

horse gram and castor. Economicswise, cowpea and castor have been found to fetch more profit. From the study, it could be concluded that contour ploughing and borad-based ridging were better *in-situ* moisture conservation practices for red soils of Chidambaranar district of Tamil Nadu.

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INTEGRATED MANAGEMENT OF TOMATO FRUIT BORER WITH INSECTICIDES, NEEM PRODUCTS AND VIRUS

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ABSTRACT

Field trials were conducted to assess the efficacy of insecticides, neem products and *Helicoverpa* nuclear polyhedrosis virus (NPV) as an individual component and integrated components in controlling fruit borer, *Helicoverpa armigera* in tomato. Application of NSKE 3% + endosulfan 0.035% + NPV @250 LE/ha thrice at 45, 55 and 65 days after planting was found to be superior in causing higher larval mortality and reducing the fruit damage with higher fruit yield followed by application of neem oil 3% + endosulfan 0.035% + NPV @250LE/ha and endosulfan 0.07%. When the cost benefit ratio was considered, endosulfan 0.07% stood first followed by NSKE 3% + NPV @250 LE/ha and NSKE 3% + endosulfan 0.035% + NPV @250 LE/ha. Thus the integrated approach may also be adopted in place of insecticides for the better control of *H. armigera* and higher return in tomato.

KEY WORDS : *Helicoverpa armigera*, tomato, integrated management.

The gram caterpillar, *Helicoverpa armigera* (Hubn.) is a pest on many field and horticultural crops in India and its severity was more during cooler months. Efficacy of insecticides (Hari Radhavendra Rao *et al.*, 1990), neem seed extract spray (Abdul Kareem, 1980) and nuclear polyhedrosis virus (NPV) (Santharam *et al.*, 1981) was reported earlier on a number of crops. Very limited reports are available for the control of *H. armigera* in tomato. Thus, the study was made to find out the efficacy of insecticides, neem products and Heliothis NPV in an integrated approach.

MATERIALS AND METHODS

Field trials were conducted for three seasons during 1989-1990 to 1991-1992 at Macheri Sheep Research Station, Pottaneri. The efficacy of

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insecticides, neem products and NPV in controlling the fruit borer, *H. armigera* was tested on Paiyur 1 tomato variety in a randomised block design with nine treatments and three replications (Table 1). In each season, three rounds of sprayings (650 l spray fluid/spray) were given at 45,55 and 65 days after planting. Observations on the number of larvae present on five plants and number of fruits damaged were taken at 10 days after each spray. Yield data were also recorded for healthy fruits.

RESULTS AND DISCUSSION

The results showed significant differences among the treatments for larval mortality and fruit damage by *H.armigera*. All the treatments were significantly superior to control. The mean data showed that higher larval mortality was observed in

Table 1. Effect of insecticides, neem products and virus on larval mortality of *Heliothis armigera*

Treatment	Mean larval mortality (%)			
	1989-90	1990-91	1991-92	Mean
Endosulfan 0.07%	92.87 (76.39)	92.40 (77.06)	80.81 (64.40)	88.89 (72.62)
Flubenzuron 75g ai/ha	52.93 (46.70)	49.73 (45.18)	55.32 (48.08)	52.66 (46.54)
ISKE 10%	61.04 (51.43)	56.68 (48.94)	49.06 (43.44)	55.59 (47.94)
Neem oil 5%	42.73 (40.72)	43.08 (40.66)	36.22 (36.91)	40.68 (39.43)
NPV 250LE + cude sugar 10%	61.86 (51.84)	52.13 (46.32)	52.71 (46.54)	55.57 (48.27)
ISKE 3% + NPV 250LE	68.62 (56.33)	68.36 (55.92)	47.29 (43.43)	61.42 (51.90)
ISKE 3% + NPV 250LE + Endosulfan 0.035%	100.00 (90.00)	98.77 (87.83)	97.90 (86.04)	98.89 (87.96)
Neem oil 3% + NPV 250LE	72.02 (58.11)	70.04 (57.22)	55.48 (48.40)	65.85 (54.57)
Neem oil 3% + NPV 250LE Endosulfan 0.035%	90.67 (72.34)	89.50 (71.20)	86.14 (69.99)	88.77 (71.18)
Untreated Control	7.39 (15.86)	7.73 (15.97)	8.80 (17.02)	7.97 (16.28)

Figures in the parentheses are arc sine transformed values

D (P=0.05)

