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TOXIC EFFECT OF LEAF EXTRACTS ON THE MORTALITY OF PESTS IN STORED GRAINS AND PRODUCTS

K.G. LAJITHA[a] AND NISHA P. ARAVIND[b1]

[ab]Department of Zoology, CMS College Kottayam, India

ABSTRACT

The present study was conducted totest the toxic effect of 5 leaf extracts such as *Azadirachta indica, Calotropis gigantea, Centella asiatica, Piper nigrum* and *Hemigraphis alternata* on the mortality of stored food insect pests, *Sitophilus oryzae, Tribolium castaneum* and *Callosobruchus chinensis.* From the study, it was observed that *Calotropis gigantea, Centellaasiatica,* and *Hemigraphis alternate* possess strong contact toxicity against these pests. While *Azadirachta indica* and *Piper nigrum* possess weak contact toxicity. Toxic effect was very clear during early periods of treatment (3hr).Topically applied leaf extracts shows dose dependant contact toxicity against these pests. In case of *Sitophilusoryzae* the maximum mortality rate was with 8% leaf extract of *Calotropis gigantea* (93%) and the minimum was with 0.5% extract of *Azadirachta indica*(18%). In case of *Tribolium castaneum* the maximum effect is produced by 8% leaf extract of *Calotropis gigantea* (95%). While the minimum effect is produced by 0.5% leaf extract of *Piper nigrum* (17%). Maximum toxic effect on *Callosobruchus chinensis* is produced by 8% extract of *Hemigraphis aiternata*. While the minimum effect is produced by 1% *Piper nigrum* (13%). Methanolic extract of the plant showed considerable insecticidal activity and hence it can be used as a potential grain protectant. Hence the plant offers a new source of biopesticide in insect pest management. Application of such plant products is more advisable in future.

KEYWORDS: Leaf Extracts, Bio Pesticides, Stored Grain, Pest, Mortality

Insects considered as primary pests of stored products cause damage to stored grains by directly feeding on the grain at some point in their life cycle. Insect pest species often develop and reproduce very quickly when the conditions are optimal. This allows for production of large populations and therefore, causes considerable damage within a matter of a few months. Many species of stored product beetles feed internally in grain kernels as larvae. Rusty grain beetles, weevils, and lesser grain borer all develop initially inside the kernel. About 5-10% of the stored grain is lost every year due to insect damage in India. (Fennemore et. al, 1992)

Protection of agricultural stored products against insect pest is of utmost importance to ensure a continuous and safe food supply all over the world. Conventional chemical methods have been used for this purpose but recently other ecologically sound methods based on natural compounds are needed for an integrated approach to pest management. A wide variety of higher plants provide new source of natural antifeedents and pesticides [Ananthakrishnan,1992]. The interaction between plants and insects is mediated by chemical compounds by plants as a result of joint evolution. Therefore the study of toxic effects of plant materials and extracts provide chances for finding alternative insecticides. The main advantage of botanicals is that they are easily produced by farmers and small scale industries; they are potentially less expensive and are virtually harmless to other animals. A large number of plant extracts and secondary metabolites having insecticidal, antifeedant and repellent properties have been screened for their activities against stored products.

Although various plant extracts are reported to possess insecticidal activities against many stored grain pest, very little information is available on the use of *Azadirachta indica, Calotropis gigantea, Centella asiatica, Piper nigrum and Hemigraphis alternate* leaf extracts on the insect pests of stored grains, especially of the pests like *Tribolium castaneum, Sitophilus oryzae and Callosobruchus chinensi*s. Therefore the present investigation was initiated to find out the insecticidal properties of these 5 leaf extracts against stored grain pests*, T. castaneum , S. oryzae , and C. chinensis.*

MATERIALS AND METHODS

Experimental plants like *Azadirachta indica* (Family:Meliaceae) ,*Calotropis gigantean* (Family: Apocyanaceae) , *Centella asiatica* (Family: Apiaceae) , *Piper nigrum* (Family: Piperaceae) , *Hemigraphiss alternata* (Family: Acantheceae) were collected and methanolic extracts were prepared. For preparing the working extracts, the stock extract was diluted to different concentrations (0.5%, 1%, 2%, 4%, and 8% respectively) with methanol and stored in air tight containers in a refrigerator.

Adults of *T. castaneum* were collected from local granaries and reared in plastic jars containing the diet and maintained at room temperature and only adult insects were used for experiments. The insects*, S. oryzae* and *C.*

[1]**Corresponding Author**

chinensis were reared on a diet of rice and pulse grains respectively. Adults were used for insecticidal experiments. For topical application studies 10 adult insects of each*, T. castaneum*, *S. oryzae*and *C. chinensis* were released into separate petri dishes. Methanol alone was applied topically in the case of control insects. The dishes were covered and kept for different time intervals viz. 1.5 h, 3 h, 6 h, 24 h, 48 h, 72 h and 96 h. Mortality of adult insects in each control and experimental were observed.

