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ICAR

PULSES Newsletter

INDIAN INSTITUTE OF PULSES RESEARCH
IIPR
भादअस

ICAR-Indian Institute of Pulses Research, Kanpur

VOLUME 29, No. 4 OCTOBER-DECEMBER, 2018

Director General, ICAR Visits IIPR Regional Station, Bhopal
Scientist-Farmer Meet Organized

The Director General, ICAR visited the IIPR Regional Station, Bhopal on 13th December, 2018 and inaugurated the newly established Seed Processing Unit and Storage Building at the regional station. On this occasion, a Scientist-Farmer Meet was also organized in which Dr N.P. Singh, Director IIPR and farmers in a big number from different parts of Madhya Pradesh state participated. During the event, scientists discussed the ongoing research activities and advancements running in achieving self-sufficiency and nutritional security in pulses in the country. On this occasion, a farmer friendly Hindi folder *"Dalhan Utpadan Kee Unnat Praudyogiki"* was also released by the Hon. Director General, ICAR.

Speaking on the occasion, the Chief Guest, Director General congratulated pulse scientists for achieving an all time high production of 25.53 million tonnes in pulses. He appreciated the activities ongoing at the station and applauded the efforts of the Director, IIPR. He urged the scientists to work for the all round benefits of the farmers and emphasized that farmers ought to be partners in various research based programmes for the better results.

Dr. N.P. Singh, Director, IIPR, briefed about the activities on going at IIPR Regional Station, Bhopal and the successful implementation of the various projects under National programmes. He emphasized that the research and development activities of the Institute were targetted towards increasing productivity and this has resulted in an all time high production of pulse. He urged the scientists working at the station to put their maximum for the all round development of the research station and with this benefitting the farmers of the nation. On this occasion, the Directors of various institutes located in Bhopal were also present. Dr C.S. Prahraj, Head, Division of Crop Production, IIPR also expressed his views in this context. Literature on seed treatment technology for pulse crops developed by IIPR in *Hindi* was also distributed among the farmers for awareness creation. Dr Archna Singh, Principal Scientist & In-charge, IIPR Regional Station, Bhopal conducted the programme.

CONTENTS

National Symposium Organized at IIPR

ICAR-Indian Institute of Pulses Research, Kanpur and Indian Society of Mycology and Plant Pathology (ISMPP), Udaipur, Rajasthan, jointly organized 39th Annual Conference of the ISMPP and National Symposium on "Plant and Soil Health Management: New Challenges and Opportunities" during November 16-18, 2018 at IIPR, Kanpur. The Hon. State Agriculture Minister, (UP) Shri Ranvendra Pratap Singh was Chief Guest in the inaugural function. Dr K.V. Raju, Chief Economic Advisor, UP Govt., Dr. A.N. Mukhopadhyay, Ex. Vice Chancellor, Assam Agricultural University, were the Guests of Honor. More than 200 scientists and research scholars working in different areas of Plant Pathology & Nematology participated in this event. Dr. N.P. Singh, Director IIPR and Chairman, Local Organizing Committee welcomed the honorable guests and participants.

Speaking on the occasion, the Chief Guest congratulated pulse scientists for achieving an all time record production of pulses. He urged the scientists to continue the research work for the all round benefit of farmers and admired the Institute research achievements. He stressed on chemical free agriculture and the need for organic farming based on his own experiences in farming.

Dr. N.P. Singh, Director, IIPR, briefed about the research activities and achievements of the Institute and their role in strengthening pulse productivity. During the function, a Souvenir as well as a number of publications were also released by the Chief Guest. The YL Nene Outstanding Plant Pathology Teacher Award-2018 was given to Prof. B.B.L. Thakore and Prof. B.N. Chakraborty, Prof. S.S. Chahal was bestowed with the Lifetime Achievement Award-2018 by Dr Ravindra Kumar Khetarpal, Chief Guest of the occasion.

