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TESTING OF IPM MODULES FOR THE MANAGEMENT OF POD BORER *HELICOVERPA ARMIGERA* IN CHICKPEA

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ABSTRACT

An experiment was conducted during rabi seasons 2006-07 and 2007-08 at, Tikamgarh to test the different IPM modules against the incidence of pod borer. Among these modules M3 (chemical) was found superior in comparison to the other module M_2 and M_1 in controlling the incidence of pod borer and pod damage. However, mean number of pods per plant were significantly higher in organic module M_1 in comparison to rest of the modules. Grain yield was also higher in organic module (1808 and 1872 kg ha^{-1}) as compared to chemical module (1727 and 1822 kg ha^{-1}) and organochemical module (1626 and 1802 kg ha^{-1}) which was perhaps due to higher number of pods in this module (27.7 and 43.1 per plant) as compared to chemical module (25.4 and 37.7 per plant) and organochemical module (24.0 and 33.5 per plant). Incremental C:B ratio were 7.4, 5.3 and 9.7 during 2006-07 and 9.3, 7.9 and 6.7 during 2007-08 in respective module (M_1 - M_3). Mean C:B ratio was almost similar in M_1 and M_3 and lower in M_2.

Keyword: Testing, IPM modules, pod borer, chickpea

INTRODUCTION

In Madhya Pradesh, chickpea (*Cicer arietinum* L) is cultivated on an area of 3.09 million hectares with the production of 3.30 million tonnes. However, the productivity (1071 kg ha^{-1}) is much low (Anonymous 2009-10). The major cardinal factors for its low yield are the damage caused by gram pod borer, *Helicoverpa armigera* (Hubner) from vegetative to podding stage (Dhingra *et al*., 2003). It is a polyphagous pest and attacks over 182 host plants. Chickpea is the most preferred host of this species and suffers losses to the tune of 25-70 % (Tripathi and Sharma, 1984). *H. armigera* is becoming increasingly important and more acute in northern state of India including M. P. (Jadhav *et al*., 1999). It is a very serious pest and has assumed the status of national pest in India because of its high fecundity, migratory behaviour, high adaptation to various agro climatic conditions and development of a very high degree of resistance to a long range of insecticides (Gowda, 1996). Therefore, it became desirable to integrate the various methods of control like plantation of pheromones traps (to trap male moth), bird purchers (to attract insectivorous birds), use of botanicals, biopesticides and chemical pesticides to combat the menace of this pest. In present study, such IPM modules have been tested against this pest.

MATERIALS AND METHODS

The experiment was conducted at the Research Farm, College of Agriculture, Tikamgarh (M. P.) during *rabi* seasons of 2006-07 and 2007-08. The crop was sown in the middle of November during both the years at a row distance of 30 cm and plant to plant distance 5-10 cm. Plot size was 15 m X 15 m. The crop was grown on recommended agronomic practices. There were four modules during both the years. Organic modules M_1 comprised of 400 bird percher per ha + three foliar sprays respectively of NSKE (in cow urine) -3%, NPV 250LE per ha and *Bacillus thuringiensis* (Helicop) -0.2%. Organochemical module M_2 consists of 400 bird percher per ha + three foliar sprays respectively of cow butter milk-4 %, *Bacillus thuringiensis* – 0.2% + cypermethrin-0. 01%. In chemical module M_3, three foliar spray of cypermethrin -0.01 % were applied during 2006-07. Whereas during 2007-08 , in module M1 and M_2, pheromone trap were also planted @ 10 trap per ha in the 3^{rd} week of December and lure were changed twice at monthly intervals. In module M_3 during 2007-08, first spray was of quinalphos -0.05% followed by cypermethrin -0.01% and third spray of indoxicarb- 0.01%. Three foliar sprays were applied first at 50 % flowering and then at interval of 15 days. Neem seed kernel extract in cow urine was prepared by soaking 300 gram powder of neem seed kernel in one liter cow urine for 7 days, thereafter the content was filtered through a muslin cloth and the residue on the muslin cloth was squeezed until all whitish material oozed out. The filtrate was made up to 3.0 liter and 30 ml extract was mixed per liter of water. Cow butter milk was also kept for 10-15 days in plastic containers. It was filtered at the time of spray and filtrate was mixed @ 40 ml per liter of water. For the preparation of spray solution of these two indigenous biorationals, required quantity of filtrate was taken into a plastic bucket and liquid detergent ezee was taken @ 0.5 ml per liter of spray solution then some water was taken in the bucket. The solution was stirred until a good fermentation and then mixed in the required quantity of water in the spray machine. Observations on the population of pod borer larvae were recorded at randomly selected 20 places in each plot on one meter row length before and after 2, 7 and 15 days of each spray. Mean number larvae per meter row were computed. Total number of pods and number of damaged pods were counted of 100 plants from each plot and mean total number of pods per plant; undamaged (healthy) pods per plant and % pod damage were worked out. Grain yield per plot was also recorded at the harvest. Male moth catches in each trap were counted daily and catches per week were computed in M_1 and M_2 modules. A general observation on the impact of bird percher was also taken.

