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Endured efficacy of selective insecticides against rose thrips under tropical polyhouse condition

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Abstract
A polyhouse trial was conducted on four cut rose cultivars *viz.*, *Top Secret*, *Solaire*, *Sovereign* and *Avalanche* with newer insecticide molecules under the tropical climatic condition to identify the endured efficacious compounds against phytophagous thrips. Experimental results revealed that in all four cultivars, imidacloprid 17.8 SL @ 0.5 ml/lit produces statistically significant long-lasting fruitful effects by controlling thrips population (57.52% to 92.66% reduction over control), followed by spinosad 45 SC, clothianidin 50 WDG, and thiamethoxam 25 WG proved their efficacy. Treatments, days after spray, and their interaction effects reveal statistically significant difference in all four cultivars. Reduction of thrips over control was realized with all the treatments ranged between 49.78% - 95.52 % in *Top Secret* (V1), 53.18 % - 95.72 % in *Solaire* (V_2), 58.08 % - 94.21 % in *Sovereign* (V_3) and 52.03 % - 90.92 % in *Avalanche* (V_4).

Keywords: Polyhouse, cut rose, thrips, efficacious, long-lasting, insecticide

Introduction
Commercial cultivation of cut rose cultivars under protected cultivation got rapidly increased in India. This is due to, yield under protected cultivation was realized more than 100 per cent when compared to that of open field cultivation [15]. Similar to open field conditions, the pest incidence especially phytophagous thrips was noticed as a major menace under polyhouse conditions. Flower crops are the major host plants that recorded seven-time higher thrips incidence than that of non-flowering plants [17]. Various species of thrips such as *Thrips tabaci* [4], *T. palmi* [25], *Scritothrips dorsalis* [18, 25] and *Frankliniella* spp. [21, 13, 25, 29] were found to be infesting the cut flowers under protected cultivation, which threaten the cut flower growers targeting the domestic as well as export markets [25].

Yield loss under commercial cut rose crops vary from 28 to 95 % due to the thrips infestation [6]. Higher thrips incidence was noticed on susceptible cultivars under the polyhouse, wherever the possibilities of immigration, favorable microclimate condition for thrips development, and other susceptible crop species cultivated outside the greenhouse during the months of spring [23]. On the other hand, polyphagous nature of thrips seen as a major menace for the protected cultivation around the globe [2]. Cut flowers are highly susceptible to thrips, even the lower population may devitalize the plants and lessen the quality of flowers [19]. Managing the menace of thrips under, protected cut rose cultivation is impossible without deploying insecticides spray at least two to three times per month [21]. Statutory laws were enacted by government agencies to regulate the misuse of insecticides. However, the pronounced application of insecticides to combat the thrips was noticed in the modern intensified agriculture system [8].

Current pest management strategies may not be sufficient to control the pesticide resistance in genetically different strains of polyphagous thrips [12]. Commercial polyhouse growers in developing countries awaited the availability of efficacious eco-friendly pest management compounds to combat the thrips incidence [20]. Novel mode of bio-rationals against various class of insect pests could be employed for the management of pesticide related ill effects [3]. Nonetheless integrated pest management should not complete without deploying insecticides especially under protected cultivation [9]. Hence a trial was conducted for the selection of commercially available novel endured efficacious insecticides on polyphagous thrips under tropical protected cultivation.

Materials and Methods

The study was carried out during the period 2019 - 2020 under naturally ventilated tropical polyhouse condition at Agricultural College and Research Institute, Killikulam, Vallanadu, Thoothukudi, 628252, located at 8°46 N latitude, and 77° 42 E longitudes and at an altitude of 40 m above Mean Sea Level. Rooted cuttings of cut rose cultivars *viz.*, *Top Secret* (V_1), *Solaire* (V_2), *Sovereign* (V_3), and *Avalanche* (V_4) were planted on the beds of 7.5m x 1 m, with the spacing of 0.75m x 0.5m as per the package of practice recommended by Tamil Nadu Agricultural University, Coimbatore without deploying any pest management strategies.

So as to study the efficacy of selected compounds, the trials were conducted with a novel class of six insecticides. The treatments were assigned to a randomized block design with three replicates. Pre and post-treatment observations were made on the thrips population by counting the mean number of thrips on five randomly selected compound leaves per plant using a magnifying lens (10x) [11] and the mean number of thrips per flower was counted by tapping them thrice on black paper [5]. Then the mean number of thrips per plant was calculated.

