Field Efficacy and Economics of Certain Biopesticides and Chemicals Against Gram Pod Borer, *Helicoverpaarmigera* (Hubner) on Greengram [*Vigna radiata* (L.) Wilczek]

ABSTRACT

A field experiment was conducted in *kharif* season of 2023at Central Research Farm (CRF), SHUATS, Uttar Pradesh, India. The experiment was laid in Randomized Block Design with eight treatments each replicated thrice *viz.,* Spinosad 45SC, *Ha* NPV 1X10^9ml/min, Neem seed kernel extract10% WP, Emamectin Benzoate 5%SG, Azadirachtin (Neem oil)00.03%WSP, Chlorantraniliprole 18.5SC, *Bacillus thuringiensis* 4% WSP and untreated Control. The data on larval population of *Helicoverpaarmigera*after first and second spray revealed that all the treatments were significantly superior over control. Among all the treatments, the plot treated with Chlorantraniliprole 18.5%SC (0.323) recorded minimum larval population followed by Spinosad 45%SC (0.456), Emamectin benzoate 5%SG (0.578), and Azadirachtin (Neem oil)00.03%EC (0.712), Neem seed kernel extract 10% WP (0.845), *Ha* NPV 1X 10^9 POB/ml/min (0.978), In this the maximum larval population was recorded in *Bacillus thuringiensis* 1x10^8CFU (1.112). While, the highest yield (15.36 q/ha) was obtained from the treatment Chlorantraniliprole 18.5% SC. When cost benefit ratio was worked out, interesting result was achieved. Among the treatments studied, the best and most economical treatment was Chlorantraniliprole 18.5 SC (1:3.65) followed by Spinosad 45%SC (1:3.26), Emamectin benzoate 5%SG (1:2.94), and Azadirachtin (Neem oil) 00.03%EC (1:1.89), Neem seed kernel extract 10% WP (1:1.92), *Ha* NPV 1X10^9 POB ml/min (1:1.62), and *Bacillus thuringiensis* 1x10^8CFU (1:1.58) as compared to control plot (1:1.04).

Keywords: Biopesticides; chemicals; greengram;Helicoverpaarmigera; pod borer.

1. INTRODUCTION

Green gram [*Vigna radiata* L. Wilczek. 2n=22] and belongs to family Fabaceae, it is an economicallyimportantlegumefoodgrownworldwideintropicalandsub-tropicalregionsand it is one of the leading pulse crops in India. The importance of this legume is related to desirable characteristics such as high protein content (25-28%) and less flatulent than other pulses, broad adaptation, low need for agricultural inputs and its ability to increase soilfertility. Sprouts and green pods of green gram are also rich in vitamins and minerals thus are good and in expensive source of dietary protein for poor people. Mehandi *et al*. (2019)

Mung beans are recognized for their high nutritive value. Mung beans contain about 55%-65% carbohydrate and are rich in protein, fat, vitamins and minerals. It is composed of about 20% to 50%

protein of total dry weight, among which globulin (60%) and albumin (25%) are the primary storage proteins. Mung bean is considered to be a substantive source of dietary proteins.

The total area under green gram cultivation was about 30.48 lakh hectares with an annual production of 13.45 lakh tonnes. It is the largest producer of grain legumes (pulses) in the world. India ranks first in green gram production (70% of the total world production). It produces about 1.5 to 2.0 million tonnes of Mung annually from about 3 to 4 million hectares of area, with an average productivity of 798 kg per hectare. Sireesha and Kumar (2022).

India is the world's largest producer as well as consumer of green gram. It produces about 1.5 to 2.0 million tonnes of mung annually from about 3 to 4 million ha of area with an average productivity of 500 kg ha^{-1}. Mung production in the country is largely concentrated in five states *viz*. Rajasthan, Maharashtra, Andhra Pradesh, Gujarat and Bihar. Among these fivestates Rajasthan (26%), Maharashtra (20%) occupies the first two positions contributing over 46%. Andhra Pradesh contributes about 10% while together Gujarat and Bihar account for about 13% of total production in the country (Anonymous 2016).

The gram pod borer, *Helicoverpaarmigera*is a potential and polyphagous pest, with various characteristic features likehigh fecundity, migratory behavior, high adaptations to variousagroclimaticconditionsanddevelopmentofresistance to various insecticides, extensively damaging many crops including greengram. (Kambrekar*et al*., 2009).
The caterpillar not only defoliates the tender leaves but also makes holes in the pods and feed upon thedeveloping seeds the anterior body portion of the caterpillar remains inside the pod and rest half or so hanging outside. Gayathri and Kumar (2021).

