremediator of soils contaminated with moderate to relatively high levels of Pb.

F03 Seed Production and Processing

017. Bahar, N.; Forest Research Institute, Dehra Dun (India). Silviculture Div.). Effect of media on seed germination of Cupaniopsis anacardioides (A. Rich.) Radlk.. Indian Journal of Forestry (India) v. 31(1) p.137-139 KEYWORDS: GERMINATION. INTRODUCED VARIETIES. PLANT DEVELOPMENTAL STAGES.

Cupaniopsis anacardioides is an exotic species and native to Australia. Seeds matured in the month of June. For best germination performance, three media were tested namely Top of Paper, Between Paper and Sand. Maximum germination and vigour index were recorded in top of Paper Medium.

018. Basnet, D.B.; Darjeeling Forest Divsion, Darjeeling (India)Dey, K.K.; Darjeeling Forest Divsion, Darjeeling (India). Studies on seed germination of an Indian ginseng (Panax assamicus Ban. spec. nov.) for successful cultivation and conservation. Indian Journal of Forestry (India) v. 31(2) p. 201-205 KEYWORDS: PANAX PSEUDOGINSENG. CULTIVATION. CULTIVATION.

A study was conducted for production of high quality seedlings for domestication and large scale commercial cultivation of Panax assamicus. The germination behaviour of graded seeds and post germination growth under different growing media were different. The results of germination percentage in highest to lowest order were in sand and leaf mould sand in I: I ratio. The effect of graded fruits containing double seeds showed highest germination per cent than fruits containing only one seed. Similarly depulped seeds with darker brown seed coat showed higher than seeds with light brown seed coat.

The post germination growth of seedling germinated out of two seeded fruit was highest among all the treatment.

F04 Fertilizing

019. Kumar, Suman; Chaudhary Charan Singh Haryana Agriculture University, Hisar (Indi)Hooda, B.K.; Chaudhary Charan Singh Haryana Agriculture University, Hisar (Indi)Jaggi, Seema; Chaudhary Charan Singh Haryana Agriculture University, Hisar (Indi)Singh, Rajendra; Chaudhary Charan Singh Haryana Agriculture University, Hisar (Indi). Use of dummy variables for investigating structural stability in fertilizer-yield response models. Indian Journal of Agricultural Sciences (India) v.78(2) p.183-186 KEYWORDS: FERTILIZER APPLICATION. FERTILIZATION.

In regression analysis, the dependent variable is influenced not only by the quantitative variabales, but also by variables that are quantitative in nature. A method of quantifying such attributes is by constructing dummy variables that take on value of 1 (presence of an attribute) or 0 (absence of an attribute). in the present paper, dummy variable technique has been used for combining data for different varieties and over years and testing structural stability of fertilizer-yield quadratic responce function fitted on wheat crop grown in Haryana for two years and over three varieties. The result shows that rate of change of yield with respect to nitrogen is different in two years. However, the quadratic response function is stable over three wheat varieties.

020. Munda, G.C.; ICAR Research Complex for North Eastern Hill Region, Umiam (India). Effect of organics and inorganics on productivity and uptake of nutrients in rice (Oryza sativa)-toria (Brassica campestris) cropping system. Indian Journal of Agronomy (India) v.52(2) p. KEYWORDS: RICE. ORYZA SATIVA. CROPPING SYSTEMS. BRASSICA CAMPESTRIS. ORGANIC FERTILIZERS. INORGANIC FERTILIZERS.

A field study was undertaken during 2003-04 to 2005-06 at Modipuram to develop appropriate establishment technique of rice (Oryza sativa L.) and to improve the growth, yield, profitability and soil fertility of rice-based cropping systems. The mean yield of hybrid rice was higher (8.52 Vha) with drum seeding and remained on a par with that of direct seeding and mechanical transplanting (puddled) compared with manual transplanting (puddled) and mechanical transplanting (unpuddled). Direct seeding (dry bed, unpuddled) adopted in the previous rice crop gave higher mean yield of the succeeding wheat (5.70 Vha), chickpea (2.20 Vha) and Indian mustard (1.86 Vha). Drum seeding recorded the highest mean net returns (Rs 47,040 /ha) in rice-wheat system, followed by rice-chickpea (Rs 42,336 /ha) and rice-Indian mustard system (Rs. 39,774 /ha), and benefit: cast ratio (1.24) in rice-chickpea followed by rice-wheat (1.21) and rice-Indian mustard system (1.12). The system-wise soil analysis undertaken after three crop cycles indicated that organic carbon increased positively over initial status in rice-chickpea system; however, the magnitude of increase was largest under mechanical transplanting (puddled), and negative balances were found in rice-wheat system. Available P and K balance was generally positive in rice-wheat, rice-chickpea and rice-Indian mustard crop sequences except for P in rice-wheat and rice-mustard crop sequences under direct seeding. The drum or direct-seeded rice-based cropping system not only produced higher grain yield of hybrid rice but also resulted in greater productivity of the subsequent crops.

021. Shekhawat, K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy)Shivay, Y.S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Effect of nitrogen sources, sulphur and boron levels on productivity, nutrient uptake and quality of sunflower (Helianthus annuus). Indian Journal of Agronomy (India) V. 52(2) p. 129-134 KEYWORDS: NITROGEN FERTILIZERS. SULPHUR FERTILIZERS. TRACE ELEMENTS. NUTRIENT UPTAKE. HELIANTHUS ANNUUS.

A field experiment was conducted during spring season of 2005 and 2006 on sunflower (Helianthus annuus L.) at New Delhi to study the effect of N sources (prilled

urea and calcium ammonium nitrate), S levels (0, 25 and 50 kg/ha) and B levels (0, 0.75 and 1.50 kg/ha) on yield attributes, yield and the oil quality of spring sunflower. Application of N, Sand B fertilizers increased significantly yield attributes, yield and the oil quality parameters of spring sunflower. Calcium ammonium nitrate proved superior to urea in terms of nutrient concentration and their uptake by sunflower. Application of 25 kg S/ha was more effective in increasing the growth, yield attributes and yields than of 50 kg S/ha. However, the highest seed yield (1.99 t/ha) was recorded with 50 kg S/ha, which was 13. higher than that of the control. Boron application 0.75 kg and 1.5 kg/ha was effective and the crop responded well up to the second dose, and the higher (1.5 kg/ha) level gave the highest seed yield (2.01 t/ha), which was 13.5 and 6.3. more than of the control and 0.75 kg B/ha respectively. It also increased the total nutrient concentration and their uptake by sunflower. Application of Sand B markedly improved the content of unsaturated fatty acids (linoleic and oleic) and reduced that of the saturated fatty acids (palmitic and stearic). Sand B application reduced the saponification but increased the iodine value significantly. The N sources and Sand B levels did not show marked changes in the acid value of sunflower oil. Thus, application of 80 kg N/ha through calcium ammonium nitrate along with 25 kg S/ha and 1.50 kg B/ha would be sufficient to sustain the productivity and quality of spring sunflower under north Indian conditions.

022. Kumar, N.; Rajendra Agricultural University, Samastipur (India). Suarcane Research Institute)Sinha, U.P.; Rajendra Agricultural University, Samastipur (India). Suarcane Research Institute). Response of spring-planted sugarcane (Saccharum officinarum) to phosphorus and sulphur application. Indian Journal of Agronomy (India) V. 52(2) p. 145-148 KEYWORDS: SUGARCANE. SACCHARUM OFFICINARUM. PHOSPHATE FERTILIZERS. SULPHUR FERTILIZERS.

An experiment was conducted during the spring season of 2003-04 and 2004-05 on sandy loam soil at Pusa, Bihar to study the effect of four levels each of phosphorus (0, 17.5, 35.0 and 52.5 kg/ha) and sulphur (0, 40, 80 and 120 kg/ha) on growth and yield of sugarcane (Saccharum officinarum L.). Application of 35.0 kg P/ha to sugarcane recorded significantly higher mean growth (tillers, 175,000lha; cane length, 221.0 cm; leaf area index, 4.04), yield attributes (millable canes, 131,1 OO/ha; single-cane weight, 570 g; cane diameter, 2.02 cm) and cane yield (73.54 t/ha) over no P. The mean increase in cane yield with application of 52.5,35.0 and 17.5 kg P/ha over the control was 20.77, 18.83 and 9.97. respectively. Application of 35.0 kg Plha registered an increase of 4.4. in su¬crose content in juice, 31.8. in P uptake and 22.1 in S uptake over the control. The use efficiency of P decreased with corresponding increase in its level. However, S-use efficiency was maximum at higher level of P application. Apparent P recovery was the highest at 35.0 kg P/ha (8.07 and 8.68.), whereas apparent S recovery progressively increased with increase in P levels from 0 to 52.5 kg/ha. The response of sulphur was also pronounced at 80 kg/ha as evident from significant increase in mean cane length (219 cm), leaf area index (4.02), number of millable canes (131,OOO/ha), single cane weight (566.0 g), cane yield (73.17 t/ha) and sucrose content in juice (17.3.). Sulphur levels significantly improved the uptake of P and S up to 80 kg S/ha and the increase was 21.4 and 22.2. over the control respectively. Application of 120 kg S/ha recorded maximum P-use efficiency (361.6 kg cane/kg S applied) and apparent P recovery (8.75.), but it recorded S-use efficiency (121.6 kg cane/kg S applied) up to 80 kg/ha level only. There was decrease in apparent S recovery with successive increase in S level from 40 to 120 kg S/ha.

023. Singh, R.; Central Arid Zone Research Institute, Jodhpur (India)Singh, B.; Central Arid Zone Research Institute, Jodhpur (India)Patidar, M.; Central Arid Zone Research Institute, Jodhpur (India). Effect of preceding crops and nutrient management on productivity of wheat (Triticum aestivum)-based cropping system in arid region. Indian Journal of Agronomy (India) v. 52(4) p. 267-272 KEYWORDS: TRITICUM AESTIVUM. CROPPING SYSTEMS. CROP RESIDUES. FERTILIZER APPLICATION. ARID ZONES.

A field experiment was conducted during 2003-04 and 2004-05 at Jodhpur to study the effect of preceding crops, viz. pearlmillet [Pennisetum glaucum (L.) R. Br. emend. Stuntz.], greengram (Phaseolus radiatus L.) and clusterbean [Cyamopsis tetragonoloba (L.) Taub.] and nutrient management practices on the production potential of wheat (Triticum aestivum L. emend. Fiori & Paol.)-based cropping systems in arid region of Rajasthan. Growing of clusterbean and greengram as the preceding crop resulted in significantly higher grain yield of wheat and the N and P uptake than the preceding pearl millet. Among the rainy season (kharif) crops, greengram gave the maxi¬mum wheat grain-equivalent yield (WGEY) and net returns, but N uptake was significantly highest with clusterbean. However, highest WGEY (5.58 t/ha) was recorded with greengram-wheat, being 10 and 31.3. higher than that of the clusterbean-wheat and pearl millet-wheat crop sequences respectively. Net returns and benefit: cost ratio were also maximum with greengram-wheat, but maximum gain in available Nand P status was noted with clusterbean-wheat sequence. Integrated use of FYM 7.5 t/ha + 50. RDF (50 kg N + 13.25 kg P/ha) + biofertilizer (Azotobacter + PSB) recorded significantly highest grain yield of wheat, which was 33.2. higher than in the control. Yield and nutrient uptake by kharif crops also increased markedly due to residual effect of FYM applied either alone or in combination. The highest WGEY, net returns and benefit: cost ratio of crop sequences were recorded with combined application of FYM 7.5 t/ha + 50. RDF + biofertilizer. The maximum gain in available N and P status was observed with the application of FYM 15 t/ha, followed by FYM 7.5 t/ha + 50. RDF + biofertilizer. Thus wheat grown after legumes (greengram or clusterbean) with combined application of FYM 7.5 t/ha + 50. RDF + biofertilizer gave maximum WGEY and monetary benefit.

024. Shivakumar, B.G.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy)Ahlawat, I.P.S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Integrated nutrient management in soybean (Glycine max)-wheat (Triticum aestivum) cropping system. Indian Journal of Agronomy (India) v. 52(4) p. 273-278 KEYWORDS: SOYBEANS. GLYCINE MAX. TRITICUM AESTIVUM. CROPPING SYSTEMS. FERTILIZER APPLICATION.

A field experiment was carried out during 2001-03 at Indian Agricultural Research Institute, New Delhi to study the impact of nutrient management practices on the growth, yield and economics of soybean (Glycine max)-wheat (Triticum aestivum) cropping system. The treatments consisted of combinations of 4 nutrient sources in main plots and 3 nutrient levels in subplots in soybean in rainy season. A general crop of wheat was grown during the follow¬ing winter season to study the residual effect of treatments imposed on the previous soybean. The results indi¬cated that application of 5 Vha each of crop residues (CR) and farmyard manure (FYM) along with 5 kg zinc/ha among the nutrient sources and 100. recommended dose of fertilizer (RDF) among the nutrient levels recorded significantly higher growth and yield parameters and yield (1.62 Vha) of soybean. The succeeding crop of wheat too showed a similar trend. The net returns were higher with 5 Vha of FYM in soybean (Rs 8,154) and 5 Vha each of CR and FYM alongwith 5 kg Zn/ha in succeeding wheat (Rs 12,577), as well as in soybean-wheat cropping system (Rs 20,334). The benefit cost (B:C) ratio was higher with 100. RDF among nutrient levels (0.89) and with 5 Vha CR (0.81) among the nutrient sources in soybean, whereas the 100. RDF among nutrient levels (0.73) and FYM 5 Vha+ CR 5 Vha + 5 kg Zn/ha among sources given to soybean recorded higher B:C ratio (0.72) in wheat. The organic carbon and the available N, P, K and Zn were higher with 5 Vha each of CR and FYM along with 5 kg zinc/ha among the nutrient sources, and 100. RDF among nutrient levels after the completion of 3 years of experimentation. It was concluded that combined application of 5 Vha each of CR and FYM along with 5 kg/ha zinc is necessary for getting higher yield and net returns from soybean-wheat cropping system.

025. Mahanta, D.; Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora (India)Rai, R.K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Effects of sources of phosphorus and biofertilizers on productivity and

profitability of soybean (Glycine max)-wheat (Triticum aestivum) system. Indian Journal of Agronomy (India) v. 52(4) p. 279-284 KEYWORDS: SOYBEANS. GLYCINE MAX. TRITICUM AESTIVUM. BIOFERTILIZERS. CROPPING SYSTEMS. PROFITABILITY. PHOSPHATE FERTILIZERS.

A field experiment was carried out during 2005-06 and 2006-07 at New Delhi to study the effect of different sources of phosphorus [single superphosphate (SP) and rock phosphate (RP)] and biofertilizers (phosphate-solu-bilizing bacteria and vesicular-arbuscular mycorrhiza) on productivity, nutrient uptake, P balance in the soil, phos-phorus-use efficiency and economics of soybean [Glycine max (L.) Merr.]-wheat (Triticum aestivum L. emend. Fiori & Paol.) cropping system. Application of 50. recommended dose of P as SP + PSB + VAM recorded the highest yield during the first year in soybean (2.0 t/ha) and during both the years in wheat (4.4 and 4.6 t/ha in the first and second years respectively), but that of 50. RD Pas RP + PSB + VAM registered the highest grain yield (2.2 t/ha) during the second year in soybean. P uptake and utilization efficiencies increased on application of both PSB and VAM under both the sources of P. In addition, the available P status of the soil improved by addition of both bio-fertilizers through both the sources. RP performed very poorly, but when inoculated with both the bio-fertilizers, it was comparable to SP. Although the highest net returns per rupee invested was observed in 0.5 RP+PSB+VAM, but 0.5 SP+PSB+VAM provided highest net returns of 34.4 and 41.3 thousand rupees in first and second years respectively, it gave benefit: cost ratio (B:C) very close to that of the previous treatment in the soybean-wheat cropping system. Thus half the dose of P could be saved through inoculation with both P-solubilizing and mobilizing micro-organisms to obtain higher productivity and profitability.

026. Meena, S.L.; Central Arid Zone Research Institute, Bhuj (India). Regional Research Station). Shamsudheen, M.; Central Arid Zone Research Institute, Bhuj (India). Regional Research Station). Dyal, D.; Central Arid Zone Research Institute, Bhuj (India). Regional Research Station). Impact of row ratio and nutrient management on performance of clusterbean (Cyamposis tetragonoloba) + sesame (Sesamum indicum) intercropping system. Indian Journal of Agronomy (India) v. 52(4) p. 285-289 KEYWORDS: INTERCROPPING. SESAMUM INDICUM. FERTILIZERS. CYAMOPSIS. SESAME.

A field experiment was conducted during rainy (kharif) season of 2005 to 2007 at Kukma, Bhuj, (Gujarat) in sandy soil to study the effect of row ratio and nutrient management on sustainability of clusterbean [Cyamopsis tetragonoloba (L.) Taub.] + sesame (Sesamum indicum L.) intercropping system under arid condition. Treatments comprised of 15 combinations of cropping systems, viz. sole clusterbean, sole sesame, clusterbean + sesame in 1 :2, 1:1 and 2:1 row proportions and nutrient management, viz. the control, 40 kg N/ha and 20 kg N + 5 t FYM/ha. Intercropping declined the seed yield of clusterbean by 30. compared to sole crop (mean of 3 years 0.71 t/ha). However, clusterbean-equivalent yield (0.92 t/ ha), net returns (Rs 6,251/ ha) and benefit: cost (B : C) ratio (1.67) were higher with clusterbean + sesame (2 : 1) intercropping system over the corresponding values of 0.71, 3,572 and 1.41 in sole clusterbean. Irrespective of the cropping system, application of 20 kg N + 5 t FYM/ha recorded significantly higher clusterbean-equivalent yield (1.036 t/ha), net monetary returns (Rs 7,793/ha) and B: C ratio (1.79) than of 40 kg N/ha alone and the absolute control. Addition of 5 t FYM/ha along with 20 kg N/ha gave 8.5 and 9.8. higher uptake of N than of 40 kg N/ha and the control respectively. The sustainable yield index (SYI) and sustainable value index (8VI) were higher with clusterbean + sesame under 2:1 row ratio (0.74, 0.76), and the highest SYI (0.81) and SVI (0.82) indices were observed under the application of 20 kg N/ha with 5 t FYM/ha. Clusterbean + sesame (2:1) with application of 20 kg N + 5 t FYMlha was more advantageous and saved 50. rec-ommended dose of N fertilizer.

027. Srivastava, T.K.; Indian Institute of Sugarcane Research, Lucknow (India)Singh, K.P.; Indian Institute of Sugarcane Research, Lucknow (India)Lal, M.; Indian Institute of Sugarcane Research, Lucknow (India)Suman, A.; Indian Institute of Sugarcane

Research, Lucknow (India)Kumar, P.; Indian Institute of Sugarcane Research, Lucknow (India). Productivity and profitability of sugarcane (Saccharum spp complex hybrid) in relation to organic nutrition under different cropping system. Indian Journal of Agronomy (India) v. 52(4) p. 310-313 KEYWORDS: SUGARCANE. SACCHARUM. ORGANIC FERTILIZERS. CROPPING SYSTEMS. PROFITABILITY.

A field experiment was conducted at Lucknow during 2003-2006 in autumn and spring-planted sugarcane (Saccharum spp. complex hybrid) grown in different cropping systems to assess the effect of organic nutrition on productivity, profitability and on soil health. Five organic nutrition modules were compared with the control (no manure or fertilizer). The highest number of millable canes (82.7 and 95.2 thousands/ha) and cane length (220.8 and 182.5 cm) were recorded with sulphitation pressmud (SPM) 10 t/ha + farmyard manure (FYM) 10 t/ha in autumn and spring planted crops respectively. SPM 10 t/ha + FYM 10 t/ha caused the highest uptake of N, P and K and produced the highest cane yield of 79.4 t/ha in autumn - and 68.8 t/ha in spring-planted sugarcane. The highest net profit (Rs 52,480) and benefit: cost (B: C) ratio (1.5) were recorded in autumn planted cane with FYM 20 t/ha + Trichoderma viride + lentil [Lens culinaris (L.) medic.] intercrop (1 :2). In spring planted cane, the highest net profit (Rs 45,101) and B: C ratio (1.3) was recorded with FYM 20 t/ha + Trichoderma viride + mungbean [Vigna radiate (L.) hepper] intercrop (1 :2). Significant improvement was observed over initial organic C (up to 70.7.), bulk den¬sity (up to 8.4.), water-infiltration rate (up to 46.7.) and total N (up to 61.5.) at crop harvest under various treat¬ments. The finding revealed profitable sugarcane cultivation under organic nutrient management with positive ef¬fect on soil health.

028. Reddy, S.V.K.; Central Tobacco Research Institute, Rajanundry (India). Div. of Crop Production)Krishna, S.K.; Central Tobacco Research Institute, Rajanundry (India). Div. of Crop Production) Singh, K.D.; Central Tobacco Research Institute, Rajanundry (India). Div. of Crop Production)Kumar, P.H.; Central Tobacco Research Institute, Rajanundry (India). Div. of Crop Production) Chandrasekharao, C.; Central Tobacco Research Institute, Rajanundry (India). Div. of Crop Production)Krishnamurthy, V.; Central Tobacco Research Institute, Rajanundry (India). Div. of Crop Production). Effect of conjunctive use of FYM and nitrogen on yield, quality and economic of FCV tobacco (Nocotiana tabacum). Indian Journal of Agronomy (India) v. 52(4) p. 318-322 KEYWORDS: TOBACCO. NICOTIANA TABACUM. FARMYARD MANURE. NITROGEN FERTILIZERS.

A field experiment was conducted during 2001-02 and 2002-03 at Rajahmundry, Andhra Pradesh to find out optimum level of farmyard manure (FYM) and nitrogen for getting higher productivity, quality, monetary returns of tobacco (Nicotiana tabacum L.), and changes in soil fertility after tobacco. Application of FYM 0 Vha, being comparable with 20 and 30 Vha, significantly increased mean yields of green leaf by 16.8, cured leaf by 15.6, bright leaf by 25, grade index by 20.2 and cured leaf production efficiency by 15.6. ; the lamina N P and K uptake by 22.2, 21.0 and 18.9. ; the residual soil organic C, available Nand P by 0.08, 6.6 and 15.5, respectively than that of no FYM application; and also accrued the highest net returns (Rs 25,800/ha), benefit: cost ratio (1.47) and profitability (Rs 191.11) compared with those of other FYM levels. Application of 40 kg N/ha, being comparable with 60 kg N/ha, significantly increased mean yields of green leaf by 9.5, cured leaf by 8.0, bright leaf by 12.8, grade index by 8.1 and cured leaf production efficiency by 7.9. ; the lamina Nand K uptake by 18.3 and 17.1, respectively; the residual soil available N by 4.2 compared with those of 20 kg N/ha application; and also accrued highest net returns (Rs 23,590/ha), benefit:cost ratio (1.42) and profitability (Rs 174.7 4/ha/day) compared to those of 20 and 60 kg N/ha application. Increasing the rate of N fertilizer from 20 to 60 kg N/ha increased the concentration of total N, nicotine and decreased sugars and sugar: nicotine ratio in tobacco cured leaf. Conjunctive application of 10 V ha of FYM and 50 kg N/ha was found optimum for obtaining higher yields and better grade index of tobacco with acceptable chemical quality parameters and higher monetary returns under conserved soil moisture conditions in Vertisols of Andhra Pradesh.

029. Kumar, G.; University of Allahabad, Allahabad (India). Dept. of Botany)Tripathi, R.; University of Allahabad, Allahabad (India). Dept. of Botany). Induced cytomictic variations through abiotic stresses in grasspea (Lathyrus sativus L.). Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 58-64 KEYWORDS: LATHYRUS SATIVUS. EXPERIMENTATION. STRESS. CYTOGENETICS.

A cytogenetic study was undertaken to evaluate various types of cytomictic variations induced by different types of abiotic stresses viz. temperature, heavy metal (Pb) and water stresses on the meiotic cells of Lathyrus sativus L. Chromosome transfer and cytoplasmic channels between microsporocytes occurred from prophase-I to telophase¬II stages of meiosis. The occurrence of cytomixis and other meiotic abnormalities were analyzed in comparison with pollen fertility. Due to cytomixis, various types of irregularities were noticed resulting into hypo- or hyperploids which may cause the origin of aneuploids or polyploids.

F08 Cropping Patterns and Systems

030. Bhargavi, K.; Acharya N G Ranga Agricultural University, Anantapur (India)Reddy, C. Ragnava; Acharya N G Ranga Agricultural University, Anantapur (India)Reddy, T. Yellamanda; Acharya N G Ranga Agricultural University, Anantapur (India)Reddy, D.Srivivasulu; Acharya N G Ranga Agricultural University, Anantapur (India). Effect of preceding crops in rainy season rice (Oryza sativa). Indian Journal of Agricultural Sciences (India) v.78(2) p.170-172 KEYWORDS: ORYZA SATIVA. GREEN MANURES.

A field experiment was conducted during 2000-2002 with sunnhemp (Crotalaria juncea L.)greengramm (Vigna radiata L. Wilczek) and sesame (Sesamum indicum L.)as preceding crop to rice and incorporated before planting of kharif rice, followed by rabi crops, viz groundnut, rice sunflower to study the qulity of rice. The grain and straw yield of kharif rice recorded with incorporation of sunnhemp green manure (5856 and 11196 kg/ha) or haulms of greengramm (5751 and 10509 kg/ha) were higher than thouse preceded by either fallow or sesame. N,P and K uptake of rice was improved with incorporation of green manure during kharif. The uptake of micronutrients, viz iron, zinc manganese and copper was doubled by green manure incorporation in kharif rice. greenmanuring improved the protein, iron zinc manganese, copper as well as the cooking quality of rice.

031. Dubey, Y.P.; CSK Himachal Predesh Krishi Vishvavidyalaya, himachal Predesh (India)Datt, Naveen; CSK Himachal Predesh Krishi Vishvavidyalaya, himachal Predesh (India). Affectivity of Rhizobium leguminosarum phaseoli with nitrogen in French bean (Phaseolus valgaris)- wheat (Triticum aestivum) cropping sequence. Indian Journal of Agricultural Sciences (India) v.78(2) p.167-169 KEYWORDS: PHASEOLUS VULGARIS. TRITICUM AESTIVUM. FERTILIZER APPLICATION. NITROGEN. SEQUENTIAL CROPPING.

A field experiment during year 2002 and 2003 consisting of one -rhizobium strain with and without 4 levels of nitrogen (0, 20, 40 and 60 kg N/ha) was conducted on northwest Himalayan acid alfisol using French bean (Phaseolus vulgaris L.) as summer crop and its residual effect on succeeding cereal crop (whet) was studid. Indigenous strain with starter dose of nitrogen was the best as compared to inoculation alon and higher doses of nitrogn with and without inoculation. higher dose of nitrogen application reduced nodule numbers and affected the nitrogen fixation process. Residual effect of rhizobium culture inoculation on succeeding cereal crop (whet) was more pronounced in inoculated treatments than the alone nitrogen applied treatments.

032. Gill, M.S.; Project Directorate for Cropping Systems Research, Modipuram (India)Pal, S.S.; Project Directorate for Cropping Systems Research, Modipuram (India)Ahlawat, I.P.S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agronomy). Approaches for sustainabillity of rice (Oryza sativa)-wheat (Triticum

aestivum) cropping system in Indo-Gangetic plains of India - A review. Indian Journal of Agronomy (India) v.53(2) p.81-96 KEYWORDS: RICE. ORYZA SATIVA. TRITICUM AESTIVUM. CROPPING SYSTEMS. SUSTAINABILITY. INDIA.

This paper describes the results of some innovative approaches for sustaining productivity of rice-wheat cropping system in the Indo-Gangetic plains. Integrated nutrient management with green manuring as a substitute saved 50 of the chemical fertilizers, with an average productivity of rice (4.8 Vha) and wheat (3.3 Vha). Site-specific nutrient management using judicious application of primary, secondary and micronutrients as per soil test and specific yield target was also found an economically-viable option with benefit: cost ratio of 4.9 under multi-location trials, with 15-17 Vha of productivity of rice and wheat. Resource conservation technologies (RCT) like zero tillage, bed planting and laser land leveling saved substantial quantity of irrigation water. Zero tillage saved 20 irrigation water, along with saving of 300 million litres of diesel per annum. Likewise, bed planting saved 37.5 em irrigation water. Laser land leveling led to 18.4 saving of water and higher water productivity (1.19 kg grain/m3 water) in wheat under on-farm trials. The average water productivity in wheat under on-farm trials in Punjab was 0.33 and 0.52 kg grain/m3 water under no levelling and laser leveling, respectively. Happy seeder gave 7-8 higher pro¬ductivity and retained 5-7 Vha rice crop residue for soil fertility improvement. Besides water-saving and direct productivity gain, RCT was a valuable option for reducing the cost of cultivation in terms of land preparation, timely sowing, decreased seed rate, improved water and nutrient-use efficiency, and left indirect effect on mitigating the adverse effect of climate change. Remote-sensing technology also proved valuable for decision-support system in N saving, based on management-zone approach.

033. Sharma, R.P.; Rajendra Agricultural University, Sabour (India). Dept. of Agronomy)Pathak, S.K.; Rajendra Agricultural University, Sabour (India). Dept. of Agronomy)Haque, M.. Rajendra Agricultural University, Sabour (India). Dept. of Agronomy)Lal, M.; Rajendra Agricultural University, Sabour (India). Dept. of Agronomy). Productivity, profitability and nutrient balance as influenced by diversification of rice (Oryza sativa)-wheat (Triticum aestivum) cropping system. Indian Journal of Agronomy (India) v.52(2) p.97-101 KEYWORDS: RICE. ORYZA SATIVA. TRITICUM AESTIVUM. CROPPING SYSTEMS. DIVERSIFICATION.

