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Effect of Border Crops, Microbials and Botanical on Chickpea Pod Borer, *Helicoverpa armigera* (Hubner)

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ABSTRACT
The present experiment was conducted to study effect of border crops, microbials and botanical on chickpea pod borer, Helicoverpa armigera (Hubner). There were total two sprays taken. On three days after first spray the treatment combinations, Maize + Btk and no border + Btk recorded zero larvae per five plants and found to be best treatments. On three days after second spray the treatment combinations Maize + Btk, Marigold + Btk, Sorghum + Btk, no border + Btk, Sorghum + HaNPV 500 LE ha^{-1}, Maize + B. bassiana, Maize + M. anisopliae, Sorghum + M. anisopliae, Marigold + Azadirachtin, Sorghum + Azadirachtin and no border + Azadirachtin recorded zero larvae per five plants and were found to be best treatment combinations. Three days after second spray the treatment combinations no border + Btk, Sorghum + HaNPV 500 LE ha^{-1}, Maize + Btk, Marigold + Btk, Maize + Azadirachtin and no border + Azadirachtin recorded least per cent pod damage and were at par with each other. At 7 days after second spray the treatment combinations no border + Btk, Sorghum + HaNPV 500 LE ha^{-1}, Maize + Btk, Marigold + Btk, Maize + Azadirachtin, no border + Azadirachtin and Sorghum + Btk recorded lowest per cent pod damage and were at par with each other.
Keywords: *Helicoverpa armigera, microbials, botanical, chickpea, Trap crop, etc.*

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INTRODUCTION

India is a premier pulse growing country. Gram pod borer, *Helicoverpa armigera* (Hubner) is the serious pest of Indian agriculture. This pest is highly polyphagous and has been reported to damage more than 182 species of host plants. Availability of many alternative hosts and extensive cultivation of this crop in various agro-climatic zones is one of the key reasons for its incidence on the crop [10]. The caterpillar not only defoliates the tender leaves but also makes holes in the pods and feed upon the developing grains. While feeding on the developing seeds the anterior body portion of the caterpillar remains inside the pod and rest half or so hanging outside. When seeds of one pod are finished, it moves to the next. Unless the pest is controlled in the initial stages of infestation it takes the heavy toll of the crop. A single larva has potential to damage up to 30 pods in its lifetime, thereby causing heavy losses to the crop (Sharma, 1978)[9]. The pod damage ranges from 3.3 to 72.8 per cent [1]. Worldwide losses due to *H. armigera* have been estimated over US $ 300 million annually [5].

The management of this noxious pest is primarily based on synthetic insecticides. Preference of insecticides due to their easy availability and applicability and their excessive and indiscriminate use has resulted in the development of insecticidal resistance in the pest and environmental pollution. Recently, *H. armigera* is reported to have developed resistance to many commonly used insecticides [8]. Biopesticides are inherently less harmful than conventional pesticides. These are quickly biodegradable in addition to etiology that they can self-propagate and have long lasting control effect as opposed to chemical which can create residual problem in addition to resistance development in pest and pest resurgence. Therefore now a days biopesticides play an important role in pest management. Intercropping is more economical method of pest management and has become popular, particularly among the small and marginal farmers and it is very well fitted in Integrated Pest Management. It is also proved very good practice for conservation of the natural enemies. There was lack of information on combination effect of border crops and plant protection measures in chickpea. Therefore present study

was carried out to find the effect of border crops, microbials and botanical on chickpea pod borer, *Helicoverpa armigera* (Hubner) in chickpea ecosystem.

MATERIALS AND METHODS

The experiment was conducted at ASPEE Agricultural Research and Development Foundation farm Village- Met, Tal- Wada, Dist- Thane during *rabi* 2012 -2013 and laid out in split plot design with two replication using of chickpea cv. Gujarat-1 with a plot size 1.8 x 1.5 m^2. The spraying of biopesticides *viz*., (T_1) *Btk* 1.5 g l^{-1}, (T_2) *HaNPV* 500 LE ha^{-1}, (T_3) *Beauveria bassiana* 5 g l^{-1}, (T_4) *M. anisopliae* 5 g l^{-1}, (T_5) Azadirachtin 50000 ppm (0.8 ml l^{-1}) and (T_6) only water spray was done after initiation of the pest. Another application was done 15 days after first spray. Whereas, border crops *viz*., (S_1) maize, (S_2) marigold, (S_3) sorghum and (S_4) no border (sole chickpea) were planted around the chickpea plot at the time of sowing of chickpea.

