Phytochemical based pesticides as Grain Protectants

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Abstract- The quantitative and qualitative food loses and feed commodities is mainly done by insect –pests which are prolific in nature and causes development of hot spots as a result of metabolic heat by developing insect populations, thereby create favourable conditions to various pathogens. Thus they cause two way spoilage of food commodities resulting into economic loss as well as loss to public health.

Keeping these points in view ,the present investigation is aimed to study essential oil based insecticide effective against stored grain insects and prepare their nanopesticides for efficient delivery. This work will surely be able to generate scientifically validated data on the bioactivity profile against targeted stored grain insects like Callosobruchus maculates and Tribolium castaneum.

Index Terms- Essential Oil, Insecticide,Bioactivity, Callasobruchus maculates , Tribolium castaneum.

I. INTRODUCTION

Food grain losses due to insect infestation during storage are a serious problem, particularly in the developing countries [1, 2]. Losses caused by insects include not only the direct consumption of kernels, but also accumulation of exuviae, webbing, and cadavers. High levels of the insect detritus may result in grain that is unfit for human consumption and loss of the food commodities, both, in terms of quality and quantity. Insect. It is estimated that more than 20,000 species of field and storage pests destroy approximately one-third of the world's food production, valued annually at than $100 billion among which the highest losses (43%) occurring in the developing world [3, 4]. The quantitative and qualitative damage to stored grains and grain product from the insect pests may amount to 20–30% in the tropical zone and 5– 10% in the temperate zone [5, 6]. Food grain production in India has reached 250 million tonnes in the year 2010-2011, in which nearly 20–25% food grains are damaged by stored grain insect pests [7, 8]. The efficient control and removal of stored grain pests from food commodities has long been the goal of entomologists throughout the world.

The major pests of stored grain and pulses of the Indian subcontinent are classified in to two groups, namely, primary pests: those which are capable of penetrating and infesting intact kernel of grain and have immature stages develop within kernel of grain and secondary pests which cannot infest the whole grain but feed on as broken kernels, debris, high moisture weed seeds, and grain damaged by primary pests. In general, the immature stages of the secondary pest species are found external to the grain. The important primary pests are the rice weevil, Sitophilus oryzae (L.), granary weevil, Sitophilus granaries (L.), (Coleoptera: Curculionidae), lesser grain borer, Rhyzopertha dominica (F.), (Coleoptera: Bostrichidae), Khapra beetle, Trogoderma granarium (Everts), (Coleoptera: Dermestidae), and the pulse beetle Callosobruchus chinensis (L.) (Coleoptera: Bruchidae). The secondary pests are rust-red flour beetle, Tribolium castaneum (Herbst), (Coleoptera: Tenebrionidae), rusty grain beetle, Cryptolestes ferrugineus (L.), (Coleoptera: Cucujidae). Fumigation is still one of the most effective methods for the prevention of stored product losses from insect pests[9].

II. METHODS

Bioassay

Fumigant Toxicity Assay:

In order to test the toxicity of essential Oil vapors to the adults of T.castaneum and C.maculatus , gas tight glass bottles of 300ml volume with plastic screw caps were used as exposure chambers. A small piece (6x8) cms filter paper strips were kept inside the glass bottle to serve as an oil diffuser after the appropriate amount of pure essential oil has been applied on it. Doses were calculated based on nominal concentrations and assumed 100% volatilization of the oils in the exposure vessels /glass bottles. In each bottle 5 insects/replication were used and kept inside plastic vials fitted with 40 copper wire net on both the ends. This arrangement with the insects was suspended into the 300 ml glass bottle and then sealed with its cap. This whole set was considered as one replication. 3 such Replns for each concentration of oil was taken. After 24 hrs of exposure to essential oil vapors the dead insects were counted . Several doses (1,2,3,4,5 to 10%) were tested for each essential oil.

Repellency Bioassay:

Repellency was arranged in 9 cm test arenas. Whatman filter paper No.1 was cut into half. Test solutions were prepared by dissolving 0.5, 1.6, 2.4, 3.2 and 4 µl (.05,0 .16,0.24, 0.32,0.40 % respectively) in 1 ml acetone. The paper disc was cut into 2 equal halves and then joined to a full disc with a sticking tape. Each prepared conc was applied to one half of a filter of the filter paper disc as uniformly as possible with a micropippete. The other half of the filter paper disc was treated with acetone alone and termed as untreated. This dried disc was kept inside the petridishes . Ten adults of mixed sexes of each beetle species were released separately at the centre of the filter disc and the petridish was covered . 10 replicates/conc was prepared. Observation on the no. of insects on the treated and untreated halves was recorded after 3hrs. % repellency was computed using the formula-

$$PR = \{ Nc-Nt\}/ \{Nc+Nt\}X100$$

Where Nc – No. of insects on the control half

Nt – No. of insects on the treated half

Contact Toxicity assay

The insecticidal activity of various essential oils against the adults of T.castaneum was evaluated by direct contact application assay. 20 ,40, 60 80 and 100 µl /ml (2,4,6 and 8% solutions) in acetone were prepared). Males and females of T.castaneum were transferred into petridishes and chilled for 2-5 min to reduce their mobility . One µl of the test solution was applied to the dorsal surface of the insect insects with the micropippete. Ten insects were treated /conc of the test solution and this was termed as one replication. Ten such replications for each dose were done. After treatment, insects were transferred into empty 12 cms diameter glass petridishes . Insects were examined after 24hrs of treatment.

Ovicidal activity:

Fresh ,intact chickpea seeds were palced in plastic jars into which 20 pairs (10Mand 10F) of pulse beetle /CM were released for egg laying. After 7 days the chick pea seeds containing the eggs were sorted. 3,6,9,12 µl essential oil of rosemary officinalis was dissolved in 1ml acetone to make (0.3%, 0.6, 0.9, 1.2%) solutions.Total 50 viable eggs /Repln were mixed thoroughly with the test solution and air dried and considered as one replicate. 5 replicates for each concentration were used . Treated chick pea seeds were placed in 300 ml glass bottles and their mouth covered with muslin cloth and left as it is for 1 month for egg hatching and adult emergence. Data on egg hatching was recorded.

III. Discussion

Essential oil of Mentha virdis showed 90% adulticidal activity against Callasobruchus maculates adults followed by essential oil of Rosemarinus officinale exhibiting only 65% adulticidal activity at 4% in vapor toxicity. Essential Oil of Rosemarinusa officinalis showed highest larvicidal activity 85% towards Tribolium castaneum larvae at 3.0% conc entration. In the ovicidal assay , essential oil of Rosemarinus officinale showed the highest egg mortality towards egg of C. maculates at various concentrations. None of the essential oils showed repellent activity towards both the insects except essential oil of Mentha virdis.. Apart from these , oleoresins of some species like coriandrum sativam and cinnamon zeylanicum has been extracted and their chemical characterization is under process.

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