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Studies on efficacy of biorational insecticides against major sucking pests, *Amrasca biguttula biguttula* (Ishida), *Bemisia tabaci* (Gennadius) and *Aphis gossypii* (Glover) on brinjal

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Abstract
Field experiments were carried out for assessing the efficacy of some biorational insecticides against sucking pests of brinjal during 2015-16 at the Indian Institute of Horticultural Research, Bengaluru. The major sucking insects included leafhopper, *Amrasca biguttula biguttula* Ishida, whitefly, *Bemisia tabaci* Gennadius, and aphid *Aphis gossypii* Glover. All the tested biorationals reduced the sucking pest population significantly over control. Two sprays of spinosad 45 SC @ 0.2 ml/l recorded less population of all the three insects followed by dimethoate 30 EC @ 1.6 ml/l.

Keywords: Biorationals, efficacy and sucking pests

Introduction
Brinjal, *Solanum melongena* L. is one of the most important vegetable crop and also one of the cash crop for the farmers in India. It is native to India and is grown throughout the country (Pareet *et al.,* 2006) [5]. Brinjal is attacked by 44 insect pests in India causing a yield loss of 50 to 70 per cent (Karkar *et al*., 2014) [2] and 25 to 40 per cent (Natrajan *et al*., 1986) [4]. Under field conditions, on brinjal various pests attack the crop at different stages starting from seedling to harvesting stage and the loss caused by them vary from season to season depending upon environmental factors. Major sucking pests damaging brinjal include jassid (*Amrasca biguttula biguttula*), white fly (*Bemisia tabaci*) and aphid (*Aphis gossypii*) and cause severe damage to the crop from nursery stage to final harvesting (Regupathy *et al.,* 1997). Among them white fly is the most destructive pest (Ghosal and Chatterjee, 2012) [6] and responsible for causing 70 to 92 per cent yield losses (Omprakash and Raju, 2014) [9]. Both nymphs and adult of these sucking pests suck the sap from the phloem tissues. They produce honey dew that reduces the photosynthetic activity on the foliage (Rahim Khan *et al.,* 2011). In addition to causing severe yield losses, they also act as a vectors for many plant pathogens such as Gemini and Clostero viruses that causes damage to the crop. (Mohd Rasdi *et al.,* 2009) [10]. Presently management of these insects is purely chemical based and are responsible for causing environmental pollution, resistance, resurgence, secondary pest outbreaks and insecticide residue problems. To overcome these problems, application of biorational insecticides would be a better option. In this background, the present study was aimed at identifying the efficient biorationals against leafhoppers, whiteflies and aphids on brinjal.

Materials and Methods
The biorationals insecticides i.e., Azadirachtin 10,000 ppm @1 ml/l, *Lecanicillium lecanii* ($2x10^8$ spores/g) @ 5 ml/l, Neem soap @10 g/l, Organic salt 30 WS @ 4 ml/l, Organic salt 30 WS @ 5 ml/l, Spinosad 45 SC @ 0.2 ml/l and one standard check Dimethoate 30 EC @ 1.6 ml/l were evaluated against the target pests on brinjal used for the experiment. RCBD design with eight treatments and three replications were used. Two sprays of different treatments given at 15 days intervals. Both adults and nymphs of leafhoppers, aphids and whiteflies were counted from three leaves, one from top, one from middle and one from bottom on 15 randomly (five plants from each treatment which was replicated thrice) selected and tagged plants. Observations on insect counts were recorded at a day before spray (DBS), three, seven and 15 days after each spray Later, mean number of insects from two sprays and also pooled mean was calculated, analysed statistically using ANOVA.

Results and Discussion

Data recorded on surviving number of major sucking pests namely, *A. biguttula biguttula*, *B. tabaci* and *A. gossypii* of brinjal at different days after treatments are presented under different subheading below:

Leafhopper, *A. biguttula*

Data recorded on population of leafhoppers at different days after treatments are presented in (Table1).

First spray

There was no significant difference among the treatments with respect to number of leafhoppers per three leaves at one day before imposition of the treatment; it ranged from 5.84 to 6.15/three leaves.

