Insecticidal and plant extracts screening against Whitefly Management in Brinjal, *Solanum melongena* L.

ABSTRACT

Eight pesticides and five plant extracts were evaluated for efficacy against brinjal whitefly during *rabi* (2018-19) and *kharif* (2019-20) at Agricultural Research Station in Virinjipuram, Vellore, Tamil Nadu. Acetamiprid 20 SP @ 0.3 g l^{-1}, imidacloprid 17.8 SL @ 0.5 ml l^{-1}, spiromesifen 240 SC @ 1.0 ml l^{-1}, thiacloprid 240 SC @ 1.0 ml l^{-1}, thiamethoxam 25 WG @ 0.4 g l^{-1}, dimethoate 30 EC @ 2.0 ml l^{-1}, and profenophos 50 EC @ 2.0 ml l^{-1}, azadirachtin 10000 ppm @ 3.0 ml l^{-1}, neem seed kernel extract at 5%, and leaf extracts of neem, bougainvillea and coconut at 10% were administered to 30-day-old plants at one month intervals. According to the findings, spiromesifen 240 SC (3.05 Nos / 3 leaves) spraying had the lowest whitefly population during the crop time. Thiacloprid 240 SC (3.28 Nos / 3 leaves) and thiamethoxam 25 WG (3.39 Nos / 3 leaves) were next in line. Plots treated with spiromesifen 240 SC, thiacloprid 240 SC, and thiamethoxam 25 WG showed the greatest population reductions (79.16, 77.59, and 76.84 percent) compared to the untreated control. Thiacloprid 240 SC @ 1.0 ml l^{-1} (5.22%), thiamethoxam 25 WG @ 0.4 g l^{-1} (5.87%), and azadirachtin 10000 ppm @ 3 ml l^{-1} (6.22%) were found to be the next treatments. Plots treated with spiromesifen 240 SC, thiacloprid 240 SC, and thiamethoxam 25 WG yielded the most fruit (28.79, 28. 01 and 27.24 tonnes ha^{-1}, respectively), increasing their cost-benefit ratio by 36.63, 32.93 and 29.28 percent over the untreated control.

Key words: Inorganic insecticides, plant extracts, screening, whitefly population, brinjal

INTRODUCTION

The fruit of the brinjal (Solanum melongena L.) is a good source of calcium, phosphorus, iron, and vitamins A, B, and C. Because of the water availability and its high consumer demand, it is grown all year round. As a result, it is attacked by several insect pests and diseases during its growing period. Vellore district is well-known for growing brinjal, which is suitable for all seasons and grown in an area of about 1500ha. Aphids, leaf hoppers, and mealy bugs are among the sucking insects that attack crops in their early stages, in addition to fruit and shoot borer. Whiteflies, or *Bemisia tabaci* (Gennadius), are the most damaging pes that infest brinjal. They are polyphagous and severely reduce crop yields (Singh *et al.,* 1994 and Norhelina *et al*., 2013). Both nymphs and adults feed on the leaf surface and suck the phloem sap from sieve tubes. They produce honey dew that reduces the capacity of photosynthetic on the foliage. Some of the pathogens like mycoplasma, Gemini virus and clostero virus are also transmitted by insects *viz*., Jassids, *Hishimonas phycitis* (Distant) and whitefly, *B. tabaci* (Duffus, 1996 and Srinivasan, 2009). The damage caused by whitefly in brinjal contributes to yield losses of about 70 - 92 per cent (Omprakash and Raju, 2014).

However, an indiscriminate use of chemical leads to number of problems like contamination of food, soil, groundwater and also causes toxic effect on non-target and other organisms. Moreover, injudicious use of pesticides may also develop resistance. At present, among the various methods of whitefly management, use of plant products and chemical insecticides are found to be very effective and plant products are ecologically safer for growing vegetable crops under organic farming. Hence, therefore, the present study was aimed for the evaluation of insecticides and plant products for whitefly control.

