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Evaluation of different IPM modules against *Helicoverpa armigera* Hubner infesting chickpea

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ABSTRACT

In a field experiment conducted at Sriganganagar for the control of gram pod borer (*Helicoverpa armigera*, Hubner) infesting chickpea crop, different modules of integrated pest management (IPM) comprising endosulfan 0.75%, neem oil 0.%, Nuclear Polyhedrosis Virus (*Ha*NPV) @ 450 LE/ha and *Bacillus thuringiensis* 1000 ml/ha were evaluated. Among the modules tested, three sprays of endosulfan was found the most effective in controlling gram pod borer (6.83% pod damage) resulting in the maximum grain yield (2489 kg/ha). This was followed by the module of *neem* oil-*Ha*NPV-endosulfan (7.92% pod damage and 2267 kg/ha yield). The cost benefit ratio (CBR) varied from 0.17 to 6.97. The maximum CBR (4.14) was recorded in the three sprays of endosulfan as against 6.97 in the recommended spray schedule (RSS). The spray of *neem* oil and *Ha*NPV alternated with endosulfan was also found effective against the pest with a CBR 1: 2.92.

Key words: *Bacillus thuringiensis*, CBR, Chickpea, *Cicer arietinum*, Endosulfan, *Ha*NPV, *Helicoverpa armigera*, *Neem* oil

Chickpea (*Cicer arietinum* L.) is the most important pulse crop in India. Gram pod borer (*Helicoverpa armigera*, Hubner) is the major yield constraint in chickpea and has been reported to cause losses ranging from 20 to 80% in different parts of the country. The chemical control measures adopted against this pest are found to be insufficient as the pest is known to develop resistance to most of the chemical insecticides. There is an immediate need to develop non-insecticidal approach for its effective control. Integrated Pest Management (IPM) strategy which integrates biological, botanical and chemical insecticides is one way of minimizing the adverse environmental effect in pest control (8). Keeping this in view, the present study was carried out to assess the performance of some of the modules based on biorationals and insecticides against gram pod borer.

MATERIALS AND METHODS

A total of 11 IPM modules consisting of plant products, bio-pesticides and chemical insecticides were tested in a randomized block design with three replications at Agricultural Research Station, Sriganganagar during *rabi* season of 1999-2000 and 2000-01. Chickpea variety GNG 469 was sown is six-row plots, each row of 3.9 m length with row to row and plant to plant distances of 30 and 10 cm. Standard cultural practices were followed as per the recommendations. The IPM modules were compared with recommended spray schedule (RSS) of the region. At the time of harvesting, healthy and damaged pods were counted on 10 randomly selected plants from each plot. Yield data was recorded on plot basis. Interaction of pod damage and seed yield, and cost benefit ratio were calculated following standard statistical methods.

RESULTS AND DISCUSSION

The module, consisting of three sprays of endosulfan had minimum pod damage (6.83%) followed by RSS (7.05%), *neem* oil-*Ha*NPV-endosulfan (7.15%) and *Ha*NPV-*Ha*NPV-endosulfan (7.92%) (Table 1). Similar findings were observed earlier (5, 6). Modules of three sprays of *Ha*NPV, *neem* oil-*neem* oil-endosulfant, *Bt-Bt*-endosulfan and *Bt-Ha*NPV-endosulfan existed in the middle order of efficacy registering 8.66, 8.71, 9.04 and 9.43% pod damage, respectively. The present investigation corroborated the observations of Sarode *et al.* (7). The modules of three sprays of *Bt* (10.95%), *neem* oil-*Bt-Ha*NPV (10.15%), three sprays of *neem* oil (10.11%) and *Bt-neem* oil-endosulfan (9.80%) were least effective. Similar trends were observed by Ali *et al.* (1) and Sharma (9) but were contrary to the findings of Kulat *et al.* (3) and Shenhmar *et al.* (10).

The pooled data of grain yield (Table 1) revealed that the maximum grain yield was obtained from RSS (2520 kg/ha) followed by endosulfan (2489 kg/ha) and *neem* oil-*Ha*NPV-endo (2267 kg/ha). Similar observations were also reported by Khan *et al.* (2) and Sanap and Pawar (6). The grain yield obtained in *Ha*NPV-*Ha*NPV-endosulfan (2158 kg), three sprays of *Ha*NPV (2095 kg), *Bt-Bt*-endosulfan (2005 kg), *neem* oil-*neem* oil-endosulfan (20.33 kg) and *Bt-Ha*NPV-endosulfan (1980 kg/ha) was also significantly superior to the control. These findings are in agreement with earlier reports (4, 5). Three spray of *Bt* (1853kg/ha), alternate spray of *neem* oil-*Bt-Ha*NPV (1900kg/ha) and three spray of *neem* oil (1932 kg/ha) at 10 days interval proved less effective in controlling the damage, resulting in poor grain yield in chickpea.

