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EFFICACY OF DIFFERENT INSECTICIDES AGAINST SUCKING PEST COMPLEX OF GUAVA

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ABSTRACT

Among the various insecticides tested against the sucking pests, all the insecticides proved their effectiveness in minimizing the sucking pests incidence when compared to the untreated control. Among them, soapnut powder @ 5g/L spray followed by Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD @ 1 ml/L recorded the least damage incidence for all the sucking pests of guava (tea mosquito bug, spiralling whitefly and mealy bug) showing better performance which is on par with detergent powder spray @ 5 g/L followed by Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD @ 1ml/L. The next most effective treatments were soapnut powder @ 5 g/L spray following Thiamethoxam 12.6 % + Lambda cyhalothrin 9.5 % ZC @ 0.4 ml/L which was at par with detergent powder – Thiamethoxam 12.6 % + Lambda cyhalothrin 9.5 % ZC @ 0.4 ml/L. Highest net returns and yield was obtained from soapnut powder @ 5g/L spray followed by Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD @ 1 ml/L treatment having B:C ratio of 1:4.87, which is in par with detergent powder spray @ 5 g/L followed by Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD @ 1ml/L with the B:C ratio of 1:4.70.
Keywords**:** Guava, sucking pests, management, cost-benefit ratio

Introduction

Guava, *Psidium guajava* L. is a climacteric fruit originated in Tropical America has been cultivated widely in many countries in the world. In India it was introduced early in seventeenth century. It belongs to the family Myrtaceae and is a major source of Vitamin A, B and C and also contains high amounts of calcium and pectin (Anita *et al*., 2012). Guava is an important fruit crop commercially cultivated and it claims to be the 4th most important fruits in area and production after mango, banana and citrus. It is eaten as such or as cooked and used for making jam and jelly. Due to its high calorific value, guava fruit is an excellent choice for the middle income group people and hence it is also called as “Poor man’s apple”.

India is the largest producer of guava in the world having an area of about 307 thousand ha with a production of 4516 thousand million tonnes (First advance estimates). The largest producer is Uttar Pradesh (983.59 thousand tonnes) followed by Madhya Pradesh (776.75 thousand tonnes) and Bihar (434.41 thousand tonnes). Karnataka having an area of 7.18 thousand ha with 140.23 thousand million tonnes of production and 19.52 million tonnes ha^{-1} productivity. The total area under guava fruit crop in Dharwad district accounts for 563 ha with a production of 10191 metric tonnes (Anon., 2019).

Various insect species causes damage to guava in different regions of the world and their abundance vary with geographical locations, availability of food sources and the season of the year. As many as 80 insect pests have been reported on guava. Of these, the most important are sucking pests which includes mealy bug (*F. virgata*), tea mosquito bug (*H. antonii),* and in some regions spiralling whiteflies (*A. dispersus*) are the primary reasons for the hindrance for the guava production, where both nymphs and adults will suck the sap from the leaves, twigs, flowers and also attacks fruits. Apart from sucking pests, fruit flies (*Bactrocera* spp.) also cause a major loss, where the maggots bore inside the fruits and start feeding on the soft pulp.

The attack of these pests causes several effects including fruit quality and its production. Apart from this, indiscriminate use of pesticides by farmers on different cultivars in guava ecosystem without proper management recommendations needs to be corrected. Use of combi-products and the use of bio-control agent such as entomo-pathogenic fungi is essential to exploit as a potential tool in the management of these sucking pests.

Material and Methods

Field experiment was laid out in completely Randomized Block Design at Main Agricultural Research Station, Saidapur farm, Dharwad. The experiment consists of ten treatments including untreated check and each treatment was replicated thrice, one plant was considered as one treatment. Management practices were carried out by following all the recommended package of practices except the plant protection measures against sucking pests in the guava orchard. Totally three sprays were given at an interval of 15 days

Treatment details: T_1-Lecanicillium lecanii @ 2g/L; T_2 –Azadirachtin 10000 ppm (Nimbecidine) @ 5 ml/L; T_3- Soapnut powder @ 5g/L-Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC @ 0.4 ml/L; T_4- Detergent powder @ 5g/L - Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC @ 0.4 ml/L; T_5- Soapnut powder @ 5g/L - Beta-cyfluthrin 8.49% + Imidacloprid 19.81% OD @ 1ml/L; T_6- Detergent powder @ 5g/L - Beta-cyfluthrin 8.49% + Imidacloprid 19.81% OD @ 1ml/L; T_7- Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC (Alika) @ 0.4 ml/L; T_8- Beta-cyfluthrin 8.49% + Imidacloprid 19.81% OD (Solomon) @ 1 ml/L; T_9- Cypermethrin 10% EC @ 0.5 ml/L; T_{10}- Untreated control.

