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Pesticidal Impact of Eicosatrienoic Acid from Gliricidia Sepium on Granary Weevils

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Annotation: The article describes a method of Bio-control of granary weevils
Keywords: Sitophilus, Gliricidia, Weevils, Bio-pesticide

I. INTRODUCTION

Cereal grains, Wheat in particular, are among the most important crops globally and their loss caused by the insects like weevils during storage amounts to 50% of total harvest (Fornal et al., 2007). As the most significant among the weevils, there have been many studies on biology and behavior of Sitophilus particularly S.granarius and S.oryzae, and their ethology been periodically reviewed (Segrove, 1951). The search for environmentally safe alternatives which would not affect non target organisms is the focus of research in many laboratories around the world (Silhacek and Murphy, 2006). In order to minimize the pest hazards Government of India has advised to adopt Integrated Pest Management program (IPM) involving bio control measures (Woodbury, 2008). The number of confirmed insect varieties with resistance against synthetic pesticides is on the rise apart from risks associated with the use of these chemicals (Aslan et al., 2004(a), (b). Therefore, in the current scenario, there is an urgent need to develop safer, environmentally friendlier and efficient alternatives that have potential to replace synthetic pesticides. The factual loss about the damage all over the world is quite immeasurable since the information regarding quantity harvested, and the quantity released for consumption after storage, is not collected and released. Yet reports of IARI reveal that such pests.

II. MATERIALS AND METHODS

Sitophilus granarius shown in Fig.1 was selected for the present study which is one of the major insect pests of whole cereal grains.

Figure 1. Sitophilus granarius

A. Rearing of Weevils

Sitophilus granarius L., granary weevils were identified ((Richards and Davies, 1997) and reared in the laboratory (27±2 °C) on whole grain wheat according to methods proposed by Davis and Bry, 1985; Harein and Soderstrom, 1966. Unsexed adult weevils shown in Fig. 2, used in all the experiments were about 2 weeks old after eclosion.

Figure 2. Sitophilus granarius adults

B. Fumigant toxicity

Filter papers (diameter 2.0 cm), each impregnated with 25 µl of an appropriate concentration of 8,11,14-eicosatrienoic acid, were placed on the underside of the screw cap of a glass vial (diameter 2.5 cm, height 5.5 cm). The solvent was allowed to evaporate for 1 min before the cap was screwed tightly on the glass vial containing 10 insects. Ethanol was used as control. Six replicates were prepared for each treatment and control and they were incubated for 24 h. The insects were then transferred to clean vials with culture media and kept in the incubator for daily observation for one week. The maximum possible amount of essential oil in the air (mg/l air) was used to express the fumigant toxicity. (Liu and Ho, 1999).

C. Contact Toxicity

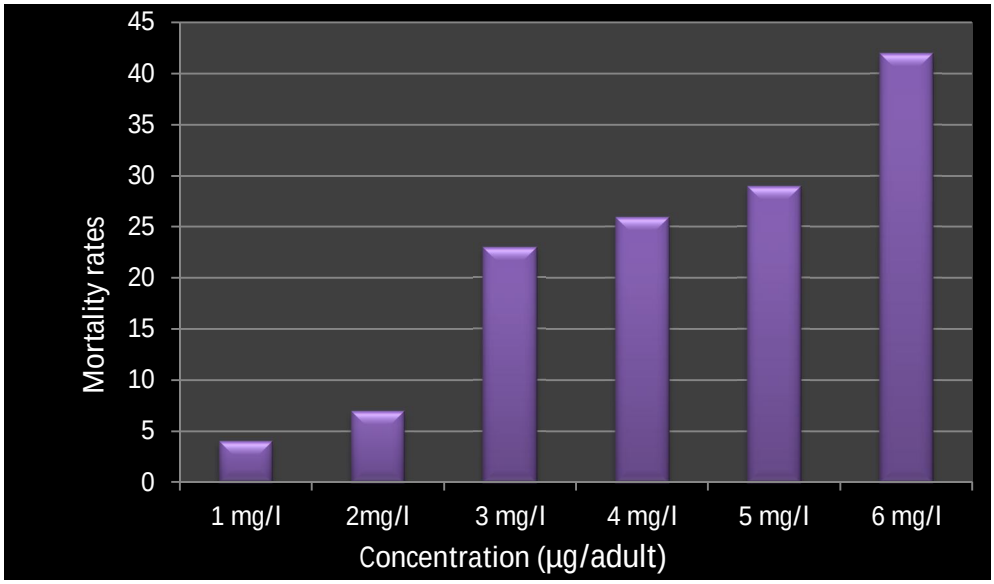
A serial dilution of the phytochemical 8, 11, 14-eicosatrienoic acid was prepared in ethanol. Aliquots of 0.5 µl per insect were topically applied dorsally to the thorax of adults. Ethanol was used for the control experiments. Ten insects were used for each concentration and control, and the experiment was replicated six times. Both treated and control insects were then transferred to glass vials (10 insects/vial) with culture media. Mortality was observed daily for one week after treatment. Contact toxicity was expressed as µg of lethal doses (LD50 and LD90) of weevils were determined using Probit analysis. The procedure followed as per Liu and Ho, 1999.

