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BIOEFFICACY OF ORGANIC SOLVENT LEAF EXTRACTS AGAINST GROWTH AND DEVELOPMENT OF TOBACCO CATERPILLAR, *SPODOPTERA LITURA* FAB.

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A laboratory study was conducted to know the effect of 12 leaf extracts @ 2% in methanol and dimethyl sulfoxide against the growth and development of tobacco caterpillar, *Spodoptera litura* Fab. In case of methanol extract, 100% larval mortality was recorded with *Lantana camara* and *Calotropis procera* followed by *Azadirachta indica* (82.6%), *Pongamia pinnata* (77.3%), *Nerium odorum* (76.0%) and *Carica papaya* (75.3%). The larval mortality in *Nicotiana tabacum, Ipomoea batatas, Datura stramonium, Occimum sanctum, Bougainvillea glabra* and *Annona squamosa* extracts was ranged from 50.6 to 68.0%. In case of dimethyl sulfoxide extracts, *Azadirachta indica* was found to be the best growth regulator followed by *Pongamia pinnata, Lantana camara, Calotropis procera, Carica papaya* and *Annona squamosa*. The length and weight of both larva and pupa were significantly less whereas, larval and pupal periods were more in all the treatments than control.

INTRODUCTION

Insect pests are mainly controlled with synthetic insecticides for the last few years. Effective pest control is no longer a matter of heavy application of pesticides, partly because of rising cost of petroleum derived products but largely because extensive use of pesticides promotes faster evolution of resistant forms of pests, destroys natural enemies, turns formerly innocuous species into pests, harms other non-target species and contaminates food. Hence, research is again focusing on the plant kingdom for solutions (Berenbaun and Zangeri, 1996). The pool of plants possessing insecticidal properties is enormous, this topic generated extraordinary interest in recent years as potential sources of natural insect control agents. Today over 2000 species of plants are known to possess some insecticidal activity (Jacobson, 1989). The deleterious effects of certain purified phytochemicals or crude plant extracts on insects are manifested in several ways, including toxicity, growth retardation, feeding inhibition, oviposition deterrent, reduction of fecundity and fertility (Muthukrishnan and Pushpalatha, 2001).

Tobacco caterpillar, *Spodoptera litura* Fab is an important pest in tobacco. The caterpillar feeds voraciously along the veins of leaves and also cut the stems of small and tender seedlings, particularly during nights. The pest can result in more than 80% damage of nurseries during prolonged drought situation. Although chemical control strategies are available for managing the pest, efforts are on for safe management practices. Keeping in view the deleterious effects of chemical pesticides and also the economic importance of this pest, a laboratory trial was conducted to find out the effect of various botanical extracts in organic solvents against growth and development of tobacco caterpillar.

MATERIALS AND METHODS

Studies were conducted at Central Tobacco Research Institute, Rajahmundry during 2005 and 2006 to know the efficacy of various botanicals. Fresh leaves of 12 different botanical species, *viz.*, *Azadirachta indica, Pongamia pinnata, Nicotiana tabacum, Ipomoea batatas, Datura stramonium, Occimum sanctum, Bougainvillea glabra, Annona squamosa, Nerium odorum, Carica papaya, Lantana camara, Calotropis procera* were collected, washed thoroughly and dried under shade for one week. The dried leaf material was further dried in an oven at 40^{o} C for 24 h. The dried leaves were macerated and powdered in blender. Dry powders of 100 g each was extracted separately with two different solvents *viz.*, methanol and dimethyl sulfoxide of standard grades. The extraction was done with 300 ml of each solvent in three stages. The pooled extract of each solvent was concentrated using rotary evaporator at a maximum temperature of 45°C. The weight of dried crude extracts of all botanicals with the above two solvents was in the range of 10 to 12 g. The residue of each botanical was dissolved in distilled water to prepare final concentration of 2% each.

The extracts were sprayed separately on castor crop of 5 sq. m each. A total of two sprays were given at one week interval. The treated leaves from first spray onwards were fed to 3 day old larvae of *S. litura* confined in a plastic jar of 5 liter capacity. In each treatment, 25 larvae were released and the feed was changed daily. An untreated control was also kept for comparison. All treatments were replicated thrice. Observations were recorded on various growth and developmental factors till the completion of life cycle of the pest.

