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Field efficacy of *Helicoverpa armigera* (Hübner) hardwick on pigeonpea

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ABSTRACT

A field experiment was conducted to determine the efficacy of different insecticides against gram pod borer, *Helicoverpa armigera* (Hübner) Hardwick infesting pigeonpea at Junagadh Agricultural University campus, Junagadh during *Kharif-Rabi* season of 2006-07. The results revealed that indoxacarb 0.007 per cent, spinosad 0.005 per cent and emamectine benzoate 0.005 per cent were found to be the most effective in reducing the gram pod borer population. The highest yield was also recorded in the treatment of indoxacarb 0.007 per cent (1658 kg/ha) followed by spinosad 0.005 per cent (1582 kg/ha) and emamectine benzoate 0.005 per cent (1494 kg/ha). The treatment of indoxacarb 0.007 per cent was found most economical as it gave the highest cost benefit ratio (1:7.546) followed by endosulfan 0.07 per cent (1: 6.766), cypermetrin 0.006 per cent (1: 5.492), novaluron 0.01 per cent (1: 5.376). Considering the overall efficacy, yield and economics of different insecticides, two sprays of indoxacarb 0.007 per cent, endosulfan 0.07 per cent, cypermetrin 0.006 per cent, novaluron 0.01 per cent can be recommend for effective and economical control of gram pod borer infesting pigeonpea.

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INTRODUCTION

Pigeonpea (*Cajanus cajan* L. Millsp.) is an important pulse crop in the semi-arid tropics and subtropical farming systems, providing high quality vegetable protein, animal feed and firewood (Mittal and Ujagir, 2005). The crop yields are generally hampered by many pests, which are problematic over years (Kumar and Nath, 2002 and 2003). Major constraint in the production of pigeonpea is the damage caused by insect pests with avoidable losses extending up to 78 per cent in India (Lateef and Reed, 1983). Nearly 300 species of insects are known to infest pigeonpea crop at its various growth stages in India (Lal and Singh, 1998). In Gujarat, it is cultivated in the area of about 2651 hectares with the production of about 2942 metric tonnes of grain and productivity of 1110 kg/ha (Anonymous, 2008). *Helicoverpa armigera* and *Melanagromyza obtusa* cause adequate economic damage leading to very low yield levels of 500 to 800 kg ha^{-1} as against the potential yield of 1800 to 2000 kg ha^{-1} (Lal *et al*., 1992). A preliminary survey around Junagadh revealed that the *Helicoverpa armigera* (Hübner) Hardwick was observed as a key pest of pigeonpea. The information on chemical insecticides for the control of gram pod borer particularly under Junagadh condition is meagre and hence, the present investigation was carried out.

MATERIAL AND METHODS

The field experiment on pigeonpea (var. BDN-2) was conducted at the College Farm, Junagadh Agricultural

University, Junagadh during *Kharif-Rabi* season of the year 2006-07. The crop was grown at a spacing of 90 cm×20 cm with three replications and total twelve treatments with control (Table 1) in Randomized Block Design. The spraying of treatments was done with the help of knapsack sprayer and obtained uniform coverage of insecticide in each plot. The first spray was given at the 50 per cent flowering and second at 15 days after first spray. All the recommended practices were adopted for raising the crop. Observations on gram pod borer population were recorded from five randomly selected and tagged plants in each net plot before 24 hours and after 1, 3 and 7 days after spray. The data on number of pod borer was converted into per cent mortality by using the modified formula as given by Henderson and Tilton (1955). To assess the pod damaged due to gram pod borer, five plants were selected at random and healthy and damaged pods were counted for working out the per cent pod damage. The pod damage due to gram pod borer was detected by the presence of characteristic large unequal holes on pods. Economics of all the treatments was worked out by considering the price of product, cost of insecticide and labour charges. Incremental cost benefit ratio (CBR) was worked out to compare the economics of insecticidal treatments.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads :

Efficacy of insecticides :

The data on per cent mortality of gram pod borer (Table 1) obtained at one, three and seven days after first spray revealed that among the different insecticidal treatments, indoxacarb 0.007 per cent gave significantly the highest mortality of the pest as recorded 92.36, 87.26 and 84.85 per cent mortality of this pest, respectively. However, it was statistically at par with spinosad 0.005 per cent and emamectine benzoate 0.005 per cent as they registered 90.12, 84.16 and 82.47 per cent and 88.15, 83.32 and 79.81 per cent mortality, respectively. The treatments of novaluron 0.01 per cent, profenofos + cypermethrin 0.044 per cent and endosulfan 0.07 per cent were the next effective treatments as they recorded 75.48, 73.59 and 72.79 per cent mortality after one day, 72.27, 70.81 and 68.49 per cent mortality after three days, 70.87, 68.31 and 63.40 per cent mortality after seven days, respectively. More or less similar trend was also observed after second spray (Patil and Patil, 1989; Yadav and Verma, 2007 and Kaushik and Das, 2006).