Dr. P.K. Chakrabarty, President (ISMPP), ADG (Plant Protection and

Oilseed & Pulses) addressed the august gathering. Dr Pokhar Rawal briefed about the activities of the Society. Dr Krishna Kumar, Organising Secretary offered vote of thanks. The programme was conducted by Principal Scientists of IIPR Dr Aditya Pratap and Dr (Smt) Uma Sah.

IMC Meeting Held

The 40th Institute Management Committee meeting was held on November 30, 2018 under the chairmanship of Dr N.P. Singh, Director. The meeting was attended by Dr. Virendra Kumar Tripathi, Joint Director (Agriculture), Directorate of Agriculture, Krishi Bhawan, Lucknow (U.P.); Sh. Ram Lal Meena, Joint Director (Agriculture), Deptt. of Agriculture, Krishi Bhawan, Jaipur, Rajasthan; Dr. Dhirendra Khare, Director Research, JNKVV, Jabalpur, M.P.; Sh. Ravi Dixit,

Kanpur Nagar, U.P.; Smt. Geeta Shakya, Auraiya, U.P.; Dr. Ajoy Kumar Roy, PS (Genetics) & PC, AICRP on Forage Crops & IGFRI, Jhansi; Dr. Jagdish Singh, PS (Biochemistry), IIVR, Varanasi, U.P.; Dr. C.S. Praharaj, PS (Agronomy), IIPR, Kanpur; Sh. Kumar Vivek, Sr. Administrative Officer & Member-Secretary, IMC; Sh. D.K. Agnihotri, Finance & Accounts Officer, IIPR, Kanpur along with all Heads of Divisions and Project Coordinators. Besides deliberations on various agenda items, the members appreciated the progress made by the Institute.

Celebration of *Kisan Diwas*

Kisan Diwas was celebrated at ICAR-IIPR, Kanpur on 23 December, 2018. Altogether 100 farmers from Fatehpur district participated in the programme. While addressing the farmers, Dr. N.P. Singh, Director, IIPR Kanpur stressed on the various effective means of farming to enhance

farmers' income. Dr. Rajesh Kumar, Principal Scientist & HoD (Act.), Division of Social Science welcomed the chief guest, farmers and other dignitaries present in the programme. Dr. G.P. Dixit, Project Coordinator, AICRP (Chickpea) proposed the vote of thanks.

Celebration of World Soil Health Day

The World Soil Health Day was celebrated at ICAR-Indian Institute of Pulse, Research, Kanpur on December 5, 2018. On this occasion, Dr. Sushil Solomon, the Hon'ble Vice Chancellor, CSAUA&T as the Chief Guest, Dr Munish Kumar, Professor and Director (Admin & Monitoring) as Guest of Honour and Dr N.P. Singh, Director, ICAR-Indian Institute of Pulses Research, Kanpur as Chairman alongwith 300 persons including 50 farmers belonging to nearby and adopted districts of Uttar Pradesh participated in this function.

Dr N.P. Singh, Director, ICAR-IIPR, Kanpur welcomed the participants and stressed on the importance of soil, water and air for the very existence of life as a building

block for sustaining both crop and human/animal life on a long-term basis and therefore, there is a need for large scale soil/plant testing and development of Soil Health Card (SHC) so as to provide a boost to both production and productivity of agriculturally important crops. He strategically urged to make the farm production stable with doubling farmers' income by 2022.

The chief guest, Dr. Sushil Solomon Hon'ble Vice Chancellor, CSAUA&T, Kanpur revealed that with diminishing productivity of soil, every effort should be made to restore the productivity and profitability of land and soil. Guest of Honour, Dr. Munish Kumar, Professor and Director (Admin & Monitoring), CSAUA&T, Kanpur also highlighted the importance of soils as a living medium. He stated that soil fertility related problems are mainly attributed to both soil nutrient imbalances. He advocated for large scale adoption of balanced fertilization and INM, enhancing efficiency of fertilizer use and use of soil health cards for enhancing soil health and overall crop production in the country. The meeting was coordinated by Dr. Narendra Kumar, PS, IIPR, Kanpur.