- To study the efficacy of certain biopesticides and chemicals on the larval population ofgram pod borer,[*Helicoverpaarmigera*(Hubner)]on greengram.
- Tocalculatethecostbenefitratioofthetreatedcrop.

2. MATERIALS AND METHODS

Theexperimentwasconductedduring*Kharif*season2023atCentralResearchFarm,SHUATS, Prayagraj, Uttar Pradesh, Prayagraj India, in a Randomized Block Design witheight treatments replicated three times using Kamad 60 variety in a plot size of (2m×1m) at aspacing of (30×10cm) with a recommended package of practices excluding plant protection.Thesoilof theexperimental site wasbewelldrainedand medium high.

In the experiments, eight different treatments, consisting application of Spinosad 45SC (T_1),*Ha* NPV $1X10^9$ml/min (T_2), Neem seed kernel extract10% WP (T_3), Emamectin Benzoate5%SG (T_4), Azadirachtin (Neem oil) 00.03%WSP (T_5), Chlorantraniliprole 18.5SC (T_6),*Bacillus thuringiensis* 4% WSP (T_7) and untreated Control (T_8) were tested against gram pod borer.

The insecticides were sprayed at recommended doses when larval population reaches ETL (10% of affected pods). Observation on the number of larvae per plant was taken at precount, 3^{rd}, 7^{th} and 14^{th} days after each application in each plot from three randomly selected plants. At maturity, the number of pods showing the damage caused by *Helicoverpaarmigera*were recorded and expressed as larval population. All the pods from each treatment were then threshed and grain yield per plot was recorded and arrived for hectare. Cost effectiveness of each treatment was be assessed based on net returns. Net return of each treatment should be worked out by deducting total cost of the treatment from gross returns. Total cost of production includes both cultivation as well as plant protection charges.

Formulae used:

Larval population = Number of Larvae /Total number of selected plants

Kumar*etal* .(2018)

Economics:

Cost Benefit ratio

C:B ratio= $Grossreturns/\ Totalcostincurred$

Gayathri and Kumar (2021)

3. RESULTS AND DISCUSSION

The data on larval population of *Helicoverpaarmigera*over control on Mean of first andsecond spray revealed that all the treatments were significantly superior over control. Amongall the treatments, the plot treated with T_6 Chlorantraniliprole 18.5%SC (0.323) recordedminimumlarvalpopulationfollowedbyT_1Spinosad45%SC(0.456),T_4Emamectinbenzoate(0.578), and T_5 Azadirachtin (Neem oil) 00.03%WSP (0.356) (0.712), T_3 Neem seed kernelextract10%WP(0.845),T_2*Ha*NPV1X10^9POBml/min(0.978),In thisthemaximumlarvalpopulationwas recordedin T_7*Bacillusthuringiensis*1x10^8CFU(1.112).

The data on the mean of larval population of first spray and second spray, overall meanrevealed that all the treatments except untreated control are effective and at par. Among allthe treatments highest percent of larval population green gram pod borer was recorded inChlorantraniliprole 18.5SC (0.323). Similar findings made by Rahman *et al*. (2014), andMahajan *et al.* (2020), Spinosad 45 SC (0.456) is found to be the next best treatment whichisinlinewiththefindingsofMuhammad*etal.*(2005),Singh*etal*.(2012)andMeena*etal*.(2014) they reported that Spinosad45 SC was found most effective in reducing percentpopulationreduction of greengrampod boreraswell as increasingtheyield.

Emamectin benzoate 5%SG (0.578) is found to be next best treatments is found to be the nexteffective treatment which is in line with the findings of Kale (2008) , Byrappa*et al*. (2012)and Rahman *et al.* (2014) Azadirachtin(Neem oil) 00.03%WSP (0.712) is found to be the nexteffective treatment which is in line with the findings of Moraly*et al.* (2000) and Chandra *et al.* (2018) Neem seed kernel extract(0.845) is found to be the next effective treatment whichis in line with the findings of Moraly*et al.* (2000) and Byrappa*et al.* (2012) *Ha* NPV1X10^9ml/min (0.978) is found to be the next effective treatment which is in line with thefindings of Kale (2008), Byrappa*et al*. (2012)and Rahman *et al.* (2014) .The result of*Bacillus thuringiensis* 4% WSP (1.822) is found to be least effective but comparativelysuperiorover thecontrol,whichis in support withKumar*et al.*(2019)andFite(2020).

