

EFFECT OF NEEM DERIVATIVES AND CHITIN INHIBITORS ON SEMI-LOOPER (*CHRYSODEIXIS ERIOSOMA* DOUBLEDAY) AND CATERPILLAR COMPLEX IN CABBAGE

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ABSTRACT

Laboratory and field experiments were carried out to determine the insecticidal and anti-feedant activities on neem (*Azadirachta indica*) derivatives and commercially available chitin inhibitors against semi-loopers (*Chrysodeixis eriosoma*) in cabbage (*Brassica oleracea*). In the laboratory experiment, the mean amounts of leaves consumed by larvae up to the death of pupation from neem oil and chlorfluazuron treatments were reduced from the untreated control by 54.5 and 63.1%, respectively. Pupation did not take place when larvae was fed with neem oil treated leaves and they died within three days of treatment, while when larvae was offered leaves treated with chlorfluazuron, pupation occurred. However, these did not emerge as adults. Under field conditions where *C. eriosoma* and *P. xylostella* are the predominant leaf-eating caterpillars, chlorfluazuron and ethofenprox gave lower leaf damage and higher marketable yield. Neem seed oil was not so promising in the field as in the laboratory. However, it gave significantly higher marketable yield in the yala 90 field experiment. Neem seed water extract also gave a similar result as neem oil.

KEY WORDS: Cabbage, Chitin inhibitors, Neem, Semi-looper.

INTRODUCTION

Cabbage (*Brassica oleracea* L.) is a widely grown vegetable crop in the upcountry region of Sri Lanka and is affected by a wide range of insect pests. Among these, semi-loopers (*Chrysodeixis eriosoma* Doubleday) and diamond-back moth (*Plutella xylostella* L.) are considered as the major pests. As insecticides are widely used to control these insect pests, overuse of insecticides is common in this region. During periods of high infestation, insecticides are used indiscriminately without taking adequate precautions and giving adequate consideration to recommended pre-harvest intervals. Such practices are bound to result in environmental pollution and harmful insecticide levels in vegetables consumed by the people. It is therefore necessary to select safer and low toxic insecticides that can economically control the pest complex in cabbage.

The control of insects using insect growth regulators (IGR) is a sophisticated form of chemical control. These compounds are effective when applied in small quantities and apparently have no harmful effects on human and wild life.

In recent years, neem (*Azadirachta indica* A. Juss) has been widely investigated as a source of natural insecticides. Derivatives of neem have traditionally been used by farmers in Asia and Africa to ward-off insect pests. Unlike ordinary insecticides based on single active ingredients, derivatives of neem comprise a complex array of novel compounds which have diverse behavioural and physiological effects on insects (Saxena, 1989). The Chemistry of neem compounds has been reviewed by Jacobson (1981, 1986) and Kraus *et al.* (1986). Repellency, feeding and oviposition deterrence, growth and reproduction inhibition, and other effects have been attributed to neem compounds, azadirachtin, salannin, meliantrion and other limonoid insect growth inhibitors, that occur mainly in the seed (Saxena, 1989). These effects and safeness to non-target organisms including humans, make them to be ideal insecticides.

In view of this, laboratory investigations were carried out to compare the insecticidal effects of neem oil and commercial chitin inhibitors on semi-loopers in cabbage. In addition a field study was conducted to evaluate the efficacy of neem derivatives and chemical insecticides on the control of cabbage pest complex. The paper reports the results of these studies.

MATERIALS AND METHODS

Laboratory and field investigations were carried out at the Regional Agricultural Research Centre, Bandarawela.

Laboratory experiment

In the laboratory experiment, 20 cabbage seedlings (Cv. Gloria F1) were planted in clay pots and placed in the glasshouse under normal environmental conditions (mean temperature 25°C and RH 70%). Each group of four plants was sprayed with 1% neem oil + 0.2% surfactant-S, 0.1% chlorfluazuron, 0.1% diflubenzuron, 0.1% triflumuron

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and water using a 500 ml hand sprayer to wet both sides of the leaves. Leaf discs of 9 cm were removed from each plant just after treatment and were placed in separate plastic petri dishes lined with moistened filter paper. Holes were made on the lids of petri dishes and covered with pieces of net cloth in order to permit ventilation and prevent the escape of larvae. The experiment was laid out in a randomized complete block design with four replicates.

The semi-looper larvae used in this assay were collected from the field. Two larvae of same size starved for one hour were introduced into each petri dish and were allowed to feed on the leaf discs. Twenty-four hours after introduction of the caterpillars, the leaf area of the discs consumed by the larvae was measured using a graph paper. Fresh leaf discs obtained from the same treated plants were introduced into the different petri dishes and the above procedure was repeated after every 24 hours up to the death or pupation of all the larvae, and the total leaf area consumed was measured. During the entire period, observations on mortality and pupation of the larvae were also made. The leaf weight (dry) consumed was determined by multiplying the difference in area of the leaf discs before and after consumption, by the specific leaf weight (SLW). The SLW is the leaf dry weight per unit area of the leaf. The leaf dry weight was determined by determining dry weight of 10 leaf discs after drying at 80°C for 24 hours.