Observations recorded on leafhoppers at three days after spraying indicated significant differences among different treatments. The minimum number of leafhopper population (2.35 leafhoppers/three leaves) was recorded in spinosad 45 SC @ 0.2 ml/l followed by dimethoate 30 EC @1.6 ml/l (2.47 leafhoppers/three leaves), azadirachtin 10,000 @ 1.0 ml/l (2.64 leafhoppers/three leaves), *L. lecanii* @ 2 g/l (3.00 leafhoppers/three leaves), organic salt 30 WS @ 5 ml/l (3.19 leafhoppers/three leaves), neem soap @ 10 g/l (3.27 leafhoppers/three leaves) and organic salt 30 WS @ 4 ml/l (3.41 leafhoppers/three leaves) and were on par with each other.

There was a significant difference among the treatments with respect to number of leafhoppers per three leaves at seven days after imposition of the treatment. Spinosad 45 SC @ 0.2 ml/l treated plots was recorded least number of leafhoppers (0.87 leafhoppers/three leaves). Whereas, highest number of population was recorded in organic salt 30 WS @ 4 ml/l (3.28 leafhoppers/three leaves) treated plot which was on par with neem soap @ 10 g/l (3.18 leafhoppers/three leaves)

There was a significant difference among the treatments with respect to number of leafhoppers per three leaves at 15 days after imposition of the treatment. Spinosad 45 SC @ 0.2 ml/l treated plots was recorded least number of leafhopper population (0.36 leafhoppers/three leaves).Whereas, highest number of population was recorded in organic salt 30 WS @ 4ml/l (3.55 leafhoppers/three leaves) treated plot which was on par with neem soap @ 10g/l (3.51 leafhoppers/three leaves).

Second spray

Observations recorded on number of leafhoppers before spraying indicates uniform distribution of leafhoppers in all the treatments. However, it ranged from 5.93 to 6.23/three leaves.

Observation recorded on leafhoppers population at three days after spraying showed significant effect of treatments over control. The minimum leafhopper population (2.10 leafhoppers/three leaves) was recorded in spinosad 45 SC @ 0.2 ml/l which was found at par with rest of the treatments. Whereas, dimethoate 30 EC @1.6 ml/l was on par with azadirachtin 10,000 @ 1.0 ml/l and the maximum number of leafhoppers was recorded inorganic salt @ 4ml/l (4.05 leafhoppers/three leaves).

Seven days after spraying, spinosad @ 0.2 ml/l was recorded least number of leafhopper population (0.64 leafhoppers/three leaves) followed by L. *lecanii* @ 2 g/l (2.10 leafhoppers/three leaves) which was on par with dimethoate 30 EC @1.6 ml/l (2.31 leafhoppers/three leaves) and azadirachtin 10,000 @ 1.0 ml/l (2.69 leafhoppers/three leaves). Whereas, maximum number was recorded in organic salt @ 4 ml/l (4.29 leafhoppers/three leaves).

15 days after the second spray shows the significant differences among different treatments. Minimum number of leafhoppers (0.26 leafhoppers/three leaves) was recorded in spinosad 45 SC @ 0.2 ml/l followed by *L. lecanii* @ 2 g/l (2.14 leafhoppers/three leaves), dimethoate 30 EC @1.6 ml/l (2.35 leafhoppers/three leaves) and azadirachtin 10,000 @ 1.0 ml/l (2.72 leafhoppers/three leaves) and were on par with each other.

The overall mean population differed significantly among treatments with respect to number of leafhoppers per three leaves. Spinosad 45 SC @ 0.2 ml/l recorded significantly lower population (1.10 leafhoppers/three leaves). The next best treatment was dimethoate 30 EC @1.6 ml/l (2.38 leafhoppers/three leaves) which was on par with L. *lecanii* @ 2 g/l (2.47 leafhoppers/three leaves) and azadirachtin 10,000 @ 1.0 ml/l (2.76 leafhoppers/three leaves). Significantly highest population was recorded in organic salt 30 WS @ 4 ml/l (3.85 leafhoppers/three leaves) which was on par with neem soap @ 10g/l (3.50 leafhoppers/three leaves). Similar effects were found by (Kalawate and Dethe, 2012) [1] who reported that spinosad afforded moderate control of leafhopper, whitefly and aphid on brinjal ecosystem.

Whitefly, *B. tabaci*

Data recorded on population of whiteflies at different days after treatments are presented in (Table 2).

