NAAS NEWS

RESEARCH EDUCATION AND TECHNOLOGY POLICY FORUM

Vol. 14 No. 3 July-September 2014

CONTENTS

From the President's Desk

Per Drop More Crop

In the previous issue of NAAS newsletter, I had written about the Monsoon-2014. The rains as per the forecast were not only deficient but erratic with heavy down pour in the upper reaches of the Kashmir valley resulting in unprecedented floods. This situation once again brings upfront the issue of an efficient system of water management, in totality. Hon'ble Prime Minister of India, while delivering the 86th ICAR Foundation Day lecture on 29 July, 2014, referred to water as nature's *prasad* and said that it be treated with reverence. He called upon the scientists to develop technologies that will improve water productivity and give the farmers 'per drop more crop'.

Water is the most critical input for agriculture. Currently 63 million ha, or 45 per cent of the net cropped area in India, is irrigated. Agriculture faces complex challenges between now and 2050 to satisfy the food demands of an estimated national population of 1.5 billion, resulting in escalation of water demand for agricultural and non-agricultural use. The net sown area in the country has almost stabilized at 140±2 mha with cropping intensity of 140%, implying that further gains in agricultural production must come from productivity enhancement. Increased cropping intensity will be a key strategy for future gains in agricultural production. Efficient use of irrigation water requires that water be applied to growing crops at appropriate times and in adequate amounts. Also there is an unprecedented over the mining and degradation of groundwater. The main task will be to (i) produce more from less water by efficient use of utilizable water resources in irrigated areas, (ii) enhance productivity of challenged ecosystems, rainfed and water logged areas, and (iii) use a part of grey water for agricultural production in a sustainable manner.

Most of the irrigation projects are operating at levels below the achievable efficiency of more than 50 per cent. Further, inefficient use of water also leads to inefficiency of all other resources/inputs. There is enormous scope to improve the productivity and efficiency of irrigation systems which can be achieved both by technological as well as social interventions. It is estimated that with a 10 per cent increase in the present level of efficiency in irrigation projects, an additional 14 million hectare area can be irrigated from the existing irrigation capacities which would involve a very modest investment compared to what is required for creating equivalent potential through new schemes. We therefore, need to adopt an integrated approach with emphasis on greater conservation and enhanced water use efficiency.

Though India is among the leading producers of food grains in the world but India's productivity *vis-à-vis* world average and highest yield (kg/ha) for major crops cereals, pulses, oilseeds, sugarcane and vegetables remains short of the highest levels achieved elsewhere in the world. Similarly, in livestock sector also, despite India being the top producer of milk, bovine productivity is only 1538 kg per year as compared to the world average of 2238 kg per year. The low productivity levels also indicate the existence of enormous untapped potential. Efficiency-mediated improvement in productivity is the most viable option to raise production. Development of new crop varieties with more efficient photosynthesis and shorter duration would be of immense help in increasing cropping intensity.

There are several technologies developed by our institutions that enable production of 'more crop per drop'. Resource Conserving Technologies (RCT) have demonstrated potential to increase factor productivity including land, labour, capital and inputs. Laser land leveler is gaining popularity as method of field preparation, ridge-furrow method for conserving water in the field and use of sprinkler and drip irrigation for judicious use of water where it is scarce and the topography and soil conditions do not permit efficient irrigation by conventional methods. Adoption of RCTs lead to an improvement in productivity of rice by 1 to 7% in mechanical transplanting, 3 to 8% in drum seeding, 1 to 2% in zero till drilling and 10 to 13% in system of rice intensification (SRI) compared to traditional hand transplanting at different locations. Similarly, in wheat, productivity increased by 5 to 29% in zero till drilling, 4 to 11% in strip-till drilling and 3 to 23% in bed planting compared to conventional sowing at different locations.

The prevailing farming in India calls for an integrated effort to address the emerging issues / problems. The integrated farming systems (IFS) approach has proved to be more remunerative especially for small and marginal farm-holders. However, these integrated farming systems are required to be location specific and designed in such a manner that lead to substantial improvement in energy efficiencies on the farm and help with maximum exploitation of synergies through adoption of close cycles. These systems also need to be socially acceptable, environmentally friendly and economically viable.

Some of the successful IFS Models developed are integrating fish & prawn culture, cereal crops, vegetables, fruits and livestock have resulted in productivity gains up to 3-5 times income generation, employment and nutritional security as compared to monocultures. Aquaculture and catch fishery is amongst the fastest growing industries in India. Integration of crop-fish in the production system especially in areas of high rainfall or areas dominated by pond based farming systems is emerging as a viable option to increase water productivity and farm income. It is estimated that water productivity increases by 12 times (1.8 kg/m^3 in okra and 2.6 kg/m^3 in French bean to 40 kg/m^3 in crop + fish + poultry + duckery system) in humid areas with pond based integrated farming systems.

The Academy is very much concerned about the farmers' interest and is organizing expert consultations on 'Energy' and 'Water' during September and October 2014 respectively. There is a need to optimize the resource' use efficiency so that they are able to harvest more crops, per drop not only for water but for every drop of their sweat.

S. Ayyappan
E-mail: dg.icar@nic.in

EDITORIAL

How Much Load the Mother Earth can Carry?

The 'space ship earth' takes 70 million new passengers aboard every year. However, to continue its space odyssey carrying this additional load there are two options either to triple the agricultural production in the coming 3 to 4 decades and/or to decelerate population growth sufficiently reducing demand for food and fibre significantly. Thomas Malthus in 1806 was first to address the issue of food scarcity as an outcome of the population pressure because of the limited capacity of the earth to produce sustenance for a sustainable population. Ehrlich (The Population Bomb, Ballantine Books, New York 1968) extended the Malthusian theory of population growth by asserting that humans were going to fail in the battle against hunger in the long run. Despite his predictions, Ehrlich and Ehrlich (J. Sustainable Development, 1.3, 2009) recognized that the some societal shifts have occurred that indicated that at least some populations were slowing their growth. Population growth rates in most developed nations have dropped to less than replacement levels. The Green Revolution had a higher impact than expected. However, the absolute number of world's hungry people in 2005 remains approximately same - 850 million as in 1968.

There are limits to which the agricultural production can be increased without damaging environment. Increased production is possible only with increasing exploitation of natural resources such as water and energy for which there is also consistent demands from sectors other than agriculture. Besides, there has to be additional inputs of plant nutrients and agrochemicals. There are constraints on soil to give continuously increasing harvests year after year without damaging its health in terms of lowering its fertility. Continuous repeated harvests will leave the soil impoverished reducing its production capability requiring larger production inputs to yield the same amount of food and fibre. This is what happened in post green revolution era. Further, per capita availability of land for agriculture has fallen drastically from 0.91 ha in 1951 to about 0.32 ha in 2001 and projected to decline further to 0.09 ha by 2050 with the present rate of alarming population growth (NAAS Policy Paper 51, 2011).

Population pressures have seriously and negatively affected agricultural practices in many ways. The per capita farmland and the fallow period which allows the soil to rest and recoup have been reduced drastically as a result of increasing numbers of people farming on restricted agricultural land resulting in reduced farm yields. Therefore, the prescription will be to produce more from less land and in less time. Loss of fertile land for non-agricultural uses for industry, housing, transport etc. would further put burden on agriculture and same is true of water whose per capita availability is going down rapidly. Over exploitation of underground water has resulted in an alarming fall in ground water table.