Five plants per plot were selected randomly to record the observations on the incidence of chickpea pod borer, *Helicoverpa armigera*. The observations on the number of larvae observed per plant recorded from the five randomly selected plants whereas, on per cent pod damage, the number of healthy and infested pods per plant were counted and on the basis of this, per cent pod damage was calculated by using following formula;

$$\text{Per cent pod damage (\%)} = \frac{\text{No. of damaged pods}}{\text{Total no. of pods}} \times 100$$

The observations on the number of larvae observed per plant, per cent pod borer incidence on chickpea was recorded before biopesticide spray and 3, 7, and 14 days after spray. The data on number basis were subjected to $\sqrt{n+1}$ transformation, on per cent basis transformed into arcsine and analysed statistically.

RESULTS AND DISCUSSION

Combination effect of border crops, microbials and botanical against chickpea pod borer, *H. armigera* on number of larva per five plants

The data pertaining combination effect of border crops, microbials and botanical against chickpea pod borer, *H. armigera* on number of larva per five plants at both spray presented in Table 1.

On three days after first spray the treatment combinations, Maize + *Btk* and no border + *Btk* recorded zero larvae per five plants and found to be best treatments. On three days after second spray the treatment combinations Maize + *Btk*, Marigold + *Btk*, Sorghum + *Btk*, no border + *Btk*, Sorghum + *HaNPV* 500 LE ha^{-1}, Maize + *B. bassiana*, Maize + *M. anisopliae*, Sorghum + *M. anisopliae*, Marigold + Azadirachtin, Sorghum + Azadirachtin and no border + Azadirachtin recorded zero larvae per five plants and were found to be best treatment combinations. While the treatment combinations Maize + Azadirachtin, Sorghum + *B. bassiana*, Maize + *HaNPV* 500 LE ha^{-1} and no border + *B. bassiana* were at par with above treatment combinations. The interaction effect of border crops, microbials and botanical on seven and fourteen days after both sprays showed non-significant effect.

The present findings confirm the results of Jadhav *et al.,* [2]. They revealed that the treatment T_7 consisting of IPM component *viz*., hand collection and destruction of larvae a day before each spraying, alternate sprays of NSKE (5%), *Bt* var. *kurstaki* (1 g l^{-1}) and *HaNPV* 250 LE ha^{-1} at 15 days interval starting from 50 per cent flowering, growing 10 days old marigold seedlings all along the border as trap crop at the time of sowing of main crop, installation of pheromone traps of *H. armigera* 1 trap per treatment at the time of 50 per cent flowering and installation of bird perches 1 perch per treatment was found more promising and economical than all other component of IPM on the basis of lowest cumulative mean larval population of 1.57 per 10 plants.

Karabhantanal *et al.* [3] reported that IPM module consisted of trap crop (15 rows of tomato: 1 row of marigold) + *Trichogramma pretiosum* (45,000 ha^{-1}) – NSKE (5%) – *HaNPV* (250 LE ha^{-1}) – endosulfan 35 EC (1250 ml ha^{-1}) was significantly superior over rest of the modules tested in restricting the larval population (100% after fourth spray).

Combination effect of border crops, microbials and botanical against chickpea pod borer, *H. armigera* on per cent pod damage per five plants

The data pertaining combination effect of border crops, microbials and botanical against chickpea pod borer, *H. armigera* on per cent pod damage per five plants at both spray presented in Table 2.

The treatment combinations no border + *HaNPV* 500 LE ha^{-1}, Marigold + Azadirachtin, Marigold + *HaNPV*, Sorghum + *Btk*, Maize + *HaNPV* 500 LE ha^{-1}, Marigold + *Btk*, Marigold + *B. bassiana*, Maize + Azadirachtin,

Table 1: Combination effect of border crops, microbials and botanical against *H. armigera* on number of larva at both sprays

