2016
INTERNATIONAL
YEAR OF PULSES

राष्ट्रीय विज्ञान संगोष्ठी-२०१६

NATIONAL SCIENCE SEMINAR-2016

स्थायी खाद्य सुरक्षा हेतु दालें:
संभावनाएँ एवं चुनौतियाँ

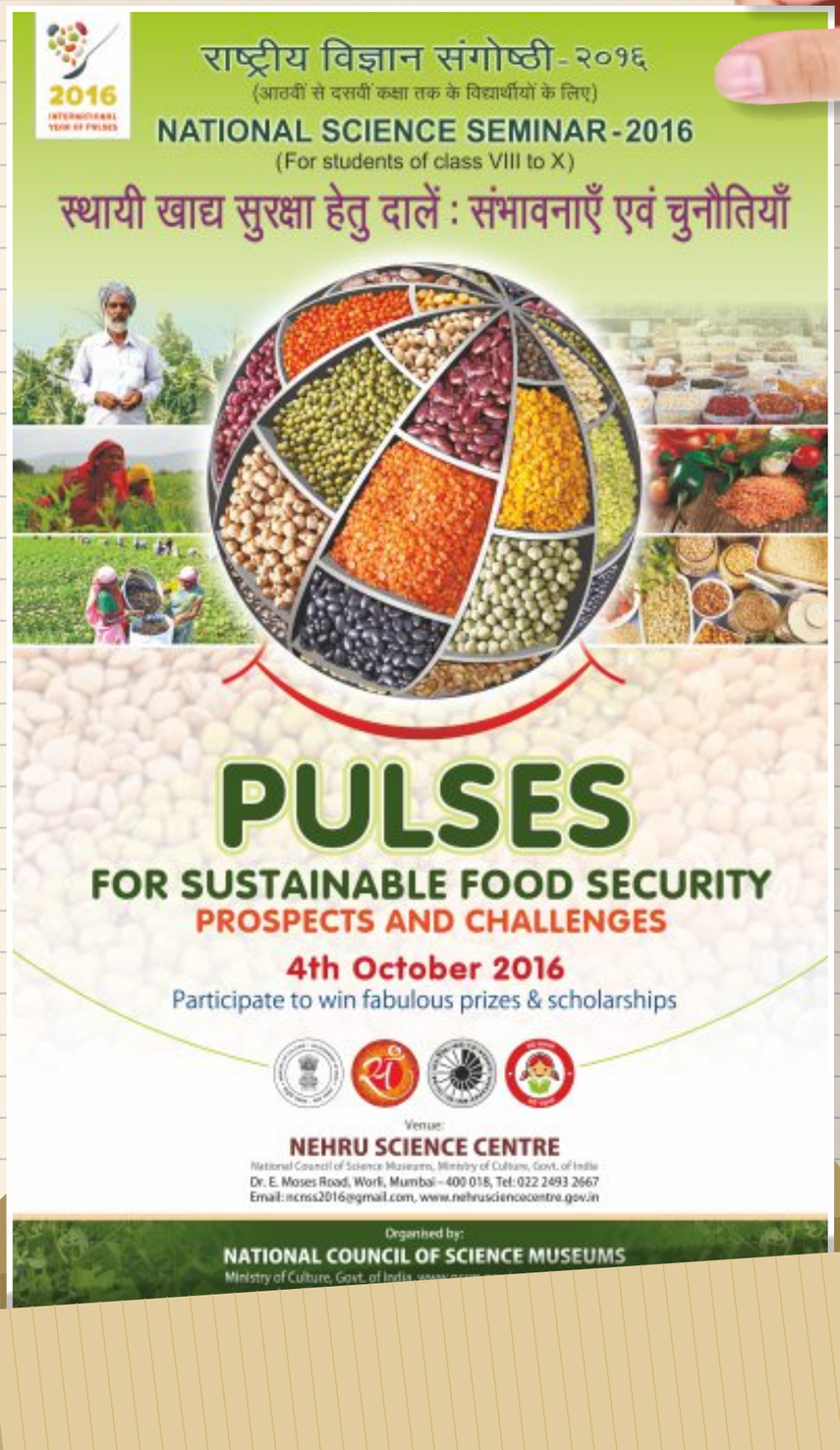
PULSES

FOR SUSTAINABLE FOOD SECURITY

PROSPECTS AND CHALLENGES

4th October 2016

Organised by:
National Council of Science Museums
Ministry of Culture, Government of India
Venue:
Nehru Science Centre, Mumbai



शमीमा सिद्दिकी
SHAMIMA SIDDIQUI
भारत के राष्ट्रपति की उप प्रेस सचिव
Deputy Press Secretary
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राष्ट्रपति सचिवालय,
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PRESIDENT'S SECRETARIAT,
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MESSAGE

The President of India, Shri Pranab Mukherjee, is happy to know that the National Council of Science Museums (NCSM), Kolkata is organising the National Science Seminar 2016 on the theme "Pulses for Sustainable Food Security: Prospects and Challenges" on October 4, 2016 at Mumbai.

The President extends his warm greetings and felicitations to the organisers and participants and sends his best wishes for the success of the Seminar.

Deputy Press Secretary to the President

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Dr Mahesh Sharma

सत्यमेव जयते

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संस्कृति एवं पर्यटन
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Minister of State (Independent Charge)
for Culture & Tourism
Government of India

MESSAGE

26 SEP 2016

I am very happy to learn that the Nehru Science Centre, Mumbai, a unit of National Council of Science Museums, is organizing this year 'National Science Seminar' on the focal theme Pulses for sustainable food security: Prospects & Challenges'.

The UN General Assembly declared 2016 The International Year of Pulses. This is the single largest opportunity to increase awareness of pulses globally, and to increase demand, utilization and production pulses worldwide. Pulses are part of a healthy, balanced diet and have been shown to have an important role in preventing illnesses such as cancer, diabetes and heart disease. The World Health Organisation estimates that up to 80% of heart disease, stroke, and type 2 diabetes and over a third of cancers could be prevented by eliminating risk factors, such as unhealthy diets and promoting better eating habits, of which pulses are an essential component. Therefore encouraging awareness of the nutritional value of pulses can help consumers adopt healthier diets.

I am happy to note that the Seminar aims to provide a platform for students and teachers of different regions and culture to interact and raise awareness about the important role of pulses in sustainable food production and healthy diets and their contribution to food security and nutrition.

I wish the seminar all the success and I also feel that his assembly of talented young minds would lead to a solid foundation of national integration.

(Dr Mahesh Sharma)

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Shri Girish Bapat
Minister of Food and Drugs Administration Civil Supplies and Consumer Protection Parliamentary Affairs Government of Maharashtra

सत्यमेव जयते

Food and Drugs Administration
Civil Supplies and
Consumer Protection
Parliamentary Affairs
Government of Maharashtra

MESSAGE

I am happy to know that Nehru Science Centre has organised a National Science Seminar for school students which will help the school students who will get the detail knowledge and updates about Pulses for sustainable Food Security. Nehru Science Centre conducts variety of educational programmes for popularization of Science among masses in general and students in particular. Some of these activities are conducted nationwide in collaboration with the State authorities/Department of the respective States/UTs. I am happy that this centre has specifically organised national level seminar for school students.

The United Nations has declared the year 2016 as the International Year of Pulses and as a Food Civil Supply Minister of Maharashtra, I really feel that this the need of the hour to talk about this subject at the state, national and international level as well as it is dealing with each person of the society. The topic selected for this year's national science seminar is 'Pulses for sustainable Food Security: Prospects and Challenges'. As we all are aware that the pulses are important food crops and have the maximum nutritional value and therefore it has wide effect in our life. Through this Seminar, I am happy that the initiative has been taken towards getting the knowledge and making the movement towards the food security.

I am happy through this seminar we will have a detail discussion on such an important topic which will focus the measures taken to provide the food security. Therefore, this seminar will definitely boost all of us to update about the food security and also our personal interest in this subject. I would also suggest the Centre to organise various seminars/workshops on various topics on regular basis.

(Girish Bapat)

एन. के. सिन्हा, आई.ए.एस.
सचिव
N. K. Sinha, IAS
Secretary

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F.No.9-21/2016-M.II(Pt.)

New Delhi the 19th September, 2016

MESSAGE

The United Nations has declared 2016 as the International Year of Pulses. The International Year of Pulses 2016 aims to heighten public awareness of the nutritional benefits of pulses as part of sustainable food production aimed towards food security and nutrition. This initiative creates a unique opportunity to encourage connections throughout the food chain that would better utilize pulsebased proteins, further global production of pulses, better utilize crop rotations and address the challenges in the trade of pulses. The pulse crops occupy a unique position in the world agriculture by virtue of their 2 to 3 times higher protein content than cereals and their capacity to fix atmospheric nitrogen. In India, about a dozen varieties of pulses are grown as an integral part of different cropping systems and significantly contribute to the sustainability of cereal-based cropping systems and important for the nutritional security and vegetarian diet of large Indian population.

I congratulate National Council of Science Museums for organising this year's National Science Seminar on ***'Pulses for sustainable food security:Prospects & Challenges'*** at Nehru Science Centre, Mumbai for promoting the value and utilization of pulses throughout the food system, their benefits for soil fertility and climate change and for combating malnutrition.

I wish the programme all success and extend my heartiest felicitations to all the participants of the seminar.

(N. K. Sinha)
Secretary, Ministry of Culture
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THE UNIVERSITY OF WESTERN AUSTRALIA

The UWA Institute of Agriculture
Professor Kadambot Siddique AM CitWA FTSE FAIA FNAAS
BSc (Ag) Hons, MSc, PhD
Hackett Professor of Agriculture Chair and Director

26 July 2016

MESSAGE

I am pleased to note that the Nehru Science Centre of the National Council of Science Museums, India is organising a seminar on October 4, 2016 in Mumbai.

The theme of this year's seminar on "Pulses for sustainable food security: Prospects and challenges" is timely and topical. The United Nations declared 2016 as the International Year of Pulses under the banner 'nutritious seeds for a sustainable future'. Yet, pulses are a minor component of most human diets at present. Food security and nutrition are a key international development objective under the Sustainable Development Goal (SDG2) of the 2030 Agenda for Sustainable Development. As 2016 is the first year of implementation of the Agenda, the International Year of Pulses will also link the contribution of pulses to critical targets under SDG2, particularly those on food access, malnutrition, smallholder incomes, and sustainable and resilient agriculture.

I am pleased to know that the objective of the seminar is to enhance the scientific enquiry and critical thinking among young students and attract their interest in science, technology, engineering and mathematics (STEM).

I hope that the participating students from all over India will have the opportunity to interact with eminent scientists and industry members engaged in agriculture.

I would like to congratulate the organisers and wish the seminar a great success.

