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Biological Control of Rice Weevils (*Sitophilus Oryzae L.*) in Stored Milled Rice by the Powders of Cinnamon and Star Anise

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Abstract:- ***Rice (Oryza sativa L.) is one of the most important staple foods in the world. Stored rice seed and milled rice grains are mostly infected by rice weevil (Sitophilus oryzae L.) (Coleoptera: Curculionidae) causing heavily economic losses. They damage rice carbohydrate in the grains leading to weight loss and product contamination. Presently, the control of rice weevils relies on fumigation and residual grain protection by synthetic insecticides, such as DDT, Lindane, Pirimiphos-methyl, and Aluminium Phosphide (Phosphine)***

Keywords: Rice (Oryza sativa L.), C-verum, I-verum

1. INTRODUCTION

Rice is the most important food crop for more than half of the world's population[1]. Losses in rice storage due to insect pests affect food availability for large number of people[2]. Milled rice is attacked by various insect pests during storage (Cogburn, 1980). Storage and upkeep of agricultural products are very important post- harvest activities. Considerable amount of rice grains is being spoiled after harvest due to chemical insecticides compounds [3] (Larsson *et al.*, 1992 and Kumar *et al.*, 2010).

Sitophilus oryzae was first described by Linnaeus in 1763. The species name of *oryzae* was given because it was found in rice [4]. The adult rice weevil is attracted by lights. The rice weevil is a small snout beetle which varies in size, about 3-4 mm long. Its morphology varies from a dull reddish-brown to black with round or irregular pits on the thorax. There are four light reddish or yellow spots on the elytra (hardened forewings). The head of many adult weevils has a characteristic snout. Male rice weevils have shorter snout, wider and more distinct punctures than female. The larvae of *S. oryzae* are legless, white to creamy with a small head. The adult *S. oryzae* is dull reddish brown with irregular shaped pit on thorax and four light spots on the wing covers. Jadhav (2006) described *S. oryzae* differs from *S. granarius*. The adult *S. granarius* is shiny reddish brown with elongated pit on thorax, whereas the adult *S. oryzae* is dull reddish brown with irregular shaped pit on the thorax and four light spots on the wing covers [5]. These deep round punctures and light spots are lacking in *S. granarius*. In addition, *S. granarius* cannot fly, while *S. oryzae* can fly. Larvae of both weevils are legless, humpbacked, and white to creamy white with a small and head. The pupae have snouts like the adults. *S. zeamais* is similar to *S. oryzae*, but larger and darker (Sukprakarn, 1985)

2. MATERIALS AND METHODS

S. oryzae grows and develops inside infested rice grains. Both adults and larvae feed on the grains. Adult females lay eggs within 3 days after emerging from their pupa cocoons. They can lay 300-400 eggs in its life time and up to 7-8 eggs per day. They will avoid damaged grains for ovi position. The female inserts her ovipositor into the hole in a grain kernel to deposit eggs and then plugs the hole with gelatinous secretion. The larvae hatch after 3-4 days at temperature of 25^{o}C and 50-70% relative humidity. The larvae develop from the 3rd to the 4th instars in about 18-22 days, after which they pupate for about 6 days. The adults stay in the grain kernels for 3-4 days until they are hardened and mature. The complete life cycle of *S. oryzae* from an egg to an adult takes 28 to 32 days under optimum conditions [6]. *S. oryzae* adults are quite long-lived and can live from 3 to 6 months (Longstaff, 1981).

3. RESULTS

Two plant powders were evaluated against rice weevil *S. oryzae*. The results of various experiments were given the effect of the powders on adult of the rice weevil [7].

When *S. oryzae* was introduced in 2gm of *C. verum* mixed with rice sample, the mortality after 7 days was 21.67±0.35. In 14 days exposure the mortality was 40.83±0.40. When *S. oryzae* was exposed to 21 days the mortality was 49.17±0.21 and then 28 days the mortality was 65.83±0.14 observed.

When *S. oryzae* was introduced in 4gm of *C. verum* mixed with rice sample, the mortality after 7 days was 25.83±0.27. In 14 days exposure the mortality was 42.50±0.41. When *S. oryzae* was exposed to 21 days the mortality was 63.33±0.25 and then 28 days the mortality was 77.50±0.12 observed.

