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REPELLANT AND INSECTICIDAL ACTIVITIES USING MEDICINAL PLANT OF *GLIRICIDIA SEPIUM* (Jacq.) STORED PEST OF *SITOPHILUS GRANARIUS*(Linn.) (COLEOPTERA: *CURCULIONIDAE*)

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Abstract: Methods for producing food and other resources, as well as storing them for future use, have vastly improved during the previous 10,000 years or more as human civilization has progressed. Furthermore, significant population expansion and rising life expectancy and industrialization have resulted in the progressive loss of arable land to make way for homes, industry, and transportation during the previous several centuries. Chemical pesticides applied in the warehouses are effectively control the insect pests of stored grain. Still, their residues on grains enter into the human system on consumption and causing severe physiological disturbances. Hence, in the present investigation, the various solvent extracts of the naturally available plant *Gliricidia sepium* was tested against the granary weevil, *Sitophilus granarius*. The stock culture of *Sitophilus granarius* was obtained from the Entomology Research Unit insectarium and used in the present experiment. Different solvent extracts, i.e., hexane, chloroform and ethanol, were used for crude extraction of *G.sepium*. All the extracts were tested individually with varying concentrations against the granary weevil. Results recorded from the present experiments showed that ethanol extract of *G.sepium*was more effective than the other solvents. The maximum repellent activity of 93.7%, and the insecticidal activity was noted 69.8% in 72hrs against *S.granarius*. The study recommended using*G. sepium* for effective control of *S.granarius* as an alternative agent to synthetic pesticides.

Keywords: *Sitophilus granarius*,*Gliricidia sepium*, Repellent activity, Insecticidal activity, Plant extracts.

1.0 INTRODUCTION

There are various species of insects, but a comparatively small number can survive on grain in storage, and only four species grow inside the kernels on the endosperm. One of the four insects is the granary weevil, *Sitophilus granarius* (Linn.) (Coleoptera: Curculionidae). The granary weevil is one of the most destructive stored grain insects. The granary weevil mainly affects stored grains such as wheat, oats, sorghum, barley, corn, rice, millet, and manufactured pasta. The granary weevil is an inside feeder and causes significantdamage to cereals distressing the quantity and quality of the grain. It chooses the temperate climate and has been found more in the northern states than in the southern states. Granary weevil has missing its control of flight and a way of walkingor determined by man for itscarrying from one place to another.

1.2About the plant- *Gliricidia sepium*

Gliricidia sepium is commonly known asquick stick. It belongs to the Fabaceae family;*Gliricidia sepium* grows about 2-15 m in height with a twisted bole of up to 30cm in diameter, planted as an ornamental tree due to its flowers or as a fuel crop. It is fast-growing and has the potential to become a weed. Further, it has symbiotic with certain soil bacteria that form root nodules and fix atmospheric nitrogen. It also functions as green manure, increasing the soil organic matter. The leaves are compound the flowers of *Gliricidia* are edible.

Sitophilus granaries, the most common species found in small warehouse storerooms, and ample grain storage were studied by several researchers (Derera *et al*., 2014; Rotim and Ostojic, 2014; Velez *et al*. 2017). Similarly, the adult and larvae cause damage to the grain. Granary weevil infestation reduces the quantity and quality of the stored product and seed germination. The larva and adults cause damage by destroying kernels, mainly the germ, producing grain debris, rising grain temperature and water content, and expediting the attack of secondary insect pests. (Lemic *et al*. 2020). The granary weevil is a severe storage grain pest. *S. granarius'* biology and behaviour are identical to that of *S. zeamais*, except that it cannot fly(Lemic *et al*., 2021).

