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INDIAN INSTITUTE OF PULSES RESEARCH
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Newsletter

ICAR-Indian Institute of Pulses Research, Kanpur

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Kisan Diwas celebrated at ICAR-IIPR in Virtual Mode

Kisan Diwas was celebrated on 23rd December 2020 at ICAR-IIPR, Kanpur in Virtual Mode wherein 93 farmers from different districts of Uttar Pradesh participated in the profound remembrance of the former Prime Minister of India, Shri Chaudhary Charan Singh Ji. On this occasion, a *Kisan Chowk* near the technology park of the institute was inaugurated by Dr. N.P. Singh, Director, ICAR-IIPR. In his address, Dr. N.P. Singh high lighted the importance of pulses for human health and environment. He stressed on the fact that research and development activities of the institute have been further strengthened towards increasing production of pulses which have resulted in continuous high production & productivity. He urged the scientists of the Institute to work for all round benefit of the farmers &

stressed on minimizing the production cost of pulses. He said that farmers ought to be partners in various research programmes for better results.

Dr. C.S. Prahraj, PS & Head, Division of Crop Production delivered a lecture on importance of pulses for health and environment to mark the values of pulses in farming system to increase the soil fertility and save environment. Dr. Rajesh Kumar, PS & Head, Division of Social Science congratulated all the farmers on *Kisan Diwas* and appreciated their hard work for feeding the nation and their contribution in the development of the country. All the scientific, technical and supporting staff participated in the programme.

ICAR-IIPR celebrated Indian Constitution Day

ICAR-IIPR, Kanpur organized an extempore talk-cum-awareness programme on "Constitutional Values and Fundamental Principles of the Indian Constitution" on 26th November, 2020. All the scientists, technical and other staff members participated in the programme. While addressing on this important occasion, Dr. N.P. Singh, Director, ICAR-IIPR, emphasized on

respecting the "Constitutional Values and Fundamental Principles of the Indian Constitution" for the development of our country. Some of the staff members were honoured by the Director, Indian Institute of Pulses Research, Kanpur. Dr. Rajesh Kumar, PS & Head, Social Science Division coordinated the programme.

INSIDE

Research Highlights

Differential response for *in vitro* shoot regeneration in green gram

Though dicotyledonary node is a preferred explant for *in vitro* regeneration in greengram and there are a number of reports claiming multiple shoot regeneration from same, it was not found reproducible in the lab and only 3-5 shoots per explant were recorded. Also, a

differential response was observed within same batch of explants. The decapitated embryonic axis (EA) was hence, used to assess its efficacy for multiple *in vitro* shoot regeneration in greengram cv. ML267 using the phytohormones BAP (1ppm) with MSB5 as basal media. With a shoot induction potential of 82%, 33% explants were found to have multiple shoots (> 10 per explant) while 44% had 4 shoots

Multiple Shoots regenerated from single DEA explant – excised during sub culturing

per explant, as observed 60 days post inoculation. Rhizogenesis was achieved on MS-agar within 15 days.While the results reveal decapitated EA as a potential explant for efficient multiple shoot regeneration, it also reveals the differential response for multiple shooting *in vitro* within the same batch of green gram.

Meenal Rathore, Sudhir Bajpai, Neetu S Kushwah and N.P. Singh

A systematic methodology to assess bruchid field infestation

Bruchids (*Callosobruchus* spp.) are serious pests of stored pulses whose infestation starts at field level and field-carry-over inoculum is one of the sources of infestation in storage. A systematic methodology was developed to identify the crop stage where bruchids initiate the primary infestation on standing crop (*i.e.* infestation window) and its subsequent losses at storage level arising due to field-carry-over infestation. In this methodology, the observations on infestation parameters on seeds/pod were recorded at definite intervals from open and caged plants starting from first Weeks After Flower Initiation (WAFI) till harvesting of mungbean, cowpea and pigeonpea. Further, at storage, the observations were also recorded from grains harvested from the open and caged plants

representing each interval and stored in cloths bags separately, and observed on bimonthly basis for one year. Results revealed that field infestation on seeds/pod started from 3rd, 4th and 7th WAFI in mungbean, cowpea and pigeonpea, respectively. The infestation found incremental towards crop end and overall, the infestation on observed pods at field level did not cross 6%. The results obtained through systematically designed methodology explicit timeline of bruchid infestation at field level and the impact of field-carry-over infestation under storage. This would help to identify and intervene a timely insecticidal schedule in the existing IPM schedule to break the bruchid field-carry-over chain.

