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EFFICACY OF INSECTICIDES AND BIOPESTICIDES AGAINST MAJOR SUCKING INSECT PESTS OF INDIAN BEAN *LABLAB PURPUREUS* VAR. *TYPICUS*

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ABSTRACT

This study was conducted to evaluate the efficacy of some insecticides and biopesticides against aphid *Aphis craccivora* (Koch), leafhopper *Empoasca fabae* (Harris) and whitefly *Bemisia tabaci* (Genn.) on Indian bean during kharif, 2019 at the SKN College of Agriculture, Jobner, Jaipur. On the basis of reduction in incidence, spiromesifen 22.9SC, diafenthiuron 50WP and standard check (alternate spray of dimethoate 30EC and malathion 50 EC) were observed to be the most effective. The pyriproxyfen 10.8EC, emamectin benzoate 5SG, chlorfenapyr 10SC and spinosad 45SC were moderately effective; whereas, the *Beauveria bassiana* 1.15WP, *Metarhizium anisopliae* 1.15WP, azadirachtin 0.03EC and NSKE (5.0%) were the least effective. The maximum pod yield of 91.25 q/ ha was obtained with spiromesifen 22.9SC at par with that of diafenthiuron 50WP (88.32 q/ ha). The maximum benefit cost ratio of 57.96 was obtained with the standard check followed by pyriproxyfen 10.8EC (36.86) and emamectin benzoate 5SG (27.47).

Key words: *Lablab purpureus* var. *typicus, Aphis craccivora*, *Empoasca fabae*, *Bemisia tabaci*, pyriproxyfen, emamectin benzoate, spiromesifen, diafenthiuron, dimethoate, malathion, efficacy, cost benefit

Indian bean *Lablab purpureus* var *typicus* (L.) Sweet commonly known as hyacinth bean, Egyptian bean, dolichos bean or Sem belonging to the family Fabaceae, is one of the important pulse cum vegetable crops grown in fields as well as in kitchen gardens throughout the tropical regions in Asia and Africa. It is also grown for medicinal and ornamental purposes. It helps in relieving constipation and weight loss due to good fibre content (Bose et al., 1993). In India, cultivation of this crop is mostly confined to the peninsular region and cultivated to a large extent in Karnataka and adjoining districts of Tamil Nadu, Andhra Pradesh and Maharashtra. Insect pests are the major constraints in achieving high productivity of Indian bean. The crop is attacked by aphid *Aphis craccivora* (Koch), leafhopper *Empoasca fabae* (Harris), *Empoasca krameri* Ross and Moore and *Empoasca kerri* (Pruthi), pod borer *Etiella zinckenella* (Treit.), whitefly *Bemisia tabaci* (Genn.), stem fly *Ophiomyia phaseoli* (Tryon), hairy caterpillar *Ascotis imparta* (WaIk.) and Bihar hairy caterpillar *Spilosoma obliqua* (Walk.) (Thejaswi et al., 2008). Among these, *A. craccivora*, *E. fabae* and *B. tabaci* have been reported as the major sucking pests infesting Indian bean (Godwal, 2010). Recently, several insecticides with novel mode of action have been explored. These insecticides are very effective, relatively selective and safe for natural enemies. Such insecticides warrant evaluation for their efficacy against sucking pests of Indian bean, and therefore, the present study undertaken in the semi-arid region of Rajasthan.

MATERIALS AND METHODS

The present study was conducted at the Research farm of S K N College of Agriculture, Jobner, Jaipur (Rajasthan) on Indian bean under field conditions during kharif, 2019. The experiment was laid out in a simple randomized block design (RBD) with 12 treatments (insecticides) including untreated control (as given in Table 1), each replicated thrice. The Indian bean variety Bauni was grown, and observations on incidence of *A. craccivora*, *E. fabae* and *B. tabaci* were made on the five randomly selected and tagged plants/ at one day before and 1,3,7,10 and 15 days after treatments in both the sprays. Yield data were recorded at every picking, compiled and converted to q/ ha. The data obtained were computed for % reduction in incidence following Henderson and Tilton (1955). The cost benefit ratio of each treatment was calculated taking into consideration the expenditure of treatment and the monetary returns.

