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Plant Based Biopesticides: Safer Alternative for Organic Food Production

Nagappan Raja* and Getinet Masresha

Department of Biology, College of Natural and Computational Sciences, University of Gondar, Ethiopia

Organic food production and consumer demand is increasing recent times in developed and developing countries. The increased demand in organic food and beverages is due to awareness among the consumer and producer about the negative consequences associated with synthetic chemical pesticides. The expected global organic food and beverage market in 2015 to be $104.50 billon. Among the European countries, Germany is the biggest consumer for organic food and beverages with a share of 32%. The estimated organic food consumption in Japan is 54% in 2010 which is one of the leading countries in Asia. The expected growth rate of organic food market in Asia is 20.6% of CAGR from 2010 to 2015. Among the various organic produces, fresh fruits and vegetables are most dominated food categories with a share of 37%. The estimated CAGR of 22.3% from 2010 to 2015 in organic industries are associated with organic supplements. By realizing health benefits and eco-safety several government and non-governmental organizations are also supporting conventional farmers to switch over organic farming practices.

Sustainable organic farming practices needs proper eco-friendly pest and disease management practices in addition to balanced nutritional supplement to improve the quality and quantity of the agricultural outputs. The discovery of synthetic pesticides contributed much for the achievement of sustainable crop protection and production after green revolution. However, indiscriminate application of their utilization in crop protection leads several disadvantages to target and non-target organism in addition to environmental pollution. Due to residual problem and toxicity to the living environment synthetic chemical pesticides are not suitable for organic food production. In this scenario, green pesticides from plant origin are given enormous importance in recent times to develop better alternatives to chemical pesticides by considering eco-friendliness, multiple mode of action against insect pests. Prehistorically many plants and their parts are used extensively for the protection of crops against pests in the field as well as in storage.

In general, botanical pesticides are eco-chemicals isolated from parts of the plants such as leaves, roots, barks, fruits, seeds or seed kernels. By nature, several higher plants have the ability to synthesis and produce numerous secondary metabolites which will be unpalatable to insect pests. Some of the secondary metabolites alter the behaviour and life cycle of insect's pests which are called as semiochemicals. In Asia, insecticidal property of several *Chrysanthimum* species is known for centuries. Many insecticidal compounds have been isolated from dried flower buds of *Chrysanthimum* species including six terpenoid esters which are successfully patented and marketed. *Azadirachta indica* is commonly called as neem which is another most promising plant used effectively and extensively for insect pest management program. The compound *azadirachtin* isolated from the seed kernel is contributed much for the development of several commercial bio-pesticide formulations. More than 100 commercial products are developed with *azadirachtin* including *Margosan-O*, *Bio-neem*, *Azatin*, *Neemies*, *Safer's ENI*, *Wellgro*, *RD-Repelin*, *Neemguard*, *Neemark*, *Neemazal*, *Nimbin, Nimbicidine* etc., which are used successfully in many parts of the world. The devotion and dedication of scientific community, chemical structure of *azadirachtin* have been successfully synthesized and developed as synthetic *azadirachtin* in 2007 which will be useful to develop bio-pesticides in the future. Several research reports highlights that neem products may not leave any toxic residue even though plants absorbed and transported to all tissue. According to Environmental Protection Agency, *azadirachtin* is classified as class IV due to low mammalian toxicity. Till today several farmers in Indian villages collect the seeds to prepare crude seed kernel extract for pest control program.

In addition, many plants contain essential oil which is a complex mixture of volatile compounds accumulated in seeds, flowers and leaves. These essential oils are includes various alcohols (eg. *linalool, geraniol, citronellol*), cyclic alcohol (eg. *menthol, isopulegol, terpeniol*), bicyclic alcohol (eg. *borneol, verbenol*), phenols (eg. *thymol, carvacrol*), ketones (eg. *carvone, menthonen thujone*), aldehydes (eg. *citronellal, citral*), acids (eg., *chrysanthemic acid*) etc., which will be released by the plants to protect against herbivores and pathogens. The essential oils of *Matricaria recutita* contain precocenes a compound which stimulate the production of juvenile hormone from the endocrine gland of insects which will suppress the insect growth during the time of molting. The *juvabione* from balsam fir wood suppress the insect development. *Ocimum basilicum* contain *juvocimenes*, an analogue of insect juvenile hormones. Aromatic plants like French marigold and coriander produce strong smells, which will be useful repellent to protect crops nearby. In general, anti-insect compounds are accumulated in several species of *Myrtaceae, Lauraceae, Rutaceae, Lamiaceae, Asteraceae, Apiaceae, Cupressaceae, Poaceae, Zingiberaceae and Piperaceae* families. The bioactive compounds isolated so far is countless and some of the compounds may also contribute in future to develop novel plant based biopesticides for organic food production. The appropriate selection of biomolecules to prepare biopesticides with multiple mode of action against target pests is unquestionably safer alternative for organic food production. Recent development in this field of research is disseminated to the scientific world through journal of bio-pesticides and bio-fertilizers are greatly appreciated.

***Corresponding author:** Nagappan Raja, Department of Biology, College of Natural and Computational Sciences, University of Gondar, Post Box 196, Gondar, Ethiopia, Tel: 00251-918-711780; E-mail: nagappanraja@yahoo.com

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