Revanasidda, Sanjay M. Bandi, Prasoon Verma, Kiran Gandhi Bapatla and Bansa Singh

Genotyping of popular cowpea cultivars

A cowpea variety panel comprising of 21 national popular cultivars was genotyped using adzuki bean and cowpea specific SSR markers in effort to assess the genetic variation present amongst the cultivars and also to identify potential SSR markers that may aid in cultivar identification. Comparative analysis revealed a large number of polymorphic primers that could be categorized into two groups – those generating missing alleles and the other generating a polymorphic allele. Molecular weight scores analysis using DARwin grouped the cultivars into two clusters. Maximum cultivars (17) fell in one cluster that further grouped into 6 subclusters. The other cluster had only four cultivars of which IT3895-1 and GC 4 were found as independent entries and did not group with any other cultivar. GC 5 and GC 6 grouped together in this cluster. This indicates that cultivars grouping in cluster II are relatively genetically distant from the remaining. Most of the popular cultivars grouped together indicating less genetic diversity amongst them.

Meenal Rathore, Pritee Sagar, Sudhir Kumar and N.P.Singh

Assessment of *Spilosoma obliqua* Walker, Kanpur populations' susceptibility to emamectin benzoate - an avermectin group insecticide

Bihar hairy caterpillar (BHC), *Spilosoma obliqua* Walker is a polyphagus insect pest that attacks nearly 126 plants. The most preferred host crops of BHC were blackgram, greengram, mustard, potato, soybean, pigeonpea and jute. The following chemical insecticides *viz.,* endosulfan 35 EC @ 2.5 ml/L, quinalphos 25 EC @ 2 ml/L, fenvalerate 20 EC @ 1 ml/L and dichlorvos 100 EC @ 1 ml/L were widely used for the management of BHC larva in blackgram and greengram. Endosulfan 35 EC and Dichlorvos 100 EC were banned and it is known fact that BHC had developed some level of insecticide resistance to organophosphorous group of conventional insecticides. Hence, the present experiment was conducted against 9 and 12 days old larvae (DOL) of BHC collected from ICAR-IIPR main farm and it was

reared in bio-ecology lab for two generations. Artificial diet contamination method was deployed with six different doses *viz.,* 0.06%, 0.044%, 0.022%, 0.01%, 0.005%, 0.0022% to assess this populations level of susceptibility or resistance to emamectin benzoate 5SG (Em-1® - insecticide that belongs to avermectins-milbemycins group). The probit analysis revealed that LC50 value for 9 and 12 DOL of BHC as 0.0057% and 0.0095%, respectively for emamectin benzoate 5SG. Thus, there is a very meager difference of 0.0038% LC50 value of 9 and 12 DOL of BHC. Interestingly, all the larvae were dead even in the lowest dose (0.0022%) within 5 days after treatment. The mode of action of this insecticide is glutamate gated chloride channel activator. The present result shows that emamectin benzoate as an effective insecticide for the management of BHC.

Pavithra, V., Sachin Dubey and Sujayan and, G.K.

Processing induced changes in -galactosides and other sugars of fieldpea

The -galactoside composition of fifteen diverse genotypes of fieldpeas was determined through HPLC-RI. Raffinose, stachyose, verbascose, sucrose, maltose and glucose content were assessed in these field pea genotypes. It was observed that raffinose and stachyose are the predominant alpha galactosides in field peas. Verbascose was detected in lesser amount as compared to raffinose and stachyose. Sucrose and maltose were also detected in all the genotypes with highest content observed for the vegetable type varieties Arkel and Azad P3.

To study the effect of processing on -galactoside profile and other sugars present in field peas, the seeds were subjected to four different treatments a) soaking in normal water (1:5 ratio) for 12 hrs., b) soaking in water containing 0.03% sodium bicarbonate (1:5 ratio) for 12 hrs., c) pressure cooking of overnight soaked seeds, d) germination of pre-soaked seeds for 15, 24, 48 and 72 hrs. at 25C with 8 hrs. of day light. It was observed that although - galactoside content were reduced significantly in all the four treatments but maximum reduction of nearly 74.6% and 67.43% for verbascose and stachyose, respectively was observed upon germination for 72 hrs (Table). None of these treatments were found to be very effective in reducing the amount of raffinose, and this oligosaccharide was marginally reduced only upon pressure cooking.

Kalpana Tewari, Vaibhav Kumar, G.K. Srivastava and Ashok Kumar Parihar

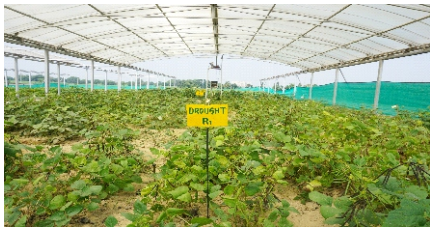
Effect of high temperature on peroxidase activity in the pollen and stigma of chickpea

Terminal heat stress negatively affects the development of reproductive parts of chickpea and this limits its growth and yield. Peroxidase is one of the antioxidant enzyme which catalyses the reduction of hydrogen peroxide with concurrent oxidation of substrate (RH2 + H2O22 H2O + R).Peroxidase activity was determined in the pollen and stigma of heat tolerantas well as heat susceptible genotypes of chickpea under normal as well as heat stress condition using guaiacol as a substrate.The peroxidase activity was found to be more in pollens as compared to the stigma. Further, its activity was found to be higher under heat treatment condition compared to the normal condition in both pollen as well as stigma. Peroxidase activity was found to be higher in heat tolerant genotypes compared to the susceptible genotypes in both pollen as well as stigma.