The yields among the different treatments were significant. All the treatments were superiorovercontrolThehighestyieldwasrecordedinChlorantraniliprole18.5SC(15.36q/ha)followedby Spinosad 45SC (14.15q/ha), Emamectin benzoate (12.21 q/ha), Azadirachtin (Neem oil)00.03%WSP (8.1 q/ha), Neem seed kernel extract10%WP (7.93q/ha), HaNPV1X10^9ml/min(7.09q/ha),*Bacillusthuringiensis*4%WSP(6.5q/ha).Whencostbenefitratiowasworkedout,interestingresultwasachieved.Amongthetreatmentsstudied,thebestandmosteconomicaltreatment wasChlorantraniliprole18.5SC(1:3.65)followed by T_1Spinosad 45%SC (1:3.26), T_4Emamectin benzoate 5%SG(1:2.94), and T_5 Azadirachtin(Neem oil) 00.03%WSP (1:1.89), T_3 Neem seed kernel extract10%WP(1:1.92),T_2*Ha*NPV1X10^9ml/min(1:1.62),andT_7*Bacillusthuringiensis*1x10^8CFU(1:1.58) These findings are supported by Cherry (2000) , Babariya *et al*.(2010),Rashid*etal*.(2003),Rahman*etal.*(2014)andVikrant*etal.*(2018).

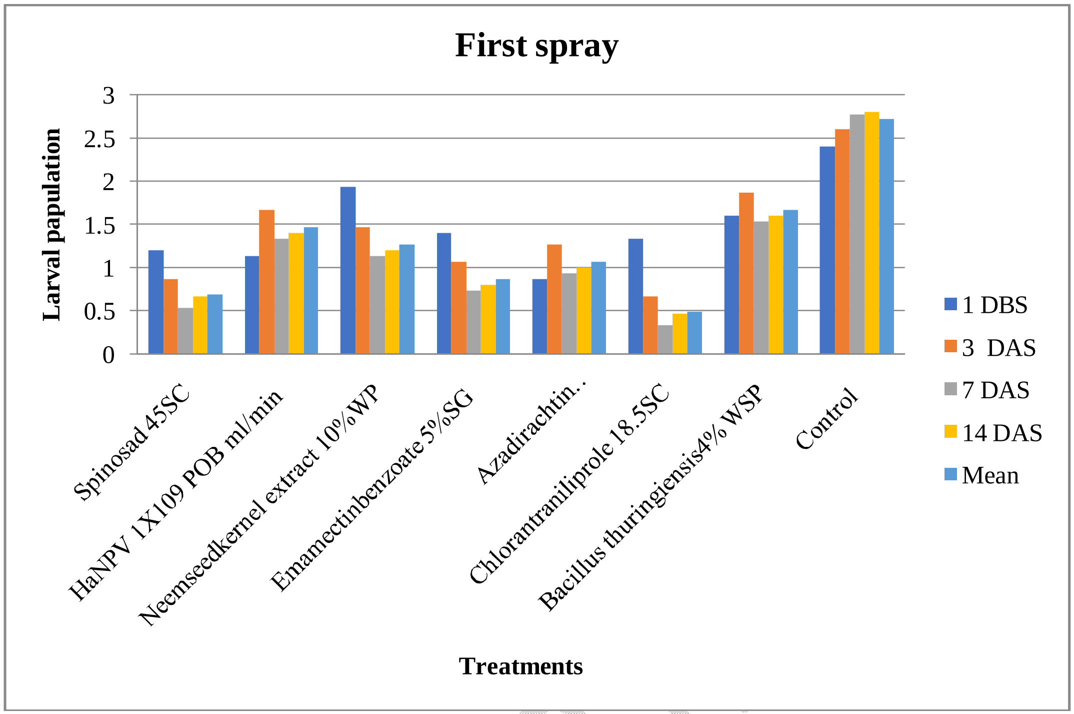

Fig. 1. Efficacyofbiopesticidesandchemicalsonthelarvalpopulationofpod borer *H.armigera*ongreengram (Firstspray)

