Annals of Plant and Soil Research 22(1): 19-24 (2020)

Efficacy of biopesticide and chemical insecticides against grampod borer *Helicoverpa armigera*

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Received: November, 2019; Revised accepted: January, 2020

ABSTRACT

A field experiment was conducted at the research farm, College of Agriculture, Tikamgarh (M.P.) during rabi season of 2017-18 to find out the efficacy of newer insecticides along with bio-pesticide against gram pod borer. Eight treatments were evaluated in randomized block design with three replications. The results revealed that the profenophos 50 EC followed by Rynaxypyr 20 SC proved to be most effective in controlling the incidence of gram pod borer (0.63 larvae/meter row length). It was significantly superior over rest of the treatments followed by NSKE 5% and Flubendiamide 39.35 SC (0.91). The maximum grain yield of 1706.57 kg/ha^{-1} and minimum pod damage (3.08 %) was recorded with the application of profenophos 50 EC followed by Rynaxypyr 20 SC. The highest net profit and cost benefit ratio were also observed from the plot treated with the application of profenophos 50 EC followed by Rynaxypyr 20 SC (Rs. 29549.96/ha^{-1} and 1:10.75). The minimum grain yield of 966 kg ha^{-1} and maximum pod damage (15.77%) was recorded in control treatment.

KEY WORDS:*Helicoverpa armigera*, chickpea, newer insecticide, bio-pesticide, pod damage

INTRODUCTION

Chickpea (*Cicer arietinum*) is an important food legume crop grown in 83.90 lakh hectare area and recorded a production of 70.60 lakh tones with average productivity is 840 kg/ha. In Madhya Pradesh, ranked first in chickpea growing states of the country covering an area of about 3017 hectares with an annual production of 3364 metric tons and productivity 1115 kg/ha. (Anonymous, 2016-17). Among the biological constraints, incidence of insect pests specially the pod borer, *Helicoverpa armigera* (Hübner) causes severe damage to the chickpea crop in almost all the chickpea growing areas. It asserts a major share in crop losses (25-40%) every year, worldwide (Shinde *et. al*. 2014). Increase in intensive crop production technologies and concomitant insecticide resistance of broad spectrum insecticides, as well as continuous accessibility of preferred food plants have favored *H. armigera* to become a major pest (Fathipour and Naseri, 2011). Recent climatic changes have also influenced the population of this pest in different crops. The attack of this pest starts from vegetative stage and continue up to crop maturity. The damage caused by insect pests is one of the main constraints which limit the production of chickpea, pod borer *Helicoverpa armigera* (Hubner). It is predominant species causing economic damage to chickpea crop. The yield loss in chickpea due to pod borer was reported as 10 to 60 % in normal weather condition (Srivastava *et. al*. 2017). In present study, the efficacies of some bio-pesticide and chemical insecticide have been tested against gram pod borer.

MATERIALS AND METHODS

The experiment was conducted at the research farm of College of Agriculture, Tikamgarh (M. P.) during *rabi* season of 2017-18. The crop was sown in the first week of November at a row distance of 30 cm and plant to plant distance 10 cm. Variety JG-315 was sown in plot size of 4.2 m x 3 m. Experimental area was conducted in a randomized block design with 3 replication. The crop was grown with recommended agronomic practices. Eight treatments including control were T_1: NSKE 5% followed by HaNPV @ 500 LE/ha, T_2: NSKE 5% followed by rynaxypyr 20 SC @ 75ml/ha, T_3: NSKE 5% followed by profenophos 50 EC @1000ml/ha, T_4: Profenophos 50 EC @1000ml /ha followed by HaNPV @ 500LE/ha, T_5: HaNPV @500LE/ha followed by rynaxypyr 20 SC @75ml/ha, T_6: Profenophos 50EC @1000ml/ha followedby rynaxypyr20SC @75ml/ha, T_7: NSKE 5% followed by Flubendiamide 39.35 SC @125ml/ha and T_8: control. Two foliar sprays were applied first at 50 % flowering and then at interval of 15 days after first spray. The observation on the population of gram pod borer larvae/meter row length were recorded in each plot at three places one day before and after 3, 7 and 14 days of each spray. Total number of pod and number of damaged pods were counted in 100 plants from each plot and % pod damage were worked out. Grain yield per plot was also recorded at the harvest.