Vaibhav Kumar, Kalpana Tewari, G.K. Srivastava, S.K. Meena, Gurumurthy S., and P.S. Basu

Identification of novel drought-tolerant genotypes in mungbean

Mungbean is taken as a catch crop in the Western Indo-Gangetic plains of India during the summer season between wheat–paddy cropping sequence. The summer season crop requires assured pre-sowing irrigation for germination and early establishment of seedlings. However, due to the erratic nature of monsoon rains and high vapour pressure deficit in hot and windy climate of summer season stored soil moisture depletes rapidly resulting in severe water deficits and drastic reduction in mungbean yield. To encounter this problem, an economically and environmentally viable solution is development of new mungbean genotypes with drought tolerance. In the light of above, the objectives of this study were to assess the genotypic differences in physiological traits and agronomic traits in mungbean and to measure the association of these traits with crop performance under drought conditions. A set of 100 genotypes was evaluated using drought sensitive (ML 5 & IPM 99-125) and drought tolerant checks (IPM 2-14 & IPM 2-3) in both field and rainout shelter condition in RCBD design



Screening of mungbean genotypes for Drought stress under rainout shelter (2020)

during 2019 & 2020. The experiment was done at 3 levels of treatment: no stress (control), stress at the vegetative stage (25 days after sowing), and stress at the reproductive stage (35 days after

sowing) by withdrawal of irrigation for 15 days.The observation was recorded on soil moisture status, and agronomic and physiological traits at various stages of the experiment. Based on the analysis of two year pooled mean value and comparative studies four genotypes *viz.*, IPM 06-5, MH421, BIG 0068-1 and MH 03-18 noticed higher value of (Fv/Fm), which indicates increased photosynthetic efficiency, photosynthetic electron transport (ETR), SPAD, relative leaf water content, 100-seed weight (>4.5 gm) with enhanced seed yield. In addition, RWC was positively correlated to the number of pods per plant and seed yield. Therefore, genotypes maintaining high RWC produced higher seed yield under drought stress condition. Hence, these genotypes will be used as a potential source for development of drought tolerant varieties in mungbean breeding.

Basavaraja. T, Aditya Pratap, Manu. B, Vikas Dubey, Revanappa, B, PS Basu, Farindra Singh and NP Singh

Genome-wide identification of genes involved in Raffinose family oligosaccharides biosynthesis in pea

Pea is an important cool season grain legume cultivated for animal and human consumption worldwide. However, the presence of the anti-nutritional compound in pea like Raffinose family oligosaccharides (RFO) limits its consumption and acceptance worldwide. These RFO causes flatulence and stomach discomfort in human and monogastric animals as they lack enzymes for RFO digestion. To improve the pea quality, identification and characterization of key genes involved in RFO biosynthesis pathway is essential. The key RFO biosynthesis pathway enzymes are Galactinol synthase (GolS), Raffinose synthase (RS) and Stachyose synthase (STS). In the present study, we have identified two genes for GolS, two for RS, one gene for STS in the pea genome using the homology-based approach. The gene name, their locus ID, gene structure, protein size are presented.

Neetu Singh Kushwah, Meenal Rathore and NP Singh

Identification of bruchid resistance in mungbean, cowpea and urdbean through improved screening methodology

Exploring bruchid resistance is one of the traditional yet most effective methods to identify bruchid-resistant genotypes in pulses. A high throughput screening methodology involving key modifications in existing 'Free Choice' and 'No Choice' tests was developed at ICAR-IIPR, Kanpur by considering certain behavioral and biological parameters of bruchids ignored in earlier studies (Credland, 1994). The methodology challenges the genotypes under test to severe bruchid infestation and damage that involved exposing a minimum of three replicative sets of seeds (n=50 per set) of each genotype to intense oviposition by bruchids (@ 1 pair per 10 seeds) and incubating infested seeds for F1 adult emergence after providing a sufficient time for insect development under controlled laboratory conditions. 'Free choice' tests were conducted in a screening arena designed by modifying the earlier descriptions (Duraimurugan *et al*., 2014; Soumia *et al.*, 2016) where 7 genotypes can be screened in each arena. Further, the genotypes found resistant in respective arenas during first experiment were validated by challenging them combined under a single arena during the second experiment. 'No choice' tests were conducted by infesting each replicative seed sets in separate plastic vials in both first and validating experiments. The initial (oviposition, hatching, egg-density, seed-weight and moisture) and final (seed damage, adult-density) observations were recorded to workout Mean Developmental Period (MDP) of bruchids prerequisite to categorize resistance based on Howe's (1971) susceptibility Index. Exposing seeds to intense oviposition for a minimum period of 72h to one week, recording damage and adult-density on daily basis for up to 40 days, were the key changes adapted in the methodology. Using this methodology, a total of 59-wild *Vigna* accession, 99-mungbean, 50-urdbean and 25-cowpea lines were screened against three bruchid species. Among these, 4 wild *Vigna* accessions were found highly-resistant while 2 mungbean and 7 urdbean lines were found resistant against studied bruchids species. The improved screening methodology may serve as an efficient tool to identify bruchid resistance in pulses.

