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PULSES Newsletter

ICAR-Indian Institute of Pulses Research, Kanpur

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International Conference on Pulses Research

Indian Society of Pulses Research and Development and ICAR-Indian Institute of Pulses Research (IIPR), Kanpur jointly organized an International Conference on "Pulses as the Climate Smart Crops : Challenges and Opportunities" at Bhopal during February 10-12, 2020. Dr. T.R. Sharma, Deputy Director

General (CS) ICAR, New Delhi was the Chief Guest on this splendid function. On this occasion, Dr. M.C. Saxena (Ex-DDG, ICARDA), Dr. K.P. Vishwanatha (VC, VNMKV), Dr. P.M. Salimath (Former VC, UAS, Raichur), Dr. S.K. Sharma (Former VC, CSKHPKV, Palampur), Dr. P.N. Behl (Ex-DDG, ICAR), Dr. S.K. Rao, VC, RVS Krishi Vishwavidyalya, Gwalior (MP) Dr. N. Nadarajan, Dr. Masood Ali (Ex-Directors IIPR, Kanpur), Dr. V.S. Gautam (Ex-Dean, RAK College of Agriculture, Sehore), Sri Dev Narayan Patel (Mahamatri Kisan Sanghamitra, M.P.), Mr. S. C. Bansal (CGM, NABARD, Bhopal) and delegates like DDG (ICRISAT), DDG (ICARDA) were among the eminent diginitories present in the conference. More than 500 scientists and research scholars from different areas of pulses research across the world participated in this event.

Dr. T.R. Sharma, Chief Guest urged the scientists to work for the all round benefit of the farmers. He admired the research works of the pulses Scientists and "Seed Hub" programme & expressed views on

the research advancements in achieving the self sufficiency and nutritional security of pulses in the country. He also encouraged the farmers to be active partner in various research based programmes. Speaking on the occasion, the chief guest also congratulated the pulse scientists for achieving an all time record production of pulses. The invited eminent delegates also addressed the august gathering.

Dr. N.P. Singh, Director, IIPR and chairman, organising committee welcomed the honourable guests and participants. He briefed about the on-going activities in pulses He stated about the successful implementation of the various projects under the National programmes. As the President ISPRD, he briefed about the activities of the society as well.

During the function, a book titled Pulses Production in India written by Dr. N.P. Singh & others was also released by the Chief Guest. On this occasion, Life Time Achievement Award was given to Dr. P.N. Behl, (Ex DDG, ICAR) & ISPRD Excellence Awards were given to Dr. Ashutosh Sarker, Dr. Kiran Sharma, Dr. (Smt.) Om Gupta and Dr. S.K. Singh. Pulse Expert, a Mobile App for Pulse Crops prepared by Dr Devraj in collaboration with IIPR and TCS was also released by the Chief Guest. The programme was conducted by Principal Scientists Dr Aditya Pratap,Dr (Smt) Meenal Rathore and Dr (Smt) Uma Sah. Dr P.K.Katiyar, Organising Secretary proposed vote of thanks to all the esteemed guests and participants.

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World Pulses Day-cum-exhibition organized at IIPR-Regional Station, Bhopal

The ICAR-Indian Institute of Pulses Research-Regional Station, Phanda, Bhopal organized the **World Pulse Day-cum-Exhibition** for the pulse farmers of central region of country on 10th Feb, 2020. The event was inaugurated by Dr. T.R. Sharma, Dy. Director General (CS) ICAR, New Delhi who was the Chief Guest on the occasion. The "World Pulse Day-cum-Exhibition" registered total 34 stalls, 150 farmers and 30 college students. A Scientific Review Meeting of seed hub was also organised.

