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METABOLIC CHANGES IN SIAMWEED, *CHROMOLAENA ODORATA* INDUCED BY FEEDING OF WEED KILLER, *PAREUCHAETES PSEUDOINSULATA* (ARCTIIDAE: LEPIDOPTERA)

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Abstract: The arctiid caterpillar, *Pareuchaetes pseudoinsulata* Rego Barros, has been identified as a potential bio-control agent of the Siam weed, *Chromolaena odorata* King and Robinson. The present studies were to assess the metabolic changes in the plants induced by larval feeding. The total nitrogen content in leaf samples showed significant variations on 4th, 6th, 8th, 10th, 12th, and 15th days after releasing variable number of *Pareuchaetes* larvae. Total nitrogen was maximum in the leaves, on the sixth day of release of four larvae per plant. Leaf nitrogen showed a declining trend when the larval load per plant was increased from the eighth day of release onwards. The nitrogen content was the least on 15th day after release of twelve larvae. Nitrate nitrogen content showed an increasing trend with increasing number of larvae and days after release. Chlorophyll content in the leaves got reduced significantly with increased larval population load in plants and with the passage of time of confinement of larvae.

Key words: *Chromolaena odorata,* metabolic changes, *Pareuchaetes pseudoinsulata,* Siam weed, weed killer

INTRODUCTION

The Siam weed, *Chromolaena odorata* King and Robinson is an aggressive species of perennial weed widely occurring in the plantations of South India. *Pareuchaetes pseudoinsulata* Rego Barros has been identified as a potential bio-control agent of the weed. It was reported that the *C. odorata* plants showed possible evasive tactics against the insect by a general trend of partial chlorosis in the leaves. Both damaged and undamaged leaves of the plant turned yellow, after attack by the arctiid. This was caused by physiological changes induced in the plants due to chemical stimuli produced by insects (Muniappan and Marutani, 1988). Mc Fadyen *et al.* (1991) studied the changes in leaves due to feeding of the insect and found that the amount of chlorophyll and rate of photosynthesis were reduced in yellow plants. Joy *et al.* (1993) also reported yellowing of the infested weeds in Kerala. The present studies were carried to asses the metabolic changes in plants induced by larval feeding which may help to counteract such responses and thus to ensure sustained efficiency of the insect against the weed.

MATERIALS AND METHODS

Field cages of 3 m height and 1 m diameter, with open bottom were fabricated and these were covered over by mosquito net. Uniform sized C. *odorata* plants collected from the field were planted in pots and the cages were placed over it by pressing the metal frame at the bottom into the soil to prevent the escape of the larvae from the cage. Third instar larvae were released on each plant in varying numbers of 0 (control), 4, 6, 8, 10 and 12 with each treatment replicated thrice. Leaf samples were drawn before the release for analysis of total nitrogen, nitrate nitrogen and chlorophyll ('a', 'b' and total) contents.

Total nitrogen content of the leaves was analyzed by the microkjeldhal method (Piper, 1942). The results were presented as per cent nitrogen in the leaves on dry weight basis. Nitrate nitrogen was determined as per the method of Bremner and Keeney (1965) and presented as percentage of nitrate nitrogen on w/w basis. Chlorophyll 'a' and 'b' and total chlorophyll were estimated following the procedure of Mahadevan and Sridhar (1986). Chlorophyll content was estimated as per cent of the fresh weight of leaves.

RESULTS AND DISCUSSION

When the total nitrogen content in the plant was assessed without considering days after release, it was found that there were significant differences between the six treatments (Table 1). In control, the nitrogen was 2.61 per cent and it was maximum when four larvae were released (2.68 per cent) and minimum when 12 were released (2.47 per cent). It showed a decreasing trend with the increasing number of insects. When total nitrogen content in the plant was analyzed by drawing the leaf samples before release, as well as at 4, 6, 8, 10, 12 and 15 days after release of the larvae without considering the number of lar-

Table 1. Changes in total nitrogen and nitrate nitrogen contents in the leaves due to the larval feeding

Number of larvae released	Total nitrogen (%)	Nitrate nitrogen (%)
0	2.61b	0.17b
4	2.68a	0.20ab
6	2.61b	0.24a
8	2.58c	0.30ab
10	2.53d	0.21ab
12	2.47e	0.21ab

Means followed by the same letter are not significantly different at 5% level

Table 2. Changes in total nitrogen and nitrate nitrogen contents in leaves after release of larvae

Days after release	Total nitrogen (%)	Nitrate nitrogen (%)
0	2.76b	0.18b
4	2.67c	0.18b
6	2.82a	0.25a
8	2.51d	0.21ab
10	2.40e	0.21ab
12	2.32f	0.22ab
15	2.20g	0.22ab