Revanasidda, Aditya Pratap, Debjyoti Sen Gupta, Ashok Parihar and N. P. Singh

Yield-loss assessment in blackgram due to direct feeding damage by whitefly, *Bemisia tabaci* (Gennadius)

Whitefly, *Bemisia tabaci* (Gennadius) is a world-wide insect-pest causing losses by acting as a virus vector, rendering damage due to direct feeding and by interfering with the physiology of the plant. An experiment was conducted to assess the yield-loss in blackgram (LBG 685) due to direct feeding damage by this pest. Different population loads of avirulent adult whiteflies was as 500, 100 and 50 numbers (along with control) were released per 10 plants in captivity at 10 days after germination. The pots were covered with 60-mesh nylon net well before germination of the seeds. The population established (adult and immature stages) was significantly higher in the treatment with highest release made. As per as the yield parameters, the number of pods per plant, pod-weight, number of seeds per pod and seed-weight were statistically at par in all the treatments with different population loads as well as control. It was noted that, up to the population level of 16.26 adult whiteflies per plant, there occurs no significant reduction in yield due to direct feeding by whiteflies, *B. tabaci.*

Anup Chandra, Sujayanand, G. K. and Debjyoti Sen Gupta

Molecular diversity and association mapping for seed weight trait in chickpea

A study of genetic variability, molecular diversity and marker-trait association analysis for 100-seed weight was performed in a panel of 96 chickpea genotypes. SSR based genetic diversity analysis grouped all the genotypes into two groups. This result was consistent with the result obtained from factorial and population structure analysis. To delineate the significant marker-trait association (MTA) for 100-seed weight association analysis was performed in the given panel of chickpea genotypes. The mixed linear model (MLM) analysis was performed for detecting significant MTAs for 100SW. Following MLM analysis, a total of seven significant MTAs were detected in the year 2016. While in the year 2017, MLM analysis showed three significant MTAs for 100 SW. Three markers TAA60, CakTpSSR02719, H1B04 markers exhibited significant MTA for both years consistently. Thus, these genomic regions could be fine mapped for improving 100 seed weight trait in chickpea.

Uday Chand Jha, Swarup K Parida, Rintu Jha, Virevol Thakro, Yogesh Kumar, Avinash Kumar Srivastava, Biswajit Mondal, Farindra Singh and N.P. Singh

Oviposition deterrence and toxic effect of *neem* seed oil on bruchids

The use of parts of *neem* plant for the protection of stored seed pulses against bruchid infestation has been an ancient practice among the farmers in India. The major constituent in *neem* seeds, azadirachtin is known to possess potent insecticidal properties. The effect of neem oil against pulse beetles (*Callosobruchus analis* F.) was evaluated in respect of oviposition deterrence and toxicity to adult beetles. Three dosages (5, 10 and 20 ppm) of *neem* oil (0.15 %) were applied separately in acetone to 10 gm mungbean seeds. Five pairs of adult beetles (0-3 days old) were added to treated seeds and incubated at 27±1OC and 65±5 % RH. A significant reduction in oviposition by pulse beetle ($F(3,8)=20.86$; $p<0.05$) was noticed following *neem* oil treatment to seed surface. The female beetle deposited 17 to 54 eggs on treated seeds as compared to 160 eggs on untreated seeds. The *neem* oil coating at 20 ppm recorded strong oviposition deterrence effect (89%) and exhibited significant toxicity ($F(3,8)=45.93$; $p<0.05$) to adult beetles (86% mortality at 6 days post-exposure) and completely inhibited the F1 emergence after 45 days storage of treated seeds. The noticeable reduction in egg deposition confirmed the potent oviposition deterrence property of neem oil against pulse beetles, thus, seed treatment with neem oil forms an affordable approach in safe seed storage.

