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CONTENTS

Editors

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From the President's Desk

Challenges and Prospects for Doubling Agricultural Exports by 2022

India's Agricultural Export Policy 2018 sets a target of *doubling agricultural exports to US$60+ billion by 2022*. This is indeed a novel objective towards accelerating agricultural growth and achieving the goal of doubling farmers' income by 2022 set by the Government of India in 2017. There is, however, scepticism about achieving these targets on several counts. India's agricultural sector is dominated by smallholders — over 86% of the landholdings are of size less than or equal to two hectares, and hardly 0.5% of the landholdings exceed the size of 10 hectares. A majority of smallholders produce primarily for their household consumption, and their transition to commercial production is constrained by a lack of access to markets and finances. Moreover, they are highly exposed to production and price risks. The increasing frequency of extreme climatic events, such as droughts, floods and heat-waves, has been posing a significant threat to the sustainable development of agriculture. The prices of agricultural commodities have become more volatile in both the domestic and international markets, discouraging the value chain actors, including traders and exporters, from investing in post-harvest infrastructure.

Globalization of trade in agri-food commodities under WTO and regional trade agreements (RTAs) has always been an issue of concern, especially for the developing countries that heavily depend on agriculture and lack social safety nets to protect their populations from food supply and price shocks. Besides, Indian farmers face several challenges in the international market. *The inherently asymmetrical nature of the WTO Agreement in Agriculture (AoA) allows developed countries to provide huge domestic support to their agricultural sector. This creates an artificial comparative advantage for them, leading to import surges and price depressions in the global market, that in turn adversely affect farm profits, and incentives to private investment in agriculture and adoption of improved technologies by the farmers in developing countries*.

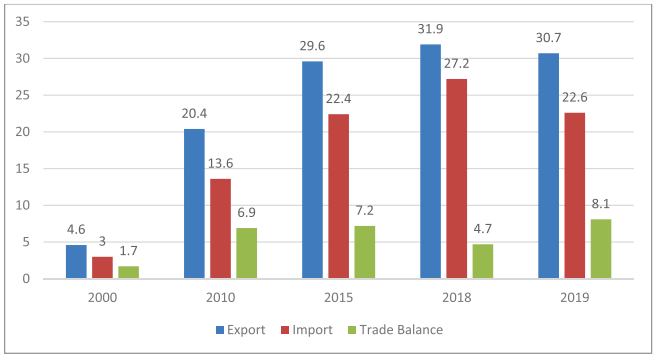
India's domestic support measures often face scrutiny at multilateral trade forums. *The frequent attacks against India's price-support programmes for rice and sugar are a testimony to this*. Further, several of the developed countries use arbitrarily several non-tariff measures (NTMs), including *Technical Barriers to Trade (TBT) and Sanitary and Phytosanitary Measures (SPS)* to prevent entry of agricultural products from developing countries like India in their domestic markets. Additionally, Indian agriculture is also exposed to adverse impacts of import surges on account

of the preferential tariff concessions under existing free trade agreement (FTAs).

Given these concerns doubts arise about the prospects of doubling agricultural exports by 2022. Can India achieve this target? What kind of technological, institutional and policy support is needed to achieve the target?

The trade in agricultural commodities has been liberalised to a great extent under the international agreements under WTO as well as through the regional and bilateral trade agreements. Over the years, India's exports have increased from US$ 4.6 billion in the year 2000 to US$ 31.9 billion in 2018 but declined marginally to US$ 30.7 billion in 2019. Similarly, its imports too have shown a significant increase until 2018, but witnessed a sharp drop in 2019. Nevertheless, India's trade balance has remained positive. Notably, the exports as well as imports experienced rapid growth during the first decade of the twenty-first century.

Trend in India's exports and imports (US$ billion)



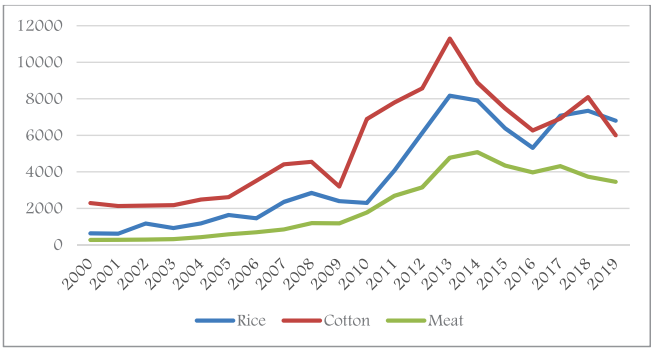
Source: World Integrated Trading System, World Bank

The other dimension that merits attention is India's participation in global trade in agricultural commodities. India gained marginally in its share in the global merchandize trade, in both exports as well as imports. Its share in global exports gradually increased from 1.15 percent in 2000 to 2.21 percent in 2019, and in imports from 0.72 percent to 1.89 percent. These trends clearly indicate increasing globalization of Indian agriculture. On the contrary, the share of agricultural commodities in the country' total merchandise trade has declined marginally during the same period. Its share in total exports fell to 9.91 percent in 2019 from 10.93 percent in 2000, and in imports to 4.40 percent from 5.61 percent during the same period.

India's export basket comprises mainly of rice, bovine meat (mainly of buffaloes), cotton, vegetable extracts and sugar. Rice (22%), and cotton (20%) bovine meat (11%) together account for over half of the total exports. On the other hand, India's edible oils comprise the main agricultural imports—palm oil (25%), soya-bean oil (10%) and sunflower oil (9%); and nuts (13%).

India's main export destinations include Iran (rice and sugar), United States (vegetables, crustaceans and molluscs), Vietnam (bovine meat), Saudi Arabia (rice and meat), United Arab Emirates (rice and nuts) and Bangladesh (cotton and sugar). India sources its imports Indonesia (palm oil), Malaysia (palm oil), United States (nuts), Argentina (soybean oil) and Ukraine (Sunflower and safflower seed).

Trend in exports of important agricultural commodities (US$ million)



Source: World Integrated Trading System, World Bank

India faces several challenges in enhancing its exports. The biggest challenge that it faces is an unfair level playing field in the international market due to significant protection accorded to agriculture by the developed countries. For instance, the United States provides an annual domestic support of US$ 61286 per farmer as against US$ 282 per farmer by India, resulting in an artificial comparative disadvantage for India. Such a high level of protection keeps the international prices depressed, that ultimately adversely affects the incomes and livelihoods of millions of smallholder farmers in the developing countries.

Over and above, the developed countries are challenging the minimum support price (MSP) policy of India at the WTO. Countries like the US, Canada and Australia allege that India provides price support to wheat, rice, cotton, sugar and pulses significantly higher than its commitments in the AoA of WTO. It is to be noted that India can provide product specific support up to 10 percent of the value of production of a commodity. In case, it crosses the limit of 10 percent, other countries can take this issue to the dispute settlement body of WTO. India's minimum support price policy is classified under the product-specific 'Amber box'. Presently, Australia, Brazil and Guatemala have initiated dispute proceeding against India's sugar policy of the Fair and Remunerative Price (FRP).

India has the flexibility to provide unlimited input subsidies — on fertilizer, irrigation and electricity — under the 'development box' of the AoA, which is exclusively available to the developing countries as a part of Special and Differential Treatment. The developed countries are seeking to limit this flexibility, if acceded to, will jeopardise the livelihood of millions of smallholder farmers, and adversely affect the hard-earned self-sufficiency in food grains.