RESULTS AND DISCUSSION

Incidence of pod borer

2006-07: The data (Table 1) indicated that larval population of pod borer was significantly reduced in all the three modules as compared to untreated module M_4 after 2, 7, and 15 days of spray during all the three sprays and in mean population of each spray. Mean larval population during all the three spray was maximum in module M_4 (1.10, 3.00 and 5.00) and minimum in chemical module M_3 (0.60, 0.70 and 1.80) followed by M_2 (0.80, 1.10 and 1.30) and M_1 (1.00, 1.00 and 2.30). Pooled mean larval population was minimum in chemical module M_3 (1.0 per m row) followed by organochemical M_2 (1.3) and organic module M_1 (1.4). Per cent pod damage caused by pod borer was also significantly reduced in all three treated modules as compared to untreated module M_4 (17.3 %). It was minimum in chemical module M_3 (6.8%) followed by organochemical module M_2 (9.8 %) and organic module M_1 (10.8 %) (Table 3). These findings are in close agreement with Rafiksab et al. (2011) and Barapatre (2001).

Table 1: Effect of IPM module on the incidence of pod borer in gram during 2006-07

Modules	Before spray	Mean number of *Helicoverpa armigera* per meter row												Pooled mean
		Days after 1st spray				Days after 2nd spray				Days after 3rd spray				
		2	7	15	Mean	2	7	15	Mean	2	7	15	Mean	
M_1- Pheromone trap @ 0/ha + 400 pegs/ha + NKE (in cow urine)-30 ml/l+NPV-250LE/ha + Bt- 0.2%	1.50 (1.41)	0.90 (1.10)	1.10 (1.20)	1.00 (1.14)	1.00 (1.15)	0.50 (0.95)	0.70 (1.05)	1.70 (1.47)	1.00 (1.16)	1.80 (1.48)	1.40 (1.35)	3.60 (2.01)	2.30 (1.61)	1.40 (1.31)
M_2- Pheromone trap @ 10/ha + 400 pegs/ha + CBM- 4% +Bt-0.2% + cypermethrin-0.01%	1.40 (1.35)	0.90 (1.10)	0.60 (1.00)	0.80 (1.08)	0.80 (1.06)	0.60 (0.96)	0.80 (1.11)	1.90 (1.53)	1.10 (1.20)	1.50 (1.39)	1.30 (1.25)	3.60 (1.99)	2.10 (1.54)	1.30 (1.27)
M_3- Quinalphos – 0.05%(1s spray) cypermethrin– 0.01% (2nd spray) +Indoxicarb 0.01% (3rd spray)	1.50 (1.39)	0.80 (1.08)	0.50 (0.92)	0.50 (0.93)	0.60 (0.98)	0.40 (0.87)	0.50 (0.94)	1.20 (1.22)	0.70 (1.01)	1.10 (1.16)	1.00 (1.17)	3.40 (1.96)	1.80 (1.43)	1.00 (1.14)
M_4- Untreated	1.80 (1.47)	1.30 (1.29)	1.80 (1.47)	1.40 (1.33)	1.50 (1.36)	1.10 (1.23)	1.40 (1.36)	6.60 (2.60)	3.00 (1.73)	5.50 (2.39)	4.40 (2.18)	5.00 (2.30)	5.00 (2.29)	3.20 (1.79)
SEm (±)	-	0.08	0.07	0.07	0.06	0.08	0.06	0.07	0.07	0.08	0.07	0.05	0.06	0.06
LSD (p=0.05)	-	NS	0.20	0.19	0.18	0.22	0.16	0.20	0.20	0.22	0.19	0.13	0.17	0.18