Synthetic insecticides have had several negative consequences, including water and soil pollution, insect resistance, and toxicity to non-target species (Zettler and Cuperus 1990). As a result, effective and safe alternatives to synthetic pesticides are in high demand. Plant-derived materials that canconstitute bio-insecticides (Regnault-Roger and Hamraoui, 1994; Regnault-Roger, 1997; Oparaeke and Kuhiep, 2006; Sathyaseelan *et al*., 2008; Khorram *et al*., 2011; Mulungu *et al*., 2011).The current study was shown to improve an integrated pest management protocol that might be different from the practices being approved presently to control insect pests of stored grains at farm level then remain safe, cost-effective, and easy to apply in the environment. This present study was aimed to evaluate the efficiency of the different solvent extracts such as hexane, chloroform and ethanol of *G. sepium* against wheat weevil-*Sitophilus granarius.*

2.0 MATREIALS AND METHODS

2.1 Collection of *Gliricidia sepium*:

The fresh *Gliricidia sepium*leaveswere collected at the Tiruvannamalai district. The leaves were thoroughlywashed and shade dried at room temperature for about 5-7 days. By using the electric blender, the dried leaves were powdered, extracted with hexane, chloroform and ethanol individually by the soaking method. they were stored in tightly closed with glass container.

2.2 Preparation of crude extraction:

The leaves were collected, dried in oven at 50°° c for overnight, and then finely pulverised in a blender. Each sample (5 g) was extracted twice at room temperature with 250 mL of hexane, chloroform, and ethanol. The extracts were filtered through filter paper (Whatman No. 1), and the combined filtrates from the twice-extracted leaves were dried by rotary evaporation at 50°C.

2.3 Rearing of *Sitophilus granarius*:

The insects werereared on wheat in our laboratory.

2.4 REPELLANT ACTIVITY OF *SITOPHILUS GRANARIUS:*

The extracts' repellant ability was tested by exposing S. granarius to *G. sepium*. The experimental set-up consists of five plastic cups. All five cups were connected with plastic tubes. All four cups contain grains treated with different concentrations of solvent extract of *G. sepium*. In each cup twenty unsexed adults were introduced. The middle cups hold untreated grain without any insect. The different concentrations of extracts are 150ppm.300ppm, 600ppm and 1200ppm.After 72 hrs treated and the control boxes were recorded by using Lwanda's method.

$$\text{EPI} = \frac{\text{Nt} - \text{Nc}}{\text{Nt} + \text{Nc}} \text{ X } 100$$

Where EPI = Excess Proportion Index
Nt = number of insects in the treated sample; Nc = number of insects in the control sample side.

2.5 INSECTICIDAL ACTIVITYOF *SITOPHILUS GRANARIUS:*

The insecticidal activity was performed on the newly emerged adults of wheat storage pest *Sitophilus granarius***.**The Whatman no.1 filter paper was treated with different concentrations (150, 300, 600 and 1200 ppm) of various plant extracts and was allowed to dry for 5 minutes. Then, the filter paper was attached to the cap of the lid internally and in each plastic jar, twenty adults were introduced. The insecticidal activity was assessed for 24, 48 and 72 hours by adapting Abbott's formula (Abbot, 1925).

$$\text{POD} = \frac{\text{Ts} - \text{Cs}}{\text{Cs}} \text{X} 100$$

POD: Percentage of damage. Ts: Number of insects in treated sample. Cs: Number of insects in control samples.

3.0 RESULTS AND DISCUSSION

The repellant activity of G. sepium showed remarkable repellant activity against the adult weevils of S. granaries (Table 1). The repellant activity of the extract showed statistically significant activity at higher concentrations of the extract in general and ethanol extract in particular. In the same way, experimental groups exposed to 72 hrs of treatment showed maximum repellant activity than the other two exposure periods. In the same way, a similar trend was observed with the insecticidal activity of G. sepium (Figures 1-3). This trend was due to the presence of many phytocompounds imbibed with the ethanol and thus the significant activities were noted. This is in corroborating with the earlier results of several authors. The current study's findings indicated that the plant extracts examined were efficient against *S. granarius* in stored rice in terms of offspring and adult mortality. Many types of research have reported on the effectiveness of plant extracts against the S. granarius weevil in stored rice in terms of offspring and adult morality (Tapondjou *et al*., 2002; Ketoh*et al*., 2005; Kestenholz *et al*., 2007; Iboudo*et al*., 2010; Derbalah and Ahmed, 2011).