Treatment combinations: Main plot x Sub plot	No. of larvae/5 plants at first spray				No. of larvae/5 plants at second spray			
	Pre count	3 DAS	7 DAS	14 DAS	Pre count	3 DAS	7 DAS	14 DAS
S_1T_1	0.70 (1.29)*	0.00 (1.00)	0.10 (1.05)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
S_1T_2	0.90 (1.37)	0.70 (1.29)	0.70 (1.29)	0.40 (1.18)	0.40 (1.18)	0.20 (1.10)	0.00 (1.00)	0.00 (1.00)
S_1T_3	1.10 (1.45)	0.60 (1.26)	0.20 (1.10)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
S_1T_4	0.70 (1.30)	0.50 (1.22)	0.30 (1.14)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
S_1T_5	0.40 (1.18)	0.20 (1.09)	0.20 (1.09)	0.00 (1.00)	0.00 (1.00)	0.10 (1.05)	0.00 (1.00)	0.00 (1.00)
S_1T_6	0.80 (1.34)	1.50 (1.57)	0.90 (1.51)	0.90 (1.37)	0.90 (1.37)	1.10 (1.45)	0.10 (1.05)	0.10 (1.05)
S_2T_1	0.40 (1.15)	0.20 (1.10)	0.40 (1.38)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
S_2T_2	1.30 (1.50)	2.00 (1.73)	1.40 (1.54)	0.60 (1.26)	0.60 (1.26)	0.60 (1.26)	0.20 (1.10)	0.10 (1.05)
S_2T_3	1.00 (1.41)	1.80 (1.66)	1.30 (1.51)	0.40 (1.18)	0.40 (1.18)	0.30 (1.14)	0.00 (1.00)	0.00 (1.00)
S_2T_4	0.60 (1.26)	0.40 (1.18)	0.50 (1.22)	0.20 (1.09)	0.20 (1.09)	0.40 (1.18)	0.00 (1.00)	0.00 (1.00)
S_2T_5	1.10 (1.45)	0.50 (1.22)	0.30 (1.14)	0.10 (1.05)	0.10 (1.05)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
S_2T_6	0.50 (1.22)	1.30 (1.51)	0.50 (1.45)	0.70 (1.30)	0.70 (1.30)	0.60 (1.26)	0.60 (1.26)	0.30 (1.14)
								Continued……..
S_3T_1	0.90 (1.37)	0.20 (1.09)	0.00 (1.00)	0.10 (1.05)	0.10 (1.05)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
S_3T_2	0.40 (1.18)	0.60 (1.26)	0.40 (1.17)	0.00 (1.00)	0.00 (1.00)	0.10 (1.05)	0.00 (1.00)	0.00 (1.00)
S_3T_3	0.60 (1.26)	1.50 (1.58)	0.80 (1.34)	0.70 (1.30)	0.70 (1.30)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
S_3T_4	0.20 (1.09)	1.00 (1.40)	0.20 (1.10)	0.10 (1.05)	0.10 (1.05)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
S_3T_5	0.10 (1.05)	0.20 (1.10)	0.10 (1.05)	0.00 (1.00)	0.00 (1.00)	0.40 (1.18)	0.40 (1.18)	0.30 (1.14)
S_3T_6	0.50 (1.22)	1.10 (1.45)	0.70 (1.58)	1.00 (1.40)	1.00 (1.40)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
S_4T_1	0.80 (1.34)	0.00 (1.00)	0.10 (1.05)	0.00 (1.00)	0.00 (1.00)	0.60 (1.26)	0.00 (1.00)	0.03 (1.01)
S_4T_2	0.60 (1.26)	1.40 (1.54)	0.80 (1.34)	0.80 (1.34)	0.80 (1.34)	0.20 (1.10)	0.00 (1.00)	0.00 (1.00)
S_4T_3	0.50 (1.22)	0.50 (1.22)	0.90 (1.37)	0.30 (1.14)	0.30 (1.14)	0.30 (1.14)	0.00 (1.00)	0.00 (1.00)
S_4T_4	0.90 (1.38)	1.00 (1.41)	0.50 (1.22)	0.40 (1.18)	0.40 (1.18)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
S_4T_5	0.60 (1.26)	0.60 (1.26)	0.10 (1.05)	0.00 (1.00)	0.00 (1.00)	0.80 (1.34)	0.40 (1.18)	0.25 (1.12)
S_4T_6	0.50 (1.22)	1.90 (1.70)	0.70 (1.52)	0.90 (1.37)	0.90 (1.37)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)
F test	NS	Sig.	NS	NS	NS	Sig.	NS	NS
S.E. ±	0.10	0.09	0.10	0.07	0.07	0.04	0.03	0.02
C.D. at 5%	-	0.27	-	-	-	0.10	-	-

