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Bio efficacy of insecticides on safflower aphid (*Uroleucon compositae*)

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Abstract
The investigation on efficacy of insecticides against safflower aphid (*Uroleucon compositae*) was conducted on research farm of Department of Agricultural Entomology, College of agriculture, V.N.M.K.V. Parbhani. Need based two foliar application was given where all treatments rendered significant suppression of aphids as compared to untreated control. Aphid population was uniform before application of treatments. Among all the treatments at one, five, seven, fourteen day after each spray, Spinetoram 11.7% SC appeared to have better control over aphids as it registered significantly least (3.43,2.21, aphids/5cm apical twig) population in both first and second spray followed by Acephate 75% SP (4.00 and 2.34 aphids/5cm apical twig). Other treatments on order of their merit was thiamethoxam 25% WG (4.15 and 3.12 aphids/5cm apical twig), Acetamiprid 20% SP (4.33 and 3.29 aphids/5cm apical twig), Imidacloprid 17.8% SL (4.56 and 3.37 aphids/5cm apical twig), and Clothianidin 50% WDG (4.83 and 3.50 aphids/5cm apical twig). However all these treatments found at par with each other. The highest aphid population was observed in untreated plots (10.99 and 11.86 aphids/5cm apical twig). The highest yield of safflower seed obtained from plots treated with spinetoram 11.7% SC (14.50q/ha) as compared to other treatments. Thiamethoxam 25% WG and imidacloprid 17.8% SL treatments showed higher net profit with a cost benefit ratio of (1:71.50) and (1:56.09).

Keywords: Insecticides, safflower, *Uroleucon compositae*, *Carthamus tinctorius* L.

Introduction
Safflower (*Carthamus tinctorius* L.) commonly known as ‘Kusum’ or ‘Kardi’ which is one of the important *Rabi* oilseed crops of the country. Traditionally, the crop is grown for its seeds for oil extraction and cake preparation. Safflower oil has strong dying properties, especially essential for the Indian subcontinent, Middle East, and Eastern Europe carpet-weaving industries. Safflower eye drops, particularly in children, decrease myopia. (Guimiano W, yilli L. 1985) [5]. Safflower is cultivated commercially in India, China, Spain, Pakistan, Turkey, Uzbekistan, and the Russian Federation. Mexico was the world's largest safflower producer until 1980, according to records, but later area and output decreased day by day and now it becomes just 10 per cent of area and production. Safflower production in India is currently (55280) tonnes with an acreage of (82148) ha. But the average productivity, i.e.673 kg / ha, is lower. It's due to inadequate crop management under conditions of input famine. It is mainly grown in Maharashtra and Karnataka and parts of Andhra Pradesh, Madhya Pradesh, Orissa, and Bihar. Maharashtra and Karnataka are top two safflower growing states. (Anonymous 2017-2018) [1].

One of the major reasons for the low productivity is the loss due to insect pests. Among the insect pests that attacks safflower, the aphid, *Uroleucon compositae* Theobald (Hemiptera: Aphididae) is the most destructive and regular pest. In case of severe infestation the yield losses range from 24.20 to 67.72% (Shetgar. 1993) [7]. Seed and oil content losses due aphid infestation has been recorded as 24 to 60 *et al*. % by (Bhumannavar and Thontadarya, 1979; Basavanagoud *et al*., 1981) [4, 2] and (Shetgar *et al*., 1992) [8]. Effective management of safflower aphid has been achieved by using different insecticides (Basavaraj *et al*., 2012) [3]. Control of safflower aphid has been achieved by using different insecticides (Neharkar *et al*., 2003) [6]. Further the information regarding efficacy of newer insecticides against safflower aphid is scanty. In the present investigation an attempt has been made to know bio efficacy of newer insecticides on safflower aphids in rendering better seed yield along with economics.

