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PULSES Newsletter

Indian Institute of Pulses Research, Kanpur

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EDITORIAL COMMITTEE

Dr. N. Nadarajan	Chairman
Dr. P.S. Basu	Member
Dr. M.S. Venkatesh	Member
Dr. Jitendra Kumar	Member
Dr. Naimuddin	Member
Mr. D. Upadhyaya	Member Secretary

Group Meet on Mungbean and Urdbean for Spring, Summer and Rice Fallow Cultivation

Annual Group Meet on "Mungbean and urdbean for spring, summer and rice fallow cultivation" was held at Central Agricultural Research Institute (CARI), Port Blair, Andaman & Nicobar Islands on October 25-26, 2013. The group meet was inaugurated by Dr. N. Nadarajan, Director, IIPR and Dr. S. Dam Roy, Director, CARI, Port Blair presided over the function. About 38 scientists from different Institutes and Universities participated in the meet including Joint Director, Department of Agriculture, A&N Administration, Dy. General Manager and Asstt. General Manager of NABARD, officers from different line departments, development personals from A&N Administration, Programme Coordinator and SMSs of KVK, Port Blair. Dr. R.K. Gautam, Head, Division of Field Crops delivered the welcome address and described about the importance of pulse cultivation and pulse nutrition.

Dr. G.P. Dixit, Principal Scientist and Project Coordinator (I/c), AICRP on MULLaRP briefly explained the research activities undertaken during last year and the future plan of research like gene pyramiding, interspecific hybridization, IPM modules for threatening diseases and pests, and conservation agricultural techniques like rice fallow pulses, minimum tillage or no tillage agronomic practices, *etc*.

Dr. N. Nadarajan, Director, IIPR inaugurated the session and discussed in detail about the pulse scenario in the country. He elaborated that the total requirement of pulses in India is about 21 million tons, whereas our present production is about 18 million tons. He also explained because of last three years of research efforts, our production raised to 18.5 million tons and thereby we could reduce the export from five to less than three million tons. He also briefed the future research priorities in pulses.

Dr. Dam Roy, Director, CARI in his presidential address explained about the scope and importance of pulses in vegetarian food and nutritional security. He mentioned about the status of area, production and productivity of pulses in Andaman & Nicobar Islands. He also stressed upon the importance of A&N island biodiversity and explained that these islands are the store houses of a number of land races like beachpea, mungan, ranmung, *etc*., which could be effectively utilized in future breeding programmes. He also stressed on the need of a MULLaRP Centre at CARI, Port Blair for sustainable development and enhancement of pulse production in this fragile agro-ecosystem. Later, the technical programmes of various disciplines for next season were discussed and finalized.

Dr. N. Nadarajan Retires

Dr. Nagasamy Nadarajan, Director, superannuated from ICAR service on December 31, 2013. His salient contributions in expanding the Institute's activities by opening of two regional stations at Bhopal and Dharwad are noteworthy. During his tenure, there has been a quantum jump in pulses production in the country from 14.5 m ton to 18.5 m tons which brought glory to the Institute. He successfully guided and executed several partnership projects with international institutions such as ICRISAT, ICARDA, USAID, *etc*.

Dr. N.P. Singh Takes over as Acting Director of IIPR

Dr. N.P. Singh, Project Coordinator (Chickpea) has assumed the charge of Acting Director of IIPR, Kanpur on January 1, 2014.

Rice- fallow Review Meeting Held

Review meeting of the project "Mitigating abiotic stresses and enhancing resource use efficiency in pulses in rice fallows through innovative resource conservation practices" was held on November 29-30, 2013 at BCKV, Kalyani under the chairmanship of Dr. C.L. Acharya, Chairman Advisory Committee. The meeting was attended by Dr. B. Mandal, Pro. V.C, BCKV, Dr. Saha, Head, Soil Science Department, BCKV, Dr. A.R. Sharma, Member Advisory Committee, Dr. P.S. Basu, PI of the project, Dr. Narendra Kumar and other CCPIs from all cooperating centres. Dr. Basu briefed about overall progress of the project, while CCPIs of different centres presented centre-wise progress. The participants also visited the fields in order to access the real situation of the rice fallows.