To feed the world without ruining the planet, agriculture will have to produce much more food and find better ways to store and distribute it, while significantly reducing the damage it does to the atmosphere, habitat and water. To double global food production without expanding agriculture's footprints into forest cover, we must significantly improve yields of existing farmlands. In this regard, the movement for promoting organic farming will prove counterproductive and disastrous. There are two options for us either we can boost the productivity of our best farms - breaking yield barriers through improved crop genetics including biotechnology and management or to improve the yields of the least productive farms closing the "yield gap" between a farm's current yield and its higher potential yield. The latter option provides the largest and most immediate gain especially in regions where hunger is most acute.

There is an urgent need to ascertain levels of population which can be sustained without damaging earth's resource base. Developing a sustainable farming system that conserve and improve resources should be the guiding principle. Sustainability of the farming system needs to be studied on a long term basis. The emphasis should shift to managing natural resources more efficiently rather than attaining yield goals. The aim should be sustainable food grain production for a sustainable human and animal population. The scientific community must send a signal loud and clear to the policy makers that agricultural productivity cannot be increased indefinitely. Therefore, it is imperative that a sound population policy must be in place for the survival of future generations. Let us not overburden the mother earth.

P.K. Chhonkar
pkchhonkar@yahoo.com

Prem Dureja
pd_dureja@yahoo.com

Note : *Fellowship may send views/comments at E-mail: editors.naas@gmail.com*

How Real is Fear of Genetically Modified (GM) Crops?

Nagendra Kumar Singh
National Professor (B.P. Pal Chair) NRC on Plant Biotechnology,
Indian Agricultural Research Institute, New Delhi

Dr NK Singh

At present a vociferous debate is on the bio-safety of GM crops worldwide and India is no exception. There are fears in the minds of some that harmful effect may occur due to long term use of GM crops as a result of unintended changes owing to insertion of foreign genes in the transgenic crops. General public, politicians and judiciary acknowledge their lack of understanding about the technical aspects of these crops. Therefore they rely on technical experts for information on this subject. However, when technical experts themselves send conflicting messages to the society then general public also gets confused which is further aggravated by the mass media which only mirrors the mood of the society. In such a situation the decisions by policy makers must be guided by the rigor of science and not by idealistic opinions of individuals or groups.

Level of opposition to GM crops

The opposition to GM crops is on three levels:

(i) **Complete rejection:** GM crops are unnatural, unethical and unsafe and must be rejected outright as these are against the laws of nature. This stand is taken by extreme groups which are opposed to modern technologies such as nuclear energy and genetic engineering.

(ii) **Put it in abeyance till we are sure:** Many argue that GM crops may be useful but our present regulatory system is not stringent enough. Therefore, we must put it on hold till we have a perfect regulatory system.

(iii) **Rejection based on socio economic grounds:** This group believes that GM technology is promoted by foreign multinational companies (MNCs). Hence, GM food products cannot be trusted on their food and environmental safety and GM seeds will be too costly leading to exploitation of the farmers.

The concerns at the points (ii) and (iii) above could be addressed easily by evolving and putting in place a fool proof regulatory system. The interests of the farmers can be protected by encouraging public sector institutions, Indian industries and public-private partnerships for development of safe and affordable GM crop seeds. But it will be difficult to address idealistic anti-technology stand to completely ban the research and field testing of GM crops. A ban on GM crop research and field testing in India will prove counterproductive to the goal of nation building as it would be very difficult to ensure food, environmental and socioeconomic safety by rejecting modern biotechnologies and make us more vulnerable to the monopolization by MNCs.

Complete rejection of GM crops is unscientific, misguided and could even be motivated by competing commercial interests. The success story of green revolution of the 1960s where dwarfing genes originating from Japanese wheat variety Norin10 and Taiwanese rice variety Dee Gee Woo Gen were recombined with the quality and adaptation properties of traditional varieties of time consuming conventional plant breeding methods is well known. Nearly half a century later same results could be obtained much more precisely and faster using recombinant DNA technology using a 'Cisgenics' approach (a variant of the transgenic GM technology). All improved varieties are actually genetically modified only the methods of obtaining them may be different.

In view of the above, it is important to clear some myths about the GM crops. Are GM crops really dangerous and unsafe for human health and the environment? It is a sweeping generalization that assumes that all GM crops are same irrespective of the nature and source of genes that has been transferred. The fact is that the gene used for making GM crops could be from a distant organism, a different crop species or even from the same species and transferred back to it after making necessary improvement though genetic engineering. The level of bio-safety concern will vary enormously depending upon the source and nature of the gene. Some of the points frequently re-iterated by the anti-GM activists are as follows:

Misconceptions about GM Crops

1. **GM crops are unethical as they are developed using unnatural process:** Scientists have learnt the trick of transferring required gene into host plant cells from a humble bacterium *Agrobacterium tumefaciens* which has been doing this for millions of years. It comes to it naturally. Horizontal gene transfer between species also occurs in nature, although at a very low frequency. Further, even distant species of plants and animals share thousands of common genes due to their common evolutionary origin.

2. **GM Technology is harmful to health and the environment:** On the contrary GM technology has been used to produce human insulin, more nutritious foods e.g. golden rice and can help save the environment by bio-remediation, e.g. cleaning of oil spills by genetically modified microbes. GM technology may lead to drastic reduction in pesticide use as is the case with Bt cotton, leading to better soil health and reducing environmental contamination. Further, genetic engineering has the potential to enhance the nutrient use efficiency of crop plants and help the development of more efficient bio-fertilizers and bio-pesticides thus reduce our dependence on chemical fertilizers and pesticides.

3. **GM crops lead to loss of biodiversity:** Loss of biodiversity is not specific to GM crops. Even by adopting improved varieties developed through conventional breeding farmers discontinued cultivation of the less productive old varieties, leading to loss of crop bio-diversity. This happened during the period of Green Revolution when new semi-dwarf varieties of rice and wheat fast replaced many of the land races and traditional varieties, but most of these have been collected and preserved in the national gene banks, and now serving as a source of useful genes for different environmental stresses for further improvement and diversification of the green revolution varieties. GM crops have had no adverse impact on the general biodiversity, which is threatened much more by human population explosion, rampant urbanization and deforestation. Higher yielding crop varieties, both GM and non-GM has actually helped produce more grains per unit of land, hence save forests and general biodiversity.

4. **GM technology lead to the development of resistance:** Development of resistance occurs due to selection pressure on the insect or weed population, leading to increase in the frequency of individuals having resistant alleles over a period of time. This happens equally with non-GM crops with excessive use of a single chemical pesticide or herbicide. The main reason for the development of resistance against a particular insecticide or herbicide is its overuse. On the contrary GM crops delay the development of resistance by reducing pesticide usage. Non-GM disease resistant varieties of crops also become susceptible to the pathogen after few years of monoculture due to build-up of virulent races of pathogen. Concepts of refugia, gene stacking and strategic gene deployment are part of a resistance management strategy that reduces the selection pressure thus delay the development of resistance.

5. **Adoption of GM crops will lead to monopolistic control of the seed business by MNCs:** This can happen with non GM crops also with lack of competitive environment. A ban on research and testing of GM crops in India will help further concentrate the GM technology in the hands of MNCs.