Materials and Methods

The field experiment was carried out at College of Agriculture, V.N.M.K.V. Parbhani (Maharashtra: India) during *Rabi* season 2019-20 which is located at 19° 16 ' North Latitude and 73° 47' East longitude and 408.50 M above the mean sea level (MSL) altitude and has a subtropical climate. The position in the northern transitional zone (zone-8) receives an annual precipitation of approximately 800-900 mm in hot and dry summer and cool winter.

The safflower variety PBNS-86 was used for experiment. The crop was sown on 15/11/2019 in randomised block design consisted 07 treatments, 03 replications, 4.5 × 2.0 m^2 plot size and 45×20 cm^2 spacing. The details of insecticides used have been presented in Table. The 90:45:45 NPK kg/ha application of fertilizer was applied at the time of sowing.

Pre count observation were taken before each spraying and further observations were taken after one, Five, Seven, Ten, Fourteen days after each spray. Two sprays were taken to observe effect of insecticides on safflower aphid. Observations were recorded by observing 10 randomly selected plants from experimental plot. Total numbers of aphids were recorded on 5 cm apical shoot length per plant. The seed yield on net plot basis was recorded separately for each plot and then per hectare yield was calculated.

Result and Discussion

Table (02) presents the data relating to the impact of insecticides on the safflower. Graphically illustrated in Fig (01, 02).

Before treatments were applied, the Aphid population was uniform. Spinetoram 11.7% SC appeared to have better control over aphids across all treatments at one day after spray as it reported substantially less (3.43 and 2.21 aphids/5 cm apical twig) population in both first and second spray followed by Acephate 75% SP (4.00 and 2.34 aphids/5 cm apical twig).

Thiamethoxam 25% WG (4.15 and 3.12 aphids/5 cm apical twig), Acetamiprid 20% SP (4.33 and 3.29 aphids/5 cm apical twig), Imidacloprid 17.8% SL (4.56 and 3.37 aphids/5 cm apical twig), and Clothianidin 50% WDG (4.83 and 3.50 aphids/5 cm apical twig) were additional treatments in order of their merit. All these treatments, however, were found to be on par with each other. In untreated plots (10.99 and 11.86 aphids/5 cm apical twig), the highest aphid population was recorded.

A similar population decrease pattern was observed at five days after spraying where the least aphid population was observed in Spinetoram 11.7% SC treated plots (2.86 and 2.10 aphids/5 cm apical twig), followed by Acephate 75% SP (3.13 and 2.21 aphids/5 cm apical twig). Thiamethoxam 25% WG (3.19 and 2.83 aphids/5 cm apical twig), Acetamiprid 20% SP (3.38 and 2.96 aphids/5 cm apical twig), Imidacloprid 17.8% SL (3.47 and 3.07 aphids/5 cm apical twig), and Clothianidin 50% WDG (3.52 and 3.28 aphids/5 cm apical twig) were other treatments in order of their merit. However all these treatments found at par with each other. In untreated plots (11.05 and 12.02 aphids/5 cm apical twig), the highest aphid population had been recorded.

Seven days after the first and second spraying, the lowest drop in the aphid population was recorded. In plots treated with Spinetoram 11.7% SC (2.68 and 1.93 aphids/5 cm apical twig), followed by Acephate 75% SP (2.77 and 2.12 aphids/5 cm apical twig), the least aphid population was observed. Thiamethoxam 25% WG and Acetamiprid 20% SP were nearly effective and registered (3.02, 2.62 aphids/5cm apical twig) and (3.20 and 2.71 aphids/5cm apical twig). Whereas in plots treated with imidacloprid 17.8% SL (3.33 and 2.90 aphids/5 cm apical twig) aphid population, Clothianidin 50% WDG (3.43 and 3.02) shows almost comparable results. However all these treatment found at par with each other. The highest aphid population was observed in untreated plots (11.38 and 12.21 aphids/5cm apical twig).

After 10 days of spraying, the aphid population increased compared to one, five and seven days after each spray. However, in plots treated with Spinetoram 11.7% SC (3.15 and 2.96 aphids/5 cm apical twig) followed by Acephate 75% SP (3.47 and 3.07 aphids/5 cm apical twig), less aphid growth was observed.