Dr. N.P. Singh, Director, IIPR welcomed the honourable guests and participants. While addressing the august gathering, he focussed on the success story of the development & scientific progress of IIPR-Regional Station, Phanda, Bhopal. Dr. Singh also emphasized about the "National Seed Hub" programme which are spread across the country in 150 centres. He also informed to the farmers about the 6 new high

yielding pulse varieties, released during 2019 for Central India farmers and urged them to adopt the improved technologies for doubling the farmer's income. The Chief Guest, Dr. T.R. Sharma, admired the research works of the IIPR Scientists and "Seed Hub" programme and expressed his views on the research advancements in achieving the self sufficiency and nutritional security on pulses in the country. He was happy to see the progress and activities of IIPR-Regional Station, Phanda, Bhopal.

The progressive farmers also narrated their experiences and advantages they have been deriving from pulses cultivation. Ten innovative farmers were also honoured for their proactive role on the pulses cultivation. The senior officials of ICAR Institutes and State Government Departments were also present during the occasion and took active part in the exhibition and exibited their new technologies. The programme was convenred by Dr Sanjeev Gupta. The programme ended with vote of thanks given by Dr. Archana Singh, Principal Scientist and In-Charge, IIPR-Regional Station, Phanda, Bhopal.

ISPP North Zonal Seminar-2020 on Crop Productivity and Stress Management

Indian Society of Plant Physiology, New Delhi in association with the Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, U.P. organized an ***ISPP North Zonal Seminar-2020*** on ***"Crop productivity and Stress Management"*** at CSAUA&T on February 22, 2020.

The seminar was inaugurated by Dr. N.P. Singh, Director, ICAR-IIPR as the Chief Guest. The Chairperson Dr. Poonam Singh, Dean, College of Agriculture, CSAUA&T along with Dr. H.G Prakash, Director Research, and Dr. Madan Pal, Treasurer, ISPP, New Delhi were present to grace the occasion. Dr. N.P. Singh during his inaugural address emphasised about the climate change and boosted the scientific community with different angle of view to tackle the climate change issues and its effect on crop productivity. Dr. Poonam Singh, also narrated about the relevance of this seminar and its importance in solving the present-day issues of stress management for increasing crop productivity. Three publications *viz.*, Souvenir cum Abstracts book, Biodiversity and Crop Improvement in the Era of Climate change and Objective General Agriculture were also released on the occasion. The vote of thanks was given by Dr. Gurumurthy S, Organizing Secretary.

Research Highlights

Identification of thermo-tolerant urdbean genotype

Yield data of 96 urdbean (*Vigna mungo* L. Hepper) genotypes which were grown at Main Farm, IIPR, Kanpur, and National Pulses Research Centre of TNAU, Vamban were analyzed for identification of heat-tolerant urdbean genotype. The field experiment design was augmented RCBD design. In each location, two trials were conducted, based on meteorological data, one was designated as "Stress environment (SE)" and another one named as "Non-stress environment (NSE)". Data of five agro-morphological traits (days to unfolding of trifoliate, days to first flower, days to first pod, days to physiological maturity, plant height (cm) were recorded on randomly selected five-plants of each test urdbean genotypes. Plants were harvested at physiological maturity and threshed plot wise. Plot yield was converted to yield per hectare for each genotype. Heat susceptibility index were calculated for each

genotype at each location. It was found that out of the 96 genotypes, eight genotypes ware heat-tolerant, namely, UPU85-86, IPU94-2, IPU98/36, NO-5731, PGRU 95014, PGRU 95016, PLU-1 and BGP-247. These genotypes along with eight heat-susceptible urdbean genotypes were subjected to physiological characterization. These studies also confirmed the heat-tolerance status of the identified urdbean genotypes.

Debjyoti Sen Gupta, Jitendra Kumar, P.S. Basu, Sanjeev Gupta, Narendra Pratap Singh

New screening technique for heat stress in chickpea

A two years field experiment was conducted to validate screening technique for heat stress in chickpea by taking ten & thirty-two genotypes during 2018-19 & 2019-20, respectively. Modulating stem reserve mobilization trait was a key step wherein the deflowering treatment was resulted into extended vegetative stage by 15-20 days. During extended period, stored reserves accumulate and current photosynthates support to the grain filling during terminal heat stress provided a good source-sink relationship.

