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Evaluation of sequences of insecticides, biopesticides and bioagents against major insect pests of okra

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Abstract
Treatment, T_3 (Acetamiprid+ *B. bassiana*+ Spinosad+ Destruction of infested shoots and fruits) (1.51/ three leaves) and T_8 (dimethoate/ malathion) emerged as best sequences in reducing the leaf hopper population, these treatments were statistically at par. The treatments T_3, T_8 and T_4 resulted in low population of whitefly (1.85 to 2.20 whiteflies/ three leaves) which were most effective and at par with each other. The treatments T_2, T_4, T_6 and T_7 proved most effective against shoot and fruit borer and resulted in 1.38, 1.57, 2.69 and 2.91 percent shoot damage, respectively. The data on fruit damage exhibited that sequences T_2 and T_4 formed best effective group of treatments (2.26 to 2.64% fruit damage) and had non-significant difference among them. The maximum benefit cost ratio of 48.44 was obtained in the sequence T_8 followed by T_6 (29.02) and T_4 (27.76), while the minimum was in T_5 (1.27) followed by T_7 (1.47).

Keywords: Evaluation of sequences of insecticides, biopesticides, bioagents, insect pests of okra, acetamiprid, *B. bassiana*, spinosad, destruction of infested shoots and fruits

Introduction
Okra [*Abelmoschus esculentus* (L.) Moench], commonly known as *bhindi* or lady's finger (family: Malvaceae) is a popular fruit vegetable crop and said to be originated from Africa. It is an important summer and rainy season vegetable crop grown throughout the world. The crop, right from germination to harvesting is attacked by about 72 species of insect pests (Rao and Rajendran, 2003). The major insect pests are shoot and fruit borer, *Eariasinsulana* (Boisd.), *Eariasvittella* (Boisd.); leaf hopper, *Amrasca biguttula biguttula* (Ishida); whitefly, *Bemisia tabaci* (Genn.) (Dangi and Ameta, 2005; Meena and Kanwat, 2005).
The shoot and fruit borer (*E. insulana* and *E. vittella*) is one of the most serious pests of okra. The larvae bore into the terminal growing shoots, floral buds, flowers and fruits of okra, resulting in cessation, withering and drying of infested shoots, tender leaves and heavy shedding of floral buds and flowers. The infested fruits become malformed and are rendered unfit for human consumption as well as for procurement of the seeds. The leaf hopper, *A. biguttula biguttul* sucks the cell sap from lower surface of the leaves and injects toxic substance in it, resulting in yellowing and curling of leaf margins and stunted plant growth. The whitefly also sucks the cell sap from the leaves which lowered vitality of the plants. This insect transmits viral diseases and acts as vector of 'yellow veins mosaic' virus in the plants (Nath *et al.*, 1992) [12]. The heavy dependence on highly toxic insecticides leads to produce toxicity hazards to environment. Therefore, efforts were made to evaluate the effectiveness of sequences of insecticides, biopesticides and bioagents along with destruction of infested shoots and fruits against insect pest complex of okra.

Materials and Methods
The experiment was laid out is a simple randomized block design (RBD) with eight sequences and an untreated control, each replicated thrice. The plot size was kept 3.0 x 2.25 m^2 keeping row to row and plant to plant distance of 45 and 30 cm, respectively. An isolation distance of 1.0 m was maintained between the plots. The okra variety Parbhani Kranti was used in the experiment and was sown on 5th July, 2013 and 2014. The recommendations as per package of practices were followed to raise the crop.