Thiamethoxam 25% WG (3.57 and 3.33 aphids/5 cm apical twig), Acetamiprid 20% SP (3.74 and 3.52 aphids/5 cm apical twig), Imidacloprid 17.8% SL (3.68 and 3.66 aphids/5 cm apical twig), and Clothianidin 50% WDG (3.83 and 3.80 aphids/5 cm apical twig) were additional treatments in order of their merit. Both these treatments, however, were found to be on par with each other. In untreated plots (11.53 and 12.41 aphids/5 cm apical twig), the highest aphid population had been observed.

In any treatment after each spray, the highest aphid population was observed at 14 days after spraying. However, in plots treated with Spinetoram 11.7% SC (5.48 and 3.50 aphids/5 cm apical twig), accompanied by Acephate 75% SP (5.72 and 3.62 aphids/5 cm apical twig), the least aphid population was observed. Thiamethoxam 25% WG (5.74 and 3.78 aphids/5 cm apical twig), Acetamiprid 20% SP (5.76 and 4.02 aphids/5 cm apical twig), Imidacloprid 17.8% SL (5.83 and 4.09 aphids/5 cm apical twig), and Clothianidin 50% WDG (5.99 and 4.22 aphids/5 cm apical twig) were additional treatments in order of their merit. Both these treatments, however, were found to be on par with each other. In untreated plots (11.67 and 12.64 aphids/5 cm apical twig), the maximum aphid population has been observed.

Table 1: Treatment details of safflower aphid control experiment

Tr. No	Treatments	Dose/ha (g/ml)	Trade Name	Class
T1	Acetamiprid 20% SP	100gm	Manik	Neonicotinoid
T2	Spinetoram 11.7% SC	420gm	Delegate	Spinosyn.
T3	Clothianidin 50% WDG	40gm	Dontetsu	Neonicotinoid
T4	Acephate 75% SP	780gm	Asataf	Organo-phosphate
T5	Imidaclporid 17.8% SL	100ml	Confidor	Neonicotinoid
T6.	Thiamethoxam 25% WG		Evident	Neonicotinoid
T7	Untreated	--	--	--

Table 2: Bio efficacy of insecticides on safflower aphid (*Uroleucon compositae*)

Tr. no	Treatment	1st Spray							2nd Spray						(ORE)	Yield (q /ha)
		1DBS	1DAS	5DAS	7DAS	10DAS	14DAS	MEAN	1DAS	5DAS	7DAS	1DAS	14DAS	MEAN		
T1	Acetamiprid 20% SP	120.67 (10.98)	18.33 (4.33)	11.00 (3.38)	10.00 (3.20)	13.66 (3.74)	34.00 (5.76)	17.39	10.33 (3.29)	8.67 (2.96)	7.33 (2.71)	12.00 (3.52)	16.00 (4.02)	10.86	14.12	11.60 (3.86)
T2	Spinetoram 11.7% SC	120.00 (10.95)	11.33 (3.43)	8.00 (2.86)	6.67 (2.68)	10.00 (3.15)	30.33 (5.48)	13.26	4.67 (2.21)	4.00 (2.10)	3.33 (1.93)	8.33 (2.96)	12.00 (3.50)	6.46	09.86	14.50 (4.83)
T3	Clothinidin 50% WDG	119.67 (11.00)	23.00 (4.83)	12.00 (3.52)	11.33 (3.43)	14.66 (3.83)	36.00 (5.99)	19.39	12.00 (3.50)	10.33 (3.28)	8.67 (3.02)	14.00 (3.80)	17.67 (4.22)	12.53	15.96	11.46 (3.72)
T4	Acephate 75% SP	119.67 (11.00)	15.66 (4.00)	09.33 (3.13)	7.33 (2.77)	12.33 (3.47)	32.67 (5.72)	15.46	5.33 (2.34)	4.67 (2.21)	4.33 (2.12)	9.00 (3.07)	13.33 (3.62)	7.33	11.39	14.06 (4.68)
T5	Imidaclporid 17.8% SL	120.0 (10.95)	21.33 (4.56)	11.66 (3.47)	10.67 (3.33)	14.00 (3.68)	34.67 (5.83)	18.46	11.00 (3.37)	9.00 (3.07)	8.00 (2.90)	13.00 (3.66)	16.67 (4.09)	11.53	14.99	12.76. (4.25)
T6	Thiamethoxam 25% WG	120.66 (11.00)	17.00 (4.15)	10.00 (3.19)	8.67 (3.02)	13.00 (3.57)	33.33 (5.74)	16.40	09.33 (3.12)	07.67 (2.83)	06.67 (2.62)	10.67 (3.33)	14.00 (3.78)	9.66	13.03	13.19 (4.39)
T7	Untreated	120.00 (10.95)	122.00 (10.99)	125.33 (11.05)	130.00 (11.38)	133.33 (11.53)	136.00 (11.67)	129.33	142.33 (11.86)	146.00 (12.02)	151.33 (12.21)	156.67 (12.41)	160.00 (12.64)	151.26	140.29	5.80 (1.93)
	SE	0.74	0.49	0.48	0.37	0.44	0.45	---	0.51	0.45	0.45	0.48	0.46	---	---	0.49
	CD@5%	N/A	1.51	1.49	0.96	1.36	1.38		1.58	1.41	1.38	1.48	1.43			1.55
	CV%	11.78	16.41	19.27	12.68	16.22	11.87		21.04	19.52	19.83	17.77	15.77			21.86