Treatments : 1.52

Seasons : 0.83

Interaction : 3.49

Plots sprayed with neem seed kernel extract @250LE/ha followed by 12.07 per cent in neem oil (NSKE) 3% + endosulfan 0.035% + NPV 3% + endosulfan 0.035% + NPV @250LE/ha and

Table 2. Effect of insecticides, neem products and virus on fruit damage by *Heliothis armigera* and yield

Treatment	Mean fruit damage (%)				Fruit yield (kg/ha)*	C:B ratio
	1989-90	1990-91	1991-92	Mean		
Endosulfan 0.07%	15.08 (22.44)	13.70 (21.37)	20.80 (26.67)	16.53 (23.47)	14950	13.64
Flubenzuron 75g ai/ha	19.31 (25.80)	20.05 (26.33)	34.56 (35.74)	24.64 (29.29)	14190	3.71
ISKE 10%	21.13 (27.16)	23.12 (28.49)	40.10 (38.93)	28.12 (31.53)	12950	9.64
Neem oil 5%	27.21 (31.20)	28.10 (31.70)	39.49 (38.20)	31.60 (33.87)	12655	5.48
NPV 250 LE + cude sugar 10%	21.66 (27.60)	24.96 (29.73)	31.80 (33.73)	26.14 (30.42)	13225	12.74
ISKE 3% + NPV 250 LE	17.09 (24.18)	19.86 (26.89)	26.71 (30.73)	21.22 (27.26)	14795	13.33
ISKE 3% + NPV 250 LE Endosulfan 0.035%	10.53 (18.69)	7.04 (15.24)	11.50 (19.66)	9.69 (17.86)	16725	12.89
Neem oil 3% + NPV 250 LE	20.99 (27.07)	21.42 (27.47)	34.42 (35.62)	25.61 (30.05)	13785	9.98
Neem oil 3% + NPV 250 LE Endosulfan 0.035%	11.48 (19.64)	9.89 (18.27)	14.84 (22.53)	12.07 (20.15)	15785	8.16
Untreated Control	60.79 (51.34)	71.95 (58.26)	76.30 (62.06)	69.68 (57.22)	8130	

Mean of three seasons

Figures in parentheses are arc sine transformed values

D (P=0.05)

Treatment : 1.32

Interaction : 2.59

Season : 0.73

Yield : 1440

16.53 per cent in endosulfan 0.07% (Table 2). More larval mortality and less fruit damage in these treatments might be due to combined attack of all components (Narayanan and Gopalakrishnan, 1990) or an additive effect of neem products and NPV with endosulfan (Jayaraj *et al.*, 1985). Control registered 69.68 per cent fruit damage.

Rabindra and Jayaraj (1988) reported that application of NPV @250LE/ha in 20% crude sugar as ULV was found to be effective against *H. armigera* in chickpea. But in the present study, application of NPV @ 250LE/ha + 10% crude sugar did not give effective control. In the present study, combinations NSKE 3% and neem oil 3% with NPV @250LE/ha + endosulfan 0.035% were found to be highly effective in controlling *H. armigera* as that of endosulfan 0.07%.

The fruit yield was also maximum in these treatments. However, when the cost benefit ratio was considered, it was high in endosulfan 0.07% (1:13.64), NSKE 3% + NPV @250LE/ha (1:13.33), NSKE 3% + endosulfan 0.035% + NPV @250LE/ha (1:12.89) and NPV @250LE/ha + 10% crude sugar (1:12.74) (Table 2). Thus, integration of NPV of *Heliothis* with neem seed kernal extract and endosulfan may also be adopted in place of endosulfan 0.07% for the control of *H. armigera* and higher return in tomato.

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CORRELATION, REGRESSION AND PATH COEFFICIENT ANALYSIS IN RAINFED LINSEED

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ABSTRACT

Nineteen linseed (*Linum usitatissimum*L.) genotypes were evaluated in 1990-91 to 1994-95 in five environments for seven characters. A high significant positive association had been observed between seed yield/plant and days to maturity. Plant height, number of primary branches/plant, number of secondary branches/plant and number of capsules/plant. Multiple regression equation revealed the importance of the number of primary branches/plant and number of capsules/plant for contribution to yield.

KEY WORDS : Correlation, linseed, *Linum usitatissimum*, path coefficient

Linseed (*Linum usitatissimum*L.) is predominantly a self-pollinated crop of industrial importance. The use of linseed oil in the manufacture of varnish and paints and its fitness in

certain types of textiles and paper is well known. It is cultivated in India in over 2.0 million ha, but its average yield in this country is quite low (224 kg/ha). The production of this crop has therefore to