. * Figures in parentheses are $\sqrt{n+1}$ transformed values. DAS – Days after spraying

Table 2: Combination effect of border crops, microbials and botanical against *H. armigera* on per cent damage at both sprays

Treatment combinations: Main plot x Sub plot	Per cent damage/5 plants at first spray				Per cent damage/5 plants at second spray			
	Pre count	3 DAS	7 DAS	14 DAS	Pre count	3 DAS	7 DAS	14 DAS
S_1T_1	14.76 (2.18)*	24.99 (2.86)	7.28 (1.50)	7.11 (1.53)	7.11 (1.53)	4.55 (1.18)	4.56 (1.18)	4.65 (1.19)
S_1T_2	14.76 (1.91)	21.39 (2.64)	7.42 (1.48)	10.78 (1.87)	10.78 (1.87)	10.84 (1.89)	10.86 (1.89)	10.94 (1.92)
S_1T_3	11.18 (3.06)	41.32 (3.66)	8.88 (1.68)	11.97 (1.98)	11.97 (1.98)	10.67 (1.87)	10.69 (1.88)	10.87 (1.97)
S_1T_4	28.91 (2.01)	27.17 (2.98)	20.27 (2.44)	7.00 (1.52)	7.00 (1.52)	16.28 (2.23)	16.32 (2.26)	16.38 (2.28)
S_1T_5	12.25 (1.89)	23.57 (2.78)	1.70 (0.53)	1.43 (0.48)	1.43 (0.48)	4.73 (1.24)	4.73 (1.24)	4.75 (1.26)
S_1T_6	10.96 (1.56)	16.36 (2.30)	11.37 (1.93)	22.10 (2.69)	22.10 (2.69)	11.82 (1.90)	11.80 (1.91)	11.86 (1.93)
S_2T_1	12.42 (2.01)	22.43 (2.71)	7.87 (1.59)	8.17 (1.63)	8.17 (1.63)	4.48 (1.18)	4.48 (1.18)	4.52 (1.20)
S_2T_2	12.42 (1.58)	16.23 (2.30)	10.04 (1.79)	16.74 (2.29)	16.74 (2.29)	16.76 (2.35)	16.78 (2.36)	16.87 (2.39)
S_2T_3	7.62 (2.08)	23.38 (2.77)	9.39 (1.75)	13.46 (2.08)	13.46 (2.08)	10.63 (1.84)	10.63 (1.84)	10.65 (1.85)
S_2T_4	13.15 (2.16)	25.87 (2.91)	11.52 (1.73)	10.19 (1.80)	10.19 (1.80)	14.52 (2.18)	14.54 (2.19)	14.62 (2.20)
S_2T_5	14.21 (1.64)	16.19 (2.29)	10.34 (1.83)	7.35 (1.55)	7.35 (1.55)	10.94 (1.90)	10.95 (1.90)	10.98 (1.92)
S_2T_6	8.35 (1.71)	29.67 (3.12)	9.02 (1.72)	4.01 (2.06)	4.01 (2.06)	9.87 (1.80)	9.89 (1.82)	9.92 (1.84)
Continued……..								
S_3T_1	17.68 (2.39)	19.98 (2.56)	11.19 (1.92)	6.45 (1.45)	6.45 (1.45)	6.74 (1.45)	6.74 (1.45)	6.76 (1.46)
S_3T_2	17.68 (2.79)	30.11 (3.04)	5.42 (1.33)	7.02 (1.43)	7.02 (1.43)	4.73 (1.16)	4.74 (1.16)	4.76 (1.18)
S_3T_3	24.21 (2.70)	31.36 (3.21)	14.16 (2.15)	14.54 (2.17)	14.54 (2.17)	11.78 (1.96)	11.79 (1.96)	11.82 (1.98)
S_3T_4	22.25 (2.63)	31.61 (3.22)	17.87 (2.41)	6.82 (1.49)	6.82 (1.49)	15.80 (2.26)	15.82 (2.27)	15.86 (2.29)
S_3T_5	21.11 (2.25)	26.05 (2.92)	13.65 (2.06)	6.71 (1.44)	6.71 (1.44)	11.19 (1.91)	11.19 (1.91)	11.23 (1.94)
S_3T_6	15.54 (2.06)	28.42 (3.05)	14.04 (2.15)	13.04 (2.04)	13.04 (2.04)	11.37 (1.93)	11.39 (1.94)	11.43 (1.98)
S_4T_1	19.15 (2.50)	32.25 (3.25)	15.25 (2.18)	5.67 (0.96)	5.67 (0.96)	1.93 (0.73)	1.94 (0.73)	1.98 (0.75)
S_4T_2	19.15 (1.67)	14.45 (2.18)	11.91 (1.97)	10.25 (1.83)	10.25 (1.83)	9.96 (1.80)	9.97 (1.81)	9.99 (1.84)
S_4T_3	8.50 (3.03)	39.61 (3.60)	11.36 (1.84)	8.61 (1.67)	8.61 (1.67)	15.03 (2.22)	15.05 (2.23)	15.10 (2.28)
S_4T_4	28.13 (2.69)	26.56 (2.95)	15.76 (2.27)	17.68 (2.39)	17.68 (2.39)	9.97 (1.77)	9.97 (1.77)	10.05 (1.87)
S_4T_5	22.72 (2.18)	27.22 (2.96)	1.57 (0.72)	3.81 (1.00)	3.81 (1.00)	5.19 (1.30)	5.20 (1.31)	5.25 (1.34)
S_4T_6	14.74 (2.53)	33.07 (3.29)	11.87 (1.95)	12.88 (2.04)	12.88 (2.04)	9.34 (1.74)	9.34 (1.74)	9.38 (1.76)
F test	NS	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	NS
S.E. ±	0.21	0.27	0.36	0.35	0.35	0.24	0.24	0.24
C.D. at 5%	-	0.79	1.06	1.02	1.02	0.71	0.72	-