First spray

There was no significant difference among the treatments with respect to number of whiteflies per three leaves at one day before imposition of the treatment; it indicates uniform distribution ranged from 9.65 to 9.97 whiteflies/three leaves.

Observations recorded on whiteflies at three days after spraying indicated significant differences among different treatments. Significantly minimum number of whitefly population (4.19 whiteflies/three leaves) was recorded in spinosad 45 SC @ 0.2 ml/l which was on par with dimethoate 30 EC @1.6 ml/l (4.73 whiteflies/three leaves). Whereas, maximum number of whitefly population (7.15 whiteflies/three leaves) was recorded in organic salt 30 WS @ 4 ml/l which was on par with neem soap @ 10 g/l (6.95 whiteflies/three leaves) and *L. lecanii* @ 2 g/l (6.57 whiteflies/three leaves) and were on par with each other.

Data recorded at seven days after spraying showed that all the treatments were effective over control in reducing the population of whiteflies. Spinosad 45 SC @ 0.2 ml/l treated plot recorded least number of whiteflies (2.23 whiteflies/three leaves) followed by dimethoate 30 EC @1.6 ml/l (4.10 whiteflies/three leaves). Organic salt 30 WS @ 4 ml/l treated plots was recorded highest population (7.10 whiteflies/three leaves) which was on par with neem soap @ 10 g/l (6.84 whiteflies/three leaves).

Data recorded at 15 days after spraying revealed that all the treatments were effective over control in reducing the population of whiteflies. The least number of whiteflies was recorded in spinosad 45 SC @ 0.2 ml/l treated plot (1.19 whiteflies/three leaves). Whereas, highest population was recorded in organic salt @ 4 ml/l (7.20 whiteflies/three leaves) which was on par with neem soap @ 10g/l (7.05 whiteflies/three leaves).

Second spray
Observations recorded on number of whiteflies before spraying indicates uniform distribution of whiteflies in all the treatments and ranged from 8.81 to 9.07/three leaves.
Three days after spraying, significant effect of treatments was observed on whitefly over control. The minimum whitefly population (3.47 whiteflies/three leaves) was recorded in spinosad @ 0.2 ml/l which was found at par with all the other treatments except dimethoate 30 EC @1.6 ml/l (4.11 whiteflies/three leaves). Whereas, maximum number of whiteflies was recorded in neem soap @ 10g/l (5.39 whiteflies/three leaves).
Seven days after spraying, spinosad 45 SC @ 0.2 ml/l recorded least number of whiteflies (1.11whiteflies/three leaves) followed by dimethoate @ 1.6 ml/l (3.06 whiteflies/three leaves). Maximum number was recorded in organic salt @ 4 ml/l (5.07 whiteflies/three leaves) which was on par with neem soap @ 10g/l (4.72 whiteflies/three leaves) followed by organic salt 30 WS @ 5 ml/l (4.57 whiteflies/three leaves) and was on par with *L. lecanii* @ 2 g/l (4.53 whiteflies/three leaves).
Data recorded on whiteflies population at 15 days after second spray indicated significant differences among different treatments. Minimum number of whiteflies (0.94 whiteflies/three leaves) was recorded in spinosad 45 SC @ 0.2 ml/l which was significantly superior to all the other treatments. The maximum population was recorded in organic salt 30 WS @ 4 ml/l (5.17 whiteflies/three leaves), organic salt 30 WS @ 5 ml/l (4.79 whiteflies/three leaves) and *L. lecanii* @ 2 g/l (4.73 whiteflies/three leaves) and were on par with each other.
The mean pooled data of two sprays revealed that, spinosad @ 0.2 ml/l (2.19 whiteflies/three leaves) was the best treatment in reducing the whitefly population followed by dimethoate 30 EC @1.6ml/l (3.72 whiteflies/three leaves). Significantly highest population was recorded in organic salt 30 WS @ 4 ml/l (6.08 whiteflies/three leaves) followed by neem soap @ 10g/l (5.97 whiteflies/three leaves), *L. lecanii* @ 2 g/l (5.62 whiteflies/three leaves) and organic salt 30 WS @ 5 ml/l (5.52 whiteflies/three leaves) and were on par with each other.

Aphid, *A. gossypii*
Data recorded on population of aphids at different days after treatments are presented in (Table 3).

