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Bio efficacy of newer insecticides for the control of safflower aphid, *uroleucon compositae* (Theobald)

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Abstract

The experiments were conducted during *Rabi* seasons of 2020-21 and 2021-22 on research farm of Department of Agricultural Entomology, College of agriculture, V.N.M.K.V. Parbhani. The Seed treatment with Imidacloprid 48 FS and thiamethoxam 30 FS was done before sowing and soil drenching of clothianidin 50 WDG was done at 15 days after sowing as per the treatment. The first spray of insecticides was applied on appearance of sufficient population of safflower aphid while second spray was given at an interval of 15 days as per the treatment. All the treatments were significantly superior over untreated control.

The minimum overall mean number of aphid population/5 cm apical shoot length/plant was recorded in the treatment with two foliar sprays of spinetoram 11.70 SC @ 420ml/ha (9.93 aphids/ 5cm apical shoot length/plant) which was at par with the treatment with two foliar sprays of Cyantraniliprole 10.26 OD @ 900ml/ha (11.22 aphids/ 5cm apical shoot length/plant). The next better treatment in order of efficacy were seed treatment with thiamethoxam 30 FS @ 10ml/kg seed & one foliar spray of spinetoram 11.70 SC @ 420ml/ha and seed treatment with thiamethoxam 30 FS @ 10ml/kg seed & one foliar spray of Cyantraniliprole 10.26 OD @ 900ml/ha which were at par with each other by recording 15.08 and 17.35 aphids/ 5cm apical shoot length/plant, respectively. In an untreated control, higher population of 181.13 aphids/ 5cm apical shoot length/plant was recorded. The treatment with two foliar sprays of spinetoram 11.70 SC @ 420ml/ha was recorded highest seed yield of 14.63 q/ha which was at par with the treatment with two foliar sprays of Cyantraniliprole 10.26 OD @ 900ml/ha (14.24q/ha). The treatments with two foliar sprays of spinetoram 11.70 SC @ 420ml/ha and the treatment with two foliar sprays of Cyantraniliprole 10.26 OD @ 900 ml/ha recorded the ICBR of 1: 3.64 and 1: 2.30, respectively.

Keywords: Safflower, *uroleucon compositae*, seed treatment, neonicotinoids

Introduction

Safflower is one of the oldest cultivated oilseed crops which are well adapted to dry regions and grown in *Rabi* season. The safflower crop is damaged by as high as 79 insect pests. Safflower aphid (*Uroleucon compositae* Theobald) is the regular and most destructive pest in India. The losses in yield of safflower due to aphids were 60-80 % (Narayanan, 1961) [7], 55–60% (Suryawanshi and Pawar, 1980) [10], 72 % (Basavanagoud, 1979) [4], 55.9–67.9% (Basavan-Goud *et al.*, 1981) [5], and 24.20 – 67.72 % (Shetgar *et al.*, 1993) [9]. Therefore, it is the most important pest of safflower.

Safflower aphid can be control by different insecticides recommended by many workers. Thiamethoxam 25 WG @ 50, 70 and 100 G.A.I/ha were found most effective than Imidacloprid 17.8 SL and dimethoate 30 EC in reducing aphid population (Wadnerkar *et al.* 2004) [11]. Akashe *et al.* (2007) [1] reported that thiamethoxam 0.005 per cent was effective for the control of safflower aphid. The indiscriminate and frequent application of insecticides especially neonicotinoids has created resistance development in the target pest, presence of pesticide residues in seed and oil, destruction of natural enemies and different pollinators. It was, therefore necessary to evaluate the efficacy of different seed treatment insecticides as well as foliar application of insecticides to find out the insecticides harmful to the aphids and safer to the natural enemies and pollinators especially honeybees. Therefore, the seed treatment insecticides and newer insecticides were evaluated to manage safflower aphids.

Methodology

A field trial was carried out to test the efficacy of insecticides against safflower aphids during the *Rabi* season of 2020-21 and 2021-22 at the Research Farm of Department of Agricultural Entomology, Vasanttrao Naik Marathwada Krishi Vidyapeeth, Parbhani.