India is also facing import surges of agricultural commodities. The highly subsidised agricultural products from the developed countries enter Indian market, displacing the local products. To mitigate the adverse impacts of import surges on Indian agriculture, the Government can increase the applied tariffs upto the bound level. At present, the applied average tariff on agricultural products is 38.8 percent, that India can raise upto the bound tariff of 113.1 percent. Although India has enough

policy space to tackle import surges through increasing applied tariff at the sectoral level, for several agricultural products the applied tariff rate is almost equivalent to the bound rate. For instance, India's applied and bound tariff rate for apple is just 50 percent. Therefore, it has no instrument to protect the producers of such commodities from cheap imports. It was on this account the developing countries have been demanding *special safeguard mechanism* to contain import surges and protect the poor producers. The import influxes also happen under the regional trade agreements (RTAs). India has Free Trade Agreements (FTAs) with Singapore, Malaysia, ASEAN, SAFTA, Japan, Sri Lanka and South Korea. In such a case, the tariff on most items, except those on the negative list, is reduced to zero. This is likely to reduce incentives for farmers to adopt yield-enhancing technologies and innovations and invest in on-farm infrastructure. Therefore, it is imperative to tread cautiously in opening the agriculture sector under FTAs.

A more daunting challenge emerges from the use of non-tariff measures like the SPS and TBT by the developed countries. They use almost impenetrable SPS measures to keep the exports from developing countries away from their domestic markets. Undoubtedly, the SPS measures are essential to ensure safe and quality food to consumers, there is a multiplicity in the standards set by different countries, and most standards are set unreasonably very high to avert exports. For instance, on occasions India had faced ban on exports of basmati rice and tea by some European countries for these being contaminated by pesticides. Belgium, Germany and Denmark impose almost zero tolerance limit on aflatoxin in spices. Japan has banned imports of cut flowers from India, and insists on compliance of very strict quarantine procedures including zero tolerance insects and pests in floricultural products, although such pests are found in Japan.

It should be noted that Basmati rice and tea have high export potential. Given the fact that India still exports primarily raw and semi-processed agricultural products, the compliance of SPS measures is more difficult. India needs to strengthen its institutional framework to ensure quality exports complying with SPS related compliances of the importing countries.

On the domestic front, India often resorts to frequent quantitative and price restrictions on exports of agricultural products as to protect its domestic consumers from the abrupt rises in their prices. For example, onions are often subjected to both the quantitative and price restrictions when there is a supply shock. Such an unstable policy environment disrupts the export supply chains discouraging both the importers, and the domestic participants in the value chain to invest in post-harvest management and food processing.

In view of these challenges on the domestic and international fronts and recently compounded by the supply disruptions due to Covid-19 pandemic, there is a bumpy road ahead towards realizing the goal of doubling agricultural exports by 2022. Nonetheless, the following suggestions merit attention of the policymakers.

- Penetrate the existing export markets and explore new markets for the dynamic food commodities like the bovine meat (carabeef), dairy products, poultry, vegetables and fruits. In fact, India is one of the largest exporters of buffalo meat. It has almost similar bio-chemical properties as that of beef and is also much cheaper in the international market. Our current export destinations for carabeef are the countries in the Southeast Asia and the Middle-east, and there is considerable scope of its production, and export to African countries.
- Post-pandemic the international demand for super foods (e.g., Quinoa), and herbal products that have medicinal and nutritional values is expected to increase exponentially. There is need to tap this potential through public-private partnership in research and development of such crops and their products.
- The Government of India should create awareness about the SPS measures and their compliance mechanisms among the value chain participants upstream to downstream, and focus on developing infrastructure for processing of agri-food commodities.
- At multilateral level, India should continue to demand elimination of trade-distorting support to agriculture in the developed countries, while addressing the challenges to its own domestic support measures.
- Identify suitable agro-climatic clusters for production of export-oriented commodities, and create public infrastructure, develop appropriate institutions for financing and risk management along the value chain, and provides incentives to attract private investment in agri-food processing. The recent reforms in agricultural markets offer a considerable scope for private investment in warehousing and value chain development.
- Invest in agricultural research to develop crop varieties with most preferred traits by the global consumers.
- Market intelligence is almost absent. The Government should establish market and trade intelligence units in the concerned Ministries to generate information on the export demand internationally for the commodities that India can supply.
- Create a stable policy and regulatory environment for attracting private investment in export-oriented agri-food processing industries.

(T. Mohapatra)
President

113th Executive Council Meeting

The 113th Meeting of the Executive Council was organized on-line on August 10, 2020 under the chairmanship of Dr T. Mohapatra, President NAAS. After a brief welcome by the Secretary and the President, regular agenda items were discussed in detail and approved.

Dr J.C. Katiyal, Vice-President of the Academy made a brief presentation on the proposed review of actionable points emerging from the policy and strategy papers of the Academy for preparation of a roadmap for future agriculture.

The Executive Council approved the draft resolution for adoption of the Annual Report and Audited Statement of Accounts for the year 2019-20.

Further, the Executive Council considered the constitution of Judging Committees for selection of the Awardees amongst the nominees for Memorial, Endowment, Recognition and Young Scientist Awards of the Academy for the biennium 2019-2020 and accorded its approval.

The EC was also informed about the NAAS's inputs on formulation of India's new Science, Technology, and Innovation Policy (STIP 2020), status of Fellowship/Associates nominations received, revised NAAS Scoring of Journals for the year 2021, filling up of the position of Executive Director and the vacancies of Office-bearers and Members of the Executive Council from January 1, 2021, proposed activities of the Academy for the current year, AGM/Foundation Day Programme 2020 and XV Agricultural Science Congress 2021.

Programmes held

Annual General Body Meeting

The 27th Annual General Body Meeting (AGM) of the Academy was convened virtually on August 13, 2020 under the Chairmanship of Dr Trilochan Mohapatra, President of the Academy. The AGM was graced by Past Presidents, Past Vice Presidents and a number of former senior peers, office bearers and more than 200 fellows and associates of the Academy. A one minute silence was observed by the entire house as a mark of respect prior to initiation of business, in the memory of the departed souls of esteemed Fellows, namely, Dr K.S. Gill, Dr C. Gopalan, Dr D.R. Bhumbla, Dr S.M. Virmani, Dr N.N. Singh, Dr S.S. Kadam, Dr D.S. Brar, Dr P.K. Chhonkar, Dr Paul Thomas, Dr V.L. Chopra, Dr P.N. Bhat, Dr Y.P. Abrol and Dr B.D. Kaushik since the last AGB meeting. Thereafter, Dr Anil K. Singh, Secretary, NAAS welcomed the dignitaries, Fellowships and Associates present in the virtual GB meeting. The President of the Academy, Dr Trilochan Mohpatra also welcomed all the esteemed Fellowship assembled including newly elected Fellows and Associates of the Academy to the Annual General Body meeting. Thereafter, the proceedings of the meeting started with the presentation of the detailed Secretary's Report by Dr Anil K. Singh, Audit and Accounts Report by Dr R.K. Jain, Editors' Report by Dr Kusumakar Sharma and Foreign Secretary's Report by Dr Anil K. Singh (as Dr U.S. was unwell). All these reports including Annual Report and Audited Accounts 2019-20 were accepted and adopted by the House after brief interaction by the Fellowship. The AGM also confirmed the minutes of the 26th Annual General Body meeting held on June 5, 2019, besides some of the important decisions taken by EC since last AGM that included appointment of Academy's auditors for the year 2020- 21, programmes during 2020 and suggested areas for NAAS activities.

After the completion of the listed agenda, the floor was opened for general discussion to seek views of the fellowship. Some of the salient points that emerged include:

- A programme on Sericulture may be organized considering its popularity and importance in South India.
- A session on the Prime Minister Garib Kalyan Yojana may be organized with focus on DBT as a tool to mitigate the rural poverty.
- Three organizations are active in GoI regarding contract farming and commercialization of agriculture. There is a need to have a discussion on how contract farming can facilitate the marketing and integrating farmers and the conditions for making contract farming successful?
- Majority of students in rural areas are unaware about undergraduate courses in agriculture. Therefore, the Academy should make efforts to popularize agriculture as a subject of first choice after 12th standard.
- Start a Regional Chapter at Izatnagar, Bareilly considering the sizable number of NAAS Fellows there.
- There should not be any restriction on the number of Fellowship admitted to a specific section if there are very deserving candidates while maintaining the overall number.
- A template should be provided to all regional Chapters for their activities so that their progress can be easily monitored.
- There is a need to play a pro-active role in handling the Post Covid 19 situation with respect to agriculture research and management systems, more specifically on teaching.
- A detailed discussion should be organized on impact of Covid- 19 on animal health and dairy industry.