Yours sincerely,

Professor Kadambot Siddique
Hackett Professor of Agriculture Chair and Director
UN FAO Special Ambassador for the International Year of the Pulses 2016

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Fighting Hunger Worldwide

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29 July 2016

Message

Food security and nutrition are essential to life and also to the growth, development and stability of any nation. This is more so in a country like India which is home to the second largest population on the planet. The increasing challenge of providing adequate, nutritious and sustainable access to food in order to feed the world's population can only be met by the coming together of effective political will, robust strategies, legislation, programme design and implementation, with the catalytic elements of science and technology.

We at WFP constantly endeavour to better our programmes through scientifically-backed research, and technology-enabled solutions to provide safe and nutritious food for all. This also drives the evidence base needed to enable policy changes which support interventions aimed at enhancing food and nutritional security.

It is heart-warming and encouraging to see that young minds of India – our future scientists, policy makers, nutritionists and food technologists amongst others, are coming together to deliberate on food security issues. It is my sincere hope that their interest, enthusiasm and passion in this area of work continues to grow, and that our youth take up food and nutrition security as a personal mission in order to serve fellow citizens on a fundamental basic human right, the right to safe and nutritious food.

I congratulate the National Council of Science Museums on organizing this seminar which promotes scientific thinking and application in this critical field. We look to initiatives like this to serve as platforms of innovation and to nurture and encourage bright minds and new ideas, both of which are abundant in a great country like India. With such seminars, which reach out to our young, active, curious minds, there is a greater sense of hope that the challenges we face will indeed be overcome in the future. Keep up the good work!

Hameed Nuru
Representative and Country Director

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Shri Shrikant P. Pathak
Curator-F, Head education cell,
National Coordinator NSS-2016
Nehru Science Centre (NCSM)
Dr. E. Moses Road, Worli,
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Dear Shri Pathak,

Many thanks for your kind mail informing me about the flagship event of NCSM, the National Student's Science Seminar, to be held on October 4, 2016 at Nehru Science Centre, Mumbai.

It gives me immense pleasure to learn that a popular student's event is organized every year by the Council involving more than 30,000 school students from a large number of States & Union Territories. The topic for this year's Seminar, 'Pulses for Sustainable Food Security: Prospects and Challenges', is also contextual and relevant to the common mass. India is a rare country which grows such a variety of pulse crops which none of the countries in the world grows. The commonly grown pulses are chickpea, pigeonpea, rice bean and others. Our group at NIPGR has been responsible for sequencing the entire genome of *desi* chickpea and has undertaken molecular genetics approach to analyse yield traits with the ultimate aim of improving *Channa.* Pulses are an affordable source of protein and minerals for a large proportion of rural populations. They have a long shelf life, which means they can be stored for long periods without losing their nutritional value. Many pulses are drought-resistant and are suitable for marginal environments. In fact, the protein obtained from pulses is significantly less expensive compared to animal foods. However, the yield of pulses remains a cause of concern for agricultural scientists. Therefore, in the present context, the organization of this seminar is quite relevant to make the students aware about the importance of pulses as well as to draw the attention of the policy makers, agriculture scientists and the farmers.

As both the institutions, the National Academy of Sciences, India and the National Council of Science Museum, are engaged in imparting scientific temper among the masses in general and students in particular, and also in enhancing the understanding of Science among school students, we strongly feel that the Academy is natural partner in such efforts of national importance.

My heartiest good wishes for the success of the 'National Student's Science Seminar'.

With warm regards,

Yours sincerely

(Akhilesh K.Tyagi)
President, NASI; and
Professor, University of
Delhi, South Campus,
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Professor **RAM RAMASWAMY**
President

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MESSAGE

The National Council of Science Museums initiative to organize an Annual National Students' Science Seminar is highly commendable. The choice of themes is also very appropriate, as for example this year's focus on "Pulses for sustainable food security: Prospects & Challenges" during the International Year of Pulses, 2016. Given the importance of pulses as a major dietary source of proteins for many Indians, the seminar will go a long way in educating and creating awareness among school students in the country on major issues of concern in regard to pulses. These include issues such as pulse diversity, socio-economic and cultural aspects of pulses, nutrition, distribution, agricultural practices, contribution of pulses in food security, storage, factors affecting pulses' production- the list is long! The NCSM, the Nehru Science Centre, and the National Coordinator, Sri Shrikant P Pathak deserve both our thanks and our compliments!

I take this opportunity to extend my warm congratulations to all students participants of the Science Seminar and on behalf of the Indian Academy of Sciences, send our good wishes for a productive and fruitful scientific session.

28 July 2016

Professor Ram Ramaswamy

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foreword

National Council of Science Museums
Ministry of Culture, Government of India

Shri A. S. Manekar
Director General
National Council of Science Museums

National Council of Science Museums (NCSM) has been organising National Science Seminar for school students since 1982 and the Council is proud today to organise the event in its 35th year. For all these years, the event has been a rich source of education and vibrant with participation of young minds from all over the country.

Hon'ble Prime Minister, Shri Narendra Modi, taking cognizance of the country's chronic nutritional imbalance, has urged the farmers to increase pulses production in the country and ensuring that pulses are a part of the diet of the common man for daily protein requirements and overall health. A large section of Indians are vegetarians and therefore the availability of vegetable protein remains the key factor in correcting the situation of nutritional imbalance in India. Being a rich source of vegetable proteins, pulses offer a viable option in ensuring nutritional security for the large Indian population.

Studies have shown that people whose diets are enriched with pulses have reduced risks of some cancers. The high levels of fibre, and low amounts of fat in pulses, and the antioxidant vitamins they contain are thought to contribute to this protective effect. As of 2015, the world's biggest producers of pulses were India, Canada, Myanmar, China, Nigeria, Brazil, Australia, USA, Russia, and Tanzania, while the world's most important pulse exporters also include Argentina, France, Ethiopia, and Turkey.

We need to grow our food in a way that least damages a fragile ecosystem that has pretty well reached the limit of its tolerance to our intensive, present production methods. That is to say we need to pursue food solutions that are not only productive but sustainable and renewable in the longer term.

The young generation will live on this planet for many years to come and therefore they must understand that awareness of the pulses as sustainable food is extremely valuable and global production of pulses has become very much relevant in the present day. I am sure, through their deliberations, the students would be able to develop a framework to evaluate multiple benefits through pulse crops and sustainability.

The United Nations declared 2016 as the International Year of Pulses (IYP) and in order to create awareness about the pulse crops, a critical and ancient part of the food basket, NCSM has chosen '**Pulses for sustainable food security: Prospects & Challenges**' as the topic of this year's National Science Seminar (NSS) to be held at Nehru Science Centre, Mumbai on October 4, 2016.

The science seminar is one of the most popular programmes of NCSM. Like every year, this year also thousands of students from Block level, District level and State level have participated in this nationwide exercise which culminates into the national level competition. Young students will use this platform to express their views and from these budding scientists we shall know the social and scientific issues related to pulses for sustainable food security.

I wish the participants all the very best.

A. S. Manekar

genesis

2016
International Year of
PULSES

INTRODUCTION

Pulses are an important source of nutrition throughout the world and are part of the food grain family known as legumes such as chickpeas, peas, lentils and beans. Considering this, the 68th United Nations General Assembly declared 2016 the International Year of Pulses (IYP 2016) vide its resolution number (A/RES/68/231). IYP 2016 aims to heighten public awareness of the nutritional benefits of pulses as part of sustainable food production aimed towards food security and nutrition. The Year will create a unique opportunity to encourage connections throughout the food chain that would better utilize pulse-based proteins, further global production of pulses, better utilize crop rotations and address the challenges in the trade of pulses.

The Food and Agriculture Organization of the United Nations (FAO) has been nominated to facilitate the implementation of the Year in collaboration with Governments, relevant organizations, non-governmental organizations and all other relevant stakeholders.

Talking of the motion, UN Secretary General Ban Ki Moon explained the rationale behind declaring this year as the IYP stating that, 'Pulse crops, such as lentils, beans, peas and chickpeas, are a vital source of plant-based proteins and amino acids. Despite strong evidence of the health and nutritional benefits of pulses, the consumption of pulses remains low in many developing and developed countries. Pulses can contribute significantly in addressing hunger, food security, malnutrition, environmental challenges and human health."

The world today faces multiple challenges like diabetes, climate change, obesity, water scarcity, cardiovascular disease, biodiversity, nutrient deficiency, nitrogen depletion, stunting, food waste, cancer, says Milan Shah an International trader in pulses. Like the story of the six blind men and the elephant, all these problems are viewed in isolation by huge panels of experts in medicine, sociology, agricultural sciences, environmental science and the farming community. Each offer a multitude of solutions to each problem. But like the wise king in the story, who saw the elephant as a whole, in each case, pulses are part of the solution: a single truth that we perceive in different ways. They are the golden thread woven through the fabric of the more balanced and sustainable world we all wish to see. They address each of the issues mentioned above.

A powerhouse of nutrition, pulses had been a dietary food source of many human civilizations for thousands of years. Pulses are the only plant based protein source and rich in fiber. Pulses contains minerals like iron, calcium, magnesium, potassium, B-group vitamins and other essential nutrients which are helpful for improving the human, animal and the environmental health of the Earth itself.

Pulse crops have a unique role to play in the global nitrogen cycle, as legumes and pulses fix atmospheric nitrogen in soils which can make them self-sufficient in nitrogen, and enable them to grow in almost any soil. The introduction of pulses into crop rotations actively helps fix nitrogen in the soil, thus reducing fertilizer requirements of the pulse crop itself, as well as the following crops, like cereals, which may not have this capability. Pulses also offer exceptional nutritional inputs to human diets, use relatively little water compared to other protein sources, thereby helping save precious water and are also capable of growing well in water stressed lands.

Pulse crops are one of the most sustainable crops a farmer can grow, with low water footprint and energy input than grain crops with a comparable nutritional yield. This year allows the World to frame the appropriate policies that can empower our farmers with advanced cultivation techniques leading to enhanced yield and thereby motivate them to grow pulse crops.

It is in line with this Global initiative, and recognising the fact that pulses form a very significant part of the average Indian diet, that the National Council of Science Museums, Ministry of Culture, Government of India has chosen the topic 'Pulses for Sustainable Food Security: Prospects and Challenges" for this IYP2016's National Science Seminar. Children from across the country have deliberated on this topic at different levels on the urgent need to understand how pulses in addition to being an extremely tasty and nutritious food, also contribute in a great measure to soil deficiency corrections, nitrogen supplementing, prevention of lifestyle diseases, and ameliorating climate change. 36 students, the respective winners of all the 36 states and union territories of India will be participating at the National Science Seminar on 4th October at Nehru Science Centre Mumbai.

Diverse activities around the world, including the National Science Seminar that National Council of Science Museums is organizing, will help raise awareness of the prospects and challenges of ensuring food security, facilitate dialogue among stakeholders, and promote innovative solutions.

