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Leaf powders of basil (*Ocimum basilicum*), lantana (*Lantana camara*) and gardenia (*Gardenia jasminoides*) affect biology of *Callasobruchus chinensis*

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Abstract

The effect of leaf powders of Basil (*Ocimum basilicum*), Lantana (*Lantana camara* L.) and Gardenia (*Gardenia jasminoides*) on the biology of *Callosobruchus chinensis* L. (Coleoptera: Bruchidae) was studied to provide information on alternatives that can be applied in small storage facilities of the chickpea seeds. A weight of 50 gram chickpea seeds was mixed separately with 0.5 g, 1.0 g, 1.5g and 2.0 g of leaf powders of these plants. Life history parameters; larval and pupal duration, fecundity, adult emergence and egg hatching) were observed in the next generation of the survivors of mortality test. The presence of leaf powders of three plants had significantly affected survival of adult beetles. Mortality increased with increasing amount of leaf powders. Highest and significant mortality was observed in 2:50 ratio of leaf powders and chickpea seeds combination. Control treatment had 50% mortality of values in leaf powder treatments after 24-hours of release of beetles. The highest number of eggs (158.7) was counted from the control treatment as compared to only 9.33 eggs in 2:50 ratio of Basil and chickpea combination. Development time (Larval + pupal durations) was prolonged with increasing amount of leaf powders. Emergence and egg hatching was significantly low in the leaf powders' treatment. Control of *C. chinensis* in chickpea with insecticide grain protectants can be dangerous due to its residual effect, Application of plant powders to chickpea seeds for household storages of the chickpea especially in months of infestation can be effective alternate.

Key-Words: Gardenia, Lantana, Life history, Mortality, Pulse basil, Repellency.

Introduction

Bruchids are important insect pest of stored grains. *Callosobruchus chinensis* known as pulse beetle attack all pulses but beans and chickpea are significantly affected both quantitatively and qualitatively. The losses become enormous and total loss of grains is often witnessed which make these grains unfit for consumption. Once eaten, these grains lose their germinating capacity completely[1-2] as well. Chickpea grains stored in godowns and warehouses in large and small quantities arc attacked by this species in tropics and sub-tropics[3-7].

Life cycle of the beetle largely depends upon many extrinsic and intrinsic factors. The beetle completes life cycle within 25-34 days during summer while 40-50 days in winter[8] (Ghosh and Durbey, 2003), but in the presence of grain protectants, life of the beetle is disturbed[9].

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The problem of residues resulting after mixing synthetic organic insecticides with pulses beyond the permissible tolerance levels for control of beetle's infestation, has forced the researchers to look for some alternate safe management of pulse beetles. The integration of natural insecticides products from locally available plants for use in storage by the farmers in developing countries appears to be quite safe and promising[10-12]. Leaf, bark, seed powder or oil extracts of plants reduce oviposition rate and suppress adult emergence of bruchids and also reduced seed damage rate when mixed with stored grains[13-19], Powdered materials of orange, lemon, lime, lemon grass, cinnamon, derris, nutmeg, cactus, ginger were evaluated by Rajpakse and Vaneben (1997) against bruchids at high dose 300g Kg-1seeds. However, low dose rate (25g kg-1) of dried powders of clove, red and black peppers have also been reported to prevent the infestation of bruchids[20]. The possible mechanism of preventing insects to attack the grains has been described as the reduction of insect movement and

death through occlusion of their spiracles, thereby, preventing respiration via trachea[21-23]. The reduction in eclosion could either be due to egg mortality or larval mortality or even reduction in the hatching of the eggs. The present studies were carried out to evaluate the effect of leaf powders of Basil (*O basilicum*), Lantana (*L.. camara*) and Gardenia (*G. jasminoides*) against pulse beetle, *C. chinensis* reared on chickpea in the laboratory.