The granary weevil is one of the severe pests of stored products. In this research work, three herbal insecticides comprising Sirinol, Palizin and Tondexir were estimated for their bio-efficacy in the control of *S. granarius* under laboratory conditions (Emami, Safavi, and Jarrahi 2017). Similarly, Chemical Insecticides are widely used to prevent and control pests, permitting the rapid decrease of their population development and damage. However, insecticides not necessarily cause pest mortality, this may motivate sub-lethal effects, which may lead to dangerous consequences. Hence results suggest that deltamethrin have maximum mortality in *S. zeamais*. At the same time, spinosad exhibited less control for controlling the weevil S. zeamais(Bansode *et al*., 2018). In another research, it was observed that the benzyl alcohol, phenethyl alcohol, and glycine as prospective attracting substances of multi-component flavouring mixtures during the calculated number of *S. granarius* in grain storage and handling facilities (Titov and Brygadyrenko 2021). Nowadays, an infestation of storage pests is the biggest problem in the storage process (Ahmed *et al*. 2021). Although the insecticidal activity of the tested plant extract could be due to primarily by the presence of the principal components, synergistic or antagonistic effects of other compounds in the combination must be taken into account (Ragasa*et al*., 2002). Each element of the plant extract contributes to the extract's biological action against the examined insect in its own way. For example, loliolide was discovered at modest concentrations, although it is known to have a variety of biological characteristics, including insect repellent (Gordon *et al*., 1982).The inhibition of acetylcholinestearase may be the mechanism of action of bioactive natural monoterpinoids (hydrocarbons, alcohols, and ketones) extracted from plant extracts oils (Miyazawa *et al*., 1997; Lee *et al*., 2000; Derbalah and Ahmed, 2011). Since Lee *et al*. (2000) revealed that of the monoterpenes examined, 1,8-cineole was the most effective inhibitor of AChE. Essential oils and monoterpenes may also suppress stored grain insect pests through this mechanism of action. Furthermore, the fumigant activity of the plant extracts examined may be primarily responsible for their mode of action (Shaaya *et al*., 1997; Park *et al*., 2003).

Table 1: Repellent activity of different solvent extracts of *Gliricidia sepium*tested against adult granary weevil, *Sitophilus granarius*

Concentrations	Exposure periods (in hrs)			Exposure periods (in hrs)			Exposure periods (in hrs)		
	Hexane extract			Chloroform extract			Ethanol extract		
	24 hrs	48 hrs	72hrs	24hrs	48hrs	72hrs	24hrs	48hrs	72hrs
150ppm	13.9± 0.82	18.2± 0.42	22.7±1.42	15.2±0.36	19.5±1.20	23.9±0.73	17.3±1.42	19.1±1.72	29.2±0.36
300ppm	30.4±0.69	41.9±0.35	48.4±0.74	29.9±0.82	37.3±0.69	44.2±1.41	37.9±0.91	42.2±0.82	50.7±0.81
600ppm	63.9±1.01	60.6±0.71	72.8±0.34	60.1±1.91	67.1±0.37	82.4±0.68	71.3±1.47	74.6±1.19	80.6±0.73
1200ppm	79.2±0.54	81.0±0.69	92.1±0.20	77.3±0.40	88.6±1.03	93.0±0.50	80.7±0.69	86.0±0.52	93.7±0.24
Neem azal	100.0±0.00	100.0±0.00	100.0±0.00	100.0±0.00	100.0±0.00	100.0±0.00	100.0±0.00	100.0±0.00	100.0±0.00

Values expressed are meanmortality ± standard deviations of five replications (n=20).