First spray
Observation recorded on number of aphids one day before spraying indicates uniform distribution of aphids in all the treatments and ranged from 29.02 to 31.73/three leaves.
Three days after spraying, significantly minimum number of aphids (14.52 aphids/three leaves) was recorded in spinosad 45 SC @ 0.2 ml/l followed by dimethoate 30 EC @1.6 ml/l (17.52 aphids/three leaves). Whereas, higher population was recorded in organic salt @ 4 ml/l (27.06 aphids/three leaves), neem soap @ 10g/l (26.63 aphids/three leaves), *L. lecanii* @ 2 g/l (26.17 aphids/three leaves) and organic salt 30 WS @ 5 ml/l (25.25 aphids/three leaves) and were on par with each other.
There was a significant difference among the treatments with espect to number of aphids per three leaves at seven days after imposition of the treatment. Significantly the lowest number of aphids (6.24 aphids/three leaves) was recorded in spinosad 45 SC @ 0.2 ml/l which at par with rest of the treatments. Whereas, highest number of whiteflies was recorded in organic salt 30 WS @ 4 ml/l (16.65 aphids/three leaves) followed by neem soap @ 10 g/l (15.41 aphids/three leaves) and *L. lecanii* (14.99 aphids/three leaves) and were on par with each other.
Data recorded at 15 days after spraying showed that all the treatments were effective over control in reducing the population of aphids. Significantly minimum number of aphids (4.62 aphids/three leaves) was recorded in spinosad 45 SC @ 0.2 ml/l followed by dimethoate 30 EC @1.6 ml/l (9.18 aphids/three leaves) and azadirachtin 10,000 @ 1.0 ml/l (11.11 aphids/three leaves), respectively.

Second spray
There was no significant difference among the treatments with respect to number of aphids per three leaves at one day before imposition of the treatment. The population ranged from 22.08 to 24.21/three leaves.
There was a significant difference among the treatments with respect to number of aphids per three leaves at three days after imposition of the treatment. Spinosad 45 SC @ 0.2 ml/l treated plot recorded least number of aphids (12.05 aphids/three leaves) followed by dimethoate 30 EC @1.6 ml/l (16.42 aphids/three leaves). Whereas, higher population was recorded in *L. lecanii* @ 2 g/l (22.23 aphids/three leaves) followed by neem soap @ 10g/l (22.10 aphids/three leaves) and organic salt 30 WS @ 4 ml/l (22.09 aphids/three leaves) and were on par with each other.
Data recorded at seven days after spraying showed that all the treatments were effective over control in reducing the population of aphids. Significantly minimum number of aphids (7.16 aphids/three leaves) was recorded in spinosad 45 SC @ 0.2 ml/l followed by dimethoate 30 EC @1.6 ml/l (9.93 aphids/three leaves).The maximum number of aphids was recorded in organic salt @ 4 ml/l (13.54 aphids/three leaves) which was on par with neem soap @ 10 g/l (12.38 aphids/three leaves).
Data recorded at 15 days after spraying showed that all the treatments were effective over control in reducing the population of aphids. Significantly minimum number of aphid population (3.06 aphids/three leaves) was recorded in spinosad 45 SC @ 0.2 ml/l. The next best treatment was dimethoate 30 EC @1.6 ml/l (5.40 aphids/three leaves).
Overall mean of aphids differed significantly among treatments with respect to number of aphids per three leaves. spinosad 45 SC @ 0.2 ml/l recorded significantly lower population (7.94 aphids/three leaves) followed by dimethoate 30 EC @1.6ml/l (11.79 aphids/three leaves). The highest number of aphids was recorded in organic salt 30 WS @ 4 ml/l (18.64 aphids/three leaves) which was on par with neem soap @ 10 g/l (17.72 aphids/three leaves). This is in conformation with Singh *et al*. (2009) [3] who reported that spinosad and dimethoate were recorded less population of aphids.