The maximum increase (909.50kg/ha) in grain yield over the control was recorded with RSS (Table 2) followed by three sprays of endosulfan (878.5 kg), *neem* oil-*Ha*NPV-endosulfan (653.5 kg) and *Ha*NPV-*Ha*NPV-endosulfan (547.5 kg/ha). The modules of *neem* oil - *neem* oil-endosulfan, three sprays of *Ha*NPV, three sprays of *neem* oil, *Bt-Ha*NPV-endosulpan and

Table 1. Efficacy of different IPM modules against *H. armigera* during 1999-2000 and 2000-2001

Treatments	Mean pod damage* (%)			Mean yield* (kg/ha)		
	1999-2000	2000-2001	Pooled	1999-2000	2000-2001	Pooled
Neem oil 0.5%; *Bt* 1000 ml/ha, *Ha*NPV 450 LE/ha	10.50 (18.90)	9.80 (18.24)	10.15 (18.57)	1858	1942	1900
Three sprays of *Ha*NPV	9.53 (17.98)	7.80 (16.21)	8.66 (17.09)	2083	2108	2095
Three sprays of *Bt*	11.50 (19.82)	10.40 (18.81)	10.95 (19.31)	1845	1861	1853
Three sprays of Neem oil	11.43 (19.76)	8.80 (17.25)	10.11 (18.50)	1916	1958	1937
NPV-*Ha*NPV-Endosulfan @ 0.75 kg/ha	8.33 (17.28)	7.50 (15.89)	7.92 (16.58)	2108	2208	2158
Bt-Bt-Endosulfan	10.36 (18.77)	7.73 (16.14)	9.04 (17.45)	1983	2026	2005
Neem oil-*Neem* oil-Endosulfan	9.60 (18.04)	7.83 (16.25)	8.71 (17.15)	2012	2054	2033
Bt-NPV-Endosulfan	10.90 (19.27)	7.96 (16.39)	9.43 (17.83)	1958	2001	1980
Neem oil-NPV-Endosulfan	8.13 (16.56)	6.16 (14.41)	7.15 (15.48)	2220	2304	2262
Bt-Neem oil-Endo sulfan	10.50 (18.90)	8.86 (17.32)	9.68 (18.11)	1942	1983	1962
Three sprays of endosulfan	7.86 (16.28)	5.80 (13.92)	6.83 (15.10)	2458	2520	2489
Methyl parathion 2% dust @ 24 kg/ha, Endosulfan 0.75 kg/ha, Fenvalerate 400ml/ha (RSS)	7.56 (15.96)	6.53 (14.29)	7.05 (15.13)	2499	2541	2520
Control (Untreated)	22.80 (28.52)	18.80 (25.69)	20.80 (27.11)	1554	1667	1610
SEm±	0.27	0.22	0.17	52	50	36
CD at 5%	0.78	0.63	0.49	151	147	102

* Average of three replications. Figures in parentheses are angular transformed value.

Table 2. Comparative economics of different IPM modules for the control of *H. armigera*

Treatments	Mean yield (kg/ha)	Increase yield over control (kg/ha)	Cost of increased yield (Rs)	Expenditure (Rs)	Net monetary return (NMR) (Rs)	Cost : Benefit ratio (CBR)
Neem oil-*Bt*-NPV	1900.0	289.5	3112	2376	736	1:0.31
Three sprays of *Ha*NPV	2033.0	422.5	4542	2076	2466	1:1.18
Three sprays of *Bt*	1853.0	242.5	2607	3576	-969	(-)
Three sprays of *Neem* oil	2004.5	394.0	4235	1476	2759	1:1.87
*Ha*NPV-*Ha*NPV-Endosulfan	2158.0	547.5	5886	1996	3890	1:1.95
Bt-Bt-Endosulfan	1937.0	326.5	3510	2996	514	1:0.17
Neem oil-*Neem* oil-Endosulfan	2095.5	485.0	5214	1576	3638	1:2.31
*Bt-Ha*NPV-Endosulfan	1979.5	369.0	3967	2496	1471	1:0.59
Neem oil-NPV-Endosulfan	2264.0	653.5	7025	1796	5229	1:2.92
Bt-Neem oil-Endosulfan	1962.5	353.0	3795	2296	1499	1:0.65
Three sprays of Endosulfan	2489.0	878.5	9444	1836	7608	1:4.14
RSS	2520.0	909.5	9777	1226	8551	1:6.97
Check	1610.5	-	-	-	-	-

RSS= Recommended Spray Schedule; Methyl parathion 2% dust, Endosulfan, Fenvalerate
Bt - Bacillus thuringiensis, *Ha*NPV - *H. armigera* nuclear polythecresis virus
Market rate of the grain = Rs. 1250/q.; Cost of inputs /l: endosulfan = Rs. 210.; *neem* oil = Rs. 150;
*Ha*NPV 450LE = Rs. 500; Bt. Methyl parathian = Rs.6/kg; Fenvalerate = 200/lit.

Bt-neem oil-endosulfan registered 485, 422.50, 394, 369 and 353 kg/ha yield increase. Minimum yield increase was recorded in module Trree spays of *Bt* (242.50 kg) followed by *neem* oil-*Bt*- *Ha*NPV (289.5 kg) and Bt-Bt-endosulfan (326.50 kg). The highest return of Rs. 8551 was obtained from the crop protected with RSS followed by three sprays of endosulfan (Rs. 7608) and *neem* oil- *Ha*NPV-endosulfan (Rs. 5229). The Cost Benefit Ratio (CBR) varied from 0.17 to 6.97. The maximum CBR (6.97) was recorded in RSS followed by three sprays of endosulfan (4.14), *neem* oil-*Ha*NPV-endosulfan (2.92) and *neem* oil-neem oil-endosulfan (2.31). The CBR less than one was recorded in all the modules where *Bt* was one of the components. These modules were *Bt-Bt*-endosulfan (0.17), *neem* oil-*Bt-Ha*NPV (0.31), *Bt-Ha*NPV-endosulfan (0.59) and *Bt-neem* oil-endosulfan (0.65). These results corroborate the findings of Sanap and Pawar (6) and Singh *et al.* (11).

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