BIOLOGICAL ACTIVITY OF EXTRACT OF DIFFERENT PLANTS AGAINST TERMITES, NETTLE TREE LEAF BEETLE AND AMALTAS LEAF STITCHER

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Abstract

Seven plant species, namely *Cassia fistula* Linn., *Calotropis procera* R.Br., *Datura alba* Ness, *Lantana camara* Linn., *Myrtus communis* Linn., *Sapium sebiferum* Roxb., and *Thevetia neriifolia* Juss were tested for biological activity at the rate of 5% (5g:100ml) against termites, nettle tree leaf beetle (*Diorhabda lusca)* and amaltas leaf stitcher (*Piesmopoda obliquifasciella).* Decoction of these plant species provided significant protection against termites for three months in the field. *D. alba* and *C. procera* were the most effective against termites with 62.5% protection. While *M. communis* and *L. camara* with 18.5 and 18.75% protection, respectively were the least effective. Similarly, cold water extract of these plant species showed positive biological activity against *D. lusca* and *P. obliquifasciella*. After two weeks, maximum cumulative control of 57.87% and 62.96% was observed due to *D. alba* against *D. lusca* and *P. obliquifasciella,* respectively in the laboratory. Likewise, *C. procera*, *C. fistula*, *L. camara*, *T. neriifolia*, *M. communis*, *S. sebiferum* & the control gave 57.41, 49.54, 34.26, 23.61, 18.92, 15.28 & 0.0 and 55.55, 48.14, 33.33, 18.52, 11.11, 11.11 & 0.0 percent control of *D. lusca* and *P. obliquifasciella*, respectively. Moreover, *C. procera (*2.84%*)*, *C. fistula* (3.24%), *M. communis* (41.28%), *S. sebiferum* (27.29%), *T. neriifolia* (21.56%) and *L. camara* (2.71%) were comparatively more effective against *D. lusca* than *P. obliquifasciella*. But effect of *D. alba* (8.08%) was otherwise.

Key words: Biological activity, plant extracts, botanical pesticides, termites, *Diorhabda lusca*, *Piesmopoda obliquifasciella*, amaltas leaf stitcher, nettle tree leaf beetle

Introduction

Use of natural resources in insect pest management is one of many ways to attain self-sufficiency for developing countries, at least in crop protection discipline. For, these countries pay heavy bills for importing synthetic pesticides. Plant extracts and their products from some indigenous plant species have potential to serve as alternatives for synthetic pesticides. These natural products, besides inexpensive and ecologically accommodative, have capacity to check pest population resurgence and combat pest resistance

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developed against synthetic pesticides (Gupta and Sharma, 1997; Williams et al., 1996). There are various ways through which botanical materials exhibit biological activities against insect pests. Mainly these are: antifeedants, growth regulators, repellent, toxicants and chemosterilants. Botanical materials may exert any of the phenomena mostly in juxta positions (Jaipal, et al., 1983; Jilani, et al., 1991; Chaudhry and Bajwa, 1992; Mondal and Akhtar, 1992; Tahir, et al., 1992; Patil, et al., 1993; Husain, 1995; Lowery and Isman, 1995; Meshram, 1995; Bajwa and Gul, 2001).

Termites, nettle tree leaf beetle (*Diorhabda lusca*) and amaltas leaf stitcher (*Piesmopoda obliquifasciella*) are regular key forest insect pests at the Pakistan Forest Institute Campus, Peshawar. Termites are polyphagous pests distributed widely all over the world. Termite fauna of Pakistan comprised 50 species and is a mixture of the oriental, palearctic and Ethiopian elements. Eleven species have been recorded for damaging woodwork in the building and others are pests of agricultural crops and forest trees (Akhtar and Sarwar, 1995). *D. lusca* is a voracious feeder, both adult and grub stage on the foliage of *Celtis australis* and other species of this genus. They feed on the leaf lamina leaving behind the skeleton of mid rib and veins (Verma, et al., 1993) Heavy foliar damage stunts tree growth and spoils quality and quantity of fodder in agro-forestry plantations. *P. obliquifasciella* is a severe pest of *Cassia fistula* – a multipurpose tree species. Larvae stitch two or more leaves together and feed within them. Attacked leaves present rusty brown look thus impairs aesthetic value and photosynthetic process. A 33-45% foliar damage has been reported due to this pest (Bajwa and Gul, 1995).

