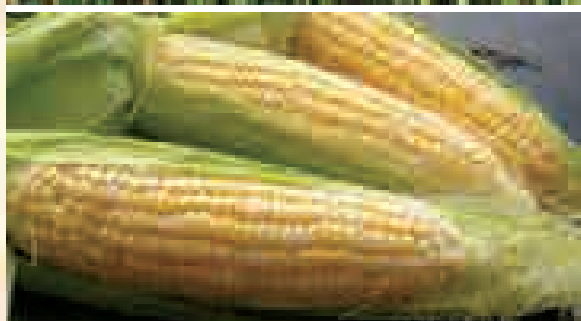


Brainstorming Workshop on

Up-scaling Quality Protein Maize for Nutritional Security



RECOMMENDATIONS

Organizers

Trust for Advancement of Agricultural Sciences (TAAS)
Indian Council of Agricultural Research (ICAR)
National Academy of Agricultural Sciences (NAAS)
Indian Institute of Maize Research (IIMR)
International Maize and Wheat Improvement Center (CIMMYT)
Borlaug Institute for South Asia (BISA)
Indian Society of Genetics and Plant Breeding (ISGPB)



Brainstorming Workshop on Up-scaling Quality Protein Maize for Nutritional Security

Preamble

The Brainstorming Workshop on "Up-scaling Quality Protein Maize (QPM) for Nutritional Security" was organized jointly by the Trust for Advancement of Agricultural Sciences (TAAS), Indian Council of Agricultural Research (ICAR), National Academy of Agricultural Sciences (NAAS), Indian Institute of Maize Research (IIMR), International Maize and Wheat Improvement Center (CIMMYT), Borlaug Institute for South Asia (BISA), and the Indian Society of Genetics and Plant Breeding (ISGPB), at National Agricultural Science Centre, New Delhi, India on 20-21 May, 2015.

The goal of the Workshop was to review the progress and identify opportunities for enhancing nutritional security in India using Quality Protein Maize (QPM). The objectives were to assess the needs of stakeholders for enhancing QPM production and productivity; share experiences of success stories of QPM and other biofortified maize cultivars; create awareness of nutritional benefits of QPM among farmers, consumers and industries; strategize the research efforts for accelerated development of micronutrient-enriched QPM and value-added processed foods; and build

effective networking and a framework for policy interventions to promote QPM.

The Workshop was attended by more than 100 participants, including government representatives, policy makers, scientists from the National Agricultural Research System (NARS) and international research organizations, public and private seed agencies, processing industries, progressive farmers and NGOs.

Dr. S. Ayyappan, Director General, Indian Council of Agricultural Research (ICAR) & Secretary, Department of Agricultural Research and Education (DARE), Government of India was the Chief Guest, to inaugurate the workshop which was presided over by Dr. Raj Paroda, Chairman, TAAS. Dr. S.K. Vasal, Former Distinguished Scientist, CIMMYT and the recipient of World Food Prize for his pioneering work on QPM gave special remarks on the occasion.

Perspective

Maize has emerged as one of the most important crops as food, feed and industrial applications. Maize alone contributes over 20% of total calories in human diets in 21 countries, and over 30% in 12 countries that are home to a total of more than 310 million people. Globally, maize is cultivated in 184

million ha with a global production of 1016 million tons. Asia produces 304 million tons of maize from 59 million ha. During 2013-14, India produced more than 24 million tons of maize from nearly 9 million ha. Nearly 20% of the maize produce in India is used for human food, while more than 63% is utilized for poultry- and animal-feed. Between now and 2050, the demand for maize in the developing world will double, as the current global population of seven billion is likely to cross nine billion by 2050.

As per Food and Agriculture Organization (FAO) of the UN, India is home to 195 million undernourished people, the highest in the world. This translates into over 15% of India's population, of which ~42% of children (<3 years old) are underweight and 58% of them are stunted by two years of age. The challenge is, therefore, to deliver nutritious, safe and affordable food to an ever-increasing population in the coming decades to eliminate food and nutritional insecurity.

QPM, by virtue of its 2-3-fold higher lysine and tryptophan and enhanced protein quality over conventional maize, holds immense promise for alleviating protein malnutrition. Also, due to its higher biological value, balanced nitrogen index and leucine-isoleucine ratio, QPM offers significant nutritional benefits, which were well-demonstrated worldwide, both in terms of human food and animal feed. An array of QPM varieties has been released in sub-Saharan Africa, Latin America and Asia over the last three decades. India released its first generation of soft endosperm-based nutritious maize composites, viz.,

'Shakti', 'Rattan' and 'Protina', way back in 1970. In 1997, the first hard endosperm QPM composite, Shakti-1, was released. The first QPM hybrid, 'Shaktiman-1' was released in 2001. So far, a dozen QPM hybrids have been released in India with wider adaptability to different agro-ecologies.