Material and Methods

Experiments on the efficacy of different plant powders were conducted in the Laboratory of IBAS, Sikar. Collection of *Callosobruchus chinensis*: Mixed populations of *Callosobruchus* spp. were collected from sounding experimental site, during July-September, 2008. The collected species were isolated and *Callosobruchus chinensis* was abundant in those samples. The beetles were kept in plastic jars containing chickpea seeds. Mouths of jars were covered with muslin cloth and these jars were put in an incubator at 30±2oC and 65±5% RH. Preparation and application of plant powders:

Full grown leaves of Basil, Gardenia and moderate size leaves of Lantana were collected from Agricultural Research Station, Sikar. The leaves were air dried in shade. Dried leaves were then ground to the powder form using an electric grinder. Powders were sieved on mesh No. 60. A weight of 50 gram chickpea seeds were mixed separately with each of 0.5 g, 1.0 g, 1.5g and 2.0 g of leaf powders in

plastic jars. A control treatment was prepared in which chickpea were not mixed with leaf powders. Ten pairs of adults (male and female in equal number) were released in each jar. Three replicates were completed in this manner for complete Randomized design (CRD). Data on mortality were taken after 24-hours from release of beetles. Life history parameters (larval and pupal duration, fecundity, emergence and egg hatching were observed in the next generation among the survivors of mortality test. Data were subjected to one way analysis of variance to find out difference among the treatments of ratios of chickpea and leaf powders through Least Significant Difference test.

Results and Conclusion

The presence of leaf powder of Basil had significantly affected survival of adult beetles. Mortality increased with increasing amount of leaf powder. Leaf powder and chickpea seed at a ratio of 2:50 showed the significantly highest mortality. Control treatment had 50% mortality of powders treatments after 24 hours of release of beetles. The beetles preferred to lay eggs on clean seeds as is evident from fact that highest number of eggs (158.7) was counted from the control treatment as compared to only 9.33 in 2:50 ratio of leaf powder and chickpea combination, though number of proportion of male and female was equal in both treatments. Development time (Larval + pupal duration) was prolonged with increasing amount of leaf powder. Emergence was significantly low in leaf powder treatment as only 3.00 adults emerged from leaf powder and chickpea treatment at 2:50 ratio as compared to 125.5 from control treatment counterpart (Table 1).

As compared to leaf powder and chickpea combination of Basil in Table 1, mortality in Lantana treatment resembled with Basil but fecundity was high at low ratios of lantana leaf powder and chickpea combination (42.44 at 0.5: 50 ratios). Developmental time was increased as compared to control and was slightly less than Basil. Different ratios of Lantana leaf powder and chickpea combination had significant difference on adult emergence and egg hatching percentage (Table2). Gardenia appeared to be less effective than other two plant powders but adult mortality was more than Basil and Lantana. Fecundity was affected much as same as above mentioned. Developmental time was prolonged with increasing amount of leaf powder and different ratios had significant difference among them in this regard. Emergence and egg hatching percentage improved slightly than other two leaf powders. Ratio of 2:50 was effective in disturbing different biological characteristics of *C. chinensis* (Table 3).

The results of the present study represent the repellent action of leaf powders towards oviposition as fecundity is low as compared to that in control. There were marginal differences among three leaf powders in exhibiting this activity, which shows that the pest controlling factors are uniformly present in each plant. The findings of the present investigation are in accordance with those of other workers who have previously reported that plant powders reduce life span and oviposition of bruchids[17-19], however, *C. maculates* was used by most of these workers in their experiments. Adult life and oviposition is short in this species of the beetle.

Adult mortality in control was < 50% of that in leaf powder treatment after 24 h. There was striking difference in the fecundity of survivors of mortality test. The moisture contents of chickpea seed might have acted on dry leaf powder to release chemical factors which inhibit the egg laying capacity. Another factor could be clean grain required for egg lying by the beetles. The second stands true as chickpea seeds were acclimatized in the laboratory before actual beginning of the experiments. The other differences

from earlier experiments were range of doses. Higher doses have been used, e.g., 300g Kg-1 seeds of the powdered materials of orange, lemon, lime, lemon grass, cinnamon, derris, nutmeg, cactus, and ginger[24], dried powders of clove, red and black pepper have also been reported to prevent the infestation of bruchids at dose of 25g Kg-1[20] but 2% (20g Kg-1) was the highest dose used in the present investigation. Low doses in the present studies did produce the same effect as highest dose, only magnitude of effect was enhanced at high doses.