Over the years GM technology has emerged as a benign technology revolutionising agricultural production, productivity, value addition and nutritional quality of crop plants. It is derived from need-based precise introduction of one or more well characterised genes into a crop plant using recombinant DNA technology. Due to their proven merit the global area under GM crops has swelled almost hundredfold between 1996 and 2013, from 1.6 million ha to 175 million ha in 27 countries (ISAAA Brief 46, 2013). In economic terms, in 2011, the GM crops gave the net global farm income of $19.8 billion.

An example of GM food crop consumed directly without any processing is GM papaya engineered to resist the ring spot virus, which is being eaten by human beings for over a decade without a single report of any harmful effect to human health or the environment. A decade of EU-funded GMO research (2001-2010) explicitly addressing Biosafety of GMOs based on more than 130 research projects, covering a period of more than 25 years of research, and involving more than 500 independent research groups has concluded that biotechnology, in particular GMOs, are not per se more risky than conventional plant breeding technologies e.g. dwarf high yielding varieties of rice and wheat. The group has further recommended that modern biological know-how and technologies should be used to address major socioeconomic challenges, including food and feed security and safety.

Bt-cotton, first approved in 2002 for commercial cultivation in India, now occupies nearly 11 million ha, covering over 90% of the total cotton area. This has resulted in doubling the average cotton yield and enhanced the net income of cotton farmers. Further, it resulted in a reduction in the use of chemical pesticides, which is of tremendous environmental benefit. It is true that presently GM crop products are dominated by a particular multinational seed company and its Indian sub-licensee, this can and will change by following a mission mode approach for the development of required GM crop seeds by Indian public sector and private companies and through effective PPP to make the GM seeds cheaper and easily affordable.

Over the years, DBT and ICAR have invested heavily in creating infrastructure for the development of GM crops and started several research projects for this

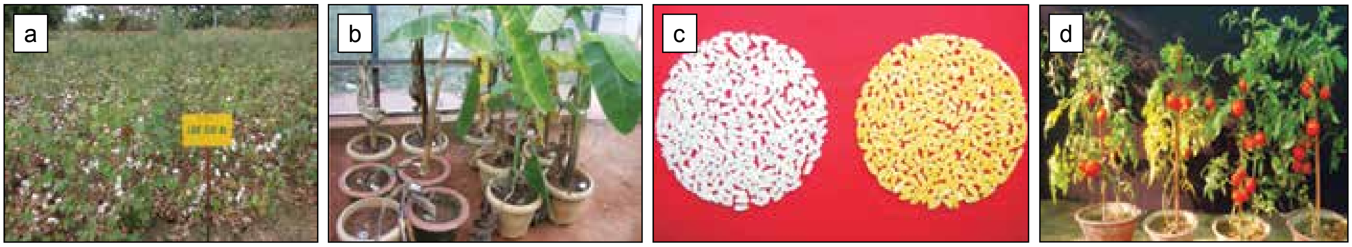


Figure 1: Some of the experimental GM crops under development by ICAR laboratories. **a.** Bt-cotton variety Anjali carrying *Bt cry 1Ac, cry 1 Aa3* genes (Courtesy Dr. G. Balasubramani CICR Nagpur); **b.** GM Banana with anti-microbial peptide gene showing resistance to *Fusarium* wilt (right side, Courtesy Dr. Sukhada Mohandas, IIHR Bangalore); **c.** GM golden rice in variety Swarna, enriched with pro-vitamin A (right Courtesy Dr. A.K. Singh, IARI New Delhi); **d.** Tomato variety 'Kashi Vishesh', incorporating *DREB1A* gene (right side) showing enhanced drought tolerance as compared to non-GM control plants (left). (*Courtesy Dr. Major Singh, IIVR Varanasi*)

purpose but the progress has been rather slow. The reasons for slow progress need to be identified and corrected for harnessing the benefits of this important technology. Many concerns regarding adoption of GM food crops in India will disappear when products start coming from the public sector. While progress in the delivery of GM crop products for the public sector is slow there are several promising events in the pipeline and such efforts should be supported and encouraged (Fig. 1A-D, for full list please see Ministry of Science and Technology website <igmoris.nic.in>).

Way forward

There is tremendous fear mongering by some anti-GM groups about GM crops in the print and electronic media. This makes it imperative for the mainstream scientific community and government agencies to inform the public about the scientific facts, regulatory safeguards in place and the benefits of GM crops as also outlined by NAAS (*Policy paper no. 52*). Curricula for schools and universities should be developed incorporating modern concepts of genetic modification of crops along with the conventional methods and their relevance to societal needs. There is a need to encourage interface of students, scientists and teachers, develop suitable models and modernize laboratory infrastructure for skill development in the area of GM technology. Extension personnel including scientists in Krishi Vigyan Kendras (KVKs) need to be sensitised about the usefulness of GM technology. English and vernacular Indian languages should be used for effective communication with the society.

There is no need to ban research, product development and confined field trials of GM crops taking all necessary safeguards. The confined field trials can be done on designated safe sites under government control. A ban on research and testing may prove counterproductive to future food and nutritional security of the nation as the stakeholders will lose faith and interest in this benign modern technology. In green economies of the future, GM technology is poised to replace many of the agrochemicals that have proven harmful side effects but are still widely used to ensure stability of agricultural production. Globally, intensive research is underway in the area of bio-energy, bio-fertilizers, bio-pesticides, photosynthetic efficiency, nutrient-use efficiency, nutritional quality improvement etc. based on the powerful tools of Genomics and GM technologies and India should not lag behind.

Over millennia the development and ascent of human civilizations has been interlinked with the use of technology. Use of fire, domestication and breeding of animals and plants, use of the plough and wheel, motorized transport on land, sea and air, electricity, pharmaceuticals and agricultural chemicals, vaccines, computers, radio communication, nuclear energy, space technology and so on, each has its own benefits and risks. Every day hundreds of human lives are lost directly due to the risks of these technologies that we happily accept because their benefits far outweigh the risks. On the other hand even after more than fifteen years of large scale global adoption there are no proven reports on the loss of human life or damage to the environment due to GM crops. Why is then such hue and cry by the anti-GM groups which are misleading the society at large? Is it the fear of unknown or competing commercial interests?

A way forward could be by delinking the research and bio-safety testing of GM crops with the commercial release process. India as a nation should have the right to decide its priority on what kind of GM crops it wants or does not want to safeguard its economic interests and benefits to the farmers. Research and biosafety testing can focus purely on the scientific issues. For example, India is not interested in developing GM in Basmati rice to safeguard its export market but has happily adopted Bt-cotton to enhance domestic supply and export of cotton. Hence, a prioritization based on our national interests is required rather than complete rejection of the GM technology.