A field experiment was conducted during 2004-2005 and 2005-06 at Sabour, Bihar to diversify the existing rice (Oryza sativa L.) n wheat (Triticum aestivum L. emend. Fiori & PaoL.) cropping system. Among the 14 rice-based cropping systems tested, rice-potato (Solanum tuberosum L.)nonion (Allium cepa L.) + maize (Zea mays L.) relay cropping gave the highest mean rice-equivalent yield (30.66 t/ha/year), followed by rice-garlic (Allium sativum L.) maize (30.35 t/ha/year) and rice-potato-onion (27.95 t/ha/year). The highest net returns of Rs 96,581/ha/year were realized from rice-garlic-maize, which were on a par with that of rice-potato-onion + maize relay cropping (Rs 92,837/ha/year). However, the benefit: cost ratio was highest (1.73) in rice-berseem [Trifolium alexandrinum (L.) Juslen.] n maize + cowpea [Vigna unguiculata (L.) Walp.], both grown for fodder. The highest water-use efficiency (37.01 kg rice-equivalent yield/ha/mm) was recorded with ricengarlicnmaize system. The rice-potato-onion + maize relay cropping proved the most effective in producing highest calorific value (61,155 K calories/ha) and showed the maximum land-use efficiency (94.8.). The same cropping system removed the maximum quantity of N (371.6 kg/ha), P (110.4 kg/ha) and K (451.4 kg/ ha), followed by rice-berseem -maize + cowpea (F), having corresponding values 352.0, 88.2 and 361.0 kg/ ha/year. Heavy removal of NPK by rice-berseem-maize+cowpea (F) resulted in maximum negative balance of nitrogen (152.9 kg/ha), phosphorus (31.4 kg/ha) and potassium (304.6 kg/ha/year). Potassium balance was negative in all the cropping systems, indicating that K was the most removable nutrient by the crops, which results in mining of soil K and thus calls for adequate K fertilization.

034. Gangwar, K.S.; Project Directorate for Cropping Systems Research, Modipuram (India)Gill, M.S.; Project Directorate for Cropping Systems Research, Modipuram (India)Tomar, O.K.; Project Directorate for Cropping Systems Research, Modipuram (India)Pandey, D.K.; Project Directorate for Cropping Systems Research, Modipuram (India). Effect of crop establishment methods on growth, productivity and soil fertility of rice (Oryza sativa)-based cropping systems. Indian Journal of Agronomy (India) v.52(2) p.102-106 KEYWORDS: RICE. ORYZA SATIVA. CROPPING SYSTEMS. SOIL FERTILITY. PLANT ESTABLISHMENT.

A field study was undertaken during 2003-04 to 2005-06 at Modipuram to develop appropriate establishment technique of rice (Oryza sativa L.) and to improve the growth, yield, profitability and soil fertility of rice-based cropping systems. The mean yield of hybrid rice was higher (8.52 Vha) with drum seeding and remained on a par with that of direct seeding and mechanical transplanting (puddled) compared with manual transplanting (puddled) and mechanical transplanting (unpuddled). Direct seeding (dry bed, unpuddled) adopted in the previous rice crop gave higher mean yield of the succeeding wheat (5.70 Vha), chickpea (2.20 Vha) and Indian mustard (1.86 Vha). Drum seeding recorded the highest mean net returns (Rs 47,040 /ha) in rice-wheat system, followed by rice-chickpea (Rs 42,336 /ha) and rice-Indian mustard system (Rs. 39,774 /ha), and benefit: cast ratio (1.24) in rice-chickpea followed by rice-wheat (1.21) and rice-Indian mustard system (1.12). The system-wise soil analysis undertaken after three crop cycles indicated that organic carbon increased positively over initial status in rice-chickpea system; however, the magnitude of increase was largest under mechanical transplanting (puddled), and negative balances were found in rice-wheat system. Available P and K balance was generally positive in rice-wheat, rice-chickpea and rice-Indian mustard crop sequences except for P in rice-wheat and rice-mustard crop sequences under direct seeding. The drum or direct-seeded rice-based cropping system not only produced higher grain yield of hybrid rice but also resulted in greater productivity of the subsequent crops.

035. Sharma, R.P.; Rajendra Agricultural University, Sabour (India) Singh, A.K.; Sher-e-Kashmir University of Agriculture and Technology, Bhadarwah (India). Regional Horticultural Research Sub-Station) Poddar, B.K.; Rajendra Agricultural University, Sabour (India)Raman, K.R.; Rajendra Agricultural University, Sabour (India). Forage production potential and economcis of maize (Zea mays) with legumes intercropping under various row proportions. Indian Journal of Agronomy (India) V. 52(2) p. 121-124 KEYWORDS: MAIZE. ZEA MAYS. INTERCROPPING. FEED LEGUMES. FORAGE.

A field experiment was conducted during the summer season of 2006 and 2007 at Sabour, Bihar to assess the production potential and economic viability of intercropping of forage maize (Zea mays L.) with cowpea [Vigna unguiculata (L.) Walp.], rice bean [Vigna umbel/ata (Thumb) ohwi and ohashi] and clusterbean [Cyamposis tetragonaloba (L.) Taub.] under four row proportions, viz. 1:1, 1 :2, 2:1 and 2:2. Intercropping of maize and cowpea in the row proportion 2: 2 recorded significantly higher total green fodder (43.2 t/ha), dry matter (9.6 t/ha) and crude-protein yield (1.1 t/ha) as well as net returns (Rs 16,104/ha) and benefit: cost ratio (1.84) compared with the other treatments except maize + rice bean planted in the ratio 2:2. The association of maize and cowpea in row ra¬tio 2:2 also showed the highest land-equivalent ratio (1.84) and relative crowding coefficient (7.08), followed by maize + rice bean in 2:2 ratio. Among the component crops, maize was more competitive and aggressive than le¬gume intercrops. However, maize intercropped with cowpea and rice bean both in row proportion 2:1 was found to be a compatible intercropping system with lower values of aggressivity (0.01) and competition ratio (1.03). Thus in¬tercropping of forage maize with cowpea or rice bean both in 2:2 row ratio are the biologically and economically sustainable intercropping systems.

036. Nanjappa, H.V.; University of Agricultural Sciences, Bangalore (India). Dept. of Agronomy)Soumya, T.M.; University of Agricultural Sciences, Bangalore (India). Dept. of Agronomy)Ramachandrappa, B.K.; University of Agricultural Sciences, Bangalore (India).

Dept. of Agronomy)Prabhakara, B.N.; University of Agricultural Sciences, Bangalore (India). Dept. of Agronomy). Productivity and economics of transparent polyethylele for soil solarization in groundnut (Arachis hypogaea)-bell pepper (Capsicum annum) sequence. Indian Journal of Agronomy (India) V. 52(2) p. 125-128 KEYWORDS: GROUNDNUTS. ARACHIS HYPOGAEA. SEQUENTIAL CROPPING. SWEET PEPPERS. POLYETHYLENE. SOIL SOLARIZATION. CAPSICUM ANNUUM.

A field experiment was conducted during 2004 and 2005 at Bangalore to work out the economics of soil solar¬ization on break-even basis with different thicknesses (0.05 and 0.01 mm) of transparent polyethylene (TPE) in groundnut (Arachis hypogaea L.) fi bell pepper (Capsicum annum L.) sequence. Soil solarization with TPE 0.05 mm covered twice in the same season recorded significantly higher pod yield of groundnut (2.36 t/ha) and fruit yield of bell pepper (15.1 t/ha), followed by TPE 0.05 mm covered once in the same season (2.27 t/ha and 12.0 t/ ha respectively) and TPE 0.10 mm covered twice (2.17 t/ha and 12.6 t/ha). Similarly, leaf area/plant and yield attributes, viz. number of pods/plant (23.0) and number of fruits/plant (6.4) were also superior in soil solarization with 0.05 mm twice, TPE 0.05 mm once (21.7 and 5.3 respectively) and TPE 0.10 mm twice (22.1 and 6.0). Significantly lower number of weeds and weed dry weight was recorded with TPE 0.05 mm twice in both groundnut and bell pepper crop sequence. Repetitive use of TPE 0.05 mm for two times in the same season recorded higher net income (Rs 139.95 x103/ha) and B : C ratio (3.86) followed by TPE 0.05 mm for three times and TPE 0.10 mm for two times continuously in the same season. Soil solarization with TPE 0.05 mm thickness twice in the same season for groundnut fi bell pepper sequence was found to be highly productive and most economical practice.

037. Singh, U.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Sopore (India). Regional Research Station)Hasan, A.A.S.B.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Sopore (India). Regional Research Station)Singh, P.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Sopore (India). Regional Research Station)Singh, S.R.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Sopore (India). Regional Research Station). Production potential and economics of intercropping of lentil (Lens culinaris) with brown sarson (Brassica compestris) and oat (Avena sativa). Indian Journal of Agronomy (India) V. 52(2) p. 135-139 KEYWORDS: LENTILS. LENS CULINARIS. INTERCROPPING. OATS. AVENA SATIVA. PRODUCTION ECONOMICS. BRASSICA CAMPESTRIS.

A field experiment was conducted during winter season of 2004-05 and 2005-06 at Wadura, Jammu and Kashmir to evaluate the production potential, biological feasibility and economic viability of intercropping of lentil (Lens culinaris Medikus) either with brown sarson (Brassica campestris L. sub sp. oleifera var. brown sarson) or oat (Avena sativa L.) in row ratios of 1:1, 2:1, 4:1 and 6:1. Lentil yield decreased by 16fi68. due to intercropping, and yield of oat was inversely proportional to lentil row number, whereas yield of brown sarson was in the order 4:1,2:1, 1:1 and 6:1. Yield components, viz. pods/plant, grains/pod and 1 ,OOO-grain weight of main crop of lentil, and siliqua/plant or tiller/m row, grains/siliqua or grains/panicle and 1,000-grain weight of intercrops (brown sarson or oat) also decreased in the intercropping systems. Lentil with brown sarson in 4:1 row proportion or oat in 2:1 row proportion was most remunerative in respect of net returns (Rs 20,755 and 21,782) and benefit: cost ratio (3.13 and 2.67). These two intercropping systems showed higher lentil-equivalent yield, land-equivalent ra¬tio, income-equivalent ratio, area-time equivalent ratio, biological efficiency and monetary advantage among all the intercropping systems.

038. Singh, A.K.; Indian Institute of Sugarcane Research, Lucknow (India)Lal, M.; Indian Institute of Sugarcane Research, Lucknow (India)Suman, A.; Indian Institute of Sugarcane Research, Lucknow (India). Effect of intercropping in sugarcane (Saccharum complex hybrid) on productivity of plant cane-ratoon system. Indian Journal of Agronomy (India) V. 52(2) p. 140-144 KEYWORDS: SUGARCANE. SACCHARUM OFFICINARUS. INTERCROPPING. RATOONING.

A field experiment was conducted at Lucknow during 2002-03 and 2003-04 to assess the production potential and economic viability of autumn-planted sugarcaneiibased intercropping systems, viz. sugarcane sole and sug¬arcane intercropped with lentil (Lens escu/entus), rajmash (Phaseo/us vulgaris L.), Indian mustard (Brassica compestris), rapeseed (Brassica sp.) and maize (Zea mays L.) for cobs at 2 row spacings of 90 and 75 cm. The intercropping with rajmash had no adverse effect on the number of millable canes (117.6 thousand/ha), cane length (213 cm) and cane yield (83.4 t/ha) compared with sole cane. Intercropping of rajmash and maize for green cobs resulted in highest net profit (Rs 89,883 and 83,815/ha) and benefit: cost ratio (B : C) (2.53 and 2.34) com¬pared with sole sugarcane (Rs 50,199 /ha). Ratoon sugarcane intercropped with lentil gave higher cane yield (64.2 t/ha) than that from sugarcane sole. Besides, there was improvement in the physico-chemical properties of the soil under sugarcane + lentil intercropping system with lower bulk density (1.26 g/cm3) and higher infiltration rate (4.75 mm/hr) compared with sole sugarcane. Inclusion of short-duration intercrops like rajmash, and maize for green cobs in autumn-planted sugarcane improved the productivity and profitability, and lentil intercropping improved the soil health under plantiiratoon system.

039. Prasad, J.V.N.S.; Central Research Institute for Dryland Agriculture, Hyderabad (India)Gill, A.S.; Indian Grassland and Fodder Research Institute, Jhansi (India)Baig, M.J.; Indian Grassland and Fodder Research Institute, Jhansi (India)Burman, D.; Central Soil Salinity Research Institute, Canning Town (India). Regional Research Station)Gupta, S.K.; Indian Grassland and Fodder Research Institute, Jhansi (India). Fodder and fuel-wood production through agroforestry in semi-arid Central India. Indian Journal of Agronomy (India) V. 52(2) p. 152-156 KEYWORDS: AGROFORESTRY. FORAGE. WOOD PRODUCTION. INDIA.

A study was conducted at Jhansi (Uttar Pradesh) during 1999fi2002 to evaluate the production potential of tree-crop systems under rainfed situations. Four tree species, viz. Azadirachta indica, Albizia lebbeck, Dalbergia sissoo and Acacia nilotica were evaluated in sole stands and intercropped with chickpea (Gicer arietinum L.) in 6 x 12 m spacing. The intercrop had a positive effect on the growth of Azadirachta indica and Albizia lebbeck but not on Acacia nilotica and D. sissoo. Acacia nilotica and D. sissoo produced maximum growth, Azadirachta indica pro¬duced minimum growth and Albizia lebbeck intermediate growth. None of the tree species reduced the crop yield in agroforestry in the first 3 years of tree growth. In the fourth year (2001-02): 25 to 36. reduction in grain yield and 37 to 45. reduction in stalk yield across the four tree species was recorded. The highest reduction was ob¬served nearer to the tree row and the negative effect decreased with distance from the tree. Forage and crude-pro¬tein yields were higher from D. sissoo and the fuel-wood yield was higher from Acacia nilotica. Benefit: cost ratio and the net present worth was the highest with Acacia nilotica system, followed by that of D. sissoo. Hence both these tree species can be grown in combination with crops in the semi-arid central India to produce fodder and fuelwood.

040. Nanjappa, H.V.; University of Agricultural Sciences, Bangalore (India). Dept. of Agronomy)Soumya, T.M.; University of Agricultural Sciences, Bangalore (India). Dept. of Agronomy)Ramachandrappa, B.K.; University of Agricultural Sciences, Bangalore (India). Dept. of Agronomy)Prabhakara, B.N. (University of Agricultural Sciences, Bangalore (India). Dept. of Agronomy). Productivity and economics of transparent polyethylele for soil solarization in groundnut (Arachis hypogaea)-bell pepper (Capsicum annum) sequence. Indian Journal of Agronomy (India) V. 52(2) p. 125-128 KEYWORDS: GROUNDNUTS. ARACHIS HYPOGAEA. SEQUENTIAL CROPPING. SWEET PEPPERS. POLYETHYLENE. SOIL SOLARIZATION. CAPSICUM ANNUUM.

041. Singh, K.A.; Indian Grassland and Fodder Research Institute, Jhansi (India). Resource management perspective for forage production and agroforestry system development in eastern Himalayan region: a review. Indian Journal of Agronomy (India)

v. 52(4) p. 255-266 KEYWORDS: FORAGE. AGROFORESTRY. RESOURCE MANAGEMENT. HIMALAYAN REGION.

Advances in forage research in eastern Himalayan zone show that forage-resource development can play a vital role in improving the traditional ago-pastoral economy. Forage-based feeding systems have shown high produc., tion and economic efficiencies in ruminants. Besides, new possibilities have emerged to substitute a part of the total concentrate requirements of non-ruminant livestock by succulent forage crops. Tailoring of a number of forage plant species in the hill land-use systems will also provide continuous vegetative cover on the hill slopes to protect land resources and conserve the abundant native forage-plant species. An unbalanced and unsustainable form of a short-cycle shifting cultivation Uhuming) and limited opportunity to expand the arable lands and their mechanization on the hill slopes necessitate a greater intervention through agrbforestry in this region. To optimize integrated land-use capacity, many traditional agroforestry practices are existing in this region; besides, farmers own innovative approach to agroforestry systems and a number of agroforestry systems developed and perfected by research. All these systems have shown a way to improve jhum-fallow through agroforestry and contour hedge intercropping. There is a need to encourage product diversification in a unit of land through agroforestry to increase the land capacity to produce full potential and linking them to assured marketing channels by identifying demands and outlets for outputs.

042. Kumaresan, M.; Central Tobacco Research Institute, Vedasandur (India). Regional Station). Kumar, P.H.; Central Tobacco Research Institute, Rajamundry (India)Krishnamurthy, V.; Central Tobacco Research Institute, Rajamundry (India)Athinarayanan, R.; Central Tobacco Research Institute, Vedasandur (India). Regional Station). Economic viability and residual soil - nutrient status in chewing tobacco (Nicotiana tabacum)-based cropping system. Indian Journal of Agronomy (India) v. 52(4) p. 290-294 KEYWORDS: TOBACCO. NICOTIANA TABACUM. CROPPING SYSTEMS. CROP RESIDUES. SOIL FERTILITY.

A field experiment was conducted during 2002-03 to 2004-05 at Vedasandur, Tamil Nadu to study the economic viabil,ity of various chewing tobacco (Nicotiana tabacum L.) based cropping systems and their effect on residual soil-nutrient status. The treatments consisted of six chewing tobacco-based cropping sequences, viz. ragi [E/eusine coracana Gaertn]-tobacco [Nicotiana tabacum L.]-sunflower [Helianthus annuus L.]; sunnhemp [Grata/aria juncea L.]-tobacco-sorghum fodder [Sorghum bic. r L. Moench]; maize [Zea mays L.]-tobacco-sun¬flower; maize-tobacco-groundnut [Arachis hypogaea L. sunflower-tobacco-maize; and sunflower-tobaccogroundnut with a sole tobacco crop. The leaf length and width, first grade leaf yield (FGLY) and total cured-leaf yield (TCLY) of rabi chewing tobacco increased with sunnhemp as a green-manure crop in kharif and with sorghum fodder in summer. The increase in FGLY and TCLY was 15 and 14. , respectively. Residual soil-nutrient status and uptake of nutrients by tobacco lamina improved with sunnhemp-tobacco-sorghum fodder sequence. Tobacco leaf-equivalent yield (6.14 t/ha) increased with maize-chewing tobacco-groundnut sequence. Sunflower-to¬bacco-groundnut sequence significantly increased the net returns by 76. over sole tobacco. It was concluded that the sequence sunflower - tobacco - groundnut was economically viable and the residual soil nutrients improved with sunnhemp-tobacco-sorghum fodder sequence.

043. Gill, B.S.; Punjab Agricultural University, Ludhiana (India). Dept. of Agronomy)Singh, A.; Punjab Agricultural University, Ludhiana (India). Dept. of Forestry and Natural Resources)Singh, D.; Punjab Agricultural University, Ludhiana (India). Dept. of Agronomy)Gandhi, N.; Punjab Agricultural University, Ludhiana (India). Dept. of Agronomy). Studies on intercropping of medicinal, aromatic and spice crops in poplar plantation. Indian Journal of Agronomy (India) v. 52(4) p. 295-298 KEYWORDS: INTERCROPPING. DRUG PLANTS. ESSENTIAL OIL CROPS. SPICE CROPS. POPULUS.

The performance of lemongrass, Tagetes minuta, turmeric, celery, coriander, fennel, dillseed, fenugreek, Mentha arvensis, Mentha spicata, sarson (Brassica napus L.) and

wheat in compact poplar plantation (clone 'Udai') established in March 2004 at 5 m x 4 m spacing, was studied at Ludhiana. Results revealed that an increase in the age of poplar decreased the yield of crops. During 2004-05 the reduction in yield was more in crops like Mentha arvensis (64.9.), M. spicata (65.5.), coriander (26.7.) and Tagetes minuta (16.1), but was less in lemongrass (2.6.), turmeric (1.1), fennel (6.8.), dillseed (12.6.), fenugreek (7.1), sarson (1.84.) and wheat (4.75.). During 2005-06 the reduction in the yield of lemongrass, Tagetes minuta, Mentha arvensis and M. spicata; and yield of turmeric rhizome, seed of coriander, fennel, dillseed, fenugreek, sarson and wheat was 6.55, 7.50, 60.5, 50.0, 40.6, 28.1,43.9, 27.6, 37.4 and 34.4 and 32.7. , respectively in compact poplar plantation compared with that in sole or pure cultivation of these crops; and in 2006-07 it was 25.4, 39.3, 78.6, 77.0, 56.3, 70.4, 88.5, 79.6, 65.6, 85.9 and 67.2. , respectively.

044. Hossain, F.; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics)Prasanna, B.M.; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics)Kumar, R.; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics)Singh, B.B.; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). Genetic analysis of kernel modification in quality protein maize (QPM) genotypes. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 1-9 KEYWORDS: KERNELS. ZEA MAYS. GENOTYPES. POLLINATION.

Kernel vitreousness, besides agronomic performance and endosperm protein quality, is important for the successful adoption of the Quality Protein Maize (QPM) genotypes. The present study was undertaken to analyze in detail different attributes of kernel modification (endosperm modification, crown opaqueness and ear appearance) in . QPM inbred lines and a set of experimental crosses (7 x 7 full diallel). Significant differences among the QPM genotypes for kernel modification were observed in the diallel set, indicating segregation of several kernel modifier genes. Correlation analysis revealed significant and positive associations among endosperm modification, crown modification as well as ear appearance under open¬pollination. Analysis of ears obtained from different pollination modes (open vs. controlled-pollination) indicated significant interaction of the genotypes with the pollination mode, suggesting the importance of the source of pollen and its genetic constitution in conferring the kernel texture. The diallel analysis also indicated almost equal contribution of additive and non-additive effects for endosperm modification; however, there was predominance of non-additive gene effects on crown modification and ear appearance. Reciprocal cross differences for kernel modification in the diallel set were also observed, suggesting the possible dosage effects of the endosperm modifiers. Overall, for analysis of combining ability and for estimation of genetic variance components in relation to kernel modification in the QPM genotypes, experiments employing controlled-pollination mode could be more reliable than those using the open¬pollination mode.

045. Bhagwat, M.D.; Agharkar Research Institute, Pune (India)Gandhi, S.S.; Agharkar Research Institute, Pune (India)Rao, V.S.; Agharkar Research Institute, Pune (India). Trisomic analysis for qualitative characters in tetraploid wheat. Indian Journal of Genetics and Plant Breeding (India) V. 68(1) p. 84-86 KEYWORDS: HISTOCYTOLOGICAL ANALYSIS. TETRAPLOIDY. WHEAT DWARF GEMINIVIRUS.

046. Hemaprabha, G.; Sugarcane Breeding Institute, Coimbatore (India). Div. of Crop Improvement)Nagarajan, R.; Sugarcane Breeding Institute, Coimbatore (India). Div. of Crop Improvement)Alarmelu, S.; Sugarcane Breeding Institute, Coimbatore (India). Div. of Crop Improvement). Performance of elite cultivars of sugarcane (Saccharum spp.) under water deficit conditions. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 90-92 KEYWORDS: SACCHARUM. DROUGHT STRESS.

047. Sharma, P.K.; Chaudhary Sawarn Kumar Himachal Pradesh Krishi Vishwavidyalaya, Palampur (India). Dept. of Soil Science)Masand, S.S.; Chaudhary Sawarn Kumar Himachal Pradesh Krishi Vishwavidyalaya, Palampur (India). Dept. of Soil Science).

Fertilizer N economy, soil nutrient status, water use efficiency and rice productivity with real-time nitrogen management and organic residues under irrigated and rainfed situations. Journal of the Indian Society of Soil Science (India) v. 56(2) p.167-173 KEYWORDS: FERTILIZER APPLICATION. NITROGEN METABOLISM. RICE. SOIL FERTILITY. EFFICIENCY. WATER USE.

Integrated nutrient management by combining organic and inorganic sources of plant nutrients has been found to improve and sustain soil and food productivity. A field experiment was conducted in a silty clay loam acid Alfisol to investigate the utility of lantana (Lantana spp.) biomass, an obnoxious weed, unfit as cattle feed, and growing abundantly in uncultivated areas, as an organic amendment in rice-wheat cropping system. Soil applications of the freshly-chopped lantana biomass at 15 t ha-I yrl before puddling were initiated ind999 wet season (ws). Three N management treatments (N applied at LCC=2 and LCC=3, and at recommended rate of 90 kg ha-1) under two water regimes (irrigated vs rainfed) were imposed to rice in 2003. After seven rice-wheat cropping cycles (June 2006), soil organic carbon, available N, Olsen's P and exchangeable K were 1.18. , 378, 42 and 110 kg ha-I, respectively, with lantana addition (Ml), and 1.1 0. , and 323,33 and 99 kg ha-I without lantana addition (Mo), as against initial values of 1.08. , and 314,22 and 121 kg ha-1. Rice grain yield (2003-2005) increased by 4-21. with M1 compared to Mo, and 4-13. with LCC = 3 compared to fixed recommended dose ofN (RFD). Irrigated rice produced 6. higher yield than rainfed rice. Water use efficiency (WUE) was highest under rainfed condition, with M1 and LCC=3. Nitrogen management using LCC saved 30 and 60 kg ha-1 fertilizer N without and with lantana addition, respectively, over RFD. Thus, real-time N management through LCC= 3 coupled with lantana biomass economized on fertilizer N, and enhanced the rice productivity and WUE under both irrigated and rainfed situations.

048. Singh, R.K.; Central Rainfed Upland Rice Research Station, Hazaribag (India)Singh, S.K.; Central Arid Zone Research Institute, Jodhpur (India)Tarafdar, J.C.; Central Rainfed Upland Rice Research Station, Hazaribag (India). Influence of cropping sequence and nutrient management on soil organic carbon and nutrient status of typic rhodustalfs. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 174-181 KEYWORDS: CROPPING SYSTEMS. NUTRITIONAL REQUIREMENTS. NUTRITION POLICIES. SOIL ORGANIC MATTER. SOIL FERTILITY. TRACE ELEMENTS.

Influence of pigeon pea (Cajanus cajan L.) (Pigeonpea-rice-pigeonpea-rice), black-gram (Phaseolus mungo Roxb.) (Black gram-rice-finger-millet, (Eleusine coracana)-fallow) and rice (Oryza sativa L.) (Rice-rice-rice-rice) based cropping sequences with three levels of fertilizers viz. no fertilizer (control), recommended dose ofNPK (RDF), and RDF + 2.5 t FYM on soil organic carbon (SOC) density and stock, available macro and micro- nutrients, soil pH, grain and straw yield was studied under split-split plot design ttom 2001 to 2004. Rice-based cropping sequence with RDF + fYM was more effective for enhancing SOC density (43.2.) and stock (40.6.) and in sequestering CO2 (30.32 t ha-1), while pigeonpea-based cropping sequence was more proficient in raising available nitrogen (45.8.), phosphorus (296.) and potassium (2.2.) as compared to others. Blackgram- and rice-based cropping sequences depleted available potassium by 13.0 to 18.6. , while pigeonpea-rice sequence in a cycle of four years enhanced the potassium availability by 9.9. . Latter also increased zinc availability (17.5 to 31.9.); reduced iron and manganese toxicity and maintained soil pHw, while rice-rice sequence during the period enhanced copp~r availability (254 to 316.). Blackgram- and rice¬based cropping sequence increased soil acidity during the course of experimentation. Legume-based cropping sequence (pigeonpea and blackgram) with RDF + FYM treatments had greater affinity for nitrogen and phosphorus uptake, while rice-based cropping sequence absorbed significantly higher amount of potassium. The RDF and RDF + FYM application significantly enhanced the available nitrogen, phosphorus, and potassium over control and also raised SOC density by 27.6 to 43.2. over initial across the cropping sequences. Data revealed that pigeonpea-rice sequence with RDF + FYM was more beneficial for enhancing! maintaining soil fertility, while blackgram-rice and rice-rice sequence ttom 2001-04 produced higher grain yield at the cost of declining soil fertility.

049. Bhattacharyya, R.; Vivekanand Institute of Hill Agriculture, Almora (India)Prakash, V.; Vivekanand Institute of Hill Agriculture, Almora (India)Kundu, S.; Vivekanand Institute of Hill Agriculture, Almora (India)Ghosh, B.N.; Vivekanand Institute of Hill Agriculture, Almora (India)Gupta, H.S.; Vivekanand Institute of Hill Agriculture, Almora (India). Potassium availability as influenced by farmyard manure application under continuous soybean-wheat cropping in a typic haplaquept. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 182-185 KEYWORDS: FARMYARD MANURE. RAINFED FARMING. SANDY SOILS. POTASSIUM. GLYCINE MAX. WHEATS.

The effect of 30 years of continuous cropping, fertilization and manuring on potassium (K)balance and availability in a sandy loam soil (Typic Haplaquept) was investigated under a rainfed soybean-wheat cropping. The total removal of K by the crops exceeded K applied to the soil in all the treatments showing a net negative K balance, ranging from 3.7 (in NK-treated plots) to 81.7 kg ha-1yrl (in N + FYM-treated plots). Continuous application of recommended doses of NPK + lOt FYM (NPK + FYM) annually to soybean resulted in build-up of available K (+56 kg K ha-1) in 0-45 cm soil depth over the initial soil value despite the highest average annual uptake of K by the system (150.8 kg ha-1yrl), whereas, there was net depletion of available K (-80 kg K ha1) in 0-45 cm soil depth under the NPK-treated plots. The non-exchangeable K decreased substantially from 1274 to 1052 kg ha-1 in the NPK treatment and to 986 kg ha-1 in 0-15 cm soil layer in NPK + FYM treatment after 30 years of soybean-wheat cropping. The decrease in total soil K was significantly correlated to decrease in non-exchangeable soil K (R2 = 0.53 **, PO.OI, n)

050. Singh, F.; Chander Sekhar Azad University of Agriculture and Technology, Kanpur (India). Regional Agricultural Research Station) Kumar, R.; Chander Sekhar Azad University of Agriculture and Technology, Kanpur (India). Regional Agricultural Research Station). Integrated nutrient management in rice-wheat cropping system for sustainable productivity. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 205-208 KEYWORDS: INTEGRATED CONTROL. SUSTAINABILITY. CROPPING SYSTEMS. NUTRIENTS. NUTRIENT AVAILABILITY.

