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Assessment of chemical and biological insecticides along with other IPM practices against pod borer of chickpea with economic gain

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Abstract
A field experiment was conducted to evaluate the integrated pest management practices against pod borer chickpea during 2013-14 and 2014-15 with medium grain size chick pea var. JG 63. Chick pea is a measure pulse crop of Madhya Pradesh affected with several insect pests from their vegetative stage to maturity stage, among them pod borers are serious pests. Average two years data indicated that chlorantraniliprole was reduced 98% pod bore infestation followed by emamactin benzoate and profenofos whereas minimum effect of HaNPV and *Beauveria bassiana* bio-pesticides were noted in the experiment. Average two years data indicated that minimum damage of pod (2. 68 and 0. 34% at 3 & 10 days observation, respectively) found in treatment applied initially sprayed with chlorantraniliprole@ 80 gram/ha followed by Ememectin benzoate and profenophos. Among the chemical treatment, highest average pod borer infestation damage infested by all three borers was recorded in profenophos treated plot (6.05% at 3rd days @ 2.55% at 10 days). In control plot, average pod infestation was 18.68 and 23.29%, respectively at 3 & 10 days interval. Plot treated with microbial insecticides significantly recorded lower pod damaged (8.66%) in comparison to control plot (23.29). As well as yield was concern, highest yield (20.95 q/ha), net profit (Rs 42745 and B:C ratio (3.12) was found in chlorantraniliprole sprayed treatment. Regular observation of the trial indicated that initial population of pests in standing crop managed by the application of integrated pest management practices like pheromone trap and light trap from each treatment. Time and dose of insecticides application was more important than the type of insecticide. Flowering and grain formation stage were more vulnerable to attack of pod borer maximum damage.

Keywords: Pod borer, application of insecticides at proper time, seeds of chickpea, yield

Introduction
Chickpea (*Cicer arietinum* L) is most important pulse crop of India for providing the protein to vegetarian, covered maximum area in rabi season with 885kg/ha average productivity at national level. The main chickpea growing states are Madhya Pradesh, Uttar Pradesh, Rajasthan, Bihar, Haryana, Maharashtra and Punjab. Chickpea is a rich source of protein, carbohydrate, fat, calcium, iron and vitamin. Production and productivity gradually going to decreased due to severe biotic and a biotic constraints in which insect pest known to became a major problems throughout the crop stages. Among the insect pest, gram pod borer, tobacco pod borer ,Bihar harry catterpiller are the dangerous polyphagus sporadic nature of pest damaging more than 150 plant species in which them important are pulses, vegetables, cereals, oilseeds ,cotton and wild plants. Chickpea is the most preferred host of this pest which caused 10-70% losses throughout the crop growth in favored weather condition (Bhatt and Patel, 2001) [2]. In insect favorable environmental condition integrated pest management practices are the sole source to management the pests. At last spraying of insecticides are most effective in reducing the crop damage and increased the yield. Alternate use of insecticide in sequential spray prevent the development of pest resistance against the insecticide (Shivaleela *et al*. 2014) [5]. In view of this, the present investigation was under taken at field level in front line demonstration in the year 2013-2015, to find out the efficacy of integrated pest management practices for management of pod borer and also evaluate economics of the trials.

Materials and Methods
The field trial was conducted in randomized block design with three replications during the year 2013-14 and 2014-15.Chickpea var. JG 63 was taken under trial with the spacing 30 x 10 cm in a plot size 4 x 3 m and the crop was sown in the first week of November in both the successive year. Integrated pest management practices such as deep summer ploughing, pheromone traps, light trap physical management practices were applied in each treatment

