

**General Article : Views and Analysis****Potential of bioactive products for the control of stored grain pests.****Suraj Chetri and Rezina Ahmed**

Department of Zoology, Cotton University, Guwahati, India

Abstract

The storing of grains has always been a problem for the farmers as various pests are commonly encountered in Assam and North East India. Infestation by these pests always cause great economic loss to the farmers every year. Various bioactive products has been known to have insecticidal property to great extent. Replacement of chemical pesticides by various bioactive products will be beneficial for the proper preservation of grain and are likely to cause less ecological damage. The use of synthetic products for the control of insect pests leads to the events like pest resistance, resurgence, product residues, undesirable environmental persistence, risk to non-target organisms etc. Plant derived bioactive compounds can be used as an alternative to control the insect pest. Various phytochemicals includes alkaloids, glycosides, terpenoids, saponins, flavonoids, phytosterols, phenolic compounds, steroids, coumarins, quinones, etheral oils, propanoid derivatives, isoprene derivatives etc. are known to have insecticidal activity to a varying degree.

Keywords : Pests, Bioactive products, Stored grain.

India with a population of about 1.27 billion is a great contributor to the world's food grain production. Agriculture is the largest livelihood source in India. India have produced 283.37 metric ton of food grains during 2018-2019 (FAO, 2019). Rice, wheat and pulses are the main food grains of India. To sustain such a large number of population, it is important to store the food grains with utmost care. Storage of food grain is important for food security. India's climate varies from humid & dry tropical in the southern part to temperate alpine in the northern parts and it has a great variety of diversity. The climatic condition of India is favourable for the growth and sustenance of large number of insect pests that act on the food grain and cause serious damage. It has been estimated that each year 1/3rd to 1/4th of world's food grain are lost during storage mainly due to attack of insects (DPIRD, 2019). Various insect pests feed on grain embryos hence reducing the protein content of food grain. The food grain insects are classified into 2 categories- Primary and Secondary pests. Primary pests have the ability to attack whole (unbroken grain) and the secondary pests attack damaged, dust and milled products. The major primary storage pests includes Rice weevil, Khapra beetle, Lesser grain borer, Angoumois grain moth, Pulse beetle,

Tamarind, Cigarette beetle, Drug store beetle, Sweet potato weevil and Potato tuber moth. The secondary storage pests include Rust red flour beetle, Long headed flour beetle, Saw toothed grain beetle, Rice moth, Fig moth and Indian meal moth (Vikashpedia, 2019).

Infested stored grains are controlled by various methods, of which fumigation is one of the effective way to kill the pests. Fumes emerging from the fumigants enter inside the body of insects via spiracles, ultimately reaches the haemolymph and abruptly changes their normal body functioning. Various synthetic chemicals used in fumigation includes sulphuryl fluoride, ethyl formate, carbonyl sulphite, ethane dinitrite etc. Ethylene dichloride and carbon tetrachloride mixture in a ratio of (3:1) is used as fumigants to kill all stages of stored grain pests (Upadhyay & Ahmed, 2011). These synthetic chemicals are more toxic than the natural chemicals and have adverse impact in the environment. Pesticides such as sulphur, endosulfan, mancozeb, phorate, methyl parathion, isoproturan, copper oxychloride etc. are used in large scale. Consumption of all these chemicals in a greater volume is poison. Methyl bromide is a widely used pesticide and is used in more than 100 crops worldwide (Roskopf *et al.*, 2005). It is used as soil

Corresponding author : surajc30@gmail.com

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fumigant to control soil insects, nematodes and weeds. The methyl bromide is known to have effect on stratospheric ozone layer depletion. It is also associated with health hazards and groundwater contamination (Messenger & Braun, 2000).

Pesticides have adverse effects on non-target species and plant biodiversity. About 80-90% of applied pesticides can volatilize within a few days of application (Majewski & Capel, 1995). The volatilized pesticide readily mix up in the air and cause harm to non-target organism. Water soluble pesticides can enter water, streams, rivers, lakes and cause harm to untargeted species. Bio amplification process in animal body also facilitates the accumulation of fat soluble pesticides which affect the organism for longer period of time. Water contaminated with pesticides affect the aquatic life, decreases dissolves oxygen in water and also leads to the behavioural changes in fish population. Exposure to pesticides leads to acute effects like headache, nausea, vomiting, irritation of skin, nose and throat, dizziness etc. It can alter the level of reproductive hormones and is associated with diseases like breast cancer, prostate, leukaemia, lymphoma etc. (California for pesticide Reforms, 2019). Chronic effect of pesticide exposure leads to neurological health effects, damages to immune system (Culliney *et al.*, 1992).

The use of synthetic products for the control of insect pests becomes a serious issue in today's world. It leads to the events like pest resistance, resurgence, product residues, undesirable environmental persistence, risk to non-target organisms etc. All these events have a severe adverse effect in the environment. India harbours a total of 47,513 plant species representing as much as 11.4% of world flora. A total of 28% of plants that exist in India are indigenous to the country (Singh & Dash, 2014). Plant derived bioactive compounds can be used as an alternative to control the insect pest. Bioactive compounds (or a substance) has a direct effect on a living organism. These effects may be positive or negative depending on the substance and the dose (Bioactive compounds, 2012). Various phytochemicals includes alkaloids, glycosides, terpenoids, saponins, flavonoids, phytosterols, phenolic compounds, steroids, coumarins, quinones, ethereal oils, propanoid derivatives, isoprene derivatives etc. All these phytochemicals are known to have insecticidal activity to a varying degree. The use of plant derived bioactive compounds for the control of insect pest have always been a key topic in the field of research. Various works has been done so far for the scientific validation and implementation of bioactive

compounds for the control of insect pests.