National Council of Science Museums, and primarily its constituent Unit, the Nehru Science Centre in Mumbai has joined various National and International bodies in organizing events, activities and programmes to sensitize the citizens of India on this all important topic, which is the need of the hour for all of us. National Science Seminar is one of the most important activities that NCSM is organizing for the school students to create awareness on this topic for students across India.

The World is made by its Nations, and a Nation is made of its citizens in more ways than one. The destiny of a Nation is shaped entirely by the citizens. It is imperative that they are healthy, wealthy and wise. It is today's children who will be tomorrow's citizens and this makes it imperative that we accord the highest priority to furthering their ability to think and arrive at conclusions that will take the World in the right path in the years to come. If NCSM as a National organisation that furthers public understanding of science, succeeds in instilling the seeds for right thought among the students of today, it will have done a great service to the Nation and to Humanity.

Hackett Professor **Dr Kadambot Siddique**
AM CitWA FTSE FNAAS FISPP, Director The UWA Institute of Agriculture, The University of Western Australia, Australia and UN FAO Special Ambassador for the International Year of the Pulses 2016
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Pulses: solutions to human health and cropping systems sustainability

Introduction

Pulses or grain legumes (edible seeds of leguminous plants) include dry beans, field pea, chickpea, lentil, mung bean, pigeonpea, urd bean and several other minor ones. As per the FAO definition, the term 'pulses' excludes grain legumes used for oil extraction (soybean and peanut). Current global pulse production is about 76 million tonnes. Pulses are rich in nutrients important for a healthy diet and relevant to several chronic non-communicable diseases. Pulses are currently underused in comparison to cereals (rice, wheat and maize) despite the known benefits to agricultural productivity, sustainability and human health. Unlike cereal and oil seed crops, pulses can symbiotically fix nitrogen, leading to significant advantages for agricultural sustainability, both in developing and developed countries (Foyer et al., 2016). The United Nations declared 2016 as the International Year of Pulses under the banner 'nutritious seeds for a sustainable future'. Yet, pulses are a minor component of most human diets at present. Food security and soil fertility could significantly improve with greater pulse usage and crop improvement in a range of pulses. Food security and nutrition are a key international development objective under the Sustainable Development Goal (SDG2) of the 2030 Agenda for Sustainable Development. As 2016 is the first year of implementation of the Agenda, the International Year of Pulses will also link the contribution of pulses to critical targets under SDG2, particularly those on food access, malnutrition, smallholder incomes, and sustainable and resilient agriculture.

Pulse crops will only achieve a competitive advantage if their profitability to the farmer is similar to or exceeds that of the dominant cereal crops. To date, pulses have received limited attention from policymakers and governments despite their multiple benefits. The current level of research and development funding for pulses is low and unstable. A recent global survey shows an investment of US$175 million per annum for the 13 pulse crops, a trifling amount compared to the billions of dollars invested in the three major cereal crops each year (Murrell, 2016).

Pulses in cropping systems

Pulses are not only important food and feed sources, but they play a major role in the sustainability and productivity of cropping systems. Pulses contribute to cropping system diversity when grown with crops of other plant families (e.g. Gramineae), disrupting the pest and disease cycles that develop during monocropping. They also contribute to soil fertility, primarily through biological nitrogen fixation but also by adding organic matter and releasing sparingly-available soil phosphorus. A shift in land use toward pulses and away from livestock

would substantially lower the carbon footprint for protein production destined for human consumption. There is significant untapped potential for genetic improvement in pulses which would contribute further to the sustainability of cropping systems.

Farming systems need to be profitable and sustainable to meet the growing needs of the global population and to respond to the changing climate. Farmers need to optimise the use of inputs such as water and fertilisers. Pulses play a significant role in cropping systems because of their sustainable and environmental benefits such as reducing the carbon footprint and the need for nitrogen fertilisers. Well-grown pulse crops typically fix between 80 and 120 kg nitrogen per hectare, such that global nitrogen fixation could account for up to 27 Mt of nitrogen without increasing the area planted to pulses. Hence, about 9 Mt of soil nitrogen would be available for the following crops, which is equivalent to about 10% of global consumption of nitrogen fertiliser and worth US$8–12 billion. Moreover, the grain protein content of cereal crops following a pulse crop increases, and soil structure and health improve after growing pulse crops. Accordingly, nitrogen-fixing pulses provide unparalleled sustainable opportunities for minimising future nitrogen fertiliser use.

The inclusion of pulses in cropping systems can increase the cropping intensity, which enhances annual productivity, increases diversity and reduces overall risk because the reliance on one or more crops declines. Pulse production is static or declining in several countries, in the face of increasing global demand. For example, current pulse production in India is about 18–19 million tonnes. However the gap between demand and supply is widening; hence, about 4–5 million tonnes of pulses are imported annually into India from countries such as Australia, Canada, Myanmar and Turkey. India is the largest producer and consumer of pulses. These crops are grown across a range of farming systems, from subsistence agriculture to sophisticated commercial production systems, so research and development need to target particular species to these various agro-ecological and cultural systems. Several studies in India show that a yield gap exists in pulses; that is, realised yields were often around half of what they could be, but with considerable spatial and temporal variations. The yield gap can be partitioned into two components: (1) the difference between achievable yields—obtained from on-farm demonstrations incorporating currently recommended production technology—and farmer yields, and (2) the difference between model-calculated potential and achievable yields. The first component is usually greater than the second, suggesting that there is scope for applying known technology. The narrowing of yield gaps depends on an understanding of the causes of those gaps.

Genetic improvement

Pulses have underpinned the development of genetics. The common garden pea was used by Gregor Mendel to demonstrate the 'particulate nature of inheritance' (Mendelian genetics) in 1865. Nevertheless, many pulse breeding programs suffer from low genetic diversity and low rates of genetic progress. In recent years, whole genome sequencing has become an affordable and powerful tool to delineate genomic information in core germplasm. Genomic information can be used to generate high-resolution genetic maps for important agronomic traits, develop molecular markers for breeding, and identify important genes for crop improvement. High-resolution genetic maps are available for 10 legumes with de novo sequence information and low-resolution maps are available for all but Bambara bean, tepary bean and lima bean. The establishment of genetic resources and grain legume genome sequencing together provides the opportunity to apply genomics-assisted breeding strategies toward crop improvement.

Health benefits

Pulses provide nutritious human food and animal feed in both commercial and low-input subsistence agriculture. The health advantages of a pulse-rich diet are many faceted. Their role in global health, including the reduction of non-communicable diseases such as obesity, diabetes, heart disease and neurodegenerative diseases, is underappreciated. A diverse diet including a range of pulses is required for health benefits. Pulses hold a near-unique position among foodstuffs because of their health-determinant properties. For example, all-cause mortality increased by 113% for Chinese women on a pulse-free diet and by 30% for Chinese men. Moreover, the mortality hazard ratio declines by 7–8% in older people globally for every 20 g increase in daily grain legume intake. The first study to assess the link between the Mediterranean diet and health, which included a 20 g intake of pulses per day, found a 10% reduction in all-cause mortality.

Pulses offer a food-based solution to decreasing the risk of certain diseases such as pre-diabetes and diabetes management as well as diabetes-associated complications, especially cardiovascular disease. Since diabetes is a major risk factor for several cancers and neurodegeneration, the future health of ageing populations may depend on a food system that provides pulses in an affordable, palatable and sustainable way. Most benefits from pulses are achieved at an intake of about 30 g per day, but lesser amounts are also beneficial. Recent studies in Western Australia consistently demonstrated that lupin-enriched (a pulse crop grown extensively in Western Australia) foods reduced blood pressure and glycaemic responses, providing strong evidence that lupin-enriched foods may have cardiovascular benefits, particularly in patients with diabetes who are at a significantly increased risk of cardiovascular disease. Moreover, lupins have negligible anti-nutritional properties and can be consumed as snack foods with minimal cooking. However, to increase the global consumption of pulses, more convenient, tasty pulse-based food products that meet the demands of consumers are needed.

Conclusions

Pulses have been included in cropping systems for hundreds of years, especially in rotation with other crop species. A boost in pulse production is urgently needed to oppose the static or declining production trends especially in developing countries, despite increasing global demand. The International Year of Pulses in 2016 provides an excellent opportunity to reflect on the status of global pulse production, consumption and potential opportunities for future expansion. Our current overreliance on a handful of major staple crops (rice, wheat, maize and potato) has inherent agronomic, ecological, nutritional and economic risks and devalues the contributions made by underused crops such as pulses. The intake of a diverse array of pulses is important in the human diet. Moreover, many underused pulse crops are already an essential source of vitamins, micronutrients and protein for vast areas of the developing world and, thus, a valuable component for nutritional security. More enduring partnerships need to be established between national and international research bodies, non-government organisations, community-based organisations and commercial entities interacting with farmers. Only then can we expect that smallholder farmers will practically implement the extensive knowledge we have so far to increase the production of pulses. Let us produce and consume more pulses in our diet in the International Year of Pulses 2016.

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UWA siddique Faba Beans Mingenew field walk

Manual harvesting of chickpea

Dr. Hameed Nuru
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Scientific thinking and innovations in technology to boost food and nutrition security

The mammoth and crucial task of providing every human being with safe and nutritious food will remain a challenge, which can only be achieved throughinnovative and practical advancements in science and technology.

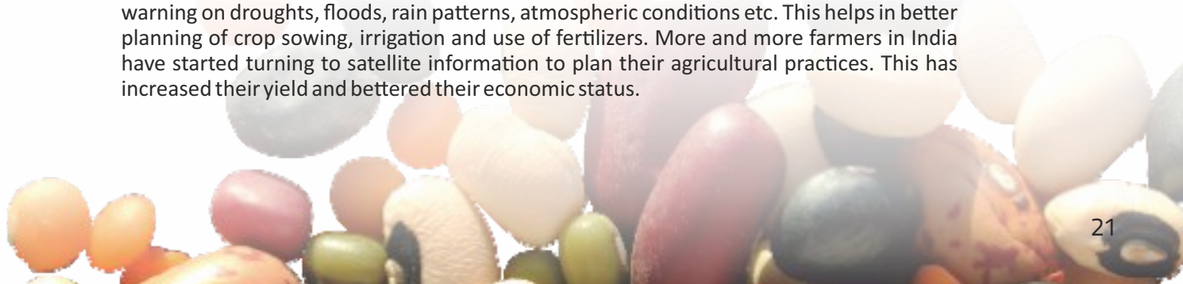
Scientific innovations: From farm to folk

The food that we eat goes through various stages of production, storage, and processing. It also travels great distances and exchanges a number of hands before it reaches our plates. This journey from farm to fork is complex, requiringinnovation, cutting edge technology, and the finest scientific minds.