RESULTS AND DISCUSSION

In the present investigation, the maximum %

reduction in the incidence of *A. craccivora*, *E. fabae, B. tabaci* was observed after three days of application; however, with entomopathogenic fungi, it was observed after seven days, and then decreased. The treatment of spiromesifen, diafenthiuron and standard check (alternate spray of dimethoate and malathion) proved to be the most effective (Table 1-3). The effectiveness of spiromesifen was in confirmity with Pachundkar et al. (2013) against whitefly on cluster bean. Anandmurthy et al. (2017) found dimethoate (0.03%) as the most effective against aphid and jassid on cowpea and dimethoate (0.03%) and spiromesifen (0.08%) against whitefly. Halder et al. (2018) reported the effectiveness of spiromesifen against jassid infesting cotton. Razaq et al. (2005) found that diafenthiuron gave high mortality of jassid and whitefly. The present observations also corroborated with those of Shaikh et al. (2012) on spiromesifen and diafenthiuron against whitefly and diafenthiuron against jassid. Reddy et al. (2014) reported >80% mortality *A. craccivora* in cowpea with dimethoate (0.06%). Kharade et al. (2018) found imidacloprid as the most effective on jassid and whitefly followed by dimethoate. The results are also in conformity with that of Choudhari (2015b) that diafenthiuron, dimethoate and chlorantraniliprole are the most effective against leafhopper and aphid on Indian bean.

In case of whitefly, the most effective treatments were diafenthiuron, dimethoate and pyriproxyfen. In the present study, pyriproxyfen (0.01%), emamectin benzoate (0.005%), chlorfenapyr (0.05%) and spinosad (0.01%) were moderately effective. These results are in agreement with the findings of Rajawat et al. (2017) on emamectin benzoate against the *B. tabaci* and *A. craccivora*. Shivanna et al. (2011) proved effectiveness of dimethoate on cotton. The treatment of *B. bassiana*, *M. anisopliae*, azadirachtin and NSKE (5.0%) were the least effective. Khade et al. (2014) proved neem oil (1.0%), karanj oil (1.0%), NSE (5.0%) and *Verticillium lecanii* (2×10^9cfu/ ml 4g) as effective against aphid and jassid in brinjal. Reddy et al. (2014) reported 69.0 and 50.0% mortality of cowpea aphid *A. craccivora* with neem oil (1.0%) and azadiracthin (0.03%), respectively. Swarnalata et al. (2015) found that the thiamethoxam (0.01%) was effective against aphid. Yadav et al. (2015) found that NSKE (5.0%) and *M. anisopliae* ($2\ \mathrm{x}10^7$ spores l^{-1}) as least effective against sucking pests in cluster bean. Chaudhari et al. (2015a) reported NSKE and neem leaf extract as effective against sucking pests.

The pod yield data given in Table 4 reveal that maximum pod yield of 91.25 q/ ha was obtained with spiromesifen followed by alternate spray of dimethoate and malathion (92.82 q/ ha) and diafenthiuron (88.32 q/ ha); and the least was in *B. bassiana* and *M. anisopliae* (58.70 and 59.15 q/ ha., respectively. The maximum benefit cost ratio of 57.96 was obtained with the standard check (alternate spray of dimethoate and malathion) followed by pyriproxyfen (36.86) and emamectin benzoate (27.47); and the least was 4.80 obtained with NSKE, azadirachtin (9.34) and *B. bassiana* (9.87). These results are partially in agreement with those of Shaikh et al. (2012) on diafenthiuron; Anandmurthy et al. (2017) observed maximum grain yield of cowpea 853 kg/ ha with dinotefuran followed by acetamiprid, spiromesifen and dimethoate. On the benefit cost ratio, acetamiprid (21.8) proved to be most economically viable followed by dimethoate (21.2). Choudhary et al. (2017) obtained the least grain yield in azadirachtin, while Jhakar et al. (2018) found imidacloprid (0.005%) as the most effective with maximum fruit yield and benefit cost ratio followed by dimethoate. Chaudhari et al. (2015a) found maximum incremental benefit cost ratio with NSKE and neem leaf extract.