Looking to the overall efficacy of the various insecticidal treatments against gram pod borer on pigeonpea, indoxacarb 0.007 per cent was found the most effective treatment. However, the treatment of spinosad 0.005 per cent and emamectine benzoate 0.005 per cent were also found equally effective with the treatment indoxacarb. Further, the insecticidal treatment novaluron 0.01 per cent, profenofos + cypermethrin 0.044 per cent, endosulfan 0.07 per cent, acephate 0.07 per cent, lufeneuron

Table 1 : Percentage pod damage and efficacy of different insecticides against *H.armigera* on pigeonpea

Sr. No.	Treatment	Concentration (%)	Mean (%) corrected larval mortality						(%) pod damaged / plant
			First spray			Second spray			
			1 DAS	3 DAS	7 DAS	1 DAS	3 DAS	7DAS	
1.	Novaluron	0.01	60.32*(75.48)	58.22 (72.27)	57.34 (70.87)	59.44 (74.14)	58.75 (73.08)	56.19(69.04)	20.70*(12.50)
2.	Lufeneuron	0.005	54.09 (65.60)	52.85 (63.53)	49.79 (58.32)	50.96 (60.33)	49.82 (58.37)	47.67(54.66)	24.66 (17.41)
3.	Emamectin benzoate	0.005	69.86 (88.15)	65.89 (83.32)	63.30 (79.81)	67.43 (85.27)	64.17 (81.02)	61.57(77.33)	19.18 (10.80)
4.	Indoxacarb	0.007	73.95 (92.36)	69.09 (87.26)	67.09 (84.85)	70.10 (88.41)	67.01 (84.75)	66.10(83.59)	17.12 (8.66)
5.	Spinosad	0.005	71.68 (90.12)	66.55 (84.16)	65.25 (82.47)	68.19 (86.20)	65.02 (82.17)	64.04(80.84)	18.14 (9.69)
6.	Profenofos	0.07	51.06 (60.51)	49.18 (57.27)	46.23 (52.14)	48.29 (55.72)	46.94 (53.39)	44.29(49.80)	23.91 (16.42)
7.	Acephate	0.07	55.08 (67.23)	54.44 (66.19)	50.81 (60.08)	54.03 (65.49)	52.08 (62.24)	49.76(58.26)	22.73 (14.93)
8.	Endosulfan	0.07	58.56 (72.79)	55.85 (68.49)	52.77 (63.40)	56.02 (68.76)	53.90 (65.29)	51.05(60.48)	21.76 (13.75)
9.	Cypermethrin	0.006	49.70 (58.17)	47.96 (55.15)	44.61 (49.32)	46.96 (53.42)	44.03 (48.32)	42.41(45.49)	25.57 (18.63)
10.	Thiodicarb	0.15	49.16 (57.24)	47.54 (54.42)	43.90 (48.07)	45.49 (50.67)	43.34 (47.11)	41.82(44.46)	22.10 (14.15)
11.	Profenofos + Cypermethrin	0.044	59.07 (73.59)	57.30 (70.81)	55.74 (68.31)	57.00 (70.34)	55.84 (68.48)	53.94(65.35)	21.37 (13.28)
12.	Control	-	-	-	-	-	-	-	29.64 (24.46)
	S.E. ±	-	3.29	3.42	3.51	3.31	3.56	3.55	1.22
	C.D. (P=0.05)	-	9.66	10.04	10.30	9.71	10.45	10.42	3.57
	C.V. (%)	-	10.49	11.38	12.21	11.03	12.32	12.74	9.47

* Arc sine transformed value Figures in the parentheses are retransformed values

0.005 per cent and profenofos 0.07 per cent were found next in order of their efficacy or moderately effective.

According to Ahmed *et al.* (2004), Gupta *et al.* (2005) and Mallah and Karejo (2005), the treatments of spinosad and emamectin benzoate were also found highly effective against gram pod borer on pigeonpea and at other crop by Karabhantanal and Awaknavar (2004), Ahmed *et al.* (2004) and Mallah and Korejo (2005). Application of novaluron, endosufan, profenofos + cypermethrin and acephate was found either effective or moderately effective against this pest by Kumar and Nath (2003), Yadav and Dahiya (2004) and Gupta *et al.* (2005). Thus, present findings corroborate the results reported earlier workers.

Percentage pod damage :

The data presented in Table 1 also revealed that the per cent pod damage due to pod borer, gram pod borer in pigeonpea varied from 8.66 to 18.63 per cent in the different insecticidal treatments, while it was 24.46 per cent in the control. Among the insecticides evaluated, indoxacarb 0.007 per cent recorded the minimum pod damage of 8.66 per cent which was at par with spinosad 0.005 per cent and emamectine benzoate 0.005 per cent which recorded the pod damage of 9.69 and 10.80 per cent, respectively (Dodia *et at.*, 2009). The remaining treatments *viz*., novaluron 0.01 per cent, profenofos + cypermethrin 0.044 per cent, endosulfan 0.07 per cent, thiodicarb 0.15 per cent, acephate 0.07 per cent and profenofos 0.07 per cent were found next in order and and recorded 12.50, 13.28, 13.75, 14.15, 14.93 and 16.42 per cent pod damage, respectively.