*Figures in parentheses are arc sin transformed values. DAS – Days after spraying

Maize + *Btk*, Marigold + *M. anisopliae*, Sorghum + Azadirachtin, no border + *M. anisopliae* and no border + Azadirachtin recorded least per cent pod damage and were at par with each other at three days after first spray. At seven days after first spray, the treatment combinations Maize + Azadirachtin, no border + Azadirachtin, Sorghum + *HaNPV* 500 LE ha^{-1}, Maize + *HaNPV* 500 LE ha^{-1}, Maize + *Btk* and Marigold + *Btk* recorded lowest per cent pod damage and were at par with each other. The treatment combinations Maize + Azadirachtin, no border + *Btk*, no border + Azadirachtin, Sorghum + *HaNPV* 500 LE ha^{-1}, Sorghum + Azadirachtin, Sorghum + *Btk* and Sorghum + *M. anisopliae* recorded lowest per cent pod damage and were at par with each other at 14 days after first spray. Three days after second spray the treatment combinations no border + *Btk*, Sorghum + *HaNPV* 500 LE ha^{-1}, Maize + *Btk*, Marigold + *Btk*, Maize + Azadirachtin and no border + Azadirachtin recorded least per cent pod damage and were at par with each other. At 7 days after second spray the treatment combinations no border + *Btk*, Sorghum + *HaNPV* 500 LE ha^{-1}, Maize + *Btk*, Marigold + *Btk*, Maize + Azadirachtin, no border + Azadirachtin and Sorghum + *Btk* recorded lowest per cent pod damage and were at par with each other.

The present findings confirm the results of Pawar [7]. He reported that cotton intercropped with cowpea or blackgram (1 row: 2-4 rows) or strip crop cotton with sorghum and spraying with Endocel 35 EC 400 ml + Heliocel R (NPV) 100 ml $acre^{-1}$ (mix 2 chicken egg's albumin) or Tricel 20 EC 400 ml + Heliocel R (NPV) 100 ml $acre^{-1}$ reduced per cent damage and gave higher yield and return. Katole *et al.* [4] revealed that IPM package without or with intercrop of maize (3:1), followed by NSE (5%) spray at ETL and subsequently with endosulfan (0.07%), *HaNPV* 250 LE ha^{-1} and methyl parathion 2 D at the rate of 20 Kg ha^{-1} at 15 days interval was found most effective and economical in reducing pod borer damage and increasing the yield of pigeonpea crop. Nadaf [6] observed that one row of marigold as a trap crop for 18-20 rows of chilli followed by application of Achook, Nimbicidine, Dipel and Carbaryl in sequences on main crop resulted in lowest damage and highest yield and B:C ratio.

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