Integrated nutrient management module for rice-wheat cropping system on an InCeptISOl was developed through field experimentation for eight consecutive crop seasons (1999-2003). The treatments consisted of FYM, vermicompost, green manure, Azotobacter, phosphate solubilizing bacteria (PSB), blue, green algae (BGA), rice residue incorporation and NPK fertilizers. Significantly higher yields to the tune of 4.3 t ha-I for rice and 4.0 t ha-I for wheat were recorded when rice-wheat were grown after green manuring of dhaincha in-situ or application of FYM (10 t ha-I yearl) or vermicompost (5 t ha-I yearl) in kharif season along with reduced quantity of fertilizers per hectare per crop (30-90 kg N, 13-20 kg P and 37 kg K) accompanied by microbial cultures (Azotobacter, BGA and PSB) as compared to the yield (4.0 - 4.1 t ha-I) with recommended dose of NPK (120-26-50) per hectare per crop. Reduction to the tune of 25. in recommended dose ofN, P and K fertilizers (30 kg N, 6.5 kg P and 13 kg K ha-I crop-I) could be made with the application of FYM or vermicompost or green manuring alone without decrease in yield of rice and wheat. Quantity ofN and P fertilizers could be further reduced to half of the recommended dose (i.e. 60 kg Nand 13 kg P ha-I crop-I) with the applicatio~f Azotobacter and PSB along with FYM or vermicompost or green manuring. Application of BGA in paddy and incorporation of rice residue before sowing of wheat further reduced the recommended dose of N fertilizer by 30 kg ha-I for both rice and wheat. Cultivation of rice and wheat on the recommended dose of NPK fertilizers alone decreased the organic carbon, available P and K content of the soil. Application of FYM, vermicompost, green manuring, and rice residue incorporation alone or in combination with biofertilizers supplemented by NPK fertilizers improved the soil fertility besides maintaining higher sustainable productivity.

F30 Plant Genetics and Breeding

051. Yadav, Rajbir; National Research Centre on Rapeseed-Mustard, Bharatpru, Rajasthan (India)Meena, S.S.; National Research Centre on Rapeseed-Mustard, Bharatpur, Rajasthan (India)Singh, G.P.; National Research Centre on Rapeseed-Mustard, Bharatpur, Rajasthan (India) Yadav, D.K.; National Research Centre on Rapeseed-Mustard, Bharatpur, Rajasthan (India). Host-insect interaction in Brassica against turnip aphid (Lipaphis erysimi). Indian Journal of Agricultural Sciences (India) v.78(2) p.155-158 KEYWORDS: BRASSICA. TURNIPS. LIPAPHIS ERYSIMI. ANTAGONISM.

The experiment was counducted during 2004-06 to study host-insect interaction in Brassica against turnip aphid (Lipaphis erysimi Kalt). Factorial analysis of variance showed that aphid population collected form taramira (Eruca sativa Miller) differed significantly in its behavior form the other 5 populations of aphid. Other 5 populations of aphid were similer in their infestation and multiplication on all the tested species of Brassica. Eruca sativa and Sinapis alba carried significantly less number of aphids than other four species under contined conditions and has antibiosis against Lipaphis erysimi. Ethiopin mustard (Brassica carinata) and gobhi sarson (Brassica napus) showed antixenosis only.

052. Gupta, G.P.; Indian Agricultural Research Institute, New Delhi (India)Birah, Ajanta; Indian Agricultural Research Institute, New Delhi (India)Rani, Seema; Indian Agricultural Research Institute, New Delhi (India). Growth-inhibitory effects of winged bean (Psophocarpus tetragonolobus) proteinase inhibitors on two problematic lepidopteran pests. Indian Journal of Agricultural Sciences (India) v.78(2) p.159-162 KEYWORDS: PSOPHOCARPUS TETRAGONOLOBUS. PSOPHOCARPUS. SPODOPTERA LITURA.

A laboratory study conducted during 2004-05 showed that winged bean (Psophocarpus tetragonolobus L. DC) proteinase inhibitors inhibited the growth and development of Helicoverpa armigera (Hubner) and Spodoptera litura (Fab). It affected the larval and pupal survival and adult emergence in a dose-dependent manner. larval-pupal intermediates and malformed adults were also observed. At higher dose of winged bean proteinase inhibitors (4.5 trypsin inhibitor units/g of diet), 44.1. of H. armigera and 50. of S. litura could only survive. There was no fecundity at this dose, however, at its lower dose less fecundity. The growth and development indices reduced form 5046 (control) to 3.53 (proteinase inhibitors fed) and 2.84 to 1.36 in H.armigera and their values in S. litura reduced form 5.55 to 5.0 and 3.0 to 1.44 respectively.

053. Nagarajan, Shantha; Indian Agricultural Research Institute, New Delhi (India)Anand, Anjali; Indian Agricultural Research Institute, New Delhi (India)Chaudhary, H.B.; Indian Agricultural Research Institute, New Delhi (India). Response of spring wheat (Triticum aestivum) genotypes under changing environment during grain filling period. Indian Journal of Agricultural Sciences (India) v.78(2) p.177-179 KEYWORDS: TRITICUM AESTIVUM. GENOTYPES. SEED FILLING.

Twenty diverse wheat (Triticum aestivum L. emend. Fiori and Paol) genotypes were grown in field for two consecutive season during 2002-04 as normal sown crop at IARI farm, New Delhi. The first seasion was normal cool winter and the second seasion was characterized by sudden increase in temperature during active grain filling period that raised the mean maximum and minimum temperatures by 7 and 6 degree C respectively. Grain yield varied between 276 and 570 g/m2 in the cool seasion and between 204 and 419 g/m2 in the hot seasion. The adapted genotypes escaped the heat by maturing early and compensated the reduced grain growth period by enhanced grain growth rate or tolerated the heat stress with minimum change in their grain growth duration and grain growth rate as compared to cool seasion. Most of the genotypes that had low susceptibility to high temperature stress were potentially low yielding types and these genotypes if combined with high yield potential will perform well under both optimum as well as heat shock conditions as it happened in the second year trial.

054. Talukdar, A.; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics)Zhang, G.Q.; South China Agricultural University, Guangzhou (People's Republic of China). Guangdong Key Laboratory of Plant Molecular Breeding). Inheritance of grain shape and molecular tagging of the QTL for reduced grain width (gw) in rice (Oryza sativa L.). Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 103-107 KEYWORDS: GRAIN. RICE. GENETICS. ORYZA SATIVA. QUANTITATIVE ANALYSIS.

Grain shape as determined by the ratios of grain length (L) to width (W) is an important trait affecting consumer preferences and the rice markets worldwide. Study of its inheritance and identification of linked molecular markers are therefore essential for rice breeding with desirable grain shapes. For this purpose, we used the Single Segment Substitution Lines (3-S Lines) developed by crossing HJX74 (medium grain) with Amol-3 (slender grain) and Basmati 370 (slender grain). Slender shape (L: W 3) of grain was found to be monogenic recessive. The QTL for grain width (gwB) was mapped to the distal end of the chromosome 8 and was found to be linked with RM447 (O.OcM) and RM502 (2.5cM) which were located at a distance of 55kb on the same clone AP005529 of rice physical map. The study should facilitate map-based cloning of the gene (QTL) and marker-assisted selection (MAS) for slender shape of grain in rice.

055. Nair, S.K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics)Vinod; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics)Singh, B.; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics) Tomar, S.M.S.; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). Inheritance and chromosomal location of flecking in a mutant C591 (M8) of wheat (Triticum aestivum). Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p.108-112 KEYWORDS: GENETIC INHERITANCE. MUTATION. CHROMOSOMES. TRANSLOCATION. TRITICUM AESTIVUM.

Genetic analysis of data in F2 generation derived from the cross NP8521C591 (M8) and NP846/C591 (M8) revealed that flecking in mutant C591 (M8) of Triticum aestivum L. is controlled by a single dominant gene. The mutant C591 (M8) was also crossed with individual monosomic lines of Chinese Spring and monosomic F1 plants were cytologically identified. The F2 plants derived from individual monosomic F 1S were scored for the presence of flecking. No critical line could be identified as several lines deviated from expected Mendelian ratio. Considering the peculiar characteristics of the mutation, which resembled the disease lesion mimic mutations reported in other crops such as maize, this indeed is a mutation in hexaploid wheat. The gene symbol Flk is proposed for flecking (= lesion mimic) in the mutant line C591 (M8). The flecking mutant will serve as a useful genetic marker.

056. Datta, D.; Indian Institute of Vegetable Research, Varanasi (India)Bhardwaj, S.C.. Directorate of Wheat Research, Shimla (India). Regional Station)Prashar, M.; Directorate of Wheat Research, Shimla (India). Regional Station). Development of bread wheat (Triticum aestivum L.) lines with specific rust resistance genes and their authentication through molecular markers. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 113-123 KEYWORDS: TRITICUM AESTIVUM. GENETIC MARKERS. RUSTS. GENETIC ENGINEERING. GENES. GENE TRANSFER.

High yielding cultivars of wheat viz. PBW343, UP2338 and WH542 were used to incorporate multiple rust resistance genes against leaf, stem and stripe rusts from winter wheat or agronomically inferior wheat lines carrying known rust resistance genes. Genetic stocks were evaluated for seedling resistance as well as field resistance with prevalent and virulent pathotypes of Puccinia triticina, Puccinia graminis tritici and Puccinia striiformis. With the help of classical tools resistance genes were fixed in the early generation. Incorporation of resistance gene in the genetic stock viz. Yr5, Yrl0, Yr15, YrSp, Lr9, Lr19, Lr24, Lr26, Lr32, Lr39, Lr28, Lr42, Lr45 was confirmed through allelism tests and presence of leaf rust resistance genes viz.Lr9, Lr19, Lr24 and Lr26 were also authenticated through molecular markers. Rust resistance and utility of genetic stocks are discussed.

057. Kumari, J.; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics)Gadag, R.N.; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics)Jha, G.K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Economics). Genetic distance based on simple sequence repeats and its relationship to specific combining ability and heterosis in maize (Zea mays L.). Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 124-131 KEYWORDS: GENETIC DISTANCE. HETEROSIS. COMBINING ABILITY. ZEA MAYS. CEREALS.

Genetic relationship among ten maize inbred lines derived from four different source populations was assessed using forty microsatellite markers. Correlations were estimated between Simple Sequence Repeat (SSR) markers based genetic distance with F, hybrid performance, midparent heterosis and combining ability for grain yield, days to silking and plant height. The genetic distances based on SSRs were almost congruent with pedigree information and depicted positive linear relationship with F, hybrid performance, heterosis value and specific combining ability for grain yield. From the present results it is concluded that the Jaccard similarity coefficient basedon SSR data might be used for determining genetic relationship among inbred lines. Although positive relation was revealed between genetic distance and mid parent heterosis in this analysis but due to its low magnitude it couldn't be used to precisely predict the F, hybrid yield performance.

058. Hossain, F.; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics)Prasanna, B.M.. Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics)Kumar, R.; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics)Singh, B.B.; Indian Agricultural Research Institute, New Delhi (India). Div. of Genetics). The effect of genotype x pollination mode interaction on kernel modification in quality protein maize (QPM) genotypes. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 132-138 KEYWORDS: GENOTYPES. GENETIC DISTANCE. ZEA MAYS. POLLINATION. PROTEIN CONCENTRATES.

Kernel vitreousness or texture is one of the most important prerequisites for successful adoption of the Quality Protein Maize (QPM) genotypes by the farmers. The present study was carried out to analyze in detail the effects of pollination mode (controlled- versus open pollination) on different kernel attributes (endosperm modification, crown modification and ear appearance) in a set of QPM inbred lines and their experimental crosses. QPM genotypes were found to differ significantly with respect to kernel modification, indicating genetic heterogeneity for endosperm modifier genes. Analysis of ears obtained from different pollination modes indicated significant interaction of the genotypes with the pollination mode, suggesting the importance of the source of pollen and its genetic constitution in conferring the kernel texture. The study also demonstrates that the data derived using controlled-pollination could be more reliable than those using the open-pollination mode for analyzing the effects of complementation of endosperm modifier genes in QPM cross combinations. Ascertaining the kernel modification potential of the QPM genotypes would aid in proper selection of genotypes during QPM breeding.

059. Arya, L.; National Bureau of Plant Genetic Resources, New Delhi (India). National Research Centre on DNA Fingerprinting)Verma, M.; National Bureau of Plant Genetic Resources, New Delhi (India). National Research Centre on DNA Fingerprinting)Sandhia, G.S.; National Bureau of Plant Genetic Resources, New Delhi (India). National Research Centre on DNA Fingerprinting)Singh, S.K.; National Bureau of Plant Genetic Resources, New Delhi (India). National Research Centre on DNA Fingerprinting)Lakhanpaul, S.; National Bureau of Plant Genetic Resources, New Delhi (India). National Research Centre on DNA Fingerprinting). Pattern of genetic relationship as revealed by AFLP markers in Indian sorghum [Sorghum bicolor (L.) Moench]. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 139-144 KEYWORDS: SORGHUM BICOLOR. GENETIC RESISTANCE. GENETICS. PLANT GENETIC RESOURCES.

Genetic relationships were assessed in 24 Indian sorghum accessions including released varieties, hybrids and their parental lines using fluorescent based Amplified Fragment Length Polymorphism (AFLP) technique. Nine AFLP primer combinations resulted in a total of 1246 amplification products. The number of polymorphic markers per primer combination ranged from 87 (E-ACT/M-CTG) to 167 (E¬ACTIM-CTA). The markers were scored for the presence or absence in binary matrix and relationships among the accessions assessed using Jaccard's similarity coefficient. Mean genetic similarity was estimated at 0.538 based on this set of AFLPs. The most distant two accessions were 104 A and SPV 462 and the closest two were CSH 16 and 27 A at Jaccard's similarity coefficient values of 0.261 and 0.731 respectively. The relationships, among released varieties, hybrids and their parental lines were in accordance with their known pedigree information. Except 104 A, C43 and SPV 462, all the accessions were more or less uniformly distributed because of interrelated pedigree and common ancestors.

060. Bidinger, F.R.; International Crops Research Institute for the Semi Arid Tropics, Patancheru (India)Sharma, M.M.; International Crops Research Institute for the Semi Arid Tropics, Patancheru (India)Yadav, O.P.; Central Arid Zone Research Institute, Jodhpur (India). Performance of landraces and hybrids of pearl millet [Pennisetum glaucum (L.) R. Br.] under good management of arid zone. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p.145-148 KEYWORDS: PENNISETUM GLAUCUM. HYBRIDS. F1 HYBRIDS. F2 HYBRIDS. F3 HYBRIDS.

The limited adoption of modern pearl millet (Pennisetum glaucum) hybrids in the arid zone of western Rajasthan has been attributed to the lack of hybrids with sufficient adaptation to this zone, a conclusion based largely on the on-farm performance of-hybrids under traditional management systems. The objective of this research was to determine if this conclusion is also true under improved management conditions. This study compared six recommended hybrids and six traditionallandraces in 16 environments created through a combination of locations and years over five crop seasons. Across all environments the average grain yield ranged from 439 kg ha-1 to 3200 kg ha-'. The mean grain yield of the landraces was similar to that of the hybrids but the landraces provided significantly higher biomass and stover yield. Only above a mean trial grain yield of 2000 kg ha-1 the hybrids out yielded the landraces for grain productivity. These results confirm that even under well managed, but rainfed, arid zone environments, current hybrids offer farmers little advantage over their traditional land races.

061. Agrawal, P.K.; Vivekanand Parvatiya Krishi Anusandhan Sansthan, Almora (India)Katiyar, A.K.; Indian Institute of Pulses Research, Kanpur (India). Validation of chickpea - STMS markers and DNA fingerprinting in lentil (Lens culinaris subsp. culinaris) cultivars of India. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 149-156 KEYWORDS: CHICKPEAS. LENTILS. GENOTYPES. CICER ARIETINUM. GRAIN LEGUMES.

A set of 31 lentil genotypes having indigenous and exotic origin were screened using 42 STMS markers derived from chickpea genome. Out of the 42 STMS primers tested, all of them gave amplified products in lentil. Among them 36 (85.7.) primers were found to be polymorphic among the lentil genotypes. At genetic distance of less than 0.29, all the 31 genotypes could be grouped into five clusters where cluster IV contained 19 genotypes, including the exotic genotype Precoz. Many primers gave genotype-specific amplified products which in combination(s) could be used for DNA fingerprintir~g of lentil genotypes. A set of 16 STMS markers have been identified which could differentiate all the lentil cultivars of India and, along with the morphological data can be used for identification and confirmation of the purity of the lentil cultivars.

062. Pattanashetti, S.K.; College of Agriculture, Bijapur (India). Dept. of Genetics and Plant Breeding)Gowda, M.V.C.; University of Agricultural Sciences, Dharwad (India). Dept. of Genetics and Plant Breeding)Girija; University of Agricultural Sciences, Dharwad

(India). Dept. of Genetics and Plant Breeding). Inheritance of morphological traits and pod features in groundnut (Arachis hypogaea L.). Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 157-162 KEYWORDS: ARACHIS HYPOGAEA. GENETICS. GENETIC INHERITANCE. PLANT BREEDING. SEED FILLING.

TMV.2, a commercially cultivated Spanish bunch (ssp. fastigists) variety on treatment with ethyl methane sulphonate (0.2.) had earlier resulted in a subspecific mutant i.e. narrow leaf mutant (NLM) with Virginia type (ssp. hypogaes) habit and mmow leaflets. TMV-2 and its mutant NLM differ from one another in many morphological traits. To know the inheritance of morphological traits, both direct (TMV-2 x NLM) and reciprocal (NLM x TMV-2) crosses were made during the rainy season 2001 and studied for their behaviour in subsequent generations viz, FI, F2 and F3 during the post¬rainy 2001, rainy 2002 and post-rainy 2002 seasons, respectively. The results indicated that growth habit, main¬stem flowering, branching pattern, leaflet shape are under the control of two genes each, while albinism, pod beak, pod constriction and pod size are under the control of three genes each with different gene action.

063. Sarkar, B.; Directorate of Wheat Research, Karnal (India)Verma, R.P.S.; Directorate of Wheat Research, Karnal (India)Mishra, B.; Directorate of Wheat Research, Karnal (India). Genetic diversity for malting quality in barley (Hordeum vulgare L.). Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 163-170 KEYWORDS: HORDEUM VULGARE. GENETIC RESOURCES. BIODIVERSITY.

Genetic diversity for malting quality was studied on a set of 131 barley genotypes of indigenous and exotic origin representing both two and six row types. Observations were recorded on seven grain and seven malt traits. The study revealed that lot of variability exists in material for all malting quality traits. It was also observed that in general two-row barleys have better malting quality. Sources for different quality traits were identified for use as donors in breeding programme. The clustering analysis revealed four major clusters amongst the genotypes with varying standards for quality traits. The non hierarchical Euclidean cluster analysis indicated that genotypes with very good malting quality were grouped in one cluster. Clustering pattern based on Ward's minimum variance method also revealed four major discrete clusters among the genotypes studied.

064. Chimote, V.P.; Mahatma Phule Krishi Vidyapeeth, Rahuri (India). Biotechnology Centre)Rajkumar; Central Potato Research Station, Jalandhar (India)Sharma, N.; Central Potato Research Institute, Shimla (India). Crop Improvement Div.)Kamal, S.; Central Potato Research Institute, Shimla (India). Crop Improvement Div.). Nuclear - tytoplasmic divdrsity in parental genotypes used for Indian early bulking potato (Solanum tuberosum ssp. tuberosum) breeding programme. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 171-176 KEYWORDS: GENOTYPES. GENETIC DISTANCE. GENETIC VARIATION. SOLANUM TUBEROSUM.

Forty parental lines used for development of early bulking potato varieties were analyzed for genetic divergence using twenty RAPD primers and cytoplasmic base by using six PCR-based markers comprising of two chloroplast DNA deletions based (HI and H3), one plastid SSR (NTCP9) and three mitochondrial SCAR markers. In RAPD divergence studies there were three clear clusters, those with andigena pedigree and JF series in pedigree formed two separate clusters from res.t of genotypes. AGB69.1 was the most distinct parent followed by the parent-prog!!ny combination (MS/82-638 and MS/92-3128). On plastome/chondriome analysis three andigena type cytoplasm possessing parents (Phulwa, AGB69-1 and A98¬175) and four wild type cytoplasm possessing parents (Le. AG14(X37)H, J99-2, A98-165 and PS/M75) were distinct from the rest i.e. tuberosum type cytoplasm genotypes. The diverse andigena type cytoplasm genotypes can be preferred as parents to broaden the genetic base in early bulking varieties, while those wild type cytoplasm genotypes may contribute to introgression of useful traits like higher dry matter and late blight resistance. The results of present study showed that divergent parents from both paternal and maternal pedigree are being used in Indian breeding programme for early bulking varieties. Divergent parents

identified in present study may be useful in planning hybridization programme aimed at effective utilization of heterosis.

065. Khan, S.H.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Olericulture)Ahmed, N.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Olericulture)Jabeen, N.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Olericulture)Wani, K.P.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Olericulture)Hossain, K.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Olericulture). Stability analysis for economic traits in kale (Brassica oleracea var. acephala L.). Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 177-182 KEYWORDS: STABILITY. BRASSICA OLERACEA. KALES.

Stability analysis was carried out in sixteen kale genotypes including three commercial checks over six environments (three locations for two years) to identify phenotypically stable genotypes that could perform more or less uniformly under different environmental conditions for various economic traits. Pooled analysis of variance for stability in the performance of different genotypes of kale were highly significant for all the characters viz. plant height, plant spread, leaf thickness, stem thickness, leaf number, leaf weight, leaf yield, leaf length, lamina length, leaf breadth, leaf size, average stalk weight, average midrib weight, leaf: stalk ratio, blade: midrib ratio, days to first leaf picking. and duration of picking indicating that the material selected possessed significant variation for all the characters under study confirming that the environments selected were variable and random and influenced the expression of most of the traits selected for stability studies. Mean squares arising due to G x E interaction were significant for most of the traits except plant spread, leaf thickness, leaf weight, average stalk weight, average midrib weight, blade: midrib ratio and leaf: stalk ratio revealing that most of the characters under study were having significant differential response to the changing environments and the characters showing non significant mean squares revealed, by and large, less effects of the changing environments. In the present study no genotype was found stable for leaf yield across environments. However, genotypes SH-K-28, SH-K-33, Khanyari and SH-K-21 could be recommended for cultivation across environments on the basis of stability performance for various economic characters.

066. Jagadeesh, S.L.; University of Agricultural Sciences, Dharwad (India). K.R.C. College of Horticulture). Reddy, B.S.; University of Agricultural Sciences, Dharwad (India). K.R.C. College of Horticulture)Basavaraj, N.; University of Agricultural Sciences, Dharwad (India). Dept. of Horticulture)Swamy, G.S.K.; University of Agricultural Sciences, Dharwad (India). K.R.C. College of Horticulture)Hegde, L.; University of Agricultural Sciences, Dharwad (India). K.R.C. College of Horticulture). Inter tree variability in chips purpose jackfruit selections of Western ghats of Karnataka, India. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 183-188 KEYWORDS: ARTOCARPUS HETEROPHYLLUS. KARNATAKA. MARKETING.

The 62 jackfruit selections studied for chips purpose from the hilly (34 types) and coastal (28 types) zones of Karnataka in India were grouped into 6 clusters using Toucher's values method employed on the Mahalanobis's generalized distance ([)2) values. Cluster A accounted for 45 selections followed by cluster B (10 selections) and cluster C (4 selections), whereas cluster D, E and F were solitary having single selection each. Inter cluster distance was maximum between cluster E and F (35.842) followed by cluster A and E (28.281) and was minimum between cluster C and D (9.362). The present study reveals that high chips yielding types have also recorded high dry matter content indicating a direct relationship between these characters. The relative contribution of characters clearly indicated that chips recovery contributed maximum for divergence (62.61.) followed by TSS (15.34.) and hence the selection of jackfruits for chips purpose should deem these characters.

067. Chandra, A.; Indian Grassland and Fodder Research Institute, Jhansi (India). Crop Improvement Div.). Transferability of SSR markers across twelve species of forage legumes for germplasm characterization and evaluation. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 189-194 KEYWORDS: FORAGE. GERMPLASM. DESMANTHUS.

Simple sequence repeat (SSR) or microsatellite marker is the most preferred and reliable molecular marker system. However, development and use of such markers for evolution and diversity assessment is limited to few tropical forage legumes. In the present investigation, 43 SSR markers of Medicago truncatula and Trifolium repens from existing data bases were used to assess their transferability in 24 accessions of 12 tropical legume species of forage importance. Cro~s-genus amplification of M. truncatula based SSR was 32.08. whereas only 23.97. transferability of T. repens markers was observed. S,eventy six polymorphic amplicons were identified could be used as DNA markers. Identified markers were demonstrated in characterization of 24 accessions of Desmanthus, thus indicated their suitability. The transfer of SSR markers across species or genus can be a very efficient approach for DNA markers development, especially for less explored legumes of tropical forage importance.

068. Kumar, B.; Indian Grassland and Fodder Research Institute, Jhansi (India)Malaviya, D.R.; Indian Grassland and Fodder Research Institute, Jhansi (India)Roy, A.K.; Indian Grassland and Fodder Research Institute, Jhansi (India)Kaushal, P.; Indian Grassland and Fodder Research Institute, Jhansi (India). Isozyme variability in Trifolium alexandrinum accessions. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 195-200 KEYWORDS: ISOENZYMES. TRIFOLIUM ALEXANDRINUM. ENZYMES.

The present investigation was carried out on 65 accessions of berseem (Trifolium alexandrinum) to estimate the genetic variability based on five enzymes - peroxidase, acid phosphatase, esterase, super oxide dismutase and glutamate oxalo acetate transaminase using starch gel electrophoresis. A similarity matrix showed 95-100. similarity among 64 accessions. Accession EC 329299 belonging to 'Saidi' ecotype showed 79. similarity with other accessions. The'accessions grouped in three major clusters based on the cutting points in the dendrogram at root level. However, phenetic line drawn at 98. identified 25 groups comprising of 1 to 10 accessions. Of these, 13 groups with more than one germplasm lines showed 100. similarity. Morphologically distinct accessions (i.e. multifoliates and red flowered) formed one cluster. Monomorphic bands (13 out of 26) were in high number. Exotic accessions also showed close similarity to many indigenous accessions which indicated less genetic variability among the germ plasm lines introduced from other countries. Polymorphism was recorded for 13 bands (2 for SOD, 3 for GOT, 1 for ACP and 7 for Peroxidase).

069. Kour, A.; Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Genetics and Plant Breeding) Bhatt, U.; Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Genetics and Plant Breeding) Grewal, S.; Indian Agricultural Research Institute, New Delhi (India). National Research Centre on Plant Biotechnology)Singh, N.K.; Indian Agricultural Research Institute, New Delhi (India). National Research Centre on Plant Biotechnology)Khanna, V.K.; Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Genetics and Plant Breeding). Effect of wheat and maize genotypes for wheat haploid production in wheat x maize crosses. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 201-203 KEYWORDS: GENOTYPES. HAPLOIDY. MAIZE. COMBINING ABILITY. WHEATS.

070. Negi, S.; Chaudhary Sawarn Kumar Himachal Pradesh Krishi Vishwavidyalaya, Palampur (India). Dept. of Vegetable Science and Floriculture)Vidyasagar; Department of Science and Technology, New Delhi (India). IS-STAC Div.). Inheritance studies of self-incompatibility in low chill requiring genotypes of cabbage (Brassica oleracea L. var. capitata) for boltized flowering. Indian Journal of Genetics and Plant Breeding (India) v.

68(2) p. 204-207 KEYWORDS: BRASSICA OLERACEA. SELF STERILITY. PROGENY. HYBRIDIZATION. GENOTYPES.

071. Chandra, A.; Indian Grassland and Fodder Research Institute, Jhansi (India). Genetic relationship among accessions of Stylosanthes hamata based on seed proteins profile. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 208-211 KEYWORDS: STYLOSANTHES HAMATA. SPECIES. ELECTROPHORESIS.

072. Mukherjee, M.; University of Kalyani, Kalyani (India). Dept. of Botany, Plant Breeding and Genetics Section)Datta, A.K.; University of Kalyani, Kalyani (India). Dept. of Botany, Plant Breeding and Genetics Section). Evaluation of genetic diversity in five species of ocimum by SDS - PAGE. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 212-214 KEYWORDS: OCIMUM. GENETIC VARIATION. ELECTROPHORESIS. LAMIACEAE.

073. Ahmed, M.F.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Plant Breeding and Genetics)Wani, N.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Plant Breeding and Genetics)Hassan, G.I.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Quality Control cum Leaf Tissue Testing Lab., Div. of Pomology, Regional Research Centre for Higher Altitude)Zafar, G.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Plant Breeding and Genetics)Khan, I.A.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Plant Breeding and Genetics). Variability in quince (Cydonia oblonga Mill.) population from Baramulla district of Kashmir Valley. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 215-218 KEYWORDS: CYDONIA OBLONGA. CULTIVATION. JAMMU AND KASHMIR. POPULATION ECOLOGY.

074. Sinha, A.; Institute of Forest Productivity, Ranchi (India) Akhtar, S.; Institute of Forest Productivity, Ranchi (India). Nodal bud culture in Schleichera oleosa : aspectic culture establishment, explant survival and influence of plant growth regulators. Indian Journal of Genetics and Plant Breeding (India) v. 68(2) p. 219-221 KEYWORDS: SCHLEICHERA OLEOSA. PLANT GROWTH SUBSTANCES. VEGETATIVE PROPAGATION. SAPINDACEAE.

075. Sirari, A.; Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding, Genetics and Biotechnology)Sharma, I.; Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding, Genetics and Biotechnology)Bains, N.S.; Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding, Genetics and Biotechnology)Raj, B.; Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding, Genetics and Biotechnology)Singh, S.; Kansas State University, Manhattan (United States of America). Dept. of Plant Pathology)Bowden, R.L.; Kansas State University, Manhattan (United States of America). Dept. of Plant Pathology). Genetics of Karnal bunt resistance in wheat : role of genetically homogenous Tilletia indica inoculum. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 10-14 KEYWORDS: TILLETIA INDICA. GENETICS. WHEATS. GENETIC RESISTANCE.