To trace the journey of our food, we have to begin at the farmer's field. Application of science and technology in farming practices has helped farmers increase productivity.For example: Choosing better seedsto match the local climate and terrain has resulted in easier management andgreater productivity. In regions like eastern India where flooding is common, farmers have taken to growing flood- tolerant rice, which can withstand total submergence for more than two weeks. In a similar manner, moving to scientifically backed livestock husbandry systems, like the use of vaccinations and better health care techniques for livestock hasresulted in the prevention of diseases, rather than management of outbreaks which are much more difficult to contain and lead to loss of livestock.

The introduction of the Soil Health Card by the Government of India is another example of how science is boosting agricultural productivity. Soil cards are issued to farmers so that they can get a regular and well-monitored report of the soil which is chosen for cultivation of crops. This guides them in choosing nutrients and fertilizers required for each type of soil, thereby increasing the crop yield.

Weather satellites are another crucial tool that give the farmer timely information and warning on droughts, floods, rain patterns, atmospheric conditions etc. This helps in better planning of crop sowing, irrigation and use of fertilizers. More and more farmers in India have started turning to satellite information to plan their agricultural practices. This has increased their yield and bettered their economic status.



Technology used in farm management has also contributed to better results for farmers. Innovative startups in India are using mobile apps to track and monitor the growth of crops on farms around the country. The app tracks what is grown, and the conditions in which the crops are grown. This enables regular and systematic monitoring of farms, and helps farmers receive advice on how to better their agricultural practices. Use of mobile technology has helped in linking farmers to their markets in real-time. It keeps them abreast of current prices, availability of products, and market locations where they are able to get competitive prices.
The 'white revolution'in India,also known as 'Operation Flood' applied science and technology to the production, processing and marketing of milk, which led to India rapidly positioning itself as the world's largest producer of milk. The revolution was fueled by the introduction of a balanced cattle feed, health services, artificial insemination, veterinary treatment and optimum use of technology.

Technology also forms the backbone of an efficient food delivery system. The efficient and accountable distribution of food to people in a large country like India requires systems that track the movement, delivery and distribution of food. The ongoing end-to-end computerization of the Government's Targeted Public Distribution System is a noteworthy example where technology is used to identify families who need the government subsidy, automate transactions at the point of delivery and also develop a system so that families can provide feedback and report complaints. The application of technology into this system creates a transparent mechanism of food delivery – one that ensures food reaches those who need it the most.

Science for nutrition security

Our task does not only involve making sure everyone has food, but the bigger task is to ensure that everyone gets adequate nutritiousfood, in a sustainable manner. Diversification of diet is an effective way to ensure that people are able to meet their daily requirement of nutrients.
However, apart from diversifying what one eats, scientific research and technology also provides us with options to fortify foods that are consumed on a daily basis. Through the process of fortification nutrients (like iron, iodine, vitamin A, vitamin B12) are added to common foods like rice, salt, wheat etc. For example: Through the commitment of the Government of Odisha and support from WFP, iron fortified rice is being served to school children in Gajapati, Odisha under the Government's Mid-Day Meal Programme. Children are being given their regular meal consisting of rice and curry – but what is different is that the rice has iron in it which is helping in reducing anemia.

Fortification is a scientific process driven by technology. Fortification of rice involves the production of fortified rice kernels, which are manufactured by combining rice powder with iron, and then converting this powder into rice-like kernels. These fortified rice kernels are then blended with regular rice and is ready to be cooked in exactly the same way as regular rice.
Awareness on nutrition is another important part of being nutrition secure. Communities need to be sensitized on what constitutes a nutritious diet, and how this benefits the body. Television and social mediacampaigns play a huge role in reaching out to people with scientifically tailored messaging. Mobile-based awareness campaigns can reach millions much more efficiently than traditional methods, even in the remotest of villages. This can be of huge importance especially in cases of outbreak of disease and/or food contamination.

Scientific evidence for policy making

We cannot afford to deviate from scientific thinking, research and application when designing policies and programmes that work towards food and nutrition security. Can you imagine a scenario where we do not have scientific data and understanding of what crops grow in a particular region, what are the food requirements of that region, and how food is consumed by the local community? It is in fact this data, when gathered methodically, that can give us clues to what is needed while designing programmes for a nation. Up-to-date technological systems will ensure that the appropriatefood is reaching the identified community.
In a country as diverse as India, food production and consumption varies through different parts of the country. In such a case, it is even more important to use the knowledge and application of science to adopt better and wholesome food practices.

Sustainable Development Goals and India

Working towards a future with zero hunger is a vision shared by the global community. When world leaders and thinkers met to plan how they envisioned the world by 2030 – a world free of hunger was high on their priority. This reflected in the framing of the Sustainable Development Goals (SDG) where – 'Ending hunger, achieving food security and improving nutrition and promoting sustainable agriculture' was crafted as SDG 2.Achieving SDG 2 in India – the world's second most populous country, is critical as until and unless India is food and nutrition secure, the rest of the world cannot be. With advances in science and technology, a lot of which is already present in India, the vison of an India free from hunger is possible within our lifetimes, and even more so by 2030, a date set for achieving the SDGs.

As India makes huge advancementsin areas like renewable energy,nuclear technology, and launches into space a record-breaking 20 satellites in a single mission, it is imperative for India to lead on food and nutrition security. India is a food surplus nation, with adequate in-house talentand resources to ensure food and nutrition security. Instrumental to this is increased scientific research, technology backed investments, innovative plans, and appropriate policies and strategies to ensure that no man, woman or child goes to bed hungry.

Diversification of diet: Inclusion of pulses

The inclusion of pulses into ones diet can have significant impact on health and nutrition.
Pulses have a higher protein content than cereals, and are also rich in micronutrients, amino acids and B-vitamins. Pulses are high in dietary fiber and contribute towards the prevention of non-communicable diseases.
They are an affordable source of protein and minerals for a large proportion of rural populations and contribute towards food security.

WFP has been in India since 1963. Currently, WFP supports the Government in increasing the efficiency, as well as the nutritional impact of food-based social safety nets. This also includes research and analysis that inform effective policy design and implementation.

WFP is supporting the governments of Kerala and Odisha in the end-to-end computerization of the Targeted Public Distribution System. Technology is used at fair price shops to ensure transparent and efficient transactions.

Photo credit : WFP/Aditya Arya

WFP is working with the government of Kerala and Odisha to fortify foods distributed under the food-based social safety nets.

Photo credit : WFP/Aditya Arya

WFP is working with the governments at the central and state level to establish mechanisms to identify food and nutrition insecure geographies and populations.

Photo credit : WFP/Aditya Arya

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Pulses in Human Welfare

The mature seeds of the plants of the family Fabaceae commonly known as 'grain legumes" or 'pulses" are major food stuffs in most countries and indispensable protein source for the third world populations. The major pulses included drypeas, lentils, chickpeas, green gram (mung), black gram (mash kalai), red gram (arhar) etc. (excluding the oil yielding soybean and peanut). Around 60% of total pulse production is from Asia and India is one of the largest producers of pulses. Daily per capita consumption of pulses products in Asia is about 110g as compared to US where only 9g is taken in diet.

Pulses being a rich in protein are considered as good source of nutrients and are also recognized as poor man's meat showing their importance for consumption in the third world countries where protein, energy malnutrition often appears as a major nutritional problem. They are also good source of minerals (fe, zn, etc.) and vitamins, contain variety of phytochemicals, display antioxidant property and record extensive array of flavonoids (anthocyanins, flavanols, isoflavones, phenolic acid etc.). Significantly the utilization of pulses have great association with many physiological and health benefits, such as prevention of cardiovascular disease, obesity, diabetes mellitus and cancer.

Sadly there is a downward trend in legume/ pulse consumption even in the most traditional markets such as India & Spain. This scenario is gradually changing due to the growing awareness of the environmental impact of food choices which has generated moderate increase in the consumption of plant vs animal foods and people are looking for a healthier and more sustainable lifestyle. To meet the demands of today's consumer there is urgent need to develop convenient and tasty pulse products. Against this backdrop it is increasingly important to have greater and clear understanding of nutritional quality of pulse seeds in terms of protein, starch, fibre and anti nutritional compounds which has to be supported by a more transparent projection demonstrating health benefits linked to pulse consumption.

PULSE PROTEIN AND QUALITY

Proteins are essential in food which provides essential and non–essential amino acids and nitrogen for human health. Pulses are generally rich in protein (ranging 23% in Chickpea to 29 % in Lentil) and carbohydrate (around 64 to 69 %) but low in fat (ranging 0.8 % in lentil to 5 % in chickpea). The major proteins are globulin (Legumin, 11S and Vicilin, 7S) and albumin (including enzymatic protein, protease inhibitors, amylase inhibitors and pectin). Importantly, proteins from the cereals and those from the pulses complement each other in diet. The pulse proteins are deficient in methionine and cysteine (sulphur containing amino acids) while rich in lysine. In contrast cereal proteins are short of lysine but high in methionine and cysteine. Proteindigestibility is an important parameter to access nutritional value. For this purpose the Digestible Indispensable Amino Acid Score (DIAAS) has recently been recommended by FAO.Though pulse protein digestibility is considered to be relatively poor there is still limited information on DIAAS for pulses.

Proteins and peptides in pulses record health benefits. Peptides with angiotensin-1 converting enzyme (ACE) inhibitory properties are recovered from the protein hydrolysates of lentil, pea, bean and chickpea. ACE plays a role in vasoconstriction that results in the elevation of blood pressure (hypertension). The lower IC_{50} (the half maximal inhibitory concentration) would indicate higher ACE inhibitory activity. The value of IC_{50} for lentil protein hydrolysate ranges from 53 to 111 µg/ml which is lower than other pulses suggesting the importance of lentil in influencing blood pressure. There are reports which suggest that pulse flours, protein concentrates and isolates have the capacity to bind bile acids. Removal of bile acids (synthesize from cholesterol in the liver) through binding of foods in the gastrointestinal tract, followed by their elimination, increases cholesterol metabolism which may help to reduce cholesterol levels in blood. Solubility has nutritional, health and functional implications. Relatively insoluble proteins that are poorly digested continue to stay longer in gastrointestinal tract would have negative impact for the people with limited absorption capacity.

DIETARY FIBRES

Pulses are good sources of structural carbohydrates due to their higher soluble dietary fibre (SDF) content compared to cereals and tubers. The dietary fibre (DF) fractions are of nutritional interest because of their important physiological properties that can promote health. The total dietary fibre (TDF), insoluble dietary fibre (IDF) and soluble dietary fibre (SDF) levels vary depending upon the pulse species. There are different IDF/SDF ratios among the pulse species with peas exhibiting the largest SDF fraction (≤ 25% of TDF). The ratio of insoluble and soluble fibre plays important role in influencing potential health benefits, with the optimum ratio being 3:1. Significantly, germination promotes DF fractions and improves IDF/SDF ratio due to the metabolic reaction accompanied by an increase of polysaccharides causing changes in cell wall matrix. It is to be noted that pulses with high level of pectic polysaccharides in IDF fraction is associated with the potential physiological effects in the human upper gastrointestinal tract. A strong positive correlation between the content of uronic acids of IDF and cation exchange capacity has been observed in pulse fibres which would facilitate the capacity to bind heavy metal ions.