Despite the well-established nutritional benefits and varietal releases worldwide since last 3-4 decades, widespread cultivation and use of QPM as food and feed remains a major challenge. Of the 90 million ha of maize grown in Mexico, Central America, sub-Saharan Africa, and Asia, only an estimated 1% or less is QPM. In India, the area under QPM cultivation is negligible, as compared to the conventional maize.

The Workshop provided a platform to discuss in depth specific constraints/bottlenecks in QPM value chain, and opportunities for up-scaling QPM production and utilization in India for enhanced nutritional security. The Workshop was structured in two plenary sessions, and six technical sessions, focusing on various aspects of QPM R&D, including: (a) staple food; (b) feed; (c) seed production and delivery; (d) policy support for promotion; (e) post-harvest processing and value addition; and (f) breeding challenges and opportunities.

Recommendations

The workshop participants unanimously agreed that QPM has great potential to address a major challenge of malnutrition being faced by large number of children in India. QPM

innovation, therefore, needs to be out scaled to ensure household nutrition security. For this, required public awareness to make maize an important food crop, instead of its current use as feed, would require urgent research, development and policy interventions in a mission mode approach. Salient recommendations that emerged out of these discussions are presented below:

QPM as Food

1. To harness full potential of QPM, there is an urgent need to sensitize the food processing and value-addition industry in India on nutritional benefits of QPM, so as to generate and deploy QPM-based value-added food products in both rural and urban markets. Village-level entrepreneurships and community-based QPM processing units (incentivized by *Gram Panchayats*) should be established for promoting QPM consumption in rural India. QPM-based products, such as QPM corn flakes, snack items, and QPM-fortified multi-grain '*atta*' can be effective in reaching the health-conscious urban population. Proper labeling, suitable branding (e.g., Nutri-maize) and aggressive promotion would attract consumers towards QPM-based products.
2. For effectively meeting the demand of the processing and value-addition industry, QPM varieties should be systematically evaluated for basic food quality parameters (industry-provided check-list) required for manufacturing specific products.

Once suitable varieties are identified, continuous supply of QPM grains for the industry needs to be ensured through effective backward linkages; contract farming and 'buy-back' policy could ensure sustainable supply of QPM.

3. 'Nixtamalization' is an important technological intervention that improves shelf-life of maize in general, including QPM, and it also helps in preventing aflatoxin contamination of stored products. This is being extensively used in Mexico, where maize is a staple food and hence could be introduced in India.

QPM as Feed

4. India is the fifth largest poultry producer and third largest egg producer, with enormous growth potential (more than 10% per annum). The potential of QPM, especially yellow QPM, in strengthening the maize-poultry value chain needs to be effectively exploited. This will require awareness generation among the poultry industry about the nutritional benefits of QPM. A special workshop on "QPM Specialists-Poultry Sector Interface" should be organized for making the poultry industry aware of the benefits of QPM over conventional maize, and for devising a Road Map for promoting the use of QPM in poultry sector.
5. Synthetic lysine is presently available at relatively cheap price to the poultry industry. Therefore, proposition of incorporating high-

lysine QPM in poultry feed may look less appealing, given the fact that QPM grain is expected to be costlier than conventional maize requiring isolation distance for its commercial production, besides need for market segregation. Therefore, it is critical to communicate the beneficial effects of tryptophan, which is high in the QPM. Tryptophan helps in regulating egg laying. Hence, benefits of availability of enhanced tryptophan in QPM grain should be compared vis-à-vis other sources of tryptophan in the feed, like soy meal, to demonstrate comparative advantages of QPM.

6. To enhance the use of QPM in the poultry and livestock industry, research needs to be undertaken on:
 - The cost-benefit ratio to determine the value gained in terms of kg of meat or number of eggs by using QPM over conventional maize.
 - Understanding better the nutritional benefits of QPM (over conventional maize) on the quality of meat and eggs; this is required for creating specialized markets for more nutritious meat and eggs. So far, studies have focused only on the weight gain attributes of QPM feed over conventional maize feed.
7. The interface between QPM breeders and the poultry industry needs to be strengthened to understand better the trait and product preferences of the clients, and to reorient the breeding programs based on such feedback; for instance, recent studies

have shown strong interest of the poultry industry in India in traits such as high methionine, provitamin A and high oil content.