Fast Track Young Scientist Project

Department of Science and Technology (DST) has sanctioned a project on "Developing Strategic and Holistic Pest Management Modules in Legume Based Cropping System and its Authentication" to Dr. Jeewesh Kumar at this Institute with financial out lay of Rs. 18, 40,000/- for three years (2013 to 2016) under the Fast Track Young Scientist scheme.

Research Highlights

Identification of Early Flowering Genotypes in Lentil

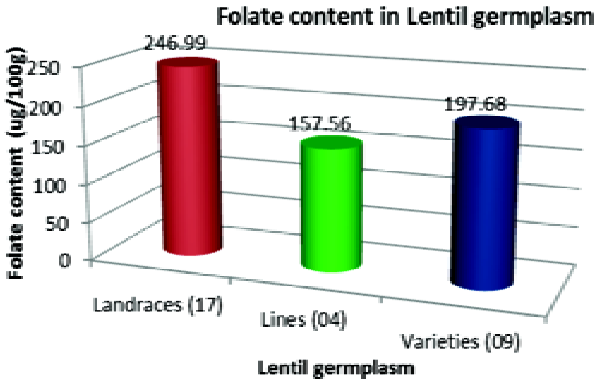
ILWLS 118-1

Thirty eight genotypes were evaluated for earliness in lentil. Among these genotypes, 6 genotypes (ILWLS 118-1, IPLS 09-17, IPLS 09-22, IC560150, IPLS 09-10 and IPLS 09-34) had initiated their flowering between 39 to 43 days. Early flowering (39 days) was observed in genotype ILWLS118-1 which is a selection from an accession (ILWL 118) of wild species (*Lens orientalis*). During the past three years, this genotype tested at different sowing dates showed its stability in days to 50% flowering over the environments. In addition to this, compared to other early flowering genotypes, this genotype also had high biomass. Therefore, it can be a useful donor in developing the early maturing cultivars for rice- fallow areas.

Jitendra Kumar, Divya Mahato and Rohit Kant

Folate Content in Lentil

Folic acid (folate) plays an important role in foetal development and maintenance of health. Humans are unable to synthesize folates. Deficiency of this vitamin can cause a range of serious diseases including early embryonic brain development, neural tube defects (NTDs), colon cancer, and brain disorders such as depression, reduced cognition, and Alzheimer's disease. Most staple food crops, including cereals are poor source of dietary folates and diets based on these foods often do not fulfil the RDA for folate. Pulses are rich in folic acid content. Therefore, this study standardized a reliable and reproducible methodology for quantification of total folate using HPLC and analyzed the folate content of 30 lentil (*Lens culinaris* L) genotypes including Mediterranean landraces, breeding lines and released varieties. Folate content in these lentil genotypes varied significantly in the range of 114.38 to 479.05 µg/100g with mean values of 222.23 µg/100g. The Mediterranean landraces of lentil had higher mean folate content (246.99 µg/100g) as compared to the released varieties (197.68 µg/100g).



Shweta Gupta, R.P. Srivastava, Jagdish Singh, Jitendra Kumar and P.S. Basu

Heavy Infestation of *Celosia argentea* in Pigeonpea at Farmers' Fields

Heavy infestation of *Celosia argentea* annual herbaceous weed commonly known as coxcomb belonging to family Amaranthaceae was observed in pigeonpea fields in Jalaun district of Uttar Pradesh. It propagates through seeds which germinate with the onset of rains. *C. argentea* plants are erect and tall and bear pinkish- white inflorescence. Pigeonpea is commonly grown in mixed cropping with sorghum in this district. *C. argentea* plants compete with pigeonpea and were observed to be of the same height as pigeonpea plants or even taller (> 1.5 m). It causes significant reduction in pigeonpea grain yield (30-40%).

Narendra Kumar, Uma Sah and Hem Saxena

Reference Gene Evaluation for Real Time PCR in Pigeonpea

Quantitative expression of eight house-keeping genes *viz*., actin, ubiquitin, alpha and beta tubulin, nuclear helicase, elongation factor, metalloprotease and TIP4 (designed on the basis of draft pigeonpea genome sequence) was studied in leaf samples of pigeonpea (*cv*. Asha) using SYBR Green chemistry in Real Time PCR. Copy number calculated on the basis of C_t (threshold cycle) values (18.41 - 34.89) showed that expression of actin, tubulin and ubiquitin genes was more stable as compared to other genes. Three genes identified in the study can be used as reference for expression studies in pigeonpea.