ICAR-IIPR won ICAR North Zone Sports Championship

A contingent of 37 staff members from ICAR-Indian Institute of Pulses Research participated in ICAR-Zonal North Zone Sports Tournament held at ICAR Central Institute for Research on Buffaloes, Hisar from November 14-16, 2018. The Institute won the championship of Volleyball smashing third time in row under the captaincy of Dr. Ashok Parihar and the team members Dr. K.R. Soren, Dr. Jagadeeswaran, Dr. Amrit Lamichaney. Dr. Ram Lal Jat, Dr. Kiran Gandhi, Dr. B. Manu, Mr. D.K. Agnihotri and Mr.

A.P. Singh. Institute Football team also won the championship under the captaincy of Dr. K.R. Soren with members Dr. Jagadeswaran, Dr. Amrit Lamichaney. Dr. Ram Lal Jat, Dr. A.K. Parihar, Dr. Kiran Gandhi, Dr. B. Manu, Mr. D.K. Agnihotri, Dr. K.K. Hazra, Dr. C.P. Nath, Dr. Krishnashis Das, Dr. Revansidda, Dr. Uday Chand Jha and Mr. G.R. Pangtey. In individual athletic events, Dr. Amrit won silver medal in 100 meter race and Dr. Basavraja won bronze medal. The winning trophies and medals were distributed by Ms. Geetika Jakhar, Olympian in Wrestling. Dr Bansa Singh led the collagist as chief-d-mission.

Research Highlights

Method of Decontamination of Storage Mites from *Ascochyta rabiei* Fungus Culture

Ascochyta rabiei is the economically important fungus infecting chickpea, worldwide. In the laboratory, *A.rabiei* grows slowly in culture medium. This fungus is threatened by storage mites who feed and cause contamination while transferring fungi during subcultures and hampers continuities of research. To eradicate these mites from fungal cultures without damaging the fungi themselves, acaricide testing and other physical procedures were followed. The fungus was incubated with napthalene balls and kept inside the freezer for 48 hours, culture medium supplemented with dicofol 18.5 EC @ 1 ml/l and wettable sulphur @ 1 g/l were tested and reduced occurrence of mite population to minimum in sub cultured fresh fungal medium was observed. Complete eradication of mites was achieved by following procedures: *Kabuli* chickpea seeds were soaked overnight in distilled water containing wettable sulphur @ 1 g/litre and autoclaved at 121ºC @ 15 lbs for 15 seconds. These autoclaved chickpea seeds were inoculated with mite contaminated *A. rabiei* fungus culture and incubated for 10 days @ 20±1ºC for their growth and sporulation. Sporulation of the fungus can be

identified by light pinkish growth of the mycelim on seeds. From each isolate, transferred the *A. rabiei* fungus spore and inoculated on the 1 per cent water agar medium, which were incubated for 15 days @ 20±1ºC. After 15 days of incubation, single spore colony was observed and picked under microscope and transferred onto freshly prepared chickpea seed meal agar medium for proper growth and development. This method is very effective and achieved 100 per cent eradication of storage mites from the contaminated fungal culture. Meanwhile, laminar air flow chamber was also fumigated overnight with 30 per cent formaldehyde and later discarded the contaminated fungal culture. Chickpea seeds did not supports the growth and multiplication of the mites and inhibited egg hatching. Authors are grateful to SERB, New Delhi for funding to carry out this research.

Manjunatha, L., Veer Singh, Krishna Kumar and Singh, N.P.