Prastuti Mishra, Sanjay M. Bandi and Revanasidda

Drought tolerant mungbean genotypes under arid environment

Mungbean genotypes (20 numbers) were evaluated to identify the donors for drought tolerance under well-watered and water deficit conditions in the arid region of Rajasthan. Sowing was done at ICAR-IIPR, Regional Centre, Bikaner in season 2020-21. Donors for drought tolerance were identified on the basis of chlorophyll content, dry matter, grain yield and drought susceptibility index (DSI). Drastic reduction (28.9-88.9%) was observed in the seed yield/plant under water deficit condition as compared to the control. Comparatively less reduction (28.9-37.4%) in seed yield/plant, chlorophyll content and dry matter was recorded in well-watered condition in 3 genotypes *viz.*, IPM 1103-1, IPM 410-3 and IPM 312-20 whereas, the higher reduction (80.8-88.9%) was recorded in IPM 1604-1, IPM 1603-7 and IPM 1603-3. The lowest DSI was observed in IPM 1103-1 (0.49) followed by IPM 410-3 (0.57), whereas it the was highest in IPM 1604-1 (1.49). Therefore, it can be inferred that all genotypes IPM 1103-1, IPM 410-3 and IPM 312-20 showed considerable resilience to drought.

Surendra Kumar Meena, Ram Lal Jat, Aditya Pratap, Prahalad Singh Dhaka and Narendra Kumar

Single-step protocol for isolation and PCR analysis in chickpea

A single-step protocol for isolation of crude DNA from chickpea leaves that can be used for PCR analysis was optimized. Approx 2 mm 2 piece of fresh chickpea leaf was homogenized in template preparation solution (TPS) and incubated at 95°C for 10 minutes. Post incubation, 1 µL of the supernatant and in dilution (0.5X and 0.01X) was used directly and in the PCR mixture 2 (10 mM Tris-HCl, pH 8.3 + 2.0 mM MgCl2 + 100 µM each dNTP + 1.5 units Taq DNA polymerase+ 1X PCR Buffer). Standard thermal profile indicated expected amplification of endogenous single copy gene BS1 (690 bp). This protocol can be used for screening of transgenic chickpea lines, with limited resources and time period.

Prateek Singh, Shallu Thakur, Alok Das and NP Singh

Draft genome sequence of *Bacillus thuringiensis* F6.IIPR highly toxic to *Spilosoma obliqua* Walker isolated from rhizosphere soil of chickpea fields

Bacillus thuringiensis is a Gram-positive, insect pathogenic bacterium isolated from chickpea fields in Fatehpur, Uttar Pradesh, India, and the spore crystal mixture was highly toxic to *Spilosoma obliqua* larvae. Genomic DNA was extracted from the *Bt* isolate F6.IIPR, the whole genome was sequenced by Illumina Hi-Seq X platform using NEBNext Ultra II DNA library prep kit adaptors to generate 1.3 GB data comprising of 8.7 million paired-end DNA sequencing reads of length 150 nucleotides. The quality of the data was assessed using FastQC, trimmed using Trimmomatic, and then De Novo assembly was performed using Unicycler, a hybrid assembly pipeline for bacterial genomes. There were 391 contigs, an estimated genome length of 6,342,611 bp, and an average G+C content of 34.7%. The N50 length, which is defined as the shortest sequence length at 50% of the genome, is 90,602 bp. The L50 count, which is defined as the smallest number of contigs whose length sum produces N50, is 22. The *Bt* isolate F6.IIPR genome was annotated using the RAST tool kit with the results revealing 6,887 protein coding sequences (CDS), 84 transfer RNA (tRNA) genes, and six ribosomal RNA (rRNA) genes. Many of the genes have a homology to recognised transporters, virulence factors, and drug targets. The genome revealed 1681 potential cry toxins, with 1352 toxins having one domain, 326 toxins having two domains, and 3 toxins having three domains. The genome sequence of Bt F6.IIPR provides an insight into the virulence of this insect pathogen and how the insect evolves to be immune to Bt toxins.

Aravind K Konda, Sujayanand G.K, Harika A, Senthil Kumar M & NP Singh

Pod weevil, Apion amplum (Faust) (*Coleoptera: Apionidae*): An emerging insect pests on blackgram and greengram

Outbreak of pod weevil, Apion amplum (Faust) (Coleoptera: Apionidae) was recorded on blackgram and greengram during *kharif* season 2020. It is one of the major pests on green gram and blackgram grown in transitional belt of Northern Karnataka district like Dharwad. The infestation of *A. amplum* starts with appearance of flower buds at 30 to 40 days after sowing. Both grubs and adults are found as damaging stages. The adults feed by remaining on the lower surface of the leaves causing shot holes. As a result, numerous minute holes could be seen on the severely damaged leaves. Adult feeds tender pods and make number of punctures with its snout on pod for egg laying. Sometimes adults are also seen feeding on flower buds. Adults lay the eggs on the pod. The grubs damage the pods by feeding on the embryo of the seed. Pupation takes place inside the pod itself. The adults come out from the pod by making circular holes with their snout. The affected pods exhibit irregular and sunken areas in comparison with healthy ones. The peak activity of the pest was observed during July to September month. Incidence of pod weevil was more severe in blackgram as compared to geengram. The pod damage and seed damage in blackgram was around 60.30% and 59.10%, respectively. In case of greengram the pod damage and seed damage was 20.10% and 17.20%, respectively.