Means followed by the same letter are not significantly different at 5% level

Table 3. Changes in chlorophyll 'a', 'b' and total after release of larvae

Days after release	Chlorophyll 'a' (%)	Chlorophyll 'b' (%)	Total chlorophyll (%)
0	1.47a	1.65a	3.12a
4	0.93b	1.53a	2.46b
6	0.83c	1.32a	2.16c
8	0.76d	1.20a	1.96d
10	0.71d	1.25a	1.96e
12	0.81c	1.04a	1.85f
15	0.65e	0.94a	1.59g

Means followed by the same letter are not significantly different at 5% level

vae released, significant differences were detected. Before release, leaf nitrogen content was 2.76 per cent while four days after release, it came down to 2.67 per cent, but it again increased to 2.82 per cent on the sixth day. Thereafter, a decreasing trend was observed for 8th, 10th, 12th and 15th days after release. It was maximum on sixth day when four larvae were released (Table 2). The in-

Table 4. Changes in chlorophyll 'a', 'b' and total due to the larval feeding

Number of larvae released	Chlorophyll 'a' (%)	Chlorophyll 'b' (%)	Total chlorophyll (%)
0	1.33a	2.09a	3.22a
4	0.95b	1.29ab	2.23b
6	0.87c	1.24ab	2.11c
8	0.80d	1.02b	1.82d
10	0.85c	1.01b	1.86e
12	0.67e	1.03b	1.70f

Means followed by the same letter are not significantly different at 5% level

crease in nitrogen up to 6 days following insect feeding may be the outcome of initial compensatory plant response to recoup from debilitation through enhanced absorption of the nutrients, but subsequent fall in nitrogen could either be due to cessation of the compensatory activity by severe debilitation or metabolic processes. According to Mooney *et al.* (1983), nitrogen is highly mobile and readily metabolized and this is an important element, which contributes to metabolic changes of plants following insect attack. An increase of nitrogenous compounds in insect defoliated tobacco plants was recorded by Baldwin (1988). The results reported in the present studies are in general agreement to the findings of Marutani and Muniappan (1988) who recorded 2.99 per cent total nitrogen in green leaves, which on feeding by *P. pseudoinsulata* got reduced to 2.72 per cent as the leaves turned yellowish. Ohmart *et al.* (1987) indicated that the first instar larvae of *Paropsis atomaria* (Chrysomelidae: Coleoptera) fed on *Eucalyptus blakelyi* leaves with low nitrogen were not able to initiate feeding and died due to leaf toughness. In the present experiment also, indication is that the nutritional deficiency imposed by low nitrogen and the biophysical constraints such as leaf toughness could be the probable defensive reactions in *C. odorata.*

The presence of nitrate nitrogen in the plant was assessed after releasing 0, 4, 6, 8, 10 and 12 larvae on 4th, 6th, 8th, 10th, 12th and 15th days after release of the insect. The results showed that with increase in the number of larvae and as the duration after release increased, there was an increasing trend in nitrate nitrogen content. But the increment did not show any statistical significance. The least nitrate nitrogen was in samples drawn from 'control' and just before release of the insect. Maximum content of nitrate nitrogen was on 15th day after release of the larvae (Table 1 and 2). According to Marutani and Muniappan (1991), nitrate nitrogen was 54.2 $\mu g\ g^{-1}$ in green leaves and 911.4 $\mu g\ g^{-1}$ in yellow leaves.

Chlorophyll:

The results showed that there was a significant decrease in the content of chlorophyll 'a' with increasing insect number. It was maximum in the control and before release of the insect and it was minimum on 15th day after release of 12 numbers of larvae. In respect of chlorophyll 'b' content also, there was a decreasing trend from 2.09 per cent to 1.03 per cent with increasing larval loads and these were significantly different. Maximum content of chlorophyll 'b' was recorded in the control and also before release of the insect, the least being on 15th day at the larval load of 12 numbers. Total chlorophyll significantly decreased with increase in larval load from 4 to 12 days after release. Total chlorophyll was maximum in control and before release of larvae and the least on the 15th day after release.

Similar results were observed by Marutani and Muniappan (1991) and according to them chlorophyll content was much lower in insect infested leaves than leaves from artificially defoliated plants and the artificial defoliation could not produce the same type of yellow leaves caused by the insect attack. Mc Fadyen *et al.* (1991) also reported the changes in leaves due to feeding of insect and found that the amount of chlorophyll and rate of photosynthesis were reduced in yellow leaves.

In general, feeding of *P. pseudoinsulata* on *C. odorata* alters the plant metabolism and this change leads to unfavourable nutritional profile of leaves causing low acceptance by the insect as it feeds. The unsuitability of yellow leaves is reflected in the retarded development of the insect when reared on such materials. It is to be recalled that I and II instar larvae reared on yellow leaves did not survive.

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