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Laboratory bio-efficacy of some green pesticides and conventional pesticides for control of *Tribolium castaneum* infesting wheat (*Triticum aestivum*)

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Abstract
The present paper reports the bio-efficacy of six green pesticides *viz*. *Parthenium* (*Parthenium hysterophorus*), Nishinda (*Vitex negundo), Lantana* (*Lantana camara*), Vasak (*Adhatoda vasica*), *Debdaru* (*Polyalthia longifolia*), Citronella (*Cymbopogon nardus*) oil (all at 5% concentration) and a conventional pesticide like Cypermethrin (10 EC/1.16%) tested against *Tribolium castaneum* infesting whole grain wheat. The overall results indicated that the mean percentage of mortality valid between (96.66%) in case of Cypermethrin followed by Vasak (92.22%), *Lantana* (88.88%), Nishinda (76.66%), *Debdaru* (75.55%) *Parthenium* (74.44%) and the minimum was in Citronella essential oil which register (62.21%) mortality. No Significant difference existed among the treatment.

Keywords: Bio-efficacy, green pesticides, cypermethrin, *Tribolium casteneum*, stored wheat grain

Introduction
Tribolium castaneum is an important stored product pest and is known to infest a good number of stored products including whole grain wheat. A severe infestation of this beetle was observed in stored wheat in a grocery shop at Dumdum. Since not much is known regarding bio-efficacy of some green pesticides for control of this beetle, it was thought necessary to conduct a laboratory trial with six green pesticides and one standard chemical insecticide for causing mortality of the concerned beetle pest and the results thereof are presented in this paper.

Material and Methods
The plant extracts were prepared following the technique of Gupta *et al* (2007). The test insects were put in a small glass vial containing sprayed green pesticides and mouth of that vial was plugged with muslin cloths tightly fitted with rubber band. The conventional chemical pesticide Cypermethrin (10 EC) was sprayed at 1.16/L of water concentration. The observation towards mortality was recorded after every 24hrs interval up to 144hrs. The percentage mortality was calculated is in the formula [(Number of death / Total number of initial population) x100] McGregor *et al*, (1970). The data were statistically analyzed by ANOVA, F value and Critical Difference (CD). All the treatments had three replications each, and there was one control treatment on which only distilled water was applied.

Results
The mortality recorded at different intervals has been mentioned as below: -

1. **24hrs:** At this interval, maximum mortality was recorded in Cypermethrin (80%) which are far superior to all other treatments excepting Vasak (73.33%) which was at par with Cypermethrin. This was followed by *Lantana* (53.33%), *Debdaru* (40.00%) and *Parthenium* (40.00%) and all these three were at par. Citronella Oil was the poorest (26.66%), which was inferior to all.

2. **48hrs:** At this interval, Cypermethrin, Vasak and *Lantana* were at par registering mortality of 100%, 93.33%, 80% respectively. *Parthenium* and Citronella oil were both registering mortality of 53.33% were inferior to all but both were at par.

3. **72hrs:** At this interval, mortality in all treatments increased and it was 100% in *Lantana*, 93.33% in Vasak, 80% in both Nishinda and *Debdaru* and 73.33% in case of *Parthenium*, and all these were at par. Citronella oil was the poorest giving mortality of 53.33%.

4. **96hrs:** the mortality further increased in this interval and all treatments were at par excepting Citronella oil where the mortality was 53.33%.

5. **120hrs:** The mortality further increased in this interval and reached 100% in Vasak and Nishinda, 93.33% in case of *Debdaru* and *Parthenium* and 86.66% in case of citronella oil. All these treatments were statistically at par.

6. **144hrs:** 100% mortality was recorded in case of *Parthenium*, *Debdaru* and Citronella oil and all were statistically at par.

