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## Isolation and characterization of phytate-mineralizing and phosphate-solubilizing *Bacillus aryabhatai* strains associated with rhizosphere of soybean cultivated in Vertisols of Central India

AKETI RAMESH, SUSHIL K. SHARMA<sup>1</sup> and MAHAVEER P. SHARMA

<sup>1</sup>Directorate of Soybean Research (ICAR), Khandwa Road, Indore-452 001 (Madhya Pradesh) ICAR-National Bureau of Agriculturally Important Microorganisms, Kushamaur, Mau Nath Bhanjan-275 003 (Uttar Pradesh)

**ABSTRACT** : Microorganisms play an important role in mediating the availability of unavailable soil phosphorus for plant assimilation. The rationale of the present study is to (1) screen isolates with high capacity to mineralize phytate, solubilize mineral phosphates, and possessing multiple plant growth-promoting attributes and (2) to evaluate potential bacterial isolates for growth, phosphorus acquisition and mobilization by soybean and wheat crops. A total of 68 morphologically different bacterial isolates were recovered from rhizosphere soils of soybean genotypes grown in Vertisols and three best isolates designated as MDSR7, MDSR11 and MDSR14 were selected and identified putatively as *Bacillus* based on the phenotypic characteristics and fatty acid methyl esters profiling. Further, 16S rRNA gene sequences of the isolates MDSR7, MDSR11 and MDSR14 revealed homology up to 99.17, 98.63 T and 100 %, respectively to *Bacillus aryabhatai* B8W22 . The strains MDSR7, MDSR11 and MDSR14 liberated phosphorus up to 182, 148, and 172 µg Pi ml<sup>-1</sup>, respectively and higher activities of phosphatases and phytase in phytate mineralizing medium. The isolates also solubilized tricalcium phosphate up to 454, 442, and 471 µg Pi ml<sup>-1</sup>, respectively in NBRIP medium. Moreover, all the strains solubilized phosphorus from zinc phosphate supplemented Tris-minimal medium to an appreciable extent. The solubilization was accompanied by a decline in pH and substantial release of organic acids mainly gluconic acid and other acids. The strains showed multiple plant growth-promoting traits like zinc solubilization; production of indole acetic acid, siderophore and ammonia. A microcosm experiment was conducted with soybean and wheat as test crops and it comprised of 4 treatments for each crop, viz., (1) un-inoculated control with crop; (2) *B. aryabhatai* MDSR7 (3) *B. aryabhatai* MDSR11 and (4) *B. aryabhatai* MDSR14 in completely randomized block design with twelve replications. Under microcosm conditions, the strains MDSR7 and MDSR14 significantly improved growth parameters, yield, phosphorus acquisition and available soil P content by both soybean and wheat crops. It could be concluded that *B. aryabhatai* isolates MDSR14 and MDSR7 mineralized

phytate and solubilized tricalcium phosphate and produced substantial amount of phosphatase, phytase and organic acids that may aid in mobilization of P from soil for plant acquisition and has potential to be developed as bio-inoculants to meet P requirement of plants. Field evaluation of *B. aryabhatai* isolates MDSR14 and MDSR7 is required to evaluate phytate mineralizing and solubilizing abilities on P mobilization with a view to increasing its concentration in edible portion, yield of soybean and wheat, and for utilization as bio-inoculants for biofertilization and biofortification.