Data obtained during this research study were subjected to square root transformation, then statistically analyzed with AGRES software. The critical difference in the data was tabulated with least significant different method.

Table 1: Treatment wise details are furnished below

S. No	Treatment	Concentration	
		g or ml/lit	%
T_1	Diafenthiuron 50 WP	1g/lit	0.05
T_2	Spinosad 45 SC	0.32 ml/lit	0.0144
T_3	Imidacloprid 17.8 SL	0.2 ml /lit	0.0036
T_4	Clothianidin 50 WDG	1 g / lit	0.05
T_5	Thiamethoxam 25 % WG	0.2 g /lit	0.005
T_6	Spinetoram 11.7 % SC	0.5 ml /lit	0.0059
T_7	Control	---	---

Results

Experimental results of all four cultivars from table 2 to table 4, revealed that the treatments, days after spray counts and their interaction effects were significant at 0.01 per cent level.

Trail over cultivar *Top secret* (V1) results significantly proves the efficacy of imidacloprid 17.8 SL (T3) against thrips population with lower mean thrips population (10.25 thrips/plant), subsequent reduction were noticed with spinosad 45 SC (T2) (11.37 thrips/ plant) and spinetorum 11.7 SC (T6) with mean population 11.36, which are statistically on par with each other. Least reduction of thrips population was noticed with thiamethoxam 25 WG (T5) with mean thrips population 13.07/ plant. The overall efficacy of all the treatments represents significantly higher reduction of thrips population at 1st day after spray itself. Treatments T1 (Diafenthiuron 50 WP), T2 (Spinosad 45 SC), and T6 (Spinetoram 11.7 % SC) cause significant reduction of thrips population up to 15th day after spray later on reduction in efficacy of these treatments were noticed. In control plots great spike of thrips population from 28.17 to 40 thrips/ plants were noticed at 1st day after spray. The efficacy of treatments T3, T4 and T5 was higher and on par during 1st to 7thday after spray. In the case of reduction over pre count, the efficacy of clothianidin 50 WDG was lasted up to 15th day after spray (81.66% - 28.37%) All other chemicals were showed significant reduction of thrips population up to 30th day after spray over the pre count. On the other hand, reduction of thrips population over control of all the treatments including clothianidin 50 WDG was found up to 30th day after spray.

In cultivar *Solaire* (V2), the overall efficacy of spinosad 45 SC (T2), imidacloprid 17.8 SL (T3), and clothianidin 50 WDG (T4) was found to be higher and on par with each other. Followed by Diafenthiuron 50 WP, Thiamethoxam 25 % WG and Spinetoram 11.7 % SC sprays resulted significant reduction in thrips population. In overall, highest reduction of thrips population was noticed during 3rd day after spray with lower mean thrips population of 11.63/ plant. Over all mean thrips population at 30th day after spray (29.60 thrips/ plant) which was on par with pre count (27.76 thrips/ plant). The efficacy of all the treatments at various days after spray which was on par with each other up to 7th day after spray. Sudden change in thrips population (from 34.31 to 40.72) on control plots were noticed at 1st day after spray later on slight deviation occurred. All the selected treatments caused significantly higher per cent reduction of thrips population up to 7th day after spray, later on the population increased in leaps and bounds. Population in control plot get increased steadily up to 7th day after spray later on slight deviation occurred. Thrips population at 30th day after spray (28.89) was surpassing the pre spray population count (28.00) in plots treated with Spinetoram 11.7 % SC @ 0.5 ml/lit. Imidacloprid 17.8 SL spray manifest the thrips population highly than those that of other chemicals and greater reduction over pre count was noticed even up to 30th day after spray (28.67%). All the insecticides adopted for this trial proved nearer and more than 90 per cent reduction of thrips at 7th day after spray over control.