In an orchard, five plants were randomly selected and five branches in each plant was observed for mealybug on the basis of number of mealybug per leaf, number of mealybug per twig and per fruit. For tea mosquito bug, observation recorded as number of affected leaves per branch, number of affected flower buds per branch and number of affected fruits per branch. Whereas observation on spiralling whitefly like number of whiteflies (nymphs and adults) per leaf, number of egg mass per leaf and per cent leaf infestation.

Observation on insect population, leaf damage and fruit damage was recorded except fruit fly at 1 day before spray and at 3, 5 and 10 days after spray. Three sprays were given at 15 days interval. Percentage of infestation was worked out. Further percent reduction of sucking pest population over control obtained through following formula,

$$\text{Per cent reduction over control} = \frac{\text{Pest population in control} - \text{Pest population in treatment}}{\text{Pest population in control}} \times 100$$

Cost economics

Based on the yield data, cost of plant protection and production, gross returns and net returns was calculated for each treatment. Benefit cost ratio was worked out by using below mentioned formula,

$$\text{ICBR} = \frac{\text{Net profit Rs/ha}}{\text{Cost of control measures in respective treatment (Rs/ha)}} \times 100$$

Where,

ICBR- Incremental cost benefit ratio

Net profit (Rs/ha) = Gross profit (Rs/ha)- Cost of control in respective treatment (Rs/ha).

Cost of control measures in respective treatment (Rs/ha) = Cost of respective treatment (Rs/ha) + Cost of application (Rs/ha).

Results and Discussion

All the tested insecticide molecules exhibited effectiveness in mitigating the sucking pests incidence in guava when compared to an untreated control group and the results are presented below.

Efficacy of biopesticides and insecticides against tea mosquito bug, *Helopeltis antonii* Signoret

Notably, soapnut powder spray followed by Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD (T_5) proved high effectiveness in reducing the tea mosquito bug incidence in guava, which was followed by detergent powder spray followed by Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD (T_6) and was equally effective as T_5 after second and third sprays. The next best treatments were soapnut powder spray following Thiamethoxam 12.6 % + Lambda cyhalothrin 9.5 % ZC (T_3) which was on par with detergent powder – Thiamethoxam 12.6 % + Lambda cyhalothrin 9.5 % ZC (T_4). Nimbecidine (T_2) had the highest incidence in all the three sprays and all of the treatments were superior over untreated control (Table 1).

The present findings align with those of Zote *et al.* (2018), who reported that among various doses of Solomon tested, Betacyfluthrin 90 % + Imidacloprid 210 % at 0.15 ml/L was effective in managing tea mosquito bugs and thrips in cashew. Similarly, Bharathi *et al.* (2022) evaluated different synthetic insecticides against tea mosquito bugs and found that Betacyfluthrin 90 % + Imidacloprid at 625 ml/ha reduced tea mosquito bug incidence by 80% compared to the control.

Efficacy of biopesticides and insecticides against mealy bug, *Ferrisia virgata* Cockerell

Soapnut powder spray followed by Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD (T_5) was highly effective in reducing mealy bug incidence in guava, closely followed by detergent powder spray combined with Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD (T_6), which was equally effective after the second and third sprays. Among the different chemicals used, the next most effective treatments were soapnut powder spray followed by Thiamethoxam 12.6 % + Lambda-cyhalothrin 9.5 % ZC (T3), which performed on par with detergent powder followed by Thiamethoxam 12.6 % + Lambda-cyhalothrin 9.5 % ZC (T_4). The highest mealy bug population was recorded in the Nimbecidine (T_2) treatment across all three sprays. All treatments were superior to the untreated control group (Table 2).

The present results were in line with the results of Wale and chandele (2013), who studied the bioefficacy of evolved doses of Solomon and reported that the treatment of Beta-cyfluthrin 9 % + Imidacloprid 21 % OD @ 15.75 + 36.75 g. a.i./ha was found most superior for the control of aphids as well as fruit borer in brinjal and also obtaining good yield which is followed by Thiamethoxam 25 WG + Lambdacyhalothrin 5 EC. Application of Solomon did not produce any type of phytotoxicity on brinjal crop.

Prasannakumar *et al.* (2023), evaluated insecticidal properties of botanicals for sucking pests management in horticultural crops wherein results indicated that *Annona squamosa* and *Sapindus mukorossi* (soapnut) seed extracts were found to have potent insecticidal properties on all sucking pests (thrips, whiteflies, mealy bugs and mites). So it can be used in organic farming for managing the sucking pests effectively.

Efficacy of biopesticides and insecticides against spiralling whitefly, *Aleurodicus disperses* Russel

Among the chemicals tested, soapnut powder spray followed by Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD (T_5) proved highly effective in reducing the whitefly population in guava. This was followed by detergent powder spray combined with Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD (T_6), which was equally effective as T_5 after three sprays. The next most effective treatments were soapnut powder spray combined with Thiamethoxam 12.6 % + Lambda-cyhalothrin 9.5 % ZC (T_3), which performed on par with detergent powder combined with Thiamethoxam 12.6 % + Lambda-cyhalothrin 9.5 % ZC (T_4). The highest population of spiraling whiteflies was recorded with the Nimbecidine (T_2) treatment across all three sprays. All treatments were superior to the untreated control group (Table 3).

