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ORIGINAL ARTICLE

Efficacy of plant products against *Tribolium castaneum* to control infestation in Chick Pea grains

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ABSTRACT
The insecticidal activities and bio-efficacy of various plants products viz., Eucalyptus (Safeda), Zanthoxylum alatum (Tira Mira), Adatoda vasica (Basunti) and Murraya koenigii (Kari patta) were tested against stored grain (chick pea) insect pest Tribolium castaneum. The effect on quantity & quality of grains, number of insect pest population and percent mortality was observed during the study. Results indicate that the Eucalyptus have shown promising signs of seed protection and insecticidal properties with 71% mortality of insect pests. Use of Eucalyptus plant leaves as grain protectant besides being cost effective, may also abate the environmental pollution and health hazards.
Keywords*: Bio-efficacy, plant leaves, mortality, stored grain, Tribolium castaneum.*

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INTRODUCTION

Stored commodities are vulnerable to the attack of insects due to which the quality of stored food is deteriorated. It is necessary to conserve the stored food grains reserves so that the supply of food remains continuous and the prices of food grains and derived products remain stable [6, 10, 17, 18]. Loss in weight and germination ability of grains is a severe problem, especially due to pitiable sanitation along with poor storage facilities that encourage stored pests attack, disease causing organisms and increase in temperature and humidity of the stored products [7, 11, 12, 15, 19]. The red flour beetle (*Tribolium castaneum*) is a species of beetle in the family Tenebrionidae, found in most tropical and subtropical countries in the world. It is an important pest of stored products and particularly of food grains affecting their quality [5]. Therefore it is important to control this pest using safe & eco-friendly methods.

Acaricidal and insecticidal properties of different plants have been proved and some plants which can also compete with synthetic pesticides [8]. To reduce the use of pesticides and to minimize environmental pollution, natural repellent, deterrent and anti-feedant substances have been found to control insect pests [9]. Chickpea (*Cicer arietinum*) commonly known as gram is one of the most popular vegetables in many regions of the world. In present studies, attempts have been made to seek the solution for preserving Chick Pea grains for consumption as well as for sowing purpose; saving them from insect attacks particularly against, *T. castaneum* using various plant products.

MATERIALS AND METHODS

The present study on infestation of Chick Pea grains by *Tribolium castaneum* pests was carried out at Zoology laboratory, Department of Bio-sciences, Arni University, H. P. situated at Longitude 75.6891619, Latitude- 32.1346399 during November 2015 to April, 2016.

Dried Chick pea grains were used for the infestation experiment. Appropriate quantity of Chick pea was purchased from the local market. Air tight plastic containers were taken for the storage of grains. Then the containers filled with grains (250 gm) were stored in the almirah. (Photograph.1). Large number of

insect pest *Tribolium castaneum* were collected from the grain depot of local area and brought to laboratory. Then counted numbers of adult pest (60 nos.) were released in air tight plastic containers having 200 gm of dried chickpea grains.

Photograph 1: Containers kept in the almirah for infestation experiment

Table 1: Detail of Bio-products used in the study

Sr. No.	Name of Bio product		Part of Plant Used
	Common Name	Scientific Name	
1	Safeda	*Eucalyptus*	Leaves
2	Tira mira	*Zanthoxylum alatum*	Leaves
3	Basunti	*Adatoda vasica*	Leaves
4	Kari patta	*Murraya koengii*	Leaves

Plant products have been getting used in insect pest control since time immemorial. In the current study, leaf part of plants was used to control the population of insect pests. Leaves of following plants were procured from local area and used in this experiment after studying their nutritional and toxic properties: *Eucalyptus* (Safeda), *Zanthoxylum alatum* (Tira Mira), *Adatoda vasica* (Basunti), *Murraya koenigii* (Kari patta) (Table 1). Leaves were observed critically for any disease or infection. The leaves were washed with tap water and then dried under partly sunlight conditions. Selected leave types were inserted in the infested containers after 60 days of infestation experiment (Photograph 2).

Adult *Tribolium castaneum* pests were allowed to feed upon the grains. Weighed containers were then kept in almirah with lock & key provision so that rodents may not harm the grain. The observation was recorded on following parameters for the feeding/damaging of Chick Pea grain by pests.

Effect on quantity of grains

After 30 days of storage, all the containers were removed from the almirah and kept in a tray to observe the effect of bio-products on quantity of grains. The containers were weighed and readings were compared with the preliminary values. Damage caused by insect pest was recorded & tabulated.