Plate 1: Experimental design to assess the repellent activity of *Sitophilus granaries*

Plate 2: Experimental design to assess the insecticidal activity of *Sitophilus granaries*

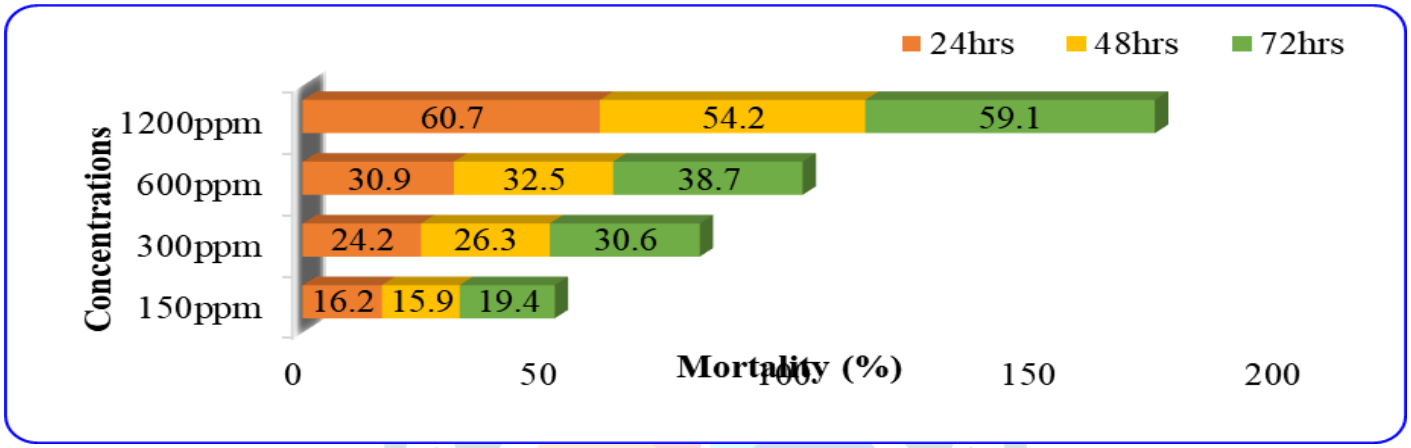

Figure 1: Insecticidal activity of Hexane extract of *Gliricidia sepium*tested against *S. granarius*

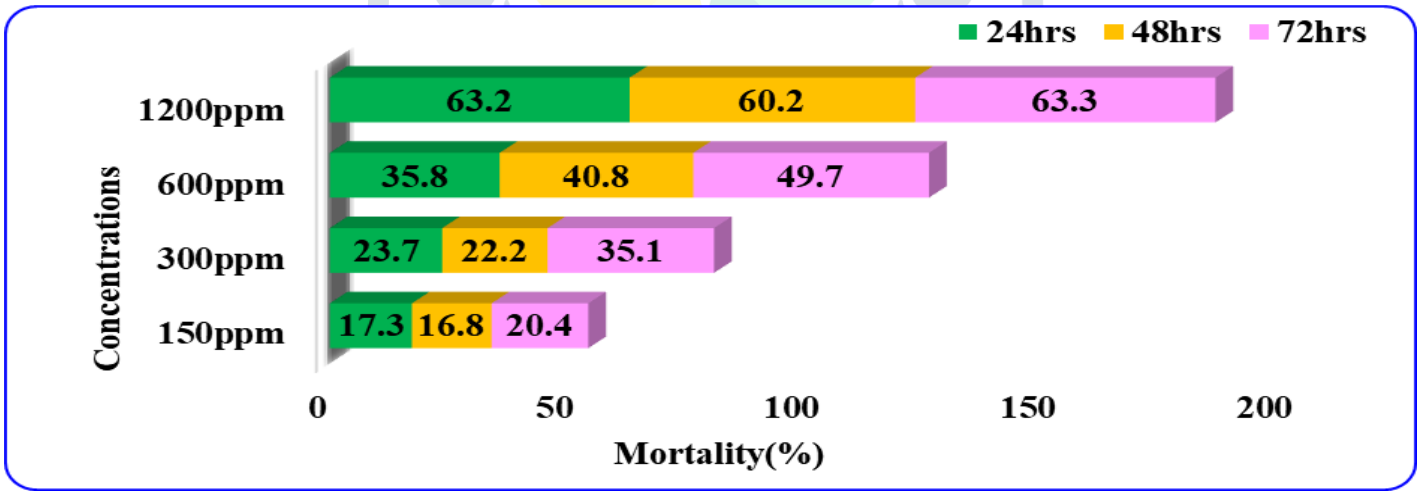

Figure 2: Insecticidal activity of Chloroform extract of *Gliricidia sepium*tested against *S. granarius*

