EVALUATION OF SOME BOTANICAL PESTICIDES AGAINST *PLUSIA ORICHALCEA* FAB. (NOCTUIDAE; LEPIDOPTERA) IN THE LABORATORY

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Abstract

Water extracts of three plant species, i.e. *Azadirachta indica* (Neem), *Cassia fistula* (Amaltas) and *Calotropis procera* (AK), to test their pesticidal effect, were tried separately and in mixture as growth inhibitor and pesticide in the laboratory against *Plusia orichalcea*, a serious defoliator of nursery plants being environmentally safe. For this purpose seed of *A.indica*, bark of *C.fistula* and leaves & tender shoots of *C.procera* were used. The reduction in larval body weight in treated larvae was 74.19% to 78.92% over control in case of *C.procera* and the mixture after 12 and 6 days of treatment, respectively. Mean larval period was extended upto 22 days in the mixture treatment while it was 11.5 days in control. However, mean pupal period was shortened to 6 days by *C.fistula* as compared to control, which was 12.5 days. 100 percent mortality was caused by *A.indica* after 3 weeks. The overall maximum mortality caused by *A.indica*, *C.fistula*, *C.procera*, the mixture and control was 100%, 75.0%, 41.67% and 25.0% respectively. Statistically, the difference in mortality between *A.indica and C.fistula; C.procera* and control; among *C.fistula*, *C.procera* and the mixture was non-significant. The three plant species inhibited growth of *P.orichalcea* by retarding larval body weight and prolonging larval period. The mortality was heavy.

Key words: Botanical pesticides, *Azadirachta indica*, *Calotropis procera*, *Cassia fistula*, *Plusia orichalcea*, growth inhibition, and mortality.

Introduction

As the awareness about environmental pollution has enhanced globally there is a growing realization of the hazards and serious effects of the synthetic pesticides which cause mortality to soil and aquatic fauna and have adverse effects on terrestrial animals including human beings. To keep balance in ecosystem and ensure the pollution free environment, new techniques are in the process of development like biological, legal, mechanical control in the field of pest management. Besides these methods, the most promising field is the exploration of natural resources of plant originated pesticides. As certain plant species like *A.indica*, *C.procera*, and *C.fistula* have such chemical compounds

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in different parts which may act as pesticides. These compounds provide a promising alternative to replace synthetic insecticides for safe pest management.

Natural plant products, such as obtained from *A.indica* and *C.procera* act as antifeedant against insect pests (Grace and Yates, 1992; Lowery and Isman, 1995; Meshran, 1995), retard growth of insects, nematodes and viruses (Khurana and Singh, 1972; Akhtar and Alam, 1989) and possess pesticidal properties (Hepburn, 1989; Wulf, 1991; Dreyer and Hellpap, 1992; Chaudhry and Bajwa, 1992). Similarly, bark extract of *C.fistula* has noticeable juvenilizing effect on insects and nematodes (Jaipal, *et al.*, 1983; Goswami and Vijayalakshmi, 1990).

P.orichalcea is a widely distributed polyphagous defoliator of numerous garden plants and field crops, particularly affecting *Butea monosperma, Cupressus lusitanica* and *Dalbergia sissoo*. It, sometimes tenders severe damage to young trees.

In this study results of growth inhibition and pesticidal effects of plant extracts of *A.indica*, *C.procera*, *C.fistula* and their mixture have been reported against the insect pest *P.orichalcea*.