Post-Emergence Herbicide Tolerance in Chickpea: Progress and Prospects

Weed infestation is a major constraint reducing upto 40% yield in chickpea under rainfed and irrigated ecosystems across the globe. Twelve species of weeds infest the chickpea crop. Controlling those weeds by post-emergent herbicides is a major technological intervention to cope up with the labour scarcity for manual weeding. Two hundred entries of chickpea comprising of selections from germplasm accessions and advanced breeding lines were screened for tolerance to Imazethapyr (@ 75 g/ha and 100 g/ha) for three consecutive seasons. No manual weeding was done in the experimental plot till maturity initiation/late podding stage. The effect to the herbicide use was observed in the form of stunted growth, canopy

Response of entries three weeks after *herbicide spray*. Plots split into treatment (*Imazethapyr spray*) and control (without spray).

architecture modification, acicular leaflets, yellowing of the terminal foliage and modification in the grain traits. Contrasting accessions with low and significant yield penalty were identified. Promising accessions with comparative higher yield and low yield penalty for more than 2 seasons were ST-3-D-2, ICC 91902, ICC 12315, ICC 1116, ICC 4963 and NBeG 511. Few genotypes reported for heat tolerance performed well under Imazethapyr spray, namely, ICC 1205, ICC 1710 and JG 16. Resurgence of only *Phalaris minor* was observed during seed setting stage for consecutive season, however, the weed population was scarse. Contrast in expression and variability for post-emergence herbicide tolerance exist in chickpea, which have potential to be exploited.

Biswajit Mondal, S.K. Chaturvedi, A.K. Srivastava, G.P. Dixit, Yogesh Kumar, R.K.S. Yadav and Arvind Singh Yadav

Extra Early Flowering Genotypes Developed in Fieldpea (*Pisum sativum* L.)

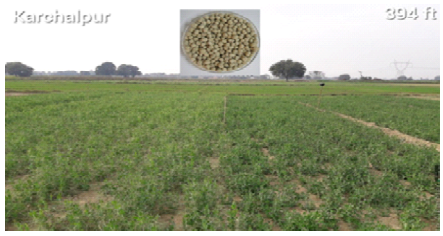
Early flowering is an important trait in fieldpea to avoid different stresses which coincide with normal flowering, as flowering period is the most sensitive stage. Therefore, an attempt was made to develop extra early flowering genotype using already available early type materials. Crosses were made between DDR 23 (grain type) x VRP 22 (Vegetable type) and DDR 30 (grain type) x VRP 6 (Vegetable type) early type parents in winter season of 2011-12. In succeeding generation's viz., F_2's and F_3's enormous amount of variability was observed for days to flowering. Single plants were selected in subsequent generate ones, for extra early flowering type. Out of 200 single plant progenies,

a total of 50 promising single plant progeny/lines comprising of 35 single plant progeny of DDR 23 x VRP 22 and 15 single plant progeny of DDR 30 x VRP 22 were planted during *rabi* 2017-18 as single line with available early type material (Arkel, VRP 6 and AGETA 6) and parents (DDR 30, DDR 23 & VRP 22) and evaluated for days to flowering. The results revealed that two lines from cross DDR 30 x VRP 22 i.e. IPFD 18-11 (flowering in 36 days) and IPFD 18-14 (flowering in 35 days) were extra early flowering type and flowered in less than 36 days. Thus, the extra early type fieldpea genotype can be recommended as donor for fieldpea breeding programme towards developing short duration varieties and also for various inheritance related studies.

A.K. Parihar, G.P. Dixit, Anil K. Singh, Shiv Sewak and N.P. Singh

Customized Fertilizers Improved Grain Yield in Fieldpea

Despite best and diverse efforts for sustainable crop production, the imbalance in the use of N, P and K still continue to haunt productivity of crops. Customized fertilizers, carrier to multi-nutrients manufactured through a systematic process, which may satisfy both crop's nutritional needs and productivity goals specific to the agro-climatic situations, substantially improved the grain yield of fieldpea. An on-farm trial (OFT) was conducted in Karchalpur village (26°09' N Latitude and 80°31' E Longitude) of Fatehpur district to evaluate performance of customized fertilizers on productivity of fieldpea genotypes. Under the OFT, five genotypes of fieldpea (Aman, IPFD 10-12, IPF 4-9, Prakash and Vikas) were evaluated for grain yield enhancement under varying nutrient management strategies (Farmers practice of nutrient management, RDF through straight