Aphanamixis polystachya (Pithraj) seed extract and seed volatiles have strong repellency to *Tribolium castaneum* (Red flour beetle) and *Callosobruchus chinensis* (Gram dhora) (Talukdar & House, 1994). Powder of flower of cloves, fruit of black pepper are tested against *Callosobruchus maculatus* (Gram dhora) mixing with grams and reported higher repellency to the pest (Javid & Poswal, 1995). Methanolic and ethanolic extract of *Andrographis paniculata* (Green chireta) and *Jatropha curcas* (Physic nut) is effective to control *Callosobruchus chinensis* (Gram dhora) (Bright *et al.*, 2001, Jadhav & Pardeshi, 2017). *Azadirachta indica* (Neem) in the form of powder and oil decreases the matting frequency, copulation duration, fecundity, growth and survivorship to next generation progenies (Saxena, 1989, Ahmed *et al.*, 2001). Oils of plants namely *Cinnamomum verum* (Cinnamon tree), *Salvia verbenaca* (Wild clary), *Scilla maritima* (Squill) & *Artemisia herba-alba* (White wormwood) have insecticidal effect (Fatiha *et al.*, 2014, Kalita *et al.*, 2014). Aqueous extract of *Nicotiana tabacum* (Tobacco), *Hydrocotyl asiatica* (Asiatic pennywort) and *Azadirachta indica* (Neem) produce maximum adult mortality in various bruchid pests (Rashid *et al.*, 2018, Bindu *et al.*, 2015). The extract of *Lantana camara* (Lantana) has antifedent, antiovipositional and pesticidal property and shows 10-43% insect mortality at 1-5% concentration (Saxena, 1992). Plant extract of *Polygonum hydropiper* (Water pepper) in chloroform and ethyl alcohol has remarkable residual effect on the pest *Tribolium castaneum* (Red flour beetle) by reducing the production of F1 progeny (Kundu *et al.*, 2007). The essential oil from *Eucalyptus globulus* (Southern blue gum) and *Ocimum basilicum* (Common basil) has repellency against insect pests (Mishra *et al.*, 2012). The acetone extracts of *Adathoda vasica* (Malabar nut), *Lantana camara* (Lantana), *Vitex negundo* (Chinese chaste tree) and *Catharanthus roseus* (Cape periwinkle) are effective to control *Sitophilus oryzae* (Rice weevil) and is dose dependent (Soujanya *et al.*, 2016). Ethanolic extracts of leaves of *Melia azedarach* (Bakain), *Menta longifolia* (Mint), *Myrtus communis* (Habulas), *Cymbopogon citratus* (lemongrass) and *Datura stramonium* (Datura) have repellent and lethal effect against *Oryzaephilus surinamensis* (Saw toothed grain beetle), *Tribolium castaneum* (Red flour beetle) and *Callosobruchus chinensis* (Gram dhora) (Manzoor *et al.*, 2011).

Although the use of chemical pesticides enhance the economic potential in terms of food production and ameliorate vector borne diseases but it has serious health implications to man and environment. Not even a small fraction of the Indian population is completely safe from the ill effects of pesticides.(WHO,1990). The farm workers, sprayers, mixers, production workers are severely exposed to pesticides and the possibility of health hazards is maximum in them. The organic compounds can pollute the tissues of every life form on the earth. Various chemicals including pesticides can elicit the functions of endocrine hormones in human and constant exposure to such chemicals leads to health effects like immune suppression, hormone disruption, diminished intelligence, reproductive anomalies and cancer (Crisp *et al.*, 1998). Pesticides contaminate soil, water, vegetation and kills various insects and weeds. It is also harmful to birds, fish, beneficial insects and non-target organisms. Pesticides can contaminate water as the pesticide runoff from the fields reaches the surface water. Pesticides are found in all the samples of major rivers & 99% of samples of urban streams (Bortleson & David, 1987). Pesticides like DDT, Endrin, Lindane, Endosulfan etc. are strongly bound to the soil. Most of them are banned now but their residue are still present in the environment. Polar pesticides including fungicides can contaminate drinking water. Pesticides also have negative impact on the soil fertility. Excessive use of pesticide can decline the population of bacteria, fungi and soil organisms and that may lead to soil degradation. Non target organisms including beneficial micro-organisms, insects, fish, birds etc. get affected by the use of

pesticides. Chlorpyrifos is a common contaminant of urban streams and is detrimental to the fish species(US Geological Survey, 1999).

The plant derived bioactive compounds do not persist for a long time in the environment and are easily degraded by various environmental factors such as temperature, UV light, rainfall etc. Most of them have repellent effect and hence grain feeding may be reduced. Most plant derived bioactive compounds are compatible with other insecticides and are useful in Integrated Pest Management. They act as repellent, disrupt mating and sexual communication, sterilants, growth retardant, oviposition deterrents, antifeedants and lethal toxins.

The production and commercialisation of plant based bioactive products for the control of pest should be encouraged by Government and Private Agencies so that the farmers can get these product at ease. The need to educate farmers about the ecological/nature friendly benefits of plant products have a crucial role which can be mediated through awareness campaigns. The government, media and NGO's have great role in making the farmers switch to the use of bioactive products from chemical pesticides. Organic farming has already been practiced from the early 20th century and India has also started such practice. Sikkim has been recognised as the country's first organic state in 2018. Such kinds of events and practices should be encouraged to mitigate various adverse environmental issues and to live a healthy life. This will further enhance the possibility of attaining Sustainable Development Goals (SDG's), particularly Zero hunger, Clean water and Sanitation, Reasonable consumption and production, Life below water and Life on land.

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