In our proposed technique, slightly modulate (delayed) the flower initiation process in normal grown crop under normal condition by manual picking (de-flowering) resulted into extended vegetative stage by 15-20 days. It may be more effective by hormonal regulation. By doing this activity, crops retain its vegetative growth and allow the plants initiate reproductive phase when the environmental temperature rise >32^{0}C mostly during the 3rd week of March to expose reproductive organs without losing its normal plant fitness.

The genotypes will be screened based on the real genetic potential of source-sink relationship. The genotypes which are showing normal flowering and grain filling in the extended period can be considered as heat stress tolerant genotypes. This simple, cost effective & high throughput procedure may transform the entire screening procedure and future breeding programme. The technique may resolve the issue of late sowing which does not maintain the proper crop fitness/ normal growth and development.

Gurumurthy, S., Soren, K.R., Basu, P.S., Hazra K.K and Singh, N.P.

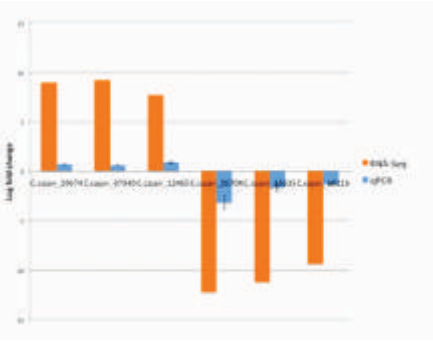
Morphological variations of land races of cowpea in Karnataka

Cowpea is an important pulse crop cultivated mainly in arid and semi arid regions of India. An exploration trip was conducted in the different parts of Northern dry zone and Northern transition zone of agro-climatic zones of Karnataka and twenty eight landraces of cowpea were collected during 2018-19. These landraces of cowpea were characterized based on morphological traits during summer season -2019. In the present study, landraces showed variability for different morphological traits. These revealed variations for pod length, seed size and seed coat colour, stem colour, stem hairiness, plant pigmentation, growth habit, twining tendency, leaf colour, terminal leaflet shape, flower bud colour, flower colour, pod shape, pod curvature, immature pod colour, pod colour at maturity, pod wall thickness and tendrils showed diverse variability among the landraces. Based on the characters observed, these landraces can be used in cowpea breeding programme.

Revannappa, Manu, B, PR Saabale, AK Parihar, Pavan Shinde, Channamma Kamati and MS Venkatesh

Experimental validation of RNA-Seq results in pigeonpea using qPCR assay

We sequenced whole transcriptomes of unopened floral buds of A2- and A4-CMS lines and corresponding maintainers using Illumina chemistry. By considering the criteria of LFC ≥ 2 fold, we estimated 184 and 505 genes showing differential expression for A4- (ICPA 2043) and A2-CMS (ICPL 88039A) lines and their cognate maintainer lines (ICPB 2043 and ICPL 88039B),



respectively from the transcriptome datasets. To further confirm the RNA-Seq results, we conducted qPCR assay of randomly selected 10 and 6 genes, respectively for A4- and A2-CMSs. Expression patterns of genes

C.cajan_20674, C.cajan_07940 and *C.cajan_12465* (A4-CMS) and *C.cajan_26704, C.cajan_13635* and *C.cajan_19226* (A2-CMS) from RNA-Seq and qPCR are illustrated in

Figure. A strong agreement was observed in case of all six DEGs related to A2-CMS, while we observed some deviations in case of A4-CMS. The deviation between RNA-Seq and qPCR can be explained by the different algorithms used in the two methodologies for detection of gene expression level. The genes *C.cajan_20674, C.cajan_12465* encode uncharacterized proteins, and *C.cajan_07940* codes for cobalamin biosynthesis protein (CobW). Similarly, *C.cajan_26704, C.cajan_13635* and *C.cajan_19226* code for pollen coat-like protein, arabinogalactan protein 16 and L-ascorbate oxidase homolog, respectively. Our findings corroborate previous evidences from pigeonpea gene expression atlas (CcGEA).

