Table 1. Biomass (dry weight in tonnes) of selected rare species across three States of India in North-West Himalaya

Species	Biomass per individual (kg)	Biomass in Uttaranchal (tonnes)	Biomass in Himachal Pradesh (tonnes)	Biomass in Jammu–Kashmir (tonnes)	Total biomass in North–West Himalaya (tonnes)
Dactylorhiza hatagirea	0.0011	3,360	2,000	13,870	19,250
Picrorhiza kurrooa	0.0017	5,690	3,390	23,470	32,560
Rheum moorcroftianum	0.1500	5,53,630	3,30,330	2,282,020	3,165,980

lesser quantity than the rest of the two categories – endangered and vulnerable.

There is a wide gap between the supply and demand of these species. From the North-West Himalaya (the present study region), the annual supply of *D. hatagirea* and *P. kurrooa*, for example, is about 100 tonnes for each species. Yet, the annual demand of *D. hatagirea* and *P. kurrooa* is 5000 tonnes for each species[3]. This variation in demand and supply is not due to low availability of these species in the wild but due to heavy collection of these species from some accessible areas and at the same time no collection from the remaining large areas. The areas used for collection have also been studied for population density in the wild, thus disseminating the false information on its availability in the wild which is used for placing the species in a respective threat category.

According to the IUCN Red List categories, a taxon is critically endangered when it is facing an extremely high risk of extinction and obtains less than 250 mature individuals in the wild. Similarly, a taxon placed in the endangered category may obtain less than 2500 mature individuals. The present study estimates about 0.56×10^{12} and 0.61×10^{12} individuals of *D. hatagirea* and *P. kurrooa* respectively. The demand of these species is, of course, high but the availability in the wild does not reflect that *D. hatagirea* should be ranked as critically endangered and *P. kurrooa* as endangered.

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MEETING REPORTS

Green pesticides for insect pest management*

Agriculture in a tropical country like India, owing to its climatic conditions and its particular environment, suffers severe losses due to pests. The Indian farmers are in need of effective tools to fight against pests. After severe setback arising from the use of chemical pesticides on living systems and the environment, the use of eco-friendly biopesticides is gaining momentum. However, the small farmers in India are not yet fully aware of the concept, use or advantages of eco-friendly pest management. Though India has a rich source of plants that could be harnessed as botanical pesticides, accentuated research on the preparation of biopesticides has not gained ground.

Botanical pesticides are good alternatives to chemical pesticides. Botanical pesticides are eco-friendly, economic, target-specific and biodegradable. For example, neem-based botanical pesticides have been used traditionally for many years. There are many other trees (besides herbs and shrubs) which are also useful as sources of botanical pesticides (Table 1). To enlighten and encourage research in botanical pesticides, the Entomology Research Institute, Loyola College, Chennai, organized a two-day National Symposium on 'Green Pesticides for Insect Pest Management' during 5–6 February 2004. Discussions during the symposium covered areas of botanical pesticides, microbial agents, contributions of biotechnology, pheromones, host plant resistance (HPR), entomophages, traditional green pesticides and Integrated Pest Management (IPM). Rabindra (Project Directorate of Biological Control, Bangalore) in his inaugural address, stated that only 20% of the IPM is adopted in the field. He stressed the ill-effects of chemical pesticides and fertilizers and the role of botanical pesticides in sustainable agriculture. He stated that actinomycetes are completely absent in Andhra Pradesh and Karnataka due to indiscriminate use of chemical fertilizers. He pointed out the efficacy of neem formulations in the control of sucking pests, but also cautioned that botanicals are not the only solution. Also, he explained the merits and demerits of microbial pesticides and elaborated on the need for increasing awareness among farmers, low-cost production of microbial pesticides,

*A report on the National Symposium on Green Pesticides for Insect Pest Management conducted at Entomology Research Institute, Loyola College, Chennai, during 5–6 February 2004.