fertilizers and customized fertilizer). The findings revealed that application of Matar formula (13.3:20:10:8.3:1.3; N:P:K:S:Zn); a locally prepared fertilizer formulation to fieldpea genotypes recorded higher grain yield over rest of the nutrient management options (Farmers practice and RDF through straight fertilizers). All the fieldpea genotypes responded well and out yielded due to application of *Matar* formula. The yield increment observed from 11-28 per cent due to application of *Matar* formula over farmers practice of nutrient management. Substantial yield increment might attributed to continuous, balanced, slow released, sustained and desired supply of plant nutrients to the fieldpea. Customized fertilizers, superiority over straight or traditional fertilizers both in terms of higher nutrient use efficiency and cost effectiveness, have the potential to pace faster in future as sources of plant nutrients.

Ummed Singh, C S Praharaj, Rajesh Kumar, Lalit Kumar and A K Parihar

Clodinafop-Propargyl + Na-Acifluorfen: A Selective Post-Emergence Herbicide in Mungbean

Performance of post-emergence (POE) herbicides was evaluated to assess their efficacy and phytotoxicity in mungbean during 2016 and 2017. The herbicides consisted of fenoxaprop-p-ethyl 70 g a.i./ha, cyhalofop-p-butyl 80 g a.i./ha, clodinafop-propargyl + Na-acifluorfen 122.5 g a.i./ha, imazethapyr + imazamox 60 g a.i./ha, oxyflourfen 150 g a.i./ha, topramezone 20.6 g a.i/ha, and tembotrione 100 g a.i./ha. These were applied 25 days after sowing (DAS). Among the tested herbicides, oxyfluorfen (150 g a.i./ha), topramezone (20.6 a a.i./ha) and tembotrione 100 g a.i./ha showed phytotoxicity in mungbean, while, clodinafop-propargyl + Na-acifluorfen 122.5 g a.i./ha did not show any crop phytotoxicity with a considerable toxicity on weeds (phytotoxicity scale 8). Subsequently, after confirmation its selectivity in mungbean, a field trial was undertaken on dose and time optimization of clodinafop-propargyl + Na-acifluorfen in *kharif* 2018. Three dose of herbicide: 122.5, 183.5, and 245 g a.i./ha and four time of application: 10, 15, 20, and 25 days after sowing were accommodated in randomized block design. Significantly lower weed count (and its biomass) were recorded in clodinafop propargyl + Na-acifluorfen 122.5 and 183.5 g a.i./ha for the time of application, 10 and 15 DAS were found suitable for controlling weeds. The study suggested that clodinafop propargyl + Na- acifluorfen as POE may be efficient in controlling the diversified weed flora in mungbean.

Clodinafop-propargyl + Na- acifluorfen 122.5 g a.i./ha at 10 DAS

Clodinafop-propargyl + Na- acifluorfen 183.5 g a.i./ha at 10 DAS

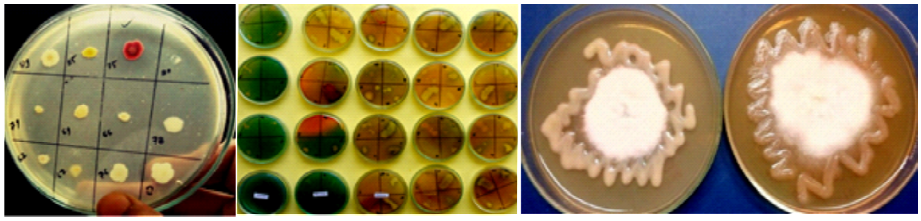
Unweeded control

Performance of mungbean under clodinafop propargyl + Na- acifluorfen in different doses of application *vis-a-vis* unweeded control