In this experiment, eight sequences of insecticidal molecules, biopesticides and bioagents were used and untreated control was maintained for comparison. The list of these sequences is given in table. The spray was done by knap sack sprayer. The acetamiprid 20 SP 0.004%, fipronil 5SC 0.01%, acephate 75 SP0.037%, NSKE 5%, *Bacillusthuringiensis* 8l 1ml/ l, Beauveria bassiana 1.15 WP 1g/ l, indoxacarb 14.5 SC 0.01%, emamectin benzoate 5SC 15 g a.i. ha^{-1}, spinosad 2.5 SC 0.01%, dimethoate 30 EC 0.03%/ malathion 50 EC 0.05% were used in different sequences shown in table-1

The populations of major insect pests (leaf hopper and whitefly) were recorded one day before and 1 and 7 days after the application of treatments (First spray). The second and third sprays were done after rebuild-up of the pest population and again the observations were recorded as in case of first spray. The mean population of sucking insect pests was worked out. The shoot damage (shoot and fruit borer) was recorded at weekly interval and fruit damage at each picking. The mean shoot and fruit damage of the season was worked out. The yield data were recorded after harvesting of the crop and converted into per hectare.

The data of population of sucking insect pests were transformed into $\sqrt{X+0.5}$ values and percent damage of shoot and fruit borer into angular values and subjected to analysis of variance. To determine the most effective and economical treatment, the net return and benefit cost ratio was worked out by taking the expenditure on individual insecticidal treatment and the corresponding yield into account. substance in it, resulting in yellowing and curling of leaf margins and stunted plant growth. The whitefly also sucks the cell sap from the leaves which lowered vitality of the plants. This insect transmits viral diseases and acts as vector of 'yellow veins mosaic' virus in the plants (Nath *et al.*, 1992) [12]. The heavy dependence on highly toxic insecticides leads to produce toxicity hazards to environment. Therefore, efforts were made to evaluate the effectiveness of sequences of insecticides, biopesticides and bioagents along with destruction of infested shoots and fruits against insect pest complex of okra.

Table 1: Details of sequences of insecticides, biopesticides and bioagents used

S. No.	Sequences
T_1	Acetamiprid+ *B. bassiana*+ spinosad
T_2	*B. bassiana*+ NSKE+ spinosad+ *Trichogramma chilonis*+ destruction of infested shoots and fruits
T_3	Acetamiprid+ *B. bassiana*+ spinosad+ destruction of infested shoots and fruits
T_4	*B. bassiana*+ NSKE+ acephate+ *Btk*+ destruction of infested shoots and fruits
T_5	Acephate+ *B. bassiana*+ spinosad
T_6	*B. bassiana*+ NSKE+ acephate+ *T. chilonis*+ destruction of infested shoots and fruits
T_7	*B. bassiana*+ NSKE+ spinosad+ *Btk*+ destruction of infested shoots and fruits
T_8	Dimethoate with alternate spray of malathion (Check)
T_9	Control (Untreated)

Two inundative releases of *T. chilonis* @ 1.5 lac eggs ha^{-1} were made at weakly interval after two weeks of application of biopesticides/ insecticides.

Results and Discussion

Integrated pest management is the farmer's best mix of compatible tactics in order to curtail or curb the population levels of insect pests below economic injury. The aim is to reduce the population level with the control tactics which are environmental friendly. In the present study nine sequences of insecticides, biopesticides and bioagents, *viz.*, T_1 (Acetamiprid + *B. bassiana* + spinosad), T_2 (B. bassiana + NSKE + spinosad+ *Trichogramma chilonis* + destruction of infested shoots and fruits), T_3 (acetamiprid + *B. bassiana* + spinosad + DISF), T_4 (*B. bassiana* + NSKE + acephate + Btk + DISF), T_5 (Acephate + *B. bassiana* + spinosad), T_6 (*B. bassiana* + NSKE + acephate + *T. chilonis* + DISF), T_7 (*B. bassiana* + NSKE + spinosad + Btk + DISF), T_8 (Dimethoate with alternate spray of malathion) and T_9 (control untreated) against major insect pests of okra were evaluated. Two inundative releases of *T. chilonis* @ 1.5 lac eggs ha^{-1} were applied at weekly interval after two weeks application of biopesticides/ insecticides. The efficacy of different sequences was evaluated by recording the reduction in leaf hopper and whitefly, damage of shoot and fruit borer, fruit yield and by studying the economics.