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The Seed treatment with imidacloprid 48 FS and thiamethoxam 30 FS was done before sowing and soil drenching of clothianidin 50 WDG was done at 15 days after sowing as per the treatment. The sowing of safflower variety PBNS-12 was done in randomized block design with three replications by dibbling at a spacing of 45x20 cm. The first spray of insecticides was applied on appearance of sufficient population of safflower aphid while second spray was given at an interval of 15 days as per the treatment. The

observations on number of aphids per 5 cm apical shoot length per plant were recorded a day before as a precount and 5, 7, 10 and 14 days after spraying of insecticide on five randomly selected plants from each plot. The seed yield of safflower from each plot was recorded separately at harvesting and the data on aphid count and seed yield was statistically analyzed as per the method suggested by Panse and Sukhatme (1965)^[8].

Table 1: Treatment details

Sr. No.	Treatment	Dose
1	Seed treatment with imidacloprid 48 FS	9 ml/kg seed
2	Seed treatment with thiamethoxam 30 FS	10 ml/kg seed
3	Soil drenching with clothianidin 50 WDG	2.5 g/10 lit. water
4	Seed treatment with imidacloprid 48 FS and one foliar spray of spinetoram 11.70 SC	9 ml/kg seed and 420 ml/ha
5	Seed treatment with imidacloprid 48 FS and one foliar spray of Cyantraniliprole 10.26 OD	9 ml/kg seed and 900 ml/ha
6	Seed treatment with thiamethoxam 30 FS and one foliar spray of spinetoram 11.70 SC	10 ml/kg seed and 420 ml/ha
7	Seed treatment with thiamethoxam 30 FS and one foliar spray of Cyantraniliprole 10.26 OD	10 ml/kg seed and 900 ml/ha
8	Soil drenching with clothianidin 50 WDG and one foliar spray of spinetoram 11.70 SC	2.5 g/10 lit. water and 420 ml/ha
9	Soil drenching with clothianidin 50 WDG and one foliar spray of Cyantraniliprole 10.26 OD	2.5 g/10 lit. water and 900 ml/ha
10	Two foliar sprays of spinetoram 11.70 SC	420 ml/ha
11	Two foliar sprays of Cyantraniliprole 10.26 OD	900 ml/ha
12	Untreated control	--

Results and Discussion

First spray: It is revealed from Table 2 (Pooled 2020-21 to 2021-22) that all the treatments were significantly superior over untreated control after first spray. The average number of survival population of aphids was recorded from 5 cm apical shoot length/plant. Among the evaluated insecticides, the treatment with seed treatment with thiamethoxam 30 FS @ 10 ml/kg seed & one foliar spray of spinetoram 11.70 SC @ 420ml/ha and seed treatment with thiamethoxam 30 FS @ 10ml/kg seed & one foliar spray of Cyantraniliprole 10.26 OD @ 900ml/ha were found most effective and at par with each other by recording 8.59 and 10.27 aphids/ 5 cm apical shoot length/plant, respectively. The next better treatments in order of efficacy were two foliar sprays of spinetoram 11.70 SC @ 420ml/ha, two foliar sprays of Cyantraniliprole 10.26 OD @

900ml/ha, seed treatment with Imidacloprid 48 FS @ 9 ml/kg seed & one foliar spray of spinetoram 11.70 SC @ 420 ml/ha and seed treatment with Imidacloprid 48 FS @ 9 ml/kg seed & one foliar spray of Cyantraniliprole 10.26 OD @ 900ml/ha which were at par with each other by recording 14.37, 15.73, 18.13 and 19.83 aphids/ 5 cm apical shoot length/plant, respectively. However, the treatments with soil drenching with clothianidin 50 WDG & one foliar spray of spinetoram 11.70 SC, soil drenching with clothianidin 50 WDG & one foliar spray of Cyantraniliprole 10.26 OD, seed treatment with thiamethoxam 30 FS, seed treatment with Imidacloprid 48 FS and soil drenching with clothianidin 50 WDG were recorded aphid population in the range of 21.70 to 72.22 aphids/ 5 cm apical shoot length/plant.

