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Different Practices in the Management of Pulse Beetle

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Abstract

Pulse beetle is the major pest infesting all type of pulses both in field and storage and it causes a major loss. So, prevention of losses in storage due to insect pest is one of the most important aspects in Indian agriculture. It can be managed by different preventive and curative measures. In both cases, the insects must be destroyed without altering the food quality of the grain. Preventive effort includes before storage of the grain, from the time it is received from the field, even if no insects are visible i.e. sanitation, disinfestations of storage container, structure and stores, proper stacking of grains and legal method. Curative effort is during or even before storage which includes chemical and non chemical method.

Introduction

Pulses are leguminous crop which constitute the major nutritional factor and plays a vital socio economic role in the daily diet of mostly vegetarian people. It is also known as poor man's meat. On the basis of its importance, 2016 was declared as the 'International Year of Pulses' by the 68th session of the United Nation General Assembly to address future global food security, nutrition and environmental sustainability. But unfortunately it suffers a great loss by insect pest attack. Among these, pulse beetle, *Callosobruchus* spp. belonging to family Chrysomelidae and Order Coleoptera poses very serious threat to legume crops. Pulse beetle damage is about 24% and it causes 40-50 % losses in storage (Gosh and Dubey, 2003*)*. The losses may be qualitative and quantitative. It causes protein loss, weight loss, germination loss, etc. Growth of agriculture based economy of world depends on sustained supply of quality seed. Thus, it is essential to protect the seed or grain against the attack of insect pests.

Different Measures for Management of Pulse Beetle

It can be managed by different preventive and curative measures. In both cases, the insects must be destroyed without altering the food quality of the grain. Preventive effort includes before storage of the grain, from the time it is received from the field, even if no insects are visible and curative effort is during or even before storage which includes chemical and non chemical method.

A. Preventive Measures

Sanitation or Hygiene

Before storage it should be ensured that food grain must be dry (8-10%), clean, cool, wholesome, free from obnoxious odour. Storage structure should neat, clean

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and air tight and removal of insects and infested grains from healthy grain before storage reduced its multiplication.

Proper Stacking of Grains

Bag should be stacked on wooden dunnage 0.5 m away from wall with spacing of 2-3 m and height of row should not be more than 15 bags and storage structure should also be kept away from ventilation.

Disinfestations of Storage Containers Structures and Stores

Before storage clean and disinfest empty used gunny bags by dipping in boiled water and drying under sun and fumigate the storage with fumigants. Treat gunny bags by dipping in 0.01% cypermethrin 25 EC or 0.01% fenvalerate 20 EC or malathion 0.1% for 10 minutes. Treat walls and surface by malathion (50 EC) or Fenitrothion (50 EC) @ 5 ml/ lit of water or Deltamethrin (WP) 1.25 g/lit of water.

B. Curative Measures

1. Non chemical method

a) Botanical

The use of plant extracts/ oil is gaining more importance in the present scenario as they are affordable, safer, non phytotoxic and biodegradable. Plant component are conventionally classified in to 6 groups namely, repellents, feeding deterrents/ antifeedants, toxicant, growth retardants, chemosterilants, attractants. Some botanicals used against pulse beetle are powder of neem leaf, neem seed, neem bark, camphor, sweet flag, lemongrass, eucalyptus, wild marigold, derk, turmeric, tulsi and oil of neem, karanj, palm, groundnut, sunflower, castor, mustard, safflower, sesame, coconut, lemon grass, cardamom and maize etc.

b) Host Plant Resistance

Use of host plant resistant is one of the most effective and economically sound technique and much lime light could be spread on developing resistant cultivars against pulse beetle under both field and storage conditions. It manifested through antixenosis, antibiosis and tolerance. The resistant trait include morphological trait (Colour, texture, size and shape of pod and seed) and physiological and/or biochemical trait (Secondary metabolites and anti nutritional compound). Physical characters of seeds with smooth seed texture, large size, light color and less thickness show susceptibility to pulse beetle while rough seed surface, small size and dark color shows resistant to pulse beetle and seeds with high protein content are susceptible to pulse beetle and high biochemical and phytochemical factor such as phenols, falvonoids, tannins shows resistant to pulse beetle.