Experimental results of cultivar *Sovereign* (V3) revealed that, among the insecticides evaluated the efficacy of imidacloprid 17.8 SL was found to be highly significant, followed by all other chemicals which were significant and on par with each other. The overall higher efficacy of insecticides against thrips was noticed at 3rd and 5th day after spray. Overall mean thrips population at 30th day after spray (28.22) was lower than that of pre-spray count (33.19), which signifies the superior efficacy of these insecticides. In control plots, thrips population was steadily increased throughout the study period. At 30th day after spray none of the treatment plots cross the pest population over pre-count. Higher efficacy of imidacloprid was noticed at 1st day after spray itself (82.98 % reduction over pre spray count). Maximum reduction over pre-count was noticed with Clothianidin 50 WDG (91.9 %) at third day after spray. Treatment plots with imidacloprid 17.8 SL showed the stable cum higher reduction over pre-count throughout the study period. Newer molecules selected for this study proved more than 58.08 per cent reduction over

control throughout the study period. Higher per cent reduction over control was noticed with clothianidin 50 WDG (94.21%) at third day after spray followed by imidacloprid 17.8 SL (93.13 %). Among the insecticides selected, efficacy of imidacloprid 17.8 SL was higher even at 30th day after spray.

Experimental results of cultivar *Avalanche* (V4) showed that the comprehensive value of thrips population in treatment means, revealed that spinosad 45 SC (13.93 thrips/ plant) and imidacloprid 17.8 SL (14.35 thrips/ plant) was found to be statistically significant, on par with each other which was superior to other chemicals followed by diafenthiuron 50 WP @ 1g/lit. Spinetoram 11.7 SC showed the least effectiveness against thrips with mean thrips population (16.76 thrips/ plant). However, more than 73.82 per cent reduction of thrips population over control was noticed with this chemical up to the 15th day after spray. In most of the cases 1st, 3rd, 5th, and 7th day after spray were on par with each other, and in these days the efficacy of all the treatments were found to be higher, than it was steadily declined up to the 30th day after spray. Pest population on 30th day after the spray (31.17) was nearer to that of pre-spray (32.67) and the reduction over pre count (4.59 %) was lower in case of spinetoram 11.7 SC. Excluding spinetoram 11.7 SC on 30th day after spray, all other days with each treatment showed more than 50 per cent reduction of thrips population over control.

Discussion

Repeated application of insecticides against *F occidentalis*, lead to development of resistance against many class of insecticides [21]. As well as shorter duration of thrips population with increased voltinism leads to development of resistant lines, hence the application of insecticides with novel mode cum higher persistency is essential. The efficacy of various treatments selected for this trial proved their longer persistency. Imidacloprid 17.8 SL was found to be better long lasting chemical which caused significant reduction of thrips population in all four cultivars which was found to agree with the previous research works [10, 16, 26, 27]. Other chemicals selected for this study also showed their higher efficacy at various days up to 15th day after spray which is in accordance with the previous findings [7, 10, 16, 22, 28]. However least number of thrips can cause significant quality reduction of cut flowers [19], which leads to repeated application of insecticides at least two to three times is inevitable [21]. On the other hand consideration of ill effects of insecticides on natural enemies, imidacloprid was better one with lower negative impact on them [1]. Most of the treatments up to 30th day after spray yields more than or nearer to 50 per cent reduction of thrips over control. However few studies reported the efficacy of insecticides especially imidacloprid was lasted only for a week under polyhouse condition [14]. This might be due to vagaries of weather under polyhouse and also plant growth characters [7]. Our trial was conducted during the months of winter, so the lasting efficacy may also occurred due to this factor [14]. On the other hand, rotational application of insecticides leads to reduction of pest population with lower resistance lines also proved by previous research work [16]. Hence rotational application of these newer class of molecules against thrips population under protected cultivation leads to fruitful results on quality cut flowers production throughout the year. On the other hand variation in the efficacy of insecticides against thrips on different cultivars also noticed [24, 21]. In cultivar *Avalanche* (V4) few chemicals showed less than ten per cent reduction, this indicates the influence of cultivar's growth character on thrips incidence (Table. 5).

Conclusion

Newer molecules selected for this study prove their higher efficacy against thrips population under polyhouse condition. However rotational applications of these insecticides are recommended for combating thrips population. The combination efficacy of these newer insecticides might be evaluated in near future to combat the resistant strains under playhouses at various locations. Further assessment on cultivar/variety based studies with insecticides may be conducted in future.