Table 2: Effect of different insecticides on safflower aphid, *uroleucon compositae* (Pooled mean 2020-21 to 2021-22)

Sr.	Treatment	Dose/ha	Average no. of aphids /5 cm apical shoot length					Mean
			Precount	5 DAS	7 DAS	10 DAS	14 DAS	
1	Seed treatment with Imidacloprid 48 FS	9 ml/kg seed	41.57 (6.49)*	53.53 (7.35)	61.60 (7.88)	69.50 (8.37)	75.53 (8.72)	65.04 (8.10)
2	Seed treatment with thiamethoxam 30 FS	10 ml/kg seed	40.40 (6.39)	51.40 (7.20)	58.40 (7.67)	63.40 (7.99)	67.43 (8.24)	60.16 (7.79)
3	Soil drenching with clothianidin 50 WDG	2.5 g/10 lit. water	43.23 (6.61)	57.23 (7.60)	69.20 (8.35)	77.20 (8.81)	85.23 (9.26)	72.22 (8.53)
4	Seed treatment with Imidacloprid 48 FS and one foliar spray of spinetoram 11.70 SC	9 ml/kg seed and 420 ml/ha	40.20 (6.38)	18.73 (4.38)	12.27 (3.57)	16.23 (4.09)	25.30 (5.08)	18.13 (4.32)
5	Seed treatment with Imidacloprid 48 FS and one foliar spray of Cyantraniliprole 10.26 OD	9 ml/kg seed and 900 ml/ha	40.53 (6.41)	20.93 (4.63)	13.93 (3.80)	16.83 (4.16)	27.63 (5.30)	19.83 (4.51)
6	Seed treatment with thiamethoxam 30 FS and one foliar spray of spinetoram 11.70 SC	10 ml/kg seed and 420 ml/ha	37.50 (6.16)	10.10 (3.25)	6.80 (2.69)	7.20 (2.77)	10.27 (3.26)	8.59 (3.02)
7	Seed treatment with thiamethoxam 30 FS and one foliar spray of Cyantraniliprole 10.26 OD	10 ml/kg seed and 900 ml/ha	39.00 (6.28)	12.10 (3.55)	7.93 (2.90)	9.13 (3.10)	11.90 (3.51)	10.27 (3.28)
8	Soil drenching with clothianidin 50 WDG and one foliar spray of spinetoram 11.70 SC	2.5 g/10 lit. water and 420 ml/ha	41.87 (6.51)	22.33 (4.78)	16.27 (4.09)	19.00 (4.41)	29.20 (5.45)	21.70 (4.71)
9	Soil drenching with clothianidin 50 WDG and one foliar spray of Cyantraniliprole 10.26 OD	2.5 g/10 lit. water and 900 ml/ha	43.20 (6.61)	23.90 (4.94)	17.93 (4.29)	20.33 (4.56)	31.27 (5.64)	23.36 (4.88)

10	Two foliar sprays of spinetoram 11.70 SC	420 ml/ha	82.07 (9.08)	17.33 (4.22)	9.57 (3.17)	11.20 (3.42)	19.37 (4.45)	14.37 (3.86)
11	Two foliar sprays of Cyantraniliprole 10.26 OD	900 ml/ha	84.33 (9.21)	18.40 (4.35)	10.37 (3.29)	12.33 (3.58)	21.80 (4.72)	15.73 (4.03)
12	Untreated control	--	88.87 (9.45)	114.07 (10.70)	124.47 (11.18)	145.13 (12.06)	187.23 (13.69)	142.73 (11.97)
		S.E. _±	0.25	0.25	0.22	0.20	0.33	0.24
		C.D. at 5%	0.75	0.75	0.63	0.59	0.97	0.69
		CV %	6.19	7.92	7.12	6.17	8.90	7.12

*Figures in parentheses are $\sqrt{x+0.5}$ transformed values DAS: Days after spray