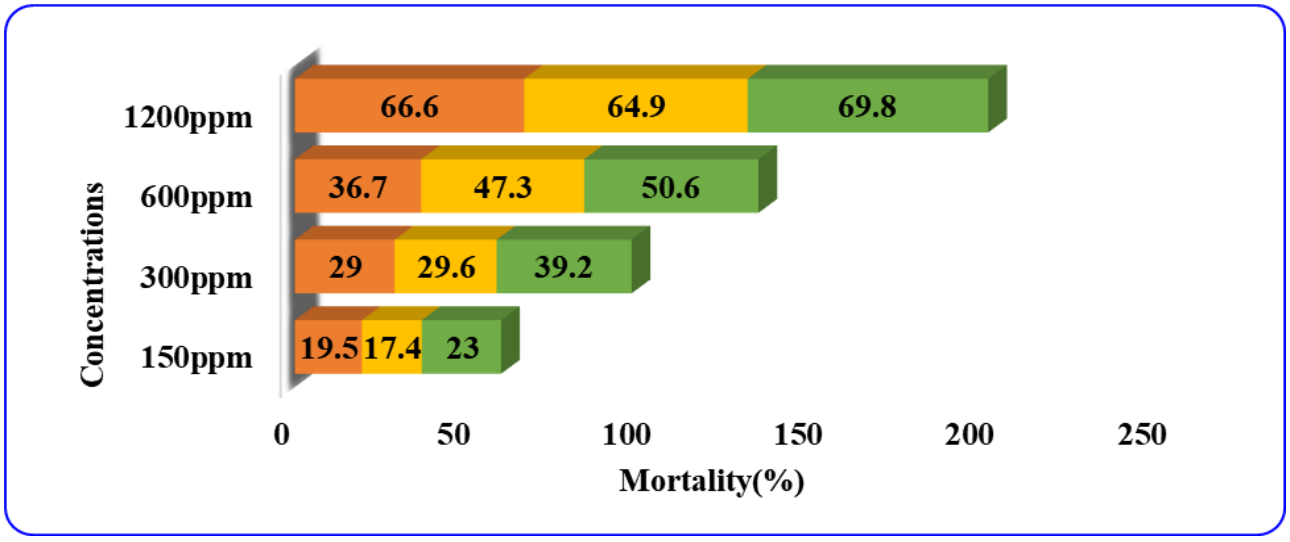

Figure 3: Insecticidal activity of Ethanol extract of *Gliricidia sepium*tested against *S. granarius*

The granary weevil *Sitophilus granarium* is the most severe stored product pest found all around the world. Demeter *et al.*, (2021) have studied that the toxicity of 25 essential oils used to control adult granary weevils. After investigation, the research work indicated that *Allium satium* has the maximum mortality against granary beetles, followed by *Mentha arvensis* and eucalyptus oils.

5.0 CONCLUSION

Farmers lose a lot of money in the field and in storage because of the selected pest species, *Sitophilus granarius*. In this study, *G. sepium* was extracted using three distinct organic solvents: hexane, chloroform, and ethanol. The potency of the solvent extracts tested at various concentrations was recorded and computed.It was pertinent to note that the efficiency of this plant was confirmed in the ethanol extract.So, *Gliricidia septum* is more prominent and successfulas evidenced from this research work. Hence concluded that*Gliricidia sepium* is the best natural green pesticide when compared to chemical pesticides.

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