Field experiment

The field experiments were carried out in maha 89/90 and yala 90. Eight insecticidal treatments were tested; the treatments were arranged in a randomized complete block design with three replicates (Table 1). Cabbage (Cv. Gloria F1) was planted in 4 m × 2 m plots at a spacing of 50 cm × 40 cm.

For the preparation of 3% aqueous solution of neem seed extract, 30 g of powdered seed kernel was loosely bundled in muslin cloth bag and soaked in one litre of water with 2 ml of surfactant-S for 12 hours. The material in cloth bag was squeezed. After rejecting the hard particles the extract was used for spraying.

Table 1. Insecticides and dosages used in the field experiments

Common name	Trade name	Rate (ml/ha)	Dilution (ml/l)
Neem oil	—	4800	8.0
Diffubenzuron	Dimilin	600	1.0
Triflazuron	Alsystin 480 SE	600	1.0
Chlorfluazuron	Atabron 5 ES	405—600	1.0
<i>Bacillus thuringiensis</i>	Larvo-Bt	150—250*	0.4
Ethofenprox	Trebon 10 EC	750	1.3
Quinalphos	Ekalux 25 EC	600—750	1.3
Neem seed extract (water)	—	—	30**
Control	—	—	—

*ml/l; **g/l

Application of all insecticides was started after the first signs of damage by both *C. eriosoma* and *P. xylostella*, continued at two-week intervals and stopped 4 weeks before harvest. All applications were done with a hand-operated knapsack sprayer. The spray fluid required per hectare was taken as 700 l (high volume spray). Leaf area damaged (maha 89/90) was assessed in 10 randomly selected plants per plot using the following scale:

1=No damage; 2=1–5% of the leaf area damaged; 3=6–10% of the leaf area damaged; 4=11–25% of the leaf area damaged and 5=over 25% of the leaf area damaged. Marketable yield of cabbage per plot was also taken.

The cost of cabbage cultivation, excluding the insecticides and their application amounted to Rs. 14250/ha. The grower's selling price for cabbage during maha 89/90 and yala 90 was fixed at Rs. 5/kg. The net income was calculated by taking the difference between gross income obtained by the grower for the produce and the cost of cultivation, including the insecticides and their application. The benefit: cost ratio was calculated by dividing the additional income over control by the additional cost incurred for pest control.

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The results revealed that increasing the number of ramets per planting hole had a significant effect on bush height, bush width and number of leaves/ramets only up to 70 DAP. Since there is less competition at the early stage of growth, increasing number of ramets per planting hole would have resulted in a consequent increase in plant growth. But there was no significant effect on these growth parameters at 70 DAP, indicating that at later stages, competition results in a uniform establishment of the crop. Green leaf yield was also unaffected by increase in the number of ramets per hole (Table 2). Since there is often a possibility of planting more than one ramet per planting hole, this finding is of value in any studies undertaken with *C. asiatica* in the future.

Table 1. Green leaf yield of three accessions of *C. asiatica*

Accessions	Green leaf yield (t/ha)			
	maha 1986/87		yala 1987	
	First harvest	Second harvest	First harvest	Second harvest
G1	9.8	11.9	10.7	16.6
G2	9.8	12.5	9.3	14.8
G3	6.8	5.2	5.8	9.7
LSD (0.05)	1.0	2.6	2.8	3.0
CV(%)	20.1	16.0	16.4	9.5

Table 2. Effect of number of ramets per planting hole on green leaf yield of *C. asiatica*

Number of ramets per planting hole	Green leaf yield (t/ha)			
	maha 1986/87		yala 1987	
	First harvest	Second harvest	First harvest	Second harvest
1	7.8	9.1	8.0	12.9
2	9.7	10.2	9.0	14.0
3	9.0	10.4	8.9	14.1
	NS	NS	NS	NS
CV(%)	20.1	16.0	16.4	9.5