Abhishek Bohra, Satheesh Naik S. J., Dibendu Datta, Farindra Singh, Indra P Singh, Narendra P Singh

Seed longevity of lentil seeds

An experiment was conducted to study the longevity of 36 lentil varieties stored in ambient laboratory condition for 4 years. The mean viability of 94% and 92% was recorded in seeds stored for 2 and 3 years tested through laboratory germination, which reduced drastically (48%) after 4 year of storage. A wide genotypic variation was observed in percent seed viability after 4 year of storage. After 4 years of storage, there was a compete loss of viability in DPL 15, DPL 62; while varieties like PL 77-12, Ranjan, NDL 1, VL 103 and WBL 77 could maintain very high viability. The data revealed that most of the lentil varieties could be stored safely upto 3 years in ambient laboratory condition.

Amrit Lamichaney, AK Parihar, PK Katiyar and Farindra Singh

Chaetomium globosum showed antifungal activity against pathogens of chickpea

The phylloplane fungi living on the surface of chickpea leaf and screening for antifungal ability is an effective strategy for the discovery of novel bio pesticides. The fungus isolated from chickpea leaves (Cultivar PG 186) was screened for their efficacy against *Ascochyta rabiei*, *Botrytis cinerea* and *Rhizoctonia bataticola* infecting chickpea which displayed potent antifungal activity against two fungal pathogens such as *R. bataticola* and *B. cinerea* under *in vitro* condition. Based on morphological and molecular method, the fungus was identified as *Chaetomium globosum*. In the dual culture assay on potato dextrose agar, the fungus *Chaetomium globosum* significantly inhibited the mycelial growth of the fungi *Botrytis cinerea* and *Rhizoctonia bataticolato* the extent of 63.19 per cent and 53.82 per cent, respectively.

Manjunatha, L. and Basavaraja, T

Bioactivity of *Cymbopogon flexuosus* essential oil on *Callosobruchus analis* (F.)

Plant essential oils, produced by aromatic plants as secondary metabolites, have been known to possess array of biological properties. Structurally-diverse bioactive constituents of essential oils are reported to possess potent insecticidal properties and act through contact, repellent and fumigant action. We evaluated the repellent activity of essential oil (EO) derived from lemongrass, *Cymbopogon flexuosus* (Poaceae) against *Callosobruchus analis* (F.) (Bruchidae).

Repellent activity of EO was evaluated by area preference method (McDonald *et al.*, 1970). EO at a dose representing LC_{50} (0.15 µl/cm2) was applied uniformly over half portion of filter paper (Whatman No.1) while remaining half portion received only acetone. The adult insects (*n*=20) were released at the centre of experiment once the solvent was evaporated and insect preference for EO treated and control was recorded from 1 to 6 hr post-exposure at 28±2^{O}C temperature and 65 ± 5 % relative humidity. Mean insect preference was converted to Repellency Index (RI) and Percent Repellency (PR).

C. flexeosus EO of exhibited considerable repellent action against adult beetles at all the times of observation. On the basis of RI (0.14) (RI< 1), the *C. flexeosus* EO was classified as a "*repellent*" to *C. analis*. EO showed 85.83% repellency which was assigned to a repellency class "*Class-V*" indicating the strong repellent activity against test insect. The bioactive constituents present in *C. flexeosus* EO possibly acted as repulsive agent to insects visiting the treated, thus EO and its constituents could be a promising source of grain protectant against *C. analis*.

