National Water Award and Bhoomijal Samvardhana Puraskar-2007, an important step in encouraging rainwater harvesting in rural India

The National Water Award and the Bhoomijal Samvardhan Puraskar-2007 were awarded by the Ministry of Water Resources, Government of India in September 2007 at Vigyan Bhawan, New Delhi. The award is given to those who have achieved significant success in rainwater harvesting over all zones of India. It is an important step for encouragement of rainwater harvesting in rural areas. Though the average annual rainfall of India is around 1300 mm, due to high run-off and lack of proper management, there is always water scarcity.

The National Water Award instituted by the Ministry of Water Resources for adopting best innovative practices of groundwater augmentation through rainwater harvesting and artificial recharge has been given to Hiware Bazar Panchayat, Ahmednagar District, Maharashtra. The village has adopted an integrated system of water conservation, which includes (i) massive plantation and forest regeneration activities, and (ii) construction of contour trenches around the hills to conserve rainwater recharge of groundwater. These activities caused a rise in the levels of groundwater in the adjoining wells, paving the way for improved irrigation. The strong institutional set-up of the village facilitated the initiatives taken up by the Gram Panchayat in identifying sites of water-harvesting structures, sharing of water, and growing crops using the principle of consensus.

The Hiware Bazar initiative has brought a turn-around in water management practices and associated gains. In 1989–90 hardly 12% of the cultivable land could be cultivated and village wells had water only during the rainy season. After successful implementation of initiatives for water management, a substantial improvement in the availability of water has occurred.

The Gram Panchayat took up water conservation work in a big way. The village adopted an integrated model of development and water conservation as the core, which in turn focused on the banning of free grazing and felling of trees.

In brief, the Hiware Bazar initiative demonstrates that: (i) Management of water resources could be done in a manner so that the infrastructure is capable of reaching out to poor people. (ii) Communities can be effectively involved in the governance of the water resources.

The Bhoomijal Samvardhan Puraskar for the East Zone was awarded to Chilnala Watershed Association, Kurumpuri Gram Panchayat, Nuapada District, Orissa. The work of the Chilnala Watershed Association is focused on two drought-prone villages, Chahakapada and Daldali of the Komna Block. The association has treated 612.29 ha of land through watershed development works. It has successfully roped in the community during all stages of work. The project has successfully checked soil erosion, improvement in soil moisture, soil quality and vegetation, enhancement of groundwater recharge, etc. As a result, people are involved in pisciculture in their ponds, vegetable cultivation and improved agriculture in their fields. There is overall economic development, which ultimately provides livelihood to the people. It has also checked the migration of labour to other states in search of a livelihood. Thus successful implementation of Integrated Watershed Development Project in other parts of the country shall help in the harvesting of rainwater in rural areas and the overall economic development of the people.

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MEETING REPORT

Facets of cecidology: Intricacies of insect–plant interactions*

The Eighth Annual Discussion Meeting on cecidology coincided with the birth centenary of one of India's cherished entomologist and cecidologist, M. S. Mani. Inaugurating the meeting, M. S. Swaminathan (Chairman, MSSRF, Chennai) called for more research on climate change and released the first base paper of The Entomology Academy of India, on 'Insects and climate change' by T. N. Ananthakrishnan. Stressing the need for protecting biostudies such as mangrove forests, Swaminathan said that in Bangladesh, casualties were not reported during the recent cyclone wherever mangroves forests occurred. In India too, people along the coast had realized the importance of mangroves after the tsunami. What was needed was improvement of productivity in perpetuity without affecting the ecological balance. C. K. Sreedharan (Principal Chief Conservator of Forests, Tamil Nadu) stressed that exotic plants introduced 30 years ago had resulted in the disappearance of large portions of natural forests. Eucalyptus was one such species which was brought to India from Australia, and for which many natural forests were cleared. The plant also brought in its wake alien insects and the recent gall epidemic is an example, besides creating problems for the endemic flora. Highlighting the recent trends on the multidimensional strategies in insect–gall genesis, Ananthakrishnan indicated that gall genesis is an excellent model system for exploitation of speciation process. Besides efficient resource partitioning, effect on utilization of hosts is typical of gall insects. A study of the taxonomic relatedness of the host plants utilized by gall insects and adaptive radiation of gall insects is equally important, he added. R. W. Alexander Jesudasan (Madras Christian College, Chennai) recollected the remarkable contributions made by Mani in the areas of high altitude entomology