Programmes Held

Brainstorming Session on Monitoring and Evaluation of Agricultural Research, Education and Extension for Development (AREE4D) (Convener: P.G. Chengappa)

A Brainstorming Session (BSS) on Monitoring and Evaluation of Agricultural Research, Education and Extension for Development (AREE4D) was organised on 28th June 2014 at the Institute for Social and Economic Change (ISEC), Bangalore. Dr P.G. Chengappa, National Professor, ICAR and convener stressed the importance of Monitoring and Evaluation (M&E) for rational investment decisions and enhancing the development effectiveness in agricultural research, education and extension (AREE). Dr Chinnadurai, Director, CARDS, TNAU, in his introductory remarks expressed the need for M&E since a large number of projects are being implemented and funding agencies are keen in assessing the impacts of such projects. Both Government and donor agencies look for the outputs and impacts of the projects implemented at the NARS through third party evaluations but trained M&E personnel are the major hurdle. Prof. M.P. Yadav, Secretary, NAAS, briefly presented achievements of livestock projects in the NARS. The following recommendations and action points emanated from the discussion:

Recommendations

Education

- At present, in most of the SAUs, M&E Cell does not exist but they are willing to constitute it, as they would promote accountability, improvement in the quality of teaching, increase employability of the graduates and the rating for the institutions.
- M&E Cell could be in the form of Education Technology Cell / Education Cell / Academic Monitoring Cell / Academic Program Committee as in the case of ISEC
- M&E Cell could be chaired by Vice-Chancellor/ Director with a maximum of 15 members that would include Faculty Deans, Dean (PG Studies), Director – Instructions, Representatives from Faculty, Stake Holders, Alumni and Agribusiness Entrepreneurs
- Performance indicators like evaluation by superiors, peer evaluation, student evaluation and self-evaluation may be included.
- Number of students admitted to foreign universities, of foreign students admitted to our SAUs and number of JRFs and SRFs from each SAUs could also be some of the key indicators.
- To strengthen the M&E Cell, incentives like reward and sending the faculty for short term overseas training could be thought of.
- Any M&E Cell in SAUs should be an statutory authority of the University / ICAR Institutes and it should be inbuilt in their Acts and Statutes

Research

- There is an imminent need for an exclusive and dedicated full-fledged M& E unit at the University/ Institute level attached to the Vice Chancellor/ Director. Motivating the institution to inbuilt the M&E is ideal.
- M&E unit should be a multidisciplinary team headed by an Economist and need to be strengthened through capacity building.
- Harmonizing the role of Dean and Director Research & PME cell in SAUs.
- Use of M&E cell for commercialization of products/ technologies.
- Centralized Data Management is the main key for the success of M&E. Accordingly, width; depth and quality of data need to be improved.

Extension

- For the Frontline extension system (mainly KVK system), Annual Review Workshop conducted by the Zonal Project Directorate and Scientific Advisory Committee by the KVKs are much useful to review the previous years' work and to plan the next year's technical programme.

Brainstorming Session on Hydroponic Fodder Production in India (Conveners: H.S. Gupta and M.P. Yadav)

Green fodder not only enhances milk and meat production, but it also brings about a qualitative change in the milk by enhancing polyunsaturated fatty acids, namely Omega 3; vitamins, minerals and carotenoids. A Brainstorming Session on "Hydroponic Fodder Production in India" was organized by NAAS at New Delhi on 05.07.2014. The session was chaired by Dr. S. Ayyappan, President, NAAS and co-chaired by Dr. R.B. Singh, immediate Past President. Dr. S. Ayyappan expressed that through hydroponic technique, it is possible to achieve better fodder production as compared to conventional production.

Prof. R.B. Singh emphasized the need for preparing a green fodder deficit map for entire India to access the problem for finding plausible solutions.

Dr. H.S. Gupta, Director, IARI and Convener informed that though India is the largest producer of milk in the world, the productivity per animal is low for which inadequate nutrition including green fodder is a major limiting factor. Since there is no scope for horizontal expansion of land for fodder production or grazing, there is a need to revisit hydroponic fodder production (HPFP). In recent years, hydroponics is being adapted in several parts of the world considering its distinct advantages. Dr. M.P. Yadav, explained that HPFP technology has several advantages, such as highly nutritious and palatable fodder, minimal use of pesticide, saving of water, soil, time and labour. Dr. Ayyappan opined that ICAR institutes and KVKs should consider establishing hydroponic fodder production units within the current year.

Dr. M.J. Saxena suggested that Ayurvet has so far commissioned 12 commercially viable HPFP machines in various parts of the country. Delegation of scientists and farmers may visit these units and give their opinion to NAAS.

The following recommendations and action points emanated from the discussion:

Recommendations:

- The increasing demand of green fodder can be met by producing hydroponic fodder with minimum inputs. The green fodder produced by this technique is rich in nutrients, protein, micronutrients and vitamins, with better palatability and digestibility. The hydroponic fodder is also rich in antioxidants, namely polyunsaturated fatty acid (PUFA) Omega 3, vitamin E, and conjugated linoleic acid (CLA).
- To make hydroponic fodder cultivation suitable for rural areas, there is a need for developing suitable models utilizing local materials, which can be operated in the absence of electricity. Use of solar power could also be considered for running hydroponic units.
- Use of locally available materials such as bamboo for making racks need to be tried along with suitable organic devices for environmental control in the chamber. Devise a system which is viable and adaptable throughout the year in a cost effective and energy sustainable manner.
- The hydroponic fodder production should be encouraged by the government by providing incentives in the form of subsidies on various inputs including electricity, seed grains and nutrient media for growing hydroponic fodder. Income from commercial hydroponic production should be exempted from income tax.
- There should be a convergence of institutions to achieve the objectives for stacked hydroponic fodder and nursery production.

Brainstorming Meeting of NAAS-IFPRI on Developing PME Indicators and Mechanisms in NARS

A Brainstorming meeting of NAAS-IFPRI was organised by the NAAS at New Delhi on 12.07.2014. The session was chaired by Dr. Mruthyunjaya, Former National Director, NAIP, ICAR. Dr. P.K. Joshi, Director- South Asia, IFPRI, New Delhi emphasized the concerns about institutionalization of the Project Monitoring & Evaluation (PME) in ICAR and the need for developing simple PME indicators and mechanisms in NARS.

Dr. Ayyappan, President, NAAS suggested that the participants of BS meeting may form the core group to demonstrate the best use of PME in the decision making. The PME inputs should lead to avoidance of redundant, repetitive projects but focus

on the needs of farmers, He hoped that PME will be projected as a new reform, the way forward in the new governance regime Dr. Madan observed that PME is the key to research progress at the institute level and the revised manual to be used effectively by all the institutions.

Dr. N.K. Singh, Secretary, NAAS expressed that systematic scientific studies on costs and returns to investment in research projects are important for research resource allocation and assessing the impact Dr. Mruthyunjaya reiterated that input from PME is itself not a decision but an aid to decision making. From the presentations the following points emerged:

Research Project Prioritization:

1. Major documents as Vision, proceedings of IRC/RAC/QRT were referred to see the thrust areas, flagship areas/sub-areas under which projects are proposed. Through such a process, the projects are screened and some get approved.
2. Systematic research prioritization does not take place at the institutional level and therefore the concern about weak "Prioritization" is genuine and needs attention. Any improvement in making this process participatory, transparent and objective will be the first major step to add credibility and acceptance.
3. Dr. Srinivas from NAARM and Dr. Mruthyunjaya shared simple templates for a simple, participatory and objective (using scores) research project prioritization exercise at the institute level. The template by Dr. Mruthyunjaya with illustration of crop science example was shared with the participants to develop/customize it to their own discipline/institute.
4. **Research Monitoring and Evaluation:**

   The following points emerged from the presentations and discussion:

   1. Research project monitoring is done through RPF-1 to 4, quarterly, annual progress reports and also recently introduced comprehensive Research Project Proposal, Monitoring and Evaluation (RPPME) proforma. The ICAR has made use of RPPME mandatory and serious efforts are being made to introduce it into the system through handholding by IBM, consultant and providing training so that eventually ICAR will be implementing FMS/MIS in the system.
   2. It was decided to discuss RPPME manual to find out whether it can serve the purpose of providing a simple, objective and transparent monitoring mechanism. The manual is comprehensive, provides indicators to monitor the projects at a broader level but not the sub-indicators and the scores to reflect the importance/intensity of each broad indicator. In view of the above it was decided to develop a cafeteria of indicators applicable to projects from different subject matter areas as articulated by participants. If such a cafeteria is made available, PME Cell may readily allocate scores and provide suitable recommendations.
   3. Since RPPME covers RPF-1 to 4, it covers the entire PME tool. In view of the lack of availability of details on sub-indicators and the scoring scheme, it was decided to develop a Companion Manual to RRPME so that together they will provide all needed guidance for effective PME implementation in NARS. The companion manual while providing details of sub-indicators and scoring scheme will remain compatible with the RPPME

Constraints of PME Cells

The participants expressed unanimously their constraints as follows:

1. They are overburdened with multiple functions outside PME which if not taken out to make them ineffective. They suggested to include RFD, HYPM and Performance Indicators in the PME Cell functions besides PME.
2. The size of the PME Cell should be 5 scientists (1 Principal Scientist and 4 Senior Scientists) with adequate Technical Assistants and SRF support. In case of medium institutions, the number of scientists may be 3. In case of small institutes, it may 1 or 2 scientists.

For details see: www.naasindia.org

Prime Minister Shri Modi's Ten Commandments For Rural Transformation through Agriculture

- ✓ "Per drop, more crop "a mantra to promote farming through optimum utilization of water.
- ✓ "Produce more on less land and in less time without any quality erosion" adopting short duration crop varieties.
- ✓ Judicious mix of "traditional wisdom" and "new technologies" to improve soil health and fertility.
- ✓ Knowledge and outcome of discussions on impacts of environmental change and global warming held in "five-star hotels" must reach farmers.
- ✓ Develop talent pool of progressive farmers and agricultural students for ensuring quick availability of technologies at village level.
- ✓ "Lab to land" approach to increase farm productivity, disseminating technologies in simple and acceptable manner.
- ✓ Agricultural universities may launch community radio to present solutions to immediate and local agricultural problems".
- ✓ Compile and develop a comprehensive digital platform of research work done by young researchers for their doctoral thesis.
- ✓ Enhance production and quality of pulses and oil seeds, and cultivation of medicinal plants.
- ✓ Usher in blue revolution for fisheries including sea weeds and cultured pearls.

Based on the speech of the Prime Minister Shri Narendra Modi on the occasion of ICAR Foundation Day held on July 29, 2014.

Plant hormone strigolactone plays key role in response to drought stress

Under environmental stresses such as drought and salinity, plants may experience restricted growth and productivity. An international team of researchers at the RIKEN Center for Sustainable Resource Science has identified a previously unknown signalling pathway that plays a key role in stress tolerance. The newly discovered signalling pathway is based on the hormone strigolactone. The synthesis of strigolactone and the plant's response to its presence is controlled by a gene family known as More Axillary Growth (MAX), defects in which can lower concentrations of the hormone or impair plant responses to it. They found that Arabidopsis plants with defective MAX genes were much less resilient to drought and higher salinity than wild-type plants. By examining gene expression in max mutants, the researchers uncovered multiple genetic targets of the strigolactone pathway. One way that strigolactone acts is by regulating plant transpiration rates. Under drought conditions, max mutants lose water faster than

Effect of drought stress on strigolactone-deficient Arabidopsis plants (left) compared with wild-type plants (right).

wild-type plants. Researchers found that the mutants had more stomata than their wild-type counterparts and their stomata closed more slowly when subjected to abscisic acid. Strigolactone therefore controls both stomatal development and stomatal function.

The gene expression results, however, also suggested a second mechanism of strigolactone action. Photosynthesis-related genes are upregulated in max mutants, implying that normal strigolactone signaling might suppress photosynthesis under environmental stress, reducing demands on the plant's resources.

The team's research provides a basis for developing genetically modified drought- or salt-tolerant crops by manipulating genes in the strigolactone synthesis and response pathway. "Stress-inducible promoters could switch on the strigolactone pathway when plants encounter stress," notes Tran. "Thus, under normal growing conditions, the plants could grow without any yield penalty."

Read more at: *http://phys.org/news/2014-03-hormone-strigolactone-key-role-response.html#jCp*

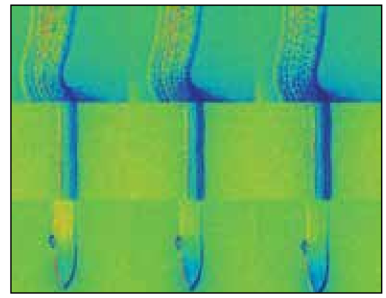
Gene Discovery Could Lead to Better Soybean Varieties

US - Researchers from Purdue University and the University of Nebraska-Lincoln have discovered a soybean gene whose mutation affects plant stem growth, a finding that could lead to the development of improved soybean cultivars. A gene known as Dt2, which causes semi determinacy in soybean plants has been identified. Semi determinate soybean plants - mid-size plants that continue vegetative growth even after flowering - can produce as many or more pods than current northern cultivars but do not grow as tall. Their reduced height makes them more resistant to lodging, a bending or breaking of the main plant stem. "This gene could help to improve the yield potential and adaptability of soybeans for specific growing areas. Soybean cultivars are often divided into two groups: indeterminate - tall plants whose main stem continues to grow after flowering - and determinate - shorter, bushier plants whose main stem halts growth when blossoms begin to form.

See more at: http://www.thecropsite.com/news/16532/gene-discovery-could-lead-to-better-soybean-varieties#sthash.IVOzmq15.dpuf

Nanosensors to visualize movements and distribution of plant stress hormone

University of California San Diego (UC San Diego) biologists have succeeded in visualizing the movement of abscisic acid (ABA), a key plant hormone responsible for growth and resistance to drought. Direct tracking of ABA allows to better understand the complex interactions involving ABA when a plant is subjected to drought or other stress. A "genetically-encoded reporter" known as "ABAleons," has been developed, which directly and instantaneously observe the movements of ABA within the mustard plant *Arabidopsis*. The "ABAleons," contain two coloured fluorescent proteins attached to an ABA-binding sensor protein. Once bound to ABA, the ABAleons change their fluorescence emission. The changes in ABA concentration and waves of ABA movement could be monitored in diverse tissues and individual cells over time and in response to stress. The results of study will allow to conduct further research to determine how ABA helps plants respond to drought and other environmental stresses brought by the continuing increase in the atmosphere's carbon dioxide concentration.



Time sequence shows how mustard seedlings take up and distribute ABA through roots and other parts of the plant during germination

---

For more details http://ucsdnews.ucsd.edu/pressrelease/biologists_develop_nanosensors_to_visualize_movements_ and_ distribution_of_p.