RESULTS

Toxic effect of 5 leaf extracts on the mortality rate of 3 stored food insect pests, *Sitophilus oryzae, Tribolium castaneum* and *Callosobruchus chinensis* were studied. Of the 5 leaf extracts, the *Calotropis gigantea* and *Hemigraphis alternata* possess more effect on these pests. Less effect was produced by *Azadirachta indica* and *Piper nigrum*. The effect of *Centella asiatica* is in between this 4 leafs.

Treatment of *S.oryzae* with *Azadirachta indica* showed that the percentage of mortality is low. In case of 8% leaf extract the mortality was 35% and with 0.5% extract it was 18%. The other values are intermediate between these two. In case of 8% leaf extract of *Calotropis gigantea*, maximum mortality rate was obtained (93%). The mortality was high after 3h of treatment. But in case of 0.5% extract the mortality rate was only 69%.

In *Centella asiatica*, the maximum effect was produced by 8% extract (67%) and minimum effect is produced by 0.5% extract (49%). In *S.oryzae* treated with *Piper nigrum*, the mortality rate is very low (27%) with 8% leaf extract and 19% with 0.5% leaf extract. 90% of mortality was obtained for *S.oryzae* when treated with 8% leaf extract of *Hemigraphis alternata*. Whereas with 8%, the death rate was maximum after 3h and then it decreased with increasing time periods. So the 8% leaf extract has an immediate effect. But the 0.5% leaf extracts produced only a least effect.

In case of t *Sitophilus oryzae* effect after 3h of treatment the maximum mortality rate was with 8% leaf extract of *Calotropis gigantean (* 93%) and the minimum was with 0.5% extract of *Azadirachta indica* (18%).

Treatment of *Azadirachta indica* with *T. castaneum* shows that 8% leaf extract cause a mortality rate of 31%. While treatment with *Calotropis gigantea*, there is almost 95% of mortality with 8% extract. Which is the maximum value. The 1% extract produce 72% of death rate which is its minimum value. The *Centella asiatica* was also found to cause a death rate of 80% with 8% leaf extract, but it was only 54% with 0.5% extract. *Piper nigrum* extracts, when treated on *T.castaneum* showed mortality rate of 25% with 8% extract and was 17% with 0.5%extract. The other values are intermediate between these two values.

The *Tribolium castaneum* treated with *Hemigraphisalternata* showed death rate of 92% with 8% leaf extract, while the 0.5% extract cause a mortality rate of only 44%. From these it is clear that in case of *Tribolium castaneum* the maximum effect is produced by 8% leaf extract of *Calotropis gigantea* (95%). While the minimum effects are produced by 0.5% leaf extract of *Piper nigrum* that is 17%.

In case of *C.chinesis* 8% leaf extract of *Azadirachta indica* caused a mortality rate of 29% that is the maximum value. While the 4% extract cause mortality rate of 23% that is the minimum value.The other values with different concentrations are intermediate between these two. The 8% extract of *Calotropis gigantea* caused a death rate of 91%. While its 0.5% cause a death rate of 66%. 8% extract of *Centella asiatica* caused a death rate of 72%.

When *C. chinensis*is was treated with *Hemigraphisalternate,* there was 94% of mortality with 8% leaf extract, while only 50% of mortality with 0.5%. From all these observations it is clear that maximum toxic effect on *Callosobruchus chinensis*is was produced by 8% extract of *Hemigraphis alternata.* While the minimum effect is produced by 1% extract of *Piper nigrum* that is 13%. (Table 1 to Table 7).

Table 1: Mortality percentage of *Sitophylus oryzae* adults exposed to *Calotropis gigantea* leaf extracts for different periods

Leaf extract (%)	Percentage of mortality during different time periods (Hours)					Total mortality (%)
	3	6	12	24	48	
Control	0	0	0	0	0	0
0.5	26	10	18	7	8	69
1	28	8	18	13	15	82
2	30	14	12	8	9	83
4	36	12	16	14	12	90
8	42	14	12	18	11	93

Table 2: Mortality percentages of *Tribolium castaneum* adults exposed to *Calotropis gigantea* leaf extracts for different periods

Leaf extract (%)	Percentage of mortality during different time periods (Hours)					Total mortality (%)
	3	6	12	24	48	
Control	0	0	0	0	0	0
0.5	24	18	12	11	11	76
1	26	14	16	8	8	72
2	32	10	8	16	12	78
4	34	16	14	10	14	88
8	38	18	12	19	8	95