Table 2: Efficacy of selected newer insecticides against thrips on rose cultivar *Top secret* (V1)

	Treatment (T)	Number of thrips per plant								Reduction over pre count (%) Days after spray						Reduction Over Control (%) Days after spray					
		Pre count	1 DAS	3 DAS	5DAS	7DAS	15DAS	30 DAS	T MEAN	1	3	5	7	15	30	1	3	5	7	15	30
Top secret (V1)	T1	31.67^{D} $(5.67)^{d}$	5.08^{B} $(2.36)^{ab}$	2.75^{A} $(1.80)^{a}$	3.58^{AB} $(2.02)^{ab}$	4.58^{B} $(2.25)^{bc}$	10.08^{C} $(3.25)^{a}$	29.08^{D} $(5.44)^{c}$	12.40^{bc} (3.59)	83.95	91.32	88.68	85.53	68.16	8.16	87.29	93.60	93.17	92.05	81.67	49.78
	T2	26.22^{D} $(5.17)^{abc}$	5.42^{B} $(2.43)^{ab}$	4.00^{AB} $(2.12)^{ab}$	3.00^{A} $(1.87)^{ab}$	2.58^{A} $(1.75)^{a}$	13.83^{C} $(3.79)^{bc}$	24.50^{D} $(5.00)^{ab}$	11.37^{b} (3.44)	79.34	84.75	88.56	90.15	47.25	6.57	86.46	90.70	94.29	95.52	74.85	57.70
	T3	22.75^{C} $(4.82)^{a}$	4.58^{A} $(2.25)^{ab}$	3.83^{A} $(2.08)^{ab}$	4.08^{A} $(2.14)^{ab}$	3.83^{A} $(2.08)^{abc}$	11.42^{B} $(3.45)^{ab}$	21.25^{C} $(4.66)^{a}$	10.25^{a} (3.28)	79.85	83.15	82.05	83.15	49.82	6.59	88.54	91.09	92.22	93.35	79.24	63.31
	T4	24.08^{C} $(4.96)^{ab}$	4.42^{A} $(2.22)^{a}$	4.83^{A} $(2.31)^{b}$	4.17^{A} $(2.16)^{ab}$	4.75^{A} $(2.29)^{bc}$	17.25^{B} $(4.21)^{d}$	24.33^{C} $(5.00)^{ab}$	12.00^{bc} (3.58)	81.66	79.93	82.70	80.28	28.37	-	88.96	88.76	92.06	91.76	68.64	57.70
	T5	29.42^{C} $(5.47)^{cd}$	6.17^{A} $(2.58)^{ab}$	4.67^{A} $(2.27)^{b}$	4.58^{A} $(2.25)^{b}$	5.25^{A} $(2.40)^{c}$	15.33^{B} $(3.98)^{cd}$	26.08^{C} $(5.16)^{bc}$	13.07^{c} (3.68)	79.04	84.14	84.42	82.15	47.88	11.33	84.58	89.15	91.27	90.90	72.12	54.96
	T6	28.39^{F} $(5.37)^{bcd}$	6.58^{C} $(2.66)^{b}$	4.39^{B} $(2.21)^{ab}$	2.78^{A} $(1.81)^{a}$	3.06^{AB} $(1.89)^{ab}$	11.69^{D} $(3.49)^{ab}$	22.61^{E} $(4.81)^{ab}$	11.36^{b} (3.44)	76.81	84.54	90.22	89.23	58.81	20.36	83.54	89.79	94.71	94.70	78.74	60.96
	T7	28.17^{A} $(5.35)^{bcd}$	40.00^{B} $(6.36)^{c}$	43.00^{B} $(6.60)^{c}$	52.50^{C} $(7.28)^{c}$	57.65^{C} $(7.63)^{d}$	55.00^{C} $(7.45)^{e}$	57.92^{C} $(7.64)^{d}$	47.75^{d} (6.95)	-	-	-	-	-	-						
	DAY MEAN	27.24 $(5.27)^{D}$	10.32 $(3.29)^{A}$	9.64 $(3.18)^{A}$	10.67 $(3.34)^{AB}$	11.67 $(3.49)^{B}$	19.23 $(4.44)^{C}$	29.42 $(5.47)^{E}$													

	T	D	T x D
Significance	0.01	0.01	0.01
CD(p= 0.01)	0.16	0.16	0.41

*Average No. Of thrips per plant

Figures in the parentheses are √x+0.5 transformed values

In a column/row, means followed by a common letter are not significantly different at 5% level (LSD).

Capital and small letters are represented in horizontal and vertical manner respectively.