In this paper biological activity of seven plant species is studied against termite, nettle tree leaf beetle (*D. lusca)* and amaltas leaf stitcher (*P. obliquifasciella)* in pursuance of seeking out alternatives of synthetic insecticides.

Materials and Methods

Seven plant species, viz. *Cassia fistula* Linn. (Indian laburnum), *Calotropis procera* R.Br. (Ak), *Datura alba* Ness (Thorn apple), *Lantana camara* Linn. (Arippu), *Myrtus communis* Linn. (Myrtle), *Sapium sebiferum* Roxb. (Tallow tree), and *Thevetia neriifolia* (or *Nerium odorum*) Juss (Yellow oleander) were evaluated for biological activity (pesticidal potential) against termites, *Diorhabda lusca* Maulik (Chrysomelidae; Coleoptera) and *Piesmopoda obliquifasciella* (Hamps) (Pyralidae; Lepidoptera). Bark of *C. fistula* while leaves & tender shoots of rest of the six plant species were collected from the field and dried at room temperature in the laboratory. These dried parts of different plant species

were ground finely and were used in various trials.

i. Trials against termites

Five grams finely ground each of the seven plant species were soaked in 100ml tap water and left for over night. Then these solutions were boiled and filtered with muslin cloth. The decoctions were used to work out biological activity (pesticidal potential) against termites. Pieces of drawing paper "DP"(106gm/m^2) were cut (9.0cm dia.) and dipped in different decoctions. For control, pieces of DP were dipped in simple tap water. The treated pieces of DP were dried at room temperature. Small pits (15cm Dia.x15cm depth) were dug in the soil. The pits were filled with water and left open for drying. The dried treated pieces of DP were placed in soil pits and covered with plastic petri dishes. There were three pits per treatment in each replication. The experiment was carried out in randomized complete block design with 8 treatments including control and four replications. First observation was recorded after 15 days of treatment and the subsequent observations on monthly basis. Percentage protection given by different treatments was calculated with the formula:

$$\%\ protection = \frac{\%\,damage\ in\ control - \%\,damage\ in\ test\ treatment}{\%\,damage\ in\ control} \times 100$$

Data of percent protection were analyzed statistically by applying analysis of variance ANOVA) and the least significant difference (LSD) test.

ii Trials against *Diorhabda lusca* and *Piesmopoda obliquifasciella*

The cold water extracts (5g:100ml soaked for 24 hrs) were used for assessing biological activity (pesticidal effects) against *Diorhabda lusca* Maulik (Chrysomelidae: Coleoptera), nettle tree leaf beetle and *Piesmopoda obliquifasciella* (Hamps) (Pyralidae: Lepidoptera), amaltas leaf stitcher in the laboratory. The plant extracts were sprayed on the leaves of *C. fistula* and *Celtis australis* Linn. (Nettle tree) till water running off. Treated leaves were dried at room temperature. For control simple tap water was sprayed on the leaves. The treated leaves were placed in glass petri dishes (8.5cm dia.) on which ten 2nd instar larvae of *P. obliquifasciella* and *D. lusca* were released in each petri-dish. Grubs of *D. lusca* were kept on mild moist soil while larvae of *P. obliquifasciella* in folded leaves in the petri-dishes. They're four petri dishes per treatment per replications. For first two days larvae were fed on treated leaves, here after fresh untreated leaves were fed. Both experiments were carried out separately in randomized complete block design with eight treatments including control and

three replications. Percent control was calculated from recorded larval mortality with the help of Abbott's formula (1925). Data on percent control were analyzed statistically with analysis of variance test (ANOVA) and least significant difference (LSD) test.

Results

Decoctions and cold water extracts of different plant species showed biological activity when good protection and control was provided against termites, *D. lusca* and *P. obliquifasciella*. However, there was a great degree of variation in effectiveness among different trial plant species.

i. Trials against termites

Data on percentage protection provided to "DP" by different plant decoctions against termites are displayed in table 1.