MATERIALS AND METHODS

Field experiments

Two field experiments were conducted at Agriculture Research Station, Virinjipuram, Vellore District, TamilNadu during *Rabi* 2019 and *Kharif* 2020 to study the efficacy of newer insecticides along with the plant products against mosaic disease incidence and its vector whitefly, *B. tabaci*. The experiments were laid out

in randomized block design (RBD) with fourteen treatments and two replications. Brinjal (variety: VRM 1 spiny type) seedlings (25 days old) were transplanted in plot size of 5x5 m with spacing of 60x45 cm (R-R x P-P) during the two consecutive seasons. The recommended agronomic package of practices was followed to raise a good crop. The experiment consisted of fourteen treatments *viz*., acetamiprid 20 SP @ 0.3 g l^{-1}, imidacloprid 17.8 SL @ 0.5 ml l^{-1}, spiromesifen 240 SC @ 1.0 ml l^{-1}, thiacloprid 240 SC @ 1.0 ml l^{-1}, thiamethoxam 25 WG @ 0.4 g l^{-1}, diafenthiuron 50 WP @ 1.0 g l^{-1}, dimethoate 30 EC @ 2.0 ml l^{-1} and profenophos 50 EC @ 2.0 ml l^{-1}, azadirachtin 10000 ppm @ 3.0 ml l^{-1}, neem seed Kernel extract 5 per cent, neem leaf extract 10 per cent, *Bougainvillea* leaf extract 10 per cent and coconut leaf extract 10 per cent along with an untreated check were applied four times at 30, 60, 90 and 120 days after transplanting (DAT) with the help of a knapsack sprayer using 500 L of spray per hectare. The insect population counts were taken from three leaves, one each at the top, middle and bottom of the each plant at pre-treatment, 3, 7 and 14 days after spraying (DAS). The pooled mean population of whitefly for the two seasons was also arrived to derive a valuable outcome. The fruit yield, thus obtained per plot has been converted in terms of fruit yield per hectare and Cost: Benefit ratio was worked out for various treated plots. Thus the data obtained on the population and fruit yield in different treatments were analyzed statistically using AGRES (Gomez and Gomez 1984).

Whitefly Population reduction (%)	=	Population in untreated plots - Population in treatment Population in untreated plots	X100
Increase over untreated check (%)	=	Yield in treatment – Yield in untreated check Yield in untreated check	X100

RESULTS AND DISCUSSION

Rabi season (2018-2019)

Whitefly: The pre-treatment population per three leaves per plant during the first spraying varied from 9.8 - 10.4 Nos and there was no significant difference between the treatments. Among the treatments, the chemical insecticides were found to be superior over botanicals. At three days after first application, the treatments *viz*., T3: spiromesifen 240 SC @ 1.0 ml l^{-1}, T5: thiamethoxam 25 WG @ 0.4 g l^{-1} and T4: thiacloprid 240 SC @1.0 ml l^{-1} were found to be superior and recorded the lowest whitefly population of 2.9, 3.0 and 3.2 Nos per 3 leaves, respectively and were on par with each other. The efficacy was then followed by T6: diafenthiuron 50 WP @1.0 g l^{-1}, T2: imidacloprid 17.8 SL @ 0.5 ml l^{-1} and T1: acetamiprid 20 SP @ 0.3 g l^{-1} with 4.8, 4.9 and 5.1 Nos per 3 leaves, respectively and was on par with each other.

Among the botanicals and botanical based products tested, T13: coconut leaf extract 10 % was found to be effective (5.2 Nos./3 leaves) followed by T11: neem leaf extract 10 % (5.8 Nos./ 3 leaves) and were at par with each other. The highest population was recorded in untreated plots (12.7 Nos./3 leaves). On fourteen days after first spraying (DAS) spraying of T10: NSKE 5 % recorded the lowest population (7.7 Nos./ 3 leaves) followed by neem leaf extract 10% and azadirachtin 10000 ppm @ 3 ml l^{-1}. The population was found to increase at 14 DAS. The superiority of treatments by spiromesifen 240 SC @ 1.0 ml l^{-1}, thiamethoxam 25 WG @ 0.4 g l^{-1} and thiacloprid 240 SC @1.0 ml l^{-1} was maintained in the population reduction of whiteflies (Table 1).

