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RESEARCH ARTICLE

Field efficacy of bio-pesticides alone and in combination with newer insecticides against *Helicoverpa armigera* of pigeonpea

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ABSTRACT

While testing the field efficacy of bio-pesticides and some insecticides alone and in combination against *Helicoverpa armigera* of pigeonpea. Bt @ 1.0 kg/ha was found to be the most effective treatment which gave highest mortality of *H. armigera*, and was found at par with *B. bassiana* @ 2.0 kg/ha. In case of insecticides, rynaxypyr 0.006 per cent proved to be the most effective treatment against *H. armigera* and was found statistically at par with indoxacarb 0.008 per cent. While, in case of combinations of bio-pesticides with insecticides, the treatment combination (b_0i_1) rynaxypyr 0.006 per cent was found to be the most effective. The next best treatment was (b_0i_2) indoxacarb @ 0.008 per cent. However, it was found at par with (b_2i_2) *B. thuringiensis* @ 0.5 kg/ha+ indoxacarb 0.004 per cent and (b_1i_1) *B. thuringiensis* @ 0.5 kg/ha + rynaxypyr 0.003 per cent. While (b_3i_2) *V. lecanii* @ 1.0 kg/ha + indoxacarb @ 0.004 per cent, *B. bassiana* @ 1 kg/ha + rynaxypyr 0.003 per cent were found moderately effective against *H. armigera*. Whereas, the combination of (b_3i_0) *V. lecanii* @ 2.0 kg/ha was found least effective against *H. armigera* as compared to rest of the combination.

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INTRODUCTION

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is an important pulse-cum-grain legume crop in semi-arid tropical and subtropical areas of the world. The food value of pigeonpea is the most essential due to its protein content (22.3%) and also rich in iron, iodine and essential amino acids like lysine, cystine and arginine. More than 200 species of insects have been found feeding on pigeonpea, although only a few of them have been found to cause significant and economic damage to the crop. Naresh *et al.* (1984) revealed that pod and grain damage caused by the pests was 40.36 to pigeonpea. Rahman (1989) reported pod borer complex with 47.92 per cent infestation reducing the grain yield up to 250.63 kg/ha. Sahoo and Senapati (2000) revealed that a yield loss of 27.77 and 14.28 kg/ha was obtained for each unit increase in larval population and for every unit per cent increase in pod damage, due to the pod borer complex. Repeated use of single insecticide for pod borers in pigeonpea may create some serious problem of development of resistance and residue in grain. Use of bio-pesticides is better option of toxic insecticides. But very little information regarding effectiveness of bio-pesticides either alone or in combination with modern insecticides are available.

MATERIAL AND METHODS

A field experiment was carried out to ascertain the field efficacy of bio-pesticides alone and in combination with newer insecticides against *Helicoverpa armigera* on pigeonpea. The experiment was conducted under field condition at instructional farm, Junagadh in 2010 with 12 treatments. In

these 12 treatments consisted of two novel insecticides, three bio-pesticides and untreated control. These all pesticides were tested alone and in combination with each other with untreated control. All the recommended agronomical practices were followed to raise the crop. The spraying of bio-pesticides/ insecticides at mentioned doses were carried out. The spray of bio-pesticides/insecticides was applied; first at 50 per cent flowering and second spray at 50 per cent pod forming stage. The spray was applied by using Knapsack sprayer during evening hours. Care was taken to rinse the sprayer thoroughly before and after each spray with soap water to avoid contamination from treatment to treatment. Observations on number of larvae were recorded from 5 randomly selected plants at 24 hours before and 3, 7 and 15 days after spray in each plot. The per cent mortality was calculated and subjected to ANOVA with arcsine transformed values.

RESULTS AND DISCUSSION

The result showed that among different pesticides tested in first spray mean per cent mortality of *H. armigera* at 50 per cent flowering stage was recorded highest at seven days after spraying in all the pesticides than three and 15 days after spraying. In case of bio-pesticides data on per cent mortality of *H. armigera* due to bio-pesticides is presented in Table 1, recorded at seven days after first spray revealed that *B. thuringiensis* @ 1 kg/ha recorded the highest mortality of *H. armigera i.e.* 70.28 per cent. It is in agreement with Shankar *et*

Table 1 : Field efficacy of bio-pesticides alone and in combination with insecticides against *H. armigera* on pigeonpea after first spray during *Kharif*-2010