*A report on the Eight Annual Discussion Meeting on 'Facets of Cecidology: Intricacies of Insect–Plant Interactions' held on 5 December 2007 at CCSTDS (formerly COSTED), Gandhi Mandap Road, Chennai.

and cecidology which paved the way for understanding the intricacies of insect–plant interactions in the context of cecidology. B. V. David (President, Entomology Academy of India) in his address outlined the gall makers with special reference to whitefly–host plant interaction.

A. Raman (Charles Sturt University, Orange, Australia) delivered the keynote address on radiation in *Mangifera indica*-infesting gall indices, and emphasized that gall-inducing insects are highly evolved groups with sophisticated biology and physiology that enable them to utilize their host plants more efficiently and resourcefully. A majority of gall-inducing insects display a strong level of fidelity and specific plant species and even specific plant organs, yet, many of them induce galls on closely related plant species. He explained the aspects with reference to gall-inducing midges, which are monophagous or narrowly oligophagous or polyphagous, as well as of host shifts. Differences in the temporally regulated flowering and leafing phenologies in susceptible host plants also play a role in isolating gall-inducing insect populations, which enable divergence and diversification via genetic drift. Although the host shifts and consequent radiation among gall-inducing insects appear to be slower than what occurs in non-gall-inducing insects, host shifts and radiation in gall-inducing insects appear more complex than the non-gall-inducing insects, he opined.

Speaking on plant defence and counter defence by the rice-gall midge, J. S. Bentur (Directorate of Rice Research, Hyderabad) indicated that the rice-gall midge exerts vital developmental control on the plant. Genetic diversity in conferring resistance to the gall midge with ten gall midge-resistant genes was investigated. He indicated that three distinct biotypes existed, enabling adoption of resistant varieties of rice. With the availability of new molecular and genetic tools, further work on resistance is in progress.

Species composition and biology of flower galls of Solanaceous vegetables was elucidated by N. K. Krishna Kumar (Indian Institute of Horticultural Research (IIHR), Bangalore). Among the five Solanaceous vegetables surveyed for gall formation, flowers, chilli, bell pepper and brinjal had significant numbers. Infestation due to gall insects on bell pepper was 11–49% at IIHR, while in the farmers' field it was 1.9–50% depending on the variety, control measures and season. Brinjal recorded an infestation of 3–5%, whereas for chilli it was greater than 1%. The gall midge species involved in gall formation both on bell pepper and brinjal was *Asphondylia capparis* Rubsaamen (Diptera: Cecidomyiidae). Hymenopteran species involved in gall formation were *Ceratoneura indi* Gerald, *Goethella asulcata* Girault (Eulophidae) and *Eurytoma chaitra* Narendran (Eurytomidae). Majority of the infested flowers in bell pepper and brinjal contained larvae of either gall midge or hymenopterans, and a few flowers (5.56–6.67%) had larvae of both gall midge and hymenopterans.

Information on insect-induced plant galls in fossil flora of India was provided by A. K. Srivastava (Birbal Sahni Institute of Palaeobotany, Lucknow). The plant fossil assemblages in sedimentary sequences of India were known from the Silurian to Devonian to the recent past, covering a time-span of about 420 million years. During this period at different stratigraphic horizons, fossil flora was represented by different plant groups. The gall-like features in the fossil assemblages of India observed for the first time in the flora of Raj Mahal Hills, confirmed the presence of galls possibly induced by mite in the coniferous leaves of *Nipanioruha granthia*, *N. lanceolata* and *Brachyphyllum nipanica*. Recent investigations have helped discover different types of insect-induced galls in the gymnospermic leaves of *Glossopteris*, *Belemnopteris*, *Ptilophyllum*, *Phyllopteroides* and *Nipaniophyllum*.