Use of heterogeneous inoculum for Kamal bunt screening in wheat is often considered to decrease precision of genetic analysis of resistance. In the present study, genetic analysis of KB resistance was carried out based on two inoculum systems. First system was based on mixture of 16 isolates of Tilletia indica representing high level of genetic heterogeneity and second consisted of a single compatible monosporidial pair, a specially generated homogeneous inoculum with no within population heterogeneity. Initial attempts at using compatible monos pori dial pair by mixing them just before inoculations resulted in markedly poor disease development, thwarting the genetic analysis. Co-culturing of compatible monosporidial pair for 20 days was found to be essential for obtaining adequate level of infection. The two inoculum systems were used on 2 RIL (Recombinant Inbred Line) populations derived from crosses of two established

KB resistance donors, HD 29 and W 485 with WH 542, a KB susceptible cultivar. Screening with mixture of isolates indicated two additive genes providing KB resistance in both- HD 29 and W 485 whereas three additive genes were found operative against compatible monosporidial pair in both the populations. The additional gene identified with compatible monosporidial pair, is proposed to be overcome by some of the more virulent constituents of mixture of isolates. Mixture of most virulent isolates is, therefore, more useful to identify the KB resistance genes effective against the entire pathogen population in a region.

076. Bandyopadhyay, B.B.; Gobind Ballabh Pant University of Agriculture and Technology, Ranichauri (India). Genetic variation in wheat upon water deficit stress to a range of low temperature regime at high altitude. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 26-32 KEYWORDS: GENETIC VARIATION. WHEATS. BIOLOGICAL PROPERTIES. HIGHLANDS. CLIMATIC FACTORS.

The performance of seveI'!. improved cultivars of wheat genotypes were examined on field trials at cool climatic conditions of high hills (2100 m above mean sea level) under normal and water deficit stress situations during 2003-04 and 2005-06, respectively. Results revealed that highest yielding genotypes at stress situation did not produce higher yield under normal condition. Variation in heritability was observed between two environments. Low heritability and low gains from selection in stress environment made it difficult to identify suitable genotypes for high grain yield and greater harvest index. Drought susceptibility index was associated with grain yield differences of a cultivar between two environments and was failed to detect superior genotypes. Additive gene effect of biomass under normal situation and non-additive gene effect of seed weight and grain yield, respectively, in stress and non-stress condition could be utilized for the improvement of wheat cultivars suitable for higher elevation of hills. Two genotypes (viz., SKW 196 and VL 738) were preferred for cultivation as they performed well both in stress and non-stress conditions.

077. Singh, P.; Punjab Agricultural University, Bathinda (India). Regional Research Station)Chahal, G.S.; Punjab Agricultrual University, Ludhiana (India). College of Agriculture)Mittal, V.P.; Punjab Agricultural University, Bathinda (India). Regional Research Station)Brar, K.S.; Punjab Agricultural University, Bathinda (India). Regional Research Station). Genetic analysis of yield components and fibre quality characters in upland cotton (Gossypium hirsutum L.). Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 33-37 KEYWORDS: YIELD COMPONENTS. COTTON. GOSSYPIUM HIRSUTUM. UPLAND CROPS. FIBRE CROPS. GENETIC DISORDERS. GENETIC DISTANCE. GENETIC VARIATION.

Generation mean analysis was carried out to estimate the nature and magnitude of gene effects for yield components and fibre quality traits in four crosses of upland cotton (Gossypium hirsutum L). The presence of epistasis was reflected by scaling tests and inadequacy of simple additive-dominance model for most of the characters studied. The results obtained revealed that the nature and magnitude of gene effects differed in different crosses and showed importance of additive as well as non additive gene effects in the inheritance of different characters. In view of the parallel role of additive and non additive gene effects in the inheritance of different characters, selection in the segregating generations should be delayed when dominance gene effects would have diminished or sophisticated selection procedures as recurrent selection and population improvement programmes may be followed. However, additive gene effects may be fixed in the pure lines with respect to some specific traits such as boll weight in cross 1 and 4 while for 2.5. span length in cross 2.

078. Amolic, V.L.; Mahatma Phule Krishi Vidyapeeth, Rahuri (India). Dept. of Botany)Mehetram S,S,; Mahatma Phule Krishi Vidyapeeth, Rahuri (India). Dept. of Botany)Shinde, G.C.; Mahatma Phule Krishi Vidyapeeth, Rahuri (India). Dept. of Botany). Gene action for morphological, anatomical and biochemical traits in inter-specific crosses of cotton. Indian Journal of Genetics and Plant Breeding (India) v.68(1)

p. 38-43 KEYWORDS: FUNGAL MORPHOLOGY. COTTON. BIOCHEMICAL REACTIONS. GOSSYPIUM ARBOREUM.

The generation mean analysis of data of inter-specific crosses viz., G. arboreum var. Y-1 x G. anomalum (Cross I) and G. arboreum var. G-27 x G. capitis viridis (Cross II) revealed that both additive and dominance gene actions were found significant for all the characters under study except dominance gene action for chlorophyll-a in cross I and stomata breadth in cross II was found non-significant. Duplicate epistasis was observed for all the characters in cross I except for upper palisade layer length, number of cells in upper palisade, chlorophyll-a1, b1 content and total sugar content where complementary epistasis was observed. Whereas in cross II the duplicate epistasis was observed for all the characters except for lower palisade layer length, distance between phloem, stomata breadth and total sugar content. Presence of both fixable and non¬fixable genetic components as well as duplicate type of epistasis observed for different characters, which indicated accumulation of favorable genes for the characters, it is worth to intermate and select desired characters from segregating generations, which would yield better results.

079. Dhaliwal, M.S.; Punjab Agricultural University, Ludhiana (India). Dept. of Vegetable Crops)Cheema, D.S.; Punjab Agricultural University, Ludhiana (India). Dept. of Vegetable Crops). Development of male sterile lines of tomato ana assessment of their utility in hybrid development. Indian Journal of Genetics and Plant Breeding (India) v.68(1) p. 44-46 KEYWORDS: TOMATOES. DEVELOPMENT INDICATORS. HYBRIDIZATION. CYTOPLASMIC MALE STERILITY.

High cost of hybrid tomato seeds is attributed to labour involved for emasculation and pollination processes. Emasculation can be avoided and labour saved if male sterile line is used as the female parent. Efforts were made to incorporate functional male sterility conditioned by ps2 gene and sporogenic male sterility conditioned by ms2 and ms33 genes into locally adapted and horticulturally superior genotypes. The lines viz. 'ps2 L 3841', 'ps2 NS 1 01”ps2 San Pedro' and 'ps2 UC 82-8' (all functional male sterile); and 'ms2 IPA' and 'ms33 IPA' (both sporogenic male sterile) were stabilized after six cycles of alternate selfing and backcrossing. It is suggested that the utility of functional male sterile lines can be enhanced if it is combined with exserted stigma conditioned by the gene ex. The stigma position of 'ms33 IPA' is exserted and is, therefore, accessible for hand-pollination for F1 hybrid seed production without disturbing the anther cone. It was estimated that while using 'ms33 IPA' as a female parent, 54.4 per cent time was saved over its fertile counterpart for F1 hybrid seed production. This indicated the potential of exploiting male sterility for heterosis breeding in tomato.

080. Hazra, P.; Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India). Dept. of Vegetable Crops)Roy, T.; Zuari Seeds Private Limited, Bangalore (India)Choudhury, J.; Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India). Dept. of Vegetable Crops). Characterization of genic functional male sterility in brinjal and its expression in different genetic backgrounds. Indian Journal of Genetics and Plant Breeding (India) v.68(1) p. 47-51 KEYWORDS: SOLANUM MELONGENA. GENETIC CORRELATION. MYCOTOXINS. CYTOPLASMIC MALE STERILITY.

The present investigation reports four years of study on the expressivity of functional male sterility gene in the original mutant line UGS-1MS and in different genetic backgrounds. In polyhouse condition, anthers of most of the plants of UGS-1MS (88.) did not dehisce.In the open field conditions under two autumn-winter and one spring¬summer seasons over two years only 63.5. plants on an average exhibited non-dehiscent anther character. However, percentage of open fruit set due to natural selfing was significantly lower in the plants showing either complete or partial anther dehisdence because anther dehiscence in these plants have occurred either very late or in few anthers only. Environmental variation for the trait indicates the role of environmentally sensitive modifier genes. Male fertility in all the six F1 hybrids due either to complete or partial anther dehiscence suggested that functional sterility due to

anther non-dehiscence was under the control of recessive genes. Wide range of heterosis for fruit yield ranging from 43.4 to 168.3 percent was manifested in the hybrids. Expressivity ofthe male sterile gene varied with the genotypes because different genotypes acquired gene causing the. male sterility in a different way. For this reason, no male sterile genotype could be recovered in the F2 populations of two hybrids, UGA-1MS x BCB-75 and UGA-1MS x BCB-45 and only one male sterile plant was observed in the F2 population of UGA-1 MS x BCB-14. Segregation pattern in 3 F 2 populations of UGA-1MS x BCB-15, UGA -IMS x BCB-1 and UGA-1MS x BCB-20, supported the good fit for 1:63 (male sterile: male fertile) segregation. It may be proposed that male sterility of UGA-IMS was controlled by one major recessive gene in combination with at least two modifier genes in recessive condition which may be symbolized as fms/fms H. One line each in the UGA-1MS x BCB-15 IineJ(designated as Bidhan UGA-1 MS-15) and UGA-1 MS x BCB-20 line (designated as Bidhan UGA-1MS-20) could be identified which possessed comparatively high flowering prop~nsity and expressed about 80. anther non¬dehiscence character in field condition in F4 generation holding enough promise for utilization in hybrid seed production.

081. Khar, A.; National Research Centre for Onion and Garlic, Pune (India)Devi, A.A.; National Research Centre for Onion and Garlic, Pune (India)Lawande, K.E.; National Research Centre for Onion and Garlic, Pune (India). Analysis of genetic diversity among Indian garlic (Allium sativum L.) cultivars and breeding lines using RAPD markers. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 52-57 KEYWORDS: BIODIVERSITY. GARLIC. ALLIUM SATIVUM. VARIETIES. ANALYTICAL METHODS. RAPD.

Randomly amplified polymorphic DNA markers were used to assess the genetic diversity among 23 commercially released varieties and breeding lines of garlic along with onion as an out-group. A total of 100 operon decamer primers were screened in duplicate and fourteen of these primers were selected for further testing. The number of bands per primer varied from 3 to 19, with an average of 11.5. Based on RAPD data, similarity values among garlic genotypes ranged from 0.97 to 0.47 with a mean value of 0.72. A low degree of similarity (0.10-0.15) was observed with onion. The UPGMA dendrogram constructed using Jaccard's similarity matrix discriminated all the genotypes into four clusters. Cluster I comprised of 14 genotypes with a similarity index of about 89. . Cluster II comprised of only one line, SKAUG 151 that had a similarity index of 62. with Cluster I. Cluster III comprised of 8 garlic genotypes at a distance of about 52. . Variation amongst the garlic accessions was about 48. , whereas, with onion it showed a dissimilarity of 90. . The clustering pattern of garlic genotypes in the present study discriminated them as per the vernalization requirement for bulb formation.

082. Singh, P.; Chander Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Genetics and Plant Breeding) Bhadauria, A.; Chander Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Genetics and Plant Breeding) Singh, P.K.; Chander Sekhar Azad University of Agriculture and Technology, Kanpur (India). Dept. of Genetics and Plant Breeding). Combining ability and gene action for Alternaria blight and powdery mildew resistance in linseed. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 65-67 KEYWORDS: COMBINING ABILITY. LINSEED. ALTERNARIA.

A 10 x 10 diallel set excluding reciprocals was made to study the gene action for Alternaria blight and powdery mildew resistance in linseed. Combining ability analysis revealed the involvement of both additive and non-additive gene effects in both F1 and F2 generations with predominance of former. Close correspondence between mean performance of the parents and their gca effects was observed over generations for both diseases. GS 280 x NP29 and Neelum x Chambal were best specific combiners over generations for low incidence of Alternaria blight and powdery mildew, respectively. Therefore, crosses involving high x high general combiners in case of Alternaria blight may be utilized for obtaining transgressive segregants. For powdery mildew, population

improvement followed by recurrent selection is suggested to accumulate desirable genes.

083. Bhat, G.; University of Agricultural Sciences, Dharwad (India). Dept. of Biotechnology)Bhat, S.; University of Agricultural Sciences, Dharwad (India). Dept. of Biotechnology)Kuruvinashetti, M.S.; University of Agricultural Sciences, Dharwad (India). Dept. of Biotechnology). Molecular analysius of endochitinase gene cloned from Trichoderma spp.. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 68-72 KEYWORDS: TRICHODERMA. CHITINASE. CLONING.

In this study, genes encoding endochitinase (chit46) were cloned from two native species of Trichoderma viz., Trichoderma viride IABT1 012 and Trichoderma harzianum IABT1015 through PCR amplification using specific primers. The nucleotide sequence of cloned gene indicated the presence of reading frame of 1290 nucleotides. Similar to other chitinases these chitinase genes have chitinase active site (FDGIDVDWE), putative chitin binding site (XXXSXGG), 21 amino acid signal peptide and secondary processing site at 32-33'd amino acid position. Phylogenetic analysis indicated that these two genes fall in a same cluster and more related to reported T. harzianum endochitinase.

084. Barooah, D.; Assam Agricultural University, Jorhat (India). Dept. of Plant Breeding and Genetics)Sarma, R.N.; Assam Agricultural University, Jorhat (India). Dept. of Plant Breeding and Genetics). Genetic diversity analysis in indigenous deep water rice of Assam using RAPD and ISSR markers. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 73-76 KEYWORDS: RAPD. ASSAM. FLOODED RICE. ORYZA SATIVA.

085. Murali, T.V.; Assam Agricultural University, Jorhat (India). Dept. of Agricultural Biotechnology)Talukdar, A.; Assam Agricultural University, Jorhat (India). Dept. of Agricultural Biotechnology). Establishment of an in vitro haploid production system for aromatic rice cultivars of Assam. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 77-80 KEYWORDS: AROMATIC COMPOUNDS. RICE. ASSAM. HAPLOIDY. PRODUCTIVITY.

086. Sharma, P.; Punjab Agricultural University, Ludhiana (India). School of Agricultural Biotechnology)Saini, R.G.; Punjab Agricultural University, Ludhiana (India). School of Agricultural Biotechnology). Inheritance of adult plant stripe rust resistance in wheat cultivars Capelle Desprez and Pari 73. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 81-83 KEYWORDS: WHEATS. FUNGAL DISEASES. VARIETIES.

087. Verma, R.; K.R. College, Mathura (India). Dept. of Botany) Sharma, R.; K.R. College, Mathura (India). Dept. of Botany)Sharma, S.K.; K.R. College, Mathura (India). Dept. of Botany). Associastion studies among yield and its component characters in Indian mustard [Brassica juncea (L.) Czern & Coss]. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 87-89 KEYWORDS: BRASSICA JUNCEA. YIELDS. GENOTYPES.

088. Paramesh, T.H.; Indian Institute of Horticultural Reseach, Bangalore (India)Sreedhara, S.A.; Indian Institute of Horticultural Reseach, Bangalore (India)Anand, L.; Indian Institute of Horticultural Reseach, Bangalore (India). Molecular markers for working out genetic relationship among genotypes of carnation (Dianthus caryophyllus L.. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 93-95 KEYWORDS: DIANTHUS CARYOPHYLLUS. GENETIC MARKERS. GENOTYPES. GENETIC RESISTANCE.

F40 Plant Ecology

089. Reshi, Shabir A.; University of Kashmir, Srinagar (India). Department of Zoology)Azim, M. Nayyar; University of Kashmir, Srinagar (India). Department of

Zoology). Studies on some aspects of biodiversity of cyrtacanthacridini (Orthoptera:Acrididae)of Kashmir,Himalayas. Annals of Plant Protection Sciences (India) v.16(2) p.393-395 KEYWORDS: BIODIVERSITY. ORTHOPTERA. ACRIDIDAE.

Four genera of the tribe Cyrtacanthacridini were reported for first time from Kashmir, India. Key to these genera along with their diagnostic characters were given distribution and habitat of all the species studied were mentioned.

090. Subharani, S.; Institute of Bioresources and sustainable development, Imphal (India)Singh, T.K.; Manipur University, Canchipur (India). Biological studies of Plume moth, exelastis atomosa wals. on Cajanus cajan (L.) millsp. Annals of Plant Protection Sciences (India) v.16(2) p.367-369 KEYWORDS: BIOLOGY. CAJANUS CAJAN.

The mean longevity adult was 6.59+-0.38 days. The average number of egs laid bay an adult femail was 93 to 101 egges hatched in 2.92 to 3.02 days. there were five larval instars witch took 23.12+-0.93 days to enter into pupal stage. Pupation took place on pod surface or entrance of hole or in the burrow of infested pods and the pupal period lasted for about 7.97+-0.33 days. The life cycle of E. atomosa was completed in 40to 42 days.

091. Hemchandra, O.; Manipur University, Canchipur (India)Singh, T.K.; Manipur University, Canchipur (India). Biology and bionomics of brachymeria excarinata gohan, a pupal parasitoid of Plutella xylostella L. on cauliflower. Annals of Plant Protection Sciences (India) v.16(2) p.363-366 KEYWORDS: BRACHYMERIA. PLUTELLA XYLOSTELLA. PARASITISM.

The endoparasitic stages (egg to pupal)and adult periods were lasted 18.24+-0.37 and 10.85 +-0.75 days, respectively. Under laboratory conditions, the parasitoid completed its life cycle in 29.09+-1.13 days and the females survived longer than males. A female parasitoid usually laid egg an average of 20.05+-0.85eggs. The pupal mean population ranged from 5to70. . The mean level of parasitisation ranged from 9.38 to 55.85. and was positively correlated with the increase of DBM population. Among the abiotic factors, temperature and sunshine showed positive significant influence on the parasitoid activity. The percentage of parasitisation also increased the late stage of cropping season.

F60 Plant Physiology and Biochemistry

092. Kamakshi, N.; S.V. Agricultural College, Tirupati (India) Srinivasan, S.; S.V. Agricultural College, Tirupati (India). influence of certain bio-physical factors on incidence of pod borer complex in selected genotypes of field bean. Annals of Plant Protection Sciences (India) v.16(2) p.407-409 KEYWORDS: LABLAB PURPUREUS. HELICOVERPA ARMIGERA.

Five plant parameters viz., pod length, pod width, trichome density, thickness and toughness of the pod were studied in ninteen selected genotypes of field bean which influenced the incidence of pod borer complex. Based on field incidence, HA-4 (white) was identified as a resistant genotype. Pod length and pod width were least in (4.51x0.75cm, respectively) in HA-4 genotype. The susceptible cultivar (USA GP 36 (12-1) FBKO2) had least number of trichomes on pod. Rind thicknes and pod toughness showed a negative correlation with pod damage. The susceptible genotype, GA 2-27, possessed lowest rind thickness (0.72mm), lest pod toughness (0.75 kg cm-1)as compared to resistant genotype, HA-4(white) (1.42mm$0.85 kg cm-2) respectively.

093. Gholamian, F.; Research Centre of Natural Resource and Agriculture of Bushehr Province, Bushehr (Iran)Gholamian, F.; Malek Ashtar University, Tehran (Iran). University Complex of Materials and Production Technology). Effects of HMX and TNT contamination on biochemical constituents in Triticum sativum L. and Raphanus sativus L. plants. Indian Journal of Plant Physiology (India) v. 13(3) p. 211-216 KEYWORDS:

PROLINE. AMINO ACIDS. CHLOROPHYLLS. RAPHANUS SATIVUS. EXPLOSIVES. TRITICUM.

Dose-response experiments formed the basis for evaluating the toxic effects using 2,4,6-trinitrotoluene (TNT) and hexahydro-l,3,5,7-tetranitro-l,3,5,7-tetrazine (HMX) spiked artificial soils. These stresses to Raphanus sativus L. resulted in a reduction in chlorophyll, increase in carotenoid and xanthophylls, reduction in leaf, tuber and root protein, a significant accumulation of free proline in leaves and tuber. HMX decreased proline in root and TNT increased it. HMX stress to Triticum sativum L. resulted in an increase in chlorophyll, decrease in carotenoid and xanthophylls, reduction in leaf protein, and increase in tuber and root protein, a reduction in leaf proline, increase in root proline. TNT resulted an increase in leaf and root proline but there are curved behavior to accumulation of free proline in ear. The magnitude of increase in free proline accumulation was higher in the more tolerant plant. Results indicate Triticum sativum L. is more tolerant to TNT and HMX than Raphanus sativus L.

094. Dhawan, R.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Dept. of Agronomy)Singh, R.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Regional Research Station)Dhawan, A.K.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Regional Research Station) Dhindsa, J.P.S.; Chaudhary Charan Singh Haryana Agricultural University, Hisar (India). Regional Research Station). Isoproturon induced changes in peroxidase and catalase enzymes in susceptible resistant biotypes of Phalaris minor Retz. Indian Journal of Plant Physiology (India) v. 13(3) p. 217-223 KEYWORDS: CATALASE. ISOPROTURON. PEROXIDASES. PHALARIS. ENZYMES.

Peroxidase and catalase activity was studied in isoproturon susceptible and resistant populations of P.minor with a view to observe differences in innate capacity of different populations under/herbicide stress. Resistant populations differed from susceptible populations in exhibiting higher acitivity of these enzymes at the seedling stage. Isoproturon spray caused increase in peroxidase acivity in the susceptible biotypes 5 days after spray. Catalase activity remained low in the sprayed susceptible biotypes. Unsprayed susceptible and resistant biotypes did not differ in isoenzyme pattern of these enzymes. Sprayed resistant plants differ from sprayed susceptible plants in continued presence of isoperoxidases at Rfs 0.32 and 0.36 at 5 days of sampling and at Rfs 0.28, 0.30 and 0.58 at 10 days of sampling.

095. Panda, S.K.; Assam University, Silchar (India). Plant Biochemistry and Molecular Biology Laboratory)Upadhyay, R.K.; Assam University, Silchar (India). Plant Biochemistry and Molecular Biology Laboratory). Biochemical changes and oxidative damage in Azolla pinnata L. under chromium phototoxicity stress. Indian Journal of Plant Physiology (India) v. 13(3) p. 243-250 KEYWORDS: AZOLLA PINNATA. CHROMIUM. LIPID PEROXIDATION. ANTIOXIDANTS. OXIDATION. STRESS.

We studied the effect of both Cr3+ and Cr2o72 on lipid peroxidation and different antioxidative enzymes, in fronds of Azolla pinnata L. in order to know the possible involvement of this metal in the induction of oxidative stress leading to biochemical and oxidative aberrations. Chromium treatment for 2, 4 or 6d resulted in decreased biomass of fronds. A significant increase in activities of superoxide dismutase (SOD), peroxidase (POX) and glutathione reductase(GR) as well as non-enzymic antioxidants, indicated accumulation of hydrogen peroxide and oxidative stress. The increase in superoxide dismutase activity with decline in catalase activity in A. pinnata indicated a sensitive biomarker in monitoring aquatic contaminants like chromium.

096. Behera, P.R.; Institute of Minerals and Materials Technology, Bhubaneswar (India). Plant Biotechnology Lab.)Nayak, P.; Institute of Minerals and Materials Technology, Bhubaneswar (India). Plant Biotechnology Lab.)Thirunavoukkarasu, M.; Institute of Minerals and Materials Technology, Bhubaneswar (India). Plant Biotechnology Lab.) Sahoo, S.; Institute of Minerals and Materials Technology, Bhubaneswar (India). Plant Biotechnology Lab.). Plant regeneration of Gmelina arborea Roxb. from cotyledonary

node explants. Indian Journal of Plant Physiology (India) v. 13(3) p. 258-265 KEYWORDS: BA. MICROPROPAGATION. IBA. COTYLEDONS. GMELINA ARBOREA. REPLANTING.

A regeneration protocol has been developed for Gmelina arborea Roxb. using cotyledonary nodes. Multiple shoots were induced on Murashige and Skoog's (MS) medium supplemented with 6¬benzyladenine (BA) and thidiazuron (TDZ) either alone or in,-combination with either indole-3-acetic acid (IAA) or a-napthalene acetic acid (NAA). Cotyledonary nodes cultured on medium with BA (4.4 J.LM) + IAA (1.4 J.LM) produced higher number of shoots. Cultures maintained in TDZ supplemented medium showed poor response. In vitro regenerated shoots were cultured on to root induction medium consisting of half-strength MS supplemented with IAA or indole-3-butyric acid (IBA) either alone or in combination with 2, 3, 5-triiodobenzoic acid (TIBA). Rooting was best in the medium supplemented with 4.9 J.LM IBA + 2.0 J.LM TIBA. Rooted plantlets were acclimatized and transferred to the field with 70 survival rate.

097. Bose, B.; Banaras Hindu University, Varanasi (India). Dept. of Plant Physiology)Kumari, S.; Banaras Hindu University, Varanasi (India). Dept. of Plant Physiology)Anaytullah; Banaras Hindu University, Varanasi (India). Dept. of Plant Physiology)Srivastavam A.K.; Banaras Hindu University, Varanasi (India). Dept. of Plant Physiology)Kuril, S.K.; Banaras Hindu University, Varanasi (India). Dept. of Plant Physiology)Singh, P.K.; Uttar Pradesh College, Varanasi (India). Dept. of Botany). Effect of mercuric chloride on seed germination, seedling growth and enzyme activities in maize (Zea mays L.). Indian Journal of Plant Physiology (India) v. 13(3) p. 284-290 KEYWORDS: GERMINATION. SEEDS. SEEDLING PRODUCTION. ENZYMES. ZEA MAYS. MERCURIC CHLORIDE.

The phytotoxic effect of mercuric chloride on seed germination and seedling growth of maize (var. Jaunpuri) was studied by seed soaking treatment with different concentrations of mercuric chloride (0 to 3.0 mM). Different physico-chemical parameters were studied, viz., seed germination, length of plumule and radicle, absolute water uptake (A WU), relative water uptake (R WU), amylase activity (endosperm) and proline content (seedling). Increase in concentration of mercuric chloride from 0.5 to 3.0 mM decreased seed germination significantly when compared with control. Similar trend was noticed in other parameters like radicle and plumule length, A WC. , RWU. and amylase activity. However, seedling proline content increased with increase in HgCl2 concentration. In another experiment seed treatment for 48 h with mercuric chloride (0.5 to 1 mM), inhibited the no. of leaves, root length, shoot length, no. of adventitious root, leaf area, fresh weight of roots and shoot, chlorophyll and nitrogen contents and nitrate reductase activity while superoxide dismutase activity as well as membrane injury enhanced in 8 and 12 days old seedlings, respectively. However, values of no. of leaves, root length, shoot length and fresh weight of roots were not significant. Similarly, maize leaves collected from 12 days old control seedling when floated over mercuric chloride solution (0.5 to 1 mM) for 24 h a constant decline was noted in nitrate reductase activity whereas accelerations were recorded in superoxide dismutase activity and membrane injury. The finding suggested that the mercury has direct impact on membrane structure of the tissue and on the enzymatic activity of the plant system.

098. Banerjee, S.N.; Bengal College of Engineering and Technology, Durgapura (India). Dept. of Biotechnology)Roy, K.; University of Tennessee, Tennessee (United States of America). Dept. of Biosystems Engineering and Soil Science)Ray, S.; Indian Association for the Cultivation of Science, Kolkata (India). Dept. of Biological Chemistry)Ray, M.; Indian Association for the Cultivation of Science, Kolkata (India). Dept. of Biological Chemistry). Retardation of senescence of detached leaves by methylglyoxal. Indian Journal of Plant Physiology (India) v. 13(3) p. 300-306 KEYWORDS: SENESCENCE. KINETIN. PYRUVATES. PYRUVIC ACID.

In the present study the effect of methyl glyoxal on detached leaf senescence of six plant species, viz. carrot, solanum, papaya, basil, ribbed gourd and rice was investigated. When the detached leaves were kept for a fixed time period, the

methylglyoxal treated leaves could significantly arrest senescence in all the plant species tested, which was evident by the retention of structural integrity as well as of chlorophyll and protein contents. However, pyruvate had a very mild effect though it has structural similarity with methylglyoxal. Comparison of activity profiles of peroxidase, glyoxalase I and glucose-6-phosphate dehydrogenase in freshly excised, senesced and methyl glyoxal treated leaves showed that the enzyme activities of methylglyoxal treated leaves closely resembled that of the freshly excised leaves.

099. Singh, N.B.; Chander Sekhar Azad University of Agricultrue and Technology, Kanpur (India). Section of Rabi Cereals)Singh, Y.P.; Chander Sekhar Azad University of Agricultrue and Technology, Kanpur (India). Section of Rabi Cereals)Tiwari, L.P.; Chander Sekhar Azad University of Agricultrue and Technology, Kanpur (India). Section of Rabi Cereals)Bahar, J.; Chander Sekhar Azad University of Agricultrue and Technology, Kanpur (India). Section of Rabi Cereals)Singh, V.P.N.; Chander Sekhar Azad University of Agricultrue and Technology, Kanpur (India). Section of Rabi Cereals)Alam, P.; Chander Sekhar Azad University of Agricultrue and Technology, Kanpur (India). Section of Rabi Cereals). Morphophysiological traits as index of screening wheat genotypes for thermotolerance. Indian Journal of Plant Physiology (India) v. 13(3) p. 307-311 KEYWORDS: CANOPY. GENOTYPES. FLOWERING. SOWING DATE. LEAVES.

Wheat genotypes which differed widely in their morpho-physiological characters were grown under two dates of sowing, i.e. normal (25th November) and late (3rd January) in order to have temperature variation which was 25-28 °C in (normal) and 30-33°C (late) during grain filling period. Results revealed that wheat genotypes with droopy leaf, viz. Raj 3765, K 7903, GW 336, NW 1014 and K 8962 recorded a wider angle of flag leaf from vertical plane, early flowering, greater canopy temperature depression, seed hardness and better performance in respect of yield and grain quality over erect leaf oriented genotypes, viz. PBW 373, K 2008, HTWYT - 9, AP 1064, KYP 0328 under high post-anthesis, temperature, i.e. 4 to 5.6°C28°C (Normal) under late sowing. Further, these traits, viz. higher leaf orientation, early flowering, canopy temperature depression and seed hardness possessed positive correlation with yield under late sowing, thereby, indicating their involvement in process of terminal heat stress. Thus, these traits which are simple and easily measurable can be used as screening techniques to identify thermo-tolerant wheat genotypes under late sown environments of north eastern plain zone of the country.