equally at proper time along with two spray of each insecticide at fifteen days interval (Chlorentanilpron, HaNP ,*Beauveria bassiana*, Emamectin benzoate and Profenophos) was taken as per doses given in table 1 and made total volume of solution 500 liter /ha with water. Before going to start spraying, Stock solution of each insecticide prepared separately in two liter water and then purred in half tank and lastly maintained total solution volume 500 litter for one hectare area with water. Control plot sprayed with same amount of plan water. Population of pod borer in /meter squire area recorded randomly from each replication during morning hours between 8 to 10 AM without disturbing the pest after 3 and 10 days of spraying of each insecticide, separately. Total volume of sprayed solution of each treatment maintained 500 liter/ha The observation on pod damage by pod borers were recorded on 10 randomly selected plants by counting the total number of healthy and damaged pods and the percent pod damaged was calculated. Whereas percent plant infestation was calculated by counting the total plant and damaged plant in a plot after involving the formulae. Economics of each treatment was calculated on the basis of total expenditure and received grass income after sold of produce. The produce soled rate was Rs 3000/q.

Table 2: Name and dose of molecule

Name of molecule	Dose/ha
Chlorantraniliprole	80 g
Emamectin benzoate	150 g
Profenophos	1000 ml
HaNPV	250 LE
Beauveria bassiana	1000 g

Results and Discussions

The results sumerised in table 2 on the present study at surviving larval population/squire meter of pod borer indicated that the differences in the larval population at three and ten days after spraying were significant. All the insecticidal treatments recorded significantly lower population than untreated control. Three days after sprayed of molecules, pod borer infestation was significantly reduced in each treatment in comparison to control. Chemical insecticides were more effective than the biological. Minimum larval population was recorded in plot sprayed with chlorantraniliprole (2.10/ squire m) after three days of spraying followed by ememectin benzoate (4.31) and profenophos (7.47) in the year 2013-14. Larval population reduced in both *Beauveria bassiana* and HaNPV biological insecticidal treatment (10.5 larvae/m^2 &11.75 larvae/m^2) in comparison to control treatment in the year 2013-14. In control there was 15.75/squire m. Survival larvae population after application of chlorantraniliprole at 10 days was 0.23 larvae/m^2. Whereas in each treatment larval population was more than chlorantraniliprole at 10 days after application in the year 2013-14. In control there was 24.95 larvae/ m2 at 10 days after application of plane water. In the year 2014-15, larval population was reduced in each treatment excluding control chlorantraniliprole insecticide dramatically reduced greater larval population (1.15 larvae/m^2) than ememectin benzoate and profenophos in the year 2014-15. Profenophos showed better performance than ememectin benzoate in the year 2014-15 but both were significantly better than biological insecticides. Between the biological insecticides, *Beauveria bassiana* was found superior to reduced pod borer population than HaNPV in the year 2014-15. Average surviving larvae/2 meter was found minimum (2.63 at 3 days & 0.34 at 10 days) in those plot treated with chlorantraniliprole followed by emamectin benzoate and profenophos in comparison to other treatments. Lower population of surviving larvae was noted in both bio-pesticides which was gave significantly results in comparison to control. Whereas untreated control plot had average 18.68 and 23.29 surviving larvae/m^2 at 3 &10 days observation. On average it was observed that bio-pesticides take more time to control larvae population in relation to chemical insecticides. It might be seen that regular application of bio-pesticides willable to manage population of pod borer larvae buy saving the environmental pollution. Results of the experiments showed that highest pod damage occurred in HaNPV treated treatment followed by *Beauveria bassiana* and profenophos. On the basis of pod damage it was found that chlorantraniliprole gave maximum control of larvae in both years at recommended dose. All the pesticides were effective against larvae throughout the crop duration. Amad *et al*. in 2014 reported that neonicotinoid group of chemicals were very effective at low doses. Yadav, D.K. 2009 [8] reported that chemical insecticides at recommended dose were more effective without harming the beneficial insects. The order of effectiveness of pesticides at 10 days after application in both respective year were found to be chlorantraniliprole, ememectin benzoate, profenophos, *Beauveria bassiana* and HnNPV. Sukumar *et al*. 2014 emphasized that systemic insecticides were more effective than contact and also had long effect against pod borer. All the chemical insecticides were at par with each other and found to be significantly better in reducing the pod damage over bio-pesticides and untreated control. On the basis of damage caused by H. armigera, it might be seen that the chlorantraniliprole treatment found most effective. The treatment plot of emamectin benzoate ranked in middle order of effective in reducing the population of all the three pod borer larvae.