PHYSIOLOGICAL PROPERTIES AND DIGESTIBILITY OF PULSES STARCHES

Starch is the most abundant carbohydrate in pulse, accounting for 22-45% of the seed. Pulse starch exhibits lower glycemic index (GI) than cereals and tubers because of high level of amylose (important component of starch) and strong interactions between amylose chains. Pigeon pea starch records lowest in vitro GI values of around 44, while it is about 51 for mung bean and chickpea. The low GI means slow release of glucose into blood stream which is beneficial for people with diabetes. Pulse starches are less digestible than cereal starches because they contain less amount of rapidly digestible starch (RDS). Mung bean contents relatively more slowly digestible starch (SDS) but less amount of resistant starch (RS). In contrast pigeon pea has less SDS but more RS, while lentil displays moderately high SDS and RS. High amounts of SDS and RS could be linked with potential physiological benefits, such as areduction of potential risk factors for then metabolic syndrome, diabetes management, protection against colonic cancer and mental performance. The dietary intervention of a substantially increased intake of pulses is advised to replace readily digested foods.

NATURAL SOURCE OF ANTIOXIDANTS

Pulse seeds are valuable source of natural antioxidants such as phenolic compounds, tocopherols etc. The antioxidants can protect against oxidative stress which is closely linked tocancer and cardiovascular disease. The potential antioxidant capacity of pulse seeds on total phenolic content. The major phenolic compounds are phenolic acids, flavonoids, and pyrocyanadins. The low levels of phenolic acids are in mung bean, lentil, faba bean and pigeon pea. The majority of flavonoids are present in the seeds as glycosides. In the seeds of pulses - tocopherol predominates and its level is greatest in pigeon pea, pea and lentil. The germination plays important role in antioxidant properties of pulse seeds. The antioxidant activity estimated by -carotene assay in mung bean sprouts has been found to be the highest in the first day of germination. The germinated mung bean seeds express significant increase in total phenolics on the contrary germinated lentil seeds record lower anti-radical capacity than that of the raw seeds.

POSITIVE AND NEGATIVE ROLE OF ANTINUTRITIONAL FACTORS

Many components of pulse seeds are recognized as anti-nutrients. Their metabolites such as vicine and convicine in faba bean or sucrose derived oligosaccharides and tannins. There are also various classes of proteins such as trypsin/chymotrypsin which inhibit the action of proteases. Vicine and Convicine in faba bean are thermostable pyrimidine glucosidic compounds which are associated with favism i.e. haemolytic anaemia. The non protein amino acid -ODAP found in grass pea that, if consumed in large quantities for extended periods can lead to neurolathyrism, a neurotoxin disease. However, activation of protein kinase C by - ODAP adds a new positive dimension for investigating its therapeutic potential in such areas as Alzheimer's disease, hypoxia and the long term potentiation of neurons essential for memory. The plant metabolite -galactosyl derivatives of sucrose abundant in pulse seeds restrict digestibility in humans and other monogastric animals as they lack digestive - galactosylase. Consequently dietary oligosaccharides are fermented by bacteria in the large intestine which produce carbon dioxide, methane and hydrogen causing flatulence. This may be perceived to be either an anti-nutritional or a prebiotic effect; for the latter benefit, purified oligosaccharides are in demand as food additives for the promotion and maintenance of gut microbial health. This family of compounds is also emerging as important immune-stimulators in animals and humans. In spite of the negative impact the anti-nutrients may play important beneficial roles in both plant metabolism and human health.

NATURAL SOURCE OF MINERALS:

About half of the world population suffers from malnutrition of iron, zinc, calcium, iodine and selenium. This is known as 'hidden hunger" and iron deficiency becomes the most serious nutritional problem. The pulses are natural rich source of several minerals and are excellent candidate foods for combating malnutrition. Beans are rich in iron, zinc and other microelements. Peas low in phytic acid are good source of iron, zinc and magnesium. Mung bean another pulse with lower phytic acid than pigeon pea is an iron rich food source with wide genetic variability for iron and zinc. Chickpea on the other hand having low phytic acid is a rich source of selenium and other microelements as well as of carotenoids which can increase mineral absorption in the human digestive system. These pulse species with enriched mineral concentration positions themselves as food based solution for global mineral micronutrient malnutrition.

Several pulse nutrients interact with each other, modulating their respective absorption rates. Efforts are made to increase the concentrations of 'promoter substances" to stimulate the absorption of essential minerals and to reduce the concentration of anti-nutrients by interfering with their absorption. The best described 'promoter substances" are insulin, amino acids, cysteine, vitamin D, E, provitamin A, niacin and choline. They promote the absorption of selenium, calcium, phosphorous, iron and zinc, methionine and tryptophan.

With best regards,
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Let us Promote Pulses – The Healthy Food

Smita Mohanty
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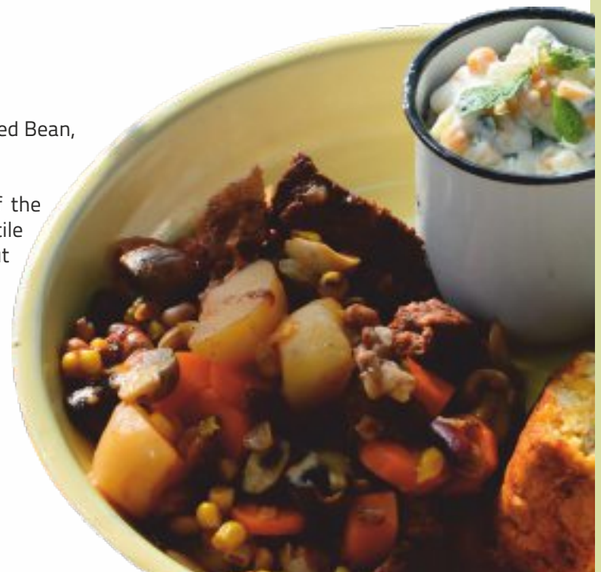
Pulses belong to the family of leguminosae (legume). The fruit of the plant is a pod containing seeds, which are called legumes. By definition, legumes are dried seeds from a pod that develops from a simple carpal and opens up along its seams on two sides. The seeds of pulses are believed to be native to South Western Asia and Northern Syria. Archaeological evidence dates back the cultivation of pulses to 6,000 BC. The seeds found in Egyptian tombs dates back to 2,400 BC. During the Neolithic period, they spread to Greece and Bulgaria and during Bronze age spread to North East and Mediterranean.

The Food and Agriculture Organisation (FAO) of United Nations defines pulses as 'an annual leguminous crop yielding from one to twelve seeds within the pod and harvested for dried seeds". The definition excludes seeds that can be used for extracting oils (soybean and peanuts). According to this definition, the green beans and green peas are vegetables, not pulses. The definition also excludes seeds for the sole purpose of sowing such as cloves and alfalfa. Basically, the term 'Pulses' cover all those legumes grown for their dried seeds. The use of pulses varies from their being used as staple diet to condiments for milk, cheese and snacks. Some of the pulses are used as fodder or green manure whereas some are used as silage.

FAO recognises the following eleven primary pulses :

I. Dry Beans which cover Kidney Beans, Lima Beans, Azuki Bean, Mung Bean, Black Gram, Scarlet Runner Bean, Rice Bean, Moth Bean
ii. Dry Broad Beans including Horse Bean, Broad Bean, Field Bean
iii. Dry Peas including Garden Pea, Protein Pea
iv. Chick Pea / Bengal Gram
v. Pigeon Pea / Toor / Arhar
vi. Dry Cow pea
vii. Earth Pea
viii. Lentil / Masoor
ix. Vetch
x. Lupins
xi. Minor Pulses including Lablab, Jack Beans, Winged Bean, Velvet Bean, Yam Bean

Pulses form an integral part of the food basket of the population in most parts of the world. They are versatile ingredients which can be stored for months without losing their nutritional value, providing increased food availability in the intervening period between harvests. Nitrogen fixing properties of pulses can improve soil fertility and productivity of land. Pulses are highly water efficient since one kg. of pulses



requires 50 litres of water whereas one kg of chicken requires 4,325 litres and one kg of mutton requires 5,520 kg of water. By producing smaller carbon footprints, they act as an ally against climate change. They are a powerful superfood being rich in protein, iron and zinc and having zero cholesterol and low fat content.

The UN General Assembly has declared 2016 as the International Year of Pulses (IYP) and Food and Agriculture Organization of the United Nations (FAO) is facilitating the implementation of the Year in collaboration with Governments and other relevant stakeholders to raise awareness about the contribution of pulses to food security and nutrition and encourage all stakeholders to work towards improving production and productivity of pulses.

Pulses in India

Overview

India is the largest producer (25% of global production), consumer (27% of world consumption) and importer (14%) of pulses in the world. Pulses account for around 20 per cent of the area under foodgrains and contribute around 7-10 per cent of the total foodgrains production in the country. Gram is the most dominant pulse having a share of around 40 per cent in the total production followed by Tur/Arhar at 15 to 20 per cent and Urad/Black Matpe and Moong at around 8-10 per cent each. Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh and Karnataka are the top ve pulses producing States in the country.

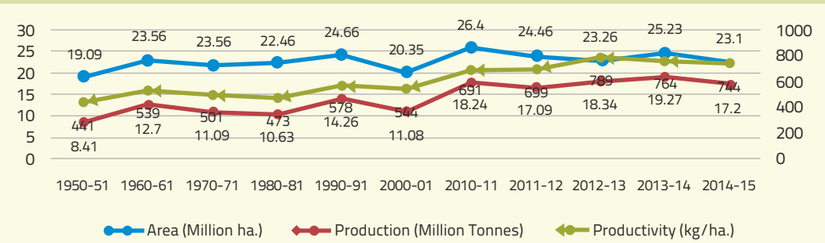
Chart – 1 : **Major Pulses in India**

1. Bengal Gram / Desi Chick Pea / Desi Chana
2. Pigeon Peas / Arhar / Toor / Red Gram
3. Green Beans / Moong Beans
4. Chick Peas / Kabuli Chana
5. Black Matpe / Urad / Mah / Black Gram
6. Red Kidney Beans/ Rajma
7. Black Eyed Peas / Lobiya
8. Lentils / Masoor
9. White Peas / Matar

Area, Production and Productivity of Pulses

The trend in area, production and productivity of pulses in India (Chart 2) gives an overview of the trend.