Second Spray: The data presented in Table 3 showed that the treatment with two foliar sprays of spinetoram 11.70 SC @ 420 ml/ha recorded minimum population of 5.50 aphids/ 5 cm apical shoot length/plant which was at par with the treatment with two foliar sprays of Cyantraniliprole 10.26 OD @ 900 ml/ha which recorded 6.72 aphids/ 5cm apical shoot length/plant. The next better treatments were seed treatment with thiamethoxam 30 FS @ 10ml/kg seed & one foliar spray of spinetoram 11.70 SC @ 420ml/ha and seed treatment with thiamethoxam 30 FS @ 10ml/kg seed & one foliar spray of Cyantraniliprole 10.26 OD @ 900ml/ha which were at par with each other by recording 21.56 and 24.43 aphids/ 5cm apical shoot length/plant, respectively. However, the treatments with seed treatment with Imidacloprid 48 FS @ 9 ml/kg seed & one foliar spray of spinetoram 11.70 SC @ 420 ml/ha and seed treatment with imidacloprid 48 FS @ 9 ml/kg seed & one foliar spray of Cyantraniliprole 10.26 OD @ 900 ml/ha, soil drenching with clothianidin 50 WDG & one foliar spray of spinetoram 11.70 SC and soil drenching with clothianidin 50 WDG & one foliar spray of Cyantraniliprole 10.26 OD which recorded 32.29, 34.59, 38.18 and 40.57 aphids/ 5cm apical shoot length/plant, respectively. In an untreated control, higher population of 219.53 aphids/ 5 cm apical shoot length/plant was recorded.

It is revealed from Table 4 that the minimum overall mean number of aphid population/5 cm apical shoot length/plant was recorded in the treatment with two foliar sprays of spinetoram 11.70 SC @ 420ml/ha (9.93 aphids/ 5cm apical shoot length/plant) which was at par with the treatment with two foliar sprays of Cyantraniliprole 10.26 OD @ 900ml/ha (11.22 aphids/ 5cm apical shoot length/plant). The next better treatment in order of efficacy were seed treatment with thiamethoxam 30 FS @ 10ml/kg seed & one foliar spray of spinetoram 11.70 SC @ 420ml/ha and seed treatment with thiamethoxam 30 FS @ 10 ml/kg seed & one foliar spray of Cyantraniliprole 10.26 OD @ 900ml/ha which were at par with each other by recording 15.08 and 17.35 aphids/ 5 cm apical shoot length/plant, respectively. However, the treatments with seed treatment with imidacloprid 48 FS @ 9ml/kg seed & one foliar spray of spinetoram 11.70 SC @ 420ml/ha, seed treatment with imidacloprid 48 FS @ 9 ml/kg

seed & one foliar spray of Cyantraniliprole 10.26 OD @ 900 ml/ha, soil drenching with clothianidin 50 WDG & one foliar spray of spinetoram 11.70 SC and soil drenching with clothianidin 50 WDG & one foliar spray of Cyantraniliprole 10.26 OD which were at par with each other by recording 25.21, 27.21, 29.94 and 31.96 aphids/ 5cm apical shoot length/plant, respectively. In an untreated control, higher population of 181.13 aphids/ 5 cm apical shoot length/plant was recorded.

Seed yield

The results showed that (Table 4) the seed yield of safflower under all the treatments were significantly superior over untreated control. The treatment with two foliar sprays of spinetoram 11.70 SC @ 420ml/ha was recorded highest seed yield of 14.63q/ha which was at par with the treatment with two foliar sprays of Cyantraniliprole 10.26 OD @ 900ml/ha (14.24q/ha). The treatments with seed treatment with thiamethoxam 30 FS @ 10ml/kg seed & one foliar spray of spinetoram 11.70 SC @ 420ml/ha and seed treatment with thiamethoxam 30 FS @ 10ml/kg seed & one foliar spray of Cyantraniliprole 10.26 OD @ 900ml/ha which recorded 12.91 and 12.56 q/ha seed yield, respectively. The next better treatments were seed treatment with imidacloprid 48 FS @ 9 ml/kg seed & one foliar spray of spinetoram 11.70 SC @ 420 ml/ha, seed treatment with imidacloprid 48 FS @ 9 ml/kg seed & one foliar spray of Cyantraniliprole 10.26 OD @ 900 ml/ha, soil drenching with clothianidin 50 WDG & one foliar spray of spinetoram 11.70 SC and soil drenching with clothianidin 50 WDG & one foliar spray of Cyantraniliprole 10.26 OD which recorded seed yield in the range of 9.82 to 11.56q/ha.