Sanjay M. Bandi, Prastuti Mishra and Revanasidda

Identification and physiological characterization of pigeonpea genotypes for cold tolerance

Screening of pigeonpea genotypes against cold stress was conducted on the basis of pod retention rate, physiological parameters and anti-oxidant enzymes activity during 2019-20. Varieties namely MAL-13, NDA-2 and ICP 2275 recorded 70.3, 69.86 and 69.14% pod retention, respectively and considered as tolerant to cold stress whereas varieties like Dholi –D, IPACT 22 and IPAD 1-17 recorded 29.42, 45.93 and 51.92% retention of pod respectively and these were considered as susceptible to cold. Among the breeding materials received from CI Division, the crosses of Bahar/IPACT-79 (6), IPACT-79/IPACT 80(12) and IPACT 79/IPACT 80(14) recorded 68.05,68.18 and 67.21% pod retention, respectively and matched with tolerant group but other crosses retained less than 67% flower /pod Anti- oxidant enzymes including peroxidase and super oxide dismutase showed higher activity in susceptible group as compared to tolerant group.

T. N. Tiwari

Potential indigenous *Trichoderma* spp. identified from pulses rhizosphere

Among the six tested *Trichoderma* isolates, IIPRTh-31, IIPRTh-33, IIPR.Tas-8 and IIPR.Tas-13 showed the presence of both ech-42 and xyn-2 genes. While the remaining three isolates (IIPRTh-31, IIPRTh-33, IIPRTg-3 and Th-38.IIPR) showed the presence of only ech-42 gene. The highest chitinase and xylanase activity was observed in IIPRTh-33 and IIPRTh-31. All the isolates were also screened for plant growth promotion enzyme production (Siderophore and IAA). Six of the 178 *Trichoderma* isolates which were earlier found to possess good antagonistic potential against soil borne plant pathogens were characterized further. Identified new potential *Trichoderma* strain for multi-trait characters would be utilized for development of *Trichoderma* based biocontrol formulation.

R.K.Mishra, Sonika Pandey, Monika Mishra, Utkarsh Singh Rathore, Naimuddin, Mohd. Akram and Bansa Singh

Characterization of indeterminate cleistogamous breeding lines in pigeonpea

Pigeonpea is unique among leguminous crops because, despite having floral structure designed for self fertilization, it permits a considerable degree of natural out crossing. The large range (25-70%) of natural out crossing led to the rapid deterioration of genetic purity in the released varieties and mapping populations. The inconvenience caused due to loss of genetic purity is incomparable for the recently developed varieties which are bred for targeted traits; generally the circumstances are knockout of that variety from seed chain due to difficulties in ensuring seed certification standards.

Keeping this in view, the present study was conducted during *Kharif* 2019 at ICAR-IIPR, Kanpur to characterize a set of 14 advanced breeding lines (IPAcliesto 1,2,3,4,5,6,7,8,9,10,11,12,13 &14) and their male and female parents' viz., IPA 203 and ICPL 87154 respectively. The study revealed that, all the breeding lines were indeterminate in growth habit and having the plant height range from 158-218 cm with an average of 19 primary branches per plants. The genotype ICPL 87154 had 13 flowers/cluster whereas, the advanced line IPAcliesto 1 had 10 flowers per cluster. IPAcliesto 14 recorded the longest flower bearing raceme of 29.33 cm. The absolute self pollination was recorded in nine advanced lines namely IPAcliesto 3, 5, 6, 7, 8, 10, 12, 13 and 14 lines. As these lines were having good yield attributing and high selfing trait holds immense scope to breeders during the course of varietal development.

Satheesh Naik S.J., Abhishek Bohra, Dibendu Datta, Shefali Tyagi, Alok Kumar Maurya, Farindra Singh, Indra P Singh, Narendra P Singh

Genotypic variations in mungbean

Genotypic variations in mungbean under field experimentation in sandy loam soil of arid western plain zone of Rajasthan resulted in SCMR (SPAD chlorophyll meter reading) variations. Genetic variability for delayed senescence through SCMR was studied among four genotypes of mungbean at different growth stages of mungbean (25 DAS, 50 DAS and at harvest. The faster leaf senescence of mungbean in arid region exposed to high temperature often limits photosynthesis and reduces assimilate transport leading to seed hardening due to incomplete sink development. Substantial variations were recorded for SCMR values among the mungbean genotypes at different growth stages and the trend was in the order:

50DAS>25DAS>at harvest, irrespective of genotypes. At harvest stage, it was highest in GM 6 (36.88), followed by GM 4 (34.89) and lowest in IPM 02-3 (31.39). Higher concentration of chlorophyll even at maturity stage leads to transformation of source to sink. This could also be considered as a trait for efficient nitrogen use by the mungbean plants.