The data summarized in table 3 showed that all the insecticides brought higher yield of chickpea as compared to control. Maximum yield (20.95 q/ha) was received in chlorantraniliprole followed by emamectin benzoate (19.16 q/ha) and profenophos (16.15 ha/ha). Similar finding was also reported by Yadve *et al*. In 2009 as obtained in the present investigation. The next effective bio- insecticide which increased the yield were *Beauveria bassiana* and HnNPV. Which resulted in 15.75/ha and 13.24/ha. Effect of bio-pesticide in increasing the yield were significantly higher than control (9.89/ha). The data given in table 3 on the economics of expenditure and grass income revealed that chlorantraniliprole gave higher net profit (Rs 42275/ha) and B: C ratio (3.12) than emamectin benzoate (Rs 38113 net profit & B:C ratio 2.96) and profenophos treated plot, respectively. Then treatment of HaNPV found lower netprofit and B:C ratio than *Beauveria bassiana*. Higher net profit(Rs 28606/ha)and B:C ratio (2.53) obtained in *Beauveria bassiana* than other bio-pesticide such as HnNPV. Sharma, *et al*. (2014) [6] reported that the application of rynaxypyr 20 SC was found to be the most effective insecticide in reducing the H. armigera larvae population and also recorded highest grain yield with net return. Flubendamidamide 0.007%, rynaxypyr 0.009% and emamectin benzoate 0.0015% were most effective in reducing the H. armigera population on chickpea (Singh and kumar, 2012) [7]. Patil *et al*., (2007) [4] reported highest yield (18.54 q/ha) and cost benefit ratio (2.27) after the application of emamectin benzoate in chickpea. Kulat *et al*. (1999) [3] reported the positive responses in increasing the yield of chickpea after the application of bio-pesticides than untreated control. It might be shown that all the treatments increased the yield and cost benefit ratio without harming the soil bio-agents. Present investigation was agreed with earlier reports.

Table 2: Effect of IPM practices along with chemical and biological insecticide against *pod* borers of chickpea

Treatments	**Dose /ha**	**Surviving larval population after insecticide spray/m2**				**Average Surviving larval population of Two year**		**Av. Pod damage (%) f both year**	**Av. Yield (q/ha) both year**
		2013-14		**2014-15**					
		3 day	**10 days**	**3 day**	**10 days**	**3 day**	**10 day**		
HaNPV	250 LE	11.75	8.75	5.57	4.78	8.66	6.61	11.53	13.24
Beauveria bassiana	1000 g	10.50	4.13	6.32	4.54	8.41	4.33	9.15	15.75
Chlorantraniliprole	80 g	2.10	0.23	1.15	o.45	2.68	0.34	1.47	20.95
Emamectin benzoate	150 g	4.31	1.01	2.09	1.27	5.35	1.14	2.98	19.16
Profenophos	1000 ml	7.17	1.97	4.94	3.12	6.05	2.55	6.87	16. 15
Control	Plane water	15.75	24.95	19.32	21.62	18.68	23.29	31.37	9.89
CD (p=0.05)	-	4.12	5.45	2.34	1.33	-		7.36	3.37

Table 2: Impact of IPM practices in yield enhancement and cost benefit ratio on average two year data.

Treatments	**Grain yield (q/ha)**	**% yield increased**	**Cost of cultivation (Rs)/ha**	**Grass income (Rs)/ha**	**Net income (Rs)/ha**	**B:C ratio**
HaNPV	13.24	33.87	18570	39720	21150	2.13
Beauveria bassiana	15.75	59.25	18644	47250	28606	2.53
Chlorantraniliprole	20.95	111.83	20105	62850	42745	3.12
Emamectin benzoate	19.16	93.73	19367	57480	38113	2.96
Profenophos	16. 15	63.29	18403	48450	30047	2.63
Control	9.89	-	16142	29670	1352	1.83
CD (p=0.05)	3.37	-	-	-	-	-

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