These results are in agreement with those of Harke G.P. (2020)^[6] who reported that spinetoram 11.70 SC @ 420 ml/ha was found most effective for the control of safflower aphid and obtaining higher seed yield. Akashe *et al.* (2009)^[3] reported that 0.005 per cent of thiamethoxam and 0.004 per cent of acetamiprid were best treatments which recorded maximum per cent decrease in aphid population and gave highest seed yield of 1087kg / ha and 952kg/ha, respectively.

Table 3: Effect of different insecticides on safflower aphid, *uroleucon compositae* (Pooled mean 2020-21 to 2021-22)

Sr.	Treatment	Dose/ha	Average no. of aphids /5 cm apical shoot length				
			5DAS	7 DAS	10 DAS	14 DAS	Mean
1	Seed treatment with imidacloprid 48 FS	9 ml/kg seed	77.77 (8.85)*	81.67 (9.06)	82.97 (9.14)	89.37 (9.48)	82.94 (9.13)
2	Seed treatment with thiamethoxam 30 FS	10 ml/kg seed	69.37 (8.36)	73.00 (8.57)	75.83 (8.74)	80.37 (8.99)	74.64 (8.67)
3	Soil drenching with clothianidin 50 WDG	2.5 g/10 lit. water	87.63 (9.39)	90.20 (9.52)	93.17 (9.68)	99.57 (10.00)	92.64 (9.65)
4	Seed treatment with imidacloprid 48 FS and one foliar spray of spinetoram 11.70 SC	9 ml/kg seed and 420 ml/ha	27.53 (5.29)	30.93 (5.61)	32.67 (5.76)	38.03 (6.21)	32.29 (5.73)

5	Seed treatment with imidacloprid 48 FS and one foliar spray of Cyantraniliprole 10.26 OD	9 ml/kg seed and 900 ml/ha	29.83 (5.51)	33.20 (5.80)	35.00 (5.96)	40.33 (6.39)	34.59 (5.92)
6	Seed treatment with thiamethoxam 30 FS and one foliar spray of spinetoram 11.70 SC	10 ml/kg seed and 420 ml/ha	16.53 (4.12)	19.90 (4.51)	22.57 (4.80)	27.23 (5.27)	21.56 (4.70)
7	Seed treatment with thiamethoxam 30 FS and one foliar spray of Cyantraniliprole 10.26 OD	10 ml/kg seed and 900 ml/ha	19.67 (4.49)	23.10 (4.86)	25.07 (5.06)	29.90 (5.51)	24.43 (4.99)
8	Soil drenching with clothianidin 50 WDG and one foliar spray of spinetoram 11.70 SC	2.5 g/10 lit. water and 420 ml/ha	33.33 (5.82)	36.87 (6.11)	38.57 (6.25)	43.93 (6.67)	38.18 (6.22)
9	Soil drenching with clothianidin 50 WDG and one foliar spray of Cyantraniliprole 10.26 OD	2.5 g/10 lit. water and 900 ml/ha	35.80 (6.02)	39.20 (6.30)	41.00 (6.44)	46.27 (6.84)	40.57 (6.41)
10	Two foliar sprays of spinetoram 11.70 SC	420 ml/ha	5.70 (2.49)	3.67 (2.04)	4.83 (2.31)	7.80 (2.88)	5.50 (2.45)
11	Two foliar sprays of Cyantraniliprole 10.26 OD	900 ml/ha	6.97 (2.73)	4.77 (2.29)	6.10 (2.57)	9.03 (3.09)	6.72 (2.69)
12	Untreated control	--	191.20 (13.85)	204.83 (14.33)	232.10 (15.25)	249.97 (15.83)	219.53 (14.83)
	S.E. _±		0.32	0.22	0.40	0.54	0.25
	C.D. at 5%		0.94	0.65	1.18	1.57	0.73
	CV %		8.68	5.84	10.23	12.83	6.35