Developing New QPM Cultivars for Needed Impact

8. To derive genetically diverse, high-yielding and climate-resilient QPM varieties that meet the requirements of stakeholders, QPM breeding program in India must be significantly strengthened, including selections from elite conventional × QPM crosses to generate new improved QPM inbreds; creation of new QPM synthetics/pools (with an understanding of heterotic groups) for extracting novel QPM inbreds with biotic and abiotic stress resilience; and diversifying the QPM germplasm base.
9. As a short-term goal, fast-track conversion of some of the most popular and widely-grown conventional maize hybrids to QPM versions through marker-assisted selection (MAS) and doubled haploid (DH) technique, is the best possible option to develop QPM hybrids with wider adoption and acceptability. As a part of this strategy, the possibility of converting some popular private-sector maize hybrids into QPM versions through public-private partnerships, and introducing these QPM hybrids in the market needs to be immediately explored as this will significantly strengthen the QPM supply chain for the processing industry.

10. More than 150 single-cross maize hybrids have been released so far by public and private sector organizations in India. These hybrids in particular have helped in doubling the maize production over last one decade in the country. While hybrids are adopted in ~60-65% of the maize-growing areas, ~35-40% of the area, especially in the tribal regions and North-Eastern states, is still under low-yielding landraces, local varieties and composites. Incidentally, these are also the areas where maize is a staple food. Hence, as an alternate strategy, the possibility of developing and deploying improved QPM synthetics as well as low-cost, affordable maize hybrids, with higher grain yields and quality, needs to be actively explored.

11. A Mission-Mode Project on developing the next-generation biofortified maize varieties (QPM, provitamin A, kernel zinc etc.) should be initiated immediately with strong emphasis on multi-disciplinary and inter-institutional partnerships. Such project having immense potential to contribute to nutritional security in India must receive required funding support through the National Agricultural Science Fund (NASF) of the ICAR.

12. 'Nutritional Quality Service Labs' must be set up for strengthening the breeding programs for biofortified crop varieties, such as QPM. Capacity development programs at the accredited nutritional quality labs will help in building skilled

manpower needed urgently for QPM research and development in India.

13. Nutritional quality traits, such as enhanced lysine and tryptophan in QPM, are "invisible" traits. Farmers, thus, would face obvious difficulty in convincing the traders regarding better quality of produce while selling in the market. Development, validation and deployment of a low-cost portable device that rapidly determines the amino-acid quality of the maize produce (through quantitative estimation) would be of great help to the farmers. Brix meter is one such example, where sugar concentration in sweet corn is analyzed rapidly.

Seed Production and Delivery

14. "QPM Seed Villages", with "One QPM hybrid-One village approach", must be established for community-based production of quality seed, through active engagement and training of progressive farmers. QPM Seed Villages should be particularly targeted in Tamil Nadu, Karnataka, eastern Uttar Pradesh, Rajasthan, Bihar and West Bengal, where opportunities for marketing (e.g., poultry/feed industry) exist. This will also help in reducing the cost of transportation as well as ensure timely availability of quality QPM grain to the industry.

Public-Private Partnership

15. Strong and active engagement of private sector in QPM R&D in India is important for up-scaling QPM

adoption and utilization. Private sector seed companies with significant maize breeding, seed production and distribution network capacity in India should take up QPM development and delivery in the target markets. The 'Agri-Innovate-India' should play an important role in this regard. Government programs such as National Food Security Mission (NFSM) must support QPM seed production, irrespective of whether the seed is produced by public or private sector.

16. Public-private partnerships for QPM research, based on mutual trust, focused objectives, respect for each other's intellectual property, and ABS (access and benefit sharing) should be encouraged by providing an enabling environment by the Government. Bottlenecks, if any, with regard to effective exchange of germplasm / breeding materials between public and private sectors must be explored through an agreed Standard Material Transfer Agreement (SMTA).

Awareness Generation and Enabling Policies

17. Lack of adequate awareness among consumers is one of the major reasons for the poor demand for QPM. Intensive awareness campaigns,

supported well by the Government, must be taken up to popularize the nutritional value of QPM and for enhancing its demand for consumption as food at the household level. QPM can potentially contribute significantly towards nutritional security, especially in the North-Eastern states and the tribal areas in India.

18. In view of its potential benefits to the household nutritional security, QPM must be considered for inclusion in the 'rural transformation' project under NITI AAYOG. QPM should also be an integral component of the Government-sponsored agricultural development programs like NFSM and Rashtriya Krishi Vikas Yojna (RKVY), as well as the nutrition intervention programs, such as 'Integrated Child Development Scheme' (ICDS) and 'Mid-day Meal Program'.
19. QPM requires policy support during the initial stages of takeoff in the form of seed kits, extension, and market support. QPM should also be supported through Market Intervention Scheme in the states where farm harvest prices are below Minimum Support Price (MSP). Processing industry should also be incentivized to use QPM in various food and feed formulations.