The President thanked the Fellowship for raising important issues and assured to get the points examined and initiate appropriate action, wherever required.

Admission of the Fellows / Associates

Dr Anil K. Singh, Secretary along with Dr P.K. Joshi, Secretary conducted the formal admission ceremony of the newly elected Fellowship and Associateship during the year 2020. The names of elected Fellows and Associates were called out one-by-one, their citations read out and by virtue of the authority vested in the President, NAAS, he admitted the 29 Fellows, 2 Foreign Fellows, 3 Pravasi Fellows and 11 Associateships on-line in different sections as under:

Fellowship

Section I: Crop Sciences

Dr Pawan Kumar Agrawal

Dr Murugasamy Sivasamy

Dr Lakshmi Kant

Dr (Mrs) Gurinderjit Randhawa

Dr Govindakurup Hemaprabha

Dr Dharam Pal

Section II: Horticultural Sciences

Dr Dangar Ram Bhardwaj

Dr D. Parasath

Dr Anilabha Das Munshi

Section III: Animal Sciences

Dr Anil Kumar Puniya

Dr Raghavendra Bhatta

Dr Naresh Kumar

Dr Pinaki Prasad Sengupta

Section IV: Fisheries Sciences

Dr Bimal Prasanna Mohanty

Dr Kalkuli M. Shankar

Section V: Natural Resources Management Sciences

Dr Dinesh Mohan

Dr Saroj Kanta Barik

Dr Yash Pal Singh

Dr Rajeev Pratap Singh

Dr Desouza Blaise

Section VI: Plant Protection Sciences

Dr Mahendrakar Sreenivasa Rao

Dr Arunava Goswami

Dr Muthappa Senthil-Kumar

Dr Pratyoosh Shukla

Section VII: Agricultural Engineering & Technology

Dr Madan Kumar Jha

Dr (Ms) Neelam Patel

Section VIII: Social Sciences

Dr Anil Rai

Dr Ashok Kumar Singh

Dr Shalander Kumar

Foreign Fellows

Dr Henry T. Nguyen (USA)

Dr Peter Carberry (Australia)

Pravasi Fellows

Prof Krishna V. Subbarao (USA)

Dr Rakesh K. Singh (USA)

Dr Prabhu L. Pingali (United States)

Associates

Name, Section

Dr S.L. Krishnamurthy, Crop Science

Dr B. Kumar, Crop Science

Dr S.S. Dey, Horticultural Sciences

Dr N.L. Selokar, Animal Sciences

Dr S.P. Singh, Animal Sciences

Dr M. Shahid, NRM

Dr V.S. Meena, NRM

Dr J. Stanley, Plant Protection

Dr Bhanu Prakash, Plant Protection

Dr Ch. J. Dash, Agril Engg & Tech

Dr M.A. Iquebal, Social Sciences

Presidenial Address

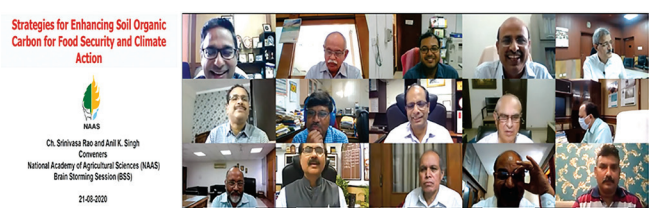
Dr T. Mohapatra delivered the Presidential Address in the 27th AGM. He expressed his appreciation to the Founder Fellows, all the Past Presidents and the entire Fellowship for the stature that the Academy has attained both nationally and internationally. He made a special mention of Prof V.L. Chopra, who left for his heavenly abode during the COVID 19 lockdown days. He also greeted Prof M.S. Swaminathan, who completed 95 years on August 7, 2020. He specifically

appealed to this Fellowship to be more proactive so that the Academy attains far greater heights in the future. He lauded the Academy's efforts in providing very timely inputs to the government on some very key policy issues, viz., Seed Policy, Pesticides Management Bill, Guidelines for Genome Edited Organisms and Direct Benefit Transfer of Fertilizer Subsidy. He highlighted the sustained growth achieved in agriculture sector, which remained largely unaffected even during the COVID pandemic. He reminded the fellowship that the nation has set the target of becoming a US$ 5 trillion economy, which would be possible only if agriculture contributes US$ 1 trillion. In this context, he called upon fellowship to contribute effectively by developing appropriate policies and guidelines. He specifically mentioned areas like exploitation of ocean resources, seaweed cultivation, pearl culture, mainstreaming millets (nutri-cereals), non-bovine milk and related products, selected organic products, diversification, value chains, malnutrition, use of advanced tools like AI, achieving SDGs, etc. that need more attention. In his view, the focus has to be on demand-driven agriculture considering national and international requirements. He congratulated the newly inducted fellows and associates and thanked the entire fellowship present in the AGM.

Brain Storming Sessions

Strategies for Enhancing Soil Organic Carbon for Food Security and Climate Action (Conveners: Dr Ch Srinivasa Rao and Dr Anil K. Singh)

A virtual brainstorming session on *Strategies for Enhancing Soil Organic Carbon for Food Security and Climate Action* was organized by National Academy of Agricultural Sciences (NAAS) on August 21, 2020 to deliberate the importance of soil



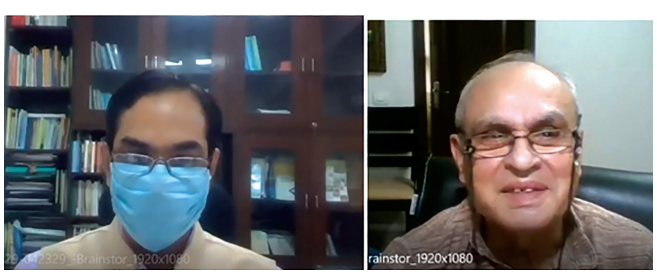
organic carbon (SOC) in nation's food security, environmental sustainability and climate adaptation and mitigation. The session, convened jointly by Dr Ch. Srinivasa Rao, Director, ICAR- NAARM and Dr Anil K. Singh, Secretary, NAAS under the chairmanship of Dr Trilochan Mohapatra, was attended by academicians from ICAR Institutes, State Agriculture Universities, and ATARI-KVK system; representatives from Ministries of Agriculture and Farmers Welfare, and Environment, Forestry and Climate Change, and UNDP. The ecosystem wise presentation on SOC for land degradation neutrality, food security and climate action covering different regions, and carbon trading and ecosystem services were made by experts and followed by a panel discussion co-chaired by Dr J.C. Katyal, Vice President, NAAS and Dr S.K. Chaudhari, DDG (NRM), ICAR.

The salient recommendations that emerged are:

- Farmers' centric holistic land management (HLM) practices,
- Reduce output losses by conservation and a harmonious blend of farmers' land use practices to enhance the effectivity of HLM and to generate multiple benefits,
- Institutionalization of inclusiveness of vulnerable farmers by enabling conditions, like facilitating creation of soil saviour and formation of Farmer Producer Organizations (FPOs) as a component of the SOC mission,
- Provision of subsidies for farmers who practice carbon smart agriculture to encourage adoption of long-term (>10 years) C sequestration programs,
- Establishment of national mission on C sequestration at macro level, and creating farmer's innovation and cross learning platform for C sequestration at micro level.

Anti-microbial Resistance (Convener: Dr A.K. Srivastava)

Antimicrobial resistance (AMR) is a cross-boundary challenge that is influenced by clinical, biological, social, political,



economic, and environmental factors and affects humans, domestic/non-domestic animals and ecosystems. AMR has emerged as the most critical threat to the global public health, food security and development. Recognizing the sensitivity of the issue and increasing scourge of antibiotic resistance, the Academy organized a virtual brainstorming session on *Antimicrobial Resistance* under the chairmanship of Dr T. Mohapatra, President, NAAS on August 29, 2020 to discuss issues related to AMR and to come out with the policy recommendations to combat this emerging threat. The brainstorming session was convened by Dr A.K. Srivastava, Vice President, NAAS jointly with Dr Anil Kumar Arora, Professor & Head, Department of Veterinary and Microbiology, GADVASU, Ludhiana. It was attended by more than 70 experts, in addition to the speakers and panelists.