Table 1. Trees as a source of botanical pesticide

Tree species	Common name	Plant part/product	Active principle	Activity
Albizia lebbeck	Wild sirissa	Seed, leaf, pod, bark and root	Caffeic acid, alkaloids and quercetin	Insecticidal
Anacardium occidentale	Cashew nut	Shell oil	Phenolic compounds	Insecticidal
Annona squamosa	Custard apple	Stem, leaf and semi-ripe fruit	Annonine	Insecticidal
Azadirachta indica	Neem	Seed and seed oil	Azadirachtin, nimbidin, salanin, meliantrol and other bitter principles (terpenoids)	Antifeedant, oviposition deterrent, IGR and insecticidal
Butea monosperma	Flame of the forest	Flower extract	Chalcones and aurones	Termiticidal
Hardwickia binata	–	Heartwood	Mopanol and epicatechin	Antifeedant
Madhuca indica	Butter	Seed and seed oil	Saponins	Repellent and insecticidal
Melia azadarach	Common bead	Fruit and seed	Meliacin	Antifeedant and insecticidal
Pongamia pinnata	Indian beech	Seed and seed oil	Karanjin	Repellent and insecticidal

rationalized biopesticide registration protocols and suggested a road map for use of biocontrol agents. S. Jayaraj (S. Jayaraj Research Foundation, Chennai) introduced the theme of the seminar, emphasizing usefulness of botanical pesticides which could be produced by women in rural areas. He detailed the constraints in the use of botanical pesticides in IPM and gave suggestions for their improvement and use in future. He advocated the need for large-scale demonstration programmes on IPM. Also, he talked on the effects of microbial pesticides in the management of *Helicoverpa armigera* (Hubn.) and *Spodoptera litura* (F.) on cotton.

The role of botanical pesticides in IPM, bio-efficacy of botanicals for the management of important pests, and recent trends in the development of botanical pesticides were discussed. A. K. Tripathi (Central Institute of Medicinal and Aromatic Plants, Lucknow) spelt out the recent trends in the development of botanical pesticides. He stated that monoterpenoids of essential oils provide effective lead molecules in the management of stored product insects, veterinary insects and insect pests of public-health importance. Uma Maheswari (S. V. Agricultural College, Tirupati) presented a wide range of botanical pesticides as tools for pest management. A. Regupathy (Tamil Nadu Agricultural University (TNAU), Coimbatore), elaborating on 'Formulations of botanical pesticides', advocated that neem-derived pesticides may be used along with other IPM components like trap crops, biocontrol agents, etc.

The role of microbial pesticides in eco-friendly pest management was discussed. Bio-efficacy of NPV, *Bacillus thuringiensis* (*Bt*) and entomopathogenic fungi against insect pests were clearly spelt out by the participants. Easwaramoorthy (Sugarcane Breeding Institute, Coimbatore) outlined the work on Granulovirus formulations in pest management in India. Padmaja (Andhra University, Visakhapatnam) gave an account of the role of entomopathogenic fungi in insect pest management. More than 700 species of fungi from 12 genera have been reported to be pathogenic to insects.

Biotechnology is used in eco-friendly pest management. Susan Eapen (Bhabha Atomic Research Centre, Mumbai) spoke about 'Biotechnological approaches for insect pest management'. She gave details on how important transgenic plants are in relation to lepidopteran and coleopteran pests. She also spoke of the constraints in the use of transgenics and strategies for the future. The drawback of *Bt* gene expression in cotton was also cited. Whether transgenic plants have altered nutrient status that make them more susceptible to other pests was debated.

The bio-efficacy of pheromones, spinosyn, HPR, entomophages and cultural control methods was spelt out in detail by the participants. S. Uthamasamy (TNAU, Coimbatore) detailed the origin, action and toxicity of spinosyn and avermectin in pest management. However, there were questions on the use of spinosyn and avermectin as pesticides due to their toxicity to non-target organisms.

Papers on traditional green pesticides were also presented. Geetha Rani (M.S. Swaminathan Research Foundation, Chennai) presented a bird's eye view of the role of indigenous technical knowledge that has been used to control pests and diseases. She pointed out that about 70 traditional practices are reported to be followed in India. She narrated about 20 traditional practices, some of which showed efficacy against brown planthopper *Nilaparvata lugens* S. in rice.

Integrated approaches for the management of mango, cabbage, groundnut, rice, cotton and chilli pests were also deliberated. Impact of green pesticides on parasitoids was dealt with in detail.

During the panel discussion chaired by the author, the need for exploring and harnessing the available literature on botanical pesticides in the form of databases was stressed. As present-day farmers are showing greater interest in the use of green pesticides, scientists were encouraged to carry out more research on botanical pesticides and low-cost production technologies to cater to the demand of farmers and to protect the environment from harmful effects.

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