Deeksha Gupta, Alok Das and Subhojit Datta

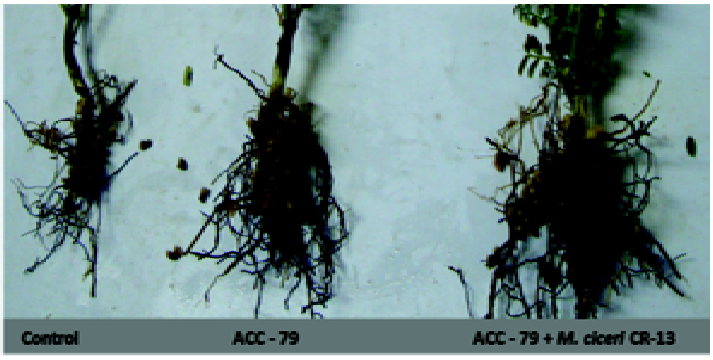
Management of Rice Ratoon in Rice-fallow Pulses System

Rice ratooning is a major problem in rice fallow-pulses systems in different parts of country becauses it causes fast depletion in soil moisture (15-20% higher) in comparison to no-ratoon. Since, soil moisture is a major abiotic stress under rice fallow-pulses, its control becomes necessary to enhance pulses productivity. The result of studies conducted at different centres under the project on rice-fallow revealed that use of post-emergence herbicide Quizalofop-ethyl @ 100 g/ha or application of Glyphosate @ 1.0 kg/ha before sowing pulse crop under zero till may control re-growth of rice stubbles and save soil moisture for pulse crop.

Narendra Kumar, P.K. Ghosh, K.K. Hazra, M.S. Venkatesh, P.S. Basu and S.K. Yadav

Co-Inoculation of ACC Deaminase Producing Bacteria and *Mesorhizobium* for Chickpea Growth and Yield

ACC (1-aminocyclo-propane-1-carboxylate) deaminase producing rhizo-bacteria conferred induced systemic tolerance (IST) to crop plants by reducing stress ethylene level at root system and preventing inhibition of root elongation. This further leads to enhanced water and nutrient uptake by plant roots, especially from deeper soil layers. The interactive effect of ACC deaminase producing bacterium Isolate No. 79 and *Mesorhizobium ciceri* CR-13 on chickpea growth and yield under rainfed condition was studied at New Research Farm of IIPR. Co-inoculation of beneficial bacteria enhanced the root biomass and grain yield to 38.38% and 45.61%, respectively over uninoculated control. However, there was no significant increase in shoot biomass at initial stages (45 DAS). It indicated that much of the photosynthates at early stages of growth were diverted for the development of root biomass. Isolate No.79 enhanced chickpea nodulation by native rhizobia under irrigated condition and insignificant difference in nodulation was observed when co-inoculated with *Mesorhizobium*. However, combined inoculation of ACC deaminase producing bacterium with *Mesorhizobium* enhanced the fresh nodule biomass to 26.76%, and 75.98% at 45 and 90 DAS, respectively over un-inoculated plants under moisture stress. Based on the above results Isolate No. 79 is proposed to be a potential candidate to enhance chickpea growth and yield under rainfed condition.

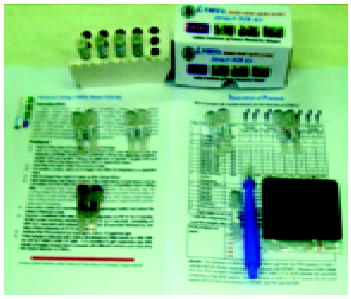


Senthilkumar M. and Mohan Singh

Diagnostic Kits for Legume Yellow Mosaic Viruses

Four different begomoviruses, *Mungbean yellow mosaic India virus* (MYMIV), *Mungbean yellow mosaic virus* (MYMV), *Horsegram yellow mosaic virus* (HgYMV) and *Dolichos yellow mosaic virus* (DoYMV) collectively called as Legume yellow mosaic viruses (LYMVs) are associated with yellow mosaic disease in different leguminous crops (mungbean, urdbean, cowpea, rajmash, pigeonpea, soybean, horsegram, dolichos, *etc*.). Symptom based identification of these viruses is not possible. To overcome this problem, two PCR based detection kits have been developed and named as "LYMVs PCR Diagnostic Kit" and "LYMVs Direct PCR Kit".