Leaf hopper, *A. biguttula biguttula*

The pooled data of *kharif*, 2013 and 2014 revealed that all the sequences were observed significantly superior over untreated control in reducing the leaf hopper population. Treatment, T_3 (1.51/ three leaves) emerged as most effective followed by T_8 (1.78) and T_1 (2.06) in reducing the leaf hopper population, however, these treatments were statistically at par. The next effective treatments were T_4, T_6 and T_5 with 2.56, 2.74 and 3.18 leaf hopper/ three leaves respectively and were comparable with each other. The treatment of T_7 (3.66) followed by T_2 (3.38) proved least effective and did not differ significantly. Thakkar and Rote (2001) reported IPM modules comprising of periodical mechanical control of affected shoots and fruits resulted in minimum mean population of jassid (3.22/ leaf), corroborate the present finding. Preetha and Nadarajan (2007) [15] reported that biointensive modules and insecticidal modules were equally effective against the major sucking pest, leaf hoppers, fully support the present finding. Biswas and Chatterjee (2008) [3] evaluated efficacy of two new insecticides and reported that thiamethoxam (35 g a.i. ha^{-1}) and acetamiprid (30 g a.i. ha^{-1}) were highly effective insecticides against jassid and whitefly reducing 80.29 and 74.37 per cent population of *B. tabaci* on brinjal and 93.31 and 87.05 per cent of *A. biguttula biguttula* on okra, respectively, results are in conformity with the present finding.

Pathan *et al.* (2010) [13] reported seed treatment with thiamethoxam 70 WS 0.3% followed by release of *Chrysoperlacarnea* @ 10,000 first instar larvae/ha + *Trichogramma chilonis* @ 1.5 lac/ ha + mechanical collection and *Bt* @ 1 kg/ha spraying gave effective protection of okra crop against jassids, partially support the present finding. Raghuraman and Birah (2010) [1] suggested that neonicotinoids are potential alternatives to conventional insecticides and could be used in formulating a successful management strategy for sucking pests in okra, fully support the present finding.Kumawat *et al.* (2014) [11] reported the

IPM modules M_2 (Imidacloprid + *B. bassiana* + spinosad + destruction of infested shoots and fruits (DISF) was effective against jassid, fully support the present finding. Birah *et al.* (2012) [2] reported that integrated module and bio-intensive module recorded significantly lower jassid population (3.32 /leaf, 4.72 /leaf) than farmer's practices (5.31 /leaf) and untreated control (10.12 /leaf), support the present finding.

Whitefly, *B. tabaci*

The pooled analysis indicated that treatments T_3, T_8 and T_4 resulted in low population of whitefly (1.85 to 2.20 whiteflies/ three leaves) which were most effective and at par with each other. These treatments were observed significantly superior over rest of the treatments in their efficacy. The next effective group of sequences was T_5, T_1 and T_6 with whitefly population ranging between 3.18 to 4.59/ three leaves. The treatments, T_5 and T_1 were comparable with each other, but treatment T_5 had non-significant difference with T_6. The highest population of whitefly was observed in T_2 (6.00/ three leaves) followed by T_7 (5.82/ three leaves) which formed a least effective group but superior to the control (13.07/ three leaves). Kumawat *et al.* (2014) [11] reported the IPM modules M_2 (Imidacloprid + *B. bassiana* + spinosad + destruction of infested shoots and fruits (DISF) was effective against whitefly, fully support the present finding. Biswas and Chatterjee (2008) [3] evaluated efficacy of two new insecticides and reported that thiamethoxam (35 g a.i. ha^{-1}) and acetamiprid (30 g a.i. ha^{-1}) were highly effective insecticides against jassid and whitefly reducing 80.29 and 74.37 per cent population of *B. tabaci* on brinjal and 93.31 and 87.05 per cent of *A. biguttula biguttula* on okra, respectively, is in conformity with the present finding. Raghuraman and Birah (2011) [16] suggested that neonicotinoids are potential alternatives to conventional insecticides and could be used in formulating a successful management strategy for sucking pests in okra, fully support the present finding.