M H Kodandaram, PR Sabale, Manu M, Revanappa and Venkatesh MS

Incidence of pink pod borer, *Cydia ptychora* (*Meyrick*) (*Lepidoptera: Tortricidae*) on *Vigna* pulses

Among the pod borers, *Cydia ptychora (Meyrick) (Lepidoptera: Tortricidae)* has gained importance as serious and emerging pest of *Vigna* pulses grown around Dharwad region of Karnataka. Cowpea, greengram, black gram and soyabean are major host of this pest. This pest is also called as cowpea seed moth or pink pod borer. It attacks the seeds within mature pods and cause considerable loss of yield. The severe incidence of this pest was recorded on cowpea and greengram during *Kharif* season 2020. The infestation of this pod borer starts at late stage of crop, when pods are at maturity. The adult moth lays eggs on the mature pods. The young larva bore into pods and feeds on the seeds, producing whitish dry frass and webbing within the pods, which result in severe seed damage and poor germination of seed. Unlike *Maruca vitrata*, which mainly feeds on the flower buds, pod tissue and seeds, the larvae of *C. ptychora* feeds exclusively on the seeds. In mungbean and cowpea around 30.19 and 65.53 % pod damage was recorded, respectively, with 30% seed damage.

M H Kodandaram, PR Sabale, Manu M, Revanappa and Venkatesh MS

Isolation of cellulolytic bacteria from termite gut

In agriculture based country like India, huge quantity of lignocellulosic agro-waste is generated every year. These crop residues are used as animal feed, thatching for rural homes, residential cooking fuel and industrial fuel. However, a large portion of the crop residues is not utilized and disposed off through burning which leads to hazardous air pollution. Cellulase producing microbes can degrade this crop residue and convert it into glucose which can be used in multifarious ways. A total of 8 bacterial isolates capable of cellulose degradation were isolated from wood-eating termite gut. Among them, isolate S2, S3 and S8 showed higher amount of cellulase activity. Apart from cellulase production all the bacterial isolates were characterized for PGPR activity. Isolate S2 and S3 were also found positive for siderophore production. Bacterial isolates S2 and S3 can be further studied for increasing their enzyme production capacity.

Smriti Sachan, Krishnashis Das and Senthilkumar M

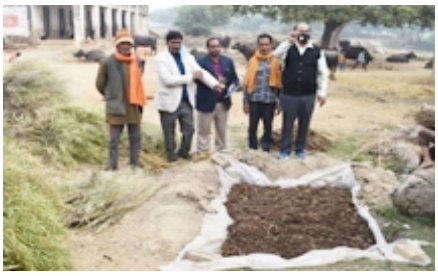
Interventions for income and employment generation and nutritional security under Farmer FIRST Project

Black wheat : Under Farmer FIRST, a new intervention project, black wheat was introduced in project area. Seed of black wheat was provided to the farmers for sowing 500 m^2 area in *Khadra* village Fatehpur for higher income and nutritional security of farming communities. Black wheat is more suitable for diabetic patients. The seed source, variety needs mention here:

Mustard : Demonstrations on mustard were conducted in the project area to enhance the food security and increasing income of farmers through introduction of mustard (Kanti) by covering 06 farmers in 02.00 ha area for enhancing of higher return of farmers.

Crop cafeteria : Under farmer FIRST Project, crop cafeteria of pulses was developed at farmers' fields to demonstrate high yielding varieties of chickpea, fieldpea, lentil and rajmash in Khadra village of Fatehpur Districts.

Establishment of Vermi-compost unit: Farmer FIRST Project team focused on organic cultivation of vegetables cultivation in project area. Participatory demonstrations of 10 vermin-compost unit in other project area for the purpose of organic vegetable cultivation and maintaining proper level of organic matter content in soil, improving the fertility status and water holding capacity of soil.



Intercropping with vegetable pea in guava orchard: Under Farmer FIRST Project, guava orchard intercropping was done with vegetable peas for higher income, employment generation and nutritional security of rural people. Shri Jagdish Paswan sown 1.20 acre of vegetable pea (Kashi Uday).

Frontline demonstrations : Social Science Division conducted 32 participatory demonstrations on chickpea, fieldpea and lentil in Kanpur Dehat, Fatehpur, Unnao and Hamirpur districts of Uttar Pradesh.

Schedule caste Sub Plan: The SCSP has been implemented in different districts of Uttar Pradesh for increasing income and nutritional security of farmers of scheduled caste category. Total 256 farmers belonging to SC category were selected and provided improved varieties of seed of chickpea and lentil.