These findings are corroborated by Giraddi *et al.* (2018), who reported that the product Solomon 300 OD (Beta-cyfluthrin 21.6 % + Imidacloprid 50.4 %) was effective in controlling thrips, whiteflies, and borers, outperforming the standard check. Khalil *et al.* (2019) compared the effectiveness of water, detergent powder, and smoke for controlling spiraling whitefly (*Aleurodicus dispersus*) and found that detergent powder significantly reduced the number of whiteflies when sprayed on twigs. Additionally, Kambrekar and Awaknavar (2010) found that neem oil (0.5 %) was less effective against spiraling whitefly in guava compared to other chemical insecticides.

Solomon is an innovative oil-based formulation that combines Imidacloprid and Beta-cyfluthrin. This combination offers both systemic and contact properties, providing rapid knockdown and anti-feeding effects, making it an effective broad-spectrum insecticide for controlling sucking and biting pests. Beta-cyfluthrin, a synthetic pyrethroid, acts through contact and ingestion, disrupting the insect's nervous system by blocking sodium channels. Imidacloprid, a systemic insecticide from the neonicotinoid group, functions as an antagonist to the nicotinic acetylcholine receptor in the central nervous system, interfering with signal transmission, causing nerve cell excitation, and ultimately leading to the insect's death. No phytotoxicity was observed on cashew crops treated with Solomon.

Soapnut powder contains Saponins (10-15 %), Sapindosides (5-10 %) and Flavonoides (2-5 %) which kills the insects by disrupting the insect cell membrane, interfere the insect hormone system and helps to deter sucking pests by their anti-feedent property. Detergent powder reduce the surface tension causing insects to dehydrate and make them difficult to survive by altering the pH of the plant surfaces.

Effect of insecticides on yield and economics of guava

Significantly highest yield (15.35 t/ha) was obtained by soapnut powder spray - Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD (T_5) with B:C ratio of 1:4.87, which was on par with detergent powder spray -Beta cyfluthrin 8.49 % + Imidacloprid 19.81 % OD (14.84 t/ha) having 1:4.70 B:C ratio. The next highest yield from soapnut powder spray - Thiamethoxam 12.6 % + Lambda cyhalothrin 9.5 % ZC (13.86 t/ha) and detergent powder- Thiamethoxam 12.6 % + Lambda cyhalothrin 9.5 % ZC (13.42 t/ha) and the least yield was observed in the nimbecidine treatment (9.18 t/ha) with the B:C ratio of 1:2.89 (Table 4 and Fig. 1).

The current findings are consistent with those of Wale and Chandele (2013), who found that the treatment of Beta-cyfluthrin 9 % + Imidacloprid 21 % OD at 15.75 + 36.75 g a.i./ha was highly effective for controlling aphids and fruit borers in brinjal and okra, also resulting in good yields. This treatment was followed in efficacy by Thiamethoxam 25 WG + Lambda-cyhalothrin 5 EC. Furthermore, the application of Solomon did not cause any phytotoxic effects on the crops, confirming its safety and effectiveness.

Conclusion

The different treatments are given for controlling sucking pest complex against guava, wherein the performance of different insecticidal treatments are recorded. Among them, soapnut powder @ 5g/L spray followed by Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD @ 1 ml/L recorded the least damage incidence for all the sucking pests of guava (tea mosquito bug, spiralling whitefly and mealy bug) showing better performance which is on par with detergent powder spray @ 5 g/L followed by Beta-cyfluthrin 8.49 % + Imidacloprid 19.81 % OD @ 1ml/L. The next most effective treatments were soapnut powder @ 5 g/L spray following Thiamethoxam 12.6 % + Lambda cyhalothrin 9.5 % ZC @ 0.4 ml/L which was at par with detergent powder – Thiamethoxam 12.6 % + Lambda cyhalothrin 9.5 % ZC @ 0.4 ml/L. These treatments were found effective in reducing sucking pests incidence.