The reasons for the long development time may be less circulation of the air in spaces between the seeds which are surrounded by leaf powders. The slow respiration by different stages of beetle might havedelayed their development. The reduction in adult emergence could either be due to larval mortality or even reduction in the hatchingof the eggs. It has been reported that the larvae which hatch from the eggs of *Callosobruchus* species must penetrate the seeds to survive. The larvae are unable to do so unless the eggs are firmly attached to the seed surface. In the present study the eggs were found to be loosely attached to the chickpea seed surface in the treated sets.

The findings of the present investigations indicate that botanical sources might be useful as insect control agents for the commercial use. All the three powders tested were effective to some degree in reducing the oviposition, emergence and survival and increasing the mortality and larval and pupal duration in *C. chinensis*. Basil powder (*Ocimum basilicum*) was the most effective among three powders. To minimize the severe damage caused by insect pests, the traditional use of plant powders proved to be highly effective against stored product insects. Application of plant powders to gram seeds for storage is an inexpensive and effective technique as these substances are of low cost for household storages of chickpea especially during months of infestation.

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Table 1: Mortality, fecundity, larval + pupal duration, emergence and egg hatching of *C. chinensis* in different ratios of Basil (*O. basilicum*): chickpea seed combination

Ratio	Mortality	Fecundity	Development time	Emergence	Egg hatching percentage
0.5 : 50	7.34d	22.67b	32.67 d	11.67 b	47.08 b
1 : 50	8.00c	15.67c	37.67 c	7.17 c	42.42 c
1.5 : 50	8.42b	11.33d	40.67 b	4.42 d	37.42 d
2 : 50	8.83a	9.33e	45.67 a	3.00 e	30.75 e
Control	3.50e	158.7a	18.00 e	125.5a	62.25 a
LSD	0.32	0.50	0.94	0.41	2.01

Means sharing similar letter in a column are statistically non-significant (P>0.05).

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Table 2: **Mortality, fecundity, larval + pupal duration, emergence and egg hatching of *C. chinensis* in different ratios of Lantana camara: chickpea seed combination**

Ratio	Mortality	Fecundity	Development time	Emergence	Egg hatching percentage
0.5 : 50	7.00 c	42.44 b	29.67 d	22.92 b	45.33 b
1 : 50	7.83 d	24.89 c	34.67 c	11.67 c	41.75 c
1.5 : 50	8.75 b	15.89 d	36.33 b	6.17 d	36.83 d
2 : 50	9.33 a	11.67 e	41.67 a	3.42 e	28.75 e
Control	3.00 e	158.7 a	18.00 e	125.50 a	62.25 a
LSD values	0.30	0.50	0.94	0.41	1.59

Table 3: Mortality, fecundity, larval + pupal duration, emergence and egg hatching of C. chinensis in different ratios of Gardenia: chickpea seed combination

Ratio	Mortality	Fecundity	Development time	Emergence	Egg hatching percentage
0.5 : 50	6.5 d	76.78 b	32.33 d	61.83 b	63.58 b
1 : 50	7.25 c	45.67 c	38.25 c	33.00 c	59.00 c
1.5 : 50	7.75 b	28.11 d	46.42 b	13.00 d	39.83 d
2 : 50	8.42 a	20.67 e	54.83 a	4.75 e	19.67 c
Control	3.50 e	158.7 a	18.00 e	125.00 a	62.25 a
LSD values	0.54	0.61	1.10	0.48	1.10

Means sharing similar letter in a column are statistically non-significant (P>0.05).