### **Assessment of parametric and non-parametric methods for selecting stable and adapted finger millet (*Eleusine coracana* (L.) Gaertn.) genotypes in submountainous Himalayan region**

SALEJ SOOD<sup>1</sup>, ARUN GUPTA<sup>2</sup> LAKSHMI KANT<sup>1</sup> and A. PATTANAYAK<sup>1</sup>

<sup>1</sup>ICAR-Vivekananda Institute of Hill Agriculture, Almora- 263 601 (Uttarakhand)

<sup>2</sup>ICAR-Indian Institute of Wheat and Barley Research, Karnal- 132001, (Haryana)

**ABSTRACT :** The objectives of this study were to assess genotype-environment interaction (GEI) and to identify stable finger millet (*Eleusine coracana* (L.) Gaertn. subsp. *coracana*) genotypes for grain yield in the North Western Himalayan region of India on the basis of 6 growing seasons. Five genotypes of different maturity duration were evaluated in a randomized complete block design with 3 replications during each growing season. Genotypes, environments main effects and GEI were significant at  $P < 0.01$ . Both parametric ( $\sigma$ ,  $s$ ,  $W_i$ , ASV) and non-parametric ( $Y_{si}$ ,  $S_i$ ,  $S_i$ ) stability statistics were used to identify stable finger millet genotypes. On the basis of both parametric and non-parametric stability methods, the genotypes HR 374 and RAU 8 were found most stable. The level of association among the stability measures was assessed using Spearman's rank correlation. The rank correlation matrix indicated that both non-parametric measures were significantly inter-correlated with parametric measures and therefore, can be used as alternatives. Simultaneous selection for yield and stability ( $Y_{si}$ ) is the better choice for screening of genotypes for both yield and stability. Utilization of cultivars HR 374 and RAU 8 is recommended in breeding program of finger millet in Himalayan region.

## **Genetic variability and trait association studies in Carnation (*Dianthus caryophyllus* L.) for quantitative attributes under low cost poly house in Kumaon region of Uttarakhand**

RAJ NARAYAN, B. L. A TTRI, NAZEER AHMED, ANIL KUMAR, MUKESH S. MER, PRAGYA, SOVAN DEBNATH and ARUN KISHOR

*ICAR-Central Institute of Temperate Horticulture- Regional Station, Mukteshwar, Nainital -263 138 (Uttarakhand), ICAR-Central Institute of Temperate Horticulture, Srinagar (J&K)-190007*

**ABSTRACT** : To harness plant potential and produce large number of flowers of better quality for longer period, six existing cultivars viz. Master, Niva, Dark Rendezvous, Tabor, Charment and Farida were assessed under low cost poly house for their growth and flower characteristics during 2014-15. The variability, heritability, genetic advance and correlation in six genotypes of carnation for eleven quantitative traits were studied. The phenotypic coefficient of variation was found higher than genotypic coefficient of variation for all the traits under study. High phenotypic and genotypic coefficients of variation were observed for total flowers/hill and number of flowers/stem. Significant variations among the genotypes were observed for most of the traits studied. Highest number of flowers/hill (104.50), maximum flower diameter (62.75 mm) and minimum days for bud to flower opening (8.00 days) were recorded in cv. Master. In general, PCV was found higher than the corresponding GCV and these ranged from 9.27 (in stem girth) to 89.35 (in total flowers/hill) and 9.16 (in stem girth) to 89.22 (in total flowers/hill), respectively. Total flowers/hill, stem girth, number of leaves and flower opening duration showed high heritability (99.72%, 99.13%, 98.80% and 94.48%, respectively) coupled with high genetic advance as per cent of mean indicating presence of additive gene action showing scope for improving these characters through selection.

## **Productivity and profitability of medium land rice under different crop management practices in rainfed conditions of Odisha**

P. PARIDA and B. BEHERA

*Department of Agronomy, Odisha University of Agriculture and Technology, Bhubaneswar- 751003 (Odisha)*

**ABSTRACT** : An experiment was conducted during kharif season of 2013 and 2014 to find out the best crop management practice of rice (*Oryza sativa* L.). Among all the treatments, transplanting with post emergence application of bispyribac sodium 0.02 kg/ha at 21 DAS followed by mechanical weeding at 35 DAS recorded the highest mean plant height at harvest (129.7cm), LAI at 75 DAS (6.34), grains/panicle (131) and 1000-grain weight (29.58), followed by drum seeding with same management practices. Transplanted rice recorded highest grain yield (4640

kg/ha), stover yield (5563 kg/ha) with maximum gross return of Rs 67771/ha and net return of Rs 37104/ha whereas, direct seeded rice in line (DSRL) with pre-emergence application of pendimethalin 1.0 kg/ha followed by one hand weeding recorded the highest return per rupee investment (2.42) with grain yield and straw yield of 3925 kg/ha and 4711 kg/ha respectively .