C.P. Nath, Narendra Kumar, K.K. Hazra and C.S. Praharaj

Identification of Multi-trait PGPR Isolates for Pulse Crops

A set of 96 PGPRs isolates from the rhizosphere of different pulse crops were screened on the basis of specific PGPR traits, such as the production of IAA, siderophore, ammonia, HCN, P solubilization, Acid/alkali production, Zinc solubilization, Chitinase and Cellulase production, ACC deaminase activity, acetylene reduction assay and antagonistic activity against *Fusarium udum*, *F. oxysporum* f.sp. *ciceri* and *F. oxysporum* f. sp. *lentis*. Out of these 96 isolates, PGPR-59 was found to be most promising for all PGP and antagonistic traits.



Monika Mishra, R.K. Mishra, Naimuddin and Krishna Kumar

Effect of Gamma Irradiation on Germination of Cowpea Seeds

An experiment was conducted to study the effect of gamma irradiation (0.25 kGy) on seed quality of cowpea varieties RC 101. The treated and untreated (control) seeds were subjected to germination testing at laboratory. Gamma irradiation considerably reduced the germination (normal seedling) of cowpea seeds from 71.3% (control seeds) to 32%. The decrease in germination percentage upon irradiation was due to increase in abnormal seedling (from 14.7 to 56%) and not seed death. Germination of abnormal seedlings is an indicator of seed physiological deterioration associated with irradiation treatment. The treated seeds recorded a shoot and root length of 2.03 and 1.37 cm, respectively, while the control seeds recorded a shoot and root length of 5.96 and 10.67 cm. Likewise, the treated and control seeds recorded seedling dry weight of 0.11 and 0.32 g, respectively. The study reveals that that exposing cowpea seeds to 0.125 kGy of gamma irradiation is detrimental with respect to germination and may only be recommended for grains and not for seeds.

Fig. Germination and seedling growth of control and irradiated cowpea seeds

Amrit Lamichaney, Revanasidda, Prasoon Verma, Yogesh Kumar Tiwari, Krishna Kumar and Shiv Sewak*

प्रौद्योगिकी हस्तांतरण

Training of Supporting Staff

A two days training programme on "*Basic skill development in field trials*" for SSS staff of ICAR-IIPR, Kanpur was organised during December 28-29, 2018. Ten supporting staff of ICAR-IIPR involved in conducting field trials participated. Training was designed to impart practical experience on different subjects such as sampling recording observations, of parameters related to soil, etc. The inaugural session was chaired by Dr. CS Praharaj, Head, Crop Production Division on December 28, 2018. The participants showed full satisfaction over structure and execution of the whole training programme. The Director, ICAR-IIPR distributed certificates on satisfactory completion of training programme to all participants in concluding session on December 29, 2018. The training was organized by Dr. Narendra Kumar, Principal Scientist (Agronomy), ICAR-IIPR, Kanpur as per Council approved ATP.

Field Day Organized under Farmer FIRST Project

A Field Day on System of Rice Intensification (SRI) of Paddy cultivation was organized on October 24, 2018 at Karchalpur village of Fatehpur under Farmer FIRST project. One hundred farmers participated in the programme. Dr. Rajesh Kumar, Dr. Devraj, Dr. Yogesh Kumar, K. Ravi Kumar and Radha Krishna from ICAR-IIPR participated in the programme. Farmers expressed their views on this occasion about different interventions implemented in the project area and interacted with the scientists about paddy cultivation.