Participatory demonstrations of chickpea: Participatory demonstrations were conducted on chickpea variety JG 14 for enhancing income, nutritional security and improving socio-economic condition of scheduled caste farmers. Under SCSP programme, 234 scheduled caste farmers were benefitted in different districts of Uttar Pradesh.

E -Training programme organization : Exposure visit: Nine farmers of district Bhind, Madhya Pradesh visited at Indian Institute of Pulses Research, Kanpur on the occasion of *Kisan Diwas* i.e. 23 December, 2020 to gain knowledge about improved pulse production technologies as well as quality seed production of different pulses varieties.

Rajesh Kumar, CP Nath, Chandra Mani Tripathi, Pradeep Kumar and Shivakant

अन्तःफसली मक्के से अतिरिक्त आय एवं खाद्य सुरक्षा में वृद्धि

भा.कृ.अनु.प.– भारतीय दलहन अनुसंन्धान संस्थान, कानपुर के द्वारा *फार्मर फर्स्ट* परियोजना के माध्यम से करचलपुर खरौली, मिराई व खदरा ग्रामों में विभिन्न फसलों के प्रदर्शनों को लगाया गया। परियोजना क्षेत्र के अनुसूचित जाति के किसानों को अनुसूचित जाति उप–योजना से भी जोड़ा गया है। *फार्मर फर्स्ट* परियोजना के अन्तर्गत दिये गये अमरूद के पौधो को सितम्बर 2019 में लगाया गया जिसमें उन्होने अन्तरासस्यन विधि के द्वारा मक्का की फसल को लगाया। *फार्मर फर्स्ट* परियोजना अन्तर्गत ग्राम खदरा निवासी जगदीश पासवान को मक्के की प्रजाति (डी.के.सी.–9108) का बीज प्रदर्शन लगाने हेतु दिया गया। मक्के की फसल को किसान ने अप्रैल माह के प्रथम पखवाड़े में बुआई कर दी थी । फसल को दो सिंचाईयों की आवश्यकता हुई, तथा एक बार गुड़ाई एवं निराई की गई, जिससे किसान को मक्के की फसल की रिकार्ड 49.20 कु. प्रति हेक्टेयर उत्पादन हुआ। इस उत्पादन से ₹ 58,260 का शुद्ध औसत लाभ हुआ। इस प्रकार से मक्के की फसल से स्वरोजगार के साथ ही साथ खाद्य एवं पोषण सुरक्षा भी प्राप्त हुई।

राजेश कुमार, सी.पी. नाथ, चन्द्रमणि त्रिपाठी, प्रदीप कुमार एवं शिवाकान्त

Appointments, Promotions, Transfers, *etc.*

Promotions

Sl.	Name	Promoted to	w.e.f.
1	Sh. Ram Swaroop Kushwaha	LDC	04/12/2020
2.	Sh. Yashwant	LDC	17/12/2020

Transfers:

Sl	Name	Designation	From	To	Date
1	Sh. K. Ravi Kumar	Scientist (Agril. Extension)	IIPR, Kanpur	ICAR-NIASM, Pune	21/11/2020

Retirements:

Sl	Name	Post held	Date of retirement
1	Sh. Kailash Chandra	Technical Officer (T-5)	31/10/2020
2	Sh. Samar Singh	LDC	31/12/2020

Director's Desk

Dear Readers

Considered as a second most vital plant nutrient as well as second most deficient element in about 90% agricultural soils, Phosphorus (P) is widely used in crop production which boosts and insures bumper crop yield, Its increasing demand for consumption is causing the decline of its reserves due to rapid excavation. Many scientists are threatening that within 50 to 100 years, phosphorus will be completely depleted by a period of only 2030 or 2033. According to some surveys, the world has 71 billion tonnes of P reserves and mine production is about 0.19 billion tonnes. But increasing fertilizer demands per day may enhance it to 1.00 billion tonnes. Thus, it will be declined in around 71 years. Agriculture cannot afford such condition in the future and huge crises can be raised. Therefore, well organized agronomic strategy must be applied to minimize P use along with improve yield and can save P and extend the threat to several hundred years. It is the need of the hour to give a call to "Reduce P use and Save P" for sustainability of agriculture.

Yield of pulses can significantly be increased by applying P. Out of 135 districts under pulses, soils in 68 districts are low and 62 districts are medium in available P status. The application of P to pulse crops must be one of the most important strategies to increase productivity of pulses in India. Mainly mungbean uptake around 24 kg P2O5, while chickpea and urdbean uptake around 10 kg P2O5. Phosphorus deficiency in Indian soils is widespread (98% of districts), and crop responses to its application are highly profitable. All indications are that P removal will continue to exceed net P additions, and P deficiency will accentuate further with time. Phosphorus is a key element involved in various functions in growth and metabolism of pulses.