### **Variability, interrelationship and path analysis for yield improvement in snapmelon (*Cucumis melo* L. var momordica)**

V R MUDDARASU, RAKESH KR DUBEY , VIKAS SINGH, GARIMA UPADHYA Y , BARUN SINGH, A K PANDEY and J P SINGH

*College of Horticulture and Forestry , Central Agricultural University, Pasighat, Arunachal Pradesh, Department of Vegetable Science, College of Agriculture, G B Pant University of Agriculture and Technology , Pantnagar-263145 (Uttarakhand)*

**ABSTRACT:** Twenty Snapmelon (*Cucumis melo* var. momordica) accessions were evaluated during summer, 2012 to estimate the magnitude of genetic variability and yield character associations for attributes viz., days to 50% emergence, vine length, number of primary branch, days to first staminate flower anthesis, days to first pistilate flower anthesis, days to first fruit harvest, fruit length, fruit diameter, fruit weight, flesh thickness, number of fruit per plant, number of seeds per fruit, TSS, ascorbic acid, titrable acidity and fruit yield per plant. Data were analyzed statistically for phenotypic and genotypic variance, coefficient of variation, heritability , genetic advance, genetic gain, correlation coefficient and path coefficient. High PCV , GCV , heritability and genetic gain were observed for days to 50% emergence, fruit length, fruit weight, flesh thickness, number of fruit per plant, number of seed per fruit, TSS, ascorbic acid, titrable acidity and fruit yield per plant. Correlation indicated that fruit yield per plant was positively and significantly correlated with vine length, number of primary branch per vine, fruit length, fruit diameter, fruit weight, flesh thickness, number of fruit per plant and number of seed per fruit. However, negative and significant association was established with TSS and titrable acidity . Maximum positive direct effect on fruit yield per plant was imposed by TSS, number of seed per fruit, flesh thickness, fruit weight and fruit length. However, high negative direct effect was observed for days to first staminate flower anthesis, number of fruit per plant and days to first pistilate flower anthesis. Fruit length, fruit weight, flesh thickness and TSS can be used as selection criteria to increase fruit yield in snapmelon.

## **Development of high yielding, micronutrient-rich, rust-resistant, winter x spring wheat (*Triticum aestivum* L.) derivative, suitable for climate change conditions of Northern Hills of India**

LAKSHMI KANT, S.K. PANT, J.C. BHATT, D. MAHANTA and H.S. GUPTA

*ICAR-VPKAS, Almora, ( Uttarakhand ), BISA, New Delhi 110 012*

**ABSTRACT:** A study was conducted during 2007-09 to evaluate 'VL Gehun 907' wheat with respect to adaptation to rainfed and irrigated timely sown conditions, micronutrients, end product quality and rust resistance in 21 rainfed trials at 10 and 11 irrigated trials at 6 locations in northern hills zone. 'VL Gehun 907' was developed from a winter x spring wheat cross between 'DYBR1982-83/842ABVD50' selected for drought tolerance and high tillers, 'VW9365', an advance line selected for shorter duration and rust resistance and 'PBW343' selected for wider adaptation, high grain yield, high iron and zinc. The results indicated that 'VL Gehun 907' have better response to changed climatic conditions, higher content of iron (43.5 & 45.2 ppm), zinc (35.4 & 36.3 ppm), copper (5.29 & 5.12 ppm) and manganese (42.5 & 41.8 ppm), respectively under rainfed and irrigated conditions, coupled with very good chapatti quality (7.52-7.64). In addition, it also possesses resistance to brown and yellow rust, exhibited higher grain yield than the prevailing varieties.