In his opening remarks, Dr Mohapatra detailed the importance of AMR as a critical issue for human, animal and environment health driven by several interconnected factors. He stressed on the need to reorient efforts in a coordinated manner targeting the factors that interplay across the three sectors rather than isolated interventions. Dr A.K. Srivastava flagged off the issues confronting AMR which was followed by the presentations by experts from different disciplines focusing on areas of intervention, one health confluence in animal agriculture, AMR from food perspective, challenges of AMR in humans, combating AMR in aquatic environment and dairy production systems through genomics and metagenomics approaches. Based on the presentations and panel discussion the policy recommendations and research issues related to AMR will be documented in the form of a policy paper.

Revision of Biological Diversity Act (BDA), BDA Rules and Guidelines (Convener: Dr Kuldeep Singh)

The Biodiversity Act – 2002 was promulgated primarily to address issues of conservation of biological diversity, sustainable use of its components and for the equitable

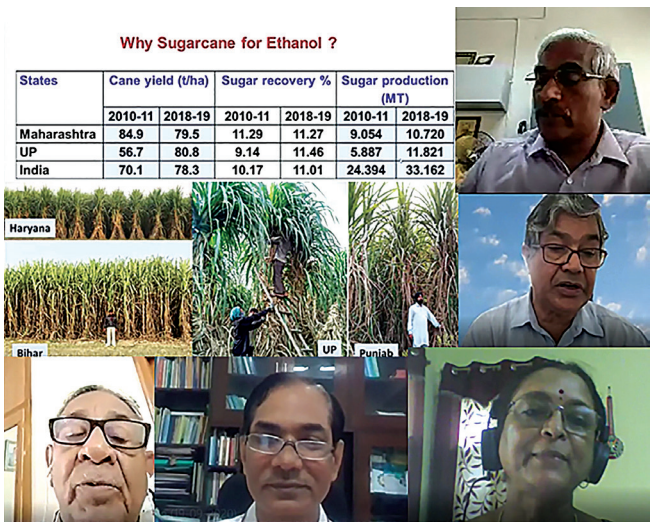
sharing of the benefits arising out of the use of biological resources. The Act also envisages setting up of Biodiversity Management Committees (BMC) at village-level, State Biodiversity Boards (SBB} at state-level, and a National Biodiversity Authority (NBA). However, it is being felt that the aims of the Act cannot be realised unless the lacunae in the Act are corrected and there is proper implementation of the Act. In view of the importance of the BDA-2002, NAAS organized a virtual brainstorming session on September 1, 2020, which was chaired by Dr Trilochan Mohapatra, President, NAAS and co-chaired by Dr P L Gautam, Former Chairperson, NBA, and PPV &FRA. The deliberations focused on revision of the Biological Diversity Act 2002, subsequent rules and guidelines issued under Biological Diversity Rules (BDR), 2004 and Access and Benefit Sharing (ABS) Guidelines, 2014 to assess how the research in the National Agricultural Research System is affected after their enactment. The issues and bottlenecks felt by the National Agricultural Research System were also discussed in the session. The following recommendations emerged from the consultation:

- The powers and responsibility to regulate all activities related to agro-biodiversity may be delegated to the Secretary, DARE & DG, ICAR u/s 16 of the BD Act considering that the DARE has the mandate for *International cooperation and assistance in the field of agricultural research and education including relations with foreign and international agricultural research and education, institutions and organisations.*
- Provide a national mechanism under the responsibility of DARE for exchange of agro-biodiversity genetic resources on the basis of reciprocity between India and providing countries.
- Formulate sector specific guidelines and rules for conservation, utilization and exchange.
- Harmonization of PPVFRA, 2001 and BDA, 2002 on priority.
- Breeders (plant/fish/livestock) working in NARS should be treated at par with farmers and local communities, as they are working for public good.
- Expand repositories of agro-biodiversity for agriculturally important plants, animals, insects, fish, and microbes.
- Exempt Inter-governmental, Inter-regional and India-CGIAR institutions collaboration from NBA regulations.
- Revision/ inclusion of definitions of access, research, biological resources, agro-biodiversity, commercial utilization, plant breeding, and others in BDA, 2002 and BDR, 2004.
- Exemption from NBA regulations for sharing /depositing of type specimen to international repositories.
- Facilitate access to microbial cultures to foreign researchers for non-commercial purposes. Designated repository to inform the NBA, in case of any violation of microbes under the BD Act.
- Fast track the approval process at NBA for optimal research outputs.

- Build a consensus on issue of access and benefit sharing on Digital Sequence Information (DSI) at national level.

Sugarcane based Ethanol Production for Sustainable Fuel Ethanol Blending Programme (Convener: Dr Bakshi Ram)

NAAS organized a brainstorming session on *Sugarcane based Ethanol Production for Sustainable Fuel Ethanol Blending Programme* on September 18, 2020 under the



chairmanship of Dr Mangala Rai, Former President, NAAS and DG, ICAR & Secretary DARE and it was co-chaired by Dr T. Mohapatra, President, NAAS. Dr Bakshi Ram, Director, ICAR–SBI, Coimbatore was the Convener of the virtual BSS. Dr Anil K. Singh, Secretary, NAAS initially welcomed the chairman, co-chairman, speakers, panelists and invited delegates. The chairman in his introductory remarks highlighted the necessity of ethanol blending, sugarcane as a source of multiple products, advantages of sugar complexes to sustain sugarcane-based cropping system and sugar industry. Subsequently, Dr Bakshi Ram made a brief presentation highlighting energy demand, new biofuel policy, 2nd generation ethanol, sugar recovery pattern and ethanol production in sugar complexes and expectations from the industry and research institutions on ethanol based blending programme. Dr Mohapatra highlighted renewable energy targets, SOPs for bioethanol production and processing, and creation of value chain as in basmati rice, in his opening remarks.

Three scientific sessions, *viz. Policy implementation on fuel ethanol production, Industry prospective on sustainable fuel ethanol production, and Sugarcane production: Feed stock for bio ethanol production,* were held. Each session had presentations from lead speakers followed by a discussion. A policy document on *Sugarcane based Ethanol Production for Sustainable Fuel Ethanol Blending Programmes* will be prepared based on the discussions, expert opinions and prevailing status. Following are the salient recommendations:

- Transportation cost of ethanol from production to blending depot should be included while fixing the fuel ethanol price by the Government.
- Price ethanol 1.6 times higher than white sugar for better economics.
- Rationalise formula for white sugar and ethanol production & encourage sugar industries for ethanol production during low recovery phase in a sugar season.
- Re-open closed sugar mills and convert them into ethanol production units.
- Adopt and promote sugarcane varieties for ethanol production during off season period of the sugar complex.

One World One Health (Convener: Dr A.K. Srivastava)

There is a growing realization that the human health at the human-animal-environment interface cannot be effectively managed by addressing one component alone, and requires collaboration across all the relevant sectors and disciplines.

In this context, a multi-sectoral one-health approach is being advocated as a meaningful strategy for timely and effective response to zoonotic disease events based on accurate and shared assessments of the situation, besides defining the specific roles and responsibilities of collaborating institutions. Keeping in view the need for a strategic and comprehensive policy of One World-One Health encompassing multisectoral collaborations, not confined to the national borders, the Academy organized a day long brainstorming session on September 19, 2020 under the chairmanship of Dr T. Mohapatra, President, NAAS. Dr A.K. Srivastava, Vice President, NAAS was the Convener and Dr R.S. Aulakh, Director, School of Veterinary Public Health, GADVASU, Ludhiana and Dr R.K. Singh, Ex-Director & Vice Chancellor of IVRI, Izatnagar were Co- conveners. More than 60 experts, in addition to panelists and speakers, participated in this session. In his opening remarks, Dr T. Mohapatra detailed the relevance and importance of forging a global alliance to realize the vision of One World One Health for better public health outcomes. Later, Dr A.K. Srivastava made a detailed presentation highlighting major issues focusing on an effective alert and response system at local and global level to detect and quickly react to the outbreaks of international concern,

following the basic principles enshrined in the concept of One Health. Later, the presentations were made mainly on subjects related to (i) One Health: Food Safety Perspective, (ii) Resistance Anywhere is Resistance Everywhere, (iii) Relevance of Soil Health in One World Initiative, (iv) Integrating Environment in One Health, (v) Zoonotic Diseases in Shrimp Aquaculture, (vi) Inter-Institutional Collaboration to Address One Health and (vii) COVID-19: Major Challenge for One World-One Health, which were followed by in-depth panel discussion. The policy recommendations and major researchable issues are being synthesized in the form of a policy paper.

