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Biological control of some pests of Pulses and Cereals

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Abstract : *The present study has been carried out to evaluate the efficacies of some plant products and spices in stemming damages to pulses and cereals caused by some pests of stored grains. Samples of equally weighed three different grains were taken, namely Matar (Pisum sativum), Moong dal (Vigna radiata), Wheat (Triticum aestivum), each containing 20 pests. They were treated with some common herbs namely- Bael (Aegle marmelos), Amla (Emblica officinalis) and Eucalyptus and spices-Dhania (Coriandrum sativum), Badi Elaichi (Amomum subulatum) and Kala Til (Sesamum orientale). These herbs were dried, ground, weighed and used in the grains to prevent their damage by pests. The doses were given and their effects were observed after 10, 20 and 30 days. Pests in isolated condition were also treated to confirm the efficacy corresponding to the control ones. The three pests were Callosobruchus chinensis in Matar and Moong dal and Rhizopertha dominica and Tribolium castaneum in Wheat. The controls of the three grains showed an increase in the number of pests and considerable damage and contamination of the grains. In the treated group, the pest population was decreased and damage to the grains was significantly less. Among the herbs, Amla leaves proved to be most effective followed by Eucalyptus and Bael. Among the spices, Dhania was found to be most effective followed by Kala til and Badi Elaichi. The combined treatments of the selected herbs as well as spices showed greater efficacy than the individual treatments. The order of resistance of the pests was as follows i.e. Tribolium castaneum > Rhizopertha dominica > Callosobruchus chinensis.*

Key words : *pests, stored grains, Botanicals, Plant parts (herbs and spices).*

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Introduction:

Callosobrunchus chinensis, Rhizopertha dominica and *Tribolium castaneum* are some of the common pests of stored grains. They cause a great damage to the stored pulses and cereals. *The* overall damage caused by the insect pests worldwide is estimated to be 10%-40% annually. It is estimated that more than 20,000 species of field and storage pests destroy approximately one-third of the world's food production, valued annually at more than $100 billion. If proper conditions are not maintained, the pests pollute them to the extent that they may even become toxic for consumption. Traditional methods that are being used for protection of post-harvest crops are beset with limitations. Therefore, biopesticides are in great demand as they cause less damage to stored grains as far as their nutritional value is concerned, and are more economically viable.

The present studies have been undertaken by selecting the following combinations of plant materials to find out whether they are efficacious, and if so, to what extent. This study was undertaken mainly to evaluate insecticidal activity of some plant parts such as leaves of Bael (*Aegle marmelos*), Amla (*Embilica officinalis)* Eucalyptus and spices like Dhania (*Coriandrum sativum)* Badi Elaichi (*Amomum subulatum*) and Kala til (*Sesamum orientale*) against stored grain pests like

- Callosobruchus *chinensis*
- *Tribolium castaneum*
- *Rhizopertha dominica*

The efficacy of these botanicals were observed in cereals and pulses. The mortality of adult insects upon treatment with these plant parts or spices were studied. The objective of this study was to reduce the spoilage of stored grains, to decrease the dependency on chemical preservatives and also to promote the use of easily available plant parts and spices since they are available in the kitchen itself.

Materials and Methods :

The study was conducted in Patna. In the present study, insects causing damage to stored grain were the pests which were selected.

The methodology included two setups - Experimental and control.

In both the groups three types of grains each containing 20 pests, were taken in uniform containers. The grains were weighed equally (100gm) and taken separately. The control set up was kept corresponding to experimental set up to observe the impact of the pests and the nature and extent of damage caused by them to the grains.

The experimental set up was further divided into two groups – pests treated in grains and pests treated in isolated condition by the herbs and spices.

The first treatment was carried out with the spices. The three common spices taken were

- Dhania (*Coriandrum sativum*)
- Badi Elaichi (*Amomum subulatum*)
- Kala Til (*Sesamum orientale*)

These three spices were dried, ground and weighed equally 1gm each for both experimental and isolated conditions.

A combined doze of these three spices were also given to the pests in grains taking each spices weighing (333mg). The isolated setup was carried out to confirm the efficacy of these spices.

Similarly, the second treatment was done with herbs. The leaves of three common plants used for this purpose were -

- Bael (*Aegle marmelos*)
- Amla (*Emblica officinalis*)
- Eucalyptus (*Eucalyptus*)

These were also dried, ground and weighed equally. Herbs were also used to observe their effects in the similar way as spices.

The three pests studied and used for the present experiment were

- (in Moong *Vigna radiate) Callosobruchus chinensis*
- (in Matar *Pisum sativum) Callosobruchus chinensis*
- (in Wheat *Triticum aestivum) Rhizopertha dominica*
- (in Wheat *Triticum aestivum) Tribolium castenum*

Observations were made over different time periods of 10, 20 and 30 days. The observation tables were made according to Zar (2008).

