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Bio-efficacy of some green pesticides along with conventional chemical pesticides FOR Control of *Sitophilus oryzae* infesting stored rice (*Oryza sativa*)

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Abstract
The present paper reports the results of the study on results of the study on bio-efficacy of five green pesticides, *viz.* Neem (*Azadirachta indica*), Lantana (*Lantana camara*), Debdaru (*Polyalthia longifolia*), Vasak *(Adhatoda vasica*), Parthenium (*Parthenium hysterophorus*) and a conventional pesticide like Cypermethrin (10% EC / 1.16ml/L) tested against *Sitophilus oryzae* infesting whole grain rice. The overall results indicated that the mean percentage of mortality varied between (91.99%) in case of Cypermethrin followed by Parthenium (74.66%), Neem (70.66%), Lantana (70.66%), Vasak (70.66%) and Debdaru (60%) mortality. No significant difference existed among the treatments.

Keywords: Bio-efficacy, green pesticides, cypermethrin, *Sitophilus oryzae*, stored rice

Introduction
Sitophilus oryzae is a very important pest of stored rice throughout the world including India and it's feeding on the grains causes total destruction of the stored rice making it unsuitable for human consumption. Recently, a severe infestation of this insect pest was observed in stored rice in a ration shop in Madhyamgram (North 24 pargana), and hence it was thought necessary to conduct a laboratory trial with some green pesticides along with a conventional chemical pesticide for control of this injurious pest and the results of that experiment are presented in this paper.

Material and Methods
The plant extracts were prepared following the technique (Gupta *et al*. 2007) The test insects were put in a small glass vial containing sprayed green pesticides on rice grains and mouth of that vial was plugged with absorbent cotton pieces. The conventional chemical pesticide Cypermethrin (10% EC) was sprayed at 1.16ml/L of water. concentration. The observation towards mortality was recorded after every 24 hrs interval up to 120 hrs. The percentage mortality was calculated using the formula [(Number of dead insects / Total number of initial population) x 100]. The data was statistically analysed by Anova, F - value and Critical Difference (CD). Each of the treatments had three replications each and there was one control treatment on which only distilled water was applied.

Results
The mortality achieved at different intervals after treatment is given bellow:

24 hrs
At this interval, Cypermethrin registered the highest mortality of 73.33% and it was superior to all other treatments. The remaining other remaining treatments registered mortality of 40% in case of Parthenium, 33.33% in case of Neem, Lantana, Vasak and the poorest mortality was 20% in case of Debdaru. However, excepting Cypermethrin, all other treatments were statistically at par.

48 hrs
With the increase of interval, the percentage mortality also increased in all the treatments reaching highest in case of Cypermethrin were it was 86.66% which was significantly better than all other treatments. Among the other treatments the mortality varied from 40% in case of Debdaru, 60% in case of Parthenium and Vasak. No significant difference existed among the other treatments.

72 hrs
At this interval Cypermethrin registered 100% mortality and was at per with Neem, Lantana, Vasak and Debdaru all these three were at par.

96 hrs
Percentage mortality increased further at this interval and it reached from 93.33% (Neem, Parthenium, Lantana), 86.66% in case of Vasak and 80% in case of Debdaru. There was no significant difference among the other treatments.

120 hrs
At this interval all treatment reached 100% mortality having no Significant difference among the treatments.

Mean Mortality
As regard mean mortality the mortality can be arranged in the following in descending order- Cypermethrin (91.99%) = 74.66% case of Parthenium = 70.66% in case of Neem, Lantana, Vasak > Debdaru (60%).

Discussion
A perusal of relevant literature reveald that different authors conducted trial, against *S. oryzae* from time to time but must of these included chemical pesticides like Bhandary *et al*. (2022) used Emmanectin Benzoate, Cypermethrin, Malathion etc, Twaibu *et al*. (2023) used green pesticides as Neem powder, Bkack papper powder; Raja (2021) used

Neem sead oil, turmeric powder, essential oil, etc. unfortunately, the plant extracts used in the present study were not tried earlier and hence, The present result could not be compared with those of others studied earlier, However, the plant extracts used here had shown promise and may be suitable substitutes of chemical pesticides.

Table 1: Percentage Mortality of *Sitophilus oryzae* infesting whole rice grain at different intervals after application of Biopesticide and standard chemical pesticide under Laboratory condition

Experiments	Replications	Initial Populations	Mean % Mortality at Different intervals After Treatment					
			24h	48h	72h	96h	120h	Mean
Neem	T1R1	5	33.33	53.33	73.33	93.33	100	70.66
	T1R2							
	T1R3							
Parthenium	T2R1	5	40.00	60.00	80.00	93.33	100	74.66
	T2R2							
	T2R3							
Lantana	T3R1	5	33.33	53.33	73.33	93.33	100	70.66
	T3R2							
	T3R3							
Vasak	T4R1	5	33.33	60.00	73.33	86.66	100	70.66
	T4R2							
	T4R3							
Debdaru	T5R1	5	20.00	40.00	60.00	80.00	100	60
	T5R2							
	T5R3							
Cypermethrin (Chemical Pesticides)	T7R1	5	73.33	86.66	100	-	-	91.99
	T7R2							
	T7R3							
Control	Control	5	0	0	0	0	0	0
Crit Value			2.57	2.57	2.57	2.57	2.57	2.57
SE			8.35	9.95	11.85	13.23	14.28	11.05
CD Value			21.47	25.59	30.47	34.00	36.71	28.40

Table 2: Anova and F- Value of mortality study in respect of *Sitophilus oryzae* infesting whole rice grains

Anova: Single Factor				
Summary				
Groups	**Count**	**Sum**	**Average**	**Variance**
24h	19	60	3.157894737	1.140350877
48h	19	42	2.210526316	1.286549708
72h	19	26	1.368421053	1.467836257
96h	19	13	0.684210526	1.450292398
120h	19	5	0.263157895	1.315789474

Anova						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	103.7263158	4	25.93157895	19.46575944	1.43829E-11	2.472927039
Within Groups	119.8947368	90	1.332163743			
Total	223.6210526	94				

Conclusion

- All these Green pesticides had proved their insecticidal property.
- No mortality is occurred in control treatment.
- It is found that Green pesticides were as good as synthetic pesticides like Cypermethrin.
- Therefore, any of the green pesticides good substitute of chemical pesticides for control of ecofriendly and cost effective and management of *S. oryzae* infested rice grain.
- Therefore, we concluded that, any of the green pesticide is good substitute of chemical pesticide for control of eco-friendly and cost-effective management of *Sitophilus oryzae* infesting rice grain.

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