Table 1: Evaluation of biorationals against *A. biguttula biguttula* on brinjal

Treatments	Mean no. of leafhoppers/three leaves (n=15 plants)										Pooled mean
	I Spray					II Spray					
	DBS	3 DAS	7 DAS	15 DAS	Mean	DBS	3 DAS	7 DAS	15 DAS	Mean	
T1 - Azadirachtin (10,000 ppm) @ 1ml/l	5.95 (2.54)	2.64 (1.77)	2.42 (1.71)	2.78 (1.81)	2.61	6.17 (2.58)	3.30 (1.95)	2.69 (1.77)	2.72 (1.79)	2.90	2.76
T2 - *Lecanicillium lecanii* @ 2 g/l	5.93 (2.53)	3.00 (1.87)	2.04 (1.59)	2.25 (1.66)	2.43	6.14 (2.58)	3.31 (1.95)	2.10 (1.61)	2.14 (1.63)	2.51	2.47
T3 - Neem soap @ 10 g/l	5.84 (2.52)	3.27 (1.94)	3.18 (1.92)	3.51 (2.00)	3.32	6.00 (2.55)	3.61 (2.03)	3.70 (2.05)	3.74 (2.06)	3.68	3.50
T4 - Organic salt 30 WS @ 4 ml/l	5.84 (2.52)	3.41 (1.98)	3.28 (1.94)	3.55 (2.01)	3.41	6.23 (2.59)	4.05 (2.13)	4.29 (2.19)	4.55 (2.25)	4.29	3.85
T5 - Organic salt 30 WS @ 5 ml/l	5.93 (2.54)	3.19 (1.92)	2.86 (1.83)	3.35 (1.96)	3.20	6.17 (2.58)	3.51 (2.00)	3.68 (2.04)	3.81 (2.08)	3.66	3.43
T6 - Spinosad 45 SC @ 0.2 ml/l	6.10 (2.57)	2.35 (1.69)	0.87 (1.17)	0.36 (0.93)	1.19	5.93 (2.54)	2.10 (1.61)	0.64 (1.05)	0.26 (0.87)	1.00	1.10
T7 - Dimethoate 30 EC @ 1.6 ml/l	6.15 (2.58)	2.47 (1.72)	2.12 (1.62)	2.14 (1.60)	2.24	6.11 (2.57)	2.92 (1.85)	2.31 (1.68)	2.35 (1.69)	2.52	2.38
T8 - Untreated control	5.91 (2.53)	6.10 (2.55)	6.26 (2.59)	6.44 (2.63)	6.26	6.09 (2.56)	6.18 (2.59)	6.35 (2.62)	6.43 (2.63)	6.32	6.29
CD at 5%	NS	1.08	0.78	0.75	-	NS	0.26	0.71	0.40	-	-
SEm±	-	0.35	0.25	0.24	-	-	0.08	0.23	0.13	-	-

DBS - Day before spraying, DAS - Days after spraying Figures in parentheses are $\sqrt{X+0.5}$ transformed values

Table 2: Evaluation of biorationals against *B. tabaci* on brinjal

Treatments	Mean no. of whiteflies/three leaves (n=15 plants)										Pooled mean
	I Spray					II Spray					
	DBS	3 DAS	7 DAS	15 DAS	Mean	DBS	3 DAS	7 DAS	15 DAS	Mean	
T1 - Azadirachtin (10,000 ppm) @ 1ml/l	9.97 (3.23)	6.17 (2.58)	5.04 (2.35)	4.46 (2.23)	5.22	8.87 (3.06)	4.52 (2.24)	4.08 (2.14)	4.20 (2.17)	4.26	4.74
T2 - *Lecanicillium lecanii* @ 2 g/l	9.76 (3.20)	6.57 (2.66)	6.38 (2.62)	6.52 (2.65)	6.49	8.81 (3.05)	4.96 (2.34)	4.53 (2.24)	4.73 (2.29)	4.74	5.62
T3 - Neem soap @ 10 g/l	9.68 (3.19)	6.95 (2.73)	6.84 (2.71)	7.05 (2.75)	6.94	9.04 (3.09)	5.39 (2.43)	4.72 (2.28)	4.89 (2.32)	5.00	5.97
T4 - Organic salt 30 WS @ 4 ml/l	9.93 (3.23)	7.15 (2.76)	7.10 (2.76)	7.20 (2.78)	7.15	9.07 (3.09)	5.16 (2.38)	5.07 (2.36)	5.17 (2.38)	5.01	6.08
T5 - Organic salt 30 WS @ 5 ml/l	9.65 (3.19)	6.37 (2.62)	6.16 (2.58)	6.45 (2.64)	6.32	8.93 (3.07)	4.81 (2.31)	4.57 (2.25)	4.79 (2.30)	4.72	5.52
T6 - Spinosad 45 SC @ 0.2 ml/l	9.80 (3.21)	4.19 (2.16)	2.23 (1.65)	1.19 (1.30)	2.53	8.97 (3.08)	3.47 (1.98)	1.11 (1.27)	0.94 (1.19)	1.84	2.19
T7 - Dimethoate 30 EC @ 1.6 ml/l	9.72 (3.20)	4.74 (2.29)	4.10 (2.15)	3.35 (1.96)	4.06	9.06 (3.09)	4.11 (2.15)	3.06 (1.89)	2.99 (1.87)	3.38	3.72
T8 - Untreated control	9.70 (3.19)	9.76 (3.20)	9.95 (3.23)	10.79 (3.36)	10.1	9.00 (3.08)	9.18 (3.11)	9.24 (3.12)	9.39 (3.14)	9.27	9.69
CD at 5%	NS	0.57	0.50	0.45	-	NS	0.80	0.37	0.47	-	
SEm±	-	0.18	0.16	0.14	-	-	0.26	0.12	0.15	-	