Kharif season (2019-2020)

Whitefly: During the season, the pre-treatment whitefly population varied from 11.1 -12.1 Nos. per three leaves per plant before application of treatments and found non-significant. Among the various treatments on newer chemical insecticides and botanicals, the chemical insecticides were found to be superior over botanicals. At 14 days after first application, the treatments *viz*., T3: spiromesifen 240 SC @ 1.0 ml l^{-1}, T4: thiacloprid 240 SC @1.0 ml l^{-1} and T5: thiamethoxam 25 WG @ 0.4 g l^{-1} were found to be superior and recorded the lowest whitefly population of 4.7, 4.9 and 5.0 Nos. per 3 leaves, respectively and were on par with each other. The efficacy was then followed with T6: diafenthiuron 50 WP @1.0 g l^{-1} (6.0 Nos / 3 leaves), T1: acetamiprid 20 SP @ 0.3 g l^{-1} (6.2 Nos./ 3leaves) and T2: imidacloprid 17.8 SL @ 0.5 ml l^{-1} (6.4 Nos./ 3 leaves) and these were found on par with each other.

Among the plant extracts tested, NSKE 5 per cent was found to be effective with 7.0 Nos per 3 leaves followed by azadirachtin @ 3 ml l^{-1} (7.5 Nos./ 3 leaves) and bougainvillea leaf extract @ 10 % (7.5 Nos./3 leaves). The highest population of whitefly was recorded in untreated plots (13.4 Nos./3 leaves). Since the population was found to increase at 14 DAS and spraying was taken up. The same trend of efficacy in the

reduction of whitefly population was followed up to fourth spray. The superiority of treatments *viz*., T3: spiromesifen 240 SC @ 1.0 ml l^{-1}, T4: thiacloprid 240 SC @ 1.0 ml l^{-1} and T5: thiamethoxam 25 WG @ 0.4 g l^{-1} was maintained in the population reduction of whiteflies (Table 2).

Pooled mean of two seasons

Vector population, Whitefly

The pooled mean of two season data revealed that among the treatments chemical insecticides were found significantly superior over botanicals and plant based products in containing the population of whitefly, which act as vector of mosaic disease. Among the chemical insecticides, spraying of spiromesifen 240 SC (3.05 Nos / 3 leaves) four times at 20 days interval starting from 30 DAT was found to record minimum population of whitefly throughout the crop period followed by thiacloprid 240 SC (3.28 Nos / 3 leaves and thiamethoxam 25 WG (3.39 Nos / 3 leaves). The highest population reduction of 79.16, 77.59 and 76.84 per cent was achieved in plots treated with spiromesifen 240 SC, thiacloprid 240 SC and thiamethoxam 25 WG, respectively over untreated check (Table 3).

Fruit Yield and Economics

Due to the lowest vector population and mosaic disease incidence in treated plots *viz*., spiromesifen 240 SC, thiacloprid 240 SC and thiamethoxam 25 WG reported with the highest fruit yield of 28.79, 28.01 and 27.24 tonnes ha^{-1}, respectively with 36.63, 32.93 and 29.28 per cent increase over untreated check. This was followed by azadirachtin (26.70 t ha^{-1}), neem seed kernel extract 5% (26.41 t ha^{-1}) and imidacloprid 17.8 SL (26.32 t ha^{-1}) which were found to be on par with each other. The highest Cost: Benefit ratio of 1:3.05 was obtained in plots treated with thiamethoxam 25 WG followed by spiromesifen 240 SC and thiacloprid 240 SC (1:3.01). Among the botanicals and plant products tested, the lowest mosaic disease incidence (6.22 %) with 6.25 Nos of whitefly per three leaves proved to be effective followed by NSKE 5 %. The lowest fruit yield (21.07 t ha $^{-1}$) was obtained in untreated check with its highest mosaic disease (14.34 %) and Vector population (14.64 Nos / 3 leaves) and also with the lowest Cost: Benefit ratio of 1:2.61 (Table 3).

Spraying of acetamiprid 20 SP @ 150 g a.i ha $^{-1}$ and thiamethoxam 25 WG @ 24 g a.i ha^{-1} were reported to be effective against cotton whitefly (Aslam *et al*., 2004) The present findings are also in conformity with the findings that the three application of Spiromesifen 240 SC @150 g a.i. ha $^{-1}$ resulted in the lowest whitefly population in brinjal as reported by Sujay Anand *et al*. (2013). The present finding corroborates with that of Palumbo (2009) who had also reported that spiromesifen reduced whitefly and sooty mould incidence on melons. The mean of five post spraying whitefly populations was lowest from the treatments spiromesifen (4.87 and 3.99 per three leaves per plant during 2010 and 2011) and thiamethoxam (4.84 and 4.76 per three

leaves per plant during 2010 and 2011). Singh *et al*. 2006 reported that all plant extract molecule gave superior control of whitefly over the untreated check. Neem oil, neem seed extract and tobacco on cotton ecosystem reduced whitefly population by 59.78, 59.38 and 40.61 per cent respectively (Noonari *et al.,* 2016)