Table 1: Efficacy of biopesticides and insecticides against tea mosquito bug, *Helopeltis antonii* in guava during 2023 after three sprays

Tr. No.	Treatments	Young leaves (%)				Flower bud (%)				Fruit damage(%)				ROC (%)		
		1DBS	3DAS	5DAS	10DAS	1DBS	3DAS	5DAS	10DAS	1DBS	3DAS	5DAS	10DAS	Leaves	Flower bud	Fruit
T_1	*Lecanicillium lecanii* @ 2g/L	12.16 (20.41)	7.12 (15.48)^{d}	6.86 (15.18)^{d}	7.01 (15.35)^{d}	12.86 (21.01)	6.27 (14.50)^{c}	5.23 (13.22)^{d}	5.48 (13.54)^{cd}	15.24 (22.98)	9.67 (18.12)^{c}	7.04 (15.39)^{d}	7.23 (15.60)^{d}	45.21	45.31	43.8
T_2	Nimbecidine @ 5 ml/L	13.87 (21.87)	8.38 (16.83)^{e}	7.78 (16.20)^{e}	8.01 (16.44)^{e}	12.28 (20.51)	6.86 (15.18)^{d}	6.14 (14.35)^{e}	6.29 (14.82)^{d}	15.89 (23.49)	10.62 (19.02)^{d}	8.65 (17.10)^{e}	8.78 (17.24)^{e}	36.91	37.87	34.15
T_3	Soapnut powder @5g-Thiamethoxam 12.6% + Lambda cyhalothrin 9.5%ZC @ 0.4 ml/L	13.01 (21.14)	5.28 (13.28)^{ab}	4.04 (12.21)^{b}	4.23 (11.87)^{ab}	12.02 (20.29)	4.48 (13.54)^{b}	2.87 (9.75)^{b}	3.01 (9.99)^{b}	16.02 (23.59)	6.54 (14.82)^{a}	3.98 (11.51)^{b}	4.02 (11.57)^{b}	64.65	63.47	65.91
T_4	Detergent powder@ 5g Thiamethoxam 12.6% + Lambda cyhalothrin 9.5%ZC @ 0.4ml/L	12.96 (21.10)	5.89 (14.05)^{b}	4.65 (12.45)^{b}	4.89 (12.78)^{b}	12.87 (21.02)	4.79 (14.05)^{b}	3.02 (10.01)^{b}	3.28 (10.43)^{b}	15.84 (23.45)	6.95 (15.29)^{b}	4.21 (11.84)^{b}	4.46 (12.19)^{b}	59.71	60.77	63.38
T_5	Soapnut powder @ 5g - Beta-cyfluthrin 8.49%+ Imidacloprid 19.81% OD @ 1ml/L	12.76 (20.93)	4.46 (12.19)^{a}	3.64 (11.00)^{a}	3.76 (11.18)^{a}	11.98 (20.25)	3.54 (12.30)^{a}	1.78 (7.67)^{a}	1.89 (7.90)^{a}	15.83 (23.45)	5.87 (14.02)^{a}	3.01 (9.99)^{a}	3.28 (10.43)^{a}	69.04	73.62	71.47
T_6	Detergent powder @ 5g-Beta-cyfluthrin 8.49%+ Imidacloprid 19.81% OD @ 1ml/L	13.01 (21.14)	4.99 (12.91)^{a}	3.89 (11.38)^{a}	4.01 (11.55)^{a}	12.78 (20.95)	3.87 (12.75)^{a}	1.98 (8.09)^{a}	2.15 (8.43)^{a}	16.03 (23.60)	6.04 (14.23)^{a}	3.54 (10.84)^{a}	3.76 (11.18)^{a}	66.37	71.01	68.73
T_7	Thiamethoxam 12.6% + Lambda cyhalothrin 9.5%ZC @ 0.4 ml/L	12.68 (20.86)	6.23 (14.45)^{c}	5.46 (13.51)^{c}	5.68 (13.79)^{c}	12.04 (20.30)	5.48 (13.54)^{b}	3.86 (11.33)^{c}	3.98 (11.51)^{c}	15.48 (23.17)	7.43 (15.82)^{b}	5.57 (13.65)^{c}	5.87 (14.02)^{c}	54.62	57.1	55.7
T_8	Beta-cyfluthrin 8.49%+ Imidacloprid 19.81% OD @ 1ml/L	12.73 (20.90)	6.01 (14.19)^{c}	5.12 (13.08)^{c}	5.35 (13.37)^{c}	11.69 (19.81)	5.1 (13.05)^{b}	3.65 (11.01)^{c}	3.78 (11.21)^{bc}	15.14 (22.90)	7.04 (15.39)^{b}	5.25 (13.25)^{c}	5.42 (13.46)^{c}	56.97	59.71	58.45
T_9	Cypermethrin @ 0.5ml/L	13.18 (21.29)	6.99 (15.33)^{d}	6.23 (14.45)^{cd}	6.43 (14.69)^{d}	12.87 (21.02)	5.99 (14.17)^{bc}	4.12 (11.71)^{c}	4.34 (12.01)^{c}	15.98 (23.56)	8.65 (17.10)^{c}	6.27 (14.50)^{d}	6.48 (14.75)^{cd}	48.66	53.52	49.78
T_{10}	Untreated control	12.58 (20.77)	11.89 (20.17)f	12.85 (21.01)f	13.54 (21.59)f	11.05 (19.42)	9.52 (17.97)^{e}	10.07 (18.50)^{f}	11.46 (19.79)^{e}	15.32 (23.04)	13.76 (21.77)^{e}	14.13 (22.08)^{f}	14.71 (22.55)f	-	-	-
	S.Em. (±)	NS	0.4	0.47	0.46	NS	0.43	0.67	0.65	NS	0.37	0.49	0.47	-	-	-
	C.D. (P=0.05)	NS	1.01	1.14	1.07	NS	1.29	1.01	1.35	NS	1.12	1.47	1.42	-	-	-
	C V (%)	9.98	10.3	12.19	12.49	13.87	12.3	12.87	13.62	13.97	7.94	12.64	12.71	-	-	-