DBS - Day before spraying, DAS - Days after spraying Figures in parentheses are $\sqrt{X+0.5}$ transformed values

Table 3: Evaluation of biorationals against *A. gossypii* on brinjal

Treatments	Mean no. of aphids/three leaves (n=15 plants)										Pooled mean
	I Spray					II Spray					
	DBS	3 DAS	7 DAS	15DAS	Mean	DBS	3 DAS	7 DAS	15DAS	Mean	
T1 - Azadirachtin (10,000 ppm) @ 1ml/l	29.95 (5.52)	23.09 (4.86)	14.01 (3.81)	11.11 (3.41)	16.07	23.26 (4.87)	18.32 (4.34)	9.94 (3.23)	9.34 (3.14)	12.53	14.30
T2 - *Lecanicillium lecanii* @ 2 g/l	29.02 (5.42)	26.17 (5.16)	14.99 (3.94)	15.43 (3.99)	18.86	23.60 (4.91)	20.23 (4.55)	10.38 (3.30)	10.53 (3.32)	13.71	16.29
T3 - Neem soap @ 10 g/l	31.36 (5.64)	26.63 (5.21)	15.41 (3.99)	16.23 (4.09)	19.42	24.21 (4.97)	22.10 (4.75)	12.38 (3.58)	13.58 (3.75)	16.02	17.72
T4 - Organic salt 30 WS @ 4 ml/l	29.55 (5.48)	27.06 (5.25)	16.65 (4.14)	17.59 (4.25)	20.43	23.35 (4.88)	22.09 (4.75)	13.54 (3.75)	14.93 (3.93)	16.85	18.64
T5 - Organic salt 30 WS @ 5 ml/l	31.08 (5.62)	25.25 (5.07)	14.38 (3.86)	13.60 (3.75)	17.74	24.03 (4.95)	19.44 (4.46)	10.28 (3.28)	11.30 (3.44)	13.67	15.71
T6 - Spinosad 45 SC @ 0.2 ml/l	31.73 (5.68)	14.52 (3.87)	6.24 (2.59)	4.62 (2.26)	8.46	22.08 (4.75)	12.05 (3.54)	7.16 (2.77)	3.06 (1.89)	7.42	7.94
T7 - Dimethoate 30 EC @ 1.6 ml/l	30.76 (5.59)	17.52 (4.25)	12.28 (3.57)	9.18 (3.11)	12.99	23.26 (4.87)	16.42 (4.11)	9.93 (3.23)	5.40 (2.43)	10.58	11.79
T8 - Untreated control	31.65 (5.67)	32.87 (5.78)	32.74 (5.76)	34.00 (5.87)	33.20	22.94 (4.84)	23.07 (4.85)	24.10 (4.96)	26.09 (5.16)	24.42	28.81
CD at 5%	NS	2.32	1.77	1.66	-	NS	1.68	1.64	0.30	-	-
SEm±	-	0.76	0.58	0.54	-	-	0.55	0.54	0.09	-	-

DBS - Day before spraying, DAS - Days after spraying Figures in parentheses are $\sqrt{X+0.5}$ transformed values

Conclusion

Among the different biorational insecticides tested, spinosad 45 SC @ 0.2 ml/l was found significantly superior in reducing leaf hoppers, whitefly and aphid population followed by dimethoate 30 EC @ 1.6 ml/l.

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