Ummed Singh, Pushkar Dev, R.C. Meena and C.S. Praharaj

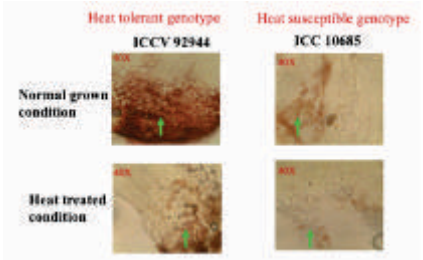
Identification of fieldpea and cowpea phenolic compounds

Phenolic compounds are a diverse group of plant secondary metabolites. They play a crucial role in plants and are also known to benefit human health by means of their antioxidant function. The phenolic compounds such as phenolic acids and flavonoids are abundant in legumes. Extraction and quantification of free and bound phenolics of fieldpea and cowpea was done using high performance liquid chromatography. Ten different standards of phenolic acids and flavonoids were used in this study (Figure). In field peas, gallic acid, and catechin hydrate were detected in all fifteen genotypes studied. However, protocatechuic acid, p-coumaric acid and ferulic acid were detected only in few genotypes. Unlike fieldpeas, cowpeas were found to have a much diverse phenolic profile. Extraction and quantification of free and bound phenolics of cowpea identified gallic acid, protocatechuic acid, catechin hydrate, p-coumaric acid and ferulic acid in all twelve genotypes used for this study but others such ascaffeic acid, ellagic acid and quercetin were detected only in few genotypes.

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

Effect of heat stress on esterase activity in the stigma of chickpea

Stigma receptivity indicates the ability of stigma to support viable and compatible pollen. It gets affected by terminal heat stress in chickpea which ultimately results in significant yield losses. Stigma receptivity can be determined from the activity of esterase enzyme present on the surface of stigma. Esterase activity was determined in the stigma of heat tolerant as well as heat susceptible genotypes of chickpea under normal as well as heat stress condition using



Esterase activity in stigma of chickpea flowers under normal and heat stress condition

napthyl acetate as a substrate in the azo-coupling reaction with fast blue B. Esterase activity was found to be more under normal condition as compared to the heat treated condition. Further, under the heat treated condition, the esterase enzyme activity was found to be relatively more in the tolerant genotype (ICCV 92944) as compared to the susceptible genotype (ICC 10685).

Vaibhav Kumar, Kalpana Tewari, GK Srivastava, S K Meena, Biswajit Mondal and PS Basu

प्रौद्योगिकी हस्तांतरण

Interventions under Farmer FIRST Project to enhance the income of farmers during COVID-19 lockdown

Summer mungbean (Virat) seed as a critical input,were provided to 47 farmers for additional income during COVID-19 lockdown. Demonstrations were also conducted on zero tillage in project area with a purpose to reduce the cost of production.

Summer Okra (navya) seed were provided as critical input to farmers for better utilization of fallow land and enhance income.

Summer Maize: Total 16 farmers were covered under summer maize (DKC-9108) in an area of four ha for better utilization of fallow land and additional income in the project area.

Seven Frontline Demonstrations were conducted on summer mungbean covering 16 farmers, in an area of seven ha in different districts of Uttar Pradesh for additional income and enhancing nutritional security.