Chart – 2 : **Area, Production and Productivity of Pulses**



As per the 4th Advanced Estimates of Ministry of Agriculture, GoI, (released in August 2016), production of pulses for the year 2015-16 is expected to be 16.47 million tonnes, Thus, on an average, India produces around 17-18 million tonnes, imports around 4-5 million tonnes and exports around 0.25 million tonnes of pulses in a year. The total pulses available for domestic consumption roughly amounts to around 21-22 million tonnes. India has been the largest importer of pulses since the beginning of the present millennium.Though pulses are grown in both Kharif and Rabi seasons, Rabi pulses contribute more than 60 per cent of the total production. The area under pulses has increased from 19 million ha. in 1950-51 to 23 million ha. in 2014-15, indicating an increase of 21 per cent whereas the production of pulses during the same period has increased from 8.41 million ha. to 19.27 million ha. (an increase of 104%). Productivity of pulses has improved by 69 per cent, from 441 kg/ha. to 744 kg/ha. during the same period.

Since ages, pulses have been well integrated into the farming system of our country as the farmers could produce them by using their own seeds and family labour without depending much on external inputs. With the advent of Green revolution during 1960s, which promoted rice and wheat using external inputs and modern varieties of seeds, pulses were pushed to the marginal lands. This resulted in decline in productivity and land degradation. Pulses are still cultivated on the marginal and sub marginal land, predominantly under unirrigated conditions. The trend of commercialisation of agriculture has further aggravated the status of pulses in the farming system

Per capita net availability of pulses in India, however, has reduced from 51.1 gm/day (1971) to 47.2 gm/day (2014) as against WHO recommendation of 80gm/day. The unabated rise in the prices of pulses during major part of the year 2015-16, both at wholesale as well as retail level was a matter of concern for the policymakers. The rate of inflation of cereals and food related items in general has been very low in comparison to that of pulses during the corresponding period, giving credence to the emergence of 'Protein inflation' of which pulses alongwith fish, meat and milk are the major triggers.

This raises question about the nutritional aspect as pulses are considered to be 'poor man's protein'. It is estimated that pulses contain 20-25 per cent of protein by weight and have twice the protein available in wheat and thrice that is present in rice[4].In addition to its nutritional advantage, pulses have low carbon and water footprints which make them an integral part of the sustainable farming system. As per estimates, one kilogram of legume emits 0.5 kilogram in CO_2equivalent whereas one kilogram of meat produce 9.5 kilogram in CO_2equivalent[5].

Research and extension are the cornerstone for increasing the production and productivity of pulses. A number of steps have been taken in this regard, prominent of which are as follow:

(i) Indian Institute of Pulses Research is coordinating three All India Coordinated Pulses Research Projects, each for Chickpea, Pigeon pea and MULLaRP (Mungbean, Urdbean, Lentil, Lathyrus, Rajmash and Pea) are involved in research and demonstration of technologies developed through the coordinated efforts for increasing and sustaining production of respective crops in the country.

(ii) National Food Security Mission (NFSM) – Pulses introduced during 12th FYP (2007-12) has covered a total of 622 districts across 27 states.

(iii) Since 2010-11 the Scheme 'Bringing Green Revolution in Eastern India (BGREI)" is being implemented in Eastern States of Assam, Bihar, Odisha, Chhattisgarh, Jharkhand, West Bengal and Eastern Uttar Pradesh. To give a boost to their area and production, pulses have also been included under BGREI from 2015-16 as part of demonstrations under cropping systems based approach to target rice fallow areas.

(iv) To encourage farmers to grow more pulses by ensuring remunerative prices, the Minimum Support Prices (MSPs) of pulses have also been increased over the years. Further, for 2015-16, over and above MSPs, the Government has announced a bonus of Rs.200/- per quintal for kharif pulses and Rs.75/- per quintal for rabi pulses.

But productivity of pulses has not improved much. Farmers still cultivate varieties which were notified ten years ago, and this coupled with low seed replacement rate, poor adoption of package of practices, unavailability of seeds at right time, etc. contribute to the low productivity. Farmers continue to depend on public extension system, which has limited outreach in view of their existing institutional capacity, infrastructure and knowledge base. Mobile based applications in PPP mode can supplement the formal extension system.

As per Indian Institute of Pulses Research (IIPR), India's population is expected to touch 1.68 billion by 2030 and pulses requirement for the year 2030 is projected at 32 million tonnes. To meet this requirement, additional 3-5 million ha. to be brought under cultivation and productivity has to be increased to 1,361 kg/ha. Further, as per VISION 2050 of IIPR, the projected demand for pulses by 2050 at 50 million tonnes necessitates annual growth rate of 4.2 per cent which additional area of 3- 5 million under cultivation and augmenting productivity to 1,500 kg/ha besides drastically reducing post-harvest losses[6].

In view of the importance of pulses in the Indian food basket, their contribution to environmental sustainability and also the small holder centric cropping system, it is imperative to give focused attention to pulses sector.

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Pulses and abiotic stress tolerance: Strategies and approaches

Pulses are important food crops with great relevance in terms of food and nutrition across the globe. Pulses are annual leguminous crops, which are important source of protein, essential amino acids as well as complex carbohydrates, several vitamins and minerals. In India, many kinds of pulses are grown such as, chickpea, pigeonpea, black gram, green gram, lentil, fieldpea, kidney bean, lima bean and several others. Apart from these, arid legumes cowpea, horse gram, moth bean and cluster bean are also grown to a limited extent mainly in dryer parts of country.

The supplementation of pulses with cereal based diets is crucial to reduce protein energy malnutrition. Pulses also contain a wide range of nutrients, including carbohydrate, dietary fibre, unsaturated fat, vitamins, minerals as well as antioxidants and phyto-estrogens. In view of the biological nitrogen fixation capacity of most leguminous species, their contribution to sustainable and climate resilient agriculture as well as their ecological importance is well known. The water requirement of pulses is much lower than several other food crops besides contributing to soil nitrogen through their root nodules. These traits reduce stress on natural resources and replenish the soil which is beneficial for the environment. When used in rotation and as inter crops pulses also have the potential to boost the yields of other crops.

However, pulses production in the country has fluctuated widely between 13 and 15 million tons with no significant growth trend between 1991 and 2010 except during last five years which has shown some improvement in pulses production in the country. Presently our annual production of total pulses is about 17.15 million tons with productivity level of 764 kg/ha (2013-14). However, the yield level is still less than the global average of 1451 kg/ha (FAOSTAT, 2013) resulting in less per capita availability. It still remains a challenge to produce more to feed the ever increasing population. These challenges are further accentuated with climate variability and change being experienced in recent years across the country. In this context, emphasis of current research challenges has to be on situations that have also relevance for climate change scenarios with a view at the most likely predictions viz., an increase of 2-4°C in the mean temperature associated with an increased frequency of heat stress events and increase in atmospheric CO2 concentration and a likely increase in climate variability.

Several of the pulse crops are predominantly rainfed and as such are exposed to water deficit and temperature stresses. Thus, developing stress tolerant cultivars in pulses for different agro-ecologies of the country appears to be the major challenge to enhance the productivity in order to meet the increasing demand of food and nutrition.

Efforts had been initiated a decade ago to study the impacts of elevated CO_2 on pulse crops at Central Research Institute for Dryland Agriculture (ICAR-CRIDA). Our studies with Open Top Chambers (OTCs) revealed that the magnitude of response of different rainfed crops to elevated CO_2 was found to be different. In general, the response of C3 crop plants was found to be higher than C4 crop plants. The increment in total biomass was 40% in C3 pulses and 35% in oilseeds with elevated CO_2, whereas with C4 cereals it was only 15%. Under elevated CO_2, the yield advantage of pulse crops of blackgram and pigeon pea was up to 89%. The response of blackgram (Vigna mungo L. Hepper) to increased levels of CO_2 was observed to be significantly higher when moisture stress was imposed. This was possible due to allocation of assimilates, which was greater to roots as compared to shoots under stress. The impact of elevated CO_2 on phenology of flowering and harvest index was also observed in pulse crops. Flowering was early by 3 to 12 days in pigeon pea genotypes under elevated CO_2 and a significant increase in harvest indenx (> 38%) was recorded. This clearly revealed that, pulse crops are more responsive to the increased atmospheric CO_2 concentration in terms of both biomass and yield improvement.

Horse gram (Macrotyloma uniflorum), an important arid legume is being used as a contingent crop due to its better tolerance to drought stress. Horse gram has special significance in subsistence farming for nutritional security of resource poor people. It is well known for its drought hardiness and suitable for cultivation on dry lands under poor fertility condition. It has been advocated as a contingency crop in case of inadequate rainfall during kharif season in India. It is also comparable to other commonly consumed pulses in its nutritional value and serves as a cheap source of nutrition. Since yield level of the then available varieties were very low, efforts were made at ICAR-CRIDA to develop new horse gram cultivars with high yield having tolerance to biotic and abiotic stresses for semi-arid region of South India. Genetic enhancement program was initiated employing mutation breeding approach. ICAR-CRIDA has developed 4 horse gram varieties (CRHG-4, CRHG-22, CRIDA-18R & CRHG-19) of which two each are black and white seeded. These varieties were released for commercial cultivation in southern states of Andhra Pradesh, Telangana, Karnataka, Tamil Nadu and Kerala.

Genotypic differences in the recovery patterns of compensatory growth responses provide useful clues to the growth and agronomic performance of pulse crops under dryland conditions. Metabolic and growth responses to water deficit and its relief were elucidated in important rainfed pulses. Also we developed efficient protocols for regeneration from cotyledonary explants in two important short duration legumes, black gram and green gram.

Presently, efforts on abiotic stress tolerance in pulses are being focussed at the institute to characterize pigeonpea germplasm including released cultivars for various morpho-physiological drought related traits to identify tolerant germplasm and to assess level of genetic diversity. Pigeonpea (Cajanus cajan L. Millsp.) is one of the most important pulse crop grown in India predominantly under rainfed conditions. Being deep rooted crop, it is considered to be water deficit tolerant. Although yield may get affected if it is exposed to prolonged drought stress during flowering and pod filling stage. There is large variation for maturity in pigeonpea, ranging from extra early (90 days) to very long (300 days) among available pigeonpea germplasm. Despite several decades of intensive efforts in various crop improvement programmes, the yield level reached a plateau, owing to the narrow genetic base.

