Original Research Article

Field efficacy and economics of different insecticides against tomato fruit borer [*Helicoverpaarmigera* (Hubner)]

ABSTRACT

ThefieldexperimentonEfficacy efficacyand economics ofdifferentinsecticidesagainsttomatofruitborer[*Helicoverpaarmigera*(Hubner)]wasconductedduringrabi2021-2022,atCentralResearchField,DepartmentofEntomology,SHUATS,Naini,Prayagraj, U.P.ThedataonincrementalpercentreductionofdifferenttreatmentsrevealedthattheT_5Spinosad 45%SC(81.379)followedbyT_1Indoxacarb14.5%SC(75.140),T_7Emamectinbenzoate5%SG(74.634), T_2 Flubendiamide 39.5% SC (68.634), T_3Novaluron 10%EC (65.647), T_4 Fipronil 5% SC(54.225), T_6Neem oil 0.03% EC (49.533) found to be least affective than all other treatments.Among the treatment studied the bestand most economical treatment was Spinosad (1:6.72), Indoxacarb 14.5% SC 14.5SC (1:6.42),followedbyEmamectinbenzoate5%SG(1:6.3),Novaluron45%SC(1:5.09),Flubendiamide 20%WG (1:4.45), Fipronil5%SC(1:7.9),(1:3.92),Neemoil 0.03% EC(1:3.45)ascompared to control T0 (1:3.04).

Key words: -Efficacy, Economics, Insecticides, *Helicoverpa armigera*, Tomato fruit borer.

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INTRODUCTION

Tomato, *Solanum lycopersicon* (Miller) is one of the most important herbaceous crops belonging to the*Solanaceae* family. It is popularly known as wolf apple, love of apple or Vilaayati baingan. It ranks thirdlargest vegetable crop after potato and sweet potato, but it tops in the list of canned vegetables. It can beused fresh in salad, curries or by-product like chutney, pickle, soups, ketchup, sauce, powder, purees andasawholeetc. **(Patil *et al.*,2018)[12]**.

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This crop is severely attacked by various insect pests *viz.*, fruit borer, *Helicoverpa armigera* (Hubner):whitefly, *Bemisia Tabaci* (Gennadius); aphid, *Aphis gossypii* (Glover); leaf eating caterpillar, *Spodopteralitura* (Fabricius); American serpentine leaf miner, *Liriomyza trifolii* (Burgess) and red spider mite,*Tetranychus urticae* (Koch) Ignacimuthu. Among these, fruit borer, *Helicoverpa armigera* is an importantpest responsible for major yield loss in tomato. *Helicoverpa armigera* has attained the status of nationalpest in recent years in the form of economic damage caused to different agricultural crops throughoutIndia.**(Sathish*et al.*, 2018)[16]**

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The *Helicoverpa armigera* (Huner) (Lepidoptera: Noctuidae), a highly polyphagous species anda pest of major economic importance on a wide range of crops, particularly cotton, soybeans, tobacco,chickpea and pigeon pea. The polyphagous pest of worldwide occurrence inflicting annual crop damagein India worth US $1 billion. This pest accounts for the consumption of half of the total insecticide usedin India for protection of different crops. In Tamil Nadu, losses of fruit range 40-50%. Similarly, inNorthernIndia,30%lossofthefruitwasobservedduetotomatofruitworm.reported5–55%lossesfromthis insect pest in the tomato growing areas of India. Tomato fruit worm has also caused 35% yield lossintomato and 37.79%specifically inKarnataka,India. (**Wajid *et al.*,2016)[21]**.

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MATERIALSANDMETHODS

The experiment ~~is~~ wasconducted during the *Rabi* season 2021- 2022 at SHUATS, CentralResearchfield, Prayagraj, is situated at 25.27^0 North latitude 80.50^0 East longitude and at an altitudeof98mt. above sea level in a randomized block design with eight treatments replicated three timesusingavarietyLakshmiwereboughtfromPrayagrajusedforfieldtrail.Thesowingwasdoneonthe15th Nov2021.Seed rate400-500 g/ha.Theseedlingsofthe onemonth theretransplantedplant toplant and row to row spacing of 60 X 45 cm was maintained. Gap filling was done 10 days after toseeuniform plant population ineach plot.

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Fertilizerswereappliedattherateofhalfdoseofnitrogenandfulldoseofphosphorousandpotassiumwas given at the time of transplanting. The remaining dose of nitrogen was applied one month aftertransplanting.Fertilizerswere applied alongthefurrows intheformofurea,DAPandMOP.

The crop was sown in *Rabi* season 2021-2022, one main irrigation channel of 1m width prepared inthe experimental field and two sub irrigation channels of 0.5 m each were made tomeet out theirrigation requirement. Crop depends on rainy water but irrigation was practiced to meet the waterrequirements.