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Table 1. Efficacy of novel insecticides and biopesticides against *A. craccivora* on Indian bean

S. No.	Treatments	Dosage/ conc. (%)	Mean % reduction days after											
			First spray						Second spray					
			One	Three	Seven	Ten	Fifteen	Mean	One	Three	Seven	Ten	Fifteen	Mean
1.	Spiromesifen 22.9SC	0.02	88.20 (69.91)	92.60 (74.21)	84.60 (66.89)	72.20 (58.18)	60.40 (51.00)	79.60 (63.15)	89.80 (71.37)	93.40 (75.11)	86.20 (68.19)	74.50 (59.67)	67.20 (55.06)	82.22 (65.06)
2.	Diafenthiruon 50WP	0.005	85.40 (67.54)	88.40 (70.09)	80.60 (63.87)	69.40 (56.42)	56.00 (48.45)	75.96 (60.64)	87.20 (69.04)	89.50 (71.09)	84.00 (66.42)	72.10 (58.12)	59.40 (50.42)	78.44 (62.33)
3.	Emamectin benzoate 5SG	0.005	80.80 (64.01)	86.00 (68.03)	76.70 (61.14)	64.10 (53.19)	52.80 (46.61)	72.08 (58.10)	83.60 (66.11)	87.30 (69.12)	78.10 (62.10)	65.67 (54.13)	55.10 (47.93)	73.95 (59.31)
4.	Spinosad 45SC	0.01	70.10 (56.85)	74.80 (59.87)	71.60 (57.80)	61.40 (51.59)	48.40 (44.08)	65.26 (53.89)	71.40 (57.67)	77.20 (61.48)	74.50 (59.67)	66.20 (54.45)	51.80 (46.03)	68.22 (55.69)
5.	Pyriproxfyen 10.8EC	0.01	80.09 (63.50)	83.20 (65.80)	77.30 (61.55)	63.80 (53.01)	51.90 (46.09)	71.26 (57.58)	82.30 (65.12)	86.50 (68.44)	77.90 (61.96)	73.40 (58.95)	53.40 (46.95)	74.70 (59.80)
6.	Chlorfenapyr 10SC	0.05	78.40 (62.31)	80.20 (63.58)	76.50 (61.00)	60.50 (51.06)	48.00 (43.85)	68.72 (55.99)	79.20 (62.87)	82.30 (65.12)	76.70 (61.14)	65.90 (54.27)	49.80 (44.89)	70.78 (57.28)
7.	NSKE	5.00	47.40 (43.51)	56.00 (48.45)	52.00 (46.15)	44.00 (41.55)	40.20 (39.35)	47.92 (43.81)	49.10 (44.48)	58.20 (49.72)	55.60 (48.22)	47.20 (43.39)	44.80 (42.02)	50.98 (45.56)
8.	Azadirachtin 0.03EC	5.00 ml/ l	50.20 (45.11)	58.20 (49.72)	54.20 (47.41)	47.50 (43.57)	42.00 (40.40)	50.42 (45.24)	51.80 (46.03)	59.60 (50.53)	58.20 (49.72)	51.00 (45.57)	47.60 (43.62)	53.64 (47.09)
9.	*Metarhizium anisopliae* 1.15WP	1.00 g/ l	20.40 (26.85)	40.10 (39.29)	44.80 (42.02)	42.70 (40.80)	40.20 (39.35)	37.64 (37.84)	30.60 (33.58)	46.70 (43.11)	50.40 (45.23)	48.20 (43.97)	50.80 (45.46)	45.34 (42.33)
10.	*Beauveria bassiana* 1.15WP	1.00 g/ l	19.80 (26.42)	39.40 (38.88)	43.00 (40.98)	41.20 (39.93)	39.80 (39.11)	36.64 (37.25)	28.80 (32.46)	46.20 (42.82)	49.10 (44.48)	44.50 (41.84)	48.40 (44.08)	43.40 (41.21)
11.	Dimethoate 30 EC/ malathion 50 EC (Check)	0.03/ 0.05	87.40 (69.21)	90.80 (72.34)	84.60 (66.89)	61.50 (51.65)	61.60 (51.71)	77.18 (61.46)	88.60 (70.27)	92.10 (73.68)	85.40 (67.54)	74.40 (59.60)	64.00 (53.13)	80.90 (64.09)
12.	Untreated control	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	SEm±		1.79	1.91	1.80	1.57	1.43	1.69	1.82	1.96	1.85	1.66	1.50	1.75
	CD (p= 0.05)		5.24	5.61	5.29	4.61	4.20	4.96	5.35	5.75	5.43	4.87	4.41	5.13