CONCLUSION

The present investigations clearly indicate that the application of spiromesifen 240 SC, thiacloprid 240 SC and thiamethoxam 25 WG at 30, 60, 90 and 120 days after transplanting recorded the lowest population of whitefly and the viral disease incidence, thereby obtained the increased fruit yield. The plant extracts gave superior control when compared with untreated check, wherever organic farming is done the plant extracts could find better place in the development of integrated management modules.

References

1. Aslam M, Razaq M, Shah SA & Ahmad F (2004) Comparative efficacy of different insecticides against sucking pests of cotton. *Journal of Research (Science):* **15**(1):53-58
2. Duffus JE (1996) Whitefly-borne Viruses. **In**: Bemisia tabaci, 1995. Taxonomy, Biology, Damage, Control and Management. (Eds. Gerling, D., Mayer, M.T.), Intercept Limited, Andover, UK, pp. 255-263
3. Gomez KA & Gomez A A (1984). Statistical procedures for agricultural research. John wiley and sons, New york 207-215
4. Noonari AM, Abro GH, Khuhro RD and Buriro AS (2016) Efficacy of bio-pestiicde for management of sucking insect pests of cotton, *Gossypium hirsutum* (L.). *Journal of Basic and applied Sciences* **12:**306-313
5. Norhelina L, Sajap AS, Mansour SA & Idris AB (2013) Infectivity of five *Metarihizium anisopliae* (Deuteromycota: Hyphomycetales) strains on whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae) infesting brinjal, *Solanum melongena* (Solanacea). *Academic Journal of Entomology* **6**(3): 127-132
6. Omprakash S & Raju SVS (2014) A brief review on abundance and management of major insect pests of brinjal (*Solanum melongena* L.). *International Journal of Applied Biology and Pharmaceutical Technology* **5**(1):18-22
7. Palumbo JC (2009) Spray timing of spiromesifen and buprofezin for managing *Bemisia* whiteflies in cantaloupes. [Online]. Plant Health Progress DOI: 10.1094/PHP-2009- 0407-01-RS. Available: http://www.plantmanagementnet work.org/sub/php/research/2009/whitefly/whitefly.pdf.
8. Singh J, Sohi AS, Mann HS & Kapur SP (1994) Studies on whitefly, *Bemisia tabaci* (Genn.) transmitted cotton leaf curl disease in Punjab. *J Insct Sci* 7: 194-198.

9. Singh S, Choudhary DP & Mathur YS (2006) Effect of plant extract against whitefly, *Bemisia tabaci* Genn. on tomato. *Indian Journal of Entomology* **68**(1): 71-73.
10. Srinivasan R (2009) Insect and mite pests on egg plant: a field guide for identification and management. AVRDC- The World Vegetable Center, Shanhua, Taiwan, 2009,10-13
11. Sujay anand, GK, Sharma RK & Shankarganesh K (2013) Efficacy of newer insecticides against leafhopper and whitefly infesting brinjal and its effect on coccinellids. *Pesticide Research Journal* **25** (1): 6-11

Table 1. Screening of newer insecticides and plant products for the management of whitefly in brinjal (*Rabi* 2018-19)