Materials and Methods

Three plant species, including *Azadirachta indica* A.Juss (Neem), *Calotropis procera* Willd. (Ak) and *Cassia fistula* L. (Amaltas) were tested against *Plusia orichalcea* Fab. (Noctuidae; Lepidoptera) for their growth inhibiting and pesticidal properties in the laboratory. Seeds of neem, bark of amaltas and leaves & tender shoots of AK (the latter two species were dried at room temperature in the laboratory) were ground finely. Ten grams for each species were mixed in 100 ml simple tap water and left for overnight. After 24 hours the materials were filtered through muslin cloth. Similarly, a mixture of these three plant species (10% conc.) was prepared. These simple water extracts were sprayed on the leaves of *Paulownia tomentosa* with the help of hand pump sprayer. The leaves were fully sprayed. In control simple tap water was sprayed. The treated leaves were dried at room temperature and placed in plastic petri dishes (9x1.5 cm). In each petri dish one 2nd instar larva of *P.orichalcea* was released. For the first two days larvae were fed on treated leaves and with fresh leaves thereafter without any treatment. There were five treatments including control with three replication in randomized complete block

design. Each replication had ten larvae, and a total of 30 larvae per treatment. Growth of larvae was measured in terms of larval body weight, longevity of larval and pupal period. The larval and pupal mortality was recorded daily. The data were analyzed statistically applying analysis of variance (ANOVA) and least significant difference test (LSD).

Results

The three test plant species considerably retarded growth of *P.orichalcea* and showed pesticidal properties.

i. Observations on Growth Inhibition

The weight of larvae, fed on treated leaves, was appreciably low than control. The data of larval body weight before and after treatment are presented in Table 1.

Table 1. Mean larval body weight of *P.orichalcea* treated with different botanical pesticides

Plant species	Observation time				
	Before treatment (g)	6 days after treatment (g)	Reduction (%)	12days after treatment (g)	Reduction (%)
C. fistula	0.022ns	0.056*b	72.55	0.105*b	62.37
A indica	0.021	0.064 b	68.63	0.105 b	62.37
C. procera	0.027	0.043 b	78.92	0.095 b	65.59
Mixture	0.023	0.051 b	75.00	0.072 b	74.19
Control	0.028	0.204 a	-	0.279 a	-
LSD	-	0.059	-	0.053	-

* Significant at 99% level, ns Non-significant

Figures sharing same alphabets in a column are non-significant among themselves.

$$Weight\ reduction\ (\%) = \frac{M.WtT. - M.WtC.}{M.Wtc.} \times 100$$

M.WtT = Mean body weight of treated Larvae
M.WtC = Mean body weight of Larvae in Control

Weight of larvae increased significantly (P>0.01) in control after 6 and 12 days of treatment over treated larvae. After 6 days a mean weight of 0.204 g (maximum) per larva was in control while it was 0.043 g (minimum) per larva was in *C.procera*. However, the difference among *C.fistula, A.indica, C.procera* and the mixture treated larvae was non-significant. After 6 days a 78.92% reduction in larval body weight over control was recorded in *C.procera* followed by the mixture (75.0%), *C.fistula* (72.55%) and *A.indica* (68.63%). The gain in body weight by larvae continued in control after 12 days of treatment. A weight of 0.279g and 0.072g in larval bodies per larva was registered in control and the mixture, respectively after 12 days. After 12 days again the difference among the mixture, *C.procera, C.fistula* and *A.indica* was non-significant. Maximum reduction in larval body weight was 74.19% over control in the mixture followed by *C.procera* (65.59%), *C.fistula* (62.37%) and *A.indica* (62.37%).

The decrease in the larval body weight influenced the longevity of larval and pupal period, as given in Table 2.

Table 2. Mean larval and pupal period of *P.orichalcea* treated with different botanical pesticides at 26±2°C and 75% RH

Plant species	Larval period (days)		Pupal period (days)	
	Range	Mean	Range	Mean
C. fistula	19-23	21	5-7	6
A. indica	18-22	20	-	-
C. procera	15-19	17	8-9	8.5
Mixture	21-23	22	7-8	7.5
Control	8-15	11.5	12-13	12.5