Figures in parentheses angular transformed values

Table 2. Efficacy of insecticides and biopesticides against *E. fabae* on Indian bean

S. No.	Treatments	Dosage/ conc. (%)	Mean % reduction days after											
			First spray						Second spray					
			One	Three	Seven	Ten	Fifteen	Mean	One	Three	Seven	Ten	Fifteen	Mean
1.	Spiromesifen 22.9SC	0.02	87.00 (68.87)	90.40 (71.95)	82.70 (65.42)	70.60 (57.17)	59.20 (50.30)	77.98 (62.01)	88.30 (70.00)	91.80 (73.36)	84.70 (66.97)	77.40 (61.61)	67.40 (55.18)	81.92 (64.84)
2.	Diafenthiruon 50WP	0.005	86.70 (68.61)	89.70 (71.28)	81.50 (64.53)	68.20 (55.67)	54.80 (47.75)	76.18 (60.79)	85.10 (67.29)	88.40 (70.09)	82.80 (65.50)	73.60 (59.08)	65.70 (54.15)	79.12 (62.81)
3.	Emamectin benzoate 5SG	0.005	79.20 (62.87)	83.80 (66.27)	74.20 (59.47)	62.70 (52.36)	50.10 (45.06)	70.00 (56.79)	80.80 (64.01)	85.20 (67.37)	75.20 (60.13)	64.90 (53.67)	59.30 (50.36)	73.08 (58.75)
4.	Spinosad 45SC	0.01	62.80 (52.42)	72.40 (58.31)	69.40 (56.42)	59.40 (50.42)	47.20 (43.39)	62.24 (52.09)	69.30 (56.35)	74.50 (59.67)	70.40 (57.04)	62.80 (52.42)	50.80 (45.46)	65.56 (54.07)
5.	Pyriproxfyen 10.8EC	0.01	77.40 (61.61)	80.70 (63.94)	72.50 (58.37)	60.70 (51.18)	47.50 (43.57)	67.76 (55.40)	79.40 (63.01)	83.70 (66.19)	73.20 (58.82)	62.20 (52.06)	52.40 (46.38)	70.18 (56.90)
6.	Chlorfenapyr 10SC	0.05	75.20 (60.13)	77.40 (61.61)	73.20 (58.82)	56.20 (48.56)	44.30 (41.73)	65.26 (53.89)	76.70 (61.14)	80.50 (63.79)	75.70 (60.47)	60.40 (51.00)	48.30 (44.03)	68.32 (55.75)
7.	NSKE	5.00	44.20 (41.67)	54.00 (47.29)	50.60 (45.34)	43.20 (41.09)	38.20 (38.17)	46.04 (42.73)	47.20 (43.39)	55.20 (47.98)	54.00 (47.29)	47.60 (43.62)	44.50 (41.84)	49.70 (44.83)
8.	Azadirachtin 0.03EC	5.00 ml/ l	46.50 (42.99)	57.40 (49.26)	52.70 (46.55)	48.30 (44.03)	42.40 (40.63)	49.46 (44.69)	50.40 (45.23)	58.40 (49.84)	56.10 (48.50)	54.90 (47.81)	48.60 (44.20)	53.68 (47.11)
9.	*Metarhizium anisopliae* 1.15WP	1.00 g/ l	21.20 (27.42)	38.20 (38.17)	43.40 (41.21)	41.40 (40.05)	39.00 (38.65)	36.64 (37.25)	30.80 (33.71)	46.70 (43.11)	47.20 (43.39)	43.70 (41.38)	42.51 (40.69)	42.18 (40.50)
10.	*Beauveria bassiana* 1.15WP	1.00 g/ l	18.40 (25.40)	37.40 (37.70)	41.20 (39.93)	39.20 (38.76)	38.10 (38.12)	34.86 (36.19)	27.20 (31.44)	43.80 (41.44)	45.40 (42.36)	42.40 (40.63)	40.70 (39.64)	39.90 (39.17)
11.	Dimethoate 30 EC/ malathion 50 EC (Check)	0.03/ 0.05	85.20 (67.37)	87.20 (69.04)	79.50 (63.08)	66.40 (54.57)	56.70 (48.85)	75.00 (60.00)	88.80 (70.45)	85.70 (67.78)	80.50 (63.79)	70.50 (57.10)	62.70 (52.36)	77.64 (61.78)
12.	Untreated control	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	S.Em.±		1.72	1.86	1.75	1.54	1.38	1.65	1.78	1.90	1.80	1.62	1.50	1.71
	CD (p= 0.05)		5.05	5.45	5.14	4.53	4.05	4.82	5.22	5.56	5.29	4.75	4.40	5.02