RESULTS AND DISCUSSION

The data obtained from first spray against the population of pod borer larvae in one meter row length at one day before and 3, 7 and 14 days after treatment were analyzed (Table 1). The larval population of *H. armigera* ranged from 2.40 to 2.60 larvae/meter row length (mrl), and did not differ significantly. Mean population of *H. armigera* larvae after 1st spray indicated that all the insecticidal treatments were significantly effective in reducing the larval population of gram pod borer as compared to untreated plots (1.90 larve/mrl). Profenophos 50 EC followed by Rynaxypyr 20 SC proved to be most effective in controlling the incidence of gram pod borer (0.63 larvae/mrl) and was significantly superior over rest of the treatments.

Table 1: Efficacy of bio-pesticide and insecticides on the incidence of gram pod borer after first spray

Treatments	Mean number of larvae per meter row				
	Before spray	Days after 1st spray			Mean
		3	7	14	
NSKE 5% followed by HaNPV @ 500 LE/ha	2.60 (1.76)	1.20 (1.30)	1.70 (1.48)	1.95 (1.57)	1.62 (1.45)
NSKE 5% followed by rynaxypyr 20 SC @ 75ml/ha	2.42 (1.70)	0.76 (1.12)	1.00 (1.22)	1.40 (1.38)	1.05 (1.25)
NSKE 5% followed by profenophos 50 EC @ 1000ml/ha.	2.47 (1.72)	1.20 (1.30)	1.30 (1.34)	1.55 (1.43)	1.35 (1.36)
Profenophos 50 EC @ 1000ml /ha followed by HaNPV @ 500LE/ha	2.50 (1.73)	1.25 (1.32)	1.40 (1.38)	1.60 (1.45)	1.42 (1.38)
HaNPV @ 500LE/ha followed by rynaxypyr 20 SC @ 125 ml/ha	2.60 (1.76)	1.10 (1.26)	1.20 (1.30)	1.30 (1.34)	1.20 (1.30)
Profenophos 50 EC @ 1000ml/ha followed by rynaxypyr 20 SC @ 75ml/ha	2.55 (1.74)	0.50 (1.00)	0.55 (1.02)	0.85 (1.16)	0.63 (1.06)
NSKE 5% followed by Flubendiamide 39.35 @ 125 ml/ha	2.40 (1.70)	0.64 (1.07)	0.90 (1.18)	1.20 (1.30)	0.91 (1.19)
Control (untreated)	2.48 (1.72)	1.60 (1.45)	2.00 (1.58)	2.10 (1.61)	1.90 (1.55)
SEm ±	0.03	0.01	0.03	0.02	0.02
C.D (P=0.05)	N/S	0.04	0.08	0.06	0.07

Whereas efficacy of rest of the treatments was in the order of NSKE 5% followed by Flubendiamide 39.35 SC (0.91) > NSKE 5% followed by rynaxypyr 20 SC (1.05), > HaNPV followed by rynaxypyr 20 SC (1.20) respectively. The NSKE 5% followed by HaNPV (1.62 larvae/meter row length) was found least effective treatment. The second insecticide spray was applied 15 days after first spray and the larval population of gram pod borer ranged from 1.14 to 2.58 larvae/meter row length (Table 2). The larval population in various treatment plots did not differ significantly. On the basis of overall mean the difference in larval population among different treatment were significant as compared to control (2.42 larve/mrl) plot. Profenophos 50 EC followed by Rynaxypyr 20 SC proved to be most effective in controlling the incidence of gram pod borer (0.53 larve/mrl) and was significantly superior over rest of the treatments. The next effective treatment was NSKE 5% followed by Flubendiamide 39.35 SC (0.88) , NSKE 5% followed by rynaxypyr20 SC (1.09). The NSKE 5% followed by HaNPV (1.55 larvae/meter row length) was significantly least effective in comparison to all tested pesticides. The present studies are in partial agreement with the findings of Sharma *et al.* (2014). Verma *et. al.* (2015) reported that neem seed kernel extract (5%) along with Flubendiamide 39.39 SC@ 50 ml/ha effectively reduced the *H. armigera* larval population.

Table 2: Efficacy of bio-pesticide and insecticides on the incidence of gram pod borer after second spray

