ComparativeEfficacyofSelectedChemicalsand Bio-pesticidesagainstGramPodBorer[*Helicoverpaarmigera*(Hubner)]onChickpea(*Cicerarietinum*L.)

Abstract

The experiment was conducted at Central Research Farm (CRF), Sam HigginbottomUniversity of Agriculture Technology and Sciences, Prayagraj during *Rabi*season in 2023-24. The experiment was carried out in Randomized Block Design (RBD) with eight treatments *viz.,* Neem oil 2% @ 2ml/lit ,*Beauveria bassiana* 1×10^{10} conidia/ml @ 2gm/lit, Profenofos 40% + Cypermethrin 4% @ 3ml/lit, *Bacillusthuringiensis*@ 2gm/lit,Indoxacarb14.5SC @ 0.5ml/lit,Spinosad45 SC @ 0.5ml/lit,Emamectinbenzoate 5% SG @ 1gm/lit and untreated control, with threereplications. The data recorded on larval population of pod borer *(Helicoverpaarmigera)* on third, seventh and fourteen days after two sprays revealed that Emamectin benzoate 5% SG was superior among all treatments with larval populationof 2.12 and with highest cost benefit ratio and marketable yield of 1:3.65 and 29.16q/ha, followedby Spinosad 45 SC with a larval population of 2.42 and cost benefit ratio and yield 1:3.14and 26.66 q/ha, Indoxacarb 14.5 SC with a larval population, cost benefit ratio and yield of 2.57, 1:3.12and25.83q/ha,Profenofos40% + Cypermethrin4%ECwith alarvalpopulation,costbenefitratioandyield of 2.79,1:2.81and22.5q/ha,*Bacillusthuringiensis*@5mg/mlwithlarvalpopulation,costbenefitratio andyield of 3.04,1:2.79and21.25q/ha,*Beauveriabassiana*@1×10^{10}conidia/mlwithalarvalpopulation,costbenefitratioandyieldof 3.25, 1:2.26, 17.08q/ha.

Keywords: Bio-pesticides, Chickpea, Chemical, Cost benefit ratio, Efficacy, *Helicoverpaarmigera*, Larval population, yield

Introduction

Gram,commonlyknownasa‘chickpea’orchana,isaveryimportantpulsecropthatgrowsasaseedof aplantnamed*Cicerarietinum*intheLeguminosaefamily.Indiaisthelargestchickpeaproduceraswe llasconsumerintheworld.Chickpeaistheworld’sthirdmostimportantlegumecrop. However, the most important chickpea producing countries are India, Turkey, Pakistan,Iran, Mexico, Australia, Ethiopia, Myanmar, and Canada. Chickpea is currently grown onabout 11 million hectares worldwide with 65 and 8 per cent share belonging to India andPakistan, respectively. Average annual production of chickpea is about 9 million tons with 95percentof chickpeacultivation and consumptionoccurringindevelopingcountries.

Chickpeaisthemostlargelyproducedpulsecropin Indiaaccountingtoashareof68to70percent of the total area (13.20 m ha), production of 11.62 mt and productivity of 995 kg/hrespectively, this makes India, the leading chickpea producing country in the world. Chickpearanks third among the pulse crops and accounts for 11.67 million tons annually. This rankingplace chickpea behind beans (25.66 million tons) and peas (11.69 million tons) with meanannualproduction of11.67 milliontons from 2013 to 2017**(Singh *et al.*,2015).**