III. RESULTS AND DISCUSSION

A. Fumigant Toxicity

Fumigant toxicity studies were conducted on weevils using eicosatrienoic acid and results as mortality rates are given in Fig. 3. No mortality was observed in the control.

Figure 3. Fumigant toxicity of 8,11,14-eicosatrienoic acid for 24h to Sitophilus adults



The LC50 and LC90 values are given in Table1. The mortality of insect species in all the controls of contact toxicity tests was zero.

Table 1. LC50 and LC90 values in fumigant toxicity experiments

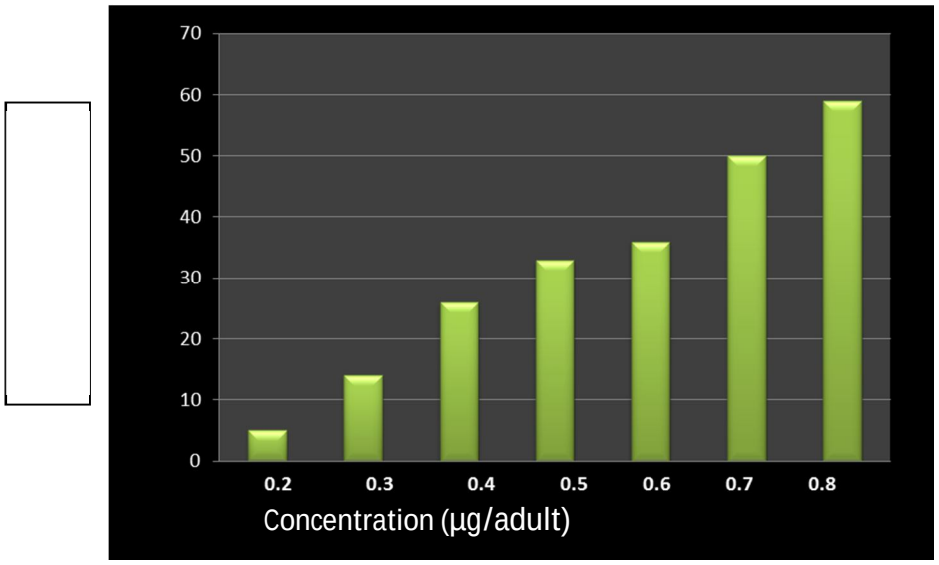
LC_{50}	95% fiducial limit	LC_{90}	95%fiducial limits
4.46 mg/l	3.918-5.224	13.66 mg/l	10.149-22.193

The LC50 value of Sitophilus granarius was 4.46 mg/l air and LC90 value was 13.66 mg/l air in fumigant toxicity studies.

B. Contact Toxicity

Results of contact toxicity studies conducted on S.granarius using eicosatrienoic acid, are shown in Fig. 4.

Figure 4. Contact toxicity of 8,11,14- eicosatrienoic acid on Sitophilus adults



The mortality of insect species in all the controls of contact toxicity tests was zero. The LD50 and LD90 values contact toxicity tests were calculated and are given in Table 2.

Table 2. LD 50 and LD 90 values of contact toxicity results

LD_{50}	95%fiducial limit	LD_{90}	95%fiducial limit
0.440 µg/adult	0.372-0.510	0.841 µg/adult	0.689-1.230

The phytochemical was found to be toxic to adults of S.granarius when applied topically to the insects. The mortality of insect species in all the controls of contact toxicity tests was zero. The LD50 for adult insects were 0.44µg/adult and LD90 value 0.84 µg/adult.

The efficient control of stored grain pests has long been the aim of entomologists throughout the world. In fumigant toxicity studies, the phytochemical showed an LC50 of 4.46mg/l and LC90 of 13.66 mg/l against S.granarius adults. Results of contact toxicity tests were obtained as LD50, 0.440µg/adult, LD90, 0.841µg/adult for the phytochemical.

It is quite surprising that attention focusing on the impact of phytochemicals on S.granarius, despite its comprehensive harm, has been very little as evidenced by the limited number of reports. Experiments of Ashouri, and Shayesteh, 2009 revealed that Piper nigrum at 0.5% concentration caused 100% mortality of S.granarius within the first five days. LC50 of oil of Foeniculum vulgare and Satureja hortensis against S. granarius was 27.30 µl/l air and 46.89 µl/l air after 24 h of treatment according to Ebadollahi, 2011. LC50 values of the fumigant tests of, Citrus sinensis and Mentha pulegium essential oils against S. granarius were 0.038 and 367.75 µL L-1 air after 24 h in the experiment conducted by Mahmoudvand et al., 2011. Yildirim et al., 2012 tested the extract of Usnea longissima and two secondary metabolites usnic acid and diffractaic acid against adults of S. granarius. The mortality rates after 96 h of treatment with the maximum concentration (10 mg /ml) were determined as 98.98, 91.91 and 94.94% respectively.