100. Saxena, D.K.; Bareilly College, Bareilly (India). Dept. of Botany)Singh, S.; Bareilly College, Bareilly (India). Dept. of Botany)Srivastava, K.; Bareilly College, Bareilly (India). Dept. of Botany). Effect of lead and copper on enzyme activity in two bryophytes. Indian Journal of Plant Physiology (India) v.13(3) p.312-316 KEYWORDS: LEAD. COPPER. ENZYMES. BRYOPHYTA.

Effect of lead and copper on nitrate reductase activity (NRA), peroxidase (POX) and superoxide dismutase (SOD) in mosses Rhodobryum roseum and Hypnum cupressiforme grown in different concentrations (control,S, 10, SO and 100 mM) for 7 and 15 days was studied. Level of NR activity significantly increased in comparison to control in 5 mM concentartion in 7 days treatment, which decreased if time period and concentration of metals (Pb and Cu) was increased, whereas, oxidative enzymes (i.e. POX and SOD) activity were observed to be significantly higher at all concentrations in 7 and 15 days of treatment period in both the mosses. The result suggests that Rhodobryum roseum is less sensitive to Pb and Cu in comparison to Hypnum cupressiforme.

101. Kansagra, M.; Saurashtra University, Rajkot (India). Dept. of Biosciences)Pawar, V.; Saurashtra University, Rajkot (India). Dept. of Biosciences)Bhatt, K.; Saurashtra University, Rajkot (India). Dept. of Biosciences)Chudasama, R.; Saurashtra University, Rajkot (India). Dept. of Biosciences)Thaker, V.; Saurashtra University, Rajkot (India). Dept. of Biosciences). Role of cationic and anionic peroxidase in browning of multiple shoots of carnation (Dianthus caryophyllus L.) in vitro. Indian Journal of Plant Physiology

(India) v.13(3) p.317-319 KEYWORDS: DIANTHUS CARYOPHYLLUS. IN VITRO. SHOOTS.

Multiple shoots were induced from nodal region of carnation (Dianthus caryophyllus L.) in Murashige and Skoog medium containing 1.5 mg 1-1 BAP and 0.5 mg J-l NAA. Induction of the shoots was observed in three weeks, but good amount of tissue turned brown in sub-cultures. Cationic and anionic peroxidase activities were studied in green and brown multiple shoot culture of carnation. It was observed that anionic protein was more in brown tissue and specific anionic peroxidase activity was also higher. It is concluded that anionic peroxidase plays an important role in browning of the tissue.

102. Chatterjee, J.; Lucknow University, Lucknow (India). Botany Dept.). Zinc stress disturbed the physiology of french bean. Indian Journal of Plant Physiology (India) v. 13(3) p. 320-323 KEYWORDS: ZINC. ENZYMES. FUNCTIONAL DISORDERS.

Zinc stress was induced in french bean cv. Anupama in refined sand at variable levels of zinc from deficient (0.00065 mgll) to excess (13.0 mgll) supply. After 35 days, depression in growth followed by initiation of chlorosis at margins of middle leaves was observed under zinc deficiency. At later stage with continuous low supply, zinc deficient plants were very retarded and stunted in growth with dense small leaves. At excess Zn (13 mgll) level, interveinal chlorosis appeared on young leaves started from the base of the lamina and spread towards the centre. Zinc stress (both deficiency and excess) caused reduction in biomass and economic yield. The concentrations of reducing sugar, starch, protein nitrogen, soluble protein and specific activity of carbonic anhydrase were decreased and stimulation in specific activities of acid phosphatase and ribonuclease in leaves and pods of french bean was observed under zinc stress. The concentration of Zn in dry matter increased with an increase in zinc supply. It appears that the zinc concentration values at deficiency, threshold of deficiency, threshold of toxicity and toxicity in leaves were 18, 32, 117 and 138 ,..g Zn/g dry matter respectively.

103. Chattopadhyay, T.; Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India). Crop Research Unit & Dept. of Biotechnology)Biswas, T.; Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India). Crop Research Unit & Dept. of Biotechnology)Chatterjee, M.; Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India). Crop Research Unit & Dept. of Biotechnology)Mandal, N.; Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India). Crop Research Unit & Dept. of Biotechnology) Bhattacharyya, S.; Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India). Crop Research Unit & Dept. of Biotechnology). Biochemical and SSR marker based characterization of some Bengal landraces of rice suffixed with 'sail' in their name. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 15-20 KEYWORDS: GENETIC MARKERS. RICE. HIGH YIELDING VARIETIES.

Twenty five rice land races of undivided Bengal (name of all these landraces have 'sail' or 'Shali' in their suffix) which were popular before popularization of semi-dwarf high yielding varieties, either for cooking, puffing, popping and flash flood tolerance have been studied using biochemical parameters and their linked SSR markers. Except Shali (blackish small bold), and Shali (golden long) all genotypes contain more than 24 amylose. RM190 linked with amylose content generated a rare allele in Shali (golden long). Another linked marker RM251 could not explain the differential amylose content in studied rice genotypes. RM 236, a SSR marker linked with rice bran content shows a rare allele (160bp) in Shali. (blakish small bold) and Netaisail. Rabansail, Kobirajsail, Mallicksail and Kakudsail have intermediate gelatinization temperature and remaining genotypes have high gelatinization temperature as indicated by alkali spreading value. Linked marker, RM 253 could not explain the difference in alkali spreading values. Screening the genotypes with RM 219, linked with submergence tolerance in rice, generated 4 alleles, viz., 192bp, 204bp, 220bp and 240bp. Allele 1 (192bp) is present in Hardijhingasail and Sankarsail only, and may be considered as a rare allele. None of the genotypes contained 85. or more similarity between each other at molecular level that suggests the absence of duplication of the landraces. RM 206 generated six alleles

although polymorphism information content (PIC) value was found t() be higher in case of RM 253 (0.491). So both the markers could be used for diversity analysis in rice.

F61 Plant Physiology - Nutrition

104. Yaligar, Raghavendra; University of Agril Sciences, Dharwad (India). Dept. of Agril Entomology)Nandihalli, B.S.; University of Agril Sciences, Dharwad (India). Dept. of Agril Entomology)Reddy, N. Aswathanarayana; Zonal Agricultural Research Station, Mudigere (India). Management of coconut perianth mite, accria guerreronis keifer through plant nutrition. Annals of Plant protection Sciences (India) v.16(2) p.294-297 KEYWORDS: NUTRIENT AVAILABILITY. PLANT NUTRITION. COCOS NUCIFERA. ACERIA GUERRERONIS.

The study revealed that soil application of Murate of Potash (1.5kg)+ MgSO4 (0.5 kg) + borax (50g) + gypsum (1.0 kg) + recommended dose of fertilizer 91.3 kg N + 2kg P + 2kg K) found to be superior in reducing mite population with low damaged nuts (33.6.) with highest number of healthy marketable nuts (43/palm), total number of nuts (88 nuts/palm) highest C:B ratio was recorded (1:2.53) compared to all other treatments. The treatment COT+RDF recorded lowest number of nuts/palm with highest mite population and damaging score over other treatments.

105. Kumar, P.; Central Potato Research Institute, Modipuram (India) Trehan, S.P.; Central Potato Research Institute, Shimla (India)Singh, B.P.; Central Potato Research Institute, Modipuram (India)Rawal, S.; Central Potato Research Institute, Modipuram (India)Khan, M.A.; Central Potato Research Institute, Modipuram (India). Precising nitrogen requirement of table potato (Solanum tuberosum) cultivars for different growth periods. Indian Journal of Agronomy (India) v. 52(4) p. 314-317 KEYWORDS: POTATOES. SOLANUM TUBEROSUM. NUTRITIONAL REQUIREMENTS. NITROGEN.

A field experiment was conducted for 3 consecutive seasons (2004-2007) at Modipuram to optimize the growth period-specific N requirements of table potato cultivars 'Kufri Pukhraj' and 'Kufri Anand' in sandy loam soils. Growth, yield and economic parameters of both the genotypes were evaluated for their response to 4 N levels (0, 90, 180 and 270 kg/ha) and 2 growth periods (75 and 110 days). The crop-growth traits and tuber number were not influenced due to harvest stages; however, tuber yield was 31.3. higher with extended duration (110 days). N application had favourable effect on growth parameters, but showed quadratic response to marketable and total tuber number/ha. Likewise, it showed steady increase in marketable and total tuber yields. Agronomic N-use efficiency (118.6-66.0 kg tubers/kg N applied) decreased linearly with increase in N levels. 'Kufri Anand' recorded better growth than 'Kufri Pukhraj', but tuber number and yield as well as economic variables were statistically similar in both the cultivars. Net income and benefit: cost (8: C) ratio indicated that both the cultivars should be fertilized with 270 kg N/ha when harvested at 110 days, but 180 kg N/ha is sufficient when harvested at 75 days.

106. Hundal, H.S.; Punjab Agricultural University, Ludhiana (India). Dept. of Soils)Singh, D.; Punjab Agricultural University, Ludhiana (India). Dept. of Soils)Singh, K.; Punjab Agricultural University, Ludhiana (India). Dept. of Soils)Brar, J.S.; Punjab Agricultural University, Ludhiana (India). Dept. of Soils). The diagnosis and recommendation integrated system for monitoring nutrient status of rice in lowland areas in the vicinity of Satluj river in Punjab. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 198-204 KEYWORDS: DIAGNOSIS. RICE. LOWLAND. PUNJAB. LEAF CONDUCTANCE.

The Diagnosis and Recommendation Integrated System (DRIS) approach was employed to monitor the nutrient status of rice crop cultivated in lowland areas in the vicinity of Satluj River in district Ludhiana. Standard reference DRIS norms were established for various nutrient ratios obtained from high yield population of rice crop and were further used to compute DRIS indices, which assessed nutrient balance and order of limitation to yield. The DRIS-derived sufficiency ranges for N, P, K, Ca, Mg and

S from nutrient indexing survey of rice plants grown on lowland areas were 1.49-2.50, 0.14-0.23, 0.57-1.11, 0.30-0.58, 0.13-0.30 and 0.14-0.26. , respectively. The limits for Fe, Mn, Zn and Cu were 64-217,72-184,15-24 and 3-6 mg kg.l, respectively. On the basis of sufficiency ranges, 14.50, 1.78, 11.20 and 0.76. samples were low in N, P, K and S, respectively, from three hundred and ninety-three rice crop fields surveyed. In case of micro nutrients, 1.53 and 2.04. samples were low in Mn and Zn, respectively. Validation experiments were carried out in the following year at some selected sites for rice crop on the basis of most required nutrient element by DRIS approach. Soil application of the most required macronutrient elements (N, P, K and S) through their respective fertilizer and micronutrients (Zn, Cu and Mn) through foliar spray of their salts changed their respective order from the most required to their lesser or the least one among the ten nutrient elements and eventually contributed to increase in grain yield of rice except Mn. The DRIS was also validated at some sites where Ca and Mg were identified as the most required nutrient elements. However, application of CaCl2 or MgCl2 at these respective locations did not contribute to increase in the grain yield of rice. Thus, DRIS approach, besides diagnosing the deficiency or identification of inadequacy of a certain nutrient element (even if all the ten nutrients are within the sufficiency range), helped in increasing rice yield by application of most required nutrient through fertilizers.

107. Stalin, P.; Tamil Nadu Agricultural University, Thanjavur (India)Ramanathan, S.; Tamil Nadu Agricultural University, Coimbatore (India)Natarajan, K.; Tamil Nadu Agricultural University, Thanjavur (India)Chandrasekaran, B.; Tamil Nadu Agricultural University, Thanjavur (India)Buresh, R.; International Rice Research Institute, Philippines (Manila). Soil and Water Science Div.). Performance of site-specific and real-time N management strategies in irrigated rice . Journal of the Indian Society of Soil Science (India) v. 56(2) p. 215-221 KEYWORDS: IRRIGATED RICE. DRY MATTER CONTENT. NITROGEN METABOLISM. PLANT NUTRITION.

Field experiments were conducted during kharif and rabi seasons of 2001 and 2002 with the objective of evaluating the performance of different fertilizer N management strategies including site-specific and real-time N management, on dry matter production, N uptake, yield, yield components and N use efficiency in rice. Among the different N fertilization strategies tried, both site-specific nutrient management (SSNM) with fixed N split approach i.e., 115 :t 20 kg ha-I in kharifand 140:t 20 kg N ha-I in rabi as well as real-time N management viz., leaf colour chart (LCC) with critical value 4 based N management (N applied at LCC=4) (35 kg N ha-I in kharifand 30 kg N ha-1 in rabi when the LCC value fell below 4) registered higher dry matter pfoduction, N uptake, N use efficiency and grain yield than the other treatments. The results suggest that as a simple tool, the adoption of real-time N management viz., the LCC=4 based N management is a profitable proposition ofN fertilization strategy for rice.

F62 Plant Physiology – Growth and Development

108. Kumar, Arvind; G.B. Pant University of Agriculture and Technology, Pantnagar (India)Singh, C.P.; G.B. Pant University of Agriculture and Technology, Pantnagar (India). Population dynamics of Papilio demoleus linn. on Psoralea corylifolia in tarai Uttarakhand. Annals of Plant protection Sciences (India) v. 16(2) p.370-372 KEYWORDS: PAPILIO. PSORALEA CORYLIFOLIA.

It is observed that population and infestation of Papilo demoleus appeared from 14th august to 27th november (3 to 18 WAT). the highest population and infestation observed 0.5/plant and 44.0. respectively.The population and infestation were also influenced weather parameters.

109. Sharma, S.; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Fruit Science)Sharma, N.; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Fruit Science). Effect of rootstocks on leaf water

potential, water relations, antioxidant activities and drought tolerant in flemish beauty pear under water stress conditions. Indian Journal of Plant Physiology (India) v. 13(3) p. 266-271 KEYWORDS: ANTIOXIDANTS. ENZYMES. DROUGHT STRESS. PYRUS COMMUNIS. LEAVES. WATER POTENTIAL. DROUGHT RESISTANCE.

A study was conducted to investigate the effect of two Pyrus seedling rootstocks [Kainth (Pyrus pashia Buck and Ham.), Shiara (Pyrus serotina Redh.) and three clonal quince (Cydonia oblonga Mill) rootstocks [BA 29, Quince A and Quince C] on growth, water relations and antioxidant activities of one-year-old Flemish Beauty pears at -0.5 bars and -10.0 bars (water-stress) of soil moisture levels. Plant height, shoot and root dry weights of plants on different rootstocks decreased markedly by water stress. Plants on Kainth and BA 29 rootstocks were less affected under water stress than those on other rootstocks. Plants on Kainth and BA 29 rootstocks maintained higher leaf water potential and showed less reduction in stomatal conductance and photosynthetic rate. These plant accumulated more soluble sugar, ascorbic acid and proline content in their leaves in comparison to plants on other rootstocks under water stress conditions. The antioxidant enzymes (catalases, peroxidases and superoxide dismutase) activities increased significantly under water stress and increase was higher in plants on Kainth and BA 29 rootstocks than those on other rootstocks. The results suggest that plants on Kainth and BA 29 rootstocks exhibit better protection mechanism against oxidative damage under water stress conditions than those on other rootstocks.

110. Bagdi, D.L.; Institute of Life Sciences, Bhubaneswar (India). Environmental Biotechnology Lab.)Afria, B.S.; S.K.N. College of Agriculture, Jobner (India). Dept. of Plant Physiology). Alleviation of salinity effects using plant growth regulators in wheat. Indian Journal of Plant Physiology (India) v. 13(3) p. 272-2777 KEYWORDS: SALINITY. OSMOTIC STRESS. SALT TOLERANCE. WHEATS. PLANT GROWTH SUBSTANCES.

A field experiment was conducted to study the harmful effects of salinity and theiv' amelioration by the application of plant growth regulators, viz. cycocel, maleic hyder_azide, benzyladenine and mixtalol on physiological, biochemical and yield attributes of wheat (Triticum aestivum L.). Salinity was found to significantly decrease photosynthetic rate, total chlorophyll content, cell membrane stability, reducing sugar content, plant height, leaf area index, test weight, number of grains/ear, number of tillers, grain and straw yield compared to non saline field. Application of plant growth regulators ameliorated the effect of salinity on these physiological parameters. A significant increase in grain nitrogen and protein contents was observed. Maximum increase in above parameters was recorded by the use of benzyladenine at 7S mg 1-1 as compared to other concentrations and other plant growth regulators.

111. Dey.S.; Fakir Mohan University, Balasore (India). Post Graduate Dept. of Environmental Sciences). Changes in some aspects of oxidative metabolism in sensing mungbean cotyledons as affected by seedling decapitation. Indian Journal of Plant Physiology (India) v. 13(3) p. 291-296 KEYWORDS: VIGNA RADIATA. SUPEROXIDE DISMUTASE. COTYLEDONS. SENESCENCE. CATALASE. SEEDLINGS. LIPID PEROXIDATION.

Decapitation effects on some aspects of oxidative metabolism in senescing mungbean (Vigna radiata (L.) Wilczek cv. PDM-54) cotyledons were studied. There was gradual decrease in fresh weight, dry weight and soluble protein contents. However, pigment contents recorded increase till 7th day and a subsequent decline. On shoot decapitation even though fresh weight, dry weight and protein contents shQwed lesser depletion, the photosynthetic pigment contents declined further. The superoxide dismJltase activity increased where as catalase activity decreased in senescing cotyledons which favoured the chances of accumulation of H202 as a result increase in lipid peroxidation was noticed. However, on reversal of senescence by decapitation, there was decline in superoxide dismutase and increase in catalase activities that could limit the oxidative corrosion in the tissues, as observed in the form of lowering lipid peroxidation in rejuvenated cotyledons. Thus, catalase (H202 - scavenging) activity seems to be one of the key regulatory aspect of oxidative metabolism in senescing mungbean cotyledons.

112. Sehgal, S.K.; Kansas State University, Manhattan (United States of America). Dept. of Plant Pathology)Kaur, G.; Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding)Sharma, I.; Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding)Bains, N.S.; Punjab Agricultural University, Ludhiana (India). Dept. of Plant Breeding). Development and molecular marker analysis of Karnal bunt resistant near isogenic lines in bread wheat variety PBW 343. Indian Journal of Genetics and Plant Breeding (India) v. 68(1) p. 21-25 KEYWORDS: GENETIC MARKERS. VIRUSES. SOFT WHEAT. TRITICUM AESTIVUM.

Karnal bunt (KB) resistant near isogenic lines (Nils) were developed using the stock (KBRl 22) with high KB resistance and the widely grown wheat cultivar (PBW 343) as recipient. Genetic analysis in BCsF2 and BCsFa populations revealed involvement of up to three additive genes for KB resistance. Single plants from lines which were uniform for resistance and susceptibility in BCsFa' were advanced to BCsF 4 and screened further for establishment of extreme Nils. The KB resistant Nils were screened for presence of donor alleles at 93 polymorphic SSR loci using the recipient parent (PBW 343) as control. Donor alleles of four markers; Xgwm99 (1Al), Xgwm149 (4Bl), Xgwm174 (5Dl) and Xgwm340 (3Bl) showed their presence in the resistant pool. These four markers were run on the 11 resistant and 10 susceptible BCsF 4Progenies. Resistant and susceptible phenotypes showed association with three of the four markers viz., Xgwm 99, Xgwm 174 and Xgwm 340 as indicated by the Chi square contingency test.

F70 Plant Taxonomy and Geography

113. Singh, A.K.; Udai Pratap Autonomous College, Varanasi (India). Dept. of Botany)Singh, S.; Udai Pratap Autonomous College, Varanasi (India). Dept. of Botany). A morpho-taxonomic observation on seedlings of Parthenium hysterophorus L. - a well known exotic weed. Indian Journal of Forestry (India) v. 31(2) p. 197-200 KEYWORDS: WEED CONTROL. PARTHENIUM. PLANT VIRUSES. TAXONOMY. SEEDLINGS.

Present communication deals with seedling morphology and taxonomy of Parthenium hysterophorus L., a well known exotic weed from Varanasi region, Uttar Pradesh, India. Seedling morphology is observed for 44 days up to 5th true leaf stage. Seedling morphology showed that seed germination is epigeal, the seedlings are macranga type and phanerocotylar. The seed leaves are isocotylar, opposite and persist up to 6th true leaf stage, obovate, entire, green, smooth with less distinct veins. The first true leaf was ovate, entire, dark green, hairy, veination unicostate reticulate. Subsequent leaves were same as first true leaf, but margin den ate at 2nd or 3rd true leaf stage. Fourth or 5th true leaves were peltate with lyrate margin and oblique base.

H10 Pests of Plants

114. Chaudhari, B.N.; Mahatma phule Krishi Vidyapeeth, Rahuri (India))Patil, C.S.; Mahatma phule Krishi Vidyapeeth, Rahuri (India) Ghorpade, S.A.; Mahatma Phule Krishi Vidyapeeth, Rahuri (India) Chandele, A.G.; Mahatma Phule Krishi Vidyapeeth, Rahuri (India). Toxicity of insecticides against helicoverpa armigera on cotton in Maharashtra.. Annals of Plant Protection Sciences v.16(2) p.298-301 KEYWORDS: TOXICITY. INSECTICIDES. PEST INSECTS.

Bioassay of five insectcides viz., fenvalerate, cypermethrin, quinalphos, carbaryl and endosulfan were undertaken in laboratory against populations of helicoverpa armigera collected form known pesticide usage locations in Maharashtra. the log dose probit assays indicated that H. armigera population form Amalner with heavy pesticide usage area recorded higher LD50 values compared to Madha population representing low pesticide usage area. Irrespective of locations, fenvalerate was most toxic to H. armigera followed by cypermethrin, Endosulfan was lest toxic to H. armigera.

115. Dhaman, S.C.; M.S. P.G. College, Saharanpur (India)Bhardwaj, Man Mohini Hira; M.S. P.G. College, Saharanpur (India)). Host and pest relationship, host specificity and orientation towards food of physopelta schlanbuschii (Heteroptera : Pyrrhocoroidea : Largidae). Annals of Plant Protection Sciences (India) v.16(2) p.373.376 KEYWORDS: PEST CONTROL. HOSTS.

Physopelta schlanbuschii, a phytosuccivorous bug fed mainly on Trivea nudiflora bark and seeds and provided fat, carbohydrate and some amount of protein to the bug. Besides this, bug population feeds on other host plants to meet the demand of water, minerals and amino acids. Food perference studies revealed that among a good number of food plants, it had preferential feeding on T. nudiflora.

116. Marmit, Kamal S.; University of Rajasthan, Jaipur (India)Meena, Vijay P.; University of Rajasthan, Jaipur (India)Sharma, Suman L.; University of Rajasthan, Jaipur (India). Quantitative estimation of phenolics and related enzymes in insect induced leaf galls of Mangifera Indica. Annals of Plant Protection Sciences (India) v.16(2) p.306-308 KEYWORDS: MANGIFERA INDICA. INSECTA. PHENOLIC COMPOUNDS.

Amradiplosis allahabadensis, an insect of order-diptera induced galls on leaf of Mangifera indica. Quantitative estimation of phenolices and related enzymes in insect leaf galls of Mangifera indica were studied. The contents of total phenols, o-dihydroxy phenol, peroxidase and polyphenol oxidase activities in leaf galls and normal counter parts of M. indica were measured. Total phenols, o-dihydroxy phenol and peroxidase were recorded higher in gall tissue while polyphenol oxidase activities were recorded higher in normal counter parts as compared gall tissues.

117. Kamakshi, N.; S.V. Agricultural College, Tirupati (India) Srinivasan, S.; S.V. Agricultural College, Tirupati (India) Muralikrishna, T.; S.V. Agricultural College, Tirupati (India). Influence of biochemical constitunts on incidence of pod borer complex in selected field bean genotypes. Annals of Plant Protection Sciences (India) v.16(2) p.302-305 KEYWORDS: DEFENCE MECHANISMS. LABLAB PURPUREUS. GENOTYPES.

Seven biochemical constituents viz. proteing, reducing sugars, phenols, tannins, crude fiber, silica and fat were studied in relation to expression of varietal reaction against borer complex in 19 selected genotypes of field bean.Of the various biochemical components, protein content and reducing sugar exhibited significant positive correlations with pod damage by deferent pod borers in the different genotypes. The most susceptible genotype, GA 2-27 with 49. damage had comparatively high amount of proten content (27.5.) and reducing sugars (1.13 mg g-1), while the resistant genotype (HA-4, white) had less content of protein 20.1. and sugars 0.60 mg g-1. The correlation coefficients between total phenols/tannins/fiber/silica/fat in pods and pod damage due to pod borers were negative and significant. The genotype HA-4 (white) had comparatively high amount of phenols (1.79 mg g-1), tannins (1.23 mg g-1), fiber (16.9.) and silica (0.7.).

118. Srivastava, Chitra; I.A.R.I., New Delhi (India)Sinha, S.N.; I.A.R.I. Regional Station, Karnal (India). Suseceptibility of Callosobruchus sp. collected from various NSP centres to insecticides . Annals of Plant Protection Sciences (India) v.16(2) p.337-340 KEYWORDS: INSECTA. CALLOSOBRUCHUS.

Susceptibility of pulse beetles Callosobruchus and maculatus and C. analis collected form different national seed programme centers was studied against commonly used insecticides viz., malathion, dichlorvos and deltamethrin. insects form different populations were found to be susceptible to deltamethrin. toxicity of malathion was decreased to some population of C. maculatus. All populations showed highest susceptibility for deltamethrin and lest to dichlorvos.

119. Nigam, V.D.; N.D. University of Agriculture and Technology, Faizabad (India)Sharma, R.C.; N.D. University of Agriculture and Technology, Faizabad (India)Ali, S.; N.D. University of Agriculture and Technology, Faizabad (India). Evaluation of rice germplasms at different cropping stages for resistance to cnaphalocrocis medinalis.

Annals of Plant Protection Sciences (India) v.16(2) p.333-336 KEYWORDS: CNAPHALOCROCIS MEDINALIS. ORYZA SATIVA. PEST CONTROL.

Twenty five rice germplasms were tested and six germplasms viz., IET 13310, NDR 6023, IET 10649-1, Mahsuri, NDR 6232 and NDR 6175 showed a consistent damage rating of 1. Among the plant morphological characters studied, number of tillers, plant height (cm), number of leaf, leaf width (cm) and leaf texture, only leaf width (cm)showed significant correlation with leaf folder infestation. Majority of the germplasms which had damage rating of 1 and 3 had rough texture.

120. Prakasam, V.; G.B. Pant Univ. of Agriculture and Technology, Pantnagar (India). Mushroom Research Training Centre). Singh, R.P.; G.B. Pant Univ. of Agriculture and Technology, Pantnagar (India). Mushroom Research Training Centre). Cultural and morphological characterization of Agaricus bisporus strains. Annals of Plant Protection Sciences (India) v.16(2) p.454-457 KEYWORDS: AGARICUS BISPORUS.

Cultural and morphological variations of seven strains of Agaricus bisporus (CM-1, CM-5, CM-10, Delta, S-130, S-140 and X-13) and a strain (NCB-13) of A.bitorquis were studid on the basis of growth on MEA medium, syntheetic compost and casing soil and different characters of their fruiting body. S-130 showed maximum growth on MEA medium, compost and casing soil whereas NCB-13 produced higher fruit body weight and stipe width. Lesser stipe length and maximum pileus diameter were observed in strain delta. Maximum pileus thickness was observed in CM-5. these informations generated in the present study will be useful in breeding programmes to develop high yielding strains of button mushroom.

121. Singh, D.K.; C.S.A. University of Agri. & Tech., Kanpur (India) Singh, Ram; C.S.A. University of Agri. & Tech., Kanpur (India) Dwivedi, R.K.; C.S.A. University of Agri. & Tech., Kanpur (India). Evaluation of bio-pesticides against lepidopterous pests of cabbage. Annals of Plant Protection Sciences (India) v.16(2) p.316-319 KEYWORDS: PESTICIDES. CABBAGES. PESTS.

Bacillus thuringiensis var. kurstaki formulation viz. delfin, dipel halt, biobit, biolep, bioasp, botanical insecctiide neemgold, nematode (steinernema feltiae), green commandos and endosulfan insecticide were evaluated against lepidopterous pests of cabbage under field conditions. Delfin was very effective in reducing the population of cabbage leaf webber, crocidolomia binotalis (67.6.)and diamond back moth, plutella xylostella (57.1.). Dipel was equally effective against these pests and recorded 67.4 and 56.2. reduction, respectively. Endosulfan proved to be effective against tobaco caterpillar spodoptera litura, witch recorded 55.45 reduction. All the test insecticides were found to be safe and did not show adverse effect on coccinellid population under field conditions.

122. James, Melvin; Univ. of West Indies, St. Augustine, Trinidad (West Indies). Dept. of Life Sciences.Khan, Ayub; Univ. of West Indies, St. Augustine, Trinidad (West Indies). Dept. of Life Sciences.. Fecundity life tables for Plutella xylostella L. at two temperatures and its implication in IPM. Annals of Plant Protection Sciences (India) v. 16(2) p. 269-273 KEYWORDS: PLUTELLA XYLOSTELLA. FERTILITY. LIFE TABLES. TEMPERATURE. INTEGRATED PEST MANAGEMENT.

123. Gupta, V.K.; Punjab Agril. Univ., Ludhiana (India). Dept. of Entomology.. virashkguptamail.comSharma, Pawan; Cotton Molecular Breeding Lab, 2356, Rainwater Rd., Tifton, GA (USA).Sharma, Rakesh; Punjab Agril. Univ., Ludhiana (India). Dept. of Entomology.Jindal, Jwala; Punjab Agril. Univ., Ludhiana (India). Dept. of Entomology. Dilawari, V.K.; Punjab Agril. Univ., Ludhiana (India). Dept. of Entomology.. Development of scar markers for specific identification of B-biotype of Bemisia tabaci (Gennadius). Annals of Plant Protection Sciences (India) v. 16(2) p. 274-281 KEYWORDS: BEMISIA TABACI. BIOTYPES. IDENTIFICATION. COTTON. GOSSYPIUM. PEST INSECTS.