Activities of Regional Chapters

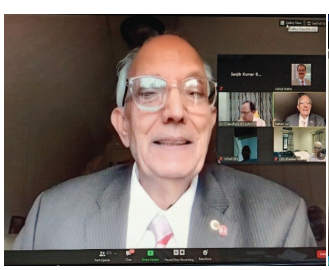
Bhopal Chapter

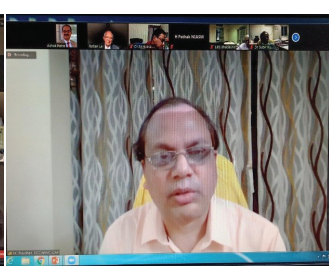
Felicitation of Dr Rattan Lal, World Food Prize 2020 Laureate

A virtual felicitation function was organized by ICAR-Indian Institute of Soil Science jointly with Bhopal Chapter of National Academy of Agricultural Sciences and Indian Society of Soil Science on July 21, 2020 in honour of Dr Rattan Lal, an Indian-American soil scientist and the winner of the **World Food Prize 2020** considered as the Nobel Prize for Food and Agriculture. He played a major role in developing and mainstreaming a soil-centric approach to increase food production that conserves natural resources and mitigates climate change. Three separate United Nations Climate Change Conferences have adopted his strategy of restoring soil health as a means to sequestering carbon and combat climate change. The programme was chaired by Dr S.K. Chaudhari, DDG (NRM), ICAR. In his felicitation address, Dr Chaudhari highlighted major achievements of Dr Lal and their importance to achieve Sustainable Developments Goals (SDGs) of the United Nations.

In his lecture, Dr Rattan Lal proposed a rethink on soil degradation resulting in low yield of several crops in India as compared to that in other countries. He cautioned that over-emphasis on input-based agriculture leads to low crop yield, besides several environmental problems and further soil health deterioration. He emphasised that the COVID-19 crisis necessitates implementation of the *One Health strategy.* He reiterated the need to reduce emissions voluntarily by changing our values, lifestyle, and business as usual before Mother Nature does it for us.

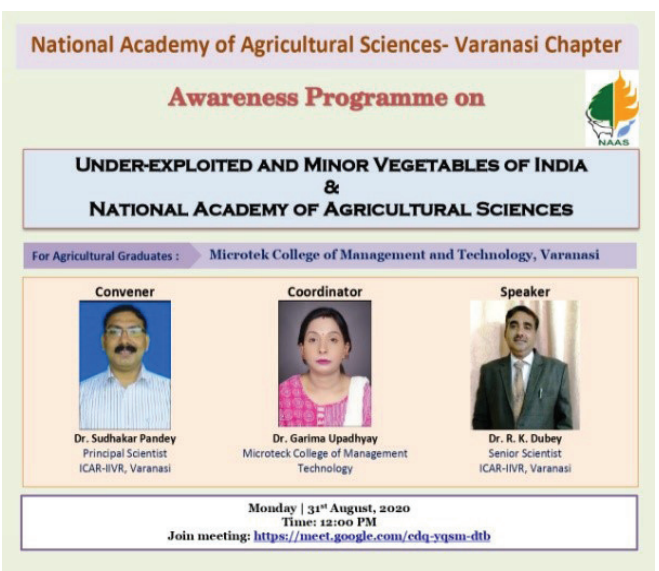
Present and former Vice-Chancellors of SAUs, Directors and past Directors of several ICAR Institutes, Fellows and Associates from NAAS-Bhopal Chapter and scientists across the country participated in the felicitation programme.





Varanasi Chapter

The National Academy of Agricultural Sciences-Varanasi Chapter organized an awareness programme for the B. Sc. (Ag) students of Microtek College of Management and Technology, Varanasi focusing on the roles and activities of the National Academy of Agricultural Sciences on August 31, 2020. On this occasion, Dr Rakesh Kumar Dubey, Senior Scientist, ICAR-IIVR, Varanasi delivered a talk on the scope and role of under-exploited and minor vegetables towards increasing farmers' income and nutritional security, particularly during Covid-19 pandemic. Dr Sudhakar Pandey, Convener, NAAS-Varanasi Chapter briefed the students and other participants about the activities of the Academy.



Hyderabad Chapter

Shri Govinda Rajulu Chintala, Chairman, NABARD interacted with Fellowship and Associates of Hyderabad Chapter of NAAS virtually at ICAR-NAARM on August 27, 2020. He highlighted various activities of NABARD on agricultural development and stressed the need for reforms in research, education and extension. He stressed on the strong need for agri-entrepreneurship for fulfilling the Prime Minister's call for doubling farmer's income. Issues related to water conservation, watershed management including ground water recharge and its use efficiency along with crop diversification and agri-startups were highlighted *vis-a-vis* the role of NABARD.

Dr Ch Srinivasa Rao presented Directory of ***Fellows and Associates of NAAS-Hyderabad chapter*** to the Chairman, NABARD for possible utilization of their expertise in various NABARD programs in Andhra Pradesh and Telangana. The program was attended by former directors of NAARM, fellows of NAAS, and faculty of NAARM besides senior officials and students of the State Agriculture Universities in both the states.

Ludhiana Chapter

Online Panel Discussion on National Educational Policy-2020 and Agricultural Education & Research

An online panel discussion was organized by Ludhiana Chapter of the National Academy of Agricultural Sciences on *National Educational Policy-2020 and Agricultural Education & Research* on September 16, 2020 under the chairmanship of Padma Shri Dr Baldev Singh Dhillon, Vice Chancellor, PAU at Punjab Agricultural University, Ludhiana.

Dr (Mrs) G.K. Sangha, Dean, Postgraduate Studies moderated the discussion. The panel discussion was attended by Vice Chancellors of various SAUs and Directors of the ICAR institutes besides NAAS Fellows under the Chapter and agricultural scientists from several organizations. Following observations emerged based on the marathon discussion to evolve policy for agricultural research and education in the context of NEP 2020.

- Agricultural universities (AUs) cannot be equated with traditional universities as mandate of former is wider and different than that of traditional universities. Given that more than half of the budget is spent on research, AUs are research institutes as well and thus, have a focus wider than traditional multiple stream universities.
- Agricultural research does not always generate publishable output, thus metrics based on scientific papers should not be made applicable to agricultural universities. On the other hand, technologies generated by farm research have huge transformative role in agricultural development. This contribution often gets eclipsed by the standard metrics of publication output. This disparity needs to be addressed urgently.
- The focus on agriculture in the NEP-2020 is incommensurate with its relevance to Indian society as it only makes a meagre mention of agricultural education with no new impetus to agricultural education.
- The policy lays emphasis on autonomy; however, it has many contradictory provisions which seem to undo the emphasis.
- Focus should not be on lateral expansion of educational set-up but on strengthening the existing set up.
- The virtual platforms for agricultural education cannot be a proxy for class room teaching as most of the skill learning in agriculture involves hands-on training.
- The existing agricultural education system honours the fundamental principles laid in the NEP-2020. However, increasing gross enrolment ratio in agriculture, as pointed out in the NEP-2020, may not be achievable as AUs are professional degree granting institutes in comparison to other universities which grant degrees in general education.
- The fundamental principle of private philanthropic investment in the universities and alumni linkages need to be strengthened and harnessed appropriately.
- Close proximity of traditional universities with specialized universities may enable the students to enroll in different universities for some credits and later on the credit score can be transferred to the parent university.