c) Biological Method

Biological methods including microbial pesticides is a kind of safety ecological measures, inherently less harmful to environment, affect only the target organisms very effective in minute quantities and decompose quickly and are included in integrated pest management (IPM) programme but their effectiveness under storage condition is yet to be exploited and it is not very encouraging in stored godowns. Some of the commonly used biopesticides are *B. thuringiensis, Trichoderma, Phytopthora, B. bassiana and Metarhizium anisopilae.*

d) Semiochemicals

It is a behavioral manipulation method for management of pulse beetle. Pheromones are secreted or excreted from the insects to affect the social behaviour of the insects (receiving individuals). These compounds are used as attractants or repellents in traps for detecting and monitoring insects in storage. A reduced receptivity to mating was observed in *C. chinensis and C. maculatus*, by the injection of octopamine and tyramine, respectively (Yamane and Miyatake, 2010).

e) Physical and Mechanical Methods

Physical and Mechanical methods such as solar drying, low temperature, inert dust, barriers, hygienic storage structures such as pusa bin, pusa cubicle, pusa kothar, improved bamboo basket etc. and grain protection devices such as TNAU two-in-one model trap, indicator device, device to remove insect eggs from stored pulse seeds could largely limit the infestation by pulse beetles. Optimum temperature range for development of pulse beetle is 25-35 °C temperature. At temperature above 40 °C and below 15 °C the reproductive potential of pulse beetle will decrease and at temperature above 45 °C and below 10 °C the insect will die.

- ***Irradiation:*** Gamma rays generated from the isotopes cobalt-60 and cesium-137 are generally used for food. The doses that various countries apply for pulse grains vary from 1 to 10 kGy for quarantine treatment and insect mortality (Hallman, 2013).

- ***Controlled Atmosphere:*** It is a way to eliminate insects from stored commodities without polluting the atmosphere and safer than traditional fumigants. It can be achieved in the following by adding gaseous or solid CO_2, adding N_2 gas, removing O_2 gas, allowing metabolic process which will remove O_2 or CO_2.

2. Chemical Method

Most of the physical methods suggested earlier may not give total insect control. Application of chemicals, therefore, sometimes becomes essential for complete insect mortality and prevention of insect growth. It features two broad type of treatment i.e. treatment by contact insecticide and treatment by Fumigation. Deltamethrin 2.8 EC at 4 ppm found to be more effective against *C. chinensis* damaging to mung bean under storage condition followed by cypermethrin 10 EC at 4 ppm and spinosad 45 SC at 4 ppm.

Fumigation

A fumigant is a chemical vapour or gas that, when released, penetrates objects or enclosed areas in concentrations that are lethal to pest. Some fumigants used are sulphury fluoride, carbonyl sulphide, EDCT (1:8 w/w). Carbon dioxide fumigation is effective, but the exorbitant cost of production and application debars many farmers and dealers to use it as a fumigant; however, producing CO_2 from burning of biomass like cow dung can be adopted by small-scale farmers.

Nanotechnology

Nanoparticles used against Pulse Beetle are silver nanoparticles like ($AgNO_3$), silica like diatomaceous earth, synthetic silica (SiO_2), sands, silica aerogel, zinc oxide (ZnO). Nanoparticles get attached to the insect body causing abration of elytra, clogging of spiracle thus affecting respiration, cause dehydration and ultimately death of the insect.

Conclusion

At present, food quality and management efficiency are the most important guidelines for planning and any decision making process. Use of botanicals has given a cheap and efficient way; use of resistance varieties is also a good tool, as it will save time, labour and money spent on various management methods. The modern storage structures should be preferred as they provide efficient storage facilities. Drying the harvested grains to safe storage moisture content followed by suitable packaging in sanitized insect proof container, can prevent grain loss to a large extent. The fumigants which are harmful or banned should be replaced by alternate/ new fumigants. The uses of new practices like irradiations, nanotechnology and microwave technology should be encouraged rather than following traditional ones. It will give better results if all the methods are combined and applied against pulse beetle in a suitable manner. An Integrated Pest Management practice is the key to food sustainability and safety.

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