Original Research Article

INSECTICIDAL ACTIVITY OF DIFFERENT DOSES OF *ACORUS CALAMUS*ESSENTIAL OIL AGAINST *SITOPHILUS ORYZAE*

Abstract

The toxicity of different doses (3, 4, 5, 6 and 7 percent) of Acorus calamusessential oil, against insect pest *Sitophilus oryzae* were evaluatedin the laboratory of Division of Entomology, FoA, Wadura, SKUAST-Kashmir during the year 2022.The various concentrations of *Acorus calamus* essential oil had significant effect on mortality of *Sitophilus Oryzae.*The highest mortality of 74.27 percent was recorded in 7 percent concentration of *Acorus calamus* essential oil on 12 Hours After Treatment (HAT) followed by 6 (71.01%), 5 (67.15%) and 4 (39.11%) percent concentration while untreated control recorded 5.13 percent mortality respectively. However, on 24 HAT the cumulative mortality increased to 76.35 in 7 percent, 74.11 in 6 and 5 percent, 43.01 in 4 percent concentration. On 72 HAT the concentrations of 7,6 and 5 recorded 94.11, 91.27 and 90.11 percent mortality respectively, while only 7.05 percent mortality was recorded in untreated control.

Keywords: Acorus calamus, Essential oil, Mortality, Rice weevil

1. Introduction

Insect pests that infest stored grain can lead to losses in weight, quality, commercial value, and seed viability. The majority of these pests, about seventy-five percent, belong to the Coleoptera order[1], with the most harmful species being found in the *Sitophilus* and *Tribolium* genera [2, 3].*Sitophilus oryzae* L. (Coleoptera: *Curculionidae*) is a widespread pest of significant economic impact that feeds internally by boring into stored grain. Adult weevils primarily consume the endosperm, thereby reducing the carbohydrate content, while the larvae prefer the germ, significantly depleting the grain's protein and vitamin levels. Insects that target the germ cause greater reductions in germination compared to others. Controlling arthropod pests in stored products has mainly involved the use of fumigants and residual chemical insecticides, in addition to maintaining proper hygiene practices [4, 5]. The overuse of traditional chemical insecticides has led to several significant issues, such as insect resistance to these chemicals, the destruction of economically beneficial insects, environmental persistence, toxicity to humans and wildlife, and increased costs of crop production[6]. Numerous insects and mites have developed the ability to withstand nearly all pesticides used for their management due to cross-resistance and multiple resistance mechanisms [7]. Recognition of the deleterious effects of pesticides has spurred the exploration of alternative, less intrusive management approaches, such as employing the use of essential oils.

Numerous medicinal plants and spices have been utilized as pest control agents [8, 9]. Farmers and researchers frequently report the effective use of plant materials for insect pest control, including ash [10, 11], vegetable oils[12], plant extracts[13], and botanical powders[14]. It has been noted that certain plant-based preparations and traditional methods are much safer than chemical insecticides[15], suggesting these materials should be explored for protecting stored products from pest infestations. *Acorus calamus* L. (*Araceae*), also known as "sweet flag," is a globally recognized ethnomedicinal and ethnobotanical plant. The rhizome of Acorus calamus exhibits a variety of pharmacological properties, including sedative, central nervous system depressant, behavior-modifying, anticonvulsant, memory-enhancing, anti-inflammatory, antioxidant, antispasmodic, cardiovascular, hypolipidemic, and immune-suppressive activities.*Acorus calamus* L. essential oil have also been used as fumigant against stored food products [16]. Keeping in view the insecticidal properties of essential oil of *Acorus calamus*, the present study was carried out to evaluate its various concentrations against rice weevil.

2. Material and methods

2.1 Raising of plant material

The seedlings of *A. calamus* which wereraised in polybags (*Kharif*, 2022)were procured from Regional cum Facilitation Centre North Zone II located at Faculty of Agriculture, Wadura Sopore and transplanted in the field with plant to plant and row to row distance of 15cm and 30cm, respectively.The rhizomes of mature plants were harvested, shade dried and ground to a fine powder and sieved through 30mm mesh. The powdered material was put to hydrodistillation for extraction of essential oil using Clevenger's apparatus.The essential oil of *A. calamus* thus obtained was collected in the vials and stored in refrigerator for further use.

2.2 Preparation of different concentrations of essential oil of *A. calamus*

Acetone was used as solvent for preparation of different concentrations.The doses 30, 40, 50, 60 and 70 µl corresponding to 3, 4, 5, 6 and 7 per cent were used for determining toxicity of *A. calamus* essential oil against *Sitophilus oryzae*.