Treatments	Mean number of larvae per meter row				
	Before spray	Days after 1st spray			Mean
		3	7	14	
NSKE 5% followed by HaNPV @ 500 LE/ha	2.42 (1.70)	1.80 (1.52)	1.40 (1.38)	1.25 (1.32)	1.48 (1.41)
NSKE 5% followed by rynaxypyr 20 SC @ 75ml/ha	1.40 (1.37)	1.27 (1.33)	1.20 (1.30)	0.88 (1.17)	1.12 (1.27)
NSKE 5% followed by profenophos 50 EC @ 1000ml/ha.	1.47 (1.40)	1.35 (1.36)	1.25 (1.32)	0.90 (1.18)	1.17 (1.29)
Profenophos 50 EC @ 1000ml /ha followed by HaNPV @ 500LE/ha	2.50 (1.73)	1.70 (1.48)	1.30 (1.34)	1.20 (1.30)	1.40 (1.38)
HaNPV @ 500LE/ha followed by rynaxypyr 20 SC @ 125 ml/ha	1.38 (1.37)	1.35 (1.36)	1.30 (1.34)	0.70 (1.10)	1.12 (1.27)
Profenophos 50 EC @ 1000ml/ha followed by rynaxypyr 20 SC @ 75ml/ha	1.14 (1.28)	0.50 (1.00)	0.40 (0.95)	0.35 (0.92)	0.42 (0.96)
NSKE 5% followed by Flubendiamide 39.35 @ 125 ml/ha	1.42 (1.38)	0.98 (1.22)	0.90 (1.18)	0.65 (1.07)	0.84 (1.16)
Control (untreated)	2.58 (1.75)	3.60 (2.03)	2.80 (1.82)	2.40 (1.70)	2.94 (1.85)
SEm ±	0.12	0.02	0.04	0.04	0.03
C.D (P=0.05)	N/S	0.05	0.11	0.12	0.09

Figures in parenthesis are $\sqrt{x+0.5}$ transformed values, DBS – Day before spray, DAS – Day after spray

Per cent Pod damage

All the insecticidal treatments were found significantly effective in reducing the pod damage caused by gram pod borer as compared to untreated plots (15.16%). The minimum per cent of pod damage was observed in the plot treated with profenophos 50 EC followed by Rynaxypyr 20 SC (3.08%) , NSKE 5% followed by Flubendiamide 39.35 SC (3.19%) and NSKE 5% followed by rynaxypyr 20 SC (3.41%). The treatment NSKE 5% followed by HaNPV was recorded highest per cent of pod damage (4.70%) by *Helicoverpa* larvae (Table 3). These results coincide with the finding of Sharma *et. al.* (2014).

Grain yield

Grain yield was significantly higher in all the treatments as compared to control. Data (Table 3) showed significant beneficial effect of different insecticidal treatments on grain yield over control. The maximum grain yield of 1706.34 kg ha^{-1} was obtained from the profenophos 50 EC followed by Rynaxypyr 20 SC treated plot and it was significantly superior over the rest of the treatment. The NSKE 5% followed by Flubendiamide 39.35 SC was the second effective treatment with the yield of 1626.98 kg ha^{-1} followed by NSKE 5% followed by rynaxypyr 20 SC (1547.61 kg ha^{-1}) Among the biopesticides and chemical insecticides, the minimum grain yield (1190.47 kg ha^{-1}) was recorded in the plot treated with profenophos 50 EC followed by HaNPV. The present findings are in partial agreement with those of Savita and Panduranga (2013). Deshmukh *et. al.* (2010) indicated that highest yield was recorded in the treatments of flubendiamide 0.007 % (1850 kg ha^{-1}).

Economics

Data (Table 3) indicated higher net profit and benefit: cost ratio over control due to application of all insecticidal treatments. Maximum net profit (Rs 29549.96 ha^{-1}) was recorded in Profenophos 50 EC followed by Rynaxypyr 20 SC, NSKE 5% followed by Flubendiamide 39.35 SC (Rs.24333.12 ha^{-1}) and NSKE 5% followed by rynaxypyr 20 SC (Rs. 22065.84 ha^{-1}). The minimum net profit was obtained in plot treated with Profenophos 50 EC followed by HaNPV (Rs.5626.68 ha^{-1}). On the basis of benefit: cost ratio, it was observed that Profenophos 50 EC followed by Rynaxypyr 20 SC was most economical (10.75:1) followed by NSKE 5% and rynaxypyr 20 SC (7.25:1). Whereas the lowestbenefit: cost ration was