Chickpea is attacked by 57 insect species, but *Helicoverpaarmigera* (Hubner) (Lepidoptera:Noctuidae), is the most important pest of chickpea **(Sarwar, 2012).** *H. armigera*, commonlyknown as cotton bollworm or American bollworm, is a major noctuid pest in Asia, causingheavy damage to agricultural, horticultural and ornamental crops **(Talekar*et al.*, 2006).** *H.armigera*isthemostseriouspestofchickpeaandothercropplantsallovertheworld.Inseverecases , it causes about 75 to 90 % losses in seed yield, and it was pointed out that gram podborer damaged leaves, tender shoots, apical tips, floral buds and pods **(Bajia, 2015).** Amongthese,the major damage iscausedby grampodborer whichispolyphagousinnature;*Helicoverpaarmigera*isoneoftheseriouspestsofchickpea,whichf eedsmorethan150cropsthroughout the world. Gram pod borer is widely distributed and a serious pest of chickpeacausing heavy crop losses (20-60%) throughout the India. *Helicoverpaarmigera*is the majorand most devastating pest of chickpea which can cause crop loss up to 80 per cent undercongenial weather conditions **(Vikrant *et al.*, 2018).** While the later instars make a more orless circular hole in the pods and insert its head and former portion of body into it and feeduponthedevelopinggrains **(Chitralekha*etal.*,2018).**Grampodborer,*Helicoverpaarmigera*(Hub.) is the most damaging pest in most of areas where this pulse crop is grown. *H. armigera*isacharismaticandoneofthemostdominantinsectpestsinagriculture,accountingforhalf of the total insecticides usage in India for protection of crops. This pest damages the chickpeaplants from seedling stage to crop maturity stage and its larvae can thrive on leaves, tendertwigs, flowers and pods. In recent years, various types of insecticides belonging to differentchemicalgroupshavebeenusedtomanagethepestsandexcessiverelianceonthesechemicalshasledtotheproblemofresistance,environmentalpollutionandhealththreattotheconsumersthusithasbecomeessentialtousetheinsecticidesinoptimaldosagesoastoreduceandcontrolthedamagetoenvironmentandhumanhealthaswellastoreducethepestincidence.Henceaninvestigation was undertaken to evaluate the performance of certain chemical insecticides andbio-pesticidesattheir recommendeddosagesagainstdiamondback mothincabbage.

Materialsandmethods

TheexperimentwasconductedattheCentralResearchFarm,SamHigginbottomUniversityofAgricultureTechnology and Sciences, during the Rabi season of 2023-24. The experimentwasconductedin Randomized Block Design with eight treatments replicated three times. Variety PUSA 362 seeds was used in a plot size of 2m x 1m at the spacing of 45 cm x 15 cm, following a recommended package of practice excluding plant protection. The treatments were Neem oil 2% @ 2ml/lit ,*Beauveria bassiana* 1×10^{10} conidia/ml @ 2gm/lit, Profenofos 40% + Cypermethrin 4%, @ 3ml/lit, *Bacillusthuringiensis*@ 2mg/lit,Indoxacarb14.5SC @ 0.5ml/lit,Spinosad45 SC @ 0.5ml/lit,Emamectinbenzoate 5% SG @ 1gm/lit.

The numbers of larvae were counted on 5 randomly selected plants in each plot. The pre-treatment count was taken a day before the first spray and second spray whereas, the post-treatmentcountsweretakenon3rd, 7th and 14thdayaftereachspray.Thelarvalpopulationovercontrolagainstgrampodborerwascalculatedby consideringthemeanofthreeobservationsof both sprays. Theinsectpopulationwascountedfromrandomlyselectedplantsineveryplotandpopulationper5plants wasnoted.Afterthatmeanofthreereplicationswascalculatedforeachtreatmentandthesamewasdonewiththeuntreatedplot. Healthypods were harvested and their weight from each treatment was expressed as marketable yieldinquintalperhectare.Ultimately,thecostbenefitratiowascalculatedonthebasisofprevailing marketpriceofyield, insecticides andspraying cost **(Deviand Tayde,2017).** Gross return was calculated by multiplying total yield with the market price of the produce.Cost of cultivation and cost of treatment imposition deducted from the gross returns, to findoutnet returns and cost benefit ratio byfollowingformula.

$$\text{Benefit Cost Ratio} = \frac{\text{GrossReturns}}{\text{TotalCost of Cultivation}}$$

(Thumar*etal*.,2020)

Result& discussion :

The data recorded after 1st and 2nd spray revealed that all the treatments were significantlysuperior over the control. The data revealed that all the treatmentswere significantly superior over control after first spray. Among the different treatments least number of larval population of gram pod borer was recorded inEmamectin benzoate 5SG (2.57 larvae per 5 plants), followed by Spinosad 45SC (2.79), Indoxacarb 14.5 SC (2.90),Profenofos 40% + Cypermethrin 4%(3.08),*Bacillusthuringiensis*@ 5mg/ml (3.33), and*Beauvariabassiana* @1×10^{10} conidia/ml(3.50),Neem oil 2% (3.88), was found to be least effectiveamongall the treatmentsas compared to Control(5.11)

The data revealed that all the treatmentswere significantly superior over control after second spray. Among all the treatments the least larval population of podborer, was recorded in Emamectin benzoate 5SG (1.68), followed by Spinosad 45SC (2.06), Indoxacarb 14.5 SC(2.24),Profenofos40% + Cypermethrin4% (2.50),*Bacillus thuringiensis* @5mg/ml (2.75),and *Beauvariabassiana*@1×10^{10}/ml(3.00), Neem oil 2% (3.26) was found to be least effectiveamongall the treatmentsas compared to Control(6.17) .