Based on about 9.6 million soil tests in India, 49.3% of districts and UTs are low in available P, 48.8% are medium, and 1.9% are high. There are many good reasons why soil P fertility should be built up. While building organic matter levels, thereby increasing long-term production potential. High P (and K) fertility improves N use efficiency in balanced plant nutrient programmes. High fertility conserves water by reducing amounts required per unit of crop production. Soil P (and K) fertility boosts yield potential, even in weather stress years. High fertility interacts positively with other production inputs (i.e., tillage practices, variety, planting date, population) to get the most out of the crop.

Pulses traditionally play a significant role in agriculture as they not only produce good quality protein but also have an important ecological function – in symbiosis with root nodule bacteria they assimilate atmospheric nitrogen. Mostly pulses are susceptible to phosphorus deficiency as the development of nitrogen-fixing bacteria requires phosphorus, which is a structural constituent of ATP (adenosine 5'-triphosphate). In poor soils, phosphorus

deficiency often limits the yield of pulses having profound significance for improving farm sustainability. The prevalence of rhizobia also depends on soil reaction. Application of vermicompost improves the P availability, which enhances various phytohormone and increase the uptake. Major organic sources of P include certain manures, as well as bone meal and pulverized rock phosphate. Rock phosphate is a P-rich rock that is ground into fine particles that release their P slowly. As P is very immobile in the soil, it does not move very far in the soil to get to the roots. As diffusion to the root is only about 1/8 of an inch per year, root growth is very important for P nutrition. Bone meal is an excellent high P fertilizer with an average N-P-K ratio of 3-15-0. The P in bone meal takes a few months to become available to plants via soil microbial processes. It also contains calcium. Because the most of the P doesn't circulate from land to air, or vice versa, most P ends up in sedimentary rock, and only reappears via tectonic uplift over geological time scales. This makes the phosphorus cycle an extremely slow cycle. Organic fertilizers often use alfalfa meal, cottonseed meal, or fish emulsion to provide nitrogen; bone meal or rock phosphate to provide phosphorus; and kelp meal or granite meal to provide potassium. India is deficient in Apatite & Rock Phosphate availability. In case of apatite, the country is fully dependent upon imports, while the Rock Phosphate production is only from Rajasthan and Madhya Pradesh.

Phosphorus is the key element for successful pulse production as it is involved in root development, stalk and stem strength, flower and seed formation, crop maturity and production, N-fixation, crop quality and resistance to plant diseases and plays a crucial role to stimulate biological activities like nodulation, nitrogen fixation, and nutrient uptake in soil and rhizosphere environment, resulting in a higher yield. The effect of P fertilization was significant on the number of pods/plant and grain yield. The optimum P application enhances the yield attributes such as the number of pods/plant, grains/pod and 1000-seed weight, resulting in high production. Lentil suffering from P deficiency stimulates the length of the primary root, length and number of lateral roots and root hairs, the increment in lateral roots was more than the primary root and resulted to increase in root surface area. The increase in the root surface area enhances the phosphorus acquisition from phosphorus-deficient soils, however, the varieties having prolific root hair formation are better in the acquisition of micronutrients. Thus, there is a need to study the effect of P fertilizer levels on the growth and yield of lentil genotypes. Phosphorus stimulates the biological nitrogen fixation (BNF) because in presence of phosphorus bacterial cell becomes mobile which is pre requisite for migration of bacterial cell to root hair for nodulation. Phosphorus helps in proper root development which increases root nodules and consequently increases nitrogen fixation. It also plays an important role in the process of photosynthesis, energy conservation and transportation, cell division and meristematic growth in living tissues, grain quality and most of physico-bio-chemical activities.

Phosphate Solubilizing Bacteria (PSB) plays an important role in solubilization of soil P through secretion of various organic acids (formic, acetic, butyric, propionic, citric, glucomic, succinic, oxalic, malic, maleic and lactic acids) and make it available to plant . Many fungi, bacteria and actinomycetes are potential solubilizers of bound phosphates in soil. Moreover use of PSB also reduce the environmental pollution caused by the heavy use of chemical fertilizers. Application of P along with PSB, improved phosphorus uptake by plants and yields indicating that the PSB were able to solubilize phosphates and to mobilize phosphorus in crop plants. The current efforts of IIPR are to identify pulses genotypes adapted to P-deficient soil along with identification of potential strains of PSB helping immobile bound phosphorus to convert into mobile soluble P for ready use by the crop. Improving nodulation has also indirect way to enhance P-acquisition as BNF is closely interacting with P availability in pulses. Efficient rhizobium and PSB strains have been identified in number of pulse species like pigeonpea, chickpea, lentil, mungbean and urdbean. Less is known about the role of rhizospheric microbes in solubilizing insoluble bound phosphorus into soluble forms. The metabolites secretion from roots and root architecture also effectively determines the P-availability in pulses in soil under deficient soil.

(N.P. Singh)

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