Scientists Discover Fungus in Dead Sea That Can Be Used To Solve World Hunger

Eurotium rubrum, a filamentous yellow fungus has been isolated from Israel's **Dead Sea** water from its surface to its bottom at the depth of 300m. Higher salt tolerance by *E. rubrum* is due to a complicated network of many genes and pathways that interact

Eurotium Rubrum

with each other. The filamentous fungus thrives in water with 34.2 percent salinity, 9.6 times as high as that of the ocean, while most other life forms avoid such salty conditions. The fungus has developed a unique way of making it all work. "Understanding the long-term adaptation of cells and organisms to high salinity is of great importance in a world with increasing desertification and salinity." The observed functional and structural adaptations provide new insight into the mechanisms that help organisms to survive under such extreme environmental conditions, but also point to new targets like the biotechnological improvement of salt tolerance in crops. The fungal cells appeared tightly controlled by genetics to prevent salt from entering. The experiments show "that the fungus tries to cope 'actively' with its extreme environment and does not simply fall into dormancy as might be expected by the greatly reduced growth rates."In principle, this discovery by Tamar and co-workers (2014)could revolutionize saline agriculture worldwide by laying the groundwork of understanding necessary to appropriately using salt-resistant genes and gene networks in crops to enable them to grow in the desert and saline environments."

1. Tamar Kis-Papo and Others (2014). Nature Communications, 5 DOI:10.1038/ncomms4745

Insights on how plants respond to elevated CO_2 levels

Biologists at University of California San Diego have discovered a new genetic pathway in plants that control the density of stomata, in plants in response to elevated carbon dioxide (CO_2) levels. Using Arabidopsis, they found that the proteins encoded by the four genes they discovered repress the development of stomata at elevated CO_2 levels. The discovery should help biologists better understand how the steadily increasing levels of CO_2 in our atmosphere are affecting the ability of plants and economically important crops to deal with heat stress and drought. It could also provide agricultural scientists with new tools to engineer plants and crops that can deal with droughts and high temperatures.

The discovery could provide agricultural scientists with new tools to engineer crops that can deal with droughts and high CO_2 levels

Using a combination of systems biology and bioinformatics techniques, the scientists cleverly isolated proteins, which, when mutated, abolished the plant's ability to respond to CO_2 stress. They found that when plants sense atmospheric CO_2 levels rising, they increase their expression of a key peptide hormone called Epidermal Patterning Factor-2, EPF2. The discoveries of these proteins and genes have the potential to address a wide range of critical agricultural problems in the future, including the limited availability of water for crops, the need to increase water use efficiency in lawns as well as crops and concerns among farmers about the impact heat stress will have in their crops as global temperatures and CO_2 levels continue to rise.

For more details http://ucsdnews.ucsd.edu/pressrelease/discovery_provides_insights_on how_plants_respond_to elevated_CO_2_levels.

Scientists identify wheat genes for boron tolerance

Scientists from the University of Adelaide in Australia have identified the genes in wheat that control tolerance to boron toxicity, a significant yield-limiting soil condition around the globe. The researchers say that in soils where boron toxicity reduces yields, genetic improvement of crops is the only effective strategy to address the problem. The scientists tracked specific boron tolerance genes from wild wheat plants grown by the world's earliest farmers in the Mediterranean region, through wheat lines brought into Australia more than a century ago, to current day Australian commercial varieties. They found a distinct pattern of gene variant distribution that was correlated to the levels of boron in soils from different geographical regions". This discovery means that wheat breeders will now have precision selection tools and the knowledge to select for the right variants of the tolerance gene needed to do the job in specific environments"

Read more at: http://www.adelaide.edu.au/news/news71403.html

Fellows may send contribution at:
editors.naas@gmail.com. Selected entries will be duly acknowledged

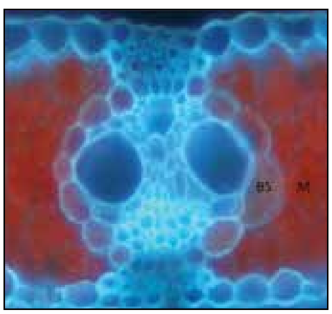
Science Spectrum - The Editors' Pick

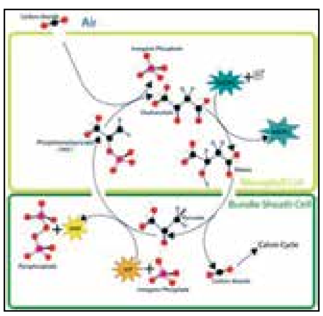
Scientists discover genetic key to evolve 50 per cent more efficient crops

A very large fraction of food consumed is contributed by plants through phosynthatic reduction of atmospheric CO2 to yield products which on oxidation yield energy sustain all forms of life on the planet. Plants photosynthesize using one of two methods: C3, a less efficient, ancient method found in most plants, including wheat and rice; and C4, a more efficient adaptation employed by grasses, maize, sorghum and sugarcane that is better suited to drought, intense sunlight, heat and low nitrogen. Cornell researchers (Slewinsky et al 2012) have taken a big leap toward evolving more efficient crop cultivars by discovering gene that could lead to new varieties of staple crops with 50 % higher yields. The gene, called Scarecrow, is the first discovered to control a special leaf structure, known as Kranz anatomy, which leads to more efficient photosynthesis in C4 plants. Enhanced efficiency of C4 mechanism is attributed to arrangements of bundle sheath and mesophyll cells into concentric rings around veins producing wreath like appearance known as Kranz anatomy (see Fig. 1). The efficiency of intercellular metabolism is enhanced by Kranz anatomy.

Researchers have been trying to find the underlying genetics of Kranz anatomy to engineer it into C3 crops (Covshoff and Hibbard 2012) The finding that Scarecrow which regulates structural differentiation of the root endodermis also regulates structural differentiation of the root endodermis also plays a similar role in the development of Kranz anatomy in maize provides a clue as to how this whole anatomical key is regulated.

If C4 photosynthesis is successfully transferred to C3 plants through genetic engineering, farmers could grow wheat and rice in hot, dryer environments with less fertilizer, while possibly increasing yields by half, the researchers said. The C4 adaptation involves Kranz





C4 pathway

Cross section of a mature maize leaf showing Kranz (German for wreath) anatomy around a large vein. The bundle sheath (BS) cells (lighter red) encircle the vascular core (light blue). Mesophyll (M) cells (dark red) encircle the bundle sheath cells. The interaction and cooperation between the mesophyll and bundle sheath is essential for the C4 photosynthetic mechanism

anatomy in the leaves, which includes a layer of special bundle sheath cells surrounding the veins and an outer layer of cells called mesophyll. Bundle sheath cells and mesophyll cells cooperate in a two-step version of photosynthesis, using different kinds of chloroplasts. Slewinski (2012) recognized that the bundle sheath cells in leaves of C4 plants were similar to endodermal cells that surrounded vascular tissue in roots and stems. It was suspected that if C4 leaves shared endodermal genes with roots and stems, the genetics that controlled those cell types may also be shared. Slewinski looked for experimental maize lines with mutant Scarecrow genes, which he knew governed endodermal cells in roots. When the researchers grew those plants, they first identified problems in the roots, then checked for abnormalities in the bundle sheath. They found that the leaves of Scarecrow mutants had abnormal and proliferated bundle sheath cells and irregular veins.