Theyieldsamongthedifferent treatmentweresignificantlysuperiorovercontrol.Thehighestyieldwasrecorded in Emamectin benzoate 5% (29.16 q/ha), followed by Spinosad (26.66 q/ha),Indoxacarb 14.5 SC (25.83 q/ha), Profenofos40%+Cypermethrin 4% (22.5 q/ha), *Bacillus thuringiensis* (21.25 q/ha), and *Beauveria bassiana*(17.08 q/ha). The treatment Neem oil 2% (13.33 q/ha) was least effectiveamong allthe treatments as compared to Control (11.00 q/ha).

Among the different treatmentstudied,the best and most economical treatment found was Emamectin benzoate 5% withacostbenefitratioof(1:3.65),followedbySpinosad45SC(1:3.14),Indoxacarb(1:3.12),Profe nofos40%+Cypermethrin4%(1:2.81),*Bacillusthuringiensis*(1:2.79),and *Beauveriabassiana*(1:2.26),Neem oil 2% (1:1.76) recorded minimum cost benefitratio among allthe treatments as compared to Control (1:1.54).

Table1: **Efficacy ofselected chemicals and bio-pesticidesagainst grampodboreronchickpeaduring*rabi*2023-2024**

Treatment	**TreatmentDetails**	**MeanLarvalPopulation**										**Yield (q/ha)**	**Benefit Cost Ratio**
		Firstspray					**Secondspray**						
		1DBS	**3DAS**	**7DAS**	**14DAS**	**MEAN**	**1DBS**	**3DAS**	**7DAS**	**14DAS**	**MEAN**		
T_0	Control	4.60	5.00	5.13	5.20	5.11	5.11	5.60	6.53	6.40	6.17	11.00	1:1.54
T_1	Neemoil 2%@ 2ml/lit	4.80	4.06	3.66	3.93	3.88	3.88	3.66	2.86	3.26	3.26	13.33	1:1.76
T_2	*Beauveriabassiana*1x10^{10}conidia/ml@2gm/lit	4.73	3.66	3.40	3.46	3.50	3.50	3.40	2.60	3.00	3.00	17.08	1:2.26
T_3	Profenofos40%+Cypermethrin4%EC@3ml/lit	4.93	3.20	2.93	3.13	3.08	3.08	3.00	2.06	2.46	2.50	22.50	1:2.81
T_4	*Bacillusthuringiensis@ 2gm/lit*	4.80	3.60	3.13	3.26	3.33	3.33	3.20	2.33	2.73	2.75	21.25	1:2.79
T_5	Indoxacarb14.5SC@0.5ml/lit	4.86	3.13	2.66	3.93	2.90	2.90	2.60	1.86	2.26	2.24	23.30	1:3.12
T_6	Spinosad45 SC@0.5ml/lit	4.93	3.06	2.53	2.80	2.79	2.79	2.40	1.66	2.13	2.06	26.66	1:3.14
T_7	Emamectinbenzoate 5%SG@1gm/lit	5.06	2.80	2.33	2.60	2.57	2.57	2.20	1.20	1.66	1.68	29.16	1:3.65
	F-test	**NS**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	-	-
	C.D.(P=0.05)	**-**	**0.381**	**0.111**	**0.224**	**0.204**	**0.204**	**0.177**	**0.255**	**0.22**	**0.569**	-	-

* DBS-DayBeforeSpraying,DAS- DayAfterSpraying,NS-Non-Significant,S–Significant.

The data on mean population after first and second spray revealed that all the insecticides were found very effective and significantly superior over untreated control. Among all seven treatments minimum larvalpopulation was found in Emamectin benzoate 5% (2.12) similar findings were reported by **Yadav *et al*. (2019)and Kambrekar*et al*. (2012)**. Spinosad 45 SC was found the next effective treatment with larval population (2.42) similar finding was reported by **Lavanya and Kumar(2022) and Gayathri and Kumar(2021)**.Indoxacarb 14.5 SC (2.57), Profenofos 40% + Cypermethrin 4% was found the next best effective treatments with the larval population (2.79) which was similarly to the findings of**Jadhav *et al*.(2021)**. Among all the treatments the higher cost benefit ratio was obtained from Emamectin benzoate (1:3.65) which is in support to the findings of**Shah *et al*., (2013)**, **Bharti *et al*. (2015)** followed by Spinosad 45 SC with a cost benefit ratio of (1:3.14) similar finding was found by **Nitish et al., (2015), Keval *et al*., (2016)** followed by Indoxacarb 14.5 SC(1:3.12).

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