Observation were recorded on the number of larvae per 5 plants in 2m row length at 5 differentlocations of all treatments were randomly selected and total number of larvae were recorded 1daybeforeapplicationand3rd 7thand14thdaysafterapplicationineachtreatment.Theresultobtainedareconvertedinto percentlarval populationand reductionpercent withfollowing formula.

Larvalpopulation =No.oflarvae/5plants in2m

$$\textbf{Percentagereductionovercontrol} = \frac{\text{Control-Treatment}}{\text{Control}} \times 100$$

BenefitCostRatio:

Cost effectiveness of each treatment was assessed based on net returns. Net return of each treatmentwas worked out by deducting total cost of the treatment from gross returns. Total cost of productionincludedboth cultivation as well as plantprotection charges.

Grossreturn = Marketable YieldxMarketprice

Netreturn = Grossreturn–Totalcost

Benefit:Cost Ratio = Grossreturn

Totalcost

RESULTSANDDISCUSSION

Among all the treatments highest percent population reduction of fruit borer was recorded in T_5Spinosad45%SC(81.379)thesefindingsareinsupportwith**Reguri*etal*.,(2021)[14],Sushma*etal*.(2016)[19] and Amalendu *et al*.,(2010)[2]**proved their superiority over other insecticides in reducingpercentage of larval population (82.6) followed by T_1 Indoxacarb 14.5 %SC (75.140) thesefindingsareinsupportwith**Santosh*etal*.,(2020)[07],Reguri*etal*.,(2021)[14]**provedtheirsuperiority over other insecticides in reducing percentage of larval population (85.04),(65.56)followed by T_7Emamectin benzoate 5%SG (74.634) these findings are in support with **Gulam *et al*., (2015)[04],Khademul *et al*. (2020)[05],kumar *et al*.,(2014)[06]**proved their superiority over other insecticides inreducing percentage of larval population(78)and (62.52), T_2 flubendiamide 39.5%SC (68.634)these findings are in support with **Gulam *et al*., (2015)[04], Padhan and Raghuraman**

(2019)[11]inreducingpercentageoflarvalpopulation(78.10),T_3Novuluron10%EC(65.647)thesefindingsare in support with **Satish *et al*. (2018)[16]**and **Singh *et al*.,(2017)[17]**in reducing percentage oflarvalpopulation(61.85),T_4Fipronil5%SC(54.225)thesefindings areinsupportwith**Ghosal*etal*. (2016)[3]**, **Meena *et al*. (2014)[08]and Santosh *et al*., (2020)[07]**proved their superiority overother insecticides in reducing percentage of larval population(81.78) and T_6 Neem oil 0.03% EC(49.533)supportedwith**Sultana*etal*.,(2015)[09]**and**Ojha*etal*.(2017)[10]**inreducingpercentageoflarvalpopulation(49.2)wasfoundtobeleasteffectivethanallthetreatmentsandissignificantlysuperiorover thecontrol.

The yield among the treatments was significant. The highest yield was recorded in Spinosad 45%SC(250q/ha)followedbyIndoxacarb14.5%SC(220q/ha),Emamectinbenzoate5%SG(210q/ha), Novaluron 10%EC (170q/ha), Flubendiamide 39.5% SC (160q/ha), Fipronil 5% SC(130q/ha), Neem oil 0.03% EC (120q/ha) as compared to T_0 control (100q/ha). When the benefitcost ratio was worked out, interesting results was achieved. Among the treatment studied the bestand most economical treatment was Spinosad (1:6.72), Indoxacarb 14.5% SC 14.5SC (1:6.42),followedbyEmamectinbenzoate5%SG(1:6.3),Novaluron45%SC(1:5.09),Flubendiamide 20%WG (1:4.45), Fipronil5%SC(1:7.9),(1:3.92),Neemoil 0.03% EC(1:3.45)ascompared to

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The present are similar with **Tejaswari and Kumar (2021)**[20], **Indira *et al*., (2014)**[06]**, Game *etal*.,(2018)**[1] **and Satish *et al.* (2018)**[06]reported that the cost benefit ratio obtained in Spinosadtreated plot was (1:7.07),(1:0.86),(1:0.78) and (1:11.42).**Hemasreelatha and Yada(2021)**[22]**,Indira*et al*., (2014)**[06], **Satish *et al.* (2018)**[16]concluded that, in terms of higher cost benefit ratio,Indoxacarbrecorded(1:8.25),(1:0.85)and (1:14.73).,**YadavandHemasreelatha(2021)**[22]**Sapkal*etal.*, (2018)**[15observed highest C:B ratio in with Emamectin benzoate 1:6.7,1:5.04. **Reddy *et al*.,(2021)**[14]**,Sapkal*etal.*,(2018)**[15reportedthatthecostbenefitratioobtainedinNovalurontreatedplot was (1:7.15),(1:0.95).**Tejaswari and Kumar (2021)** [20]**,Ghosal *et al*.,(2012)**[2]**, Meena *etal*.,(2014)**[08] concluded that, in terms of higher cost benefit ratio, Flubendiamide and neem oilrecorded(1:6.4)and (1:5.6).