Table 1. Mean percent protection of DP afforded by decoctions of different plant species against termites in the field

Treatments	Observation time after treatment				
	15 days	1 month	2 months	3 months	4 months
C. fistula	75.0**a	75.0**ab	75.0**a	50.0**ab	37.5ns
C. procera	100a	87.5a	68.75a	62.5a	31.25
D. alba	100a	100a	62.50a	62.5a	37.5
L. camara	100a	37.5c	31.25bc	18.75bc	18.75
M. communis	75.0a	50.0bc	25.0cd	18.75bc	12.5
S. sebiferum	100a	75.0ab	50.0abc	29.17abc	0.00
T. neriifolia	75.0a	75.0ab	68.75a	27.08bc	18.75
Control	0.00b	0.00d	0.00d	0.00c	0.00
LSD	27.21	31.34	30.72	34.39	-

** Significant at 99% level of significance

n.s non-significant, – Figures in a column sharing same alphabets are non-significant among themselves (P 0.05)

After 15 days, effect of all plant decoctions was highly significant (P0.01) against control. Cent percent protection was registered by virtue of *C. procera*, *D. alba*, and *L. camara* against zero percent in control. However individual difference among the seven plant species was non-significant. After one, two and three months of treatment, overall protection provided by the botanical materials was also highly significant. On the other hand, after four months

protection was non-significant. After one month of application, *D. alba* gave 100% protection but that was statistically non-significant with that of *C. procera*, *C. fistula*, *S. sebiferum* and *T. neriifolia*. Likewise, there was non-significant difference among *C. fistula*, *M. communis*, *T. neriifolia* and *S. sebiferum*; between *M. communis* and *L. camara*. After two months of treatment, maximum 75% protection was registered by virtue of *C. fistula* versus zero percent in the control. But this protection was non-significant with that of *C. procera*, *D. alba*, *S. sebiferum* and *T. neriifolia*. Moreover, *L. camara* and *S. sebiferum*; *L. camara* *M. communis* and *S. sebiferum*; *M. communis* and control also did not differ significantly among themselves. After three months, maximum 62.5% protection was recorded in *D. alba* and *C. procera* treatments against zero percent in the control. The difference among *C. fistula*, *C. procera*, *D. alba* and *S. sebiferum*; *C. fistula*, *L. camara*, *M. communis*, *S. sebiferum* and *T. neriifolia*; *L. camara*, *M. communis*, *S. sebiferum* and the control was statistically non-significant. Although after four months overall protection was non-significant, but even then 37.5% protection was observed in *C. fistula* and *D. alba*.

ii Trials against *Diorhabda lusca* and *Piesmopoda obliquifasciella*

D. lusca

Data on the mean percent control of *D. lusca* acquired with the help of cold water extracts of different plant species are depicted in table 2.

Table 2. Mean percent control of *D. lusca* obtained with different cold water plant extracts in the laboratory

Treatments	Observation time after treatment				
	24 hours	48 hours	72 hours	1 week	2 weeks
C. fistula	3.70ns	3.70ns	18.52*a	26.85**abc	49.54**a
C. procera	6.67	7.04	18.52a	39.35ab	57.41a
D. alba	3.33	7.41	18.52a	42.59a	57.87a
L. camara	3.33	3.33	7.41ab	30.55abc	34.26bc
M. communis	0.00	3.33	7.41ab	11.11cd	18.92de
S. sebiferum	3.33	3.33	11.11ab	11.11cd	15.28e
T. neriifolia	3.70	4.71	7.41ab	19.44bcd	23.61cde
Control	0.00	0.00	0.00b	0.00d	0.00f
LSD	-	-	11.92	20.58	14.57

** Significant at 99% level of significance, * Significant at 95% level of significance,

n.s. non-significant, – Figures in a column sharing same alphabets are non-significant among themselves (P0.05)

After 24 h and 48 h of treatment, overall control was non-significant. Maximum 6.67% and & 7.41% control of *D. lusca* was demonstrated by *C. procera* and *D. alba* & *T. neriifolia* after 24 h and 48 h *viz.-a-viz.* zero percent in the control, respectively. After 72 h the toxicity effect of botanical materials became statistically significant. Maximum 18.52% control was obtained through *C. fistula*, *C. procera* and *D. alba*. However, the control observed in these three treatments was statistically non-significant with that of *L. camara*, *M. communis*, *S. sebiferum* and *T. neriifolia*. Similarly, *L. camara*, *M. communis*, *S. sebiferum*, *T. neriifolia* and control did not differ significantly among themselves. After one and two weeks of treatment, toxicity effect increased further and reached highly significant level. *D. alba* gave maximum control of 42.5% and 57.87% after one and two weeks, respectively. After one week of treatment, the difference among *C. fistula*, *C. procera*, *D. alba* and *L. camara*; *C. fistula*, *C. procera*, *L. camara* and *T. neriifolia*; *C. fistula*, *L. camara*, *M. communis*, *S. sebiferum* and *T. neriifolia*; *T. neriifolia*, *M. communis*, *S. sebiferum* and control was non-significant. After two weeks, again mixed effect was found. Here, the difference among *C. fistula*, *C. procera* and *D. alba*; between *L. camara* and *T. neriifolia*; *T. neriifolia*, *M. communis; T. neriifolia, M. communis* and *S. sebiferum* were non-significant. Growth of the grubs was slowed down and larval period was also lightly extended. Those grubs, which survived, pupated normally after two weeks.