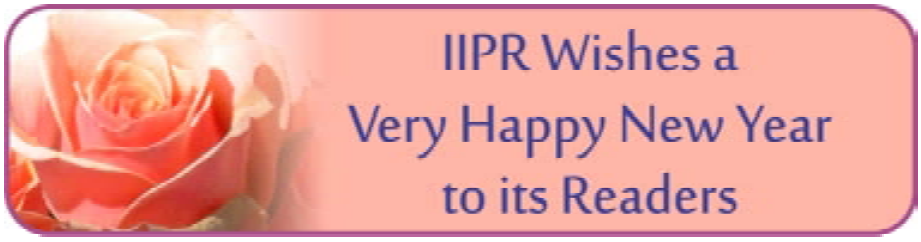
LYMVs PCR Diagnostic Kit



LYMVs Direct PCR Kit

These two kits are basically similar except that in LYMVs PCR Diagnostic Kit, the total DNA extraction is required (which is used as template for the amplification of target virus) from the infected samples, whereas in LYMVs Direct PCR Kit, the infected samples (leaf tissues) are used directly (as a source of template for the amplification of target virus) in PCR mixture.

Mohd. Akram, Naimuddin and A.K. Agnihotri



Land Configuration for Better Plant Stand

During *kharif* season under Eastern Indo-Gangetic Plain Zone, the problem of poor survival of plants and stunted growth are more apparent due to intermittent flooding/ waterlogging in flat planting crops. However our study showed that appropriate land configurations including raised bed planting of early pigeonpea cultivars had significantly lower plant mortality (6%) over flat bed planting (23%). Plant mortality and poor crop growth also varied with pigeonpea cultivars (UPAS 120> Pusa 992 > ICP 67B) due to their relatively late maturity irrespective of planting techniques. Therefore, use of raised bed planters or even ridge makers can help to maintain optimum plant stand and realize higher yield of early season pigeonpea cultivars.

Raised bed (left) had better plant survival and vigour over flat (right)

Ummed Singh, C.S. Praharaj and Jagdish Singh

Pulses are Highly Responsive to Organic Agriculture

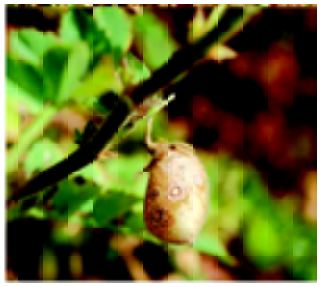
Pulses have been shown highly responsive to organic nutrient management in different cereal based production systems. In general, low nutrient input and reduced availability of nutrients under organic nutrient management often limits the plant growth and yield. Interestingly, the results from the long-term experiments indicated very strong response of pulse crops (pigeonpea, chickpea and mungbean) upon application of organic amendments through crop residues, farm yard manure and biofertilizers (*Rhiizobium*, PSB) and the organic management over yielded balanced application of inorganic fertilizers (NPKSZnB) for all above pulses. The relative response of different pulses to organic nutrient management was found in the order of chickpea (12.2%)>pigeonpea (10.9%) > mungbean (8.8%). The higher yield of pulses in organic management plots was mainly attributed to higher soil organic carbon, moisture storage, better nodulation and higher root penetration. Hence, pulses could be the promising component crops for organic farming.

K.K. Hazra, M.S. Venkatesh, P.K. Ghosh, N. kumar, C.S. Praharaj and Jagdish Singh

Occurrence of *Colletotrichum* blight on Chickpea in Karnataka

Dry root rot, *Fusarium* wilt and collar rot are the most destructive diseases in Karnataka which cause severe yield loss in chickpea. However, recently another foliar disease, *Colletotrichum* blight caused by *Colletotrichum dematium* appeared in destructive form at GKVK, UAS, Bangalore. It caused economic loss when the crop was sown during June to early October in experimental plots and under poly house conditions.