When *S. oryzae* was introduced in 6gm of *C. verum* mixed with rice sample, the mortality after 7 days was 39.17±0.37. In 14 days exposure the mortality was 51.67±0.31. When *S. oryzae* was exposed to 21 days the mortality was 72.50±0.12 and then 28 days the mortality was 90.00±0.09 observed.

When *S. oryzae* was introduced in 8gm of *C. verum* mixed with rice sample, the mortality after 7 days was 43.33±0.44. In 14 days exposure the mortality was 59.17±0.23. When *S. oryzae* was exposed to 21 days the mortality was 78.33±0.13 and then 97.58±0.08 was observed after 28 days.

When *S. oryzae* was introduced in 10gm of *C. verum* mixed with rice sample, the mortality after 7 days was 46.67±0.41. In 14 days exposure the mortality was 63.33±0.33. When *S. oryzae* was exposed to 21 days the mortality was 83.33±0.17 and then 100.00±0.00 was observed after 28 days.

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Mortality of *S. oryzae* on application of *C. verum* powder

Conc (gm)	Mortality			
	7 days	14 days	21 days	28 days
2	21.67±0.35	40.83±0.40	49.17±0.21	65.83±0.14
4	25.83±0.27	42.50±0.41	63.33±0.25	77.50±0.12
6	39.17±0.37	51.67±0.31	72.50±0.12	90.00±0.09
8	43.33±0.44	59.17±0.23	78.33±0.13	97.58±0.08
10	46.67±0.41	63.33±0.33	83.33±0.17	100.00±0.00

When *S. oryzae* was introduced in 2gm of *Illicium verum* mixed with rice sample, the mortality after 7 days was 35.00±0.15. In 14 days exposure the mortality was 71.67±0.26. When *S. oryzae* was exposed to 21 days the mortality was 79.17±0.23 and then 95.83±0.10 was observed after 28 days.

When *S. oryzae* was introduced in 4gm *I. verum* mixed with rice sample, the mortality after 7 days was 41.67±0.13. In 14 days exposure the mortality was 78.33±0.24. When *S. oryzae* was exposed to 21 days the mortality was 85.33±0.16 and then 99.17±0.60 was observed after 28 days.

When *S. oryzae* was introduced in 6gm of *I. verum* mixed with rice sample, the mortality after 7 days was 50.83±0.16. In 14 days exposure the mortality was 86.67±0.08. When *S. oryzae* was exposed to 21 days the mortality was 100.00±0.00 and then 100.00±0.00 was observed after 28 days.

When *S. oryzae* was introduced in 8gm of *I. verum* mixed with rice sample, the mortality after 7 days was 63.33±0.10. In 14 days exposure the mortality was 92.50±0.11. When *S. oryzae* was exposed to 21 days the mortality was 100.00±0.00 and then 100.00±0.00 was observed after 28 days.

When *S. oryzae* was introduced in 10gm of *I. verum* mixed with rice sample, the mortality after 7 days was 83.33±0.17. In 14 days exposure the mortality was 97.50±0.08. When *S. oryzae* was exposed to 21 days the mortality was 100.00±0.00 and then 100.00±0.00 was observed after 28 days.

Mortality of *S. oryzae* on application of *I. verum* powder

Conc (gm)	Mortality			
	7 days	14 days	21 days	28 days
2	35.00±0.15	71.67±0.26	79.17±0.23	95.83±0.10
4	41.67±0.13	78.33±0.24	85.33±0.16	99.17±0.60
6	50.83±0.16	86.67±0.08	100.00±0.00	100.00±0.00
8	63.33±0.10	92.50±0.11	100.00±0.00	100.00±0.00
10	83.33±0.17	97.50±0.08	100.00±0.00	100.00±0.00