Shoot damage by *Earias* spp.

The pooled data on shoot damage indicated that the treatments T_2, T_4, T_6 and T_7 proved most effective and resulted in 1.38, 1.57, 2.69 and 2.91 percent shoot damage, respectively and did not differ significantly. The next best treatments were T_8 and T_3 showing 3.76 and 5.96 per cent shoot damage and both were observed at par. The other treatments T_5 and T_1 were found at the lower order of effectiveness (7.79 and 6.69%) but superior over the control (10.94%) in reducing the shoot damage. Singh *et al.* (2012) [17] reported lowest incidence of shoot and fruit borer in M_1 module as compared to other IPM module. The module M_1 comprised of hand picking and destruction of infested leaves, shoots and fruits, seed treatment with imidacloprid, application of indoxacarb, thiamethoxam, hexythiazox, deep summer ploughing and use of neem cake @ 250 kg/ ha before sowing, support the present finding. Kumawat *et al.* (2014) [11] reported module M_8 (*M. anisopliae* + NSKE + spinosad + Btk + DISF) and M_3 (*B. bassiana* + NSKE + spinosad + *T. chilonis* + DISF), as most effective against shoot and fruit borer, support the present finding. Yadav *et al*. (2008b) [19] recorded 1.93 per cent shoot and fruit borer infestation in the treatment of *B. thuringiensis* (*Bt*)- neem formulation with azadirachtin- endosulfan- *Trichogramma.*

Fruit damage by *Earias* spp.

The pooled data on fruit damage exhibited that sequences T_2 and T_4 formed best effective group of treatments (2.26 to 2.64% fruit damage) and had non-significant difference among them. Sequence T_6, T_7, T_8 and T_3 formed next best group of treatments in which fruit damage ranged from 6.30 to 8.84 percent and ranked in middle order of effectiveness, however, these treatments differ non-significantly. Treatments T_5 and T_1 exhibited maximum fruit damage of 11.86 and 9.90 percent, respectively and formed least effective group, however, both were comparable to each other. Thakkar and Rote (2001) reported that the infestation of fruit borer was lowest in IPM block (5.32%) which was at par with insecticidal block (6.39%), partially support the present finding.

Fruit yield

The pooled data of fruit yield during 2013 and 2014 was found to be more or less in the same order. The T_3, T_1, T_2 and T_6 recorded fruit yield ranging from 83.40 to 87.93 q ha^{-1}, these sequences were comparable to each other and emerged as the effective group in increasing the yield. The sequence T_4 (81.90 qha^{-1}) was found at par with T_8 (80.85 q ha^{-1}) T_7 (79.25 q ha^{-1}) and ranked in middle order. The treatment, T_5 observed as least effective with fruit yield of 75.30 q ha^{-1}, however, it was significantly superior over untreated control 47.85 q ha^{-1}. The present results are in full agreement with Thakkar and Rote (2001) who reported higher yield (2,554 kg ha^{-1}) in IPM block as compared to insecticidal block (1,496 kg ha^{-1}). Yadav *et al*. (2008b) [19] recorded highest yield of 79.70 q ha^{-1} in the treatment of *B. thuringiensis* (*Bt*)- neem formulation with azadirachtin- endosulfan- *Trichogramma.* Birah *et al.* (2012) [2] registered highest fruit yield (8.66 tonnes/ ha) in integrated module as compared to untreated control (5.25 tonnes/ ha).

Singh *et al.* (2012) [17] reported maximum fruit yield in the module M_1, *i.e.*, 254.00 and 232.00 q/ha, respectively during 2010 and 2011 which was significantly superior over all the treatments. Parveen and Dhandapani (2001) [14] reported that combined application of *Chrysoperlacarnea* and econeem gave maximum yield of fruits. Mathur *et al*. (1997) also reported that the combined application of monocrotophos followed by two sprays of *Btk* + methomyl provided highest fruit yield.