Results :

- The observation tables obtained for the different experimental set up are as follows:

Table No. 1(a) Table showing survival of *Callosobruchus chinensis* when treated with leaves

In pulses -Matar(100g)			(experimental)		
Name of the herbs	Plant part	Quantity (in gms)	Duration of treatment		
			10 days	20 days	30 days
Eucalyptus	Leaves	1	3	0	0
Bael	Leaves	1	4	0	0
Amla	Leaves	1	0	0	0

Isolated (*Callosobrunchus chinensis)*					
Name of the herbs	Plant part	Quantity (in gms)	Duration of treatment		
			10 days	20 days	30 days
Eucalyptus	Leaves	1	0	0	0
Bael	Leaves	1	1	0	0
Amla	Leaves	1	0	0	0

Table No. 2(a) Table showing survival of *Callosobruchus chinensis* when treated with leaves

In pulses-Moong dal (100g)			(experimental)		
Name of the herbs	Plant part	Quantity (in gms)	Duration of treatment		
			10 days	20 days	30 days
Eucalyptus	Leaves	1	2	0	0
Bael	Leaves	1	1	0	0
Amla	Leaves	1	0	0	0

Isolated (*Callosobrunchus chinensis)*					
Name of the herbs	Plant part	Quantity (in gms)	Duration of treatment		
			10 days	20 days	30 days
Eucalyptus	Leaves	1	0	0	0
Bael	Leaves	1	0	0	0
Amla	Leaves	1	0	0	0

Table No. 3 (a) Table showing survival of *Rhizopertha dominica* when treated with leaves

In cereal-wheat (100g)			(experimental)		
Name of the herbs	Plant part	Quantity (in gms)	Duration of treatment		
			10 days	20 days	30 days
Eucalyptus	Leaves	1	14	4	2
Bael	Leaves	1	10	6	4
Amla	Leaves	1	16	6	4

Isolated (*Rhizopertha dominica)*					
Name of the herbs	Plant part	Quantity (in gms)	Duration of treatment		
			10 days	20 days	30 days
Eucalyptus	Leaves	1	2	0	0
Bael	Leaves	1	5	0	0
Amla	Leaves	1	2	0	0

Table No. 4 (a) Table showing survival of *Tribolium castaneum* when treated with leaves

In cereal-wheat (100g)			(experimental)		
Name of the herbs	Plant part	Quantity (in gms)	Duration of treatment		
			10 days	20 days	30 days
Eucalyptus	Leaves	1	16	9	5
Bael	Leaves	1	13	7	4
Amla	Leaves	1	15	10	6

Isolated (*Tribolium castaneum)*					
Name of the herbs	Plant part	Quantity (in gms)	Duration of treatment		
			10 days	20 days	30 days
Eucalyptus	Leaves	1	4	0	0
Bael	Leaves	1	7	0	0
Amla	Leaves	1	8	3	1

Table No.1 (b) Table showing survival of *Callosobruchus chinensis* when treated with spices

In pulses - Matar (100g)		(experimental)		
Name of the spices	Quantity (in gms)	Duration of treatment		
		10 days	20 days	30 days
Dhania	1	2	0	0
Badi elaichi	1	0	0	0
Kala til	1	0	0	0

Isolated (*Callosobruchus chinensis*)				
Name of the spices	Quantity (in gms)	Duration of treatment		
		10 days	20 days	30 days
Dhania	1	0	0	0
Badi elaichi	1	0	0	0
Kala til	1	0	0	0

Table No. -2(b) Table showing survival of *Callosobruchus chinensis* when treated with spices

In pulses - Moong dal (100g)		(experimental)		
Name of the spices	Quantity (in gms)	Duration of treatment		
		10 days	20 days	30 days
Dhania	1	0	0	0
Badi elaichi	1	1	0	0
Kala til	1	0	0	0

Isolated (*Callosobruchus chinensis*)				
Name of the spices	Quantity (in gms)	Duration of treatment		
		10 days	20 days	30 days
Dhania	1	0	0	0
Badi elaichi	1	0	0	0
Kala til	1	0	0	0

Table No. 3(b) Table showing survival of *Rhizopertha dominica* when treated with spices

In cereal - Wheat (100g)		(experimental)		
Name of the spices	Quantity (in gms)	Duration of treatment		
		10 days	20 days	30 days
Dhania	1	14	8	6
Badi elaichi	1	14	8	5
Kala til	1	11	9	5

Isolated (*Rhizopertha dominica*)				
Name of the spices	Quantity (in gms)	Duration of treatment		
		10 days	20 days	30 days
Dhania	1	19	1	0
Badi elaichi	1	11	9	6
Kala til	1	11	6	0

Table No. 4(b) Table showing survival of *Tribolium castaneum* when treated with spices

In cereal - Wheat (100g)		(experimental)		
Name of the spices	Quantity (in gms)	Duration of treatment		
		10 days	20 days	30 days
Dhania	1	15	8	5
Badi elaichi	1	18	8	6
Kala til	1	15	10	7

Isolated (*Tribolium castaneum*)				
Name of the spices	Quantity (in gms)	Duration of treatment		
		10 days	20 days	30 days
Dhania	1	15	10	1
Badi elaichi	1	14	8	2
Kala til	1	16	8	5

Table No. 5(a) Table showing survival of the pest when treated with combination of leaves.