124. Gupta, M.P.; College of Agriculture, Tikamgarh (India).. Efficacy and economics of biorationals and their admixtures against incidence of major insect pests of soybean. Annals of Plant Protection Sciences (India) v. 16(2) p. 282-288 KEYWORDS: GLYCINE MAX. PEST INSECTS. ECONOMICS. INSECT CONTROL.

H20 Plant Diseases

125. Parashar, Anamika; University of Rajasthan, Jaipur (India) Lodha, Payal; University of Rajasthan, Jaipur (India). Quantification of total carbohydrates and related enzymes in ramularia blight infected fennel plants. Annals of Plant Protection Sciences (India) v.16(2) p.438-440 KEYWORDS: PATHOGENESIS. RAMULARIA. FOENICULUM VULGARE. CARBOHYDRATES.

Quantification of carbohydrates and their related enzymes was studied in fennel (Foeniculum vulgare) infected with Ramularia foeniculi causing blight disease. The content of total carbohydrates, and their related enzymes were recorded in healthy and diseased counter parts. Different plant parts showed varation in their sugar contents, total soluble sugars and reducing sugars were recorded higher in blight infected plant parts while starch contents were recorded lower in infected plant parts. A mylase and invertase activity were recorded higher in blight infected plant then healthy counter parts.

126. Deepak; AICRP on Pearl Millet, ARS, RAU, Jodhpur (India)Arora, D.K.; University of Rajasthan (India)Saran, P.L.; AICRP on Pearl Millet, ARS, RAU, Jodhpur (India)Lal, G.; AICRP on Pearl Millet, ARS, RAU, Jodhpur (India). Evaluation of cumin varieties against Bilight and Wilt disease with time of sowing. Annals of Plant Protection Sciences (India) v.16(2) p.441-443 KEYWORDS: MORBIDITY. CUMINUM CYMINUM. SOWING DATE. WILTS.

Cumin plants with age ranging from 20 to 75 days indicated that period of 10 weeks from sowing was favourable for initiation and further spread of the blight disease. The wilt disease symptoms appeared when the crop was 08 week old from the date of sowing. The lowest blight and wilt disease incidence was observed in december month sown crop with 75% R.H. The highest blight and wilt disease incidence was observed in October month sown crop with 65% R.H.

127. Johnson, M.; Agricultural Research Station, Anantapur (India) Reddy, P. Narayan; Agricultural Research Station, Anantapur (India) Reddy, D. Rajaram; ANGRAU, Rajendranagar, Hyderabad (India). Effective management of stem rot of groundnut through application of Pseudomonas Fluorescens. Annals of Plant Protection Sciences (India) v.16(2) p.428-432 KEYWORDS: ARACHIS HYPOGAEA. PSEUDOMONAS FLUORESCENS. CORTICIUM. TRYPTOPHAN.

The treatments involving Pseudomonas Fluorescens with or without tryptophan along with and without FYM were superior in decreasing the stem rot incidence (22.8-25.2). In addition , the same treatments gave increased pod (1441-1372 kg ha-1) and haulm yield (3045-2953 kg ha-1) besides decreasing pods left over in soil (118-117 kg ha-1) and leaf drop (259-280 kg ha-1) then other treatments.

128. Singh, A.K.; I.G.Agril University (India)Singh, Ajit K.; Dhanuka Agritech limited, New Delhi (India)Singh, Mandvi; C.S.A. University of Agriculture and Technology, Kanpur (India)Singh, Jitendra; C.S.A. University of Agriculture and Technology, Kanpur (India)Singh, S.P.; C.S.A. University of Agriculture and Technology, Kanpur (India). Bio-intensive management of soilborne diseases of sunflower. Annals of Plant Protection Sciences (India) v.16(2) p.433-437 KEYWORDS: ANTAGONISM. CONIOTHYRIUM. HELIANTHUS. TRICHODERMA VIRIDE.

In virto all the bio-agents were able to inhibit of test organisms where Trichoderma viride exerted maximum against Pythium aphanidermatum (27.8), Rhizoctonia solani

(38.2.)sclerotinia sclerotiorum (33.4) and sclerotiorum rolfii (36.9). Under pot conditions, maximum seed germination, shoot and root length were observed in those tritement where formulation of T.veride was applied except for S. sclerotiorum. maximum reduction in disease severity (17.1) and higher yield (13.52q/ha)were observed when seeds were treated with a combination of T.viride (4 g/kg seed)+ vitavax (1 g/kg seed). T.viride (2.5kg) alone as a soil applicant gave maximum reduction in disease severity (20.0) with maximum reduction in disease severity (20.0) with maximum yield (13.5q/ha).

129. Bardia, P.K.; S.K.N. College of Plant Pathology, Jobner (India) Rai, P.K.; S.V.B. Patel University of Agriculture and Technology, Meerut (India). Variability in Fusarium oxysporum f. sp. cumini causing cumin wilt. Annals of Plant Protection Sciences (India) v.16(2) p.444-448 KEYWORDS: WILTS. CUMINUM CYMINUM. FUSARIUM OXYSPORUM.

A total six isolates of fusarium oxysporum f.sp.cumini, isolated from different cumin growing areas of Rajasthan, had cultural and morphological variability on different agar and broth media. Significant varsion in mycelial growth and conidia formation was observed on different media. Maximum mycelial growth (8.16cm) and conidia formation was observed on Czapek Dox agar followed by PDA. highest fungal biomass (246.87 mg) was observed with Czapek Dox broth followed by PDB (233.66mg). Pathogenic variability was also observed among the isolates. Isolate A3 was found moist virulent showing 8.0. wilt incidence on 4th day of inoculation followed by isolate A5. Isolate A2 was found least virulent as wilting appeared on 9th day of inoculation.

130. Tiwari, P.K.; Indira Gandhi Agricultural Univ., Raipur (India). Dept. of Plant PathologyThrimurty, V.S.; Indira Gandhi Agricultural Univ., Raipur (India). Dept. of Plant PathologyDantre, R.K.; Indira Gandhi Agricultural Univ., Raipur (India). Dept. of Plant Pathology. Influence of temperature, concentration, fumigation and organic amendment on plant growth promoting efficacy of Pseudomonas fluorescenns. Annals of Plant Protection Sciences (India) v.16(2) p.449-453 KEYWORDS: PSEUDOMONAS FLUORESCENS. TEMPERATURE. FUMIGATION. ORGANIC AMENDMENTS. PLANT GROWTH SUBSTANCES.

Preconditioning of Pseudomonas fluorescens at 40, 35 and 300^{o}C temperatures for 48 and 72 hours were found increasing plant growth promoting efficacy. Influence of different concentrations on plant growth promoting efficacy were also studied by using P. fluorescens as seed treatment. The dilutions starting from 10-1 to 10-8 significantly increased the growth of rice seedling over control. The bacterial inoculums applied under fumigated conditions as seed dressing or soil application sifnificantly increased the growth of rice seedling over non-fumigated conditions. P. fluorescens growth promoting performance was recorded superior with FYM amended soil over unamended soil.

131. Usharani, S,; Annamalai University, Annamalainagar (India) Sujaritha, A.; Annamalai University, Annamalainagar (India) Christopher, D.John; Annamalai University, Annamalainagar (India). Effect of PGPR on fusarium oxysporum f.sp. lycopersici infection through elicitation of defense enzymes. Annals of Plant Protection Sciences (India) v.16(2) p.410-413 KEYWORDS: FUSARIUM OXYSPORUM. LYCOPERSICON ESCULENTUM.

Seed treatment, soil application and ST+SA of plant growth promoting rhizobacterial strains viz., Pseudomonas fluorescens Pf-04 strains on tomato induced synthesis of peroxidases (PO) and polyphenol oxidases (PPO)when challenge inoculated against Fusarium oxysporum f.sp. lycopersici. All the treatments increased PO and PPO activities when compared to control. Thus, the investigation suggested that seed treatment and soil application were effective methods and could be used to manage diseases under field conditions. Further, maxmum enzyme activity was observed after 48hrs. All the methods of application of pseudomonas strains was suggestive of induced systemic resistance.

132. Maheshwari, S.K.; Regional Research Station, Wadura (India). Dept. of Plant Pathology)Bhat, Nazir A.; Regional Research Station, Wadura (India). Dept. of Plant Pathology)Masoodi, S.D.; Regional Research Station, Wadura (India). Dept. of Plant Pathology)Beig, M.A.; Regional Research Station, Wadura (India). Dept. of Plant Pathology). Chemical control of lentil wilt caused by Fusarium oxysporum f. sp. lentis. Annals of Plant Protection Sciences (India) v.16(2) p.419-421 KEYWORDS: DISEASE RESISTANCE. FUNGICIDES. FUSARIUM OXYSPORUM. WILTS.

Seven fungitoxicants were tested against Fusarium oxysporum f.sp. lentis. All these significantly checked the growth of the pathogen as compared to control. Carbendazim proved most effective fungitoxicant for checking the funganal growth (5.6 mm) followed by captan (9.9 mm) and hexaconazole and diniconazole. Seed treatment + soil drenching with carben dazim was most effective to minimize the wilt incidence (10.6), plant mortality (4.5) and gave highest grain yield 97.48q/ha) followed by captain (15.9, 6.3 and 6.10 q/ha). Hexaconazole and diniconazole were the next best fungitoxicants in order of superiority in case of disease incidence, mortality and grain yield.

133. Johnson, M; Agricultural Research Station, Anantapur (India) Reddy, P. Narayan; Agricultural Research Station, Anantapur (India) Reddy, D. Rajaram; ANGARU, Hyderabad (India). Comparative efficacy of rhizosphere mycoflora, fungicides, insecticides and herbicides against groundnut stem rot caused by sclerotium rolfsii. Annals of Plant Protection Sciences (India) v.16(2) p.414-418 KEYWORDS: ANTIMETABOLITES. PESTICIDES. CORTICIUM ROLFSII.

Trichoderma viride was found significantly superior over other antagonists in inhibiting the growth of sclerotium rolfsii. Among five pesticides tested for their efficacy, hexaconazole (1000, 1500 & 2000 ppm) and propiconazole (500, 750 & 1000 ppm) completely inhibited the growth of S. rolfsii. Whereas chlorpyriphos completely inhibited the pathogen at one step lower (1500 ppm) and at recommended concentration (2000 ppm), while quinalphos inhibited the growth at 2000 ppm. Of the four herbicides, pendimethalin completely inhibited the growth of S. rolfsii at recommended concentration 91000 ppm). Sensitivity of T. viride against three agrochemicals showed complete inhibition of the growth of t. viride with hexaconazole and 48 with pendimethalin. However, no inhibition of the fungal antagonist was observed with calcium ammonium nitrate.

134. Verma, K.C.; Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Biochemistry)Gaur, A.K.; Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Biochemistry)Singh, U.S.; Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Plant Pathology). Evaluation of in vitro responses from different explants of elite Jatropha curcas L.. Indian Journal of Plant Physiology (India) v. 13(3) p. 231-237 KEYWORDS: JATROPHA CURCAS. PETIOLES. REGENERATION. IN VITRO. EVALUATION.

Jatropha is a genus of approximately 175 succulents, shrubs and trees (some are deciduous like Jatropha curcas L) from the family Euphorbiaceae. Seeds, besides being a source of oil for biodiesel, can also be used for manufacturing other useful products such as candles, high quality soaps and cosmetics, and other herbal products. Since J. curcas is primarily a cross pollinated crop, vegetative propagation is important to maintain genetic purity of the elite lines and transformants. A regeneration protocol was optimized for the faster propagation of elite jatropha plant. Out of different explants tested (petiole, apical bud and leaf), apical buds were found to be the best for callus induction. Shoot regeneration from calli induced from petioles was the best. Various combinations of auxins with cytokinins were suitable for callus induction. The best shoot regeneration (75) was in MS medium supplemented with IBA (1.23IIM) and BAP (6.6IIM). Root induction (100) was successfully obtained in MS and 1/2 MS medium. Acclimatization and hardening was quite successful with survival rate of 75 per cent.

135. Singh, A.; Banaras Hindu University, Varanasi (India). Dept. of Botany). Influence of tree canopy on dry matter yield of seedlings of Leucaena laucocephala on mine spoil in a dry tropical environment. Indian Journal of Forestry (India) v. 31(2) p. 207-208 KEYWORDS: CANOPY. HUMID TROPICS. NATURAL DRYING. YIELDS. LEUCAENA LEUCOCEPHALA.

H60 Weeds and Weed Control

136. Maity, S.K.; Uttar Banga Krishi Viswavidyalaya, Cooch Behar (India). Dept. of Agronomy)Mukherjee, P.K.; Uttar Banga Krishi Viswavidyalaya, Cooch Behar (India). Dept. of Agronomy). Integrated weed management in dry direct-seeded rainy season rice (Oryza sativa) . Indian Journal of Agronomy (India) v.52(2) p.116-120 KEYWORDS: RICE. ORYZA SATIVA. DIRECT SOWING. WEED CONTROL.

A field experiment was carried out during rainy season (khari~ of 2006 and 2007 at Pundibari, West Bengal to work out integrated weed management practices and their economics in dry direct-seeded rice. The weed flora emerged during experimentation were: grasses like Cynodon dactylon and Echinochl()a colonum; sedges like Cyperus rotundus, C. iria, and Fimbristylis miliacea; and broad-leaved weeds like Ludwigia parviflora, Ageratum conyzoides, Spilanthes paniculata, Eclipta alba and Enhydra fIuctuans. In integrated weed-management practices, butachlor 1.5 kg/ha as pre-plant surface application + brown manuring with Sesbania rostrata + 2,4-D 0.50 kg/ha recorded the highest grain yield (3.00-3.88 t/ha), which was significantly on a par with that obtained from season-long weed-free situation (3.14-3.98 t/ha). The highest net returns (Rs11 ,889 and 19,029/ha) and benefit: cost ratio (0.74 and 1.19) were also recorded in this treatment. Therefore, this integrated weed management prac-tice could become effective in dry-direct seeded kharif rice under foothill (tera) agro-climatic region of West Ben-gal.

137. Ghorai, A.K.; Central Research Institute for Jute and Allied Fibres, Barrackpore (India). Integrated weed management in jute (Corchorus olitorius). Indian Journal of Agronomy (India) V. 52(2) p. 149-151 KEYWORDS: JUTE. CORCHORUS OLITORIUS. WEED CONTROL.

An experiment was conducted at Barrackpore during 2003-2005 to find out suitable eco-friendly and remunera-tive integrated weed-control approaches for jute cv EiRO 524f (eNavinf). Cultural, organic and integrated chemical weed-control methods were found better than conventional manual weeding twice. In cultural method, smothering of weeds by leafy vegetable mixtures [red amaranth (Amaranthus tricolor L., cv Ealabakusumf), white amaranth (Amarantus spp.) and summer radish (Raphanus sativus L. cv EPaus mulaf] in jute, reduced the dry matter of weeds up to 45. when the field was dominated by grasses and broad-leaf weeds. This was followed by two manual weedings which gave 3.57 t/ha jute fibre (along with 2.9 t/ha red amaranth, 0.6 t/ha white amaranth and 0.7 t/ha summer radish, respectively). The organic approach, rice straw mulch 10 t/ha and mixed cropping with same vegetables, followed by one manual weeding produced 3.9 t/ha jute fibre (1.15, 0.64 and 0.94 t/ha red and white amaranth and summer radish, respectively). It reduced the dry matter of weeds by 68 to 82. In integrated chemical approach, spray of quizalofop ethyl (DT 50 1 d) 60 g/ha + dhanuvit 0.5 to 0.6 I/ha (adjuvant) at 21 DAE combined with 1 hand weeding produced 3.87 t/ha jute fibre. The benefit: cost ratio from conventional, cul¬tural, organic and chemical approaches was 1.50, 1.57, 2.19 and 1.66 respectively. The residue of quizalofop ethyl was found below the detectable limit (0.84 to 4.2 ppm) within 8 days of its application.

138. Mishra, J.S.; National Research Centre for Weed Science, Jabalpur (India)Singh, V.P.; National Research Centre for Weed Science, Jabalpur (India). Integrated weed management in dry-seeded irrigated rice (Oryza sativa). Indian Journal of Agronomy (India) v. 52(4) p. 299-300 KEYWORDS: RICE. ORYZA SATIVA. WEED CONTROL.

A field experiment was conducted during rainy seasons of 2006 and 2007 on clay-loam soil at Jabalpur, Madhya Pradesh to find out the effect of tillage (zero and conventional), time of sowing (before and after monsoon) and weed-control measures (integration of hand weeding and Sesbania with herbicides and rotational use of herbicides) on weeds, yield, nutrient uptake and economics of dry-seeded irrigated rice (Oryza sativa L.). The major weeds associated with dry-seeded rice were: Echinoch/oa c. na (31.5), Phyllanthus spp. (26.5), Commelina communis (17.8), Cyperus iria (9.9), A/ternanthera sessi/is (5.9), Dinebra retro/exa (5.1), Physalis minima (1.8) and Caesulia axil/aris (1.2). Zero tillage significantly reduced the total population and dry matter of weeds compared with conventional tillage, but the difference in yield was not significant. Dry seeding before monsoon resulted in lower grain yield due to higher population and dry matter of weeds. Infestation of weeds reduced the grain yield of dry-seeded rice by 60. compared with hand-weeding twice and removed 10.99 kg N, 2.78 kg P and 7.22 kg K/ha. The maximum rice yield (3.41 t/ha) was obtained from 2 hand-weeding. Integration of pendimethalin 1.0 kg/ha or pretilachlor 0.75 kglha with 1 hand-weeding at 30 days after sowing or sequential application of pre-emergence herbicides followed by post-emergence application of 2, 4-D (0.5 kg/ha) and fenoxaprop (0.07 kg/ha), being on a par with each other, proved quite effective against weeds and gave significantly higher grain yields and benefits than weedy check.

J10 Handling, Transport, Storage and Protecion of Agricultural Products

139. Grover, J.K.; Punjab Agricultural University, Sangrur (India). Krishi Vigyan Kendra)Singh, K.; Punjab Agricultural University, Sangrur (India). Dept. of Botany)Kumar, A.; Punjab Agricultural University, Ludhiana (India). Dept. of Processing and Food Engineering). Effect of passive hypobaric pressure on storage of gladiolus spikes. Indian Journal of Plant Physiology (India) v. 13(3) p. 238-242 KEYWORDS: STORAGE. GLADIOLUS. CARBON DIOXIDE. CUT FLOWERS. PASSIVE IMMUNITY.

The spikes of gladiolus cv. White Prosperity were stored under sub atmospheric pressure (368.3 mm of Hg) in two polymeric film packages viz. High Density Polyethylene (HDPE) and Polypropylene (PP) of 100 gauge (25U) thiCkness. PP film maintained high levels of CO2 and low levels of °2 inside the packages throughout the storage period. The accumulation of CO2 in the HDPE packages was very low. HDPE packages also accumulated very high percentage of °2 i.e. near the atmospheric level. PP film packages retarded per cent loss of weight of the spikes and opening of florets in storage but increased post storage floret opening and vase life of the spikes. Florets in PP film packages also retained high starch and low soluble sugar contents in the tepals.

K01 Forestry – General Aspects

140. Srivastava, A.K.; Kumaun University, Nainital (India). Dept. of Forestry)Tewari, A.; Kumaun University, Nainital (India). Dept. of Forestry)Shah, S.; Kumaun University, Nainital (India). Dept. of Forestry)Tewari, B.; Kumaun University, Nainital (India). Dept. of Forestry). Species composition and regeneration pattern along a transect perpendicular to a river course in foot hill deciduous tropical forest of Kumaun. Indian Journal of Forestry (India) v. 31(1) p. 7-12 KEYWORDS: FOREST TREES. REGENERATION. TROPICAL FORESTS. HIMALAYAN REGION.

Thirteen forest stands located perpendicular to a river course were studied for species composition and regeneration pattern in the Bhabhar belt located at the foothill of the Himalaya characterized by tropical climate. The study area was severely impacted by anthropogenic disturbances. In the stands complete dominance by anyone species was lacking except one stand were Sal (Shorea robusta) the late successional Dipterocarpaceae species grew pure. In a few stands trees of Holoptela integrifolia, Dalbergia sissoo and Tectona grandis (planted), Trewia nudiflora and Acacia catechu were present in sizable number. Mallotus phillipensis is the greatest reproducer in this study area recruiting generally many more seedlings and saplings than other forest

species. This non¬fodder species had comparatively better regeneration than good fodder species.

141. Verma, R.K.; Himalayan Forest Research Institute, Shimla (India)Jishtu, V.; Himalayan Forest Research Institute, Shimla (India)Kapoor, K.S.; Himalayan Forest Research Institute, Shimla (India)Kumar, S.; Himalayan Forest Research Institute, Shimla (India) . Plant diversity in alpine pasture of talra wildlife sanctuary of district Shimla, Himachal Pradesh. Indian Journal of Forestry (India) v. 31(1) p. 13-18 KEYWORDS: PLANT ECOLOGY. HIMACHAL PRADESH. ALPINE GRASSLANDS.

Studies to evaluate the plant diversity and growth forms in alpine pasture of Taira Wildlife Sanctuary ofOistrict Shimla, Himachal Pradesh were carried out during August, 2003. Total 75 species of plant, comprising of 7 grasses, 4 sedges, 4 leguminous forbs and 60 non-leguminous forbs were recorded from the area. On the basis of Importance Value Index (lVI). Sibbaldia cuneata O. Ktze., was found to be the dominant species followed by Geum elatum Wall ex O.Don., Ligularia amplexicaulis Oc., Primula denticulata Smith and Saxifraga parnassifolia O.Oon. The distribution of all the plant species was contagious. Index of dominance was 0.036 and index of diversity 5.386. The contribution of tall forbs, short forbs and cushioned and spreading forbs in the alpine pasture was 29.33. , 54.66. and 16.0. respectively.

142. Jamwal, P.; Intel Education, Educomp Solution Pvt., New Delhi (India)Uniyal, S.K.; Institute of Himalayan Bioresource Technology, Palampur (India). Biodiversity Div.). Vegetation characteristics and under - canopy assemblages of subtropical chir pine forests at two sites in Western Himalaya. Indian Journal of Forestry (India) v. 31(1) p. 29-36 KEYWORDS: VEGETATION. HIMALAYAN REGION. FORESTS. SUBTROPICAL CLIMATE. SHRUBS. CANOPY.

Chir pine forests occurring at 750 amsl (Site I) and 1400 amsl (Site 2) in Western Himalaya were studied for vegetation characteristics and under-canopy assemblages. The vegetation was sampled using quadrats. Total of 40 plant species belonging to 27 families were encountered in the sampling plots. Members of Asteraceae, Leguminosae and Rosaceae dominated the Chir pine under-canopy. At both the Sites, species to genera ratio was found to be one. Amongst the two Sites, the number of tree and shrub species was more at Site I; while that of herbs was more at Site 2. Higher tree and shrub diversity was recorded at Site 1,0.63 and 1.32 respectively, while Site 2 had higher (2.12) herb diversity. In general, both Sites had higher shrub and herb diversity compared to tree diversity. Chir pine forests at lower altitude (Site I) were found to be more diverse than at higher altitude (Site 2). Above ground biomass of Chir pine at the study Sites ranged from 302 t/ha at Site I to 338 tlha at Site 2. The density, diversity and biomass estimates from the present study area are comparable to other Chir pine forests in the Western Himalaya; however, regeneration potential of the present area was recorded to be comparatively poor.

143. Raj, A.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Leh (India). Regional Agriculture Research Station) Sharma, P.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Leh (India). Regional Agriculture Research Station). Populus euphratica community in nubra valley of Ladakh : a comment. Indian Journal of Forestry (India) v. 31(1) p. 47-51 KEYWORDS: POPULUS EUPHRATICA. HIMALAYAN REGION. COMMUNITY FORESTRY. VEGETATION.

Phytosociological study of Populus euphratica community in the Trans Himalayas of Ladakh was conducted. The vegetation was a high altitude riverain forest with low species diversity (H'=O.8569) and high concentration of dominance (Cd=O.5I62). In the upper layer P euphratica dominated the association with IVI value of 219.26 while in the middle layer Berberis ulicina was the dominant species (IVI=57.33). A change in nomenclature of the forest under type 13/1Sz in the Forest Types of India is suggested in light of the present observations.

144. Sharma, D.P.; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India)Nanda, R.; Himalayan Forest Research Institute, Shimla (India). Volume prediction model for chir pine (Pinus roxburghii Sargent). Indian Journal of Forestry (India) v. 31(1) p. 57-60 KEYWORDS: VOLUME. MODELS. PINUS ROXBURGHII. FORECASTING.

The study was conducted on Chir pine stand (Pinus roxburghii Sargent) at Barog range (R-31) under Solan Forest Division (H.P.) during the year 2004-2005, to develop volume prediction model based allometric relationships between stand volume and stem growth parameters (DBH and Height). Among various linear and non-linear function, both log-linear and power function performed comparatively better over other functions. In both the functions, DBH and Height parameters explained 99 per cent and 95 per cent of variation in the stem volume, respectively. However, the power function outperformed the log-linear function, when data were subjected to chi-square test of goodness of fit and thereafter using Theil-U test. The predicted volumes based on DBH and Height was cross validated and the DBH proved to be the best predictive parameter for stem volume estimation.

145. Khantwal, A.; Government Post Graduate College, Kotdwara (India)Negi, K.S.; Post Graduate College, Vedikhal (India)Madwal, K.; Forest Research Institute, Dehra Dun (India). Impact of pre-sowing seed treatments on germination of common fodder tree species of lower Siwalik range of Garhwal Himalayas. Indian Journal of Forestry (India) v. 31(1) p. 73-75 KEYWORDS: SEED TREATMENT. GERMINATION. SOWING. HIMALAYAN REGION. FORAGE. TESTA.

The Present investigation based on experiment conducted at Kotdwara Forest Division nursery to assess the effects of certain type of treatment for increasing regeneration potential of common fodder tree species especially having tough seed coat viz., Bauhinia variegata (Kachnar), Linn. ; Grewia disprema (Dayamul), Schleichera oleosa (Kusum) and Terminalia bellirica (Bahera). It was found that hard seed coat act as a barrier for general seedling growth on natural condition. The percentage germination of seed has been found to be very low which affects regeneration under natural condition. The present study was undertaken to find out the effect of various pre-sowing treatment on such fodder tree species to get early germination with good germination percentage.

146. Nair, K.K.N.; Kerala Forest Research Institute, Peechi (India). Phytogeography, endemism and affinities of the flora of new amarambalam reserve forests in the Western ghats of India. Indian Journal of Forestry v. 31(1) p. 85-94 KEYWORDS: BIOGEOGRAPHY. SURVEYS. AFFORESTATION. FLORA. KERALA. FORESTS. BOTANICAL COMPOSITION.

Floristic analysis of New Amarambalam Reserve Forests, situated in the Western Ghats of India and forming part of Nilgiri Biosphere Reserve, based on surveys conducted during 1997-2000, has been presented in the paper. The forest area extents to about 265 km2, at an altitudinal range of 40-2600 m above ms!. The area is the abode of almost all the forest types of the Indian Peninsula, preserved in an almost pristine state. Intensive floristic survey of the area recorded of a total of 1135 taxa of angiosperms, which belonged to 136 families and 644 genera. The flora is composed of 78 per cent dicotyledons and 22 per cent monocotyledons. Phytogeographical analysis of the flora revealed very high endemism, and almost 21 per cent of the total flowering plants recorded from there were those endemic to Western Ghats of India. Among them, 12.5 per cent were species restricted to Southern part of the Western Ghats. Peninsular Indo-Sri Lankan elements represented 15 per cent of the total flora, which demonstrates the affinity of the region with that of the adjacent ocean Island. Regarding the pattern of distribution of various species outside India, 66 per cent of them were of Indo-Malayan and South and South-East Asian range and 30 per cent of the total flora were composed of pluri-regional species or wides. There were only four per cent taxa in the flora, which are either exotic weeds or escapes from cultivation, showing the less disturbed status of the vegetation.

147. Sati, S.C.; Kumaun University, Nainital (India). Dept. of Botany)Pargaien, N.; Kumaun University, Nainital (India). Dept. of Botany). VAM fungi in some ravine plant roots of Kumaun Himalayan forest. Indian Journal of Forestry (India) v. 31(1) p. 103-108 KEYWORDS: MYCORRHIZAE. VESICULAR ARBUSCULAR MYCORRHIZAE. HIMALAYAN REGION. ROOTS.

Wet and ravine forest areas of Nainital locality was surveyed to assess the VAM infection in some selected plant roots. Fine roots of selected plants were carefully dug out, washed and stained using root clearing methods and observed under microscope. Out of 18 plant roots only 16 were found to be associated with VA mycorrhiza. Acer pic/um and Berberis species had no VAM colonization in this study. Percentage root colonization varied among the selected plant roots. In Valeriana wallichii 100. infection was observed whereas it was only 31. in Myrsine semiserra/a. Vesicles were very common in VAM infected plant roots. The per cent infection was observed more in herbaceous plants followed by shrubs and woody plants. All the plant species surveyed were screened for the first time for VAM from Nainital, Kumaun Himalaya.

148. Murugesan, M.; Kongunadu Arts and Science College, Coimbatore (India). P.G. Research Detp. of Botany)Balasubramaniam, V.; Kongunadu Arts and Science College, Coimbatore (India). P.G. Research Detp. of Botany). Tropical velliangiriensis (Poaceae)-a new species from Tamil Nadu, India. Indian Journal of Forestry (India) v. 31(1) p. 109-111 KEYWORDS: POACEAE. SPECIES. TAMIL NADU. TROPICAL FORESTS. NEW SPECIES.

A new species of Poaceae, Tripogon velliangiriensis Murugesan and Balasubramaniam, from Tamil Nadu, India is described and illustrated.

149. Geetha Kumary, M.P.; Tropical Botanic Garden and Research Institute, Thiruvananthauram (India)Santhosh Kumar, E.S.; Tropical Botanic Garden and Research Institute, Thiruvananthauram (India) Pandurangan, A.G.; Tropical Botanic Garden and Research Institute, Thiruvananthauram (India). A new variety of Phyllocephalum rangacharii (Gamble) Narayana (Asteraceae) from Kerala, India. Indian Journal of Forestry (India) v. 31(1) p. 119-120 KEYWORDS: GENERA. NEW SPECIES. KERALA. BIOSYSTEMATICS.