Economics of various sequences

The highest net profit (Rs 77323.2 q ha^{-1}) was recorded in the sequence of T_6 followed by T_4 and T_8 with corresponding value of 73948.2 and 72748.2, respectively; while minimum net profit of Rs 34,542.2 was recorded in the sequence of T_5 followed by T_7 (Rs 42,061.3 ha^{-1}). In the other sequences, *viz*., T_2, T_1 and T_3, the net profit was Rs 57,571.3, 60,648 and 62,678.5, respectively. Thakkar and Rote (2001) registered net profit of Rs 17,087 ha^{-1} in IPM block as compared to insecticidal block, Rs 15,689 ha^{-1}. Yadav *et al*. (2008a) [18] registered highest economic return of Rs. 2,31,151 and Rs. 2,10,315 in overall treatments of combination, *Bt-neemarin-Trichogramma* and *Bt-* Neemarin - endosulfan - *Trichogramma* modules.

The maximum benefit cost ratio of 48.44 was obtained in the sequence T_8 (check of chemical control, conventional insecticides) followed by T_6 (29.02) and T_4 (27.76), while the minimum was in T_5 (1.27) followed by T_7 (1.47). The sequences T_3, T_1 and T_2 provided benefit cost ratio of 2.28, 2.23 and 2.03, respectively. This was due to low cost of conventional insecticides. The present results are in full conformity with that of Kumawat *et al.* (2014) [11] recorded highest benefit: cost ratio in the standard check, M_9 (Dimethoate with alternate spray of endosulfan) and lowest in M_3 (*B. bassiana*+ NSKE+ spinosad+ *T. chilonis*+ DISF).

Table 2: Evaluation of sequences of insecticides, biopesticides and bio-agents against leaf hopper, *A. biguttula biguttula*on okra (Pooled, *kharif*, 2013 and 2014)

	Sequences	**Population of leaf hopper/ three leaves**		
		2013	**2014**	**Pooled**
T_1	Acetamiprid+ *B. bassiana*+ Spinosad	1.89	2.22	2.06
		(1.55)	(1.65)	(1.60)
T_2	*B. bassiana*+ NSKE+ Spinosad+ *Trichogramma chilonis*+ Destruction of infested shoots and fruits	3.32	3.44	3.38
		(1.95)	(1.98)	(1.97)
T_3	Acetamiprid+ *B. bassiana*+ Spinosad+ Destruction of infested shoots and fruits	1.38	1.64	1.51
		(1.37)	(1.46)	(1.42)
T_4	*B. bassiana*+ NSKE+ Acephate+ *Btk*+ Destruction of infested shoots and fruits	2.46	2.65	2.56
		(1.72)	(1.77)	(1.75)
T_5	Acephate+ *B. bassiana*+ Spinosad	3.12	3.24	3.18
		(1.90)	(1.93)	(1.92)
T_6	*B. bassiana*+ NSKE+ Acephate+ *T. chilonis*+ Destruction of infested shoots and fruits	2.68	2.79	2.74
		(1.78)	(1.81)	(1.80)
T_7	*B. bassiana*+ NSKE+ Spinosad+ *Btk*+ Destruction of infested shoots and fruits	3.58	3.73	3.66
		(2.02)	(2.06)	(2.04)
T_8	Dimethoate with alternate spray of malathion (check)	1.63	1.92	1.78
		(1.46)	(1.56)	(1.51)
T_9	Control (untreated) (untreated)	8.00	8.30	8.15
		(2.92)	(2.97)	(2.94)
	S.Em. ±	0.06	0.07	0.06
	CD (=0.05)	0.18	0.20	0.19

* Mean of three replications
Figures in the parentheses are $\sqrt{x+0.5}$ values

Table 3: Evaluation of sequences of insecticides, biopesticides and bio-agents against whitefly, *B. tabaci* on okra (Pooled, *kharif*, 2013 and 2014)