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Table 1: Evaluation of different insecticides on per cent reduction of larvalpopulationoftomatofruitborer,*H.armigera*during*rabi*2021-2022(1st spray)

Treatment		Percent Population reduction of *Helicoverpaarmigera* /Fiveplants				
		1DBS(No.of.larva/fiveplants	**3 DAS**	**7 DAS**	**14DAS**	**Mean**
T_1	Indoxacarb14.5% S	2.33	60.910	76.613	69.343	68.955
T_2	Flubendaimide39.5%SC	2.067	52.793	68.390	61.010	60.731
T_3	Novaluron10%EC	2.467	41.643	56.437	60.713	52.931
T_4	Fipronil5% SC	2.000	28.403	48.317	49.700	42.140
T_5	Spinosad45% SC	2.333	72.100	82.657	76.190	76.982
T_6	Neemoil0.03%	2.000	33.020	45.937	43.450	40.802
T_7	Emamectinbenzoate5%SG	2.267	58.347	72.070	65.473	65.297
T_0	Control	2.200	---	---	---	---
	F-test	**NS**	**S**	**S**	**S**	**S**
	C.D.at 5%		**11.355**	**10.590**	**9.718**	**6.591**
	S.Ed.(+)	**0.040**	**5.211**	**4.860**	**4.459**	**2.66**

Table2:Evaluationofdifferentinsecticidesonpercentreductionoflarvalpopulationoftomatofruitborer,*H.armigera*during*rabi*2021-2022(2nd spray)

Treatment		**Per cent Population reduction of *Helicoverpaarmigera* /5plants**			
		3rd DAS	**7th DAS**	**14th DAS**	**Mean**
T_1	Indoxacarb14.5% SC	75.422	84.470	84.080	81.324
T_2	Flubendaimide39.5%SC	67.840	81.013	80.757	76.537
T_3	Novaluron10%EC	73.460	80.783	80.847	78.363
T_4	Fipronil5% SC	61.173	71.063	66.690	66.309
T_5	Spinosad45% SC	83.773	92.357	91.203	85.776
T_6	Neemoil0.03%	53.060	63.653	58.087	58.263
T_7	Emamectinbenzoate5%SG	77.647	88.420	85.847	83.971
T_0	Control	---	---	---	---
	F-test	**S**	**S**	**S**	**S**
	C.D.at 5%	**9.416**	**6.760**	**7.702**	**4.464**
	S.Ed.(+)	**4.320**	**3.102**	**3.534**	**2.048**

Figure:1YIELDOFDIFFERENTTREATMENTS(q/ha)

Table:3Economics andbenefitcostratio.

Treatment Symbols	Yield(q/ha)	Selling price(Rs/q)	Gross return (Rs)	Total cost ofcultivation (Rs)	Net return(Rs)	B: C Ratio
Indoxacarb 14.5%SC	220	1200	264000	41176	222824	1:6.42
Neem oil 0.03%	120	1200	144000	41701	102299	1:3.45
Fipronil 5% SC	130	1200	156000	39783	116217	1:3.92
Emamectinbenzoate 5% SG	210	1200	252000	39951	212049	1:6.3
Novaluron 10%EC	170	1200	204000	40051	163949	1:5.09
Spinosad45% SC	250	1200	300000	44641	255359	1:6.72
Flubendiamide 39.5%SC	160	1200	192000	43051	148949	1:4.45
Control	100	1200	120000	39451	80549z	1:3.04

CONCLUSION

From the above discussion it was found that, spraying of insecticides significantlyreduced thefruit borer population in tomato. The present findings conclude that the new generationinsecticideslikeSpinosad,Indoxacarb,Navuluron,emamectinbenzoateandFlubendiamide,Fipronil ,neemoil were found effective against lepidopteran caterpillar *Helicovera armigera* along with anadditional yield level in tomato. Further, it was observed that the cost benefit ratio was also high withSpinosad and Indoxacarb. Hence, it is suggested that the effective insecticides may be alternated inharmony with the existing Intergrated pest management programes in order to avoid the problemsassociatedwith insecticidalresistance, pestresurgenceetc.

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