A new variety of Phyllocephalum rangachari viz. var. agastyamalayanum from Kerala, India is described.

150. Pangtey, Y.P.S.; Kumaun University, Nainital (India). Dept. of Botany)Tewari, L.M.; Kumaun University, Nainital (India). Dept. of Botany)Upreti, K.; Kumaun University, Nainital (India). Dept. of Botany)Jalal, J.S.; Wildlife Institute of India, Dehra Dun (India). On the occurrence of Rubus niveus Thunb. (Family Rosaceae) in the Tarai region of Kumaun in Uttarakhand. Indian Journal of Forestry (India) v. 31(1) p. 117-118 KEYWORDS: SPERMATOPHYTA. ROSACEAE. INDIA. HIMALAYAN REGION. WILD PLANTS.

151. Murugan, C.; Botanical Survey of India, Coimbatore (India). Southern Circle)Manickam, V.S.; Centre for Biodiversity and Biotechnology, Palayamkottai (India). Dept. of Botany). Grewia kothayarensis (Tiliaceae), a new species from southern western ghats, India. Indian Journal of Forestry (India) v. 31(1) p. 121-122 KEYWORDS: GREWIA. NEW SPECIES. INDIA. FLORA

Grewia kothayarensis sp. nov., a new species ofTiliaceae is described with illustration from Southern Western Ghats of Tamil Nadu, India.

152. Kabeer, K.A.A.; Botanical Survey of India, Coimbatore (India). Southern Circle)Nair, V.J.; Botanical Survey of India, Coimbatore (India). Southern Circle). Ehrharta stipoides Labill. (Poaceae) : a new record for India from the Nilgiris, Tamil Nadu. Indian Journal of Forestry (India) v. 31(1) p. 123-126 KEYWORDS: NEW SPECIES. TAMIL NADU. GRASSES. GENERA.

153. Gautam, M.K.; Forest Research Institute, Dehra Dun (India). Forest Ecology and Environment Div.)Tripathi, A.K.; Forest Research Institute, Dehra Dun (India). Forest Ecology and Environment Div.) Manhas, R.K.; Forest Research Institute, Dehra Dun (India). Forest Ecology and Environment Div.). Plant diversity and structure of sub-tropical Shorea robusta Gaertn. f. (SAL) forests of Doon Valley, India. Indian Journal of Forestry (India) v. 31(1) p. 127-136 KEYWORDS: SHOREA ROBUSTA. INDIA. HIMALAYAN REGION. PLANT ECOLOGY. VEGETATION.

Doon valley is famous for mono cultures of moist Sal resulted due to various silvicultural operations in the past. However in recent years these forests were subjected to numerous anthropogenic perturbations, which have posed a great threat to their existence. In the present paper, we have analyzed the diversity and structure of moist Sal forests and compared them with the previous studies. After analyzing the results we found that these forests are still dominated by the Sal tree. However the structure of shrub and herb layers has been changed. These layers, once dominated by shade loving Clerodendrum viscosum, are now being dominated by xerophytic species like Mallotus philippensis, Litsea glutinosa, Flacourtia indica etc. The general diversity of tree, shrub and herb layers has increased in these forests and so is the heterogeneity.

154. Chowdhery, H.J.; Botanical Survey of India, Dehra Dun (India). Northern Circle)Agrawala, D.K.; Botanical Survey of India, Dehra Dun (India). Northern Circle). Pleione hookeriana (Lindl.) B.S. Williams - an interesting orchard species form Garhwal Himalaya. Indian Journal of Forestry (India) v. 31(1) p.147-149 KEYWORDS: NEW SPECIES. HIMALAYAN REGION.

Pleione hookeriana (Lindl.) B.S. Williams is reported here for the first time from Garhwal Himalaya. A brief description along with photographs is provided.

155. Singh, D.; Botanical Survey of India, Howrah (India). Central National Herbarium)Singh, D.K.; Botanical Survey of India, Kolkata (India)Singh, M.P.; Udai Pratap Autonomous College, Varanasi (India). Dept. of Botany). Scapania contorta Mitt. (Subgen. Scapania : Sect. Plicaticalyx) with a note on diversity and distribution of the genus in India. Indian Journal of Forestry (India) v. 31(1) p. 151-158 KEYWORDS: BIODIVERSITY. INDIA. HIMALAYAN REGION. CRYPTOGAMS.

Scapania contorta Mitt., a poorly known Himalayan species is described, for the first time with complete details of sporophyte. A key to the Indian species of section Plicaticalyx (Mtill.Frib.) Potemkin and a note on the diversity and distribution of the genus in the country is provided.

156. Singh, J.N.; Botanical Survey of India, Howrah (India). Chemical characteristics of natural watrs of Nilgiri biosphere reserve, Kerala and Karnataka - their possible utility in wildlife management. Indian Journal of Forestry (India) v. 31(2) p. 159-166 KEYWORDS: CHEMICAL COMPOSITION. NATURE RESERVES. KERALA. KARNATAKA. NATURAL RESOURCES.

The present investigation deals with the chemical characteristics/composition of the natural waters of the Nilgiri Biosphere Reserve (NBR), located within Kerala and Karnataka States respectively. Waters of both localities differ significantly in their chemical characteristics and composition. The waters of NBR - Kerala are bereft of dissolved minerals in their per unit volume, irrespective of their sources and location. Calcium ions dominate within cations and bicarbonate within anions. Carbonate ions are conspicuously absent in all waters. In contrast to above, the waters of Karnataka have sufficient dissolved minerals in their per unit volume and magnesium ions are prominent within cations and chloride within anions in large number of water bodies. Carbonate ions are sufficiently present in majority of the waters. In both localities, the calcium and magnesium ions show a close resemblance in their concentration but sodium ions exhibit an erratic variation. The waters of NBR - Kerala are neutral to moderately alkaline in reaction (pH 7.0-8.4) but the Karnataka waters show comparatively high alkalinity (pH 7.0-9.0). The waters ofNBR - Kerala have been categorized as CISI class and thus, found

to be highly suitable for safe use either by the flora, fauna or even by the soils of the area but the waters of NBR - Karnataka, barring a few, have been categorized as CZSI class and thus, suitable for fauna but may create problem of alkali hazards within soils and for plant species which are susceptible to sodium ions concentration. The present study pertinently suggests that to compensate the mineral deficiency especially in carnivores, the salt-licks having sufficient minerals may be placed in the entire biosphere reserve under Kerala and within Karnataka, it may be placed within those area which are not covered by artificial tanks.

157. Giri, D.; Kumaon University, Nainital (India). Dept. of Forestry)Tewari, A.aKumaon University, Nainital (India). Dept. of Forestry)Rawat, Y.S.; Kumaon University, Nainital (India). Dept. of Forestry). Vegetational analysis in mixed banj (Quercus leucotrichophora A. Campus) - tilong loak (Quercus floribunda Lindl.) forests in Nainital catchment. Indian Journal of Forestry (India) v. 31(2) p. 167-174 KEYWORDS: PLANT PROPAGATION. FORESTS. QUERCUS. HIMALAYAN REGION.

The present study was carried out on six forest sites dominated by Quercus leucotrichophora and Q. floribunda forests to assess variations in floral biodiversity and community with changes in microcIimatic conditions between 2090 and 2200 m elevation in Nainital on 3 different aspects. The composition of tree layer was more or less similar across the studied sites. The impact of aspect change on shrub and herb species diversity and density was also insignificant possibly because of little change in altitude and canopy cover (above 70.) in the studied sites.

158. Ramachandran, A.; Tamil Nadu Forest Department, Tiruchirappalli (India). Deputy Conservator of Forests)Natarajan, D.; St. Joseph's College, Tiruchirappalli (India). Rapinat Herbarium)Nagamurugan, N.; Kurinji College of Arts and Science, Tirucherappalli (India). Dept. of Biotechnology)Balaguru, B.; National Innovation Foundation, Ahmedabad (India)Soosairaj, S.; St. Joseph College, Tiruchirappalli (India). Dept. of Plant Biology and Biotechnology)Britto, S.J.; St. Joseph College, Tiruchirappalli (India). Rapinat Herbarium). Assessment of tree species diversity in semi-evergreen forests of Chitteri hills, Eastern Ghats of Tamil Nadu, South India. Indian Journal of Forestry (India) v. 31(2) p. 175-180 KEYWORDS: FORESTS. TAMIL NADU. EVERGREEN MIXED FORESTS. VEGETATION. STATISTICAL METHODS.

This paper describes the status and tree species diversity of Semi-Evergreen forests in Chitteri Hills, Tamil Nadu. Stratified random sampling method and distribution of sample plots using vegetation maps prepared from IRS LISS III FCC was used to study the tree species having girth :::30 cm at breast height. A total number of 466 stems from 51 tree species were recorded from the study area representing 24 families and 40 genera. The total basal area was 21.92 m2. Anogeissus latifolia was the highest contributor (19.29.) followed by Memecylon edule (17.93.), Psydrax dicoccos (11.) and Nothopegia colebrookiana (10.). Memecylon edule (47.26), has the highest IVI value followed by Anogeissus latifolia (46.77), Psydrax dicoccos (38.34) and Nothopegia colebrookiana (28.87). Percentage of family important value was high in Combretaceae followed by Anacardiaceae, Verbenaceae, Rubiaceae, Ebenaceae and Euphorbiaceae. Shannon-Weiner and Simpson diversity Index value were 2.76 and 0.11.

159. Khera, N.; The Energy Resources Initiatives, New Delhi (India). Dept. of Natural Resources)Saxena, A.K.; Narendra Deva University of Agricultrue and Technology, Faizabad (India). Dept. of Forestry). Effect of presowing treatments on germination and seedling growth of Tectona grandis. Indian Journal of Forestry (India) v. 31(2) p. 181-186 KEYWORDS: FORESTRY. TECTONA GRANDIS. GROWTH. GERMINATION.

Tectona grandis (Teak) is one of the most valuable timber producing species of India. However, seeds of this species from dry regions show poor germination due to dormancy. To overcome dormancy, a total of 140 pre-sowing treatments, which consisted of scarification, pre-chilling and chemical-soaking, were applied to the seeds of Teak. All germination parameters and root-shoot ratio were significantly improved after cold water soaking (15 days) + humid storage (15 days). However, the growth

characters and dry weight of seedlings were significantly higher when the seeds were soaked in GAJ-100ppm for 48 hrs as compared to rest of the treatments. For farmers and nursery persons point of view the easy and cost effective method of presowing treatment of water soaking for 15 days + humid storage for 15 days is recommended.

160. Tripathi, S.; Forest Research Institute, Dehra Dun (India). Forest Products Div.)Bagga, J.K.; Forest Research Institute, Dehra Dun (India). Forest Products Div.). Suitability of Eucalyptus hybrid, Melia azedarach and Mangifera indica treated with CCA, ACA and copper lignate in cooling tower. Indian Journal of Forestry (India) v. 31(2) p. 209-216 KEYWORDS: EUCALYPTUS. HYBRIDS. MANGIFERA INDICA. MELIA AZEDARACH. COPPER.

Eucalyptus hybrid, Mangifera indica and Melia azedarach were treated with different concentrations of CCA, ACA and Copper lignate. Pinus roxburghii (Pine) was also treated with the same preservatives and used as reference species. Two experiments for different periods i.e. 4 and 5 years were conducted in the same cooling tower. Observations in terms of weight loss were taken. It was found that Melia azedarach (Melia), Pinus roxburghii and Eucalyptus hybrid (Eucalyptus) performed excellently when treated with CCA at 16 kg/ m' retention throughout the period of investigation. While ACA (16 kg/m') and CCA (i) (consisting As2O]” 2H,O) treated samples were protected considerably but were not comparable with CCA treated samples. Copper ligiiate (1.0, 1.5 and 2.0 kg/m') treated samples (10 x 2.5 x 0.6 em') of all species, could not perform satisfactorily. Visual observations of Mangifera indica (Mango) samples indicated heavy attack of soft rot fungus on the sample in the 3cd year of experiment itself, thus indicating none of the preservative treatment being able to protect Mango wood samples.Thus, Eucalyptus hybrid (heartwood) and Melia azedarach treated with CCA can be recommended for smaller size samples used in cooling towers whereas for bigger size of wood used in cooling towers, where strength is important criteria, bigger samples i.e. stake test (45 x 5 x 4 em') is required.

161. Harsh, N.S.K.; Forest Research Institute, Dehra Dun (India). Forest Pathology Div.)Chandra, S.; Forest Research Institute, Dehra Dun (India). Forest Pathology Div.). A new twig canker disease of Cinnamomum camphora. Indian Journal of Forestry (India) v. 31(2) p. 217-219 KEYWORDS: CINNAMOMUM CAMPHORA.

A new twig canker disease of Cinnamomum camphora caused by Pestalotiopsis versicolor has been reported for the first time and studied in detail.

162. Walia, A.; Brooke India, Ghaziabad (India). Research Coordinator)Kaushik, J.C.; CCS Haryana Agricultural University, Hisar (India). Dept. of Forestry). Studies on Dalbergia sissoo Roxb. (Shisham) mortality in arid zone of Haryana, India. Indian Journal of Forestry (India) v. 31(2) p. 221-226 KEYWORDS: MORTALITY. HARYANA. INDIA. SURVEYS. DALBERGIA SISSOO.

An extensive survey was made in arid zone of Haryana, India for recording symptoms of Da/bergia sissoo mortality and for collecting roots and rhizospheric soil samples from ten sites having declined Sissoo trees. Isolation of fungus Fusarium so/ani was done from roots and rhizospheric soil. The pathogencity tests of isolated fungus were conducted on Sissoo seedlings under different conditions. Wilting was most pronounced symptom associated with mortality in this area besides others like drying from top, oozing and debarking. All sites (except one) frequently yielded F so/ani from root bits and rhizospheric soil depending on the location. The pre and post emergence damping off of Sissoo seedlings inoculated with F so/ani proved pathogencity of isolated fungus. High humidity, heavy soil texture and more soil saturation were proved positively correlated with pathogencity of F so/ani.

163. Hossain, M.; Khulna University, Khulna (Bangladesh). Forestry and Wood Technology Discipline)Hoque, A.K.F.; Khulna University, Khulna (Bangladesh). Forestry and Wood Technology Discipline). Litter production and decomposition in mangroves - a

review. Indian Journal of Forestry (India) v. 31(2) p. 227-238 KEYWORDS: POLYEMBRYONY. PRODUCTION. MANGROVES. REPRODUCTION.

Litter production and decomposition are important in nutrient cycling and detritus based food chain. Litter production in mangrove varies widely with species, forest type, stand age, geographical location and environmental parameters (e.g. rainfall, temperature, wind). Higher rate of litter production is observed at the lower latitudes (tropical region) and it decreases linearly with increasing latitude (sub-tropical region). Decomposition of leaf litter is characterized by an initial leaching of soluble organic and inorganic compounds with subsequent colonization by micro-organisms, which initiates physical and biological fragmentation of plant material. Litter degradation rate varies with species, geographical location, degree and frequency of tidal inundation, climatic and edaphic factors and presence of litter consuming fauna in the mangrove forest. In mangroves, higher rate of microbial decomposition of litter is observed in litter with lower content of tannin and leaves with thin cuticle, wet season and lower tidal inundation classes.

164. Chand, K.; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Silviculture and Agroforestry) Mishra, V.K.; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Silviculture and Agroforestry) Verma, K.S.; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Silviculture and Agroforestry)Bhardwaj, D.R.; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Silviculture and Agroforestry). Response of cutting height on biomass productivity and plant nutrient concentrations in four multipurpose tree species of North West Himalaya. Indian Journal of Forestry (India) v. 31(2) p. 243-250 KEYWORDS: BIOMASS. SPECIES. HIMALAYAN REGION. PRODUCTIVITY. CUTTING. NUTRIENTS.

Response of cutting height viz., 0.5, 1.0, 1.5 and 2.0 m was examined on biomass productivity and plant nutrient concentration of four multipurpose tree species viz., Morus alba, Celtis australis, Bauhinia variegata and Grewia optiva of North-West Himalaya. Morus alba accumulated maximum leaf+branch biomass followed by Grewia optiva, Celtis australis and Bauhinia variegata, respectively. The productivity of leaf, branch and their total improved with increase cutting height up to 2.0m under all species. The leafN, K, Ca and Mg concentrations, irrespective of cutting heights demonstrated a significant variation among species. However, leafP concentration showed negative trend to those observed forleafN, K, Ca and Mg concentrations. With increasing cutting height irrespective of species, leafN, P, K, Ca and Mg concentrations improved markedly. The species x cutting height interaction evinced a significant effect on leaf nutrient concentration. The branch, N, P, K, Ca and Mg concentrations, irrespective of cutting heights showed significant variation among species. The nutrient concentrations evinced a positive trend with increase in cutting height. The species x cutting height interaction demonstrated significant effect on branch nutrient concentration.

165. Kumar, M.; Kerala Forest Research Institute, Thrissur (India) Sequiera, S.; Kerala Forest Research Institute, Thrissur (India). A preliminary study of lower group of plants in the Neyyar wildlife sanctuary, Karala (India). Indian Journal of Forestry (India) v. 31(2) p. 261-268 KEYWORDS: FORESTS. KERALA. ALTERNATIVE AGRICULTURE.

A preliminary study of lower group of plants from Neyyar Wildlife Sanctuary revealed the occurrence of36 species oflichens, 20 species ofbryophytes and 81 species of pteridophytes. Under bryophytes the following 7 species Campylopus flexuosus, Dicranum majus, Homaliodendronflabellatum, Rhodobryum roseum, Theriotia sp., Thuidium delicatulum, Tortella tortuosa are new records to Kerala. All species are enumerated along with their frequency of occurrence.

166. Agrawala, D.K.; Botanical Survey of India, Dehra Dun (India) Sabapathy, C.M.; Botanical Survey of India, Howrah (India). Central National Herbarium). Malaxis cylindrostachya (Lindl.) Kuntze (Orchidaceae) : a new record for West Bengal. Indian

Journal of Forestry (India) v. 31(2) p. 285-286 KEYWORDS: NEW SPECIES. WEST BENGAL.

Malaxis cylindrostachya (Lind!.) Kuntze is described as a new orcbid record for the flora of West Bengal.

167. Sekar, K.C.; Botanical Survey of India, Pune (India)Srivastava, S.K.; Botanical Survey of India, Howrah (India). Central National Herbarium). Three new plant records for India from PIN valley National Park, Himachal Pradesh. Indian Journal of Forestry (India) v. 31(2) p. 291-293 KEYWORDS: HIMACHAL PRADESH. PLANTS. FORESTS. NATIONAL PARKS. SPECIES.

Three species viz., Aconitum bhutanicum Yuchi Kadota, Taraxacum lanigerum van Soest and T. ludlowii van Soest have been described as new records for India from Pin Valley National Park, Lahaul-Spiti, Himachal Pradesh.

168. Bhattacharjee, A.; Botanical Survey of India, Howrah (India). Central National Herbarium)Bhakat, R.K.; Vidyasagar University, Midnapore (India). Botany Dept.). Pollinarium morphology of some Indian members of subtribe Goodyerinae klotzsch (Orchidaceae). Indian Journal of Forestry (India) v. 31(2) p. 295-298 KEYWORDS: FUNGAL MORPHOLOGY. ORCHIDACEAE. POLLINATION. INDIA.

Critical studies conducted on the pollinaria of 20 species of the subtribe Goodyerinae Klotzsch (Orchidaceae) have revealed that the pollinarium structure is an important character for distinguishing different species of the subtribe Goodyerinae. Based on the pollinarium characters, an artificial key and a photo plate of the pollinaria is provided for easy identification of these species.

169. Bahar, N.; Forest Research Institute, Dehra Dun (India). Silviculture Div.). Sprouting ability of chir pine (Pinus roxburghii) seedling : a pyric characters. Indian Journal of Forestry (India) v. 31(2) p. 299-300 KEYWORDS: PINUS ROXBURGHII. SEEDLINGS.

The present study reveals that the fire has a beneficial effect at seedling stage but high incidence of fire every year leads to death of natural regeneration of Chir pine. It is evident from the result that some morphological parameter of seedling such as number of sprouted shoots was more in burnt seedlings as compare to unburnt. The dormant buds of Chir pine seedling sprouted after fire incidence.

170. Singh, D.; Botanical Survey of India, Howrah (India). Central National Herbarium)Dey, M.; Botanical Survey of India, Kolkata (India)Singh, D.K.; Botanical Survey of India, Kolkata (India). Studies on oil-bodies in some foliose liverworts from East Sikkim-II. Indian Journal of Forestry (India) v. 31(2) p. 315-320 KEYWORDS: SPECIES. SIKKIM. LUNGERMANNIALES.

Oil-bodies in 24 species of leafy liverworts belonging to order lungermanniales are described from East Sikkim. 0430. Ansari, A.A.; Botanical Survey of India, Gangtok (India). Sikkim Himalayan Circle). Padus cornuta (Wall. ex Royle) Carr. var. Integrifolia (Ghora & Panigrahi) Ansari (Rosaceae) - a new combination. Indian Journal of Forestry (India) v. 31(2) p. 321 KEYWORDS: PRUNUS.

K10 Forestry Production

171. Thakur, P.S.; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Silviculture and Agroforestry) Singh, S.; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Silviculture and Agroforestry). Impact of tree management on growth and production behaviour of intercrops under rainfed agroforestry. Indian Journal of Forestry (India) v. 31(1) p. 37-46 KEYWORDS: INTERCROPPING. INHIBITION. RAINFED FARMING. AGROFORESTRY. PRODUCTION. FOREST MANAGEMENT.

This investigation was aimed to evaluate the impact of changes in incident radiation through crown modification on crop performance. Different shade intensities created through tree crown management significantly affected growth, physiological attributes and yield related parameters in Vigna mungo (syn. Phaseolus mungo) and Pisum sativum grown as understorey field crops with Morus alba under rain fed conditions. The crown management treatments namely, no crown removal, 25, 50 and 75. crown removal resulted in 91, 85, 63 and 47. shade, respectively. Plant height, number of flowers, leaf area of crops was reduced significantly with the increase in shade. intensities and decrease in distance from t~e tree trunk. Higher pods per plant, grains per pod, grain yield and harvest index were observed at lower shade intensities. Growth and yield was maximum in open control (without tree); while unmanaged canopy of Morus trees caused overall yield reduction of 42. beneath canopy up to 3 m distance from the tree trunk. The crown management regulated physiological attributes in the field crops. The maximum photosynthetic rate was recorded for open plot plants, which declined in plants beneath dense canopy. The amount of water transpired from the crop plants decreased with increase in shade intensity. The conversion efficiency was maximum for plants growing as sole crop which decreased with increasing shade intensities. Based on the results of present investigation, it can be recommended that out of the four tree canopy management options tried i.e. 0, 25, 50 and 76. crown removal; 75. crown removal causing least negative effects on crop growth and yield may be adopted as a compromised crown management practice.

172. Thakur, M.K.; Regional Horticultural Research Station, Kullu (India)Chauhan, R.; Regional Horticultural Research Station, Kullu (India)). Growth performance of seven tree species in riverain area of North Western Himalaya. Indian Journal of Forestry (India) v. 31(1) p. 53-55 KEYWORDS: DEVELOPMENTAL STAGES. HIMALAYAN REGION. CHOICE OF SPECIES.

The growth performance of 17 years old seven tree species namely Salix tetrasperma, Robinia pseudoacacia, Alnus nitida, Populus deltoides, Eucalyptus tereticornis, Pinus roxburghii and Dalbergia sissoo was evaluated in riverain site of Kullu valley of Himachal Pradesh. The growth performance of these tree specie were recorded in the order of Populus deltoides Alnus nitida Salix tetrasperma Eucalyptus tereticornis Robinia pseudoacacia Pinus roxburghii Dalbergia sissoo. The species like Populus deltoids, Alnus nitida, Salix tetrasperma and Eucalyptus tereticornis are more suitable for plantation along the river basin of Kullu valley as they exhibited high growth under such conditions.

173. Malik, A.R.; Gobind Ballabh Pant Institute of Himalayan Environment and Development, Almora (India)Shamet, G.S.; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Silviculture and Agroforestry). Germination and biochemical changes in the seeds of chilgoza pine (Pinus gerardiana Wall.) by stratification: an endangered conifer species of North-West Himalaya. Indian Journal of Plant Physiology (India) v.13(3) p. 278-283 KEYWORDS: GERMINATION. BIOCHEMICAL REACTIONS. SEEDS. PINUS. CONIFERALES. PREPLANTING TREATMENT. HIMALAYAN REGION.

Natural regeneration is lacking in Pinus gerardiana Wall. commonly known as ch1lgoza and artificial regeneration has to be resorted to produce quality seedling for planting performance in the species. Seeds were subjected to six stratification durations (0, 15, 30, 45, 60 and 75 days) and four temperature treatments to break the dormancy. Stratification of 45 to 60 days as outdoor-pit treatment (16.5°/4.5°C:dJ n) followed by 4:!:I°C temperature accelerates the germination along with significant increase in reducing sugar, total sugar and soluble protein while decreasing the total starch content in stratified seeds.

174. Shukla, A.N.; Botanical Survey of India, Allahabad (India) Singh, K.P.; Botanical Survey of India, Allahabad (India). Diversity of woody plants in Achanakmar-Amarkantak

biosphere reserve, Central India. Indian Journal of Forestry (India) v. 31(2) p. 269-282 KEYWORDS: NATURE RESERVES. INDIA. WOODY PLANTS.

The woody plants of Achanakmar-Amarkantak Biosphere Reserve, Madhya Pradesh and Clihattisgarh have been dealt with. The critical study on collections as well as published literature revealed the occurrence of 168 species belonging to 114 genera and 44 families. A systematic enumeration of the species along with their habit, flowering and fruiting periods, uses and localities have been provided.

K11 Forest Engineering

175. Rawat, K.K.; National Botanical Research Institute, Lucknow (India). Dept. of Botany)Srivastava, S.C.; University of Lucknow, Lucknow (India). Dept. of Botany). Some interesting species of Plagiochila from India. Indian Journal of Forestry (India) v. 31(1) p. 141-146 KEYWORDS: SPECIES. BRYOLOGY. GENERA. INDIA. TAXA.

Four taxa of Plagiochila, P. detecta Grolle et So, P. defolians Grolle et So, P. perserrata Herz. and P. hattorii Inoue have been described for the first time from India territory. Report of P. detecta from India also introduces the section Cobanae in India. Plagiochila hattorii. which was earlier treated under P. parvifolia Lindenb., is considered here as a genuine species and is reported for the first time from India.

K50 Processing of Forest Products

176. Hegde, R.; College of Forestry, Kodagu (India)Varghese, M.; Institute of Forest Genetics and Tree Breeding, Coimbatore (India). Genetic divergence analysis in Eucalyptus camaldulensis Dehnh. Indian Journal of Forestry (India) v. 31(1) p. 61-66 KEYWORDS: GENETIC VARIATION. ANALYTICAL METHODS. EUCALYPTUS CAMALDULENSIS.

Eucalyptus camaldulensis Dehnh. is one of the important tree species used in modern plantation forestry programme. The genetic divergence analysis helps in assessing the genetic diversity within the species and also provide information for developing breeding plan, establishment of seed orchards and expolitation of heterosis through hybridization. In the present study attempts were made to assess the genetic diversity among the different open pollinated families of E. camaldulensis based on growth parameters at 24 months of age in three different locations.

177. Athar, B.; Tropical Forest Research Institute, Jabalpur (India). Forest Entomology Div.)Joshi, K.C.; Tropical Forest Research Institute, Jabalpur (India). Forest Entomology Div.). Effectiveness of some synthetic pyrethroids against larvae of the teak skeletonizer Eutectona machaeralis (Walker). Indian Journal of Forestry (India) v. 31(1) p. 67-71 KEYWORDS: SYNTHETIC PYRETHRINS. LARVAE. SKELETONEMA COSTATUM. CHEMICOPHYSICAL PROPERTIES.

Three synthetic pyrethroids viz. alphamethrin (Alphaguard 10 EC), cypermethrin (Bilcyp 10 EC) and deltamethrin (Decis 2.8 EC) in different concentrations were tested against the 4'h ins tar larvae of E. machaeralis. All the insecticidal formulations were found superior to the control. Foliar sprayings of 0.02 per cent cypermethrin and deltamethrin 0.01 per cent were highly effective to control the larvae. Deltamethrin 0.01 per cent was proved effective, safer and economical as compared to cypermethrin O. 01 per cent for the control of these larvae.

178. Tikader, A.; Central Sericultural Germplasm Resources Centre, Hosur (India)Dandin, S.B.; Central Sericultural Research and Training Institute, Mysore (India). Foliar morphology and venation pattern in different mulberry (Morus spp.). Indian Journal of Forestry (India) v. 31(1) p. 77-84 KEYWORDS: PLANT NUTRITION. MORUS. MORACEAE. FUNGAL MORPHOLOGY. MORUS ALBA. MORUS INDICA. MORUS NIGRA. MORUS SERRATOR.

The morphological features are the basis of taxonomic identification of Mulberry species. The leaf morphology and venation pattern have been described in 4 Indian Mulberry species Le., M. indica, M. alba, M. laevigata and M. serrata of the family Moraceae. The median strand joined and formed the mid rib, which extends into secondary in the opposite of both sides of lamina. The veins turned into a dense reticulum. The overall venation is reticulate with marked diversity in the mode of ramification. The development of areole showed variation in different species. The leaf size of Morus species varied and a wide range Le., M. indica (120.00 - 234.00 cm2), M. alba (168.00 - 253.00 cm2), M. laevigata (204.00 - 480.00 cm2) and M. serrata (168.00-272.00 cm2). Number of strands ending into petiole is more or less similar in all species, which ranges from 3 - 5 but the venation pattern is thick in case of M. laevigata and M. serrata. The areole number/mm2 varies from 1.54 - 5.20 and areole size from 0.18 - 0.65/mm2 in different species. The areole number is higher in M. laevigata .and M. serrata and lower in M. indica and M. alba. The leaf morphological characters, the foliar venation pattern, areole formation, number of veins ending into petiole and veins/areole are the important features for identification of different Morus species at the vegetative stage. The minor venation, which ramifies into lamina also indicates the leaf quality i.e., palatability to silkworm.