Molecular characterization of 138 pigeonpea genotypes led to the identification of a few drought tolerant genotypes with high photosynthesis rate, stomatal conductance, transpiration rate and high yield under rainfed condition. Molecular diversity study revealed 15 polymorphic single sequence repeat (SSR) and 52 alleles were identified while population structure analysis grouped these genotypes into seven sub populations. This study indicates presence of considerable genetic diversity among Indian accessions which can be eventually utilized for diversification of gene pool and using them in crop improvement for high yield.

proud winner 2015

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National Science Seminar 2015

Topic:

Harnessing Light
Possibilities and Challenges

Ms. S. Hanusha Vardhini
Sri Jayendra Swamigal Silver Jubilee Matriculation
Hr. Sec. School, Thirunelveli, Tamilnadu

Best delibration 2015

NATIONAL SCIENCE SEMINAR 2015

HARNESSING LIGHT : POSSIBILITIES AND CHALLENGES

Distinguished judges, respected teachers and friends, a hearty greetings to you all. In this international year of light I am honoured to present a seminar on the topic 'HARNESSING LIGHT: POSSIBILITIES AND CHALLENGES"

Light is a charge less, mass less form of electromagnetic radiation. Light has a unique nature of duality. It behaves both a particle and wave. Worlds 1st photo of light's duality.

Possibilities?

Even a speck of light has immense possibilities. Light flashes for just a few attoseconds, 10^{-18} seconds duration can trace and steer electrons. A valence electron motion is captured here. It is possible to enhance computational speed by a factor of 1000 times. Molecular fingerprinting using attosecond laser can trace a needle in haystack It could become possible to detect diseases from human exhale.

Light is a great enabler in many fields.

Agriculture

Photo selective shade netting

No high tech. Simple coloured nets. It helps to harness selective frequencies of natural light. It increases the yield and prolongs shelf life of vegetables like Tomatoes, capsicum etc.

LED

LEDs can provide light for round the clock photosynthesis in plants and can facilitate vertical agriculture in closed environment.

Energy

By 2030 our energy needs will be 20 terawatts. Harnessing light in multiple ways is the only possible path to reach with lowest carbon foot print.

Bionic leaf

Solar harvesters combined with photo catalysts immersed in water and exposed to sun light can produce hydrogen. When this is combined with suitable microbes it is termed as bionic leaves. Such leaves can produce liquid fuels like isopropanol, butane., acetic acid, biodegradable plastics and drugs.

Solar pv

Perovskites a new, cheap crystal, 2 dimensional metallic compounds combined with graphene can harness sunlight hitting vertical walls and turning into electricity.

Photo switch

Azobenzene combined with carbon nanotube can harvest energy from sunlight and store it forever. They can release it as heat energy on demand. It's possible to eliminate fire wood, charcoal and carbon based fuels.

Magnetic effect of light

At the right intensity, when light is travelling through an insulator the light field generates magnetic effects that are 100 million times stronger than previously expected, that helps to derive electric current directly.

Energy from fusion

It is possible to create nuclear fusion energy with the assistance of lasers.

Manufacturing

Lasers

Lasers are used for cutting, welding, drilling, metal finishing, manufacturing of electrical circuit on semi conductor chips and also in 3D printing.

Lasers enabled 3D printing possibly reduces 50% of energy needs and 90% of material costs.

Computing and Communication

All optical permanent data memory

Ultra short light pulses can change GST materials from crystalline to amorphous and back. Using this principle all optical permanent data memory can be created.

Li-Fi

Can 18 movies be downloaded in a second? Yes, it's possible with Li-Fi (LIGHT FIDELITY). Using suitable signal converters every light bulb can transmit data at an ultra high speed of 224 GB / sec.

Quantum teleportation

One can transfer quantum state of a photon from one location to another location without physically transferring the photon. Scientists have achieved a teleportation distance of 143 km. Total encryption and speed are the major factors.

Defence

Laser Weapon

The laser weapon system is a directed-energy weapon. No bomb, no missile just beams of infra red energy to destroy targets. Terrestrial and space based systems are possible.

Light craft

It is possible for a space craft to ride on a laser beam in to space.

Laser beams are reflected into engine air, where air gets heated and combusts and which propels the craft.

Life Sciences

Bio Luminescent bacterium

Recently bioluminescent bacterial systems are developed. Luminescent plants and trees can be created using normal nutrients.

Health Care

Raman Scanners

Every molecule has a unique Raman spectrum. Hand held Raman scanners could make brain tumour removal more complete. Raman scanners can detect antioxidant levels in non invasive method.

Light can steer the Living Cells

Actin rods in our cells are responsible for their spontaneous motion. A low-intensity polarized light can guide 'actin rods' in their Brownian motion. Light helps to line up slowly and move in a desired direction. A major step in harnessing is the healing power of stem cells.

Optogenetics

Optogenetics enables light to switch of pain, thirst, hunger, violence etc.

Light can reduce alcohol consumption in rats. Using ATG, light activated learning is possible.

Scientific Research

Harnessing Photons with synthetic magnets

Photons are free to run even in the most intense magnetic fields. Certain synthetic magnets exert force on photons. This could yield a new class of nanoscale applications that use light instead of electricity.

Breaking diffraction Limit

A super lens of thin silver film is used. Using UV rays, it is possible to capture evanescent waves in addition to natural light waves. Thus breaking the diffraction limit of light and can achieve a resolution of 60 nm.

It has impact on bio-medical imaging, higher density electronic circuitry and faster fibre optic communication.

Creating Matter

When a trillion watt laser is made to collide with electron beam it created a particle pair of electrons and positrons, it is possible to make matter with light and electrons

Challenges

- Develop lead free and stable PEROVSKITES.
- Integrating photonics and IC circuitry is key.
- Developing LIFT for long haul communications
- Integrating nanophotonics and nanomechanics.
- Building Cost effective 3D printing.
- Developing table top soft X-ray lasers.
- Compacting Laser weapon systems to be deployable from space.

"LET THERE BE LIGHT YEARS OF SUCCESS IN YOUR LIFE"

Topics of NSS in the past

Following is the list of various important topics on which the National Science Seminar was held from the year of inception.

1982	Space and Mankind
1983	Communication : Today and Tomorrow
1984	Environment and Human Survival
1985	We and the Ocean
1986	Green Revolution and Our Future
1987	Pollute and Perish : Conserve and Flourish
1988	Information Revolution
1989	Atomic Energy : Potentialities and Hazards
1990	Natural Disasters : Man - Slave or Master
1991	Origin of Life
1992	Tomorrow's Habitat
1993	Are We Alone in the Universe ?
1994	Population : A Resource or a Burden ?
1995	Resources from the Earth
1996	Genetic Manipulation : Scope, Potential and Impact
1997	Recycling : A Step Towards Conservation
1998	50 Years of Science & Technology in Independent India : Aspirations and Achievement
1999	Science & Technology in the New Millennium : Prospects & Problems
2000	Health for All : Vision and Reality
2001	Biotechnological Revolution : Benefits and Concerns
2002	Remote Sensing Applications for National Development : Potential & Impediments
2003	Powered Flight : A Century of Innovation & the Future of Aviation
2004	Science Awareness : Needs & Prospects
2005	A Century of Physics : Achievements & Challenges
2006	Conservation of Biodiversity : Prospects & Concerns
2007	Global Climate Change and Its Impact
2008	Water Crisis on Earth : Problems and Remedies
2009	Chandrayaan : Promises & Concerns
2010	India & World Science : Are We There?
2011	Chemistry For Human Welfare : Promises and Concerns
2012	Mathematics in India : Past, Present & Future
2013	Water Co-operation: Issue & Challenges
2014	Innovation in Agriculture for a Sustainable Future-Prospects & Challenges
2015	Harnessing Light: Possibilities and Challenges

Past Winners

Winners of National Science Seminar since 1982

YEAR	NAME	SCHOOL	STATE
1982	Shri Ashish Khosla	St. Luke High School, Solan	HIMACHAL PRADESH
	Ms. Sumita Trivedi	La Martiniere School for Girls, Kolkata	WEST BENGAL
1984	Savitha Murthy	Women's Peace League H. School, Bangalore	KARNATAKA
1985	Kum. Elizabeth Joseph	Mount Fort School Kansbahal	ORISSA
1986	Kumari Sucharita Hota	St. Joseph's Con. H. School, Sambalpur	ORISSA
1987	Kumari Sudipa Banerjee	Jodhpur Park Girls' H. School, Kolkata	WEST BENGAL
1988	Shri Abhinav Taneja	Mt. Fort School, Sundergarh	ORISSA
1989	Shri M. Manoj	K. R. High School, Cannanore	KERALA
1990	Kumari B. P. Divya	Women's Peace League, Bangalore	KARNATAKA
	Shri Rituparna Goswami	Michael's High School, Dighaghat	BIHAR
1991	Shri Jasmeet Singh Sahni	Govt. Model Sr. Sec. School	CHANDIGARH
1992	Shri Maninder Jit Singh	Guru Nanak Public School, Ludhiana	PUNJAB
1993	Kumari Sharon Kuruvilla	G. B. English High School, Kottayam	KERALA
1994	Kumari Shilpa Sharma	St. John High School, Tuensang	NAGALAND
	Kumari Jayanti	Prabhat Tara G.M. School, Muzaffarpur	BIHAR
1995	Kumari Chari D. Nathamuni	S.R. Girls' High School, Sevasadan	MAHARASHTRA
1996	Kumari Suchismita Deb	Holy Cross School, Silchar	ASSAM
1997	Kumari Anu Singla	St. Joseph's Convent School, Bathinda	PUNJAB
1998	Shri Brajesh Ranjan	Ramakrishna Mission Vidhyapith, Deoghar	BIHAR
1999	Kumari Anupama Kondayya	Saraswati Vidyalaya, Nagpur	MAHARASHTRA
2000	Kumari Purva S. Dholakia	Matruchhaya Kanya Vidyalaya, Bhuj	GUJARAT
2001	Shri Biswanath patel	St. Joseph's convent H. School, Sambalpur	ORISSA
2002	Ms. Gunjan Jhunjhunwala	St. Mary's Hr. Sec. School, Shillong	MEGHALAYA
2003	Dharav Sinh M. Solanki	Institute of Our Lady of Fatima, Moti Daman	DAMAN & DIU
2004	Devangana Kalita	Little Flower School, Dibrugarh	ASSAM
2005	Ms. Anwesha Dash	St. Anne's Convent School, Sonepur	ORISSA
2006	Nishant Prabhakar	Ramkrishna Mission Vidyapith, Deoghar	JHARKHAND
2007	Subhajit Dasgupta	Ramkrishna Mission Vidyapith, Deoghar	JHARKHAND
2008	Vikram Aditya	Ramkrishna Mission Vidyapith, Deoghar	JHARKHAND
2009	Kum. Sonam Lhamu Monpa	Ramakrishna Sarada Mission Girls' School, Khonsa	ARUNACHAL PRADESH
2010	Sh. Satyesh Mundra	St. Francis School, Deoghar	JHARKHAND
2011	Sh. Ganeshwar. S	Sri Jayendra Golden Jubilee School, Tirunelveli	TAMILNADU
2012	Miss Urbi Datta	Shishu Bihar H.S. Schoo, Agartala	TRIPURA
2013	Aliva Mishra	Chinmaya Vidyalaya (E.M.), Rourkela	Odisha
2014	Niyati Totala	BAPS, SVM, Silvassa	Dadra & Nagar Haveli
2015	Ms. S. Hanusha Vardhini	Sri JSSJM Hr. Sec. School, Thirunelveli	TAMIL NADU