Treatments	Dose (g or ml l^{-1})	Whitefly (No./3 leaves)															
		I spray				II spray				III spray				IV spray			
		PT	3 DAS	7 DAS	14 DAS	PT	3 DAS	7 DAS	14 DAS	PT	3 DAS	7 DAS	14 DAS	PT	3 DAS	7 DAS	14 DAS
T_1 Acetamiprid 20 SP	0.3	10.2	5.1 (2.3)^{b}	5.4 (2.3)^{bc}	6.0 (2.4)^{b}	10.5	4.0 (2.0)^{cd}	4.3 (2.1)^{b}	5.5 (2.3)^{a}	10.7	4.3 (2.1)^{b}	5.0 (2.2)^{bc}	5.7 (2.4)^{cd}	8.4	4.3 (2.1)^{cd}	5.9 (2.4)^{b}	5.6 (2.4)^{b}
T_2 Imidacloprid17.8 SL	0.5	9.8	4.9 (2.2)^{b}	5.0 (2.2)^{b}	6.1 (2.5)^{b}	10.7	4.4 (2.1)^{d}	4.1 (2.0)^{b}	5.7 (2.4)^{a}	11.1	4.6 (2.1)^{bc}	4.2 (2.1)^{bc}	4.5 (2.1)^{bc}	8.3	3.7 (1.9)^{cd}	5.9 (2.4)^{b}	5.5 (2.3)^{b}
T_3 Spiromesifen 240 SC	1.0	10.3	2.9 (1.7)^{a}	3.3 (1.8)^{a}	3.7 (1.9)^{a}	8.6	2.0 (1.4)^{a}	2.4 (1.5)^{a}	5.5 (2.3)^{a}	10.1	2.4 (1.5)^{a}	3.0 (1.7)^{a}	2.9 (1.7)^{a}	6.9	2.3 (1.5)^{a}	4.2 (2.1)^{a}	3.1 (1.7)^{a}
T_4 Thiacloprid 240 SC	1.0	9.9	3.2 (1.8)^{a}	3.4 (1.8)^{a}	4.4 (2.1)^{a}	8.9	2.4 (1.5)^{ab}	2.6 (1.6)^{a}	5.5 (2.3)^{a}	9.9	2.7 (1.6)^{a}	3.3 (1.8)^{ab}	3.1 (1.7)^{ab}	7.4	2.5 (1.6)^{ab}	4.2 (2.0)^{a}	3.2 (1.8)^{a}
T_5 Thiamethoxam 25 WG	0.4	10.1	3.0 (1.7)^{a}	3.1 (1.7)^{a}	4.3 (2.1)^{a}	8.8	2.3 (1.5)^{ab}	2.7 (1.6)^{a}	5.6 (2.4)^{a}	10.0	2.4 (1.5)^{a}	3.8 (1.9)^{ab}	2.8 (1.7)^{ab}	7.1	3.2 (1.8)^{bc}	4.1 (2.0)^{a}	3.2 (1.8)^{a}
T_6 Diafenthiuron 50 WP	1.0	10.3	4.8 (2.2)^{b}	5.0 (2.2)^{b}	6.3 (2.5)^{b}	10.0	4.3 (2.1)^{cd}	4.6 (2.2)^{b}	6.6 (2.6)^{b}	11.0	4.4 (2.1)^{b}	6.1 (2.5)^{c}	4.9 (2.2)^{c}	7.6	5.3 (2.3)^{ef}	6.2 (2.5)^{bc}	6.3 (2.5)^{b}
T_7 Dimethoate 30 EC	2.0	10.4	5.9 (2.4)^{cd}	6.4 (2.5)^{cd}	7.2 (2.7)^{bc}	9.9	5.9 (2.4)^{cd}	6.7 (2.6)^{c}	7.3 (2.7)^{bc}	10.9	5.7 (2.4)^{bc}	6.9 (2.6)^{cd}	5.1 (2.3)^{cd}	7.6	6.2 (2.5)^{gh}	7.4 (2.7)^{cd}	5.9 (2.4)^{b}