P. obliquifasciella

Biological activity outcome of cold water extracts of the seven plant species against amaltas leaf stitcher in terms of percent control is presented in table 3.

After 24 h and 48 h of treatment, mortality of the pest was meager and so was the control. Nearly same pattern of control prevailed as was against *D. lusca*, i.e. after 72 h and one week & two weeks control was significant and highly significant, respectively. The variation in individual treatment effectiveness was as follow: after 72 h, 27.04% control was demonstrated by *D. alba* but was statistically non-significant with that of *C. fistula*, *C. procera*, *L. camara* and *T. neriifolia*. Similarly, there was non-significant difference among *C. fistula*, *C. procera*, *L. camara*, *T. neriifolia* and *S. sebiferum*; *C. fistula*, *C. procera*, *M. communis*, *S. sebiferum* and *T. neriifolia*; *C. procera*, *M. communis*, *S. sebiferum* and control. After one week, maximum control of 42.22% was observed due to *D. alba* against zero percent in the control. Nevertheless, this control was statistically non-significant with that of *L. camara*. At the same time the difference among *C. fistula*, *C. procera*, *L. camara*, *S. sebiferum* and *T. neriifolia*; *C. fistula*, *C. procera*, *M. communis*, *S. sebiferum*

and *T. neriifolia*; *M. communis*, *S. sebiferum* and control was non-significant too. After two weeks, maximum control of 62.96% was recorded by virtue of *D. alba* and this control was statistically non-significant with that of *C. fistula* and *C. procera*. Also the difference between *C. fistula* and *L. camara; L. camara* and *T. neriifolia*; among *M. communis*, *S. sebiferum*, *T. neriifolia*; *M. communis*, *S. sebiferum* and control was non-significant. Slow larval growth as well as marginally prolonged larval period was noticed. The larvae, those survived from the treatment were pupated normally after two weeks of application.

Table 3. Mean percent control of *P. obliquifasciella* obtained with different cold water plant extracts in the laboratory

Treatments	Observation time after treatment				
	24 hours	48 hours	72 hours	1 week	2 weeks
C. fistula	0.0ns	3.33ns	17.41*abc	17.78**bc	48.14**ab
C. procera	3.33	3.70	13.70abcd	21.48bc	55.55a
D. alba	0.00	10.0	27.04a	42.22a	62.96a
L. camara	3.33	3.70	24.44ab	25.18ab	33.33bc
M. communis	0.0	0.0	7.04cd	7.41cd	11.11de
S. sebiferum	3.33	3.70	10.37bcd	10.74bcd	11.11de
T. neriifolia	0.0	3.33	17.04abc	17.41bc	18.52cd
Control	0.00	0.00	0.00d	0.00d	0.00e
LSD	-	-	14.92	17.34	20.08

** Significant at 99% level of significance,

* Significant at 95% level of significance,

n.s non-significant, – Figures in a column sharing same alphabets are non-significant among themselves (P 0.05).

Discussion

The results reveal that the seven plant species, i.e. *C. fistula*, *C. procera*, *D. alba*, *L. camara*, *M communis*, *S. sebiferum* and *T. neriifolia* have good biological activity (pesticidal effect as well as regulating capacity) against termites, *D. lusca* and *P. obliquifasciella*. Two source of variation in pesticidal effect are noted, namely effectiveness of botanical materials diversifies with the time factor, secondly with insect species. With a few exceptions, under trial plant species can be categorized according to biological activity in three groups. The groups are most effective, moderate effective and the least effective. *D. alba*, *C. procera* and *C. fistula* are the most effective. Whereas, *L. camara* & *T. neriifolia* and *M. communis* & *S. sebiferum* are moderate effective and least effective, respectively. This categorization is as valid in the laboratory experiments as in the field trials. These results of biological activity (pesticidal potential) are in corroboration with the earlier workers like, Jaipal et al., 1983;

Raman, et al., 1987; Venkatarammireddy, et al., 1993; Patil, et al., 1993; Meshram, 1995. These workers have reported pesticidal potential of *C. fistula*, *C. procera*, *D. alba*, *L. camara* and *T. neriifolia* (*Nerium odorum*) against various insect pests.