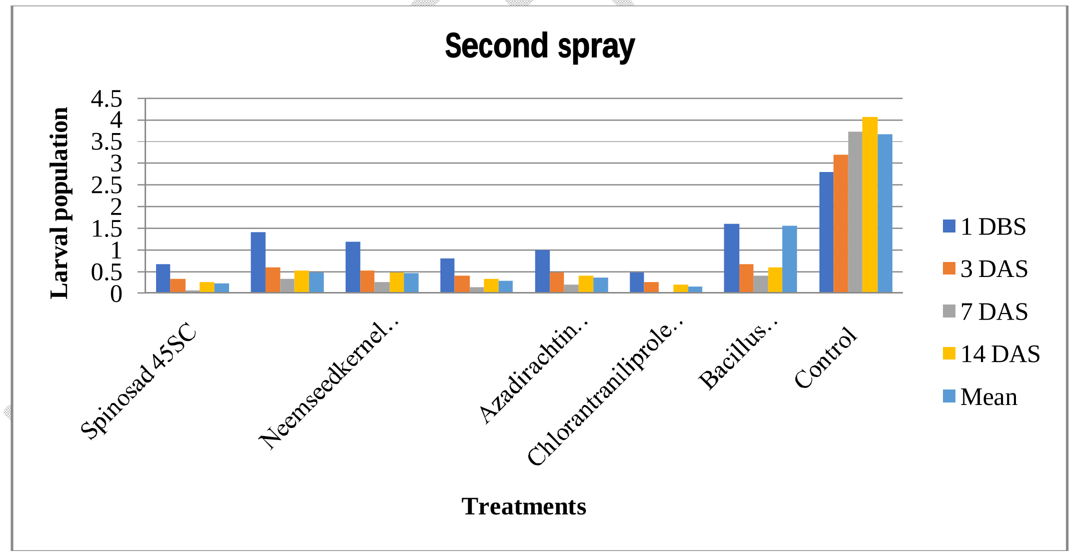

Fig. 2. Efficacyofbiopesticidesandchemicalsonthelarvalpopulationofpod borer *H.armigera*ongreengram (Secondspray)

Table1. Field efficacy of biopesticidesandchemicalsonlarvalpopulationofpodborer *H.armigera*ongreengram and Yield andC:B ratio

T.No	Treatments	Number of larvalpopulationper5plants									Overallmean	Yield (q/ha)	C:B Ratio
		1st Spray					2ndSpray						
		1DBS	3 DAS	7 DAS	14DAS	Mean	3 DAS	7DAS	14DAS	Mean			
T_1	Spinosad45SC	1.200	0.867	0.533	0.667	0.689	0.333	0.067	0.267	0.222	0.456	14.15	1:3.26
T_2	*Ha*NPV1X10^{9}ml/min	1.133	1.667	1.333	1.400	1.467	0.600	0.333	0.533	0.489	0.978	7.09	1:1.62
T_3	Neemseedkernelextract10%WP	1.933	1.467	1.133	1.200	1.267	0.533	0.267	0.467	0.422	0.845	7.93	1:1.92
T_4	Emamectinbenzoate5%SG	1.400	1.067	0.733	0.800	0.867	0.400	0.133	0.333	0.289	0.578	12.21	1:2.94
T_5	Azadirachtin(Neemoil) 00.03%WSP	0.867	1.267	0.933	1.000	1.067	0.467	0.200	0.400	0.356	0.712	8.1	1:1.89
T_6	Chlorantraniliprole18.5 SC	1.333	0.667	0.333	0.467	0.489	0.267	0.000	0.200	0.156	0.323	15.36	1:3.65
T_7	*Bacillusthuringiensis* 4%WSP	1.600	1.867	1.533	1.600	1.667	0.667	0.400	0.600	1.556	1.112	6.5	1:1.58
T_8	Control	2.400	2.600	2.767	2.800	2.722	3.200	3.733	4.067	3.667	3.195	4.3	1:1.14
	F-test	NS	S	S	S	S	S	S	S	S	S		
	S.Ed.(±)	0.142	0.003	0.111	0.001	0.004	0.006	0.008	0.009	0.015	0.097	-	-
	C.D.(P=0.05)	-	0.143	0.279	0.094	0.173	0.209	0.310	0.252	0.313	1.070	-	-

4. CONCLUSION

From the critical analysis of the present findings, it can be concluded that Chlorantraniliprole18.5SCismoreeffectiveincontrollinglarvalpopulationofgreengrampodborerfollowedby Spinosad 45SC, Emamectin benzoate, Azadirachtin (Neem oil) 00.03%WSP, Neem seedkernel extract10%WP in managing green gram pod borer. Among the treatments studied, thebestandmosteconomicaltreatmentwasChlorantraniliprole18.5SCgavethecostbenefitratioof(1:3.65) andmarketingyieldof(15.36q/ha)followedbySpinosad45SC(1:3.94and14.15q/ha), Emamectin benzoate(1:2.94 and12.21 q/ha), Azadirachtin(Neem oil) 00.03WSP(1:1.89and8.1q/ha),Neemseedkernelextract10%WP(1:1.92and7.93q/ha),*Ha*NPV1X10^{9}ml/m in (1:1.62 and7.09 q/ha), and *Bacillus thuringiensis* 1x10^{8}CFU (1:1.58 and 6.5q/ha).Hencethiscanbeapartofintegratedpestmanagementinordertoavoidindiscriminateuse of pesticides for ecofriendly management and to balance flora and fauna from ecosystemwhichcausespollutionintheenvironmentandalsoitwasbelessharmfultobeneficialinsectsand human beings. Respectively as such more trails are required in future to validate thefindings.

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