## **Effect of foliar applied nutrients on the yield of wheat in sandy loam soils of North Western Plain Zone of Uttar Pradesh**

A. K. KATIYAR<sup>1</sup>, A.S. JAT<sup>2</sup>, K.G. YADAV<sup>3</sup> and H.R. SINGH<sup>4</sup>

<sup>1</sup>KVK Muzaffarnagar <sup>2</sup>KVK Badaun, <sup>3</sup>Directorate of Extension, <sup>4</sup>KVK Ghaziabad, Sardar Vallabhbhai Patel University of Agriculture and Technology- Meerut (Uttar Pradesh)

**ABSTRACT:** The field experiments were conducted in Badaun District of Uttar Pradesh in rabi seasons of 2010-11 and 2011-12 to evaluate the effect of foliar applied nutrients on the yield of wheat at five farmer's fields. The wheat variety PBW-343 was taken for experimentation. One per cent of nutrient solution was prepared for foliar application by using 80% W.P. sulphur, 19% ferrous sulphate, however, 0.5% zinc solution was prepared by 21% zinc sulphate and 0.5% manganese solution prepared from 30.5% manganese sulphate commercially available from the market. These solutions were sprayed on standing crop at tillering and boot stage (30 and 60 days after sowing). All the foliar applications were in addition with farmer dose of fertilizers. Farmers in Badaun District generally using NPK 145:80:40, as 5 bag NPK (12:32:16) and 5 bag of urea (46% N) in one hectare for wheat production. The results indicated that application of zinc sulphate (489/m) being at par with sulphur (478/m), ferrous sulphate (462/m) and magnesium sulphate (452.5/m) produced significantly more fertile tillers as compared to farmer's practice (421.5/m).

Data further indicated that grain and straw yields of wheat were significantly influenced by the foliar application of different micronutrient solutions. Foliar application of zinc sulphate being at par with the sulphur produced significantly higher grain (40.50 q/ha) and straw (51.15 q/ha) yields as compared to farmer's practice (38.50 and 48.40 q/ha, respectively).

## **Impact of front line demonstrations on productivity and profitability of groundnut (*Arachis hypogaea* L.)**

A. S. JAT<sup>1</sup> and A. K. KATIYAR<sup>2</sup>

<sup>1</sup>Krishi Vigyan Kendra, Ujhani (Budaun), Sardar Vallabhbhai Patel University of Agricultural and Technology, Meerut (Uttar Pradesh), <sup>2</sup>Krishi Vigyan Kendra, Baghara (Muzaffarnagar).

**ABSTRACT** : Front line demonstrations (FLDs) at adopted farmer's fields by the scientists of Krishi Vigyan Kendra Ujhani, Budaun, Sardar Vallabhbhai Patel University of Agricultural & Technology, Meerut (UP) were conducted during 2005 to 2009. Cultivation practices comprised of use of improved variety, line sowing, balanced application of fertilizers, timely weed management and control of insect-pest through insecticide-pesticides at economic threshold level showed that the yield of groundnut increased from 13.17 to 29.49 percent over farmer's practice. The technological gap of 271 kg/ha as minimum during 2009 to maximum of 531 kg/ha at the initial stage of study (2005) and reduced subsequently in the following years. The front line demonstrations recorded higher average gross returns (Rs. 23988/ha) and net return (Rs. 12287/ha) with higher cost: benefit ratio (2.03) compared to farmer's practice (Rs. 19518/ha, Rs. 9141/ha and 1.86, respectively).