NS—not significant

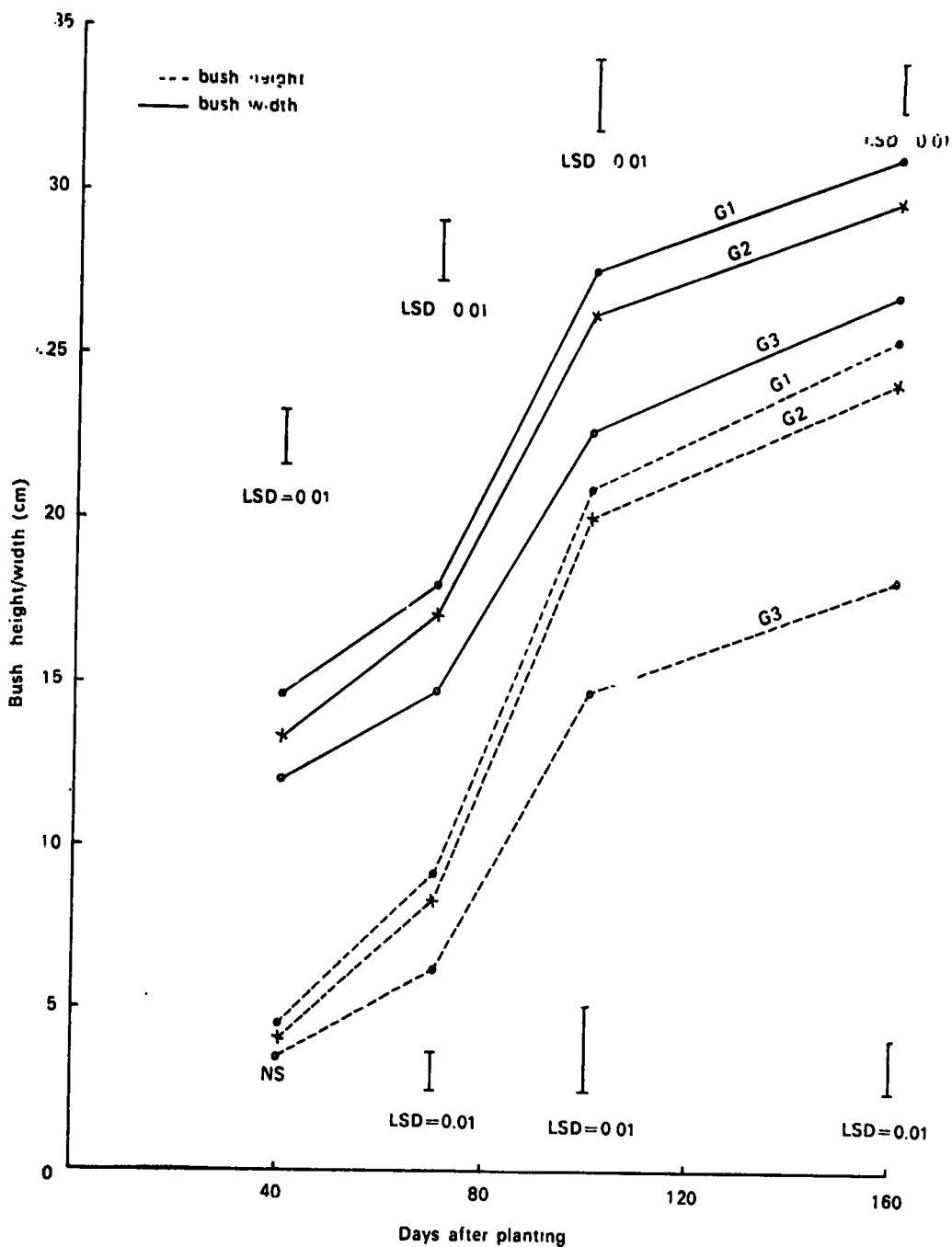


Fig. 1. Bush height and width of three accessions of *C. asiatica* (G1, G2 and G3) at different growth stages (maha 1986/87)

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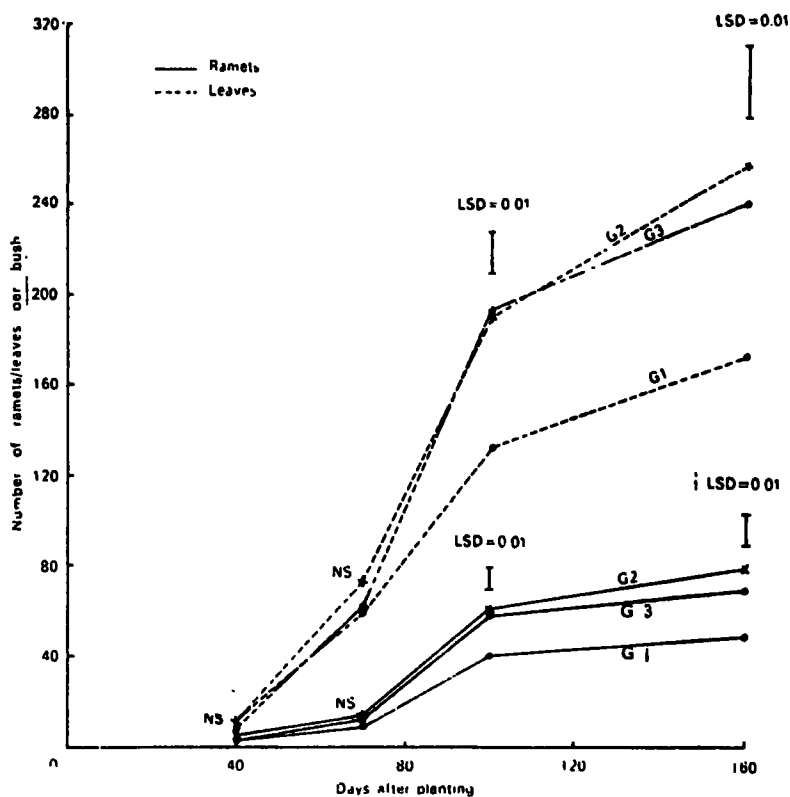


Fig. 2. Number of ramets and leaves produced by the three accessions of *C. asiatica* (G1, G2 and G3) at different growth stages (maha 1986/87).