The symptoms of the disease includes dried-up and killed plants scattered in the field, on seedlings elongated, sunken, dark brown spots on the lower part of the stem, wilting and drying due to severe infection. In adult plants lesions are seen on all the above ground parts. On stem, leaves and pods, lesions are circular to elongated and sunken at the center with yellow margins. The disease can be seen at any stage of the crop growth depending up on the weather conditions and can kill the plants. Infected plants and branches showed



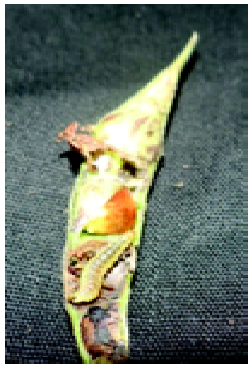
Symptoms of *Colletotrichum* blight on different parts

drying and death of plants both at seedling and adult stages. The fungus penetrates the pods, infect the seeds and causes shriveling discoloration of the seeds. The pathogen *Colletotrichum dematium* was isolated and the sickle shaped conidia were observed under microscope.

Muhammad Saifulla, Manjunatha H., Jayaramegowda, Chaithra H.R. and Gowdra Nagamma
University of Agricultural Sciences, GKVK, Bangalore

Insect Pest Incidence in Short Duration Pigeonpea

In a survey conducted in November, 2013 in three villages *viz*., Kirpalpur, Macha and Chaitini of Kanpur Dehat district, severe infestation of spotted pod borer *Maruca vitrata* Fabricius was observed in short duration pigeonpea. Pigeonpea leaves, flowers and pods were webbed by the *M. vitrata* larvae. Based on the laboratory examination on developing pods, infestation of spotted pod borer, *M. vitrata* was 32% in both Kirpalpur and Macha, while it was 12% in Chaitini village. Interestingly infestation of *Helicoverpa armigera* was only 4% in Kirpalpur. Besides, other insect pests such as pod bugs, *Clavigralla sp*, and *Riptortus pedestris* (Fabricius), blister beetle, *Mylabris pustulata* Thunberg, leaf folder, *Grapholita critica* Meyrick blue butterfly, *Lampides boeticus* Linnaeus and plume moth, *Exelastis atomosa* Walsingham were also observed on short duration pigeonpea.



M. vitrata infested pod

Sujayanand, G. K. and Hem Saxena

PERSONNEL

Deputation Abroad

❖ Drs. Jagdish Singh, HoD, Basic Science and Jitendra Kumar, Senior Scientist were deputed to attend the Review and Planning Meeting of ICARDA South Asia and China Regional Programme under HarvestPlus Challenge Programme on Lentil Biofortification held on September 23-25, 2013 at Kathmandu, Nepal. Dr. Singh delivered a lecture on "Nutritional quality traits in pulses: Potential for biofortification".

❖ Dr. Aditya Pratap, Senior Scientist, was deputed to visit Nairobi, Kenya to attend a training course on "Application of Biometrics and Bioinformatics Tools in Crop Improvement Research" organized and sponsored by ICRISAT, Hyderabad on November 4-9, 2013. Hands-on training on crop improvement related softwares such as GenStat, genotypic data management system, Integrated Breeding Platform, *etc.* were also organized during this training.

❖ Dr. M.S. Venkatesh, Principal Scientist, was deputed to attend international training on Carbon Sequestration during September 23 to December 21, 2013 at Carbon Management and Sequestration Center (C-MASC), School of Environment and Natural Resources (SENR), Ohio State University, Columbus, USA. The training was sponsored by National Agricultural Innovation Project (NAIP) of Indian Council of Agricultural Research.

❖ Dr. C.S.Praharaj, Principal Scientist, was deputed to participate and present a research paper at International Conference on Policies for Water and Food Security in Dry Areas held on June 24-26, 2013 at Cario, Egypt. The Conference was organized jointly by ICARDA, FAO, IFAD, IDRC, CRDI and ARC.

Honour and Award

Dr. Ummed Singh, Senior Scientist was honoured with IMPHOS-FAI Award 2013, by Fertiliser Association of India during FAI Annual Seminar 2013,

held on December 11-13, 2013 at New Delhi for his outstanding research work done on role of phosphorus on yield and quality of crops.

Promotions

Name	Promoted to	*W.e.f.*
Mr. Shukdeo Mehto	Asstt. Administrative Officer	11.12.2013
Mr. Arvind Kumar	Sr. Technical Assistant	12.2.2013

Transfers

Name	Designation	From	To	W.e.f.
Dr. P. Nandisha	Scientist	IIPR, Kanpur	IIHR, Banglore	29 October 2013
Dr. Muraleedhar S. Aski	Scientist	IIPR, Kanpur	IARI, New Delhi	31 October 2013

Retirement

Mr. V.B. Choubey, Technical Officer, superannuated from ICAR service on December 31, 2013.