Table 3: Efficacy of selected newer insecticides against thrips on rose cultivar *Solaire* (V2)

	Treatment (T)	Number of thrips per plant								Reduction over pre count (%) Days after spray						Reduction Over Control (%) Days after spray					
		Pre count	1 DAS	3 DAS	5DAS	7DAS	15DAS	30 DAS	T MEAN	1	3	5	7	15	30	1	3	5	7	15	30
Solaire (V2)	T1	27.33^{C} (5.28)^{ab}	6.64^{A} (2.67)^{bc}	7.08^{A} (2.75)^{c}	6.17^{A} (2.58)^{cd}	5.92^{A} (2.53)^{abc}	19.08^{B} (4.42)^{d}	25.61^{C} (5.11)^{ab}	13.98^{b} (3.80)	75.72	74.09	77.44	78.35	30.18	6.30	86.52	86.53	88.99	90.14	63.92	53.88
	T2	25.19^{C} (5.07)^{ab}	4.78^{A} (2.30)^{ab}	3.63^{A} (2.03)^{ab}	4.00^{A} (2.12)^{abc}	4.78^{A} (2.30)^{abc}	15.39^{B} (3.99)^{cd}	23.31^{C} (4.88)^{a}	11.58^{a} (3.48)	81.04	85.61	84.12	81.04	38.91	7.49	90.30	93.11	92.86	92.04	70.90	58.03
	T3	30.14^{D} (5.54)^{b}	5.61^{A} (2.47)^{abc}	3.86^{A} (2.09)^{ab}	3.47^{A} (1.99)^{ab}	4.08^{A} (2.14)^{ab}	9.75^{B} (3.20)^{a}	21.50^{C} (4.69)^{a}	11.20^{a} (3.42)	81.39	87.19	88.48	86.45	67.65	28.67	88.61	92.66	93.80	93.19	81.57	61.28
	T4	24.42^{C} (4.99)^{a}	3.58^{A} (2.02)^{a}	2.25^{A} (1.66)^{a}	2.92^{A} (1.85)^{a}	3.92^{A} (2.10)^{a}	11.06^{B} (3.40)^{ab}	26.39^{C} (5.19)^{ab}	10.65^{a} (3.34)	85.32	90.78	88.05	83.96	54.72	-	92.72	95.72	94.79	93.47	79.09	52.47
	T5	28.58^{C} (5.39)^{ab}	7.58^{A} (2.84)^{c}	6.58^{A} (2.66)^{c}	7.00^{A} (2.74)^{d}	6.92^{A} (2.72)^{c}	14.08^{B} (3.82)^{bc}	26.00^{C} (5.15)^{ab}	13.82^{b} (3.78)	73.47	76.97	75.51	75.80	50.73	9.04	84.60	87.48	87.50	88.47	73.37	53.18
	T6	28.00^{C} (5.34)^{ab}	6.97^{A} (2.73)^{bc}	5.39^{A} (2.43)^{bc}	5.11^{A} (2.37)^{bcd}	6.36^{A} (2.62)^{bc}	16.19^{B} (4.09)^{cd}	28.89^{C} (5.42)^{b}	13.85^{b} (3.79)	75.10	80.75	81.75	77.29	42.17	-	85.84	89.75	90.88	89.40	69.38	47.97
	T7	30.67^{A} (5.58)^{b}	49.25^{B} (7.05)^{d}	52.58^{BC} (7.29)^{d}	56.00^{BC} (7.52)^{e}	60.00^{C} (7.78)^{d}	52.89^{BC} (7.31)^{e}	55.53^{BC} (7.49)^{c}	50.99^{c} (7.18)	-	-	-	-	-	-						
	DAY MEAN	27.76 (5.32)^{D}	12.06 (3.54)^{AB}	11.63 (3.48)^{A}	12.10 (3.55)^{AB}	13.14 (3.69)^{B}	19.78 (4.50)^{C}	29.60 (5.49)^{D}													

	T	D	T x D
Significance	0.01	0.01	0.01
CD(p= 0.01)	0.19	0.19	0.51

*Average No. Of thrips per plant
Figures in the parentheses are √x+0.5 transformed values
In a column/row, means followed by a common letter are not significantly different at 5% level (LSD).
Capital and small letters are represented in horizontal and vertical manner respectively.