The lower pod damage due to pod borer in the treatment of indoxicarb, emamectine benzoate, spinosad and endosulfan were noted by Giraddi *et al*. (2002); Yadav and Dahiya (2004), Deshmukh *et al.*, 2010; Baruah and Chauhan, 1997; Bhandari *et al*., 2002 and Patil *et al*., 1988 which are in agreement with the present findings.

Yield and economics :

The grain yield of pigeonpea in different insecticidal treatments varied from 959 to 1658 kg/ha (Table 2). The highest grain yield (1658 kg/ha) was recorded in the treatment of indoxacarb 0.007 per cent. However, it was at par with spinosad 0.005 per cent (1582 kg/ha) and emamectine benzoate 0.005 per cent (1494 kg/ha). The next best treatments were novaluron 0.01 per cent, profenofos + cypermethrin 0.044 per cent, endosulfan 0.07 per cent and thiodicarb 0.15 per cent as they were equally effective by registering 1221, 1141, 1124 and 1111 kg/ha seed yield. The treatment of acephate 0.07 per cent, profenofos 0.07 per cent, lufeneron 0.005 per cent and cypermetrin 0.006 per cent recorded lower yield *i.e.*1035, 1014, 976 and 959 kg/ha seed yield, respectively which could not significantly increase the yield over untreated control (854 kg/ha).

The economics of the various treatments are presented in Table 2. The results indicated that indoxacarb 0.007 per cent gave the highest cost benefit ratio of 1:7.546 followed

Table 2 : Yield and economics of different insecticidal treatments applied for the control of *H. armigera* on pigeon pea

Sr. No.	Treatment	Concentration (%)	Quantity of pesticide (kg/ha or l/ha)	Cost of treatment including labour charges (Rs./ha)	Yield (kg/ha)	Gross realization (Rs./ha)	Realization over control (Rs./ha)	Incremental cost – benefit ratio
1.	Novaluron	0.01	0.36	1363	1221	24411	7331	1 : 5.376
2.	Lufeneuron	0.005	0.16	760	976	19520	2440	1 : 3.389
3.	Emamectin benzoate	0.005	0.32	3144	1494	29880	12800	1 : 4.071
4.	Indoxacarb	0.007	0.55	2131	1658	33160	16080	1 : 7.546
5.	Spinosad	0.005	0.25	3186	1582	31650	14570	1 : 4.572
6.	Profenofos	0.07	2.24	1409	1014	20286	3206	1 : 2.275
7.	Acephate	0.07	1.49	1245	1035	20707	3627	1 : 2.913
8.	Endosulfan	0.07	2.49	797	1124	22475	5395	1 : 6.766
9.	Cypermethrin	0.006	0.38	382	959	19180	2100	1 : 5.492
10.	Thiodicarb	0.15	3.20	3208	1111	22222	5142	1 : 1.603
11.	Profenofos + Cypermethrin	0.044	1.60	1120	1141	22811	5731	1 : 5.117
12.	Control		0	0.00	854	17080	0	0
	S.E. ±				62.25			
	C.D. (P=0.05)				183.33			
	C.V. (%)				9.18			

Price of pigeonpea seed Rs. 20.00/kg, Labour charges Rs. 100/day

by endosulfan 0.07 per cent (1:6.766). The treatment found next in order of their economy was cypermetrin 0.006 per cent, novaluron 0.01 per cent and profenofos + cypermethrin 0.044 per cent with cost benefit ration of 1:5.492, 1:5.376 and 1:5.117, respectively. The remaining treatments *viz*., spinosad 0.005 per cent, emamectine benzoate 0.005 per cent, lufeneron 0.005 per cent, acephate 0.07 per cent, profenofos 0.07 per cent and thiodicarb 0.15 per cent gave the cost benefit ration of 1:4.572, 1:4.071, 1:3.389, 1: 2.913, 1:2.275 and 1:1.603, respectively. Indoxacarb was found economical treatment by Giraddi *et al*. (2002). Further, novaluron, endosulfan and cypermethrin were also reported economical treatment with high cost benefit ratio by Patel *et al*. (1997); Patil *et al*. (1993); Chiranjeevi *et al*. (2002) and Rajasekhar *et al*. (2000). Thus, present findings corroborate the results reported by earlier workers.

The study concluded that indoxacarb 0.007 per cent, endosulfan 0.07 per cent, spinosad 0.005 per cent and emamectine benzoate 0.005 per cent were found the most effective and economical which can be used for the management of gram pod borer in pigeonpea.

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