Figures in parentheses angular transformed values.

Table 3. Efficacy of insecticides and biopesticides against *B. tabaci* on Indian bean

S. No.	Treatments	Dosage/ Conc. (%)	Mean % reduction days after											
			First spray						Second spray					
			One	Three	Seven	Ten	Fifteen	Mean	One	Three	Seven	Ten	Fifteen	Mean
1.	Spiromesifen 22.9SC	0.02	86.40 (68.36)	88.60 (70.27)	83.00 (65.65)	71.40 (57.67)	58.10 (49.66)	77.50 (61.68)	87.20 (69.04)	90.20 (71.76)	87.40 (69.21)	72.60 (58.44)	68.40 (55.80)	81.16 (64.28)
2.	Diafenthiruon 50WP	0.005	84.20 (66.58)	86.80 (68.70)	80.20 (63.58)	67.50 (55.24)	53.60 (47.06)	74.46 (59.64)	85.00 (67.21)	87.40 (69.21)	84.00 (66.42)	68.20 (55.67)	64.60 (53.49)	77.84 (61.92)
3.	Emamectin benzoate 5SG	0.005	76.40 (60.94)	81.60 (64.60)	72.50 (58.37)	61.60 (51.71)	50.00 (45.00)	68.42 (55.81)	77.40 (61.61)	82.00 (64.90)	75.20 (60.13)	63.40 (52.77)	60.20 (50.89)	71.64 (57.82)
4.	Spinosad 45SC	0.01	58.60 (49.95)	71.00 (57.42)	68.40 (55.80)	58.20 (49.72)	46.20 (42.82)	60.48 (51.05)	59.50 (50.48)	73.20 (58.82)	70.60 (57.17)	60.20 (50.89)	58.50 (49.89)	64.40 (53.37)
5.	Pyriproxyfen 10.8EC	0.01	75.20 (60.13)	79.20 (62.87)	70.80 (57.29)	59.00 (50.18)	48.00 (43.85)	66.44 (54.60)	77.60 (61.75)	80.40 (63.72)	72.20 (58.18)	61.80 (51.83)	59.80 (50.65)	70.36 (57.01)
6.	Chlorfenapyr 10SC	0.05	72.60 (58.44)	76.50 (61.00)	69.40 (56.42)	55.40 (48.10)	44.60 (41.90)	63.70 (52.95)	73.80 (59.21)	78.20 (62.17)	71.40 (57.67)	57.00 (49.02)	60.20 (50.89)	68.12 (55.62)
7.	NSKE	5.00	41.80 (40.28)	52.60 (46.49)	50.20 (45.11)	42.50 (40.69)	37.40 (37.70)	44.90 (42.07)	42.50 (40.69)	53.60 (47.06)	52.00 (46.15)	44.20 (41.67)	51.00 (45.57)	48.66 (44.23)
8.	Azadirachtin 0.03EC	5.00 ml/ l	43.50 (41.27)	56.40 (48.68)	52.40 (46.38)	47.40 (43.51)	39.80 (39.11)	47.90 (43.80)	44.60 (41.90)	58.20 (49.72)	56.60 (48.79)	50.40 (45.23)	55.20 (47.98)	53.00 (46.72)