	Sequences	**Population of whitefly/ three leaves**		
		2013	**2014**	**Pooled**
T_1	Acetamiprid+ *B. bassiana*+ Spinosad	4.07	4.27	4.17
		(2.14)	(2.18)	(2.16)
T_2	*B. bassiana*+ NSKE+ Spinosad+ *Trichogramma chilonis*+ Destruction of infested shoots and fruits	5.93	6.06	6.00
		(2.54)	(2.56)	(2.55)
T_3	Acetamiprid+ *B. bassiana*+ Spinosad+ Destruction of infested shoots and fruits	1.73	1.97	1.85
		(1.49)	(1.57)	(1.53)
T_4	*B. bassiana*+ NSKE+ Acephate+ *Btk*+ Destruction of infested shoots and fruits	2.14	2.26	2.20
		(1.62)	(1.66)	(1.64)
T_5	Acephate+ *B. bassiana*+ Spinosad	3.10	3.25	3.18
		(1.90)	(1.94)	(1.92)
T_6	*B. bassiana*+ NSKE+ Acephate+ *T. chilonis*+ Destruction of infested shoots and fruits	4.52	4.66	4.59
		(2.24)	(2.27)	(2.26)
T_7	*B. bassiana*+ NSKE+ Spinosad+ *Btk*+ Destruction of infested shoots and fruits	5.76	5.87	5.82
		(2.50)	(2.52)	(2.51)
T_8	Dimethoate with alternate spray of malathion (check)	1.81	2.10	1.96
		(1.52	(1.61)	(1.57)
T_9	Control (untreated) (untreated)	12.76	13.38	13.07
		(3.64)	(3.73)	(3.68)
	S.Em. ±	0.08	0.09	0.08
	CD (=0.05)	0.24	0.26	0.25

* Mean of three replications
Figures in the parentheses are $\sqrt{x+0.5}$ values

Table 4: Evaluation of sequences of insecticides, biopesticides and bio-agents against shoot and fruit borer, *Earias* spp. on okra(Pooled, *kharif*, 2013 and 2014)

	Sequences	**Per cent shoot damage**			**Per cent fruit damage**		
		2013	**2014**	**Pooled**	**2013**	**2014**	**Pooled**
T_1	Acetamiprid+ *B. bassiana*+ Spinosad	5.94	7.43	6.69	9.15	10.65	9.90
		(2.54)	(2.82)	(2.68)	(3.11)	(3.34)	(3.22)
T_2	*B. bassiana*+ NSKE+ Spinosad+ *Trichogramma chilonis*+ Destruction of infested shoots and fruits	1.23	1.52	1.38	2.13	2.39	2.26
		(1.32)	(1.42)	(1.37)	(1.62)	(1.70)	(1.66)

T_3	Acetamiprid+ *B. bassiana*+ Spinosad+ Destruction of infested shoots and fruits	5.89 (2.53)	6.02 (2.55)	5.96 (2.54)	8.57 (3.01)	9.10 (3.10)	8.84 (3.06)
T_4	*B. bassiana*+ NSKE+ Acephate+ *Btk*+ Destruction of infested shoots and fruits	1.36 (1.36)	1.77 (1.51)	1.57 (1.44)	2.29 (1.67)	2.99 (1.87)	2.64 (1.77)
T_5	Acephate+ *B. bassiana*+ Spinosad	7.73 (2.87)	7.84 (2.89)	7.79 (2.88)	11.46 (3.46)	12.26 (3.57)	11.86 (3.52)
T_6	*B. bassiana*+ NSKE+ Acephate+ *T. chilonis*+ Destruction of infested shoots and fruits	2.62 (1.77)	2.76 (1.81)	2.69 (1.79)	6.00 (2.55)	6.60 (2.66)	6.30 (2.61)
T_7	*B. bassiana*+ NSKE+ Spinosad+ *Btk*+ Destruction of infested shoots and fruits	2.79 (1.81)	3.02 (1.88)	2.91 (1.85)	6.87 (2.71)	7.85 (2.89)	7.36 (2.80)
T_8	Dimethoate with alternate spray of malathion (check)	3.12 (1.90)	4.40 (2.21)	3.76 (2.06)	7.53 (2.83)	8.07 (2.93)	7.80 (2.88)
T_9	Control (untreated) (untreated)	10.87 (3.37)	11.00 (3.39)	10.94 (3.38)	20.16 (4.55)	21.93 (4.74)	21.05 (4.64)
	S.Em. ±	0.16	0.17	0.17	0.19	0.20	0.19
	CD (=0.05)	0.48	0.52	0.50	0.56	0.59	0.57