179. Srivastava, K.K.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Pomology)Sharma, A.K.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Pomology)Singh, S.R.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Pomology)Khalil, A.; Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar (India). Div. of Pomology). Estimate of genetic variability, heritability and genetic advance in plum (Prunus salicina L.) cultivars. Indian Journal of Forestry (India) v. 31(1) p. 99-102 KEYWORDS: GENETIC VARIATION. GENETIC INHERITANCE. GENETIC GAIN. PRUNUS SALICINA. VARIETIES.

Studies on correlation coefficient and genetic variability along with heritability were conducted in Plum cultivars. A wide range of variability along with high estimates of genotypic coefficient variability and phenotypic coefficient of variability was noted for plant spread North-South and East-West spread, tree volume, yield and fruit weight. High heritability noted for days taken to maturity, yield, fruit weight, fruit length and fruit diameter, Total soluble solids and acidity. High genetic advance was recorded for days taken to maturity, yield and fruit weight. Genetic gain was found high for plant spread (E-W), yield and fruit weight, which might be assigned to additive gene action.

180. Lone, A.A.; Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Genetics and Plant Breeding) Tewari, S.K.; Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Dept. of Genetics and Plant Breeding). Genetic variability and correlation studies in poplar (Populus deltoides Bartr.). Indian Journal of Forestry (India) v. 31(2) p. 192-196 KEYWORDS: POPULUS DELTOIDES. GENETIC VARIATION. CLONES.

Forty nine exotic and indigenous clones of Poplar were evaluated for eight morphological traits. These clones have shown considerable variability for all the parameters. Wide range of GCV and PCV was observed for petiole length, diameter and plant height. The heritability estimates were high for almost for all traits accompanied by fair amount or genetic advance. Genotypic correlation coefficients were higher than the corresponding phenotypic values for most of the character combinations. Plant height showed positive and significant c:rrelation with plant diameter indicating that selection can playa great role in the improvement of Poplar clones.

181. Punetha, N.; Government Post Graduate College, Pithoragarh (India). Dept. . of Botany)Bhakuni, K.; Government Post Graduate College, Pithoragarh (India). Dept. . of Botany)Kholia, B.S.; Botanical Survey of India, Noida (India). Botanic Garden of Indian Republic). Habitat ecology and prothallial development in endemic Pteris subquinata.

Indian Journal of Forestry (India) v. 31(2) p. 287-290 KEYWORDS: ECOLOGY. ENDEMICS. HABITATS.

Population structure of endemic Pteris subquinata is given along with the ecology of the substrata. Gametophytes collected from the nature were analyzed for the sexuality which revealed that the gametophyte populations are generally unisexual but when isolated gametophytes were grown, they became bisexual. Reasons of being endemic are discussed.

K70 Forest Injuries and Protection

182. Prakash, O.; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Determining people's participation in forest fire control : a study of Himachal Pradesh. Indian Journal of Forestry (India) v. 31(1) p. 1-6 KEYWORDS: FORESTS. FOREST FIRES. FOREST PROTECTION. PARTICIPATION. HIMACHAL PRADESH.

Among the different causes of forest fires. accidental causes result into m0re than 90 per cent fires followed by natural causes. Socio-economic factors, viz., land holding and social participation play an importan't role in the management of forest fires. This finding was further conformed by the regression analysis. However, education was found inversely related. The lack of interaction with forest department was reported as an important factor for the non participation of the respondent in the forest fire control.

183. Kumar, R.; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Tree Improvement and Genetic Resources)Thakur, V.; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India). Dept. of Tree Improvement and Genetic Resources). Effect of forest fire on trees, shrubs and regeneration behaviour in Chir Pine forest in Northern aspects under Solan Forest Division, Himachal Pradesh. Indian Journal of Forestry (India) v. 31(1) p. 19-27 KEYWORDS: FORESTS. FIRE CONTROL. REGENERATION. HIMACHAL PRADESH.

Effect of forest fire on woody vegetation and regeneration behavior was studied in Chir pine forest situated between 1150-1800 m in Solan Forest Division in Himachal Pradesh, India. Four fire affected Sites and one control Site were surveyed for floristic composition, density, basal area, lVI, AIF, Shannon-Weaver index, Simpson's Index of dominance (Cd), Species richness (d), Sorenson index (S) and natural regeneration potential of tree and shrubs. A total of 3 tree species and 10 shrub species were recorded on the five experimental sites. Fire resistant species were observed more in selected Chir pine forests. There was not observed any consistent trend for density, basal area, lVI, H. Sorenson's index of similarity between fire affected and control'sites fortrees. Density and basal area in fire affected sites were lesser than control sites for shrubs. Contagious pattern of distribution for trees and shrubs was common. Seedlings density of trees and shrubs was higher on occasional fire affected sites than control sites. Density of saplings of trees was higher in control sites than fire affected sites.

184. Sangha, K.S.; Punjab Agricultural University, Ludhiana (India). Dept. of Forestry and Natural Resources)Sohi, A.S.; Punjab Agricultural University, Ludhiana (India). Dept. of Entomology). Prospective biological control agents for regulation of population of Clostera fulgurita (Walker) on poplar in Punjab. Indian Journal of Forestry (India) v. 31(1) p. 95-98 KEYWORDS: BIOLOGICAL CONTROL AGENTS. POPULUS DELTOIDES. PUNJAB. BIOLOGICAL COMPETITION.

Population of Closterafulgurita (Walker) can be regulated by natural enemies. Can!heconafurcellata Wolff (Hemiptera: Pentatomidae), a predatory bug and Aleoides percurrens Lyle (Hymenoptera: Braconidae), larval parasitoid have potential in regulating the population of this defoliator. Both these biocontrol agents are host density dependent. Temperature range of 20-25 °C for Aleoides and 15-20 °C for Canthecona is optimum for the development of their population. Adult longevity of Aleoides was more during August-October with maximum parasitisation during Octoher..November, 2003.

185. Das, D.K.; Rajendra Agricultural University, Samastipur (India). Dept. of Forestry)Ali, M.S.; Rajendra Agricultural University, Samastipur (India). Dept. of Forestry)Mandal, M.P.; Rajendra Agricultural University, Samastipur (India). Dept. of Forestry)Kumar, R.; Rajendra Agricultural University, Samastipur (India). Dept. of Forestry). Residual effect of some tree species on soil productivity and fertility in North-West alluvial plain in Bihar . Indian Journal of Forestry (India) v. 31(2) p. 187-192 KEYWORDS: PRODUCTIVITY. FERTILITY. BIHAR. SPECIES. FORESTS.

An attempt was made to study the productivity and fertility of cropped marginal lands as influenced by residual effect of some tree species. A field experiment was carried out in split-plot design with 15 treatment combinations comprising four tree species viz., Leucaena leucocephala, Sesbania grandiflora, Wendlandia exserta, Eucalyptus tereticornis and control (open) in main plot and three crops viz., Wheat, Mustard and Maize in sub¬plots with three replications. The tree species were felled after 8 years of their plantation and then three crops were grown for judging the residual effect of tree species. Considerable variation in biomass of components for different tree species was noticed. A positive residual effect of all the tree species on crop yield was recorded and the increase in yield was in between 10-31 more as compared to control. Electrical conductivity and pH were lower under L. leucocephala and decreased from 0.81 to 0.43 dSm-1 and 8.6 to 7.8, respectively. Available N, p,os' KP and organic carbon were also noted relatively high with L. leucocephala followed by S. grandiflora. This study infers that tree species are effective in brining about improvement in fertility and productivity of the soil.

186. Chakrabarti, S.; Himalayan Forest Research Institute, Shimla (India). Forest Protection Div.)Kumar, S.; Forest Research Institute, Dehra Dun (India). Forest Pathology Div.). Dose-mortality-bioassay of Beauveria bassiana (Balsamo) Vuill. on Acraea issoria (Lepdoptera:Nymphalidae), A defiliator of Debregeasia hypoleuca in Himachal Pradesh. Indian Journal of Forestry (India) v. 31(2) p. 239-242 KEYWORDS: DEFORESTATION. FORESTS. PESTS.

Beauveria bassiana, was isolated from the infected pupal cadavers of Ectropis deodarae (Lepidoptera: Geometridae), a defoliator of Cedrus deodara, from Jhungi area ofSundernagar Forest Division, Himachal Pradesh. The native isolate of the fungus was tested to assess its virulence on Acraea issoria (Lepidoptera:Nymphalidae), commonly known as Yellow Coster. A dose mortality bioassay experiment using seven doses of Beauveria bassiana was conducted on third instar larvae of the butterfly that defoliate Debregeasia hypoleuca in and around Shimla, Himachal Pradesh. Results indicate that 76% larval mortality is possible using 6.77 Spores/ml of aqueous solution of this entomopathogenic fungus. The LDso calculated using 'Probit Analysis' was 3 E + 07 spores per ml. of water suspension and at 95. confidence, the lower limit is 3E + 06 (2983882.87517) and upper limit is 1.9E + 08 (186770301.094). This study indicates that the Jhungi isolate of Beauveria bassiana would be an effective microbial pathogen to control the lepidopteran defoliator.

187. Naghdi, R.; University of Guilan, Sowmeasara (Iran). Dept. of Forestry)Bagheri, I.; University of Guilan, Sowmeasara (Iran). Dept. of Forestry)Zamanipour, S.; General Office of Guilan Natural Resources (Iran). Planning of optimum skid trials in order to reduce environmental damages in Shafaroud forest (Northern Iran). Indian Journal of Forestry (India) v. 31(2) p. 251-256 KEYWORDS: HARVESTING. ENVIRONMENT. IRAN ISLAMIC REPUBLIC.

Harvesting and intervening in forest with regard to their capability and capacity is necessary in order to promote quality, quantity and breeding of forest stand. On the other hand extraction of logs and their products is one of the most important operations in harvesting which is generally carried out by machinery along skid trail network. Therefore determining skid trails and taking into consideration the related standards is necessary in order to reach harvesting objectives. GPS was used to survey skid trails and existing road network of Shafaroud Forest District number 3 and then a Map of skid trail network was prepared. The prepared Map covered 1059 hectares of Shefarood Forest

District Number 3. Then with the use of environmental factors and analyzing them the area was divided into suitable and unsuitable areas: Unsuitable areas are; areas with slope of more than 65. , soil susceptible to land slide, areas with ruined forest (volume less thanI00m3/ha), areas which contain Porotia, Diospirus and Pertrocaria species, areas with no trees, rural areas and valleys. Suitable areas are; areas with slope ofless than 65. , areas with suitable soil, good drainage and suitable texture, areas that have volume of more than 100m3!ha, area which have Fagus arid Carpinus species etc. GIS Arc view! Arc info and etc were used to digitize and prepare related Maps and in order to find suitable areas and avoiding environmental damages the most suitable skid trails network were designed which covers 801ha of total area of district. Finally the existing skid trails network Map was compared with the most suitable designed skid trails network. The results showed that 712 ha of the area that were covered by existing skid trails network were unsuitable areas for designing and constructing skid trails network and therefore causes environmental damages and also only 347 ha of the area that were covered by existing skid trails network were suitable areas. Meanwhile 454 ha oftotaJ District which were suitable areas, were not covered by the existing skid trails network. These areas were considered when designing the new skid trails network. The results of this research can be used in designing more appropriate skid trails with less environmental damages.

188. Sreejith, K.A.; Kerala Forest Research Institute, Thrissur (India)Chandrashekara, U.M.; Kerala Forest Research Institute, Thrissur (India)Kallarackal, J.; Kerala Forest Research Institute, Thrissur (India). Determination of the successional status of tropical evergreen species using chlorophyll fluorescence technique. Indian Journal of Forestry (India) v. 31(2) p. 257-259 KEYWORDS: TROPICAL FORESTS. CHLOROPHYLLS. FLUORESCENCE.

Photosynthetic performance of six tropical evergreen forest species, representing three successional groups was studied using the chlorophyll fluorescence technique. The study showed that the maximum photosynthetic efficiency could be seen under less light conditions in Palaquium ellipticum and Cullenia exarillata and in high light conditions in Macaranga peltata. The study also showed that in species such as Actinodaphne bourdillonii and Clerodendrum viscosum, analysis of photosynthetic performance alone might not be sufficient to categorize them into different successional groups. Thus an integrated study on phenology, growth and survivability patterns and photosynthetic performance of tropical evergreen species to assign them the successional status is suggested.

189. Ramani, R.; Indian Institute of Natural Resins and Gums, Ranchi (India)Sharma, K.K.; Indian Institute of Natural Resins and Gums, Ranchi (India)Kumar, P.; Indian Institute of Natural Resins and Gums, Ranchi (India). A new record of occurrence of Indian lac insect, Kerria lacca (Kerr) (Coccoidea:Tachardidiidae) on Euphorbia pulcherrima Willd. (Euphorbiaceae). Indian Journal of Forestry (India) v. 31(2) p. 283-284 KEYWORDS: LAC. KERRIA LACCA. EUPHORBIA PULCHERRIMA. INSECT CONTROL.

The Indian lac insect, Kerria lacca (Kerr) is an economically important insect, which is cultured widely for its products of commerce. Lac insects have been reported to thrive on more than 400 plant species. Occurrence of K. lacca on Euphorbia pulcherrima (Poinsettia), an ornamental plant has been reported for the first time. The infestation level on this plant species is indicative of its potential as an economic host for lac culture for summer crop.

190. Narain, S.; University Allahabad, Allahabad (India). Dept. of Botany)Mishra, S.; University Allahabad, Allahabad (India). Dept. of Botany). A list of aquatic and marshy plants of Bundelkhand region of Uttar Pradesh. Indian Journal of Forestry (India) v. 31(2) p. 301-208 KEYWORDS: UTTAR PRADESH. AQUATIC PLANTS.

The present paper deals with an account of aquatic angiosperms of Bundelkhand region. The plant specimens of aquatic and marshy plants were studied from Duthie herbarium of Botany Department of Allahabad University, Allahabad belonging to four

Districts of Bundelkhand region i.e. Banda (including Chitrakoot), Jalaun, Lalitpur and Hamirpur (including Mahoba). In all 179 species belonging to 97 genera and 49 families have been recorded. Out of these 30 species were not reported in Flora of Upper Gangetic Plain (Duthie, 1903-1923).

191. Murugesan, M.; Kongunadu Arts and Science College, Coimbatore (India). Post Graduate and Research Dept. of Botany)Balasubramaniam, V.; Kongunadu Arts and Science College, Coimbatore (India). Post Graduate and Research Dept. of Botany). Rare endemic and threatened angiosperms of velliangiri hills in coimbatore district of Tamil Nadu . Indian Journal of Forestry (India) v. 31(2) p. 309-314 KEYWORDS: ENDEMICS. TAMIL NADU. ANGIOSPERMS.

Velliangiri hills in Coimbatore District of Tamil Nadu form a portion of the Western Ghats. Floristic diversity assessment study was conducted in the study area, which resulted in the collection of 1200 species of Angiosperms out of which 19 species viz., Elaeocarpus munronii, E. recurvatus, Crotalaria longipes, C. priestleyoides, Medinella malabarica, Hydrocotyle conferata, Vanasushava pedata, Hedyotis swertioides, Ophiorrhiza brunonis, Psycho tria johnsonii, Anaphalis beddomei, Vernonia travancorica, Smilax wightii, Disporum leschenaultianum, Brachycorythis iantha, Coelogyne nervosa, Habenaria richardiana, Fimbristylis kingii, F. uliginosa are rare and endemic to Southern Western Ghats.

P30 Soil Science and Management

192. Lal, R.; The Ohio State University, Columbus (United States of America). Carbon Management and Sequestration Centre). Soils and India's food security. Journal of the Indian Society of Soil Science (India) v. 56(2) p.129-138 KEYWORDS: FOOD SECURITY. WATER QUALITY. POVERTY. FOOD PRODUCTION. SUSTAINABILITY. SOIL.

Indian agriculture is on the cross roads. Yields of major food crops have stagnated or declined since 2000. Thus, Indian agriculture is facing a triple challenge of: (i) doubling the food production by 2030 compared with 2005, (ii) restoring degraded soils and improving quality of surface and ground waters, and (iii) alleviating rural poverty by value addition and diverting population to other professions (e.g., agro¬based industries). Yields of principal crops in India are 2 to 4 times less than those in the industrialized economies. In addition to biophysical (soil, water, climate) factors, there are also serious human dimension issues which need to be addressed to enhance and sustain agronomic production. While building upon the conventional technologies (e.g., conservation tillage, mulch farming, use of plastic mulch, drip sub-soil irrigation, aerobic rice, positive nutrient budget), it is also important to use modem innovations based on nanotechnology, biotechnology and information technology. Zeolites-based amendments have an application in nutrient and moisture conservation. The critical issue is of enhancing the use efficiency of inputs (e.g., fertilizer, irrigation water, energy) by reducing losses. The ~trategy is to improve agronomic yield per unit land area, time and the off-farm inputs of nutrients, energy, water, and labour. With its vast soil and water resources and a range of clirilates,lndia has the capacity to be the world's bread basket by mobilizing farming community,making soil science relevant to societal needs, and improving accoUntability and governance.

193. Goyal, V.; National Bureau of Soil Science and Land Use Planning, New Delhi (India). Regional Centre)Jhorar, B.S.Malik, R.S.. Quantification of interactions on recharging the brackish aquifer using cavity type aquifer storage recovery well. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 139-147 KEYWORDS: WATER STORAGE. HYDROGEOLOGY. CHEMICOPHYSICAL PROPERTIES.

Better understanding of mixing and geo-chemical reactions help in installation, operation and sustaining the aquifer storage recovery (ASR) system. Buffer storage volume (BSV) of 2000, 6000,10,000 at4 14,000 m3 were created in successive cycles of injection and recovery in a cavity-type brackish ASR well. I Two-residence times (t) of 13

and 70 days were allowed at a BSV of 14,000 m3. Calcite dissolution decreased with BSV and increased with residence time of 70 days. Groundwater quality of the recovered water was better than that of native water. Potassium concentration and temperature of the recovered water were more than that of injected water at all BSVs. Energy of 6.5 kJ was gained in one litre of the recovered water by raising the temperature of injected water from 27.5 to 29.05 °C. Potassium and borate released from the illite : and tourmaline minerals, respectively were 924 and 433 moles in 2000 m3 of recovered water at BSV of 2000 m3. The study has a potential of finding its application in conservation and better utilization of the scarce water resources in the semi-arid regions.

194. Aggarwal, P.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Physics)Chopra, U.K.; Indian Agricultural Research Institute, New Delhi (India). Div. of Agricultural Physics)Singh, A.K.; Indian Council of Agricultural Research, New Delhi (India). Development of pedotransfer functions for penetration resistance of few soils under major soil orders of India. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 146-153 KEYWORDS: SOIL CONSERVATION. SOIL WATER CONTENT. SOIL CRUSTS. SOIL PH. SOIL BIOLOGY. SOIL CHEMISTRY. SOIL CRACKING.

Pedotransfer functions for soil penetration resistance were developed for soils belonging to soil orders Inceptisols, Alfisols and Vertisols. For upland crops grown on Inceptisol and Alfisol, soil water content (SWC) along with bulk density (BD) accounted for nearly 72-85. variation in penetration resistance (PR). However, under saturated soil water conditions during lowland rice cultivation on Inceptisols and Vertisols, the correlation between PR and BD was between 64-78. . It was further observed that for most BD's, at lower SWC, PR was higher under Alfisols than Inceptisols but trend reversed at relatively higher I SWc. Above developed pedotransfer functions are of great importance in calculating soil water content at 2MPa soil strength (SWC2MPa) which is the soil water content below which plant experiences severe stress and is now being considered as the critical soil water content at which irrigation should be recommended. They are also useful in calculating the soil water stress period experienced by growing upland crops under different irrigation schedules. Computation of SWC2MPa ftom above developed regression equations showed an increase with increase in bulk density and clay content. There was an increase of 4-5. in the value of SWC2MPa at maturity over its value at initial stage.

P33 Soil Chemistry and Physics

195. Muralidharan, P.; Central Soil and Water Conservation Research and Training Institute, Udhagamandlam (India). Research Centre)Sahoo, D.C.; Central Soil and Water Conservation Research and Training Institute, Udhagamandlam (India). Research Centre)Madhu, M.; Central Soil and Water Conservation Research and Training Institute, Udhagamandlam (India). Research Centre)Sundarambal, P.; Central Soil and Water Conservation Research and Training Institute, Udhagamandlam (India). Research Centre). Soil moisture availability and crop yield as influenced by different land management practices in the Nilgiris. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 161-166 KEYWORDS: LAND MANAGEMENT. SOIL WATER CONTENT. CROP YIELD. SLOPING LAND.

A field experiment was conducted for four years from 2003 to 2006 to compare different land management practices like inward sloping bench terraces (lET), outward sloping bench terraces (OBT), and sloping lands with supporting vegetative meas oil and water conservation and yield of crops in a silty clay loam soil in the Nilgiris. The trea nts include'd two per cent lET, five and ten per cent OBT with planting of medicinal plants viz. ge, um (Pelargonium graveolense), rosemary (Rosemarinus officinalis) and cineraria (Cineraria martima) on the riser, farmers' practice (ten per cent OBT with grass on the riser) and 25 per cent sloping land with strips of geranium as vegetative barrier across the slope. Crop rotation of potato-cabbage in the first year and carrot-beans in

the second year was followed and two rotations completed. The sloping plots with vegetative barrier of geranium across the slope produced significantly higher yield of carrot in both the rotations and that of potato and cabbage in the second rotation. However, the runoff and soil loss occurring from the different treatments did not vary significantly and were within the critical limits. The soil moisture content measured at 10, 20, and 30 cm depth revealed that at 20 and 30 cm depth, it was consistently higher in the sloping land with vegetative barrier of geranium across the slope. This would have resulted in the higher yield of crops in addition to the better drainage conditions in this plot.

196. Borkotoki, B.; Assam Agricultural University, Jorhat (India). Dept. of Soil Science)Das, K.N.; Assam Agricultural University, Jorhat (India). Dept. of Soil Science). Forms of sulphur and their relationship with soil properties in entisols, inceptisols and alfisols of Assam. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 186-191 KEYWORDS: SOIL SCIENCES. SOIL CHEMICOPHYSICAL PROPERTIES. LUVISOLS. ASSAM.

Seventy-five surface soil samples representing three soil orders viz., Entisols, Inceptisols and Alfisols of Assam were analysed for various forms of sulphur (S). Entisols contained lowest and Alfisols the highest level of all the fractions ofS. Organic S (79.61-82.34.) constituted the dominant form ofS in all the orders followed by non-sulphate sulphur (11.19-17.08.). Water soluble and adsorbed S constituted 3.50 and 0.74. of total Spool, 4.07 and 1.66,7.28 and 4.01. in Entisols, Inceptisols and Alfisols, respectively. The adsorbed S contributed the least to the total S pool in all the soils. All forms of S were positively and significantly linked with total S excluding non-sulphate S in Entisols and Alfisols. The soil organic-C was positively correlated with all forms of S except non-sulphate S.

197. Singh, R.S.; National Bureauj of Soil Survey and Land Use Planning, Udaipur (India). Regional Centre)Dubey, P.N.; National Bureauj of Soil Survey and Land Use Planning, Udaipur (India). Regional Centre)Singh, S.K.; Central Soil Salinity Research Institute, Karnal (India)Shyampura, R.L.; National Bureauj of Soil Survey and Land Use Planning, Udaipur (India). Regional Centre). Distgribution of chemical practions of micronutrient cations in some vertisols under the agro-eco-sub region 4.2 of eastern Rajasthan. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 192-197 KEYWORDS: TRACE ELEMENTS. VERTISOLS. SOIL CHEMICOPHYSICAL PROPERTIES. RAJASTHAN.

The agro-eco-subregion (AESR) 4.2 encompasses Aravalli foot hills, central Rajasthan plains and adjoining areas. Four pedons of Vertisols from benchmark soil series classified as Calcic Haplusterts (Bhupalsagar soils series), Petrocalcic Haplusterts (Taswaria soil series), Sodic Haplusterts (Bhatewar soil series) and Typic Haplusterts (Sanwata soil series) occurring mostly on dolomitic and gneissic sub-surface were subject to fractionation of Cu, Zn, Mn and Fe into organic bound (OB), crystalline (C), complexed (CD), amorphous (AM) and exchangeable (EX). The results showed that the major portion of the Cu, Zn, Mn and Fe resided in the residual fraction. The trends for the mean values of Cu, Zn, Mn and Fe observed were OB (4.89) C (2.20) CD (1.70) EX (0.51) AM (0.48); OB (10.84) C (4.14) CD (1.20) AM (0.92) EX (0.66); C (58.56 AM (42.26) OB (31.52) CD (18.90 EX (1.51) and AM (1194.8) OB (745.4) C (194.0) CD (11.71) EX (0.46) mg kg & rdquo;1, respectively. Bhupalsagar soil series had higher content of crystalline Cu due to higher pH and low organic carbon. The coefficients of correlation for Cu and Zn fractions responded significantly amongst the fractions and soil properties viz., silt, clay and organic carbon. For Fe, the organic and amorphous components had significant relationship with soil properties (R2=0.81 and 0.97); amongst the different fractions the complexed and crystalline forms showed significant relationship (R2=0.78 and 0.80). In the manganese fractions the amorphous and complexed fractions had a significant relationship with soil properties (R2= 0.88 and 0.80). The organically-bound fractions showed positive relationship with different forms of Mn (R2= 0.86).

198. Lingade, S.R.; National Bureau of Soil Science and Land Use Planning, Nagpur (India)Srivastava, R.; National Bureau of Soil Science and Land Use Planning, Nagpur (India)Prasad, J.; National Bureau of Soil Science and Land Use Planning, Nagpur (India)Saxena, R.K.; National Bureau of Soil Science and Land Use Planning, Nagpur (India). Occurrence of sodic vertisols in Nagpur district, Maharashtra. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 231-232 KEYWORDS: SALINITY. SOIL CHEMICOPHYSICAL PROPERTIES. MAHARASHTRA.

199. Tiwari, S.C.; Guru Ghasidas University, Bilaspur (India). Dept. of Forestry, Wild Life and Environmental Sciences)Pastelan, M.; Polish Academy of Sciendes, Lublin (Poland). Institute of Agrophysics)Brzezinska, M.; Polish Academy of Sciendes, Lublin (Poland). Institute of Agrophysics)Stepniewska, Z.; Polish Academy of Sciendes, Lublin (Poland). Institute of Agrophysics). Variation in phosphatase enzyme activity in a eutric histosol irrigated with pre-treated wastewater and normal tap water. Journal of the Indian Society of Soil Science (India) v. 56(2) p. 233-235 KEYWORDS: SOIL GENESIS. WATER USE. IRRIGATION.

How to obtain the full text of documents

1. Recommendations to scientists

- First determine whether your local library or another library in your area can provide you with a copy of the document you want.
- Most authors keep small stocks of reprints of their own publications, and they are usually prepared to respond to a polite request from a fellow scientist.
- In addition many of the NARD Input Centers have a document delivery service. Your librarian may write and request a photocopy for which you may often be charged the photocopy and mailing cost.
- If your librarian is unable to find the document you want, you could send us the document delivery coupon which is included in each copy of this journal. This coupon enables you to ask the NARD Headquarter to supply one or two items for your personal interest. We make no charge for this limited service, but the coupons should be used only as a last resort.
- Because of copy right regulations, photocopies of entire publications (e.g. complete books) cannot be provided.

2. Recommendations to librarians

- Become a NARD member early and get your work visible to others.
- Establish good working relationships with other librarians and be as helpful as possible in providing document delivery services from the collection you hold.
- Make your managers aware of the importance of having your own collection effectively organized, with back copies available for document delivery with access to a photocopy machine and some funds to provide requested copies of your documents.
- Contact the NARD Headquarter to make sure that relevant publications of your institution are entered/indexed in NARD.

Document Delivery Coupon

Please use this coupon only as a last resort after having tried to obtain the document you need from your own library or a national or regional information centre/library/NARD Input Centre.

Send your request to: The Information Systems Officer,
Agricultural Research Information Centre, DIPA
Krishi Anusandhan Bhavan, Pusa, New Delhi 110 012
e-mail: hansraj@icar.org.in

Please send me a reprint/photocopy of the following document listed in NARD for the purpose of my personal study or research:

Volume No./Year ___________ Entry Number _____ Author _________________________

Title ____

Source ____

Year of Publication of the source/journal _________ Pages __________________________

Write your name/address on the reverse of this coupon

✂ -

Document Delivery Coupon

Please use this coupon only as a last resort after having tried to obtain the document you need from your own library or a national or regional information centre/library/NARD Input Centre.

Send your request to: The Information Systems Officer,
Agricultural Research Information Centre, DIPA
Krishi Anusandhan Bhavan, Pusa, New Delhi 110 012
e-mail: hansraj@icar.org.in

Please send me a reprint/photocopy of the following document listed in NARD for the purpose of my personal study or research:

Volume No./Year ________ Entry Number ________ Author _________________________

Title ____

Source ____

Year of Publication of the source/journal _________ Pages __________________________

Write your name/address on the reverse of this coupon

✂ -

Document Delivery Coupon

Please use this coupon only as a last resort after having tried to obtain the document you need from your own library or a national or regional information centre/library/NARD Input Centre.

Send your request to: The Information Systems Officer,
Agricultural Research Information Centre, DIPA
Krishi Anusandhan Bhavan, Pusa, New Delhi 110 012
e-mail: hansraj@icar.org.in

Please send me a reprint/photocopy of the following document listed in NARD for the purpose of my personal study or research:

Volume No./Year ____________ Entry Number ____ Author _________________________

Title ____

Source ____

Year of Publication of the source/journal _____________ Pages ______________________

Write your name/address on the reverse of this coupon

My name and institutional address are:

____

____

____

____

____

____

____

____

Date: ______________________ **Signature: ______________________**

✂ -

My name and institutional address are:

____

____

____

____

____

____

____

____

Date: ______________________ **Signature: ______________________**

✂ -

My name and institutional address are:

____

____

____

____

____

____

____

Date: ______________________ **Signature: ______________________**