- Agricultural research, of late, has started receiving same policy focus as industrial research. This momentum needs be sustained and steered towards exploring partnerships.
- The Land Grant institutes model of AUs already aligns with the newly mooted *'Atma Nirbhar'* concept. More than 400 experiential learning modules available to agricultural degree students speak volumes for the already in-place focus on skill development.
- The metric of student-teacher ratio recommended by NEP -2020 is not a valid indicator in agriculture, given the three-dimensional (research-teaching-extension) mandate of agricultural universities in comparison to one/two dimensional system being followed in general universities.

Campaign of CRM through school students under the aegis of NAAS

The Punjab Agricultural University's Krishi Vigyan Kendra, Ropar organized a webinar on *Crop Residue Management* under Ludhiana Chapter of National Academy of Agricultural Sciences, on September 29, 2020 with the aim to sensitize the school students on the issue of stubble burning and natural resource management. Besides four speakers, 40 students of Government Senior Secondary School, Mianpur, Ropar (Punjab) participated in this programme through online mode. Speakers elaborated on various aspects of campaign on crop residue management, the challenges faced and the opportunities realized. The harmful effects of stubble burning on environment and human health were highlighted, besides alternative approaches for efficient management of paddy straw. The programme ended with a vote of thanks and an encouragement note to stop the paddy straw burning through spreading message and information among families and villages of the participating school students.

A similar online webinar on *Crop Residue Management* was also organized by Krishi Vigyan Kendra (KVK) of the Punjab Agricultural University, at Bahowal, District Hoshiarpur, under the aegis of Ludhiana Chapter of National Academy of Agricultural Sciences, as an awareness campaign through students of classes +1 and + 2 from Doaba Public School, Dohlron (Mahilpur) on September 30, 2020.

Dr Maninder Singh Bons, Deputy Director (Training) of the KVK presided over the programme and sensitized the students about detrimental effects of crop residue burning on environment and also gave a clarion call to the students for playing an active role in creating awareness regarding crop residue management among the masses. Mr Arun Gupta, Principal of the School, thanked the NAAS and the PAU for organizing this programme towards societal welfare and also the technical experts for their informative lectures. He assured all support for this noble cause for curbing residue burning.

Lucknow Chapter

Two important publications of NAAS (Policy Papers 90 and 91) were translated into Hindi and published for their wider circulation and effective implementation of the recommendations proposed in these documents. The present version of the document would be of significant importance at local level to synthesize strategies and plan based on the recommendations proposed. It was also highlighted through the document that Lucknow Chapter of the Academy has more than 70 NAAS Fellows and Associates, and they are always ready to help in developing strategies and road map to the desired departments, institutions and other agencies. Publication has been sent to all NAAS executive committee members, conveners of all NAAS regional chapters, VCs and Directors of Agricultural Universities, ICAR institutes especially those functioning in Hindi belt, Head KVKs of UP and Uttarakhand, NAAS Fellows and associates of Lucknow chapter, Director/ Officials of state line departments and eminent agricultural personnels and prominent NGOs working in the field of agriculture.

GM Diagnostics: Meeting a Challenge

Over the years, genetic modification of crops has emerged as one of the most promising technologies in ensuring global food security. However, before their release the consumers' apprehensions need to be addressed through appropriate risk assessment and management. GM events are approved for commercial cultivation or use as food and feed, as per the national regulations. GM crops approved in India may not necessarily have the same approval status as in another countries, which may have a considerable impact on international trade and trans-boundary movements. The approval of GM crops and products are regulated in different countries ranging from voluntary labelling as in the United States, to the stringent legislation as in the European Union. Several countries have implemented labelling thresholds for unintentional presence of approved GM crops defined as 0.9% in the EU and Russia, 3% in Korea, 5% in Japan, Indonesia, Thailand and Taiwan, and 1% in Brazil. So far, no labelling threshold has been decided and implemented in India. Harnessing the potential of GM crops, therefore, hinges on the availability of GM diagnostics to address issues pertaining to their impact on the biodiversity, checking for the unauthorized GM events and to solve legal/IPR disputes. Increasing number of approved GM events in different crops poses a challenge to develop the robust and cost-effective diagnostics to check unauthorized GM events in the supply chain and during the import and export. India being the centre of origin and diversity of several crop species, it is of utmost importance to monitor the adventitious presence of transgenes in the farmer's fields, and diversity-rich areas.

GM detection strategies

Reliable analytical methods for detection and quantification of GM content in food commodities or seed lots are required to effectively implement the regulatory obligations. It is necessary to develop user-friendly, cost-effective and reliable GM detection strategies to screen a large number of GM crops/events. DNA-based diagnostics can be employed for monitoring adventitious presence of transgenes and for ensuring post-release monitoring of GM events.

Based on the target amplification, DNA-based detection methods can be categorized as: (i) Target amplification methods to increase the amount of target DNA, as in polymerase chain reaction (PCR); and (ii) Signal amplification methods to increase the signal of the target, as in real-time PCR (qPCR). PCR and qPCR are being widely employed for GM detection and quantification. In the recent years, researchers have improvised DNA-based GM diagnostics by adopting different approaches, such as GMO matrix, loop-mediated isothermal amplification (LAMP), qPCR-based multi-target system, microarrays and next generation sequencing.

GM detection research facility for quality assurance

ICAR-NBPGR, New Delhi is the nodal agency to issue *import permit* and undertake quarantine processing of imported transgenics for research purposes as per the Government of India Notification No. GSR 1067 (E) dated 05.12.1989 and Plant Quarantine (Regulation of Import into India) Order, 2003. Till date, 245 transgenic consignments of 15 GM crops have been imported for research purposes from 24 countries by various public and private research institutions in India through ICAR-NBPGR. Besides quarantine processing of imported transgenics, molecular testing of specific transgenic elements is regularly undertaken at GM Detection Research Facility (GDRF), an ISO/IEC17025:2017 accredited and designated National Referral Laboratory to detect the presence or absence of Living Modified Organisms and Genetically Modified Organisms (under sub-section (1) of Section 4 of the Seeds Act, 1966 in the Gazette of India: Extraordinary Notification (Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India, dated 15 November 2017).

For quality assurance and global harmonization as per ISO/IEC17043:2010, GDRF has successfully participated in:

- Twenty five Proficiency/Comparative testings for testing the unknown levels of different GM events in blind test samples organized by European Commission-Joint Research Centre, Italy and Grain Inspection, Packers and Stockyards Administration, USDA;
- Ring trial for validation of real-time PCR methods organized by the Federal Office of Consumer Protection and Food Safety, Germany for detection of *bt* rice with *cry1Ab/Ac* and *pubi-cry;* and EC-Joint Research Centre, Italy for quantitative detection of Golden Rice 2.

These validated methods will be very useful to check GM contamination in rice.

Research work in the area of GM diagnostics at GDRF over the past two decades aimed precisely to develop nationally and globally harmonized novel cost efficient GM diagnostic technologies, *viz.* GMO screening matrix, a novel cost efficient decision support system enables efficient detection of 141 GM events of 21 crops, visual LAMP (loop mediated Isothermal amplification) and real-time LAMP assays and PCR/Real time PCR assays for more than fifteen GM crops and their dissemination to different stakeholders including transfer to private sector for commercialization.

DNA based GM diagnostics have been developed at GDRF for initial screening, identification and quantification of GM content:

- PCR-based diagnostic for initial screening of GM crops using multiplex PCR assays for simultaneous

amplification of commonly used marker genes which would be useful in verifying the GM status of a sample irrespective of the crop and GM trait:

- Hexaplex PCR assay for simultaneous amplification of commonly used six marker genes being employed in most of GM crops *i.e., aadA, bar, hpt, nptII, pat* and *uidA.*

- Heptaplex PCR assay simultaneously amplifying marker genes; *nptII, aadA, pat, uidA* and regulatory elements *viz., CaMV 35S, nos* promoters and *nos* terminator.