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West Bengal

Jammu & Kashmir

Sikkim

Glimpses of State Level Science Seminars 2016

Glimpses of State Level Science Seminars 2016

Glimpses of State Level Science Seminars 2016

Objectives and Awards

STATE SCIENCE SEMINAR-2016 AT A GLANCE

Places where State Seminar was held with number of participants

उद्देश्य

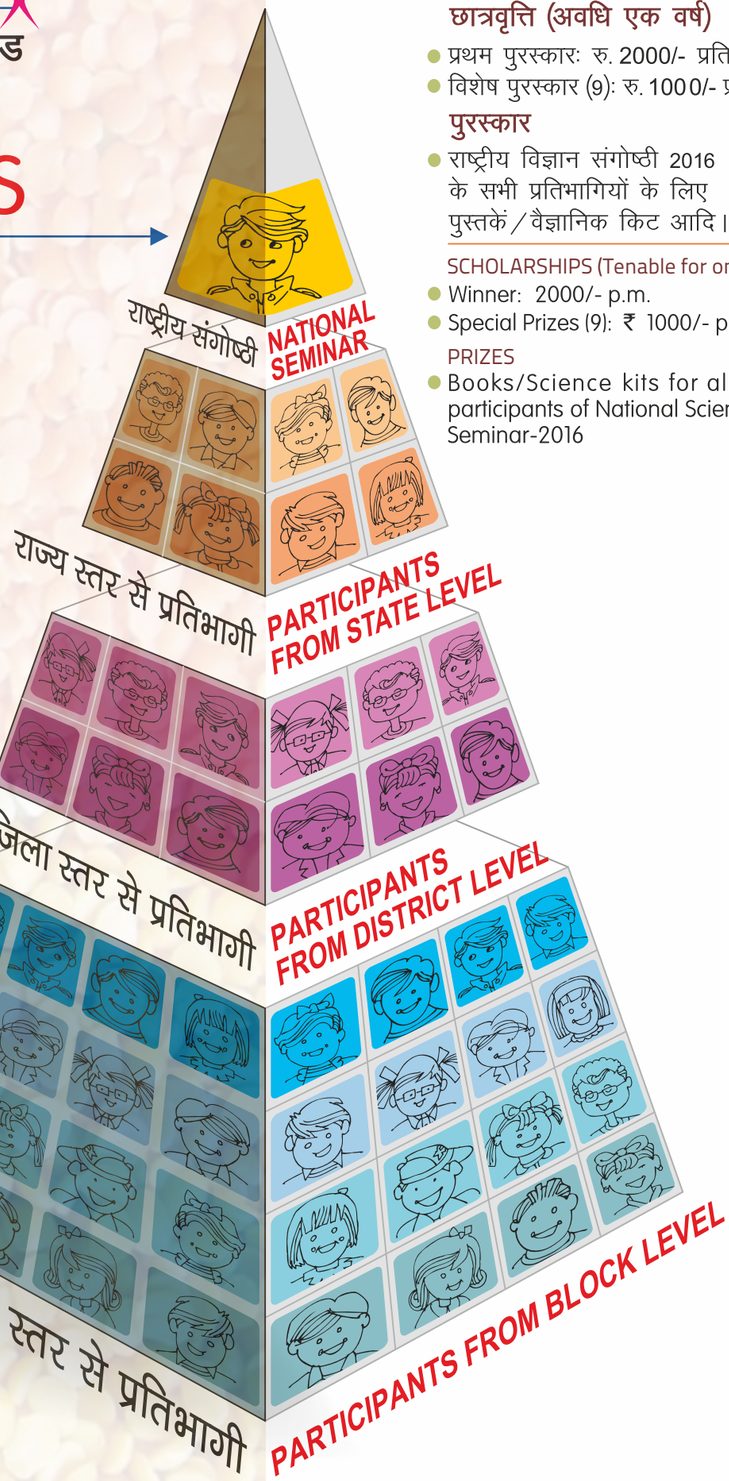
- विद्यार्थियों में वैज्ञानिक खोज के संबंध में रचनात्मक एवं विश्लेषणात्मक प्रवृत्ति जागृत करना।
- उभरते वैज्ञानिकों को विचारों के आदान–प्रदान हेतु मंच उपलब्ध कराना।
- देश भर के विद्यार्थियों में राष्ट्रीय एकता की भावना विकसित करना।

OBJECTIVES

- To inculcate in the minds of young students a spirit of scientific enquiry and analytical thinking.
- To provide a platform to the budding scientists for exchanging ideas.
- To nurture a feeling of national integration among young talents from every corner of the country.

सफलता का पिरामिड

STEPS OF SUCCESS



छात्रवृत्ति (अवधि एक वर्ष)

- प्रथम पुरस्कार: रु. 2000/- प्रतिमाह
- विशेष पुरस्कार (9): रु. 1000/- प्रतिमाह

पुरस्कार

- राष्ट्रीय विज्ञान संगोष्ठी 2016 के सभी प्रतिभागियों के लिए पुस्तकें/वैज्ञानिक किट आदि।

SCHOLARSHIPS (Tenable for one year)

- Winner: 2000/- p.m.
- Special Prizes (9): ₹ 1000/- p.m.

PRIZES

- Books/Science kits for all participants of National Science Seminar-2016

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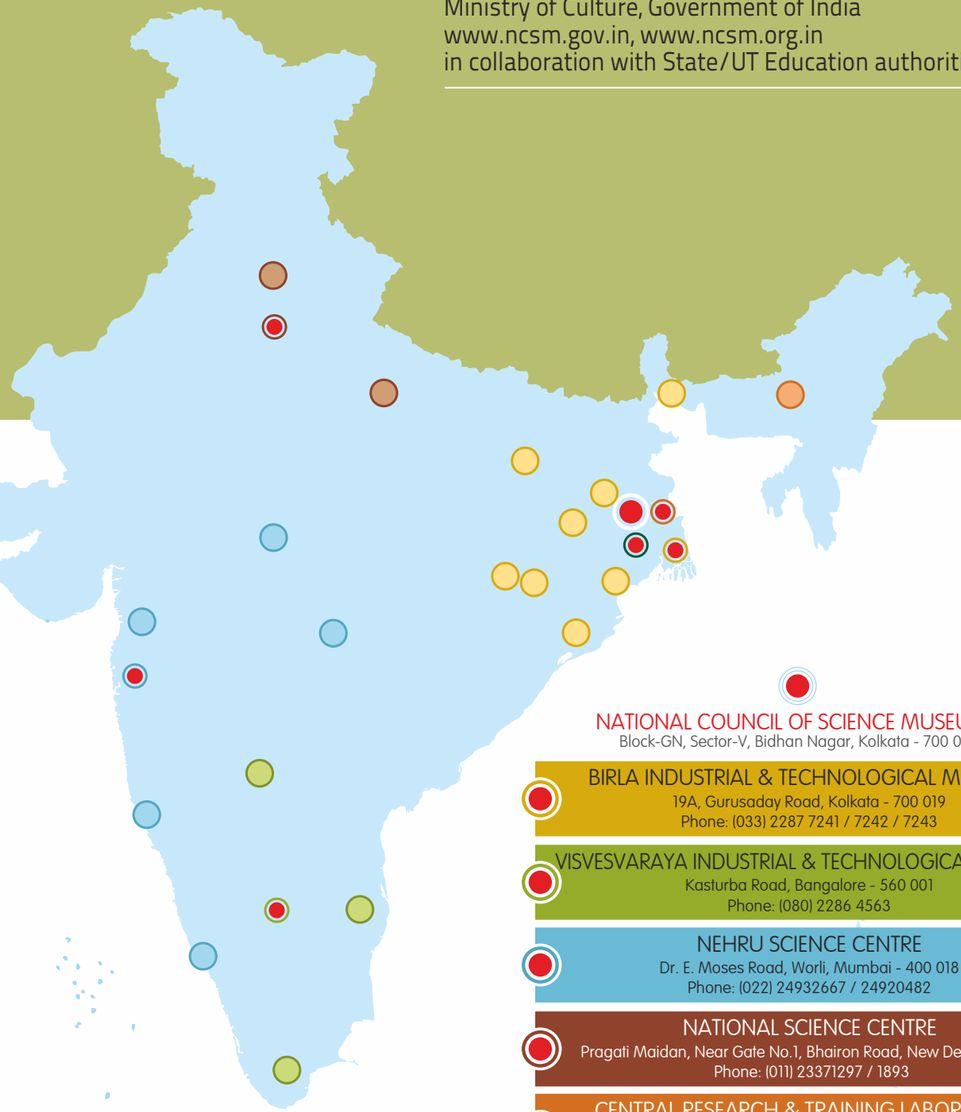

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- District Science Centre — Purulia
- Shrikrishna Science Centre — Patna
- Regional Science Centre — Bhubaneswar
- Digha Science Centre & National Science Camp
- Dhenkanal Science Centre — Dhenkanal
- Kapilas Science Park — Kapilas
- Bardhaman Science Centre — Bardhaman
- North Bengal Science Centre — Siliguri

Visvesvaraya Industrial & Technological Museum

- District Science Centre — Gulbarga
- District Science Centre — Tirunelveli
- Regional Science Centre — Tirupati

Nehru Science Centre

- District Science Centre & Planetarium — Dharampur
- Raman Science Centre & Planetarium — Nagpur
- Regional Science Centre — Bhopal
- Regional Science Centre & Planetarium — Calicut
- Goa Science Centre & Planetarium — Panaji

National Science Centre

- Regional Science City — Lucknow
- Kurukshetra Panorama & Science Centre — Kurukshetra

Central Research & Training Laboratory

- Regional Science Centre — Guwahati

Collaboration

STATE SCIENCE SEMINAR-2016

Organised by: NATIONAL COUNCIL OF SCIENCE MUSEUMS in collaboration with:

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Govt. of Manipur

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Govt. of Uttarakhand

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Representative and Country Director World Food Programme, India

3) **Prof. P. K. Das**
President, APBI & Former Head Dept. of Genetics, BCKV, West Bengal

4) **Smita Mohanty**
Deputy General Manager, National Bank for Agriculture and Rural Development, Mumbai

5) **Dr M. Maheswari**
ICAR-Central Research Institute for Dryland Agriculture Santoshnagar, Hyderabad

6) **Prof. Ram Ramaswamy**
President, Indian Academy of Sciences, Bengaluru

7) **Prof. Akhilesh Kumar Tyagi**
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