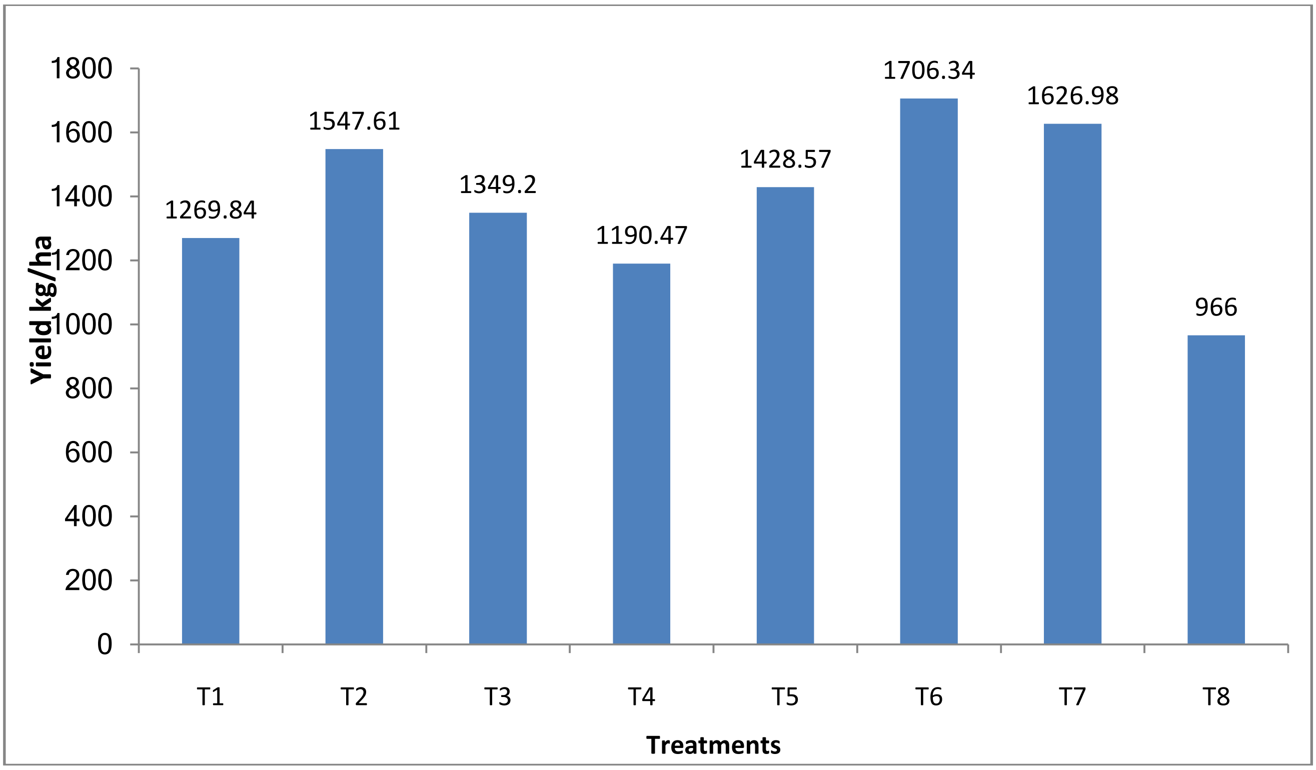

Fig 1: Seed yield of chickpea under different treatments

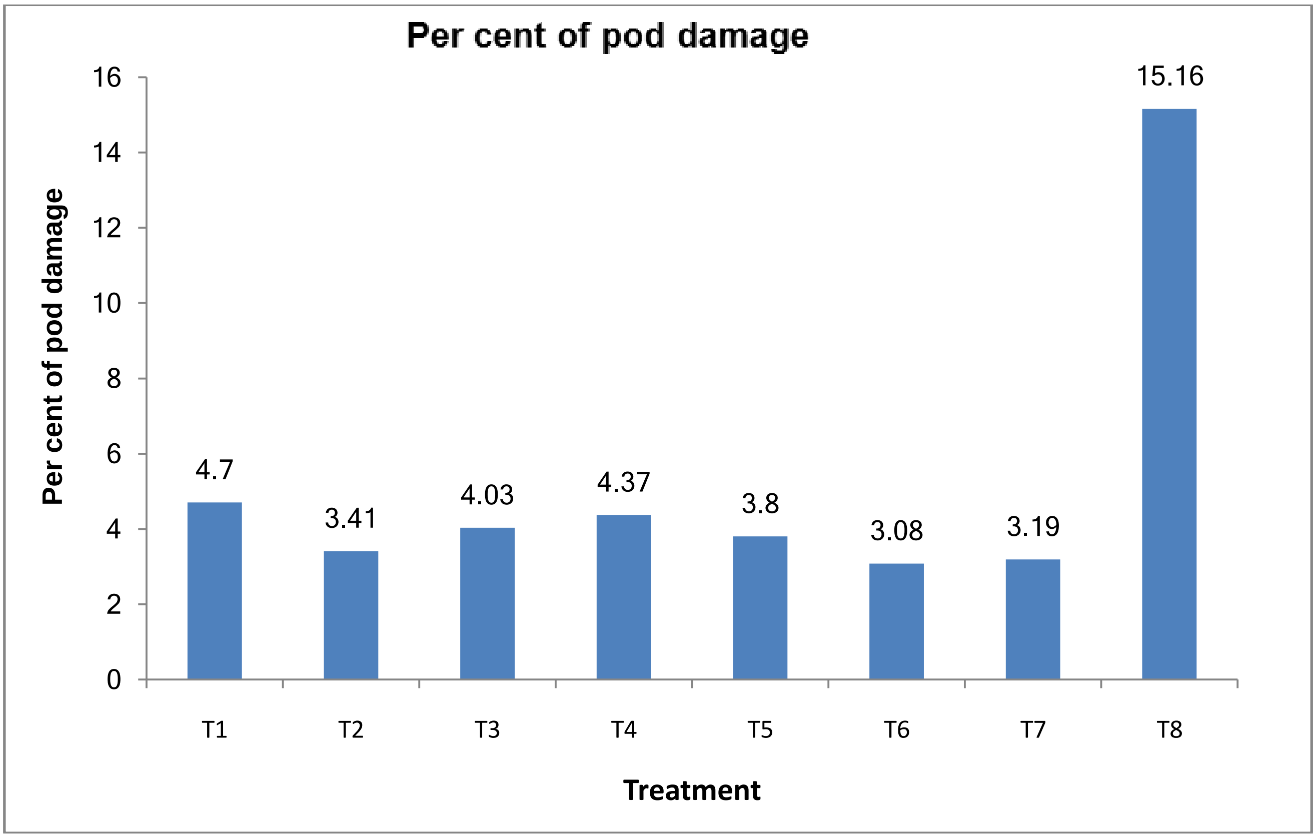

Fig 2: Per cent pod damage under different treatments

Table 3: Effect of bio-pesticide and insecticide on per cent pod damage, grain yield and economics

Treatments	Percent pod Damage	Grain yield (kg/h)	Additional Yield Over Control	Additional profit (Rs/ha)	Additional cost (Rs/ha)	Net profit (Rs/ha)	B.C. Ratio
T_1	4.70 (2.28)	1296.84	303.84	13368.96	4750	8618.96	2.81:1
T_2	3.41 (1.98)	1547.61	581.61	25590.84	3525	22065.84	7.25:1
T_3	4.03 (2.13)	1349.20	383.20	16860.80	2800	14060.80	6.02:1
T_4	4.37 (2.21)	1190.47	224.47	9876.68	4250	5626.68	2.32:1
T_5	3.80 (2.07)	1428.57	462.57	20353.08	4975	15378.08	4.09:1
T_6	3.08 (1.89)	1706.57	740.34	32574.96	3025	29549.96	10.75:1
T_7	3.19 (1.92)	1626.98	660.98	29083.12	4750	24333.12	6.12:1
T_8	15.77 (3.95)	966	-	-	-	-	-
SEm ±	0.03	61.82	-	-	-	-	-
C.D (at 5 %)	0.07	181.82	-	-	-	-	-

Price of chickpea @ Rs 44/kg, Labor charges @ Rs 600/ Spray, NSKE = Rs 350/lit, HaNPV = Rs 1000 LE/lit, Rynaxypyr = Rs 17000, Profenophos =Rs 550/lit and Flubendiamide = Rs 12000/lit