## **Physiological studies for high temperature tolerance indicators in summer mungbean under subtropical conditions of Indo Gangetic plains of North-West India**

G. CHAND, A. S. NANDWAL<sup>2</sup>, N. KUMAR<sup>2</sup>, R. YADAV<sup>3</sup>, BRIJ NANDAN<sup>4</sup>, P. BHASKER<sup>2</sup> and S. DEVI<sup>2</sup>

*Division of Plant Physiology FBSKUAST Jammu* <sup>2</sup>*Department of Botany & Plant Physiology,* <sup>3</sup>*Department of Genetics and Plant Breeding,* <sup>4</sup>*PRSS, Samba, SKUAST-Jammu, CCS Haryana Agricultural University, Hisar-125004, Haryana, India.*

**ABSTRACT:** A study on effect of physiological indicators for high temperature tolerance in Summer mungbean was undertaken at CCS HAU, Hissar. The study indicated that the effect of high temperature (>35°C) on chlorophyll fluorescence, SPAD

and canopy temperature depression (CTD  $^{\circ}\text{C}$ ) in three mungbean genotypes viz. MH 421, MH 318 and *Basanti* differing in their sensitivity to high temperature raised in earthen pots (30 cm diameter) filled with 5.5 kg of dune sand (*Typic Torrispammments*) was investigated under screen house conditions. High temperature stress was given by manipulating sowing dates i.e. normal (12<sup>th</sup> March, 2013) and late (29<sup>th</sup> March, 2013) sown. The quantum yield/photochemical efficiency (Fv/Fm) of the PS II in leaves was maximum in MH 421 (0.673) followed by MH 318 (0.577) and minimum in *Basanti* (0.546) under normal sown conditions and similar trend, was observed under late sown condition. The leaf-chlorophyll content (SPAD) was observed to be maximum in MH 421 (48.72) followed by *Basanti* (46.49) and minimum in MH 318 (46.46) under late sown conditions. The canopy temperature depression CTD  $^{\circ}\text{C}$  declined with increasing days after exposure (DAE) to high temperature in all the three genotypes under both the conditions. The maximum CTD  $^{\circ}\text{C}$  values were in MH 421(-6.41 $^{\circ}\text{C}$ ) followed by MH 318 (-4.58  $^{\circ}\text{C}$ ) and *Basanti* (-2.90  $^{\circ}\text{C}$ ) in normal sown condition and similar results were noticed under late sown conditions. Hence the mechanism of heat tolerance was better in MH 421 as compared to MH 318 and *Basanti*.

## **Productivity potential of sweet corn cultivars under different planting time in subtropical foothills of N-W Himalayas**

M BANOTRA, B.C SHARMA, BRIJ NANDAN and RAKESH KUMAR

*Division of Agronomy and Pulses Research Sub Station Samba. SKUAST -J, Main Campus Chatha, Jammu -180009 (J&K)*

**ABSTRACT:** A field experiment was conducted from kharif season of 2013 to identify the suitable planting time and cultivar of the sweet corn. Three sweet corn cultivars “Misthi, Sugar-75 and Gold star” and six planting times “29 March 15 April, 30 April, 15 May, 30 May and 19 June” forming eighteen treatment combinations were taken as main and sub-plot treatments, respectively and tested in a split-plot design with three replications. Cultivar 'Misthi' not only registered its numerical superiority in plants/m, yield and yield attributes, protein and starch contents, but also in net returns and benefit: cost ratio. Among the planting times, the crop sown on April 15, March 29 and April 30 recorded statistically similar but significantly fresh cob weight and fresh cob and stover yields at harvest maturity, than the crop sown on 15 of May and onwards. The similar trends with respect to quality parameters like per cent protein and starch contents and higher net returns and benefit cost ratio were recorded at harvest maturity.

