

## Harnessing desirable insects and managing undesirable insects: Way forward in Indian Agriculture

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The global population is projected to grow to 9.6 billion from 6.9 billion in 2010, as per UN estimates made in 2012 (UN, 2013). India would overtake China to become the most populous country by 2050, adding around 400 million people, equivalent to US population in 2050. Another interesting trend in the pattern of population growth during this period is the phenomenal urban growth. According to UN projections made in 2014, the global urban population would increase to 66 percent by 2050, from the present 54 per cent. This change would be marked in countries like India, which would add 404 million urban dwellers by 2050 (UN, 2014). The larger middle-class and elite urban population and life style change would stimulate demand for less explored food delicacies and need for farming systems of novel produce. There will also be qualitative changes in the requirement of various food commodities due to differences in food habits and future dietary shifts. India's rural population of 857 (2014) will shrink by 51.5 million by 2050. Yet, India would still house a larger rural population, and agriculture would remain their mainstay. All the above considerations along with other challenges like climate change, agri-resource poverty, regulations, etc. add further dimensions to the formidable task of achieving and sustaining food and nutritional security of India during the forthcoming decades.

Insects, in agricultural context have many facets, from notorious pests to insects farmed for their commercial products. As agricultural crop pests, the present losses due to insect pest damages is estimated at 17.5%, equivalent to a monetary loss of about Rs.2.7 billion (Singh *et al.*, 2014). Climate change and other anthropogenic and agricultural systems would trigger qualitative, quantitative, spatial and temporal changes in insect pest populations (Sharma, 2014). Pollinators play a significant role in the



*Dr. Krishna Kumar, DDG (HS) addressing the gathering.*

productivity of a number of crops. Commercial insects that yield products of utility like silk, honey and lac have been shown to be important for livelihood and employment. Insect food farming is a potential segment of agriculture to meet the culinary needs of urban and nutritional requirement of the rural population of the country alike. According to a recent FAO report (Huis *et al.*, 2013), at least two billion people include more than 1900 species of insects in their food; the beetles are the most commonly insects. Insects are sometimes the only source of essential proteins (amino acids), fats, vitamins and minerals for forest people. In the Central African Republic, 95 percent of forest people are dependent on eating insects for their protein intake. Edible insects have been part of diet for some ethnic societies but a general distaste for their consumption is a stumbling block in making these a part of nutritional basket. As majority of edible insects are gathered from forest habitats, their mass-rearing needs to be explored by merging traditional knowledge and modern science.

In order to appropriately gear the agricultural insect science towards the emerging national scenario, the National Entomologists' Meet was organized jointly by Society for Advancement of Natural Resins and Gums (SANRAG), ICAR-Indian Institute of Natural Resins and Gums (IINRG) and Network Project on Conservation of Lac Insect genetic Resources (NP-CLIGR) on February 5-7, 2015 at IINRG, Ranchi. Leading entomologists from different parts of the country and expert domains converged in Ranchi to deliberate on various issues and suggest right directions. The Meet was organized by Dr. K. K. Sharma, Head, Lac Production Division (Convener) Dr Md. Monobrullah, Principal Scientist (Co-convener) and Dr. A. Mohanasundaram (Organizing Secretary) of ICAR-IINRG. The Meet was attended by 122 delegates from 19 States; twenty-four lead lectures on key topics were delivered. A compilation of the lead lectures as well as the 52 oral and 110 poster presentations was also released during the inaugural session. Nine best oral and eight best posters presentations were awarded. The deliberations of the meet centered around on seven theme areas encompassing current and emerging insect pest challenges including resistance, invasive species and outbreaks; integrated pest management; insect vector management; biocontrol agents; biopesticides; chemical ecology; habitat architecture; harnessing insects for economic products; commercial and other beneficial insect farming; impact of climate change, agriculture and anthropogenic activities on insect dynamics; biosecurity; biosafety ; biodiversity and conservation; and insect prospecting.

Dr. R. Ramani, Director, ICAR-IINRG and OSD, IIAB, in welcome address, pointed out that it has provided a platform for convergence of entomologists linked with agriculture and hoped that it would lead to impactful recommendations in agricultural entomology. He expressed his concern about the dwindling number of entomologists in National Agricultural Research and Education System (NARES) and need for significant enhancement of infrastructure for insect science in the era of climate change and other emerging situations. He emphasized on the need for paradigm shift in perception about the role of entomologists in NARES. Dr. Ramani desired use of IT for consultations, exchange of information through social network as well as creation databases of information and data. He also put forth specific actionable points for deliberation during the ensuing sessions. He also proposed a four-point plan for holistic development of lac subsector in his lead lecture.

Dr. T. P. Rajendran, Former ADG (Plant Protection) ICAR and OSD, National Institute for Biotic Stress Management, Raipur stressed on the need for cataloguing the edible insect species of the country and developing farming of suitable edible insects. He also sought interventions on the bill on biosecurity and biosafety issues.

Dr. N. K. Krishnakumar, Deputy Director-General (Horticultural Science), ICAR and Chief Guest of the Inaugural Session stressed on the populations genetics research of pests, chemical ecology, vector entomology, flow of pesticides in food chain, etc. He emphasized that vector management should form an important component of IPM. He desired more emphasis on harnessing pollinators for enhancing agricultural productivity. He wanted constitution of local-level task force for pest surveillance and urged for suitable biosecurity measures to restrict inter-state movement of pests/diseases through co-operation

of State Governments. He pointed out the need for complementation of applied entomological research with relevant basic science. He also called for a national institute for entomological research to address several neglected areas of entomology in the prevailing institutional framework.