- *Multiplex PCR and Real-time PCR based assays* for more than 50 GM events of 15 crops. Multiplex PCR, assays to detect and identification of specific transgenes/marker genes/promoter in twelve GM crops, *viz.* cotton, soybean, maize, mustard, rice, brinjal, cauliflower, cabbage, okra, tomato, potato and wheat.

- *Decaplex PCR differentiating five commercialized events of Bt cotton, viz.,* MON531, MON15985, Event1, GFM-cry1A and MLS-9124 and another Decaplex PCR to differentiate and to check the adulterants in two major commercialized *Bt* cotton events in India, *viz.,* MON531 (Bollgard® I) and MON15985 (Bollgard® II) (Fig.1).

- *Multi-target real-time PCR-based screening system,* a user-friendly system simultaneously targeting 47 targets in duplicate per plate, including 21 GM events, 5 constructs, 8 transgenes, 4 control elements, 3 marker genes and 6 endogenous genes.

- *GMO screening matrix to check authorized and unauthorized GM events in India:* GMO matrix of 141 GM events of 21 crops based on the information on 106 genetic element for detection. Ten most frequently present targets have been identified to screen these events using a GMOseek algorithm. Matrix approach facilitates efficient, rapid and cost-effective screening by eliminating the need for development of specific testing methodologies for each individual GM event.

- *Crop-specific GMO matrix combined with multiplex PCR for screening of >90% of globally commercialized GM cotton and maize events:* GM maize and cotton comprise the major part of imports for research purposes. Crop-specific GMO matrices of 199 GM events, comprising 143 GM maize events with 75 genetic elements and 56 cotton events with 45 genetic elements, to screen globally approved GM maize and cotton events. Frequently present genetic elements were identified, based on the cost-efficiency, feasibility of plexing and coverage of GM events, maize-specific tetraplex PCR, targeting *P-35S, T-nos, T-35S* and endogenous *Adh1* gene. For screening of GM cotton events, pentaplex PCR, targeting *P-35S, T-nos, nptII, pat* and endogenous *Sad1* gene was developed. The tetraplex and pentaplex PCR assays could efficiently screen 94% of maize and 93% of cotton events approved globally.

- *Visual and real-time Loop-mediated isothermal amplification (LAMP) assays for rapid, cost-effective and reliable GMO screening:* LAMP assay targeting commonly employed promoters and marker genes using two chemistries, using *Bst* DNA polymerase and ready-to-use isothermal master mix. The utility of four amplification systems, *viz.,* conventional heating block, thermal cycler, Light Cycler480 real-time PCR system, and isothermal real-time system (Genei® II), was compared **(Fig. 2).** Visual and real time LAMP assays developed to screen GM events with LOD 0.1% for visual LAMP and 0.01% LOD for Real-time LAMP. LAMP based visual and real time screening assay, to detect of specific transgene/ marker, gene/promoter event/construct in cotton and other crops.

- *Employing the diagnostics for ensuring GM free Conservation of Germplasm in National Genebank at NBPGR:* To ensure GM free conservation strategies were devised for monitoring adventitious presence of transgenes in *ex situ* collections of cotton (280 accessions), maize (200 accessions), brinjal (150 accessions) and okra (50 accessions). None of the accessions tested of these crops showed adventitious presence of transgenes.

- *Monitoring adventitious presence of transgenes in brinjal collections from the regions in India bordering Bangladesh:* Adventitious presence of transgenes was monitored in collections of 211 brinjal samples from 32 locations of five bordering states to Bangladesh, *viz.,* Assam, Meghalaya, Mizoram, Tripura and West Bengal **(Fig. 3, 4)** employing singleplex/multiplex PCR, real time PCR and LAMP assays targeting *cry1Ac* gene, 35S promoter and *nptII* and *aadA* marker genes. The study showed that cultivated and wild brinjal accessions collected from adjoining areas of Bangladesh, post field trials and release, no adventitious presence of transgenes was detected.

With increase in number of GM events and diversification of traits, cost-effective GM diagnostics could facilitate effective risk assessment and management of GM crops and for their post-release monitoring. PCR and qPCR-based assays are being widely employed for GM detection and quantification due to their specificity, sensitivity and robustness. Novel strategies/technologies based on GMO matrix, LAMP, qPCR-based multi-target system are gaining popularity in GM detection due to wider applicability and cost-efficiency. In the recent past, technological advancements such as next generation sequencing has emerged as an efficient tool for testing GM events without any sequence information available which would be of immense use to track the unknown GM events. With the emergence of gene-editing technology as a faster pace for the development of GE plants with desired traits, efficient diagnostics/ detection strategies especially for such crops also need to be established.

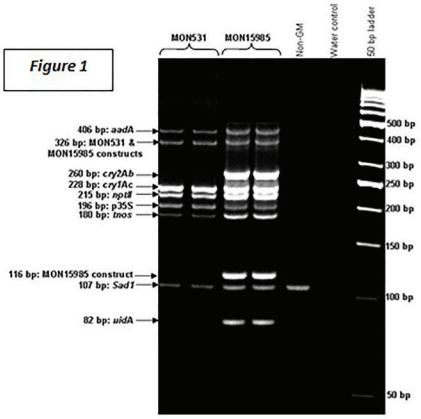


Figure 1

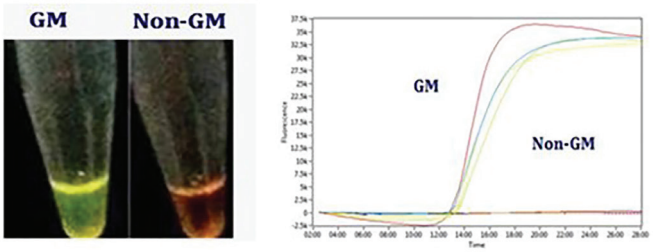


Figure 2

Figure 3

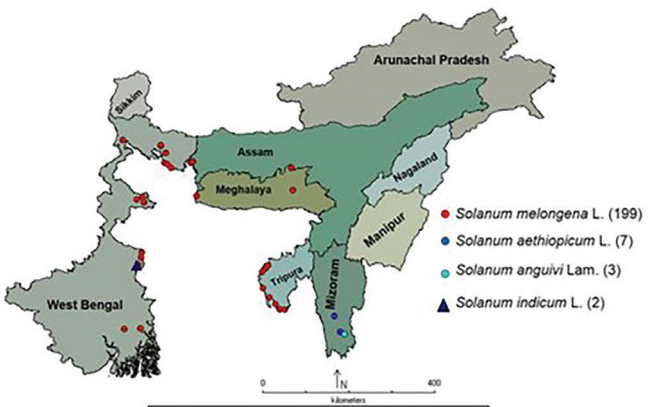


Figure 4

Dr Gurinderjit Randhawa, NAAS Fellow

Forthcoming Programmes

- Strategy workshop on Bio-fortification (Dr U.S. Singh)
- Brainstorming session on the Role of Agriculture for a Five Trillion Economy in the post-COVID Scenario (Dr Suresh Pal)
- Strategy workshop on Emergency Preparedness for Prevention of Trans-boundary Infectious Diseases in Indian Livestock and Poultry (Dr Parimal Roy and Dr V.P. Singh)
- Strategy workshop on Wastewater Utilisation in Urban and Peri-Urban Agriculture (Dr J.C. Dagar)
- Strategy workshop on Innovations in Potato Seed Production and Its Adoption (Dr S.K. Chakrabarti)
- Strategy workshop on Need for Breeding Tomatoes Suitable for Processing in India (Dr A.T. Sadashiva)
- Brainstorming session on Ethno-medicine (Dr P.L. Gautam)

Change of Address

- Dr Pritam Kalia, J1 024 Indiabulls Centrum Park, Sector 103, VPO Daultabad, Gurugram 122006; Cell: 9810185336; Email: pritam.kalia@gmail.com; pkalia@iari.res.in

Obituaries

Dr Yash Pal Abrol

Born in Lahore (now in Pakistan) on December 23, 1935, Dr Abrol did his Ph D from the University of Chicago in 1963 and worked as post-doctoral fellow in the University of California before returning to India.