*Figures in parentheses are $\sqrt{x+0.5}$ transformed values DAS: Days after spray

Table 4: Overall effect of different insecticides on safflower aphid, *uroleucon compositae* (Pooled mean 2020-21 to 2021-22)

Sr. No.	Treatment	Dose/ha	Overall mean no. of aphids /5 cm apical shoot length				Seed yield (q/ha)	
			5DAS	7 DAS	10 DAS	14 DAS		
Overall mean								
1	Seed treatment with imidacloprid 48 FS	9 ml/kg seed	65.65 (8.13)*	71.63 (8.49)	76.23 (8.76)	82.45 (9.11)	73.99 (8.63)	4.64
2	Seed treatment with thiamethoxam 30 FS	10 ml/kg seed	60.38 (7.80)	65.70 (8.14)	69.62 (8.37)	73.90 (8.63)	67.40 (8.24)	4.91
3	Soil drenching with clothianidin 50 WDG	2.5 g/10 lit. water	72.43 (8.54)	79.70 (8.96)	85.18 (9.26)	92.40 (9.64)	82.43 (9.11)	4.11
4	Seed treatment with imidacloprid 48 FS and one foliar spray of spinetoram 11.70 SC	9 ml/kg seed and 420 ml/ha	23.13 (4.86)	21.60 (4.70)	24.45 (4.99)	31.67 (5.67)	25.21 (5.07)	11.56
5	Seed treatment with imidacloprid 48 FS and one foliar spray of Cyantraniliprole 10.26 OD	9 ml/kg seed and 900 ml/ha	25.38 (5.09)	23.57 (4.91)	25.92 (5.14)	33.98 (5.87)	27.21 (5.26)	10.53
6	Seed treatment with thiamethoxam 30 FS and one foliar spray of spinetoram 11.70 SC	10 ml/kg seed and 420 ml/ha	13.32 (3.72)	13.35 (3.72)	14.88 (3.92)	18.75 (4.39)	15.08 (3.94)	12.91
7	Seed treatment with thiamethoxam 30 FS and one foliar spray of Cyantraniliprole 10.26 OD	10 ml/kg seed and 900 ml/ha	15.88 (4.05)	15.52 (4.00)	17.10 (4.20)	20.90 (4.63)	17.35 (4.22)	12.56
8	Soil drenching with clothianidin 50 WDG and one foliar spray of spinetoram 11.70 SC	2.5 g/10 lit. water and 420 ml/ha	27.83 (5.32)	26.57 (5.20)	28.78 (5.41)	36.57 (6.09)	29.94 (5.52)	10.17
9	Soil drenching with clothianidin 50 WDG and one foliar spray of Cyantraniliprole 10.26 OD	2.5 g/10 lit. water and 900 ml/ha	29.85 (5.51)	28.57 (5.39)	30.67 (5.58)	38.77 (6.27)	31.96 (5.70)	9.82
10	Two foliar sprays of spinetoram 11.70 SC	420 ml/ha	11.52 (3.47)	6.62 (2.67)	8.02 (2.92)	13.58 (3.75)	9.93 (3.23)	14.63
11	Two foliar sprays of Cyantraniliprole 10.26 OD	900 ml/ha	12.68 (3.63)	7.57 (2.84)	9.22 (3.12)	15.42 (3.99)	11.22 (3.42)	14.24
12	Untreated control	--	152.63 (12.37)	164.65 (12.85)	188.62 (13.75)	218.60 (14.80)	181.13 (13.47)	3.00
	S.E. _±		0.26	0.19	0.29	0.44	0.24	0.43
	C.D. at 5%		0.77	0.55	0.85	1.29	0.70	1.25
	CV %		7.57	5.39	8.01	11.05	6.62	7.86