Number of pest

Number of pests were analysed visually. For this purpose, the grains were spreaded in the tray and increase or decrease in the numbers of insect pest was analyzed by counted number of pests.

Deterioration of grains quality

Deterioration of grains quality were analysed by visually. For this purpose, the grains were spreaded in the tray and destructed grains and powder was separated (Photograph3).

Mortality & overall insect pest population

Observations were recorded after 15 and 30 days of addition of leaves (Bio-product). For fulfilling this objective, the containers were emptied & grains were spreaded in a sterilized tray and the numbers of insect pest were counted. The readings were compared with initial reading taken at the time of addition of bio-product.

The results obtained during the study were recorded, tabulated, analyzed and observed statistically using Sigma Plot software by taking necessary transformations where ever applicable.

Photograph 2: Showing addition of plant leaves in the containers.

Photograph 3: Showing deterioration of grain by insect pest.

RESULTS AND DISCUSSION

The results obtained during the present study are presented under following subheadings:

Effect on weight of grains

Observations on the effect of pest on weight of grains were recorded for two subsequent months and are presented in table 2. The weight of grains in all the experimental as well as control containers started decreasing after one month.

The maximum average decrease in the weight was observed in case of sample 1 (262.9), which was statistically similar to sample 4 (263.2). Both these values were statically higher than other samples where values were 265.4 in sample 2, 264.6 in sample 5 and 264.9 in sample 3. After two months, maximum average decrease in the weight was observed in case of sample 3 (250.5), which was statistically similar to sample 2 (253.4) and sample 4 (253.1). Both these values were statically different than other two samples where values being 254.5 and 257.3 in sample 1 & 5 respectively (Table 2).

Table 2: Showing change in weight of grains during infestation experiment

Sample No.	Initial weight of Containers With Grains (in gm)	Weight After One Month (in gm)	Decrease in Weight (in gm)	Weight After Two Months (in gm)	Decrease in weight (in gm)
1	281	262.9±2.2	18.6	254.5±3.5	8.4
2	282	265.4±2.3	16.8	253.4±2.8	12
3	281	264.9±2.2	16.6	250.5±1.6	14.4
4	281	263.2±2.1	18.5	253.1±2.2	10.1
5	281	264.6±0.1	16.4	257.3±0.2	7.3

*Value expressed as Mean ± S.E

Effect on number of insect pests

Results on number of insect pests are depicted in table 3. Results revealed that the number of insect pests was increased in all the containers. The maximum number of insect pest was recorded in sample 1

(111.6) followed by sample 3, 2, 4 and 5 values being 109.3, 108.3, 106 and 101.6 respectively. There was statistical difference ($p<0.05$) in the number of insect pests between sample 1 and 5. After two months, maximum number was recorded in sample 3 (176.6) followed by sample 4, 1 and 2 values being 174.0, 173.6 and 173.6 respectively. In control containers, the number of insect pests was recorded to be 169.0 (Table 3).

Table 3: Showing change in number of insect pest after one month

Sample No.	Number of initially Inoculated	Number of pest after one month	Increase in number	Number of pest after two month	Increase in number
1	60	111.6±2.3	51	173.6±1.4	62
2	60	108.3±3.2	48.3	173.6±1.6	65.3
3	60	109.3±2.6	49.3	176.6±1.8	65.3
4	60	106.0±2.8	46	174.0±0.5	68
5	60	101.6±0.3	41.6	169.0±0.5	67.4

*Value expressed as Mean ± S.E

Effect on weight of grains after Bio product inoculation

Observations on the effect of bio-product on weight of grains were recorded after 30 & 60 days and are presented in table 4. The weight of grains in all the experimental as well as control containers further decreased to some extent. The maximum average decrease in the weight was observed in case of sample 5 (control) which is statistically lowest than all other samples. Best results were obtained in sample 1 (244.9) followed by sample 2, 3 and 4 values being be 242.5, 240.1 and 242.8 respectively. After 60 days, minimum weight loss was recorded in sample 1 (240.9 gm). Whereas, maximum average decrease in the weight was observed in sample 5 (control), which was statistically lower as compared to all other samples. Loss in weight of grains in sample 2, 3 and 4 was recorded to be 237.50, 232.0 and 238.0 respectively (Table 4).

Number of Insect Pests

The number of insect pests decreased in all the containers except control. The maximum decrease was recorded in sample 1 (137.3) followed by sample 3, 2 and 4 values being 141.3, 141.6 and 147.0 respectively. Whereas, number of insect pests further increased in sample 5 (control) & recorded maximum i.e. 197.3. After two months, maximum decrease in number of pests was recorded in sample 1 (90.0) followed by sample 4, 3 and 2 values being 107.3, 105.0 and 105.6 respectively. The number of pest was recorded maximum (223.3) in control container at the end of the study.