As the larvae treated with botanical pesticides could not attain full growth, hence pupation was delayed. While in control larvae grew well, attained full body size and thus pupated earlier. Larval period prolonged on upto 23 days in *C.fistula* and the mixture treatment whereas, it was 11.5 days in an average in

control. The difference in larval duration among *C.fistula, A.indica* and the mixture was not much while the lowest duration in *C.procera* treatment was intermediate between control and other treatments. In case of A. indica the larvae survived for 22 days. They could not moult and consequently died. On the Contrary, pupal period shortened in *C.fistula*, *C.procera* and the mixture. The mean longest pupal period was 12.5 days in control and the shortest (6 days) was noticed in *C.fistula*. The difference among *C.fistula, C.procera* and the mixture was little.

ii. Observations on Larval and pupal mortality

Pesticidal potential of *C.fistula, A.indica* and *C.procera* water extracts was evaluated to cause mortality to larvae and pupae of *P.orichalcea*. The data are shown in Table 3.

In the treated larvae after one week, although 25% mortality was recorded in the treatments of *C.fistula* and *A.indica* but overall this mortality was non-significant. After two weeks, the mortality was significant. The highest mortality was 83.33% in *A.indica* and the lowest 16.67% in control. There was non-significant difference in mortality among *C.fistula, C.procera*, the mixture and the control. After 3 weeks mortality was highly significant. This was highest (100%) and lowest (16.67%) in *A.indica* and control, respectively. The mortality did not differ significantly among *C.fistula, C.procera* and the mixture; *C.procera*, and control. After 24 days in all treatments the surviving larvae went into pupation. The overall larval mortality was highly significant. Nearly same trend of mortality was observed throughout the larval period, namely highest mortality was occurred in *A.indica* followed by *C.fistula*, the mixture and *C.procera*. Overall, *A.indica* caused 100% mortality, however this was statistically non-significant with that of *C.fistula* (75%). Whereas, 25% mortality was recorded in control and was non-significant with *C.procera*. There was non-significant difference among *C.fistula, C.procera* and the mixture; between *C.procera* and control. Pupal mortality was non-significant.

Table 3. Mean percent mortality of *P.orichalcea* larvae and pupae treated with different botanical pesticides

Plant species	Larval mortality after treatment				Pupal mortality
	1 weeks	2 weeks	3 weeks	Overall (24 days)	
C. fistula	25.00ns	41.67*b	58.33**b	75.0**ab	25ns
A. indica	25.00	83.33 a	100.0 a	100.0 a	-
C. procera	8.33	25.00 b	33.33 bc	41.67 bc	12.5
Mixture	8.33	33.33 b	41.67 bc	66.67 b	20
Control	8.33	16.67 b	16.67 c	25.0 c	0.0
LSD	-	41.60	27.18	29.77	-

* Significant at 95% level, ** Significant at 99% level, ns = Non-significant,

\- Figures sharing same alphabets in a column are non-significant among themselves.

Discussion

The results indicate that *C.fistula*, *A.indica*, *C.procera* and the mixture suppress growth of larvae of *P.orichalcea*. After 12 days a 62.37% to 74.19% decrease in body weight of larvae is due to antifeeding and growth inhibiting properties of these plants. These results are in conformity with Skatulla and Meisner, (1975) who obtained 13 times less larval weight over control of Lymantria dispar when treated with 0.5% neem extract. Similarly, Rao and Subrahmanyam, (1986) found that 1-8μg/g azadirachtin caused reduction in body weight of *Schistocerca gregaria*. They also observed that some of the azadirachtin treated nymphs survived beyond 40 days without moult and those attempted to moult after the normal moult period (16-18 days) generally died during ecdysis. This inhibited moulting and under body weight led to delayed pupation. This is evident from these results, where larval period was recorded almost double (22-23 days) in *A.indica* and *C.fistula* to control (11.5 days). Bhattacharya *et al.* (1977) have reported normal 14 days (being a little longer for the males than for the females) and 8.2 days larval and pupal period, respectively at 27°C and 80% RH. under laboratory conditions for this pest. Under fed and weak larvae cannot accumulate required fat bodies, resulting in

shorter pupal period.