9.	*Metarhizium anisopliae* 1.15WP	1.00 g/ l	20.40 (26.85)	37.50 (37.76)	44.60 (41.90)	41.00 (39.82)	37.20 (37.58)	36.14 (36.95)	23.40 (28.93)	39.40 (38.88)	49.20 (44.54)	44.50 (41.84)	43.60 (41.32)	40.02 (39.24)
10.	*Beauveria bassiana* 1.15WP	1.00 g/ l	18.60 (25.55)	36.20 (36.99)	41.80 (40.28)	38.20 (38.17)	34.80 (36.15)	33.92 (35.62)	21.00 (27.27)	38.60 (38.41)	45.40 (42.36)	41.60 (40.16)	40.20 (39.35)	37.36 (37.68)
11.	Dimethoate 30 EC/ malathion 50 EC (Check)	0.03/ 0.05	85.00 (67.21)	87.40 (69.21)	81.80 (64.75)	69.20 (56.29)	55.20 (47.98)	75.72 (60.48)	86.40 (68.36)	88.60 (70.27)	85.20 (67.37)	69.80 (56.66)	65.40 (53.97)	79.08 (62.78)
12.	Untreated control	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
	S.Em.±		1.67	1.83	1.73	1.53	1.37	1.62	1.69	1.86	1.77	1.57	1.63	1.70
	CD (p= 0.05)		4.90	5.37	5.07	4.49	4.02	4.75	4.97	5.44	5.20	4.59	4.77	4.98

Figures in parentheses angular transformed values.

Table 4. Economics of insecticides and biopesticides applied against major sucking insect pests of Indian bean

S.No.	Insecticides	Yield (q ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C ratio
1.	Spiromesifen 22.9SC	91.25	121650.0	115950.0	20.34
2.	Diafenthiuron 50WP	88.32	112860.0	106080.0	15.65
3.	Emamectin benzoate 5SG	78.60	83700.0	80760.0	27.47
4.	Spinosad 45SC	66.90	45600.0	43465.0	20.36
5.	Pyriproxyfen 10.8EC	79.82	84360.0	82132.0	36.86
6.	Chlorfenapyr 10SC	77.50	80400.0	74810.0	13.38
7.	NSKE	64.85	39450.0	32650.0	4.80
8.	Azadirachtin 0.03EC	65.10	43200.0	39024.0	9.34
9.	*Metarhizium anisopliae* 1.15WP	59.15	25350.0	23418.0	12.12
10.	*Beauveria bassiana* 1.15WP	58.70	21000.0	19068.0	9.87
11.	Dimethoate30EC/ malathion 50EC (Check)	86.82	105360.0	103573.0	57.96
12.	Untreated control	51.70	-	-	-

NSKE- Neem seed kernel extract; Price of pods @ Rs.30.00/ kg

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