T_8 Profenophos 50 EC	2.0	10.0	7.5 (2.7)^{e}	8.1 (2.8)^{e}	8.7 (2.9)^{cd}	10.1	7.2 (2.7)^{cd}	7.2 (2.7)^{d}	8.1 (2.8)^{cd}	11.1	7.1 (2.7)^{d}	6.7 (2.6)^{cd}	7.0 (2.6)^{d}	7.8	5.8 (2.1)^{fg}	7.9 (2.8)^{d}	6.3 (2.5)^{b}
T_9 Azadirachtin 10000ppm	3.0	9.8	6.2 (2.5)^{d}	6.7 (2.6)^{de}	8.1 (2.8)^{cd}	9.6	6.2 (2.5)^{c}	6.4 (2.5)^{cd}	7.2 (2.7)^{bc}	10.9	6.2 (2.5)^{cd}	6.9 (2.6)^{cd}	6.4 (2.5)^{cd}	8.5	5.2 (2.3)^{ef}	7.3 (2.7)^{bc}	5.9 (2.4)^{b}
T_{10} NSKE	5%	10.1	6.3 (2.5)^{d}	6.6 (2.6)^{cd}	7.7 (2.8)^{cd}	10.3	6.5 (2.5)^{cd}	7.0 (2.6)^{cd}	8.3 (2.9)^{de}	11.1	5.7 (2.4)^{bc}	6.9 (2.6)^{cd}	5.5 (2.4)^{cd}	8.7	4.7 (2.2)^{de}	7.3 (2.7)^{bc}	5.4 (2.3)^{b}
T_{11} Neem leaf extract	10%	10.3	5.8 (2.4)^{cd}	6.0 (2.5)^{bc}	7.8 (2.8)^{cd}	10.4	6.2 (2.5)^{cd}	6.8 (2.6)^{cd}	8.5 (2.9)^{de}	11.3	5.5 (2.3)^{bc}	7.3 (2.7)^{de}	6.0 (2.4)^{cd}	8.4	5.8 (2.4)^{fg}	7.3 (2.7)^{bc}	6.5 (2.5)^{b}
T_{12} Bogainvillea leaf extract	10%	10.2	7.4 (2.7)^{e}	7.6 (2.7)^{de}	9.3 (3.0)^{d}	10.4	6.7 (2.6)^{cd}	7.3 (2.7)^{cd}	8.7 (2.9)^{de}	11.4	6.5 (2.5)^{d}	8.4 (2.9)^{e}	7.0 (2.6)^{d}	8.8	6.9 (2.6)^{h}	8.1 (2.8)^{d}	6.6 (2.6)^{b}
T_{13} Coconut leaf extract	10%	10.2	5.2 (2.3)^{bc}	6.1 (2.5)^{bc}	9.1 (3.0)^{d}	10.0	6.7 (2.6)^{cd}	7.0 (2.6)^{cd}	9.1 (3.0)^{e}	11.2	5.5 (2.4)^{bc}	8.1 (2.8)^{e}	6.5 (2.5)^{cd}	8.9	6.6 (2.6)^{gh}	7.2 (2.7)^{bc}	6.5 (2.5)^{b}
T_{14} Untreated check	-	9.9	12.7 (3.6)^{f}	12.6 (3.5)^{f}	14.4 (3.8)^{e}	14.4	15.3 (3.9)^{e}	15.1 (3.9)^{e}	15.7 (3.9)^{f}	12.8	14.0 (3.7)^{e}	14.9 (3.8)^{f}	13.7 (3.7)^{e}	15.2	14.8 (3.8)^{i}	14.1 (3.7)^{e}	14.0 (3.7)^{c}
SEd			0.06	0.12	0.03	0.02	0.10	0.07	0.07	0.12	0.05	0.18	0.21	0.15	0.13	0.13	0.19
CD<0.5 %			0.14	0.26	0.08	0.04	0.22	0.15	0.16	0.27	0.12	0.40	0.46	0.32	0.29	0.28	0.42