Early high mortality is attributed to pesticidal action followed by juvenilizing effects and less by antifeeding effects. High mortality, i.e. 83.33% after two weeks and 100% after three weeks shows Pesticidal potential of *A.indica*. Pesticidal potential in *A.indica* is comparatively more than *C.fistula* and *C.procera* as displayed in Figure 1.

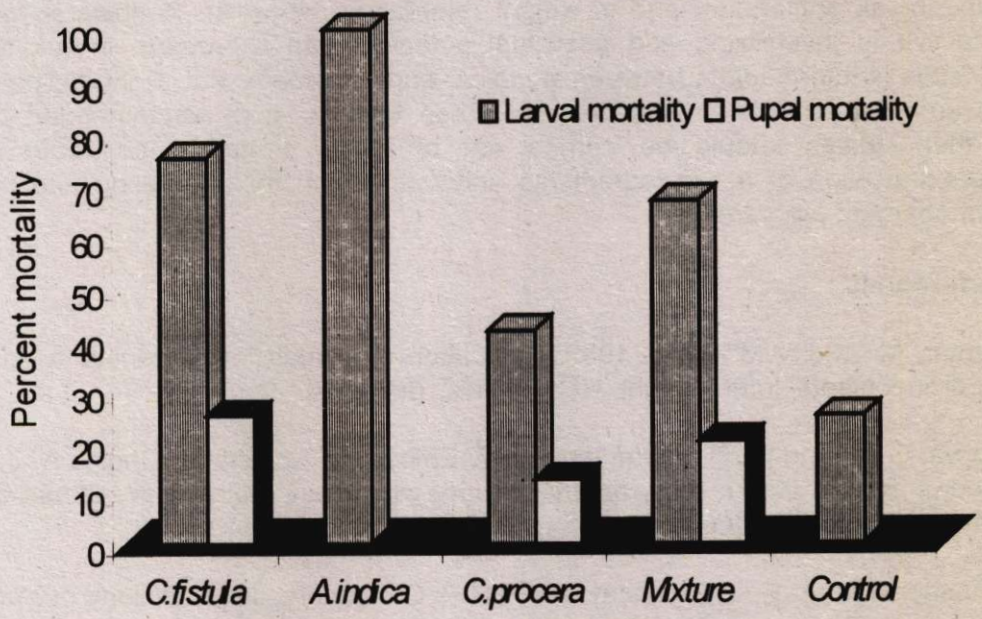

Fig.1. Mean percent larval and pupal mortality of *P.orichalcea*

100 percent mortality by *A.indica* also gets support from Skatulla & Meisner, (1975) and Bajwa & Zimmermann, (1997). The authors got 100% mortality of *L.dispar* with 0.02-0.5% and 3.2-8% neem extract and neem oil applications, respectively. Likewise, Nasseh *et al.*, (1993) found 100% mortality of *Schistocerca gregaria* with a neem product Azal-F @ 1lit/hac. On the other

hand, 41.67% mortality due to *C.procera* is not in conformity with Chaudhry and Bajwa (1992) who reported 66.7% mortality in *Plecoptera reflexa* due to this plant species. They used the leaf decoction of *C.procera*, whereas, we used simple aqueous extracts. This and the different pest species may be the possible reason of discrepancy in results. Mortality because of the mixture (75%) does not show an antagonistic relation among these plant species.

Conclusions

The findings of the studies show that the three plant species, i.e. *A.indica*, *C.fistula* and *C.procera* are good growth inhibitors. *C.procera* is slightly superior as antifeedant and in weight retardation. However, *A.indica* is more effective in juvenilizing and pesticidal potential than *C.procera*. In addition, *C.fistula* is intermediate between *A.indica*, and *C.procera* with slight inclination towards the former. On the basis of these findings, it is recommended that further studies should be carried out on these botanical pesticides for standardization of active ingredients and formulation for integrating into pest management programmes.

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