Figure in parentheses are transformed values ($\sqrt{X+0.5}$)

2007-08: Larval population was significantly reduced in all the three treated modules (M_1 - M_3) as compared to untreated module M_4 after 2, 7 and 15 days of spray during all three sprays. Mean larval population during 1st, 2nd and 3rd spray was observed maximum in module M_4 (4.00, 6.79 and 6.91) and minimum in chemical module M_3 (1.75, 2.56 and 0.12) followed by M_2 (2.33, 3.73 and 3.20) and M_1 (2.33, 3.85 and 3.60). Among treated modules (M_1 to M_3), the larval population was at par during first spray period but was significantly lower in chemical module M_3 during second and third spray as compared to M_2 and M_1.

Table 2: Effect of IPM module on the incidence of pod borer in gram (Second year)

Modules	Before spray	Mean number of *Helicoverpa armigera* per meter row												Pooled mean
		Days after 1st spray				Days after 2nd spray				Days after 3rd spray				
		2	7	15	Mean	2	7	15	Mean	2	7	15	Mean	
M_1-	1.95 (1.57)	2.25 (1.50)	2.43 (1.71)	2.31 (1.68)	2.33 (1.63)	2.00 (1.58)	3.93 (2.07)	5.62 (2.42)	3.85 (2.02)	4.75 (2.24)	3.93 (2.07)	2.12 (1.58)	3.60 (1.96)	3.26 (1.87)
M_2-	1.90 (1.55)	2.88 (1.81)	1.81 (1.50)	2.31 (1.65)	2.33 (1.65)	2.25 (1.66)	3.75 (2.04)	5.18 (2.33)	3.73 (2.01)	3.31 (1.93)	4.12 (2.11)	2.18 (1.61)	3.20 (1.88)	3.09 (1.85)
M_3-	2.30 (1.58)	2.00 (1.56)	1.68 (1.417)	1.75 (1.46)	1.81 (1.50)	1.50 (1.38)	2.68 (1.76)	2.56 (1.70)	2.25 (1.61)	0.37 (0.87)	0.00 (0.71)	0.00 (0.71)	0.12 (0.76)	1.39 (1.29)
M_4-	2.00 (1.58)	4.81 (2.26)	3.87 (2.07)	4.00 (2.10)	4.23 (2.14)	4.37 (2.17)	7.25 (2.74)	8.75 (3.00)	6.79 (2.64)	8.93 (3.02)	7.87 (2.85)	3.93 (2.02)	6.91 (2.63)	5.98 (2.47)
SEm (±)		0.08	0.05	0.08	0.06	0.06	0.06	0.07	0.06	0.07	0.06	0.07	0.06	0.05
LSD (p=0.05)		0.23	0.15	0.22	0.18	0.17	0.18	0.21	0.18	0.19	0.16	0.21	0.18	0.14

Figure in parentheses are transformed values ($\sqrt{X+0.5}$)

Pooled mean population was also significantly minimum in M_3 (1.4 per meter row) as compared to M_2 (3.1 per meter row) and M_1 (3.3 per meter row). The results of chemical module M3 indicated that larval population was drastically reduced with the inclusion of indoxicarb during 2007-08 at the place of cypermethrin. Per cent pod damage was also significantly reduced in all three treated modules as compared to untreated module M_4 (32%). Among treated module (M_1 - M_3), it was markedly low in chemical module M_3 (3.7 %) as compared to organic module M_1 (15.6 %) and organochemical module M_2 (12.3%) (Table 3). These findings are in close agreement with those of Dhingra *et al.* (2003) and Boomathi *et al*. (2006).

Table 3: Effect of IPM module on number of pods, grain yield, pod damage and economics during 2006-07 and 2007-08