Table 3: Mortality percentages of *Callosobruchus chinensis* adults exposed to *Calotropis gigantea* leaf extracts for different periods

Leaf extract (%)	Percentage of mortality during different time periods (Hours)					Total mortality (%)
	3	6	12	24	48	
Control	0	0	0	0	0	0
0.5	24	9	12	9	12	66
1	26	14	13	13	8	74
2	30	12	13	12	9	76
4	39	14	14	8	11	86
8	46	13	12	14	6	91

Table 4: Mortality percentages of *Tribolium castaneum* adults exposed to *Centella asiatica* leaf extracts for different periods

Leaf extract (%)	Percentage of mortality during different time (Hours)					Total mortality (%)
	3	6	12	24	48	
Control	0	0	0	0	0	0
0.5	8	11	12	7	15	54
1	11	10	9	12	11	53
2	15	9	13	14	21	72
4	17	10	14	9	18	68
8	24	18	12	8	18	80

Table 5: Mortality percentages of *Sitophilus oryzae* adults exposed to *Hemigraphis alternata* leaf extracts for different periods

Leaf extract (%)	Percentage of mortality during different time period (Hours)					Total mortality (%)
	3	6	12	24	48	
Control	0	0	0	0	0	0
0.5	4	4	6	16	34	64
1	8	1	16	8	34	67
2	14	10	6	14	30	74
4	36	12	4	18	16	86
8	52	14	2	10	12	90

Table 6: Mortality percentages of *Tribolium castaneum* adults exposed to *Hemigraphis alternata* leaf extracts for different periods

Leaf extract (%)	Percentage of mortality during different time periods(Hours)					Total mortality (%)
	3	6	12	24	48	
Control	0	0	0	0	0	0
0.5	18	6	4	10	6	44
1	20	0	2	4	6	32
2	36	12	8	14	2	72
4	52	2	8	4	14	80
8	74	2	8	4	4	92

Table 7: Mortality percentages of *Callosobruchus chinens*is adults exposed to *Hemigraphis alternata* leaf extracts for different periods

Leaf extract (%)	Percentage of mortality during different time periods (Hours)					Total mortality (%)
	3	6	12	24	48	
Control	0	0	0	0	0	0
0.5	14	12	8	10	6	50
1	26	12	10	14	4	66
2	30	8	8	10	4	60
4	38	8	16	16	10	88
8	74	8	8	4	0	94

DISCUSSION

The toxicity studies by topical application of 5 leaf extracts such as *Azadirachta indica, Calotropis gigantea, Centella asiatica, Piper nigrum* and *Hemigraphis alternata* for a period from 3h to 48h on stored product insect pests, *Tribolium castaneum, Sitophilus oryzae* and *Callosobruchus chinensis* showed contact toxicity. In that *Calotropis gigantea, Centella asiatica* and *Hemigraphis alternate* possess strong contact toxicity. While *Azadirachta indica* and *Piper nigrum* possess weak contact toxicity. It was seen that toxic effect was very clear and immediate during early periods of treatment (3hrs). The data obtained from toxicity study indicates that the toxic materials are present in the leaf extracts of these leafs in different amounts.

Dose dependant toxicity of plant extracts and oils have been reported by various authors. El-Lakwah et al. (1992) reported that mortality of some stored product insects (*S.oryzae* and *T.castaneum*) increased with increasing concentration of the extract of *Withaniasomnifera l*eaves and fruits. Similarly, cineoles from the essential oil of *Ocimumkenyense* (Obeng- Ofari et al., 1998) have been reported to possess dose dependant activity.

The topical application method employed in toxicity studies, is found to be more toxic to the insects than the other types of studies like, film residue method. In

topical application the main route of toxic chemicals is by means of penetration through the cuticle, penetrating in to the haemolymph and then acting on the nervous system. The toxicants may also penetrate through spiracles and trachea.

The present study thus indicates that topically applied leaf extracts of*Azadirachtaindica, Calotropisgigantea, Centellaasiatica, Piper nigrum*and *Hemigraphisalternata*shows dose dependant contact toxicity against the stored insect pests, *T.castaneum*, *S. oryzae* and *C.chinensis*. More over toxic effect was more prominent during early periods of exposure which last for even up to 48h. Bouda et al. (2001) also observed insecticide activity of essential oils of *A. conyzoides* against *Sitophilus zeamais* at concentrations of 0.013, 0.025, 0.05, 0.10%.The effect of methanolic extract of the plant shown considerable insecticidal activity and they can be used as a potential grain protectant due to their insecticidal property. Hence the plant offers a new source of biopesticide in stored insect pest management.

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