Treatment No.	Treatments	Per cent mortality of *H. armigera* after first spray		
		3 DAS	7 DAS	15 DAS
b_0	Untreated control	43.20* (46.86)	48.87 (56.73)	44.78 (49.62)
b_1	*B. thuringiensis* @ 1 kg/ha	51.77 (61.72)	56.96 (70.28)	56.25 (69.14)
b_2	*B. bassiana* @ 2 kg/ha	48.54 (56.17)	56.52 (69.57)	54.20 (65.79)
b_3	*V. lecanii* @ 2.0 kg/ha	47.92 (55.08)	54.019 (65.48)	52.01 (62.12)
	S.Em. ±	1.447	1.699	1.590
	C.D. (P=0.05)	4.243	4.984	4.689
i_0	Untreated control	35.17 (33.18)	39.23 (40.00)	38.99 (39.60)
i_1	Rynaxypyr @ 0.006%	54.56 (66.38)	62.38 (78.50)	59.02 (73.51)
i_2	Indoxacarb @ 0.008%	53.85 (65.20)	60.67 (76.00)	57.41 (71.02)
	S.Em. ±	1.253	1.472	1.384
	C.D. (P=0.05)	3.674	4.316	4.069
b x i	S.Em. ±	2.506	2.943	2.769
	C.D. (P=0.05)	7.349	8.632	8.253
	C. V.	9.07	9.42	9.26

* Arcsine transformed value; Figures in parentheses are retransformed values.
DAS- Days after spraying

Table 2 : Two way table for B × I interaction

Treatment combinations	Per cent mortality of *H. armigera* after first spray		
	3 DAS	7 DAS	15 DAS
b_0i_0	0.00* (0.00)	0.00 (0.00)	0.00 (0.00)
b_0i_1	62.30 (78.40)	75.41 (93.66)	65.98 (83.43)
b_0i_2	58.36 (72.49)	65.96 (83.40)	58.82 (73.19)
b_1i_0	47.33 (54.07)	53.01 (63.80)	52.41 (62.78)
b_1i_1	56.02 (68.77)	61.03 (76.54)	60.12 (75.18)
b_1i_2	51.97 (62.05)	56.85 (70.10)	56.22 (69.09)
b_2i_0	43.07 (46.64)	49.82 (58.38)	48.08 (55.36)
b_2i_1	51.39 (61.07)	58.35 (72.46)	57.72 (71.48)
b_2i_2	51.17(60.69)	61.38 (77.06)	56.81 (70.04)
b_3i_0	41.34 (43.64)	48.85 (56.70)	45.96 (51.68)
b_3i_1	48.51 (56.12)	54.35 (66.64)	52.27 (62.56)
b_3i_2	53.89 (65.27)	58.48 (72.67)	57.81 (71.62)

al. (1992) who reported the higher effectiveness of Biobit WP (Bt var. kurstaki) formulation @ 1 kg/ha against *H. armigera* on pigeonpea and it was found statistically at par with *B. bassiana* @ 2 kg/ha (69.57). However, all the bio-pesticide treatments were found statistically superior over untreated control against *H. armigera* after three days of insecticidal application.

The present study also supports the findings of Gundannavar *et al.* (2004) who reported that the *N. rileyi*, *B. bassiana* and HaNPV, when applied individually, induced significantly higher mortality of *H. armigera* at higher than at the lower concentration.

In case of insecticides, both the insecticides *i.e.* rynaxypyr 0.006 per cent (78.50) and indoxacarb 0.008 per cent (76.00) were found statistically superior over untreated control against *H. armigera* after seven days of insecticidal application. The results are in accordance with the findings of Singh and Yadav (2007). They reported that Indoxacarb recorded the highest larval mortality of *H. armigera* after seven days of spraying in both the sprayings, *i.e.*, 99.4 and 98.3 per cent after first and second spray, respectively, which was closely followed by thiamethoxam and spinosad.

While the treatment combinations were found significantly superior over untreated control after seven days of spraying (Table 2). The treatment combination (b_0i_1) rynaxypyr 0.006 per cent was found to be the most effective which showed 93.66 per cent mortality of *H. armigera.* The next best treatment was (b_0i_2) indoxacarb @ 0.008 per cent per cent which recorded 83.40 per cent mortality of *H. armigera.* However, it was found at par with (b_2i_2) *B. thuringiensis* @ 0.5 kg/ha + indoxacarb

Table 3 : Field-efficacy of bio-pesticides alone and in combination with insecticides against *H. armigera* on pigeonpea after second spray during *Kharif*-2010

Treatment No.	Treatments	Per cent mortality of *H. armigera* after second spray		
		3 DAS	7 DAS	15 DAS
b_0	Untreated control	44.62* (49.33)	50.66 (59.81)	46.81 (53.16)
b_1	*B. thuringiensis* @ 1kg/ha	52.98 (63.75)	57.69 (71.43)	57.61 (71.31)
b_2	*B. bassiana* @ 2 kg/ha	49.72 (58.20)	57.16 (70.59)	55.31 (67.62)
b_3	*V. lecanii* @ 2.0 kg/ha	47.66 (54.64)	54.22 (65.82)	52.78 (62.78)
	S.Em. ±	1.429	1.748	1.663
	C.D. (P=0.05)	4.429	5.127	4.877
i_0	Untreated control	36.13 (34.74)	40.48 (42.14)	39.40 (40.28)
i_1	Rynaxypyr @ 0.006 %	55.52 (67.69)	63.20 (79.67)	60.82 (76.24)
i_2	Indoxacarb @ 0.008 %	54.58 (66.41)	61.12 (76.67)	58.88 (73.33)
	S.Em. ±	1.309	1.514	1.440
	C.D. (P=0.05)	3.835	4.440	4.223
b x i	S.Em. ±	2.616	3.028	2.880
	C.D. (P=0.05)	7.671	8.881	8.447
	C. V.	9.29	9.55	9.41