## **Nutritional studies in sesame-chickpea cropping system under *rainfed* situations of low foothills of Jammu Region**

BRIJ NANDAN, B.C. SHARMA, B.S. JAMWAL, G. CHAND RANJEET KOUR and RAKESH SHARMA

*Pulses Research Sub Station Samba, Division of Agronomy, Division of Plant Physiology, FBSc. SKUAST-J, Main Campus Chatha, Jammu-180009. (J&K)*

**ABSTRACT:** A field experiment was conducted at Research Farm of Pulses Research Sub-Station, Samba of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu during *Rabi* 2011-12 and 2012-13 and *kharif* 2012 and 2013 to study the response of phosphorous and sulphur in *kharif* on sesam-chickpea cropping system under rainfed situation of Jammu region. The data revealed that application of 5 t/ha FYM coupled with 60 Kg P<sub>2</sub>O<sub>5</sub> and 20 kg/ha S gave significantly higher grain yield of sesame and chickpea respectively, grown during *kharif* and *rabi* seasons. The alone application of FYM also showed significant increase in grain yield of sesame and chickpea in different cropping seasons. Similarly, when both the crops supplemented with 60 kg/ha phosphorus and 20 kg/ha sulphur recorded higher Sesame grain yield and chickpea grain yield over no FYM, P and S. FYM @ 5t/ha registered significantly higher chickpea equivalent yield of 1992.38 kg/ha. Whereas significantly higher chickpea equivalent yield of 2005.75 kg /ha and an application of 20 kg/ha of sulphur recorded 1944.75 kg/ha of chickpea equivalent yield over noapplication of FYM (1699.74 kg/ha), phosphorus (1571.34 kg/ha) and sulphur (1747.01 kg/ha). The percent increase in Chickpea equivalent yield by the application of 5t/ha FYM application, 60 Kg/ha P O and 20 Kg/ha Sulphur was to the tune of 17.22, 27.64 and 11.33 over no application of FYM, Phosphorus and Sulphur. The similar set of treatments recorded higher values of gross returns, net returns and benefit cost ratio.

## **Genetic variability study in *Cucumis sativus* var. *hardwickii* : key to cucumber improvement**

HARSHAWARDHAN CHOUDHARY<sup>1</sup> D. K. SINGH<sup>2</sup> and S. R. DAMKE<sup>3</sup>

<sup>1</sup>*Division of vegetable science, IARI, Pusa, New Delhi,* <sup>2</sup>*Department of Vegetable Science, G.B. Pant University of Agriculture and Technology, Pantnagar - 263145,*

<sup>3</sup>*DIBR Office, Pithoragarh*

**ABSTRACT:** Cucumber is an important vegetable crop of Indian origin and its wild progenitor *Cucumis sativus* var. *hardwickii* is still found to be naturally grown in Himalayan region. Genetic variability of cultivated cucumber is limited due to continuous selection for few desirable genes of fruit quality like bitter free which resulted in loss of some important yield contributing traits such as number of lateral branches and number of fruits per plant and introgression of these traits from wild germplasm is important for increasing genetic diversity of cucumber and its improvement. Twenty six lines of wild and feral form of cucumber genotypes were evaluated for 16 important horticultural traits including number of lateral branches, number of fruits per plant and fruit yield per plant. Highly significant differences for all the characters were recorded except inter nodal length which showed that wild germplasm had a wide range of variability for many yield contributing characters. Higher number of lateral branches and number of fruits per plant were recorded in PCPGR 2314 (10.33, 30) and PCPGR 2316 (11, 24) which may be utilized as donor parent in cucumber improvement. High level of heritability coupled with greater genetic advance were recorded for average fruit weight, fruit yield per plant and number of fruits per plant and improvement of these traits are possible by crossing with wild genotypes and selection of desirable traits in segregating generations.