B. K. Das (Bidhan Chandra Krishi Vishwa Vidyalaya, AINP on Betelvine, Kalyani) outlined the biology and ecology of mango shoot gall psylla, *Apsylla cistellata* (Buckton) (Psyllidae: Homoptera). The conical green-bud galls on axils of apical mango shoots, are among the most important pests in northern and eastern India. The relationship between this psyllid and gall induction on mango shoot is a unique example of systemic gall formation by an insect, where galls are formed much away (axillary and terminal buds on shoot) from the site of feeding (midrib). The dormant adventitious axillary and terminal buds are converted into rudimentary shoots probably due to the effects of some chemical stimuli released by the pharate nymphs during feeding on the leaf midrib. The early-instar nymphs, emerging from the midrib, harbour the galls which are already formed and complete the subsequent stages within the gall. The probable physiology of gall formation has been postulated based on the nature of the gall and its development.

Renee M. Borges (Indian Institute of Science, Bangalore) indicated that the fig wasp community is a model system for understanding community ecology of parasitic wasps, due to their closely connected biology. The effect of water, sucrose, body size and host availability was tested on the fig wasp community of *Ficus racemosa*, a monoecious fig, comprising seven species belonging to three genera, *Ceratosolen* (pollinator and galler), *Apocryptophagus* (non-pollinator and galler) and *Apocrypta* (non-pollinator and parasitoid). The studies revealed that the gallers had a shorter lifespan than the parasitoids. The parasitoids showed an increase in longevity with sucrose. Wasp body size was not correlated with lifespan in any species. However, host availability was found to explain the lifespan for some species.

R. Varatharajan (Manipur University, Imphal) discussed the diversity of gall-forming phlaeothripids of northeastern India, one of the hotspot regions and their zoogeographical implications. Surveys made during the last few years reveal the occurrence of nearly 45 species of gall-forming thrips belonging to 12 genera under the family Phlaeothripidae. Thrips belonging to genera *Crotonothrips*, *Gynaikothrips*, *Inermothrips*, *Liophlaeothrips*, *Liothrips*, *Mesothrips*, *Nagathrips*, *Neodixothrips*, *Octothrips*, *Pegothrips* and *Thlibothrips* were collected. Plants belonging to families Bixaceae, Euphorbiaceae, Fagaceae, Lauraceae, Melastomataceae, Moraceae, Piperaceae, Rubiaceae and Sterculiaceae form their host plants, among which the common oak, *Quercus* sp. (Fagaceae) showed rich diversity with over 15 species of thrips. Infestation of thrips results in diverse forms of galls as in simple marginal rolls of oak leaf, horn-shaped outgrowth in *Schefflera* and a pouch-like manifestation in *Bixa orellana*.

Prasanth Jacob (Institute of Forest Genetics and Tree Breeding, Coimbatore) compared the relative susceptibility of eucalyptus in terms of intensity of gall incidence by the eulophid wasp on clones and seedlings of *Eucalyptus camaldulensis* raised from different seedlings. Differences in the intensity of gall incidence

and growth of seedlings besides tissue-specific variation in the occurrence of gall in seedlings were assessed. Variations in the anatomical characters and biochemical parameters were compared to understand the relative resistance/susceptibility among clones and seed sources of eucalyptus to *L. invasa*. Gall development studies showed that the point of oviposition is distinct by few darkly stained sub-epidermal cells. As the egg develops and hatches, the surrounding parenchyma cells intensively divide, and as a consequence the gall protrudes out. In susceptible plants nearby multiple galls diffuse together, whereas in resistant plants isolated galls of maximum two units occur distinctly on the stem.