*Figures in parentheses are $\sqrt{x+0.5}$ transformed values DAS: Days after spray

Table 5: ICBR of effect of insecticides on safflower aphid (*uroleucon compositae*) (Pooled mean 2020-21 to 2021-22)

Sr. No.	Treatments	Dose/ha	QTY of insecticide/ha	Cost of insecticide /ha	Labour cost @ Rs. 272/day	Total cost of plant protection	Yield (q/ha)	Increased yield over control (q/ha)	Value of additional yield	Net profit	ICBR Ratio
1	Seed treatment with imidacloprid 48 FS	9 ml/kg seed	108	562	272	834.00	4.64	1.64	8830	7996	1 : 9.59
2	Seed treatment with thiamethoxam 30 FS	10 ml/kg seed	120	330	272	602.00	4.91	1.91	10292	9690	1 : 16.10
3	Soil drenching with clothianidin 50	2.5 g/10 lit. water	200	4267	544	4811.00	4.11	1.11	5994	1183	1 : 0.25

WDG											
4	Seed treatment with imidacloprid 48 FS and one foliar spray of spinetoram 11.70 SC	9 ml/kg seed and 420 ml/ha	108 & 420	561.60 + 6195	816	7573.00	11.56	8.56	46105	38532	1 : 5.09
5	Seed treatment with imidacloprid 48 FS and one foliar spray of Cyantraniliprole 10.26 OD	9 ml/kg seed and 900 ml/ha	108 & 900	561.60 +8625	816	10003.00	10.53	7.53	40533	30530	1 : 3.05
6	Seed treatment with thiamethoxam 30 FS and one foliar spray of spinetoram 11.70 SC	10 ml/kg seed and 420 ml/ha	120 & 420	330 +6195	816	7341.00	12.91	9.91	53373	46032	1 : 6.27
7	Seed treatment with thiamethoxam 30 FS and one foliar spray of Cyantraniliprole 10.26 OD	10 ml/kg seed and 900 ml/ha	120 & 900	330 + 8625	816	9771.00	12.56	9.56	51489	41718	1 : 4.27
8	Soil drenching with clothianidin 50 WDG and one foliar spray of spinetoram 11.70 SC	2.5 g/10 lit. water and 420 ml/ha	200 & 420	4266.67 +6195	1088	11550.00	10.17	7.17	38594	27044	1 : 2.34
9	Soil drenching with clothianidin 50 WDG and one foliar spray of Cyantraniliprole 10.26 OD	2.5 g/10 lit. water and 900 ml/ha	200 & 900	4266.67 +8625	1088	13980.00	9.82	6.82	36719	22739	1 : 1.63
10	Two foliar sprays of Spinetoram 11.70 SC	420 ml/ha	420	12390	1088	13478.00	14.63	11.63	62600	49122	1 : 3.64
11	Two foliar sprays of Cyantraniliprole 10.26 OD	900 ml/ha	900	17250	1088	18338.00	14.24	11.24	60489	42151	1 : 2.30
12	Untreated control	--	0	0	0	0	0	3.00	0.00	--	--
	S.E. _±	--	--	--	--	--	--	0.43	--	--	--
	C.D. at 5%	--	--	--	--	--	--	1.25	--	--	--
	CV %	--	--	--	--	--	--	7.86	--	--	--

Safflower rate @ Rs. 5384/quintal, Seed required/ha: 12kg, Imidacloprid 48 FS: Rs. 520/100ml, Thiamethoxam 30 FS: Rs. 275/100ml, Spinetoram 11.70 SC: Rs. 295/20ml, Cyantraniliprole 10.26 OD: Rs. 2300/240ml, Clothianidin 50 WDG: Rs. 128/6gm, Labour cost @ Rs.272/day

Conclusion

The overall results on bio efficacy of insecticides revealed that the treatments with two foliar sprays of spinetoram 11.70 SC @ 420ml/ha and the treatment with two foliar sprays of Cyantraniliprole 10.26 OD @ 900 ml/ha were found most effective for the control of safflower aphid and in obtaining higher seed yield.

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