MORTALITY & OVERALL PEST POPULATION

Pest mortality was observed in all experimental containers. After 30 days, average mortality of pests was recorded to be 60%. Maximum mortality (71%) was recorded in the sample 1 in which *Eucalyptus* (*Safeda*) was added as bio-product followed by container no. 2, 3, 4 and 5 (Fig. 1).

It was observed that the weight of grains was decreased whereas, number of pests increased in all containers. The decrease in weight of grains might be due to degradation of grain by insect pest. They feed upon the grains and made tunnels / holes in the grains. Results were similar to [4, 5, 13, 14] who reported decrease in weight of stored grains when they were exposed to one or another type of pests. Weight of stored grain (chick pea) decreased even after the addition of bio product, but the decrease in weight was less when compared to the previous value. The containers in which *Eucalyptus* leaves (*Safeda*) were added showed maximum decrease in pest population. This shows that the leaves added as bio-products, controlled the population of insect pest which further influenced the weight of grains. Result obtained is in accordance to [1, 2, 3, 16] who were reported that decrease in weight is controlled to some extent after the addition of bio-products.

The present study reveals that, all the treatments showed insecticidal activities with varying degree and were found to be effective when compared with untreated chickpea. Results indicate that the Eucalyptus leaves controlled the pest population to maximum extent with highest mortality of *Tribolium castaneum*. It is therefore recommended that *Eucalyptus* leaves can be used as grain protectant to improve insecticidal property as well as help to control post harvest and food grain losses during storage at farm level.

Table 4: Showing changes in weight of grain after 15 days of Bio-product inoculation

Sample No.	Final weight (in gm)	Weight of grain after 15 days of Bio-product inoculation (in gm)	Decrease in weight (in gm)	Weight of grain after 30 days of Bio-product inoculation (in gm)	Decrease in weight (in gm)
1	254.5±3.5	244.9±3.0	9.6	240.9±2.6	4
2	253.4±2.8	242.5±3.3	10.9	237.5±3.4	5
3	250.5±1.6	240.1±1.9	10.4	232.0±3.0	8.1
4	253.1±2.2	242.8±2.2	10.3	238.0±1.6	4.8
5	257.3±3.7	221.3±0.4	36	201.0±0.1	20

*Value expressed as Mean ± S.E

Table 5: Showing changes in number of insect pest

Sample No.	Number of pest after two month	Number of pest after 15 days	Decrease in number	Number of pest after 30 days	Decrease in number
1	173.6±1.4	137.3±1.7	36.6	90.0±3.7	47.3
2	173.6±1.6	141.6±5.2	32	105.6±1.4	36
3	176.6±1.8	141.3±3.2	35.3	105.0±2.0	36.3
4	174.0±0.5	147.0±1.5	27	107.3±1.4	39.7
5	169.0±1.6	197.3±0.3	28.3	223.3±0.5	26

*Value expressed as Mean ± S.E

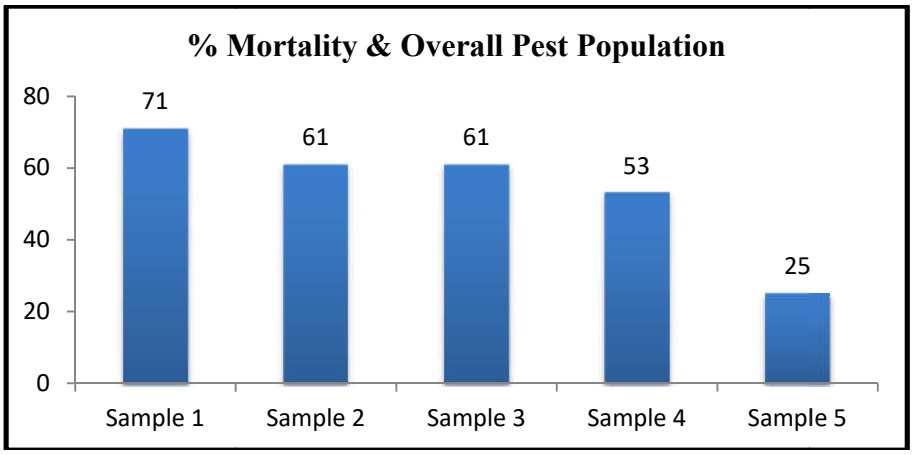

Fig. 1: Showing % Mortality & Effect on Overall Pest Population.

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