2.3 Rearing of *Sitophilus oryzae*

The rearing of *S. oryzae* was carried in the laboratory of Division of Entomology, FoA, Wadura, SKUAST-Kashmir.The rice grains (K-39 Variety)infested with *S. oryzae*,was brought from different godowns/shops of Kashmir. Rice grainswere taken in 5 litre capacity rearing jars and placed in hot air oven at 60˚C for 24 hours for sterilization. The adult insects (both male and female) were collected randomly from the infested grains with the help of aspirator and transferred to the respective sterilized food placed in jars (5 litre capacity).The jars were covered with muslin cloth in order to supply adequate humidity to the grains and kept in B.O.D incubator at 28.5 ± 2˚C and 65± 5% relative humidity to ensure proper egg laying and maintaining culture of rice weevil for further investigation.Mortality per cent was recorded after 12, 24, 36, 48, 60 and 72 hours after treatmentusing fumigation method.Test insects were considereddead if appendages do not move when prodded with a fine brush.

$$\textbf{Mortality (\%)} = \frac{\textbf{No. of insects dead}}{\textbf{Total No. of insects fumigated}} \times 100$$

2.4 Data analysis

The data recorded in different treatments were subjected to analysis of variance (ANOVA) using R software.

3. Results and Discussion

The insecticidal activity of Sweet flag against rice weevil is shown in Table 1. The highest mortality of 74.27 percent was recorded in 7 percent concentration of Sweet Flag on 12 Hours After Treatment (HAT) followed by 6 (71.01%), 5 (67.15%) and 4 (39.11%) percent concentration while untreated control recorded 5.13 percent mortality respectively (Table 1). However, on 24 HAT the cumulative adult mortality increased to 76.35 in 7 percent, 74.11 in 6and 5 percent, 43.01 in 4 percent concentration (Table 1). On 72 HAT the concentrations of 7,6 and 5 recorded 94.11, 91.27 and 90.11 percent mortality respectively, while only 7.05 percent mortality was recorded in untreated control.

Table 1: Effect of different concentrations of *Acorus calamus* essential oil against rice weevil

Concentration (%)	**Mortality (%) (HAT)**						
	12	**24**	**36**	**48**	**60**	**72**	**Mean**
3	28.01^{k} (5.34)	33.03^{jk} (5.79)	39.11^{ijk} (6.29)	41.01^{ijk} (6.44)	42.13^{hij} (6.53)	43.05^{hij} (6.60)	**37.72±2.42** (6.18)
4	39.11^{ijk} (6.29)	43.01^{ijk} (6.60)	45.03^{hij} (6.75)	46.13^{hi} (6.83)	47.11^{ghi} (6.90)	49.15^{fgh} (7.05)	**44.92±1.43** (6.74)
5	67.15^{efg} (8.22)	74.11^{cdef} (8.64)	81.13^{abcde} (9.03)	88.03^{abc} (9.41)	89.01^{abc} (9.46)	90.11^{ab} (9.52)	**81.59±3.80** (9.06)
6	71.01^{def} (8.46)	74.11^{cdef} (8.64)	80.03^{abcde} (8.97)	88.17^{abc} (9.42)	88.35^{abc} (9.43)	91.27^{ab} (9.58)	**82.16±3.42** (9.09)
7	74.27^{cdef} (8.65)	76.35^{bcde} (8.77)	81.17^{abcde} (9.04)	86.03^{abcd} (9.30)	89.01^{abc} (9.46)	94.11^{a} (9.73)	**83.49±3.11** (9.16)
Control	5.13^{i} (2.37)	5.05^{i} (2.36)	4.05^{i} (2.13)	6.01^{i} (2.55)	4.03^{i} (2.13)	7.05^{i} (2.75)	**5.22±0.47** (2.39)
Mean	**47.45±11.1** (6.92)	**50.94±11.85** (7.17)	**55.09±12.84** (7.46)	**59.23±13.81** (7.73)	**59.94±14.26** (7.77)	**62.46±14.4** (7.93)	

HAT = Hours After treatment

*** Values in parenthesis are square root transformed values**

It was observed that, the toxicity was dose dependent and enhanced with the increase in exposure time. Our results are in accordance with the findings of [17, 18 and 19], who observed that concentration of *Acorus calamus* essential oil had significant effect on mortality of *Sitophilus Oryzae.*

4. Conclusion

The study concludes that various concentrations of *Acorus calamus* essential oil had significant effect on mortality of *Sitophilus Oryzae* and the essential oil of *Acorus calamus* can be useful in controlling the stored product insect by surface treatment in godowns as an alternative to synthetic insecticides, further the efficacy of the botanical can be tested on other stored product insects also.

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