Trust for Advancement of Agricultural Sciences

The Trust for Advancement of Agricultural Sciences (TAAS) was established on 17 October 2002. Its mission is to promote growth and advancement of agriculture through scientific interactions and partnerships. The major objectives are (i) to act as think tank on key policy issues relating to agricultural research for development, (ii) organizing seminars and special lectures on emerging issues and new development in agriculture sciences in different regions of India, (iii) instituting national awards for the outstanding contributions to Indian agriculture by the scientists of Indian origin, and (iv) facilitating partnerships with non-resident Indian agricultural scientists. The main activities include organizing foundation day lectures, special lectures, brain storming sessions/symposia/seminars/workshops on important themes, developing strategy papers on key policy matters, promoting farmers' innovations and conferring Dr. M.S. Swaminathan Award for Leadership in Agriculture. For more detail please visit: www.taas.in



Indian Council of Agricultural Research

The Indian Council of Agricultural Research (ICAR) is an autonomous organization under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture, Government of India. The Council is the apex body for coordinating, guiding and managing research and education in agricultural systems in the country. The ICAR has played a pioneering role in ushering Green Revolution and subsequent developments in agriculture in India through its research and technology development. It has played a major role in promoting excellence in higher education in agriculture. It is engaged in cutting edge areas of science and technology development. For more information please visit: www.icar.org.in



National Academy of Agricultural Sciences

The National Academy of Agricultural Sciences (NAAS), established in 1990, is among the youngest of the Science Academies in India. The Academy focuses on the broad field of agricultural sciences including crop husbandry, animal husbandry, fisheries, agro-forestry and interface between agriculture and agro-industry. The Academy's role is to provide a forum to agricultural scientists to deliberate on important issues of agricultural research, education and extension and present views of the scientific community as policy inputs to planners, and decision/opinion makers at various levels. The academy organizes and supports national and international congresses, conferences, seminars, symposia, workshops and brainstorming sessions on critical issues in the field of agricultural sciences. The Academy accords recognition to scientists at various levels, and encourages cutting edge research in different fields of agricultural sciences. For more detail please visit: www.naasindia.org



Indian Institute of Maize Research

ICAR-Indian Institute of Maize Research (IIMR) is a constituent of the Indian Council of Agricultural Research (ICAR) - an autonomous organization of Department of Agricultural Research and Education (DARE), Ministry of Agriculture, Government of India. It is the only institute in the country exclusively mandated for maize research. The main objective of IIMR is to conduct basic, strategic and applied research aimed at enhancement of production and productivity of maize in India. The institute also serves as core centre for maintenance and supply of maize improved germplasm and breeding material; and also responsible for developing linkages with national, international and private sector for collaborative research programmes. IIMR provides consultancy services and undertake contractual research on various aspects of maize. It also coordinates the All India Coordinated Research Project (AICRP) on Maize, which includes 32 centres spread across 21 states. For more information please visit: www.iimr.res.in



International Maize and Wheat Improvement Center

International Maize and Wheat Improvement Center (known by its Spanish acronym, CIMMYT) is a not-for-profit agriculture research and training organization. The Center works to improve food security and livelihoods by sustainably increasing the productivity of maize and wheat in the developing world. CIMMYT maintains the world's largest maize and wheat seed bank and is best known for initiating the Green Revolution, which saved millions of lives across Asia and for which CIMMYT's Dr. Norman Borlaug was awarded the Nobel Peace Prize. CIMMYT is a member of the CGIAR Consortium and receives support from national governments, foundations, development banks and other public and private agencies. For more information visit: www.cimmyt.org



Borlaug Institute for South Asia

Established initially in India, Borlaug Institute for South Asia (BISA) is developing a state-of-the-art agricultural research platform, technology transfer centers and training facilities throughout South Asia. BISA's focus is on holistic, interdisciplinary and collaborative approaches to AR4D in breeding, conservation agriculture and socioeconomics for wheat- and maize-based cropping and food systems. BISA will also help develop a new generation of agricultural researchers. With the cooperation of national and state government, BISA has established three research sites in India, is planning a fourth research station/training centre in Nepal, a fifth in Pakistan and is negotiating with other countries in the region for additional sites. For more information please visit: www.bisa.org



Indian Society of Genetics and Plant Breeding

The Indian Society of Genetics and Plant Breeding (ISGPB) is the oldest and most prestigious registered society of practicing Geneticists and Plant Breeders from public and private institutions and the students pursuing Genetics and Plant Breeding disciplines. It has a vital role to play in fostering the progress of Science of Genetics and Plant Breeding in the country. The Society was founded in January, 1941 at the Indian Congress Session at BHU, Varanasi by a group of Indian geneticists and plant breeders led by Late Dr. B.P. Pal. The Indian Journal of Genetics & Plant Breeding is the official publication of Society. For more information please visit: www.isgpb.co.in

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Printed in July, 2015

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