Training programme organized in collaboration with NIAM Jaipur

ICAR-IIPR organized a three day training programme during January 27-29, 2020 on Enhancement of Farmers Income through Improved Pulses Production Technology, Processing and Marketing Strategies sponsored by National Institute of Agricultural Marketing (NIAM), Jaipur, Rajasthan. Twenty five trainees from agricultural departments, farmers and self help group members attended the training programme.

Dr. G.P. Dixit, Project Coordinator, AICRP on Chickpea, IIPR, inaugurated the training programme and Course Director, Dr. Rajesh Kumar, Head, Division of Social Science welcomed the trainees. The training focused on capacity building of trainees on various pulse production technologies and methodologies for enhancing farmers' income. The course content of the programme included all the aspects of pulse production such as prospects and challenges of pulses, suitable and potential varieties, improved technologies for *kharif* and *rabi* pulses, integrated pest management, post-harvest technologies, role of bio-agents, climate change and extension strategies for dissemination of technologies along with practical session of technologies demonstration and lab visit. Topic on processing, value addition and marketing of pulses were also covered in this training. This training helped the trainees in updating their knowledge on pulses production technologies for improving farmers' income.

Award/Honour

ISPRD Recognition Award 2020 : Dr. G.P. Dixit, PC, Chickpea, Dr. C.S. Prahraj, Head, Crop Production, Dr. G.K. Tragger, PAU, Ludhiana and Dr. Uma Sah, Pr. Scientist (Agril. Extension) were awarded ISPRD Recognition Award 2020, by Indian Society of Pulses Research and Development, IIPR, Kanpur. The award was presented at International Conference on "Pulses as the climate smart crops: challenges and opportunities" held during Feb. 10-12, 2020 at International Convention Centre (Minto Hall), Bhopal. Dr. A.K. Parihar was given Young Scientist Award.

Fellow Award

Dr. Uma Sah, Pr. Scientist (Agril. Extension) received Fellow award by Community Mobilization for Sustainable Development Society at National Seminar on Doubling Farmers Income by 2022: Challenges, Opportunities and Way Forward. The seminar was organised during February 15-17, 2020 at Career Point University, Hamirpur (H.P.).

Dr. Shallu Thakur, DST-INSPIRE Faculty, Division of Plant Biotechnology of the Institute has been awarded Jerome P. Miksche

Travel Grant Award to attend XXVIII Plant and Animal Genome Conference, San Diego, USA from January 11-15, 2020.

Appointments, Promotions, Transfers, *etc.*

Promotions

Name	Name
Sh. Kamlesh Chandra	Sh. Ram Babu
Promoted to	**Promoted to**
Technical Officer	Sr. Technician
W.e.f.	**W.e.f.**
21/10/2018	04/07/2019

Retirements

Name	Post held	Date of retirement
Sh. Ramesh Chandra	ACTO	31/03/2020

Director's Desk

Dear Readers,

Considering the current pandemic of COVID-19 where no effective preventive and curative medicine is available, a healthy immune system is one of the most important weapons. Almost every plant based products like vegetables, fruits, cereals, pulses *etc* contain essential nutrients such as proteins, vitamins, fibres, omega -3-fatty acids, and minerals to boost human health system. However, many of those plant based commodities are beyond the reach of poor people. Moreover, all those plant-based immunity booster are not integrat part of our daily diets. Therefore, pulses appear as a super food which has been considered as complete diet to supplement all essential components to enhance the human immunity and these pulses are well integrated as daily diets, cheap , easily available for large population of India. Pulses are the cheapest source of protein which is one of the most critical nutrients that support our immune system. A look at the world Covid meter shows that there is striking variation in mortality rates across countries, ranging from 0.2% to 15% depending on age, and pre-existing co-morbidities. In general, countries in the Northern hemisphere have faced the maximum brunt, and those in the Southern hemisphere (and those located proximate to the Equator) have so far escaped high infection numbers.