Figures in the parenthesis are arcsine transformed values; Means showing similar alphabets do not differ significantly by DMRT (P=0.05); DBS- Day before spray, DAS- Days after spray, NS- Non significant; ROC- Reduction over control

Table 2: Efficacy of biopesticides and insecticides against mealy bug, *Ferrisia virgata* Cockerell in guava during 2023 after three sprays

Tr no	Treatments	Mealy bug / leaf				Mealy bug / twig				Mealy bug / fruit				Reduction over control (%)		
		1DBS	3DAS	5DAS	10DAS	1DBS	3DAS	5DAS	10DAS	1DBS	3DAS	5DAS	10DAS	Leaves	Twig	Fruit
T_1	*Lecanicillium lecanii* @ 2g/L	4.58 (2.25)	3.27 (1.94) ^{d}	1.91 (1.52)^{cd}	2.13 (1.62)^{d}	2.68 (1.78)	1.46 (1.40)^{d}	1.04 (1.24)^{cd}	1.16 (1.29)^{d}	5.56 (2.46)	3.53 (2.01)^{d}	2.9 (1.84)^{cd}	3.14 (1.91)^{d}	49.35	41.75	46.33
T_2	Nimbecidine @ 5 ml/L	4.85 (2.31)	3.76 (2.06)^{d}	2.67 (1.78)^{d}	2.76 (1.81)^{e}	2.97 (1.86)	1.73 (1.48)^{d}	1.37 (1.37)^{d}	1.41 (1.38)^{e}	5.87 (2.52)	4.06 (2.14)^{d}	3.26 (1.94)^{d}	3.37 (2.00)^{e}	36.86	28.63	36.81
T_3	Soapnut powder @5g-Thiamethoxam 12.6% + Lambda cyhalothrin 9.5%ZC @ 0.4 ml/L	4.42 (2.22)	2.04 (1.59)^{b}	0.62 (1.06)^{b}	0.81 (1.14)^{b}	2.42 (1.71)	0.92 (1.19)^{b}	0.33 (0.91)^{b}	0.39 (0.93)^{b}	6.12 (2.57)	2.71 (1.79)^{b}	1.63 (1.46)^{b}	1.71 (1.49)^{b}	73.01	69.62	65.43
T_4	Detergent powder @ 5g Thiamethoxam 12.6% + Lambda cyhalothrin 9.5%ZC @ 0.4ml/L	4.27 (2.18)	2.18 (1.64)^{b}	0.84 (1.16)^{b}	0.93 (1.20)^{b}	2.57 (1.75)	1.03 (1.24)^{b}	0.31 (0.89)^{b}	0.41 (0.96)^{b}	5.98 (2.55)	3.03 (1.88)^{b}	1.76 (1.50)^{b}	1.78 (1.51)^{b}	71.82	67.98	62.05
T_5	Soapnut powder @ 5g - Beta-cyfluthrin 8.49%+ Imidacloprid 19.81% OD @ 1ml/L	4.16 (2.16)	1.16 (1.29)^{a}	0.37 (0.82)^{a}	0.47 (0.98)^{a}	2.36 (1.69)	0.27 (0.88)^{a}	0.13 (0.79)^{a}	0.22 (0.81)^{a}	5.87 (2.52)	2.14 (1.62)^{a}	1.23 (1.32)^{a}	1.37 (1.37)^{a}	83.26	83.78	72.38
T_6	Detergent powder @ 5g-Beta-cyfluthrin 8.49%+ Imidacloprid 19.81% OD @ 1ml/L	4.87 (2.32)	1.27 (1.33)^{a}	0.42 (0.87)^{a}	0.53 (1.01)^{a}	2.79 (1.81)	0.51 (1.00)^{a}	0.11 (0.78)^{a}	0.27 (0.89)^{a}	5.42 (2.43)	2.21 (1.65)^{a}	1.26 (1.34)^{a}	1.50 (1.41)^{a}	82.2	79.58	71.25
T_7	Thiamethoxam 12.6% + Lambda cyhalothrin 9.5%ZC @ 0.4 ml/L	4.37 (2.21)	2.92 (1.85)^{c}	1.12 (1.27)^{c}	1.24 (1.32)^{c}	2.48 (1.73)	1.14 (1.28)^{bc}	0.39 (0.94)^{c}	0.51 (1.01)^{c}	5.17 (2.38)	2.42 (1.71)^{c}	2.12 (1.62)^{c}	2.32 (1.68)^{c}	62.8	63.88	61.06
T_8	Beta-cyfluthrin 8.49%+ Imidacloprid 19.81% OD @ 1ml/L	4.17 (2.16)	2.73 (1.80)^{c}	1.03 (1.23)^{c}	1.12 (1.27)^{c}	2.84 (1.83)	1.11 (1.27)^{bc}	0.43 (0.96)^{c}	0.48 (0.99)^{c}	5.71 (2.49)	2.73 (1.80)^{bc}	2.01 (1.58)^{c}	2.14 (1.61)^{c}	65.6	64.29	59.89
T_9	Cypermethrin @ 0.5ml/L	4.62 (2.26)	3.09 (1.89)^{c}	1.34 (1.38)^{c}	1.46 (1.40)^{cd}	2.03 (1.59)	1.23 (1.32)^{cd}	0.53 (1.01)^{cd}	0.83 (1.11)^{cd}	5.87 (2.52)	3.03 (1.90)^{cd}	2.27 (1.72)^{cd}	2.41 (1.71)^{cd}	58.78	57.73	55.36
T_{10}	Untreated control	4.18 (2.16)	4.51 (2.24)^{e}	4.76 (2.29)^{e}	4.98 (2.34)^{f}	2.01 (1.58)	1.86 (1.79)^{e}	2.23 (1.65)^{e}	2.62 (1.77)f	5.79 (2.51)	5.7 (2.49)	5.89 (2.53)^{e}	6.2 (2.59)^{f}	-	-	-
	S.Em. (±)	NS	0.14	0.08	0.11	NS	0.06	0.04	0.05	NS	0.15	0.13	0.14	-	-	-
	C.D. (P=0.05)	NS	0.41	0.25	0.32	NS	0.18	0.13	0.15	NS	0.46	0.09	0.49	-	-	-
	C V (%)	9.7	9.05	10.06	10.66	7.97	9.4	11.05	11.03	7.62	8.53	9.29	9.49	-	-	-