7. **Mean Mortality:** the mean mortality may be arranged in the following Descending order – Cypermethrin (96.66%) = Vasak (92.22%) = *Lantana* (88.88%) = Nishinda (76.66%) = *Debdaru* (75.55%) = *Parthenium* (74.44%) = Citronella oil (62.21%)

Discussion
The scanning of pertaining literature reveals that various authors published their resulture for control of *T. castaneum*

from time to time. Some of those used chemical Pesticides Sherif *et al*. (2018) used Chlorpyriphos, Malathion, Chlorpyriphos-methyl etc.; Zkic *et al* (2023) used Cypermethrin Zhang *et al*. (2020) [5] used Benzothiazole, El-Deeb *et al* (2021) used Malathion.) On the Contrary, some others like Nova *et al* (2020) [15] used Neem, Krishna and Yadav (2023) [10] used extracts of Neem, *Tulsi*, *Eucalyptus*, Turmeric, Ginger etc. and Ebadollahi *et al*. (2021) [6] used two essential oils. However, in the present study the plant extracts which were used were not tried by the past workers and hence the present result cannot be compared with those of others and hence the present study provides novel information for control *T. castaneum* in storage, which are safe as those are natural products and easily available

Table 1: Percentage Mortality of *Tribolium casteneum* infesting whole wheat grains at different intervals after application of Biopesticides and standard chemical pesticide under Laboratory condition

Experiments	Replications	Initial Populations	Mean % Mortality at Different intervals After Treatment						
			24h	48h	72h	96h	120h	144h	Mean
Parthenium	T1R1	5	40.00	53.33	73.33	86.66	93.33	100	74.44
	T1R2								
	T1R3								
Nishinda	T2R1	5	33.33	53.33	80.00	93.33	100	-	76.66
	T2R2								
	T2R3								
Lantana	T3R1	5	53.33	80.00	100	-	-	-	88.88
	T3R2								
	T3R3								
Vasak	T4R1	5	73.33	93.33	93.33	93.33	100	-	92.22
	T4R2								
	T4R3								
Debdaru	T5R1	5	40.00	60.00	80.00	80.00	93.33	100	75.55
	T5R2								
	T5R3								
Citronella Essential Oil	T6R1	5	26.66	53.33	53.33	53.33	86.66	100	62.21
	T6R2								
	T6R3								
Cypermethrin (Chemical Pesticides)	T7R1	5	80.00	100	-	-	-	-	96.66
	T7R2								
	T7R3								
Control	CONTROL	5	0	0	0	0	0	0	0
Crit Value			2.36	2.36	2.36	2.36	2.36	2.36	2.36
SE			9.08	11.03	11.71	12.08	12.14	12.5	10.86
CD Value			21.44	26.04	27.64	28.50	28.66	29.50	25.64

Table 2: ANOVA and F- Value of mortality study in respect of *Tribolium castaneum* infesting whole wheat grains

Anova: Single Factor						
Summary						
Groups	**Count**	**Sum**	**Average**	**Variance**		
24h	22	58	2.636363636	2.147186147		
48h	22	36	1.636363636	2.718614719		
72h	22	23	1.045454545	2.426406926		
96h	22	19	0.863636364	2.313852814		
120h	22	9	0.409090909	1.205627706		
144h	22	5	0.227272727	1.136363636		
Anova						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	86.6363636	5	17.32727273	8.701304348	4.12991E-07	2.286184429
Within Groups	250.909091	126	1.991341991			
Total	337.545455	131				

Conclusion

- All the plant extracts and essential oil proved insecticidal property exhibiting mortality and were as good as conventional chemical insecticide, Cypermethrin.
- Percentage mortality increased with the increase of interval becoming 100% in cypermethrin at 24hrs interval and the other treatment reached 100% at different other intervals.
- Though Cypermethrin initially appeared to be far better compared to other treatments, but with the increase of intervals the other treatments also registered improved mortality and no – significant difference was noticed in their mean values.
- No mortality was recorded in control treatment at any of the intervals.
- The results of the statistical analysis (ANOVA) revealed no significant difference among the treatment as their mean values although at the initial stage had shown significant difference but subsequently became at par.

- From the above result, it can be concluded that, any of the green pesticides can be applied for control of *Tribolium casteneum* infesting wheat in storage and there may be no reason to use chemical insecticides.

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