Individual weight	**Eucalyptus**	**Bael**	**Amla**
Total weight of combination of herbs	1g		
Name of pest	10days	20 days	30 days
Callosobruchus chinensis in matar 100g	0	0	0
Callosobruchus chinensis in moong 100g	0	0	0
Rhizopertha dominica in wheat 100g	10	4	0
Tribolium castaneum in wheat 100 g	15	10	2

Table No. 5(b) Table showing survival of the pest when treated with combination of spices

Individual weight	Dhania (333 mg)	Badi eliachi (333 mg)	Kala til (333 mg)
Total weight of combination of spices	1g		
Name of pest	10days	20 days	30 days
Callosobruchus chinensis in matar 100g	0	0	0
Callosobruchus chinensis in moong 100g	0	0	0
Rhizopertha dominica in wheat 100g	8	7	2
Tribolium castaneum in wheat 100 g	16	10	2

Discussion:

The results of the present work showed that the grains were considerably damaged in the control set up in which it was not treated with any plant part or its product. In the present experimental setup, the effects of *Aegle marmelos* (Bael) leaves on the pests were most pronounced followed by *Eucalyptus* (Eucalyptus) and *Emblica officinalis (Amla)* in the category of plant products. Among the spices, *Coriandrum sativum* (Dhania) was the most effective followed by *Sesamum orientale* (Kala Til) and *Amomum subulatum* (Badi Elaichi). Several studies (Collins, 2006 ; Golab and Webely, 1980; Mukherjee and Joseph 2000; Dakshinamurthy 1998 ; Sabbour, 2000) support the use of botanicals for the control of plant pests. Derbalah and Ahmad (2011) have also advocated against the use of chemical control of *Sitophilus Oryzae* in wheat. Koul (2004) reported the efficacy of the seeds of *Azadirachta indica* on stored grain pests like *Sitophilus oryzae* and *Tribolium castaneum.* Studies on pulse beetle *Callosobruchus maculates* by Rahman and Talukdar (2006) shows the efficacy of plant derivatives on pests of pulse as well. Upadhyay and Jaiswal (2007) evaluated the effect of *Piper nigrum* oil on *Tribolium castaneum*. The combination of plant parts as well as the combination of spices had greater effect on the control of the pest population according to the present work. Thus, the present result shows that plant parts (herbs) or spices serve as a useful biological agent for the control of stored grain pests. This is important since pests are increasingly becoming resistant to chemical pesticides (Affa, 1986).

In the control setup, it was observed that the pests in all the three grains increased in number and damaged the grains in different ways as stated by Vincent, Croettel and Lazaronits (2007).

The damage caused were as follows :

- In the control set up *Callosobruchus chinensis* caused greater damage to Matar(*Pisum Sativum)* than Moong (*Vigna radiata*).
- In the other control set up Wheat (*Triticum aestivum*) was most affected by *Tribolium castaneum* than *Rhizopertha dominica.*
- *Rhizopertha dominica* was greatly affected by herbs and spices than *Tribolium castaneum.*
- Among the pests taken, *Callosobruchus chinensis* was mostly affected by Herbs and Spices.
- In Wheat (*Triticum aestivum*), some of the grains were broken and turned shining brownish yellow to pale yellow in colour. Some pale powdery dusts of the grains were observed in between them and some at the bottom of the container.

In Moong (*Vigna radiata*) and Matar (*Pisum sativum*), some hollowed grains were seen with a thin shell which was intact and the pests were present within the hollow cavities of the grains.

Conclusion :

- In the experimental setup, the pest decreased in number and damage caused to these grains were much less. Among the herbs, *Aegle marmelos (*Bael) leaves proved to be the most effective followed by Eucalyptus and then *Embilica officinalis* (Amla).
- In spices, *Coriandrum sativum* (Dhania) was found to be more efficacious than *Seasamum orientale* (Kala Til) and *Amomum subulatum* (Badi Elaichi).

- Moreover the combined treatment of these herbs and spices displayed greater efficacy than individual treatment. Hence their combination can also be used to ensure greater protection to the grains.
- The order of resistance of the three pests to these treatments were:

  Tribolium>Rhizopertha>Callosobruchus.

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