Figures in the parenthesis are arcsine transformed values; Means showing similar alphabets do not differ significantly by DMRT (P=0.05); DBS- Day before spray, DAS- Days after spray, NS- Non significant

Table 3: Efficacy of biopesticides and insecticides against spiralling whitefly, *Aleurodicus disperses* Russel in guava during 2023 after three sprays

Tr no	Treatments	Egg mass / leaf				Whiteflies / leaf				Leaf infestation (%)				Reduction over control (%)
		1DBS	3DAS	5DAS	10DAS	1DBS	3DAS	5DAS	10DAS	1DBS	3DAS	5DAS	10DAS	Leaves
T_1	*Lecanicillium lecanii* @ 2g/L	4.37 (2.21)	2.52 (1.74)^{d}	2.02 (1.59)^{e}	1.93 (1.56)^{d}	5.17 (2.38)	2.9 (1.84)^{d}	1.85 (1.47)^{d}	1.65 (1.50)^{e}	46.74 (43.13)	37.24 (37.61)^{cd}	31.58 (34.19)^{cd}	32.45 (34.73)^{d}	57.32
T_2	Nimbecidine @ 5 ml/L	4.48 (2.23)	2.92 (1.85)^{e}	2.42 (1.71)^{f}	2.47 (1.72)^{e}	5.53 (2.46)	3.42 (2.00)^{e}	2.55 (1.63)^{e}	2.13 (1.68)^{f}	47.18 (43.38)	38.87 (38.57)^{d}	34.56 (36.02)^{d}	36.75 (37.32)^{e}	44.27
T_3	Soapnut powder @5g-Thiamethoxam 12.6% + Lambda cyhalothrin 9.5%ZC @ 0.4 ml/L	3.96 (2.11)	1.34 (1.36)^{b}	0.84 (1.16)^{b}	0.64 (1.07)^{b}	5.26 (2.40)	1.74 (1.50)^{b}	0.39 (0.87)^{b}	0.33 (0.91)^{b}	47.98 (43.84)	32.64 (34.84)^{a}	24.78 (29.85)^{b}	25.76 (30.50)^{b}	77.49
T_4	Detergent powder @ 5g Thiamethoxam 12.6% + Lambda cyhalothrin 9.5%ZC @ 0.4ml/L	4.72 (2.28)	1.43 (1.40)^{b}	0.93 (1.20)^{b}	0.69 (1.10)^{b}	5.39 (2.43)	2.04 (1.59)^{b}	0.46 (0.93)^{b}	0.41 (0.95)^{b}	46.76 (43.14)	33.65 (35.46)^{ab}	23.56 (29.16)^{b}	24.24 (29.49)^{b}	75.94
T_5	Soapnut powder @ 5g - Beta-cyfluthrin 8.49%+ Imidacloprid 19.81% OD @ 1ml/L	4.68 (2.28)	0.77 (1.13)^{a}	0.27 (0.88)^{a}	0.28 (0.89)^{a}	5.68 (2.49)	1.46 (1.40)^{a}	0.22 (0.79)^{a}	0.23 (0.79)^{a}	47.29 (43.45)	31.49 (34.14)^{a}	21.76 (27.81)^{a}	22.54 (27.34)^{a}	81.52
T_6	Detergent powder @ 5g-Beta-cyfluthrin 8.49%+ Imidacloprid 19.81% OD @ 1ml/L	4.67 (2.27)	1.12 (1.27)^{ab}	0.62 (1.01)^{ab}	0.32 (1.02)^{a}	5.67 (2.48)	1.57 (1.45)^{a}	0.27 (0.82)^{ab}	0.29 (0.84)^{a}	47.15 (43.37)	31.96 (34.43)^{ab}	22.61 (28.21)^{a}	23.63 (28.07)^{a}	80.37
T_7	Thiamethoxam 12.6% + Lambda cyhalothrin 9.5%ZC @ 0.4 ml/L	4.57 (2.25)	1.72 (1.49)^{bc}	1.22 (1.31)^{c}	1.1 (1.26)^{c}	5.37 (2.42)	2.17 (1.63)^{c}	0.61 (1.05)^{bc}	0.69 (1.09)^{c}	47.65 (43.65)	35.28 (36.44)^{b}	23.94 (29.29)^{c}	24.87 (29.98)^{bc}	71.68