Table 4: Efficacy of selected newer insecticides against thrips on rose cultivar *Sovereign* (V3)

	Treatment (T)	Number of thrips per plant								Reduction over pre count (%) Days after spray						Reduction Over Control (%) Days after spray					
		Pre count	1 DAS	3 DAS	5DAS	7DAS	15DAS	30 DAS	T MEAN	1	3	5	7	15	30	1	3	5	7	15	30
Sovereign (V3)	T1	31.53^{D} (5.66)^{ab}	9.06^{B} (3.09)^{b}	5.81^{A} (2.51)^{c}	5.92^{A} (2.53)^{a}	6.89^{AB} (2.72)^{b}	14.47^{C} (3.87)^{ab}	26.53^{D} (5.20)^{b}	14.31^{b} (3.85)	71.27	81.58	81.23	78.15	54.09	15.86	77.76	88.14	88.51	88.50	76.35	58.08
	T2	36.14^{D} (6.05)^{b}	8.56^{B} (3.01)^{b}	4.72^{A} (2.28)^{abc}	4.97^{A} (2.34)^{a}	4.25^{A} (2.18)^{a}	11.81^{B} (3.51)^{a}	22.69^{C} (4.82)^{b}	13.31^{b} (3.72)	76.32	86.93	86.23	88.24	67.33	37.21	78.99	90.35	90.34	92.90	80.71	64.14
	T3	31.00^{D} (5.61)^{ab}	5.28^{A} (2.40)^{a}	3.36^{A} (1.96)^{ab}	3.83^{A} (2.08)^{a}	4.06^{A} (2.14)^{a}	11.73^{B} (3.50)^{a}	17.75^{C} (4.27)^{a}	11.00^{a} (3.39)	82.98	89.16	87.63	86.91	62.18	42.74	87.04	93.13	92.56	93.23	80.84	71.95
	T4	34.78^{F} (5.94)^{b}	7.06^{C} (2.75)^{ab}	2.83^{A} (1.82)^{a}	3.81^{AB} (2.08)^{a}	4.97^{BC} (2.34)^{ab}	18.22^{E} (4.33)^{b}	22.61^{E} (4.70)^{ab}	13.33^{b} (3.72)	79.71	91.85	89.05	85.70	47.60	37.86	82.67	94.21	92.61	91.70	70.22	65.85
	T5	37.00^{E} (6.12)^{b}	8.92^{B} (3.07)^{b}	5.67^{A} (2.48)^{bc}	5.50^{A} (2.45)^{a}	6.00^{A} (2.55)^{ab}	16.17^{C} (4.08)^{b}	22.17^{D} (4.76)^{ab}	14.49^{b} (3.87)	75.90	84.68	85.14	83.78	56.31	40.09	78.10	88.42	89.32	89.98	73.58	64.97
	T6	27.58^{D} (5.30)^{a}	10.25^{B} (3.28)^{b}	6.17^{A} (2.58)^{c}	6.08^{A} (2.57)^{a}	5.50^{A} (2.45)^{ab}	14.92^{C} (3.93)^{ab}	23.50^{D} (4.90)^{b}	13.43^{b} (3.73)	62.84	77.64	77.95	80.06	45.92	14.80	74.83	87.40	88.19	90.82	75.62	62.86
	T7	34.31^{A} (5.90)^{b}	40.72^{A} (6.42)^{c}	48.94^{B} (7.03)^{d}	51.50^{B} (7.21)^{b}	56.56^{BC} (7.77)^{c}	61.19^{C} (7.85)^{c}	63.28^{C} (7.99)^{c}	51.40^{c} (7.20)	-	-	-	-	-	-						
	DAY MEAN	33.19 (5.80)^{E}	12.83 (3.65)^{B}	11.07 (3.40)^{A}	11.66 (3.49)^{AB}	13.08 (3.69)^{B}	21.21 (4.66)^{C}	28.22 (5.36)^{D}													

	T	D	T x D
Significance	0.01	0.01	0.01
CD(p= 0.01)	0.20	0.20	0.53

*Average No. Of thrips per plant
Figures in the parentheses are √x+0.5 transformed values
In a column/row, means followed by a common letter are not significantly different at 5% level (LSD).
Capital and small letters are represented in horizontal and vertical manner respectively.