प्रौद्योगिकी हस्तातंरण

मॉडल प्रशिक्षण कार्यक्रम आयोजित

संस्थान में दिनांक 21-28 अक्टूबर, 2013 को "दलहनी फसलों में समेकित कीट प्रबन्धन" विषय पर आठ दिवसीय मॉडल प्रशिक्षण कार्यक्रम का आयोजन किया गया। उक्त प्रशिक्षण कार्यक्रम कृषि एवं सहकारिता विभाग, कृषि मंत्रालय, भारत सरकार, द्वारा वित्त पोषित था। डा. ना. नडराजन, निदेशक ने अपने उद्घाटन भाषण में इस बात पर जोर दिया कि कृषकगण मृदा की उर्वरता में सुधार एवं खाद्यान्नों के टिकाऊ उत्पादन हेतु अपनी पारम्परिक खेती में दल्हनी फसलों को भी शामिल करें। प्रशिक्षण के दौरान प्रतिभागियों को प्रदेश/जिला विशेष की कृषि पारिस्थिकी के अनुरूप नवीनतम जानकारी उपलब्ध करायी गई। प्रशिक्षण के दौरान प्रतिभागियों को कार्यकुशलता सम्बन्धी महत्वपूर्ण पहलुओं जैसे

फसल सुधार, सस्य क्रियायें, संसाधन संरक्षण प्रौद्योगिकी, रोग-कीट एवं सूत्रकृमि से सुरक्षा एवं उनका प्रबन्धन आदि पर जानकारी प्रदान की गई। प्रतिभागियों को कानपुर देहात के बाढ़ापुर गाँव का शैक्षिक भ्रमण भी कराया गया। सभी प्रशिक्षुओं को दलहनी फसलों के सहभागिता आधारित बीज उत्पादन एवं दलहनों के विपणन की भी जानकारी दी गई। प्रशिक्षण में, आसाम, आंध्रप्रदेश, बिहार, हरियाणा, झारखण्ड, नागालैण्ड, पंजाब, उत्तर प्रदेश एवं पश्चिम बंगाल से आये 18 प्रतिभागियों ने भाग लिया। प्रतिभागियों को संस्थान द्वारा प्रकाशित साहित्य भी उपलब्ध कराया गया। डा. सुशील कुमार सिंह, प्रधान वैज्ञानिक (कृषि प्रसार) एवं प्रभारी अध्यक्ष, सामाजिक विज्ञान विभाग उक्त कार्यक्रम के कोर्स निदेशक थे।

कृषक प्रशिक्षण कार्यक्रमों का आयोजन

दिनांक/अवधि	जिला/प्रदेश	प्रतिभागियों की संख्या	प्रायोजित योजना
अक्टूबर 4-6, 2013	फतेहपुर (उत्तर प्रदेश)	28	एटीएमए (आत्मा)
अक्टूबर 8-10, 2013	अल्मोड़ा (उत्तराखण्ड)	32	नाबार्ड
नवम्बर 6-10, 2013	हजारीबाग (झारखण्ड)	26	एटीएमए (आत्मा)

दिनांक/अवधि	जिला/प्रदेश	प्रतिभागियों की संख्या	प्रायोजित योजना
दिसम्बर 5-6, 2013	कानपुर नगर (उत्तर प्रदेश)	84	एटीएमए (आत्मा)
दिसम्बर 13, 2013	शाहजहाँपुर (उत्तर प्रदेश)	20	
दिसम्बर 18-22, 2013	लातेहर (झारखण्ड)	25	
दिसम्बर 26-28, 2013	नवादा (बिहार)	84	

Director's Desk

Dear Reader,

Human dietary requirements essentially include macronutrients such as carbohydrates, lipids, proteins, amino acids, for growth and body development and 17 micronutrients (minerals), 13 vitamins and many phytochemicals which are necessary to enhance metabolic activities and immune system. Among 17 trace elements, iron, zinc, calcium and selenium are most important. Most of the essential micronutrients in our daily food are present in either very low quantity below the desired level or totally lacking. Deficiencies of iron zinc and vitamin A are most debilitating. A 23% reduction in vitamin A supplementation lower cognitive ability, impaired growth and reproduction. Anemia affects 2 billion people worldwide, iron deficiency affects 3.7 billion people, 58% of pregnant women, 31% of children under five in developing countries are anemic. Abnormalities caused by zinc deficiency include retarded growth, depressed immune function, anorexia, skeletal abnormalities, diarrhea, alopecia and dermatitis.