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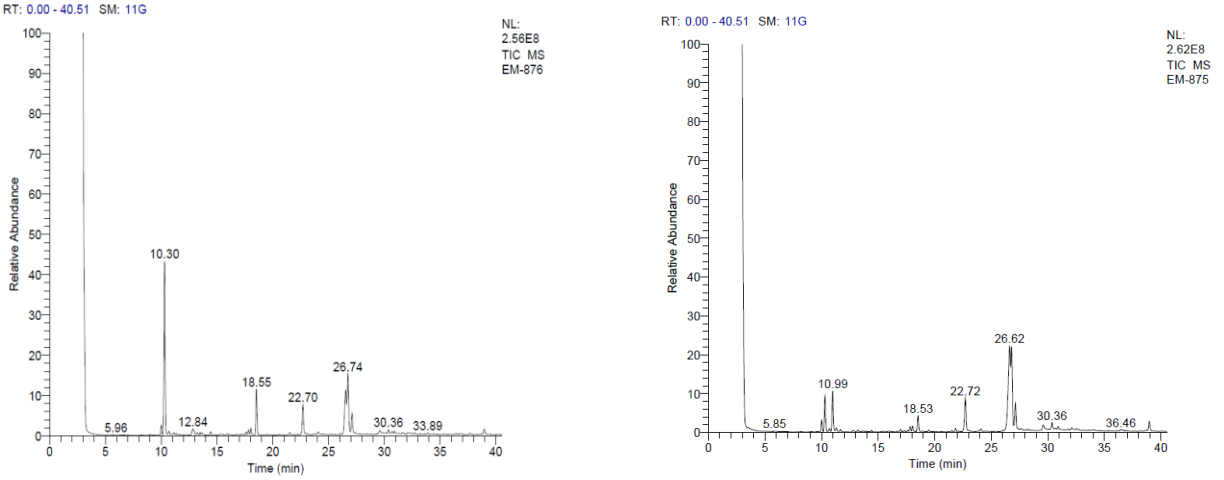
The GC pattern of the powder of cinnamon recorded 6 major peaks with the retention time of 5.85, 10.99, 18.53, 22.72, 26.62, 30.36 and 36.46.The possible compounds recorded for the different peaks were analyzed by mass spectrum some of the peaks and their possible compounds recorded for the peak I are Cinnamaldehyde.

The GC pattern of the powder of star anise 7 major peaks with the retention time of 10.30, 12.84, 18.55, 22.70, 26.74, 30.36 and 33.89.The possible compounds recorded for the different peaks were analyzed by mass spectrum. Some of the peaks and their possible compounds recorded for the peak I are 1. Benzene 2. 1-methoxy-4-(1-propenyl) - (CAS).



4. DISCUSSION

Adult rice weevils (*S. oryza*e) were obtained from naturally infested milled rice from a local market in Tirunelveli. The insects were reared in a plastic container [8] (3.7 cm height × 7.5 cm diameter) under laboratory Conditions at 28±2ºC, 65-70% relative humidity, and 12 hour light: 12 hour dark and covered with a fine mesh cloth for ventilation [9]. The insects were allowed to deposit their eggs. After 2 weeks of ovi position, they were removed through a sieve with mesh sized of 2 mm. The container was returned to the rearing room and the culture was continued for a month to allow the new adults emerged. The adult insects of 7-10 days old were used for the experiments.

The barks of cinnamon and star anise were collected from local market from Tirunelveli. They were cleaned, dried in sunlight, ground into powder, and kept at 20oC for further studies [10].

Twenty-gram milled rice was placed in a bottle (7.5 × 5.5 cm2) and thoroughly mixed with 2gm, 4gm, 6gm, 8gm and 10gm of cinnamon and star anise powders. Twenty-adult weevils were introduced into the mixed grains. The bottle was covered with cloth sheet and secured with a rubber band. The death insects were considered by no response when poked with forceps. The dead weevils were investigated and counted after7 days, 14 days, 21 days and 28 days. Rice without

plant powers were used as controls. The experiments were done in triplicate for each concentrations of the individual plant powers and each day's interval. The mortality was calculated using the Abbott formula (Abbott, 1925). Mortality was recorded after 7 days, 14 days, 21 days and 28 days.

5. CONCLUSION

The present study strongly suggest the damage rice carbohydrate in the grains leading to weight loss and product contamination. The conclusion was deals with the biological control of rice weevils (*Sitophilus oryzae*) in stored milled rice by the powders of *Cinnamomum verum* and *Illicium verum* and their life traits.

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