The work in our laboratory has shown that the 8,11,14-eicosatrienoic acid extracted from G.sepium has high toxicity against weevils. But for few, no report seems to be available on the toxic effects of plant materials against materials against Sitophilus granarius. Our attempt to suggest a non-toxic biomaterial that could control weevils by even spraying the preparation without producing any toxic effects to humans who consume the grains, is an important discovery. Since no work is carried out with 8,11,14-eicosatrienoic acid to study the toxic effect in mosquitoes and weevils, this is deemed as the first report.

8,11,14-eicosatrienoic acid has proved as an effective molecule which would be recommended for the control of severe threat, the society is now facing from weevils.

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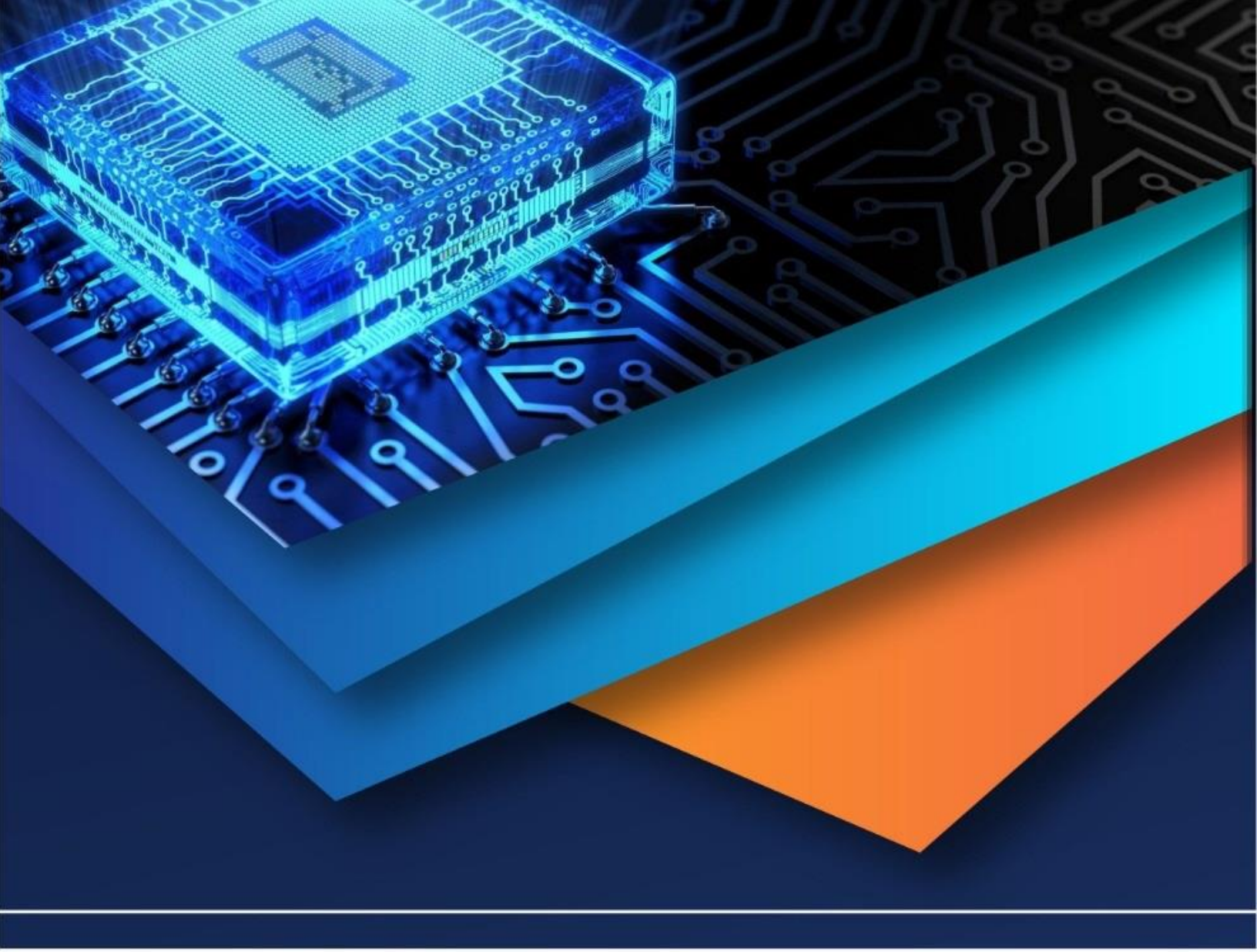

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