## **Efficacy of different fungicides on *Colletotrichum* leaf spot of turmeric (*Curcuma longa* L.).**

ABHISHEK KUMAR, A. K. MISHRA<sup>1</sup> and S. P. SINGH

<sup>1</sup>*Tirhut College of Agriculture, Dholi, Muzaffarpur, 843 121, Rajendra Agricultural University, Pusa (Samastipur), Bihar*

**ABSTRACT:** Turmeric (*Curcuma longa* L.) is an important rhizome spices crop emerging as a high valued cash crop for intercropping in agro-forestry plantation. Among various diseases attacking turmeric, *Colletotrichum* leaf spot caused by *Colletotrichum capsici* is the most devastating disease. Under fungicidal management of *Colletotrichum* leaf spot of turmeric, minimum PDI (13.33) with highest rhizome yield (35.13t/ha) followed by PDI (16.67) and rhizome yield (34.42t/ha) was recorded in four spray with Zineb @0.3% followed by Tricyclazole @0.1% at fortnightly interval. Best incremental cost benefit ratio (1:10.64) was recorded under the treatment where the crop was sprayed with Hexaconazole @0.1% followed by ICBR of 1:9.38 with fungicidal spray of Tricyclazole @0.1%.

## **Biological activities of rhizome and leaf essential oil of Turmeric (*Curcuma longa* L).**

SHWETA SINGH, MAHESH PAL, ALOK LEHRI and S.K. TEWARI

*CSIR-National Botanical Research Institute, Lucknow-226 001*

**ABSTRACT:** The essential oils have been widely used for various applications in health and agriculture sectors since the middle ages. Turmeric powder is a major ingredient in culinary, also used as food-colouring agent and natural dye. It is also used widely in the traditional systems of medicine in several Asian countries. The essential oil is present mainly in rhizomes and leaves of turmeric and obtained by steam distillation or solvent extraction of fresh rhizomes and leaves. The oil obtained from rhizomes contains the turmerones that are responsible for the aroma, flavour and preservative quality of turmeric. The essential oils and the diarylheptanoid curcumin, which are the major secondary metabolites of turmeric have been responsible for the pharmacological activities of turmeric powder, extracts and oleoresins. The composition of leaf and rhizome essential oils varies depending on the rhizome's geographic origin, genetic material and method of extraction. Various phyto-chemical constituents of turmeric leaf and rhizome essential oil contribute for their biological activities in pharmaceutical, cosmetic, agricultural and food sectors, described in this review.

## **Effect of pollination time on fruit setting and seed yield in cucumber under polyhouse condition**

SUNITA NAGAR and I. B. MAURYA

*Department of Vegetable Science, College of Horticulture and Forestry, Jhalrapatan, Jhalawar-326023 (Rajasthan)*

**ABSTRACT :** The present investigation was carried out at Protected Cultivation Unit at the College of Horticulture and Forestry, Jhalawar, Rajasthan during Rainy season, 2013 under naturally ventilated polyhouse condition to study the effect of pollination time on fruit setting and seed yield in two gynoeious cucumber (*Cucumis sativus* L.) cv. 'Infinity' and 'Hilton'. Pollination was carried out at four timings viz., 6.00 AM, 7.00 AM, 8.00 AM and 9.00 AM. The experimental results showed that the pollination carried out at 9.00 AM increased percentage of fruit setting (96.97% and 90.25%), number of fruit developed to physiological maturity (96.19% and 89.06%), number of seeds per fruit (303.55 and 279.52), number of filled seeds (270.56 and 217.44), 50-seeds weight (1.54g and 1.53g), seed yield (6.07g and 6.05 g) and reduced the number of unfilled seeds (41.00 and 39.89) in cv. 'Infinity' and 'Hilton', respectively followed by 8.00 AM, 7.00 AM and 6.00 AM of pollination. This might be due to environmental condition which might have affected the pollen viability and stigma receptivity.