PT: Pretreatment ; Values in parentheses are square root transformed

Table 2. Screening of newer insecticides and plant products for the management of whitefly in brinjal (*Kharif* 2019-20)

Treatments	Dose (g or ml l^{-1})	Whitefly (No./3 leaves)															
		I spray				II spray				III spray				IV spray			
		PT	3 DAS	7 DAS	14 DAS	PT	3 DAS	7 DAS	14 DAS	PT	3 DAS	7 DAS	14 DAS	PT	3 DAS	7 DAS	14 DAS
T_1 Acetamiprid 20 SP	0.3	11.1	5.0 (2.2)^{b}	5.0 (2.2)^{c}	6.2 (2.5)^{b}	8.7	5.1 (2.3)^{bc}	6.0 (2.4)^{cd}	7.0 (2.6)^{b}	9.6	5.0 (2.2)^{b}	5.1 (2.2)^{b}	6.7 (2.6)^{cd}	8.2	4.1 (2.0)^{cd}	4.2 (2.0)^{bc}	4.4 (2.1)^{bc}
T_2 Imidacloprid17.8 SL	0.5	11.3	4.8 (2.2)^{b}	5.6 (2.4)^{d}	6.4 (2.5)^{bc}	8.4	4.7 (2.2)^{b}	5.3 (2.3)^{b}	7.0 (2.6)^{b}	9.0	5.1 (2.3)^{b}	5.3 (2.3)^{b}	6.8 (2.6)^{cd}	8.3	3.7 (1.9)^{c}	3.9 (1.9)^{b}	3.9 (1.9)^{b}
T_3 Spiromesifen 240 SC	1.0	11.6	3.0 (1.7)^{a}	3.0 (1.7)^{a}	4.7 (2.1)^{a}	6.9	3.4 (1.8)^{a}	3.4 (1.8)^{a}	5.0 (2.2)^{a}	7.7	2.1 (1.4)^{a}	2.4 (1.5)^{a}	3.4 (1.8)^{a}	7.5	1.6 (1.3)^{a}	1.7 (1.3)^{a}	1.7 (1.3)^{a}
T_4 Thiacloprid 240 SC	1.0	11.3	3.3 (1.8)^{a}	3.6 (1.9)^{b}	4.9 (2.2)^{a}	7.8	3.0 (1.7)^{a}	4.1 (2.0)^{ab}	4.8 (2.2)^{a}	7.4	2.1 (1.4)^{a}	2.5 (1.6)^{a}	3.6 (1.8)^{a}	6.6	2.3 (1.5)^{b}	1.9 (1.4)^{a}	2.1 (1.4)^{a}
T_5 Thiamethoxam 25 WG	0.4	11.6	3.1 (1.7)^{a}	3.5 (1.9)^{b}	5.0 (2.3)^{a}	7.2	3.5 (1.8)^{a}	3.7 (1.9)^{a}	4.8 (2.2)^{a}	7.4	2.5 (1.6)^{a}	2.9 (1.7)^{a}	4.9 (2.2)^{b}	6.8	2.5 (1.6)^{b}	2.1 (1.4)^{a}	2.4 (1.5)^{a}
T_6 Diafenthiuron 50 WP	1.0	11.8	5.0 (2.2)^{b}	5.7 (2.4)^{de}	6.0 (2.5)^{b}	7.8	6.6 (2.6)^{de}	7.2 (2.7)^{de}	7.5 (2.7)^{bc}	8.1	5.0 (2.2)^{b}	5.1 (2.3)^{b}	6.1 (2.5)^{c}	7.7	4.8 (2.2)^{de}	5.4 (2.3)^{cd}	5.2 (2.3)^{cd}
T_7 Dimethoate 30 EC	2.0	12.0	6.0 (2.4)^{c}	7.0 (2.6)^{gh}	7.0 (2.6)^{bc}	8.0	6.9 (2.6)^{ef}	7.4 (2.7)^{de}	7.8 (2.7)^{bc}	7.9	5.2 (2.3)^{b}	5.3 (2.3)^{b}	7.0 (2.6)^{e}	7.6	5.4 (2.3)^{ef}	4.6 (2.1)^{bc}	5.5 (2.3)^{cd}
T_8 Profenophos 50 EC	2.0	12.1	7.6 (2.7)^{e}	7.5 (2.7)^{h}	7.5 (2.7)^{cd}	7.6	6.0 (2.4)^{cd}	6.1 (2.5)^{cd}	8.5 (2.9)^{cd}	7.7	5.7 (2.4)^{b}	6.0 (2.4)^{bc}	6.9 (2.6)^{de}	8.0	5.0 (2.2)^{de}	5.2 (2.3)^{cd}	6.0 (2.4)^{e}
T_9 Azadirachtin 10000ppm	3.0	12.0	5.0 (2.2)^{b}	5.0 (2.2)^{c}	7.5 (2.7)^{cd}	8.5	5.8 (2.4)^{cd}	6.5 (2.5)^{cd}	8.3 (2.9)^{cd}	7.9	5.7 (2.4)^{b}	5.8 (2.4)^{bc}	7.2 (2.7)^{e}	8.1	4.4 (2.1)^{cd}	4.9 (2.2)^{bc}	5.1 (2.3)^{bc}
T_{10} NSKE	5%	11.7	6.5 (2.5)^{cd}	6.6 (2.6)^{g}	7.0 (2.6)^{bc}	10.0	5.7 (2.4)^{cd}	7.0 (2.7)^{de}	8.7 (2.9)^{de}	8.5	5.2 (2.3)^{b}	5.1 (2.3)^{b}	6.2 (2.5)^{cd}	7.2	4.2 (2.0)^{cd}	4.2 (2.0)^{bc}	4.1 (2.0)^{bc}
T_{11} Neem leaf extract	10%	11.8	6.0 (2.4)^{c}	7.3 (2.7)^{h}	7.6 (2.7)^{cd}	8.9	6.9 (2.6)^{ef}	7.8 (2.8)^{ef}	8.6 (2.9)^{de}	8.5	5.4 (2.3)^{b}	5.5 (2.3)^{b}	6.8 (2.6)^{de}	8.3	5.0 (2.2)^{de}	5.2 (2.3)^{cd}	5.5 (2.3)^{cd}
T_{12} Bougainvillea leaf extract	10%	11.9	7.3 (2.7)^{de}	6.0 (2.4)^{d}	7.5 (2.7)^{cd}	9.8	7.7 (2.8)^{fg}	8.7 (2.9)^{g}	9.2 (3.0)^{ef}	9.3	5.6 (2.4)^{b}	5.5 (2.3)^{b}	7.9 (2.8)^{fg}	8.6	6.0 (2.4)^{f}	6.1 (2.5)^{d}	6.2 (2.5)^{e}
T_{13} Coconut leaf extract	10%	11.8	5.1 (2.3)^{b}	6.2 (2.5)^{ef}	7.8 (2.8)^{d}	10.1	7.9 (2.8)^{g}	8.2 (2.9)^{fg}	9.5 (3.1)^{f}	9.5	6.9 (2.6)^{c}	6.8 (2.6)^{c}	8.1 (2.8)^{g}	8.6	5.4 (2.3)^{ef}	5.0 (2.2)^{cd}	5.7 (2.4)^{de}
T_{14} Untreated check	-	12.1	12.4 (3.5)^{f}	12.3 (3.5)^{i}	13.4 (3.6)^{e}	15.0	15.4 (3.9)^{h}	15.5 (3.9)^{h}	16.0 (4.0)^{g}	16.0	16.5 (4.1)^{d}	16.4 (4.0)^{d}	16.8 (4.1)^{h}	16.6	15.4 (3.9)^{g}	15.0 (3.9)^{e}	15.0 (3.8)^{f}
		SEd	0.06	0.04	0.09	0.02	0.03	0.13	0.08	0.15	0.11	0.12	0.06	0.09	0.11	0.13	0.14