These micronutrient deficiencies can be addressed or eradicated through dietary diversification, food fortification, and biofortification. Biofortification of food crops is development of micronutrient-dense staple crops using traditional breeding practices and modern biotechnology. This approach has multiple advantages. First, it capitalizes on the regular daily intake of food staples. Second, after the one-time investment to develop seeds that fortify themselves, recurrent costs are low. Third, once in place, the biofortified crop system is highly sustainable. Nutritionally improved varieties will continue to be grown and consumed year after year. Fourth, biofortification provides a feasible means of reaching undernourished populations delivering naturally fortified foods to people. Finally, breeding for higher trace mineral density in seeds will not incur a yield penalty. These trace mineral packed seeds are essential in helping plants resist disease and other environmental stresses and ultimately yields are higher.

Cereal consumption rose 112% between 1969 and 2009 and oilseeds increased 357%, while pulse consumption rose only 47%. It is indeed unfortunate because pulses are richer in nutrients than cereals and oilseeds. Nutritionists claim that pulses are a perfect fit for biofortification.

Biofortified pulse crops may be closer to reality than many producers realize. That is a very simple way to make a better food product as pulses are one of the basic food ingredients. Genomics research is underway to identify the genes responsible for high nutrient levels in pulses to ensure future genotypes are biofortified. The breeding programme is focusing on five top nutrients: iron, zinc, selenium, folates and pro-vitamin A carotenoids.

Eating pulses that are high in available iron would help address the nutritional deficiency. Evidences indicate that biofortified lentils are rich in iron and zinc. Some lines of lentils contain 55 to 95 ppm of available iron as compared to one ppm for polished rice, 13 ppm for milled wheat and 30 ppm for yellow corn. Lentils are rich in minerals such as Se (500–2500 μg/kg), Fe (60–80 mg/kg), Zn (44–54 mg/kg), with very low concentration of phytic acid (6–8 mg/g) and high in ascorbic acid. More than 90% of Se in lentils is organic Se. A quarter-cup serving of lentils (30 g by dry weight) could provide approximately 3.6 g of prebiotic carbohydrates fructans. In addition to minerals and prebiotics, lentils are also rich source of beta carotene (1–5 mg/kg), bio-beneficial phenolics and numerous folates.

Mungbean provides significant amount of protein (25%) and carbohydrate (65%)) and a range of micronutrients. Mungbean protein and carbohydrate are easily digestible and create less flatulence. In addition, mungbean is lower in phytic acid (72% of total phosphorus content) than pigeonpea, soybean and cereals which has a negative impact on iron and zinc bio-availability in plant-based diets. The wide genetic variability of mineral concentrations (0.03-0.06 μg Fe/kg and 0.02-0.04 μg Zn/kg) in mungbean indicates possibilities to improve its micronutrient content through biofortification. Therefore biofortification of existing mungbean varieties has great potential for enhancing the nutritional quality of diets.

Horse gram is another unexploited legume which is an excellent source of iron and molybdenum. It is consumed as a whole seed, sprouts, or whole meal by a large population in rural areas. Biofortification for enriching zinc content in this legume is necessary and important for enhancing its nutritive value.

Linking agriculture and nutrition to promote dietary change and improve nutritional status can generate wide economic benefits, such as increased agricultural production and greater household security. Indian Parliament recently has passed a budget for Biofortification Project (DBT) which includes $15 million for biofortification for rice, wheat, and maize. It can be envisaged that pulses will also be included for biofortification keeping in view of their high nutritional status and wide consumption among various cross sections of people.

(N. Nadarajan)

Published by Dr. N. Nadarajan, Director, Indian Institute of Pulses Research, Kanpur-208 024
Tel. : 0512-2570264; EPBAX Lines : 0512- 2572464, 2572465; Fax : 0512-2572582
E-mail : director@iipr.ernet.in ; n.nadarajan@gmail.com; Website; http://www.iipr.res.in

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