## **Nutritional status profile of farm families in rice based cropping system: An exploratory study**

ABHA SINGH, M.P.S. ARYA, L.P. SAHOO and SABITA MISHRA

*ICAR-Central Institute for Women in Agriculture, Bhubaneswar , Odisha*

**ABSTRACT:** Anthropometric measurements as calculated by BMI and estimation of haemoglobin count are the best and direct method of assessing the malnutrition. The present study investigates the nutritional status of farm women in four rice based cropping systems in Odisha, Uttarakhand, Uttar Pradesh and Madhya Pradesh. In this cross sectional study height and weight of farm women for calculating Body Mass Index and haemoglobin count was estimated to assess the nutritional status situation of farm women. Malnutrition based on low haemoglobin count of farm women was highest (63.33%) in rice-rice cropping in Puri district of Odisha and lowest (42.23%) in rice-pulse cropping system in Hoshangabad district of Madhya Pradesh. Malnutrition assessed by Chronic Energy Deficiency as calculated by Body Mass Index was highest (54.45%) in rice-rice cropping in Puri district of Odisha and lowest (31.12%) in rice-pulse cropping system in Hoshangabad district of Madhya Pradesh. Comparison between four rice based cropping systems based on haemoglobin count of men and women as estimated by different level of anaemia condition indicated that highest gender gap was found in rice-rice cropping system and lowest in rice-wheat cropping pattern in Faizabad district of Uttar Pradesh. Comparison between four rice cropping systems on chronic energy deficiency of men and women as calculated by their body mass index indicated that highest gender gap in chronic energy deficiency was found in rice-rice cropping system (13.33 per cent) followed by rice-millet (11.11 per cent) and negligible in rice-wheat cropping system (only one per cent). Cultivation of pulses, cowpea, maize and vegetables in rice-rice cropping system should be promoted to increase the availability of iron and protein in the food basket and diet of rural families. Proper monitoring and motivation to continue this cropping pattern in this rice system will be beneficial.

## **Studies on variability of pathogen causing black point in wheat**

DINESH SINGH<sup>1</sup>, ANKITA TRIPATHI<sup>2</sup>, A. K. SINHA<sup>3</sup> and T. N. TIWARI<sup>3</sup>

<sup>1</sup>Indian Institute of Sugarcane Research, Lucknow <sup>2</sup>National Bureau of Agriculturally Important Microorganisms, Kushmaur, Mau 275101(UP) 226002 and <sup>3</sup>Directorate of Seed Research, Kushmaur, Mau 275101 (Uttar Pradesh)

**ABSTRACT:** Variability amongst ten *Bipolaris sorokiniana* isolates, collected from wheat seed (*Triticum aestivum* L) from distant localities of India was studied. Different level of pathogenicity had been observed with different host. Isolate BS 3 with dark brown colour, bigger size and more number of spot/leaf and average disease rating of 51.55 % being at par with BS 7 (51.99 %) and found most virulent. Isolate BS 4; BS 2; BS 10; BS 6; BS 5 and BS 9 were rated in between. Isolate BS 1 was found least virulent and similar to the isolate BS 8. Variation in linear growth was also observed in different

isolates. The overall average maximum 586.79 mg growth was noted with BS 7 isolate while minimum (432.24 mg) with BS 1 isolate. For temperature selectivity, the isolate BS 3 with 361.75 mg growth being at par with BS 7 produced significantly more growth while it was not significant with BS 1 and BS 8. The remaining isolates were in between and statistically non-significant to each other. Growth of all the isolates was more at 6.5 pH level but combination of isolate BS 3  $\times$  6.5 pH gave maximum of 695.25 mg growth which was non-significant with the combination of BS 7  $\times$  6.5 pH and these combinations were statistically superior over the rest. Minimum growth was associated with combination of BS 4  $\times$  3.5 pH. In carbon study, combination of maltose  $\times$  BS 7 (695.85 mg) being at par with maltose  $\times$  BS 3 (694.50 mg) produced statistically more growth than other combinations. While minimum of 09.45 mg was recorded with combination of check  $\times$  BS 6. On the basis of overall results three physiologic forms of *B. sorokiniana* were distinguished. Isolates from Uttar Pradesh and Bihar were extremely virulent; isolates from Haryana, Punjab, Maharashtra, Karnataka, J&K and Madhya Pradesh were moderately virulent whereas isolates from West Bengal and Rajasthan were less virulent.