recorded in the plot treated with NSKE 5% followed by HaNPV (2.81). The findings of Dineshet *al.* (2017) differ from the present study, they reported that highest benefit: cost ratio of 1.26 and 1.42 was recorded in the treatment of flubendamide 480 SC @ 200ml/ha.

It may be concluded from the study that all the treatments were found significantly effective in reducing the larval population of gram pod borer as compared to untreated plots. The minimum larval population per meter row length was recorded in the plot treated with Profenophos 50 EC followed by Rynaxypyr 20 SC, NSKE 5% followed by Flubendiamide 39.35 SC (0.91) and NSKE 5% followed by rynaxypyr 20 SC. The maximum grain yield of 1706.34 kg ha^{-1} was obtained from the profenophos 50 EC followed by Rynaxypyr 20 SC treated plot and it was significantly superior over the rest of the treatment. The NSKE 5% followed by Flubendiamide 39.35 SC was the second effective treatment with the yield of 1626.98 kg ha^{-1}. The maximum net profit (Rs 29549.96 ha^{-1}) was recorded in Profenophos 50 EC followed by Rynaxypyr 20 SC, NSKE 5% followed by Flubendiamide 39.35 SC (Rs.24333.12 ha^{-1}) and NSKE 5% followed by rynaxypyr 20 SC (Rs. 22065.84 ha^{-1}).

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