RESULTS AND DISCUSSION

Effect of methanol extracts

The results revealed that 100% larval mortality was recorded with *L. camara* and *C. procera* extracts while it is reasonably good in *A. indica* (82.6%), *P. pinnata* (77.3%), *N. odorum* (76.0%) and *C. papaya* (75.3%) (Table 1). Larval mortality in the remaining treatments varied from 50.6 to 68.0%. Larval length & weight were less and larval period was more in all the treatments compared to control. Regarding pupal mortality, there were no significant differences among treatments and control. However, pupal length & weight were less and pupal period was more in all the treatments than in control. Adult emergence and egg masses laid were less in *A. indica* (12% and 1.3) followed by *C. papaya* (14.7% and 0.7), *P. pinnata* (16.0% and 2.3) and *N. odorum* (18.6% and 1.0). Total number of eggs laid in each egg mass was also less in all botanical treatments compared to untreated control. Egg hatching was nil in *A. indica, P. pinnata, N. odorum* and *C. papaya.* Highest egg hatching (71.3%) was recorded in untreated control and in the remaining treatments, hatchability was ranged from 17.6 (*N. tabacum.*) to 49.6% (*O. sanctum*).

Effect of dimethyl sulfoxide

The results revealed that *A. indica* was found to be the best growth regulator and ovipositional repellent against *S. litura* followed by *P. pinnata, Lcamara, C. procera, C. papaya* and *Annona* sp. Larval mortality was more (90%) in *Calotropis* sp. followed by *A. squamosa* (86.6%), *Carica* (80.0%), *L. camara* & *N. odorum* (76.6%) and *A. indica* (73.3%) (Table 2). Larval length & weight were less and larval period was more in all the treatments compared to control. Regarding pupal mortality, there was no significant difference among all treatments and control. However, pupal length & weight were less and pupal period was more in all the treatments than control. Adult emergence was nil in *Azadirachta* sp., *A. squamosa, L. camara* and *C. procera* Adults have not laid eggs on *P. pinnata* and *C. papaya* treated leaves. Total number of eggs laid in each egg mass was also less in all botanical treatments compared to untreated control. Egg hatching was nil in *N. odorum.* The highest egg hatching (81.5%) was recorded in untreated control followed by *O. sanctum.* (49.7%), *B. glabra* (48.6%), *I. batatas* (37.9%), *N. tabacum* (33.4%) and *D. stramonium* (21.7%).

A large amount of data was available on phyto chemicals having insecticidal, growth regulating, antifeedant, repellant and reproduction affecting properties. Amin *et al.* (2000) reported the direct toxicity of the three plant extracts, *viz.*, *biskatali*, neem and *akand* were lesser grain borer. Talukder and Howse (1993) noted similar direct toxicity effect of Pithraj, *Aphanamixis polystacha* on red flour beetle. Roy *et al.* (2005) also reported the direct toxicity of leaf extracts of shyislmutra on rice weevil, *Sitophilus oryzae*. Chloroform extracts of *L. camara* gave the highest reduction (36.7 to 46.9%) of damage by tea mosquito bug followed by petroleum ether extracts of *L. camara* (Deka *et al.*, 2001). Extracts of *Adhatoda vasica* with chloroform, petroleum ether and methanol also gave significant reduction (30.0 to 44.7%) over control. Brinage *et al.* (2004) reported that 5% neem seed extract along with 0.33% endosulfan showed the lowest infestation of diamondback moth larvae (0.4 per plant), cabbage aphids (11.6 per leaf) and tobacco caterpillar (0.5 per plant). However, leaf extracts of *I. carnea, N. odorum* and *A. squamosa* showed minimum advantage over the control. The present observation of reduced egg hatchability by botanicals was similar to other studies, where Rebellos (1994) reported a reduction in egg viability for the cabbage webworm, *Crocidolomia binotalis*

Table 1: Methanol extract of different botanical species against growth and development of *Spodoptera litura*