Stressing the need to develop management strategies against galling in plantation forestry, R. Sundararaj (Institute of Wood Technology, Bangalore) added that large-scale plantation programmes have necessitated a demand for planting stock, for which nurseries have been established in different states. Among the plantation tree species of India, the establishment of teak (*Tectona grandis*) and eucalyptus (*Eucalyptus* spp.) for timber, khejiri (*Prosopis cineraria*) for agro forestry and pongam (*Pongamia pinnata*) for bioenergy plantation often faces problems with a variety of gall inducers, both in nurseries and plantations. In-depth knowledge of galling in these tree species is the key to protecting plantation forests from devastating outbreaks of gall inducers to achieve the goal of plantation forestry.

Highlighting the dynamics of the mango galls, Abraham Verghese opined that among the gall-forming insects on mango leaves, *Procontarinia matteiana* Keiffer & Cocconi (Cecidomyiidae: Diptera) is the most important, occurring in Java, Mauritius and South Africa besides India. *P. matteiana* lay eggs on the ventral surface of the leaves. On hatching the maggots bore into the leaf tissue and feed within, resulting in the formation of circular, biconvex galls on the leaves. The affected leaves get deformed and fall prematurely, which may affect the yield. An attempt was made to find if galls on fallen leaves are related to infestation on the trees, to see whether fallen leaf is an index of gall population on mango trees. This may be a pointer to using fallen leaves as an index of future gall infestation. However, these studies need scaling-up and field testing before they are fully integrated into management.

Chairing the plenary session, Raman stressed the need for more intensive studies of insect galls with an insight into the modalities of gall induction by diverse gallers, so as to be able to appreciate the diversities involved in the process.

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MEETING REPORT

Food technology for better nutrition*

Though India is the largest producer of milk and second largest producer of vegetables and fruits, the quantity produced is inadequate to meet the requirements of its population and out of reach of the poor due to lack of purchasing power. A confounding factor is the wastage that occurs due to inadequate and substandard storage facilities, lack of cold storage, and infrastructure for food-processing for value-addition. About 30% of the fruits and vegetables grown in India (40 million tonnes amounting to US$ 13 billion) is estimated to get wasted annually. Wasted food can feed almost 232 million people. Multiplication factor for food processing is 2.4, i.e. for every one rupee wealth created directly, additional 2.4 rupees are earned indirectly through transportation, packaging, cold storage, etc. (D. G. Rao, lecture delivered on World Food Day, Hyderabad, 16 October 2007).

Apart from preventing wastage, generating employment and making food available off-season (which indirectly help in food security), food technology can directly contribute to food security through value-addition to enhance nutrient density. Ready to Cook (RTC), Ready to Heat (RTH) and Ready to Eat (RTE) food help to reduce drudgery. RTE food is popular among all segments of the population.

Against this background, a symposium on food technology for better nutrition was organized in New Delhi. Though the focus was on India, several international experts also participated and provided a global perspective. C. Gopalan (Chairman, Nutrition Foundation of India, New Delhi) welcoming the delegates, highlighted the nutrition challenges in the country and stressed the need for developing affordable technologies that would help improve the nutrition status of the poor, besides meeting the growing demand from the rich for processed food having variety and flavour. He also stressed the need for food-based approaches to combat malnutrition, rather than quick-fix pharmacy-based approaches. V. Prakash (CFTRI, Mysore) said that food technology can also have a societal mission of reaching out to the have-nots. Currently, emphasis is on medium and large-scale industries. There is need for setting up small-scale industries in rural areas where food is produced and where employment is needed.

Food technology can be pre-harvest or post-harvest. The symposium covered both aspects. There were basically three major themes: (a) Technology for improving nutrient content of crops through bio-fortification. (b) Technology for reducing wastage of vegetables and fruits and processing of millets, oils and vegetables. (c) Food fortification to combat micronutrient deficiencies.

The Department of Biotechnology, New Delhi has launched an Indian bio-fortification network project involving more than 15 R&D institutions, with an objective of developing transgenic cultivars of staples like rice, wheat and maize, high in nutrients like iron and zinc that are deficient in the Indian diet. The process involves identification of

*A report of the symposium on 'Food Technology for Better Nutrition' organized by the Nutrition Foundation of India during 30 November–1 December 2007 at the India International Centre, New Delhi.