* Mean of three replications

Figures in the parentheses are $\sqrt{x+0.5}$ values

Table 5: Effect of sequences of insecticides, biopesticides and bio-agents on fruit yield of okra

	Sequences	**Marketable yield of okra fruits (q/ha)**		
		2013	**2014**	**Pooled**
T_1	Acetamiprid+ *B. bassiana*+ Spinosad	87.60	86.20	86.90
T_2	*B. bassiana*+ NSKE+ Spinosad+ *Trichogramma chilonis*+ DISF	86.50	85.60	86.05
T_3	Acetamiprid+ *B. bassiana*+ Spinosad+ DISF	88.90	87.00	87.95
T_4	*B. bassiana*+ NSKE+ Acephate+ *Btk*+ DISF	83.10	80.70	81.90
T_5	Acephate+ *B. bassiana*+ Spinosad	76.70	73.90	75.30
T_6	*B. bassiana*+ NSKE+ Acephate+ *T. chilonis*+ DISF	84.00	82.80	83.40
T_7	*B. bassiana*+ NSKE+ Spinosad+ *Btk*+ DISF	80.20	78.30	79.25
T_8	Dimethoate with alternate spray of malathion (check)	81.00	80.70	80.85
T_9	Control (untreated) (untreated)	48.70	47.00	47.85
	S.Em. ±	2.51	2.40	2.47
	CD (p= 0.05)	7.49	7.19	7.33

* Mean of three replications

DISF = Destruction of infested shoots and fruits

Table 6: Comparative economics of sequences of insecticides, biopesticides and botanicals against major insect pests of okra (Pooled, *kharif*, 2013 and 2014)

	Sequences	**Yield (q ha^{-1})**	**Increase in yield over untreated check (q ha^{-1})**	**Return of increased yield (Rs ha^{-1})***	**Total cost of expenditure (Rs)****	**Net profit (Rs ha^{-1})**	**B: C ratio**
T_1	Acetamiprid+ *B. bassiana*+ Spinosad	86.90	39.05	87862.5	27214.47	60648	2.23
T_2	*B. bassiana*+ NSKE+ Spinosad+ *Trichogramma chilonis*+ DISF	86.05	38.20	85950	28378.67	57571.3	2.03
T_3	Acetamiprid+ *B. bassiana*+ Spinosad+ DISF	87.95	40.10	90225	27546.47	62678.5	2.28
T_4	*B. bassiana*+ NSKE+ Acephate+ *Btk*+ DISF	81.90	34.05	76612.5	2664.30	73948.2	27.76
T_5	Acephate+ *B. bassiana*+ Spinosad	75.30	27.45	61762.5	27220.30	34542.2	1.27
T_6	*B. bassiana*+ NSKE+ Acephate+ *T. chilonis*+ DISF	83.40	35.55	79987.5	2664.30	77323.2	29.02
T_7	*B. bassiana*+ NSKE+ Spinosad+ *Btk*+ DISF	79.25	31.40	70650	28588.67	42061.3	1.47
T_8	Dimethoate with alternate spray of malathion (check)	80.85	33.00	74250	1501.80	72748.2	48.44
T_9	Control (untreated) (untreated)	47.85	-	-	-	-	-

* Cost of okra fruit at current season was Rs 2250/- per q.

** It includes cost of insecticides and labour charges.

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