Several factors seem to be playing a role in the observed lower numbers of mortality in India with almost very moderate occurrence of severe Covid-19 cases (until now). Firstly, food habit of Indians consuming more of pulses and other spices such as ginger, turmeric, garlic, cloves, cinnamon and cardamom which could be helpful in building adequate immunity to fight against any foreign pathogens, Secondly, broad-based immunity in the population due to the extensive microbial load. The Indian population has been exposed to a vast variety of pathogens, including bacteria, parasites and viruses leading to the generation of broad specific memory T-cells in the system, ready to attack additional foreign invaders. Third, epigenetic factors that include environment and food habits may also play a beneficial role for countries such as India; much literature is already available in *Ayurveda* and other Indian systems of medicine on the definitive beneficial effects of Indian pulses and spices in augmenting immunity. Finally, the most important, is the possible role of immune response genes in the Indian population. These genes are collectively referred to as comprising the human leucocyte antigen system or simply, the HLA genes. Their main biological function is to present invading foreign antigens to the immune systems, since T-cells, which act as the body's soldiers come into play only when

pathogens are presented to them in a more formal manner in association with HLA genes. In other words, the pathogen must first attach to compounds created by HLA genes before T-Cells attack it. If no such compounds are produced by the body, then the T-Cells are ineffective. As a consequence of the microbial load, the Indian population possesses a high genetic diversity of HLA, much more extensive than Caucasian populations. Indeed, studies by the author at the All India Institute of Medical Sciences, New Delhi, over several decades revealed the presence of several novel HLA genes and their alleles in the Indian population, most of which do not occur in other ethnic groups. Such genetic diversity of HLA could affect viral fitness.The big question is: Does this give Indians a better chance at fighting the virus effectively? From the epidemiological data and food habit so far, it seems so (although much more extensive research is required). However, it is important for us to keep viral loads in check and below the threshold levels. Indians have some genetic advantage as well: They have evolved to gain more genes that protect against viral infections, these genes enable natural killer (NK) cells, a type of white blood cells in our body that provide a first line of defense against viral infections. Two families of genes — KIR genes and HLA genes — play a part in this protective function. Indians have more KIR genes than the Chinese and caucasians. This could make Indians more immune to the virus

Medical experts says that people having previous history of diabetes, heart , respiratory and cancer diseases are more vulnerable to COVID-19 attack. Therefore, management of these diseases seems to be very important in the present crisis. Numerous studies demonstrate the ability of pulses to support weight loss and lower the risk of type 2 diabetes, heart disease, and certain cancers. On the weight loss front, pulses have been shown to boost fullness and satiety, up calorie and fat burning, reduce belly fat, and curb cravings for processed snacks. Eating more pulses has also been shown to improve overall nutrition quality, as pulses are chock-full of vitamins and minerals, in addition to plant-based protein, fiber, and antioxidant levels. They also happen to be gluten-free, and they're not a common allergen, so they can serve as nutritionally dense replacements for foods many people need to eliminate due to allergies and intolerances. And with more and more people moving towards plant-based diets, even part-time, they'are prime alternative to animal-based proteins. In addition to being drought-friendly (pulses use just 1/10th the water of other proteins), and frost-hardy, pulses enrich the soil where they grow, which reduces the need for chemical fertilizers. In fact, pulses can boast the lowest carbon footprint of any food group, and the cost per serving is just Rs 7, compared to Rs 46 for chicken, Rs 40 for pork, and Rs 112 for beef. One cup of versatile green lentils has 92 micrograms of folate, a quarter of the recommended dietary allowance (RDA) for this, a B vitamin that supports immune function as well. And like beans, lentils are rich in fiber, which human colon needs to keep things moving.The zinc and iron are the trace elements and play major role towards boosting human immunity. The Institute has revamped its innovative research activities to fortify the lentil enriched with these two elements zinc and iron and a landmark lentil biofortified variety IPL 220 has been already released. In addition, many promising lines of chickpea exceeding protein content more than 25% have been identified under quality breeding programme. The Institute is making consistent efforts to make pulses as a super food.

(N.P. Singh)

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