* Arcsine transformed value; Figures in parentheses are retransformed values.
DAS- Days after spraying

Table 4 : Two way table for B × I interaction

Treatment combinations	Per cent mortality of *H. armigera* after second spray		
	3 DAS	7 DAS	15 DAS
b_0i_0	0.00* (0.00)	0.00 (0.00)	0.00 (0.00)
b_0i_1	63.73 (80.41)	76.74 (94.74)	69.11 (87.28)
b_0i_2	59.68 (74.52)	66.76 (84.44)	62.17 (78.21)
b_1i_0	48.50 (56.10)	53.61 (64.81)	53.61 (64.81)
b_1i_1	57.28 (70.78)	61.72 (77.55)	62.34 (78.45)
b_1i_2	53.17 (64.06)	57.74 (71.52)	56.88 (70.15)
b_2i_0	44.23 (48.66)	50.41 (59.39)	49.24 (57.37)
b_2i_1	52.58 (63.08)	59.00 (73.55)	58.81 (73.19)
b_2i_2	52.35 (62.69)	62.07 (78.07)	57.89 (71.75)
b_3i_0	41.34 (43.64)	49.43 (57.70)	45.57 (51.00)
b_3i_1	48.51 (56.12)	55.34 (67.66)	53.04 (63.86)
b_3i_2	53.89 (65.27)	57.90 (71.76)	58.59 (72.84)

0.004 per cent (77.06) and (b_1i_1) *B. thuringiensis* @ 0.5 kg/ha + rynaxypyr 0.003 per cent (76.54) after seven days of insecticidal spray. Reddy *et al.* (2001) noted that combination of deltamethrin 0.002 or 0.004 per cent + Bt (dipel) @ 625 ml/ha effectively reduced the damage of pod borers and also gave higher yield of pigeonpea.Whereas, the lowest per cent mortality of *H. armigera* was noticed in the combination of (b_3i_0) *V. lecanii* @ 2.0 kg/ha.

While in the second spray also mean per cent mortality of *H. armigera* at 50 per cent flowering stage was recorded highest at seven days after spraying in all the pesticides than three and 15 days after spraying. Data on per cent mortality of *H. armigera* due to bio-pesticides (Table 3) recorded at seven days after second spray revealed that *B. thuringiensis* @ 1 kg/ha recorded the highest mortality of *H. armigera i.e*. 71.43 per cent and it was found statistically at par with *B. bassiana* @ 2 kg/ha (70.59).

In case of insecticides, both the insecticides *i.e*. rynaxypyr 0.006 per cent (79.67) and indoxacarb 0.008 per cent (76.67) were found statistically superior over untreated control. Per cent mortality of *H. armigera* due to combination presented in Table 4 indicated that all the treatment combinations were found significantly superior over untreated control after seven days of spraying. The treatment combination (b_0i_1) rynaxypyr 0.006 per cent was found to be the most effective which showed 94.74 per cent mortality of *H. armigera*. The next best treatments combinations were (b_0i_2) indoxacarb @ 0.008 per cent (84.44), (b_2i_2) *B. thuringiensis* @ 0.5 kg/ha+ indoxacarb 0.002 per cent (78.07), (b_1i_1) *B. thuringiensis* @ 0.5 kg/ha + rynaxypyr 0.003 per cent (77.55), (b_2i_1) *B. thuringiensis* @ 0.5 kg/ha+ rynaxypyr 0.003 per cent (73.55) and (b_3i_2) *V. lecanii* @ 1.0 kg/ha (71.76) + indoxacarb 0.002 per cent after seven days of insecticidal spray. Result also supported Santharam *et al*. (1994) who reported that Bt @ 2.5 kg/ha + NPV 250 LE/ha and NPV 250 LE/ha + endosulfan 175 g/ha gave better control of *H. armigera* on pigeonpea, whereas, the lowest per cent mortality of *H. armigera* was noticed in the combination of (b_3i_0) *V. lecanii* @ 2.0 kg/ha.

Based on the present study, it is evident that the pest can be effectively controlled by selecting the new generation chemicals like indoxacarb and rynaxypyr with bio-pesticide alone and in combination in that the novel insecticides give the better result alone than the bio-pesticides but bio-pesticides give good results in combination with these both insecticides which showed better toxicity, ovicidel action and safety to natural enemies.

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