In all plants, an enzyme called RuBisCo facilitates a reaction that captures carbon dioxide from the air, the first step in producing sucrose, the energy-rich product of photosynthesis that powers the plant. But in C3 plants RuBisCo also facilitates a competing reaction with oxygen, creating a by-product that has to be degraded, at a cost of about 30-40 per cent overall efficiency. In C4 plants, carbon dioxide fixation takes place in two stages. The first step occurs in the mesophyll, and the product of this reaction is shuttled to the bundle sheath for the RuBisCo step. The RuBisCo step is very efficient because in the bundle sheath cells, the oxygen concentration is low and the carbon dioxide concentration is high. This eliminates the problem of the competing oxygen reaction, making the plant far more efficient.

References:

Coveshoff, S. and Hibbard, J.M. (2012) Integrating C4 photosynthesis into C3 crops to increase yield potential. *Curr. Opin. Biotechnol*. **23**: 209-214.

Slewinsky, T.L., Anderson, A.A., Zhang, C. and Turgeon, R. (2013) Scarecrow Plays a Role in Establishing Kranz Anatomy in Maize Leaves. *Plant and Cell Physiology*. **53**(12): 2030-37.

For further information contact; Prof. Robert Turgeon, Department of Plant Biology, Cornell University, Ithaca, NY 14853 NY, USA. Email: ert22cornell.edu. Fax + 1607 255 540

Fellows' Views

Groundwater decline putting perennial horticultural crops in peril: Urgent policy intervention needed

Ground water depletion is by far the most widely debated issues in the context of resource management. Over exploitation of groundwater and its consequences are the result of certain developments taking place in irrigated agriculture that occur at the cost of depletion of aquifers and sustainable farming systems. Perennial horticulture in India has undergone a change from rain-fed system to drip fertigation systems and from isolated hedge and bund trees to high intensity orchard systems with an enhanced several trees per unit area. In several parts, particularly in the Deccan plateau, the system has now become completely dependent on water pumped from tube wells. Prolonged exposure of perennial horticultural crops led to the withering of fruit trees and nuts in large areas. These plantations are likely to become increasingly maladapted to their environment become vulnerable for attack by diseases and insects. Coconuts, Areca nuts and mango trees have died in large areas.

The state intervened initially through agrarian reforms, and later by providing credit facilities and supporting marginalized groups to have irrigation facilities by implementing Million Well Schemes, Ganga Kalyan Yojana and politically influenced free power supply etc. All these led to rise in groundwater structures, shifting cropping pattern towards water intensive crops as well as resource abuse by over exploitation of the aquifer. The distinctive impact of irrigation, in general, and groundwater irrigation, in particular, on farming begins to emerge more clearly and recognizably where irrigation permits extension of cultivation for additional seasons. This allows farmers' to benefit from surplus production which otherwise would not have been possible. As a result, groundwater became a chief source of irrigation primarily in dry sub-humid, semi-arid and arid areas and at the same time several problems emerge due to heavy pumping.

Today 175 million Indians are now fed with food produced with the unsustainable use of groundwater. In addition, several crops which need huge quantity of water are grown for export like sugar cane, gherkins, tomatoes, capsicum, scented rice etc. These crops are exporting water more than the produce. The actual cost of water is not calculated while working out the economics. Growing crops for export purpose using groundwater are not justified when local populations are going to suffer from a severe shortage of water. This increase has dried up rivers and lakes, because there is a hydrologic connection between groundwater and surface water. Yet the legal rules governing water use usually ignore the link between law and science. The issue needs thorough examination and needs policy interventions to come out of this vicious circle. Some policy related points that need attention are placed below:

- Put a price on water. Our habits of water use will not change until the cost of water rises sufficiently to force an alteration. All users must pay the replacement value of the water,. Economists agree that significant price increases would create incentives for all users to conserve.
- The government should establish minimum stream flows and protect those flows from pumping of hydrologically connected groundwater. The legislature should authorize the concerned Departments to establish minimum water levels for streams and lakes to protect water resources.
- The government should prohibit the drilling of new wells in areas that are hydrologically connected to surface flows. Generally speaking, the farther a well is from a watercourse, the less significant the impact of groundwater pumping from that well will be.
- Both the state governments and Panchayats should commit resources to purchasing and retiring groundwater rights to protect critical catchments, watersheds and habitats.
- Government should foster a market in water rights by allowing the easy transferability of rights. State law must facilitate the movement of water from low value uses to higher-value ones by establishing a water rights market as the mechanism for accomplishing this shift.
- The government should impose an extraction tax on water pumped from any well within a certain distance of a river, spring, or lake. It would encourage existing pumpers to conserve water, and creating an incentive for new pumpers to locate wells farther away from watercourses.
- The government should not allow land developers to drill wells in an aquifer already under stress and land developers should not be allowed to source water from agricultural areas.
- Financial incentives as a significant part of water policy. Water rates for billing should include extraction, storage, distribution costs.
- Unplanned urbanization has forced cities to depend on rural areas for sourcing water supplies. The flow of water from rural tube wells in urban areas for meeting domestic and industrial water requirements of cities must be stopped.

The impact of groundwater pumping on the environment is enormous. And it is getting worse. In the situation of drought and water scarcity, farmers, cities and individual homeowners are scrambling in search of additional water supplies. They have often focused on groundwater; well-drilling businesses around the country are booming and so are the water diviners. The drought has prompted the media to bring into focus water issues. It is time that a massive campaign to save water is taken up before too late.

AN. Ganeshamurthy
Indian Institute of Horticultural Research,
Bengaluru 560089

Supplement family farming with medicinal and aromatic plants for increased income

Family farming has diverse dimensions in terms of food production, income generation, equity, entrepreneurship and environment. Farmers particularly in south India have been cultivating several medicinal aromatic crops for higher economic returns. Medicinal plants are cultivated to supply raw materials to the pharmaceutical industry. The plant parts supplied are leaves, roots, seeds, and fruits, whole plants which are either directly

Fig. 1 Patchouli intercropped in banana

Fig. 2 Intercropping blackgram in palmaros

Fig. 3 Distillation of patchouli oil in a farmer's field

used in herbal formulations or extracted to derive active constituents which form components of drugs. Aromatic crops yield essential oils on steam distillation. These essential oils are used in perfume and flavor industries; in products such as soaps, *agarbattis,* perfumes etc.

The family farming demands that besides economics, continuous up gradation of knowledge levels, entrepreneurship and benefits to the environment are duly considered. As the economics of cultivation of medicinal and aromatic crops have been long debated, to make the cultivation of these crops more viable scientific research has been initiated in south India to address the issues of productivity, economics of cultivation, extraction of active principles etc. for a variety crops such as Java citronella, lemongrass, Palmarosa, Vetiver, *Eucalyptus citriodora*, Davana, geranium, patchouli, rosemary, *vinca rosea* and others.

Monoculture of medicinal and aromatic plants has been riddled with several problems of agronomy and marketing. Therefore, these crops have to be integrated in the existing cropping systems of the target region. Intercropping of food crops in aromatic crops such as Java citronella, lemongrass, Palmarosa, geranium, patchouli has increased the land use efficiency up to 30% (Figs. 1 & 2). Identification of nutrient deficiencies and subsequent application of organic and inorganic nutrients, proper water management and adoption of good agronomic practices have increased the yields and improved the economics at the farm level. On farm processing of aromatic crops have not only increased the economic returns to the farmers but also facilitated rural entrepreneurship. Some recent research and demonstration at farmers' fields in coastal Karnataka have shown that cultivation and processing of Vetiver, an aromatic plant was more economical than paddy, cashew nut and areca nut; however this crop has to be cultivated in lands not suitable for food crops thus not affecting food production in the region. Improved distillation methods have substantially improved the farm economics (Fig.3). Recent research has shown that Vetiver can sequester more than 15 t/ha/year of C, thus helping the environment. Medicinal and aromatic plants hold a great promise as candidates for family farming in south India; these crops help economics, environment and rural livelihoods and entrepreneurship.