Training Programme on Improved Technologies for Sustainable Pulse Production by MANAGE, Hyderabad

ICAR-Indian Institute of Pulses Research (ICAR-IIPR), Kanpur organized a training programme on "Improved Technologies for Sustainable Pulse Production" October, 03-17, 2018. The training was sponsored by National Institute of Agricultural Extension Management (MANAGE), Hyderabad. Ten officers from State Agriculture Department/KVK of different states (Bihar, Jharkhand, Tamilnadu, Maharashtra, Gujarat and Uttar

Pradesh) participated in this training programme. They were exposed to advanced knowledge and skill based training on improved varieties, agronomic and cultural practices, impact of climate change, resource use efficiency, integrated disease and pest management and post-harvest management of pulses. They were updated about innovative extension methodo-logies to reach large number of diverse group of farmers in an effective way. Trainees were also taken to the village to show the demonstrations on pulses and interacted with the farmers.

प्रशिक्षणों का आयोजन

- आत्मा, एसएसइपीइआरएस, विल्लुपुरम, जिला (तमिलनाडु) द्वारा प्रायोजित, दिनांक 29-30 अक्टूबर, 2018 के मध्य, संस्थान में विक्रावण्डी ब्लाक, जिला विल्लुपुरम (तमिलनाडु) के 22 किसानों के लिए ''दलहनी फसलों की उन्नत प्रौद्योगिकी'' विषय पर, दो दिवसीय कृषक प्रशिक्षण कार्यक्रम का आयोजन किया गया।

- आत्मा, ईस्ट सिंहभुम, जिला जमशेदपुर, (झारखण्ड) द्वारा प्रायोजित, दिनांक 19-22 नवम्बर, 2018 के मध्य, संस्थान में सिंहभुम, जिला जमशेदपुर (झारखण्ड) के 18 किसानों के लिए ''दलहनी फसलों की उन्नत प्रौद्योगिकी'' विषय पर पाँच दिवसीय कृषक प्रशिक्षण कार्यक्रम का आयोजन किया गया।
- आत्मा, गढ़वा (झारखण्ड) द्वारा प्रायोजित, दिनांक 17-21 दिसम्बर, 2018 के मध्य संस्थान में गढ़वा (झारखण्ड) के 24 किसानों के लिए ''दलहनी फसलों की उन्नत प्रौद्योगिकी'' विषय पर तीन दिवसीय कृषक प्रशिक्षण कार्यक्रम का आयोजन किया गया।

Personnel

Appointments

Sl.No.	Name	Post	Discipline/Division	Date of joining
1.	Sh. Asik Dutta	Scientist	Soil Science	09/10/2018
2.	Sh. Mohite Nikhil Ramrao	Tech. Asstt.	-	11/10/2018 at Dharwad
3.	Ms. Shweta Gupta	LDC	-	01/11/2018
4.	Sh. Priyank Srivastava	Tech. Asstt.	-	26/11/2018 at Bhopal

Promotions

Sl.No.	Name	Promoted to	w.e.f.
1.	Sh. R.K.S. Yadav	Sr. Tech. Officer	01/05/2018
2.	Sh. Anil Kumar Sonker	Assistant	19/11/2018
3.	Sh. Sanjay Kumar Sharma	UDC	19/11/2018

Retirements

Sl.No.	Name	Post held	Date of retirement
1.	Sh. D.N. Awasthi	CTO	31/12/2018
2.	Sh. Deshraj	CTO	31/12/2018

Obituary

Sh. Chhedi Lal, SSS left for the heavenly abode on 01/11/2018. May the soul rest in peace.