CD<0.5 %	0.14	0.10	0.21	0.05	0.06	0.29	0.19	0.33	0.23	0.27	0.14	0.19	0.24	0.28	0.32

PT: Pretreatment ; Values in parentheses are square root transformed

Table 3. Effect of newer insecticides and plant products on the management of whitefly in brinjal

Treatments	Dose (g /ml l^{-1})	Pooled mean*				
		Whitefly population (No./3 leaves)	Population reduction (%)	Fruit yield (t/ha)	Increased yield (%)	C:B
T_1: Acetamiprid 20 SP	0.3	5.20	64.48	25.07	18.98	1:2.87
T_2: Imidacloprid17.8 SL	0.5	5.05	65.50	26.32	24.91	1:2.96
T_3 : Spiromesifen 240 SC	1.0	3.05	79.16	28.79	36.63	1:3.01
T_4 : Thiacloprid 240 SC	1.0	3.28	77.59	28.01	32.93	1:3.01
T_5 : Thiamethoxam 25 WG	0.4	3.39	76.84	27.24	29.28	1:3.05
T_6 : Diafenthiuron 50 WP	1.0	5.60	61.74	25.02	18.74	1:2.54
T_7 : Dimethoate 30 EC	2.0	6.32	56.83	24.57	16.61	1:2.72
T_8 : Profenophos 50 EC	2.0	6.90	52.86	24.10	13.95	1:2.52
T_9 : Azadirachtin 10000ppm	3.0	6.25	57.30	26.70	26.72	1:2.67
T_{10} : NSKE	5%	6.18	57.78	26.41	25.34	1:2.88
T_{11} : Neem leaf extract	10%	6.55	55.25	23.13	9.77	1:2.54
T_{12} : *Bougainvillea* leaf extract	10%	7.26	50.40	22.67	7.59	1:2.49
T_{13} Coconut leaf extract	10%	6.90	52.86	22.72	7.83	1:2.51
T_{14} Untreated check	-	14.64	-	21.07	-	1:2.61
S. Ed. **C. D. (p=0.05)**		-		1.27 2.52		-

* Pooled mean of two seasons; Values in parentheses are angular transformed values