E.V.S.Prakasa Rao
Email: *evsprakasarao@gmail.com*

Forthcoming Programmes

- Good Aquaculture Practice (GAP) Certification of Aquaculture in India – Criteria and Implementation Plan (Convener: Dr. I. Karunasagar)
- Climate Resilient Livestock Production (Convener: Dr. Kusumakar Sharma)
- Breaking Low-productivity Syndrome of Soybean in India (Convener: Dr. S.M. Virmani)
- Practical and Affordable Approaches in Implement Precision (Convener: Dr. S.R. Verma)
- GM Technology (Convener: Dr. K.V. Prabhu)

Change of Addresses

- Dr. A.S. Bawa, Vice-President, Amity Food & Agriculture Foundation & Director, Amity Institute of Food Technology, Amity University Uttar Pradesh, Block - I-1, 4th Floor, Sector – 125, Noida 201303 U.P., Tel: Off. (0120) 4392217; Cell: 8826856222, Email: asbawa@amity.edu; amarinderbawa@yahoo.co.in
- Dr. J.B. Chowdhury, Former Vice Chancellor, Y 68, Regency Park II, DLF Phave IV, Gurgaon 122002 Haryana, Cell: 9811619758, Email: jaibchowdhury@yahoo.com
- Dr. H.S. Gupta, Director General, Borlaug Institute for South Asia (BISA), CG Block, NASC Complex, DPS Marg, Pusa Campus, New Delhi 110012, Tel:

Off. (011) 25842940, Email: hsgupta.53@gmail.com

- Dr. M.S. Jairajpuri, 274-Aslam Manzil, Flat No. 104, 1st Floor, Block-B, Jamia Nagar, Okhla, New Delhi 110025, Cell: 9540981665, Email: msjairajpuri@gmail.com
- Prof. Dr. Indrani Karunasagar, Director (R&D), Nitte University, Director, UNESCO MIRCEN for Medical & Marine Biotechnology & Nitte University Center for Science Education and Research, Head, Faculty of Biomedical Sciences, University Enclave, Medical Sciences Complex, Deralakatte, Mangalore 575018, India, Tel: Off. (0824) 2204300/301/302; Res. (0824) 2439750; Cell: 09448479750, Fax: (0824) 2204308, Email: karuna8sagar@yahoo.com
- Dr. Anjani Kumar, Research Fellow, International Food Policy Research Institute, CG Block, NASC Complex, Dev Prakash Shastry Marg, Pusa, New Delhi 110012, Tel: Off. (011) 25846565, 25846566; Cell: 9911106918, Fax: (011) 25848008, Email: anjani.kumar@cgiar.org
- Dr. M.P. Pandey, Former VC, BAU, “Shri Kripa”, 2/38, Vinamra Khand, Gomti Nagar, Lucknow 226010 U.P., Cell: 09956901946, Email: matappandey@gmail.com
- Dr. R.K. Pathak, 1201, 2A-ACMEY Complex, Malad West, Mumbai 400064 Maharashtra, Cell: 09454974422, Email: pathakramkripal@gmail.com; pathakrkripal@yahoo.co.in
- Dr. K.K. Singh, Director, Central Institute of Agricultural Engineering, Nabibagh, Berasia Road, Bhopal 462038 M.P., Tel: Off. (0755) 2737191, Cell: 9582898993, Fax: (0755) 2734016, Email: director@ciae.res.in; singh_ciae@yahoo.com, kksingh@icar.org.in
- Dr. Lalji Singh, Bhatnagar Fellow (CSIR), Centre for Cellular & Molecular Biology, Habsiguda, Uppal Road, Hyderabad 500007 Andhra Pradesh, Tel: Off. (040) 27160053; Res. (040) 27160555, Fax: (040) 27160033, Email: lalji@ccmb.res.in
- Dr. Ch. Srinivasarao, Director, Central Research Institute for Dryland Agriculture, Santoshnagar, Saidabad (PO), Hyderabad 500059 Andhra Pradesh, Tel: Off. (040) 24530828; Res. (040) 24051231, Cell: 09848848453, Fax: (040) 24530828, 24531802, Email: cherukumalli2011@gmail.com; chsrao@crida.in
- Dr. Rakesh Ranjan (Associate), Senior Scientist (Veterinary Medicine), National Research Center on Camel, Post Bag No. 7, Jorbeer, Bikaner 334001 Rajasthan, Tel: Off. (0151) 2230183; Cell: 9417643441, Fax: (0151) 2231213, Email: rakesh_ranjan3@rediffmail.com, ranjanpau@gmail.com

Obituary


1940 - 2014

Dr. Saiyed Asif Husain Abidi was born on 4th April 1940 in Badagaon village of District Jaunpur (Uttar Pradesh). He obtained his M.Sc. (Zoology) degree in 1962, M. Phil in 1968 and Ph.D. in 1981 from Aligarh Muslim University, Aligarh. He started his career as a Scientist with the International Biological Programme under auspicious of the International Indian Ocean Expedition, (CSIR) New Delhi/Cochin. He shared the responsibilities of Director Fisheries and as Advisor to Department of Ocean Development, Govt of Tanzania. He held various positions as Scientist and later as I/C Biology Division, National Institute of Oceanography, Goa. He served as Principal Scientific Officer and Senior Advisor, Department of Ocean Development, Govt of India and thereafter as Director/Vice Chancellor, Central Institute of Fisheries Education, Mumbai during 1996-99. He was later Member, Agricultural Scientist Recruitment Board, New Delhi in 1999-2005.

He was one of the pioneers in the country in the area of marine sciences and fisheries research and education. He published more the 200 research papers and popular articles, and wrote/ edited more than 12 books. He received various awards and honours which among others included the prestigious Zoological Society of India Gold Medal, ICAR Rajendra Prasad Puruskar for scientific writing in Hindi, S.L. Hora Award of ISCA and Society of Fisheries Technologists’ Award. He was elected Fellow of Zoological Society of London, Zoological Society of India, National Academy of Sciences, India, Allahabad, and Indian Fisheries Society of India.

Dr Abidi suddenly expired on 11th July, 2014 at Lucknow. In his passing away country has lost an eminent fisheries scientist who made pioneering contributions in planning coastal zone management and oceanography research. The Fellowship mourns the sad demise of its one of distinguished fellows and pays its homage to the departed soul.

Dr. Neelam Saharan (Mumbai)

Editors: Dr. P.K. Chhonkar & Dr. (Ms) Prem Dureja

Published by: H.C. Pathak, Executive Secretary, on behalf of the National Academy of Agricultural Sciences, NASC, Dev Prakash Shastry Marg, New Delhi 110012; Tel. (011) 25846051-52, Fax. 25846054; Email: naas@vsnl.com; Webside: http://www.naasindia.org