Dr. George John, Vice-Chancellor, Birsa Agricultural University called the Meet a landmark event. He opined that consideration of edible insects as a major theme area is appropriate and there is need to identify some potential species which are amenable to farming and take it forward. He said that insect taxonomists have now moved on to "endangered" category, which needs to be remedied. He felt that public-private partnership is essential for development tasar silk sector.

Dr. C. Chattopadhyay, Director, ICAR-National Research Center for IPM called for i) governmental steps for discouraging indiscriminate use of chemicals pesticides and measures for filling in the lacunae in the registration of biopesticides and promotion of their use; ii) IT-supported Integrated Design Support System for surveillance and management of insect pests through Good Agricultural Practices (GAP).

Dr. R. D. Gautam, Emeritus Scientist, IARI highlighted some insect species of medicinal importance and appealed for documentation of indigenous knowledge and conservation of such species and desired coordinated efforts of State and Central governments to check biopiracy. Dr. V. V. Belavady, UAS pointed out the impact of monocropping on pollinator diversity. He emphasized on assessment studies as well as conservation of pollinator diversity and numbers with powerful examples of impact of pollinators in crop productivity. Dr. Sithanandam, Sun Agro Biotech Research Centre showed the potential of climate stress adapted *Trichogramma* species/strains for biocontrol of moth borers and desired research on imparting insecticide tolerance to such biocontrol agents. Dr. Srinivasa Rao, CRIDA presented an analysis of the potential impact of climate change on insect pests and different adaptation strategies. He pointed out that we have a long way to go to in understanding the pest scenario under climate change. He outlined various initiatives and contributions of his Institute on climate change impact, especially under NICRA. Dr. T. V. K. Singh, PJTSAU, Hyderabad provided insights into the insect resistance to Bt crops and underlined the need for in-depth studies to understand the mechanisms. Dr. R. K. Gupta, SKUAST Jammu laid emphasis on Entomophage insect park through introduction of suitable plant species for *in situ* establishment insect enemies of crop pests.

Dr. B. Vasantharaj David, a renowned entomologist and International Consultant made an extensive coverage of various edible insect species in India as well as across the world. He said promotional drives are needed to change the general negative attitude towards inclusion of insects in diet. In view of changes witnessed in pest scenario, he desired preparation of crop-specific insect pest calendars.

The theme areas of the Meet comprehensively attempted to bring out thrust areas related to insects of agricultural importance with special focus on edible insects. The discussions addressed both desirable and undesirable insect fauna: agricultural pests; commercial insects (lac, silk and honey); edible insects; pollinators and other insects of utility; soil insects; insects of value in medicine, fashion and ecotourism; etc.

The points which emerged during the discussions were crystallized into action points which have been summarized below:

**Policy and interventions (Action: Central/State Govt.; ICAR)**

1. Establishment of an Institute of Agricultural Entomology Research: To encompass hitherto unaddressed or under-addressed facets of basic and applied entomological research such as edible insects, chemical ecology, biosystematics, insect tourism, vector management, etc. (q.v. 13).
2. Strengthening the scientific manpower in Entomology in ICAR institutes.
3. Modification and finalization of Biosafety and Biosecurity policy in view of emerging scenario.
4. Edible insects: Promotion of edible insect farming and collection, esp. in NEH region through a

holistic action plan; legislation and its execution to prevent illegal trading edible insects leading to depletion due to unmindful and unscrupulous practices and regularization of systematic harnessing of edible insects.

5. Development of national standards for phytosanitary measures.

**Infrastructure, support system, services (Action: Central/State Govt.; ICAR)**

6. Strengthening national academic infrastructure for capacity building priority/emerging areas: edible insects, entomotourism, insect vector biology, insect parataxonomy, etc.
7. Establishment of IT-based network of agricultural entomologists for exchange of information, consultations, etc.
8. Constitution of task force for addressing invasive insect pests.
9. Constitution of regional expert panels to address emerging insect pest outbreaks.
10. Biopesticides: Promotion and support mechanisms for establishment of production units of insect biocontrol agents and biopesticides in villages; establishment of biovillages to showcase biointensive pest management (BIPM). In view of acute gap in production, a major push for enhanced production through incentivization and capacity building.

**Research thrusts (Action: ICAR; ICAR institutes; SAUs; Other Universities)**

11. Creation of national databases of i) Awareness and promotion of edible insects ii) molecular systematics of for quick and reliable identification of potential invasive insect pests
12. Edible and medicinal insects: Identification of select edible insect species amenable to farming and its development, including their nutritional value and farming techniques; documentation of indigenous knowledge and practices.
13. Stress on fundamental science research in agricultural entomology: Population genetics of agricultural pests with changing scenario; impact of climate change, agriculture and anthropogenic activities on spatial and temporal dynamics, behaviour of insects; pesticide residue in food chain including biomagnification; exhaustive investigations on soil arthropod diversity influenced by agrochemicals; strengthening taxonomic and biosystematics research in agricultural entomology.
14. Promotion of multi-cropping to minimize vector-transmitted plant diseases.
15. Mission mode programme for increasing crop yields conservation and fostering of crop-specific pollinators for enhancing crop productivity: habitat configuration based on chemical ecology and through promotion of crop specific *Apis* and non-*apis* pollinators esp. in key crops.
16. Identification of alternate discriminatory term for entomophagy, which has animal connotation, with a term more applicable for a human, like insectarian.
17. Development of crop, area and season-specific pest calendars for the country.

It is hoped that the above recommendations are taken on board by concerned government departments, universities and institutes to lead to desired action.

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