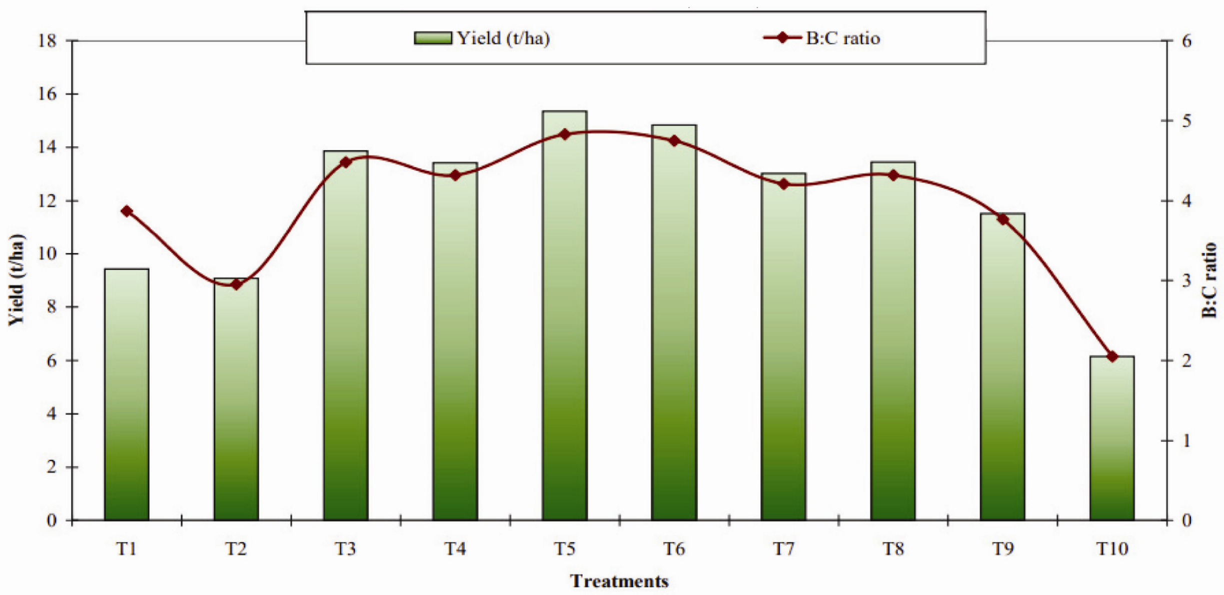
T_8	Beta-cyfluthrin 8.49%+ Imidacloprid 19.81% OD @ 1ml/L	4.73 (2.29)	1.56 $(1.44)^{bc}$	1.06 $(1.26)^{c}$	0.86 $(1.17)^{c}$	5.58 (2.47)	2.37 $(1.69)^{c}$	0.55 $(1.02)^{bc}$	0.61 $(1.05)^{c}$	47.63 (43.64)	34.97 $(36.25)^{b}$	22.02 $(27.99)^{c}$	23.76 $(29.34)^{bc}$	70.59
T_9	Cypermethrin @ 0.5ml/L	4.59 (2.26)	1.89 $(1.55)^{c}$	1.39 $(1.37)^{d}$	1.53 $(1.42)^{cd}$	5.27 (2.40)	2.51 $(1.73)^{cd}$	0.76 $(1.12)^{c}$	0.90 $(1.18)^{d}$	47.29 (43.45)	36.56 $(37.20)^{bc}$	26.98 $(31.29)^{cd}$	27.17 $(31.42)^{c}$	68.29
T_{10}	Untreated control	3.98 (2.12)	4.04 $(2.13)^{e}$	4.17 $(2.16)^{g}$	4.52 $(2.24)^{f}$	5.02 (2.35)	4.52 $(2.24)^{f}$	4.86 $(2.32)^{f}$	4.97 $(2.34)^{g}$	48.06 (43.89)	43.08 $(41.02)^{e}$	43.92 $(41.51)^{e}$	44.74 $(41.98)^{f}$	-
	S.Em. (±)	NS	0.10	0.10	0.01	NS	0.12	0.09	0.08	NS	1.63	1.34	1.39	-
	C.D. (P=0.05)	NS	0.31	0.31	0.27	NS	0.37	0.26	0.25	NS	4.87	4.01	4.14	-
	C V (%)	7.66	9.54	9.55	11.03	7.65	8.85	12.09	12.47	7.72	7.98	8.46	8.45	-