Modules	Mean no. of pods per plant	Mean no. of undamaged pods per plant	% pod damage	Grain yield Kg ha^{-1}	Additional profit Rs./ha	Additional cost	Net profit Rs./ha	ICBR
2006-07								
M_1-	31.1	27.7	10.8 (17.1)	1808	9990	1350	8640	7.4
M_2-	26.3	24.0	9.8 (18.0)	1626	7260	1475	5785	4.9
M_3-	27.3	25.4	6.8 (14.4)	1727	8775	1200	7575	4.3
M_4-	26.6	21.9	17.3 (24.5)	1142	-	-	-	-
SEm ($\pm$)	1.0		(0.38)	61	-	-	-	-
LSD (p=0.05)	2.7		(1.06)	92	-	-	-	-
2007-08								
M_1-	51.0	43.1	15.57 (23.19)	1872	15,400	1650	13750	9.3
M_2-	38.2	33.5	12.32 (20.51)	1802	14,000	1775	12225	7.9
M_3-	39.1	37.7	3.65 (10.70)	1822	14,400	2145	12255	6.7
M_4-	34.8	23.7	31.95 (34.41)	1102	-	-	-	-
SEm ($\pm$)	0.9	0.80	0.50	49	-	-	-	-
LSD (p=0.05)	2.6	2.30	1.43	156	-	-	-	-

Figure in parentheses are transformed values (arc Sin $\sqrt{p}$)

Role of Bird purcher: T– type bird purchers were effective in providing sitting shelter to the insectivorous birds. 10-15 birds were found sitting in pegged plots (M1 and M2) and in picking the larvae, whereas unpaged plots (M3 and M4) were avoided by the birds.

Role of pheromones traps: The data on pheromone trap catches (Table 4) indicated that catches started in 3rd week of January and continued up to 2nd week of March being maximum during 4th week of February (284-288 per week). During nine weeks a total number of 1361 and 1447 male moths were trapped in module M1 and M2. Such large number of male moth catches might have some impact on avoiding mating with female and such unmated female were enforced to lay unfertilized eggs.

Mean number of pods per plant

Mean number of pods per plant were significantly higher in organic module M_1 (31.1 pods per plant) as compared to M_4 (26.5 pods per plant), M2 (26.3 pods per plant) and M_3 (27.3 pods per plant) during 2006-07 (Table-3). The later three were statistically at par with respect to number of pods per plant. Whereas, during 2007-08 all three treated modules have significantly higher number of pods as compared to untreated module. Among treated module (M_1-M_3), mean number of pods were significantly higher in organic module M_1 (51.0 pods per plant) as compared to organo-chemical module M_2 (38.2 pods per plant) and chemical module M_3 (39.1 pods per plant) (Table-3). Higher number of pods in organic module might be due to some physiological effect of NSKE (in cow urine) -3 % applied as foliar spray at flowering stage in this module.

Grain yield

Grain yield was significantly higher in all three modules (M_1 - M_3) as compared to untreated module M_4 during both years of study, being maximum in organic module M_1 (1808 and 1872 kg ha^{-1}) followed by chemical module M_3 (1727 and 1822 kg ha^{-1}) and organo chemical module M_2 (1626 and 1802 kg ha^{-1}) as compared to 1142 and 1102 kg ha^{-1} in untreated module M_4 (Table3). Higher yield in treated modules as compared to untreated module might be due to the control of pod borer incidence. Whereas, greater yield in organic module M_1 as compared to chemical module (M_2) in spite of higher pod damage might be due to higher number of undamaged healthy pods in organic module (27.7 and 43.1 per plant) as compared to chemical module (25.4 and 37.7 per plant). Similar finding have been reported by Bajpai and Sehgal (1999), Das *et al.* (2000), Sanap *et al*. (2001) and Butani and Kapadia (2000).

Table 4: Population of *Helicoverpa armigera* moths trapped in pheromone\traps

Date of observation	Number of trapped moth per week		Total moth catches per trap	Mean moth catches per trap
	Module M_1	Module M_2		
14-20 January , 2006	119	122	241	121
21-27 January , 2006	121	141	262	131
28 January to 03 February, 2006	83	80	163	82
04 -10 February, 2006	101	107	208	104
11-17 February, 2006	181	197	378	189
18-24 February, 2006	284	288	572	286
25 February to 03 March, 2006	203	215	418	209
04-10 March, 2006	201	217	418	209
11-17 March, 2006	68	80	148	74
Total	1361	1447	2808	1404

Economics

Net profit was maximum with organic module M_1 during both years (Rs. 8640 and 13750 per ha) followed by chemical module M_3 (Rs. 7875 and 12255 per ha) and organochemical module M_2 (Rs. 5885 and 12225 per ha). Chavan *et.al*. (2003) also reported highest grain yield and highest return per rupees investment with the IPM module i.e. hand collection of larvae and bird perching with three spray Bt., HaNPV and NSKE.

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