Director's Desk

Dear Readers

A pulse revolution has taken place in the country with a quantum leap in its production since 2009-10 to reach 25.23 million metric tonnes in 2017-18. An analysis by the Tata Strategic Management Group has shown that by adopting best practices and increasing yield to the highest levels, India can increase an additional production by 13 million metric tonnes besides present level of 25.23 million metric tonnes. Additional areas that can be brought under pulses cultivation include existing rice fallows and the hilly reaches of the north and the north-east India, while intercropping will also increase the area with additional production. India certainly has the potential to produce 37 million metric tonnes of pulses a year. The Government has announced a time bound action plan to set the second phase of Green Revolution in motion. This will involve increasing the production of pulses and oilseeds in the eastern region with the help of high-yielding seeds. We need to understand how countries such as Canada achieve three times our yields per acre. We need to adapt their agronomy practices to suit our conditions: soil testing, good seed varieties, integrated pest and nutrition management, irrigation, small-farm mechanisation, and deployment of information and communication technologies. Appropriate government support for prices, procurement and marketing is needed. Introduction of chickpea crop into non-traditional areas like the South Indian states is an example of technological and institutional breakthrough, which has the potential to be replicated in other crops. The area under chickpea has shifted from northern states to southern states. During the period 1991-93 to 2006-08, the highest increase in productivity of chickpea has been recorded in Andhra Pradesh (124%), followed by Karnataka (63%), Maharashtra (52%) and Gujarat (40%). Still, there is scope for productivity enhancement in the states to increase production to meet growing demand at the national level. Many institutional and technological factors contributed to the expansion of area into the South India. These include introduction of chickpea into black cotton soils, availability of plenty of *rabi* fallow lands, adoption of short duration and high yielding varieties (KAK 2, which was a *Kabuli* type with higher market demand; and short duration and wilt resistant varieties like JG 11), stable yield and prices, and well developed land lease market, which facilitated large scale mechanization.

This large scale mechanization facilitated consolidation of operational holdings, contracting out of major labour demanding works like harvesting and threshing, to address the labour shortage, helped in scale economies in procurement of inputs as well as in production and marketing of output.

Overall, even though investments increased in chickpea cultivation due to adoption of technology, it helped in reducing cost of production due to steeper increase in yields and profitability. The wider availability of highly subsidized cold storage warehouses helped farmers to store chickpea during the peak harvest season to overcome lower market price and to reap profits from higher prices during later periods. Importance of successful government programmes like NFSM, subsidized seed distribution and mechanization, encouragement for cold storage structures and higher MSP helped in chickpea revolution in the South India.

In Andhra Pradesh and Telangana, several high-yielding, early- to medium-maturing, wilt-resistant chickpea varieties have been released. First machine harvestable variety NBeG 47 (ICCV 2 X PDG 84-16) released in Andhra Pradesh. It was considered that chickpea is not well adapted to this area. Until 1988-89, area under chickpea cultivation in Andhra Pradesh was less than 80,000 ha and yield was less than 0.5 t/ha. The adoption of short-duration, high yielding and disease resistant varieties has brought a revolution in chickpea production in the area during the past decade. Now, area and productivity has increased to more than 500,000 ha and 1.2 t/ha, respectively. Varieties JG 11, JAKI 9218, KAK 2, and Vihar cover 95% of the chickpea area in Andhra Pradesh, Telangana and 65% in Karnataka. The *desi* chickpea variety JG 11, is presently the most popular variety in Andhra Pradesh and grown in over 50% of the chickpea. Production of chickpea boosted five-fold (from 95,000 tonnes to 5,00,000 tonnes). Total yield sees a two fold increase–from 583 kg/ha to 1200 kg/ha. Higher utilization and consumption were observed in households. Lentil, lathyrus, rajmash, peas and some other minor pulses are secondary winter legumes which together contribute 14 per cent of the total pulses production.

There is ample scope for bringing additional area under these pulses in newer niches areas such as rice fallows, *tal* (lake) areas, hill agriculture and in intercropping for remunerating cropping system. An estimated additional 3.0 million hectare can be brought under such pulses cultivation across the country. Development of many short duration synchronous maturity mungbean varieties have been adopted by farmers as summer crop fetching extra income as well as contributing towards increasing production of pulses in the country. Extra early varieties of pigeonpea (140 days durations) have been developed for the diversification of rice-wheat system in the North India. Thus, another pulse revolution can be realized by diversifying their cultivation in non-tradtional areas, introducing small mechanization for harvesting, location specific short duration varieties, minimizing milling loss, capturing efficient marketing and policy support.

(N. P. Singh)

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