Two experiments were carried out in the laboratory under similar conditions, therefore their results are compared in the following paragraphs. Biological activity in both the experiments is more or less same. After two weeks of treatment, overall control of 2nd stage larvae of *D. lusca* and *P. obliquifasciella* shows that for the first 48 hours, the seven plant species are relatively ineffective (Fig. 1).

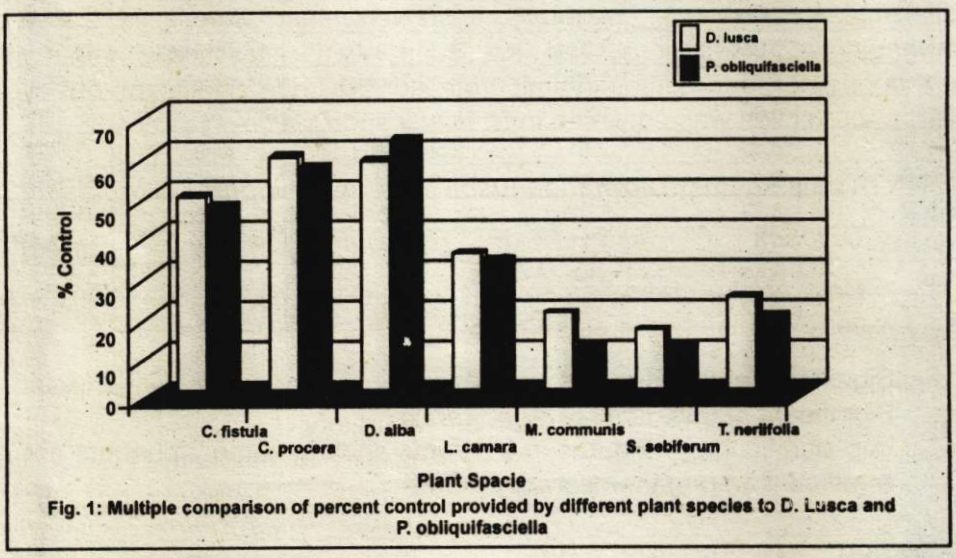

Fig. 1: Multiple comparison of percent control provided by different plant species to D. lusca and P. obliquifasciella

After 48h control of *D. lusca* and *P. obliquifasciella* ranges between 3.33-7.41% and 3.33-10%, respectively versus zero percent in the control. This difference is negligible. Results also indicate that gradual and cumulative control is provided by different plant extracts. After two weeks *C. fistula*, *C. procera*, *M. communis*, *S. sebiferum* and *T. neriifolia* and *L. camara* give 2.83, 3.24, 41.28, 27.29, 21.56 and 2.71 percent more control of *D. lusca* than *P. obliquifasciella*, respectively. On the other hand, *D. alba* affords 8.08% more control of *P. obliquifasciella* than *D. lusca*, respectively.

The results of *D. alba* and *C. procera* are incomparable with Chaudhry and Bajwa (1992), where they reported 90% and 66.67% larval mortality of *Plecoptera reflexa* against 13.3% in control when decoctions of these two plant species were sprayed at the rate of 21% and 15%, respectively. This

discrepancy in the results may be assigned to higher dose rates used by the earlier workers. But the results of *C. fistula* against *D. lusca* and *P. obliquifasciella* are in conformation with those of Bajwa and Gul (2001), where they have recorded 75% larval mortality of *Plusia orichalcea*, after three weeks. Our results of *C. procera*, namely 55.55% and 57.41% control of *D. lusca* and *P. obliquifasciella*, respectively are better than 41.67% larval mortality of *P. orichalcea* reported by Bajwa and Gul (2001).

Conclusion

Almost all the under trial plant species show biological activity in terms of pesticidal effect against termites, *D. lusca* and *P. obliquifasciella*. Among these seven plant species, *D. alba*, *C. procera* and *C. fistula* are most effective. *L. camara* and *T. neriifolia* show moderate effectiveness while *M. communis* and *S. sebiferum* are least effective. The plant species also give recognizable growth regulating impact. On the basis of these results it is recommended that at least three of the test plant species (*D. alba*, *C. procera* and *C. fistula*) should be incorporated in the control programs of these insect pests as alternatives of synthetic insecticides. However, to obtain higher level of control more dose rates should be evaluated.

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