Table 5: Efficacy of selected newer insecticides against thrips on rose cultivar *Avalanche* (V4)

	Treatment (T)	Number of thrips per plant								Reduction over pre count (%) Days after spray						Reduction Over Control (%) Days after spray					
		Pre count	1 DAS	3 DAS	5DAS	7DAS	15DAS	30 DAS	T MEAN	1	3	5	7	15	30	1	3	5	7	15	30
Avalanche (V4)	T1	34.42^{D} (5.91)^{ab}	7.83^{A} (2.89)^{a}	6.33^{A} (2.61)^{a}	5.42^{A} (2.43)^{a}	7.08^{A} (2.75)^{ab}	13.58^{B} (3.75)^{a}	26.58^{C} (5.20)^{ab}	14.46^{ab} (3.87)	77.24	81.60	84.26	79.42	60.53	22.76	81.74	86.12	89.16	86.22	75.76	55.43
	T2	28.81^{C} (5.41)^{a}	9.64^{AB} (3.18)^{a}	8.00^{A} (2.92)^{ab}	6.25^{A} (2.60)^{ab}	6.50^{A} (2.65)^{ab}	13.67^{B} (3.76)^{a}	24.64^{C} (5.01)^{a}	13.93^{a} (3.80)	66.54	72.23	78.30	77.44	52.56	14.46	77.52	82.47	87.49	87.35	75.61	58.69
	T3	35.83^{E} (6.03)^{b}	8.33^{B} (2.97)^{a}	7.00^{AB} (2.74)^{ab}	6.00^{AB} (2.55)^{ab}	4.67^{A} (2.27)^{a}	13.25^{AB} (3.71)^{a}	25.33^{D} (5.08)^{ab}	14.35^{a} (3.85)	76.74	80.47	83.26	86.98	63.02	29.30	80.57	84.66	87.99	90.92	76.35	57.52
	T4	35.00^{D} (5.96)^{ab}	11.25^{B} (3.43)^{a}	9.33^{AB} (3.14)^{ab}	7.57^{AB} (2.84)^{ab}	7.00^{A} (2.74)^{ab}	14.75^{C} (3.91)^{a}	28.42^{D} (5.38)^{ab}	16.19^{bc} (4.09)	67.86	73.33	78.36	80.00	57.86	18.81	73.77	79.55	84.85	86.38	73.67	52.35
	T5	31.69^{C} (5.67)^{ab}	10.31^{A} (3.29)^{a}	8.69^{A} (3.03)^{ab}	9.25^{A} (3.12)^{b}	7.86^{A} (2.89)^{b}	17.31^{B} (4.22)^{a}	28.61^{C} (5.40)^{ab}	16.25^{bc} (4.09)	67.48	72.57	70.81	75.20	45.39	9.73	75.97	80.95	81.49	84.71	69.11	52.03

	T6	32.67^{C} $(5.76)^{ab}$	11.25^{AB} $(3.43)^{a}$	10.42^{AB} $(3.30)^{b}$	9.08^{A} $(2.80)^{ab}$	9.67^{A} $(3.19)^{b}$	14.67^{B} $(3.89)^{a}$	31.17^{C} $(5.63)^{b}$	16.74^{c} (4.15)	65.56	68.11	77.55	70.41	55.10	4.59	73.77	77.18	85.33	81.19	73.82	47.74
	T7	37.97^{A} $(6.20)^{b}$	42.89^{AB} $(6.59)^{b}$	45.64^{ABC} $(6.79)^{c}$	49.97^{BCD} $(7.10)^{c}$	51.39^{CDE} $(7.20)^{c}$	56.03^{CD} $(7.52)^{b}$	59.64^{D} $(7.75)^{c}$	49.08^{d} (7.04)	-	-	-	-	-	-						
	DAY MEAN	33.77 $(5.85)^{C}$	14.50 $(3.87)^{A}$	13.63 $(3.76)^{A}$	13.11 $(3.69)^{A}$	13.45 $(3.74)^{A}$	20.46 $(4.58)^{B}$	32.06 $(5.71)^{BC}$													

	T	D	T x D
Significance	0.01	0.01	0.01
CD(p= 0.01)	0.23	0.23	0.61

*Average No. Of thrips per plant
Figures in the parentheses are √x+0.5 transformed values
In a column/row, means followed by a common letter are not significantly different at 5% level (LSD).
Capital and small letters are represented in horizontal and vertical manner respectively.

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