Botanical	Larval length (mm)	Larval weight (mg)	Larval period (days)	Larval mortality (%)	Pupal length (mm)	Pupal weight (mg)	Pupal period (days)	Pupal mortality (%)	Adult emergence (%)	Egg masses laid	Total no. of eggs	Egg hatching (%)
Azadirachta indica	24.1	522	23.0	82.6	15.9	320	6.7	5.3	12.0	1.3	203	0.0
Pongamia pinnata	26.6	584	22.8	77.3	16.4	330	6.6	6.6	16.6	2.3	393	0.0
Nicotiana tabaccum	33.1	694	19.9	62.6	19.0	425	6.2	4.0	33.3	3.3	741	17.6
Ipomoea batatas	34.4	769	19.1	50.6	20.6	424	5.9	4.0	45.3	5.6	1656	44.3
Datura stramonium	31.4	651	21.3	68.0	18.9	397	6.3	6.6	25.3	3.3	891	35.6
Occimum sanctum	34.1	763	19.0	53.3	21.9	430	6.2	5.3	41.3	5.3	1533	49.6
Bougainvillea glabra	35.2	783	18.8	54.6	20.8	407	6.1	10.6	34.6	3.0	700	28.3
Annona squamosa	34.2	754	19.4	58.6	20.3	404	6.3	5.3	36.0	3.6	858	26.3
Nerium odorum	30.1	634	20.6	76.0	19.6	411	6.5	5.3	18.6	1.0	175	0.0
Carica papaya	29.2	623	21.2	75.3	19.3	379	6.2	9.3	14.6	0.6	133	0.0
Lantana camara	24.0	433	23.1	100.0	--	--	--	--	--	--	--	--
Calotropis procera	22.6	420	22.8	100.0	--	--	--	--	--	--	--	--
Control	38.7	832	18.3	46.6	22.6	463	5.4	4.3	48.0	10.6	3383	71.3
SEm±	**0.72**	**1021**	**0.23**	**2.29**	**0.42**	**11.98**	**0.15**	**--**	**1.48**	**0.60**	**98.41**	**3.05**
CD (P=0.05)	**2.12**	**29.82**	**0.68**	**6.70**	**1.25**	**35.34**	**0.46**	**NS**	**4.37**	**1.77**	**290.31**	**9.01**
CV (%)	**4.12**	**3.72**	**2.95**	**6.71**	**4.76**	**5.20**	**4.37**	**--**	**8.68**	**28.45**	**17.57**	**21.31**

Table 2: Dimethyl sulfoxide extract of different botanicals against growth and development of *Spodoptera litura*

Botanical	Larval length (mm)	Larval weight (mg)	Larval period (days)	Larval mortality (%)	Pupal length (mm)	Pupal weight (mg)	Pupal period (days)	Pupal mortality (%)	Adult emergence (%)	Egg masses laid	Total no. of eggs	Egg hatching (%)
Azadirachta indica	21.5	401	22.4	73.3	14.9	302	--	26.6	00	--	--	--
Pongamia pinnata	23.5	419	21.7	66.6	15.3	313	6.9	16.6	16.6	--	--	--
Nicotiana tabaccum	32.1	626	18.8	63.3	18.8	407	6.0	13.3	23.3	2.0	433	33.4
Ipomoea batatas	32.8	640	18.8	60.0	19.1	413	5.9	10.0	30.0	2.3	533	37.9
Datura stramonium	25.3	442	20.2	66.6	17.7	343	6.4	10.0	23.3	2.0	433	21.7
Occimum sanctum	34.8	694	18.3	46.6	20.3	425	6.1	13.3	40.0	3.6	883	49.7
Bougainvillea glabra	36.3	713	18.1	50.0	20.2	399	6.1	16.6	33.3	3.3	750	48.6
Annona squamosa	29.3	520	19.9	86.6	19.1	391	--	13.3	0.0	--	--	--
Nerium odorum	29.4	517	20.5	76.6	19.2	398	6.3	10.0	13.3	1.3	216	0.0
Carica papaya	27.3	493	20.9	80.0	19.0	361	6.2	10.0	10.0	--	--	--
Lantana camara	24.2	436	21.4	76.6	14.6	328	--	23.3	0.0	--	--	--
Calotropis procera	23.4	421	21.8	90.0	13.8	308	--	10.0	0.0	--	---	--
Control	37.4	736	17.7	36.6	21.2	432	5.8	1.0	53.3	8.0	2450	81.5
SEm±	**0.83**	**18.80**	**0.34**	**6.24**	**0.39**	**14.88**	**0.13**	**--**	**4.17**	**0.62**	**141.11**	**5.31**
CD (P=0.05)	**2.43**	**54.89**	**0.99**	**18.23**	**1.16**	**43.43**	**0.40**	**NS**	**12.19**	**1.91**	**433.06**	**16.31**
CV (%)	**5.07**	**6.00**	**2.98**	**16.11**	**3.93**	**6.95**	**3.79**	**--**	**38.65**	**33.36**	**30.02**	**23.61**

Zeller by neem extract. Similar study of reduced egg hatching by botanicals was also reported by Reddy and Singh (1998). For practical use of these plant extracts as insect pest control agents, further research is required along with safety issues for human health.

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