Dr Yash Pal Abrol, a pioneer in the field of nitrogen research in India and a renowned plant physiologist and biochemist served the profession as ICAR National Fellow (Professorial Chair), 1978-84, Principal Scientist (Professor) and Head, Division of Plant Physiology, 1988-95 at Indian Agricultural Research Institute, New Delhi; Visiting Scientist, McMaster University, Hamilton, Canada (1983-1985); Consultant, FAO (1971, 1993); Emeritus Scientist (CSIR) 1996-2000; INSA Senior Scientist 2001-2005; INSA Honorary Scientist (2006 onwards), Member, International Nitrogen Initiative Advisory Committee, 2009. He held senior positions at the Indian National Science Academy between 2000 and 2020.

He was a fellow of two other national academies —Indian Academy of Sciences and The National Academy of Sciences — and received several awards and honours including Dhiru Morarji Memorial Award (Fertilizer Association of India), 1977; ICAR R.D. Asana Endowment Fund Prize, 1974-77; IARI Sukumar Basu Award, 1980; FICCI Award, 1990; Vasvik Award, 1993; Platinum Jubilee Lecture Award, Indian Science Congress, 1995; T.M. Das Memorial Lecture Award, 2002; Birbal Sahni Medal (Indian Botanical Society), 2008. Dr Abrol published more than 150 research papers and wrote / edited over 15 books. He was best known for his pioneering work on cyanogenic glycosides, screening of wheat varieties for *roti* and *chapati* during green revolution years and his N balance sheet for wheat and barley, which formed the basis for optimal N fertilizer recommendations in India. His most recent contribution was the Indian Nitrogen Assessment (2017), which led India to pilot the first ever United Nations (UN) resolution on sustainable nitrogen management.

Prof Abrol, a distinguished researcher and fellow of the Academy left for his heavenly abode on July 28, 2020. On behalf of the Fellowship fraternity, to which late Prof Yash Pal Abrol belonged to, the Academy prays to the Almighty to grant peace to the departed soul, and strength to the bereaved family to bear this great loss.

Dr Brahma Dutta Kaushik

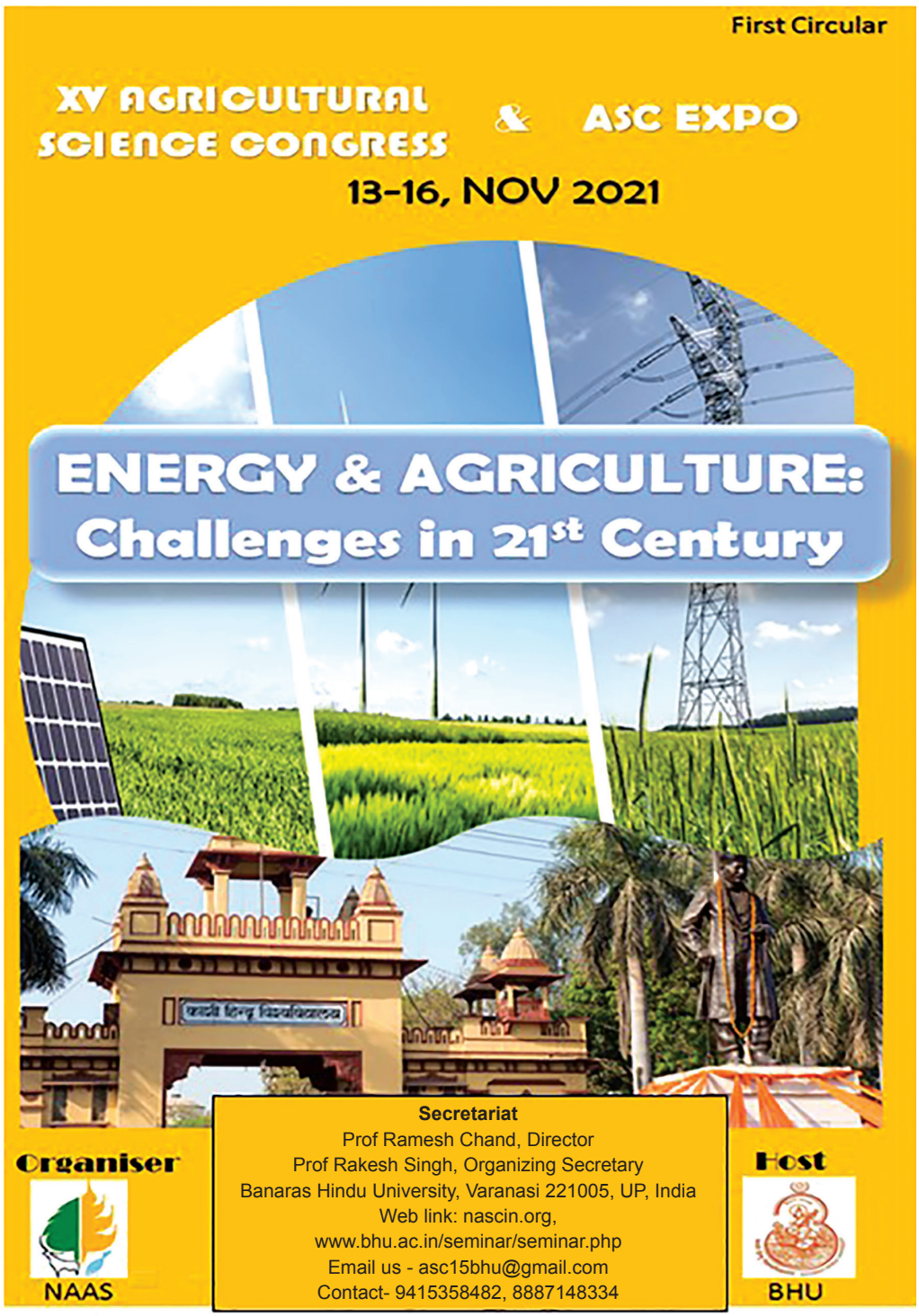
Born in Kotkasim, India on May 21, 1945, Dr Kaushik had his early education (1959-61) at Govt. High School, Dausa, Rajasthan. Subsequently, he did his graduation from SKN College of Agriculture Jobner, Rajasthan (1961-1966); and pursued MSc and PhD in Microbiology from the Indian Agricultural Research Institute (1966-71).

Dr Kaushik was bestowed with several prestigious national and international fellowships, awards and assignments for his contributions to agricultural science including German Academic Exchange Service Fellowship, 1975-76; Indo-UK Exchange Programme, London, 1981; Indo-US Senior Scientific Panel on Biological Nitrogen Fixation 1984, 1986, 1988, 1991 to Ithaca, Davis, Hawaii (USA), S.R. Vyas Memorial Award, 2000; K.S. Bilgrami Gold Medal, 2005; Life Time Achievement Award, 2010 by Krishnamurthy Institute of Algology, Chennai, Life Time Achievement Award 2014 by North Maharashtra University, Jalgaon, President, AMI, 2001; President, Indian Phycological Society, 2007 until his demise. He was also a fellow of Association of Microbiologist, India.

He served as Professor of Microbiology, 1997-2001 and Head 2002-2007, Indian Agricultural Research Institute, New Delhi; Professor of Eminence, Division of Biotechnology, Netaji Subash Institute of Technology, New Delhi 2007-10; Dean (R & D), Anand Engineering College, Agra, 2011-13 and Director (R&D), Shri Ram Solvent Extraction Pvt. Ltd., Jaipur and contributed immensely in the domain of agricultural microbiology and biological nitrogen fixation.

Dr Kaushik, a distinguished researcher and fellow of the Academy left for his heavenly abode on August 8, 2020. On behalf of the Fellowship fraternity, to which Dr Brahma Dutta Kaushik belonged to, the Academy prays to the Almighty to grant peace to the departed soul, and strength to the bereaved family to bear this great loss.

Announcement



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