Figures in the parenthesis are arcsine transformed values; Means showing similar alphabets do not differ significantly by DMRT (P=0.05); DBS- Day before spray, DAS- Days after spray, NS- Non significant

Table 4 : Cost benefit ratio of different biopesticides and insecticides against major sucking pests of guava during 2023.

Sl. No.	Treatments	Yield (t/ha)	Gross returns (Rs/ha)	Total cost of protection (Rs/ha)	Total cost of cultivation (Rs/ha)	Net returns (Rs/ha)	B:C ratio
1	*Lecanicillium lecanii* @ 2 gm/L	9.43^{e}	471500	1250	151250	320250	3.12
2	Nimbecidine @ 5 ml/ L	9.18^{e}	459000	9000	159000	298000	2.89
3	Soapnut powder @ 5 gm/L - Thiamethoxam 12.6 % + Lambda cyhalothrin 9.5 % ZC @ 0.4 ml/L	13.86^{b}	693000	3200	153200	539800	4.52
4	Detergent powder @ 5gm/L - Thiamethoxam 12.6 % + Lambda cyhalothrin 9.5 % ZC @ 0.4 ml/L	13.42^{b}	671000	3500	153500	517500	4.37
5	Soapnut powder @ 5 gm/L - Beta-cyfluthrin 8.49%+ Imidacloprid 19.81% OD @ 1ml/L	15.35^{a}	767500	7500	157500	610000	4.87
6	Detergrnt powder @ 5 gm/L - Beta-cyfluthrin 8.49 %+ Imidacloprid 19.81 % OD @ 1ml/L	14.84^{a}	742000	7900	157900	584100	4.70
7	Thiamethoxam 12.6% + Lambda cyhalothrin 9.5 % ZC @ 0.4 ml/L	12.82^{c}	648000	3200	153200	494800	4.16
8	Beta-cyfluthrin 8.49 %+ Imidacloprid 19.81% OD @ 1ml/L	12.95^{c}	654500	7500	157500	497000	4.23
9	Cypermethrin 10% EC @ 0.5ml/L	11.52^{d}	576000	800	150800	425200	3.82
10	Untreated control	5.67^{f}	283500	0	141000	142500	2.01
	S.Em. (±)	0.50					
	C V (%)	7.26					

Note: Market price of guava Rs.50/ kg. Cost of labour: Rs.500/day/person; Standard spray volume:2500 litre/ha;
Cost of cultivation: Rs. 1,41,000
Means showing similar alphabets do not differ significantly by DMRT (P=0.05).



T_1 *Lecanicillium leacni* @ 2g/L
T_2 Nimbicidine @ 5 ml/L
T_3 Soapnut powder @5g- Thiamethoxam 12.6% + Lambda cyhalothrin 9.5%ZC @ 0.4 ml/L
T_4 Detergent powder2 5g Thiamethoxam 12.6% + Lambda cyhalothrin 9.5%ZC @ 0.4ml/L
T_5 Soapnut powder @ 5g - Beta-cyfluthrin 8.49%+ Imidacloprid 19.81% OD @ 1ml/L
T_6 Detergent powder @ 5g-Beta-cyfluthrin 8.49%+ Imidacloprid 19.81% OD @ 1ml/L
T_7 Thiamethoxam 12.6% + Lambda cyhalothrin 9.5%ZC @ 0.4 ml/L
T_8 Beta-cyfluthrin 8.49%+ Imidacloprid 19.81% OD @ 1ml/L
T_9 cypermethrin @ 0.5ml/L
T_{10} Untreated control

Fig. 1 : Cost benefit ratio of different biopesticides and insecticides against major sucking pests of guava during 2023

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