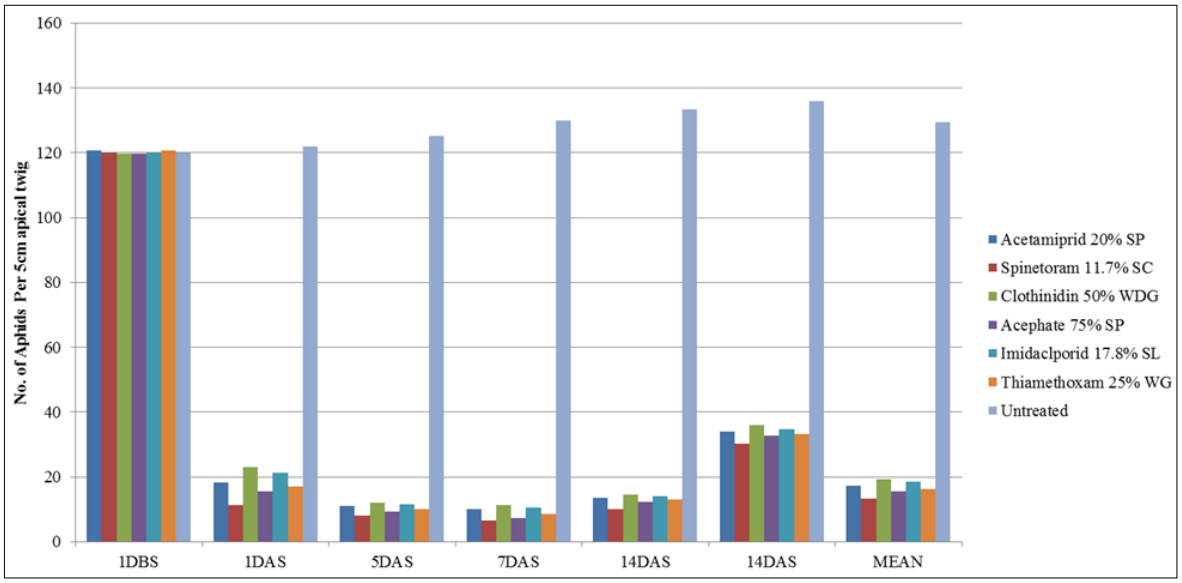

Fig 1: Effects of insecticides on safflower aphid (1st Spray)

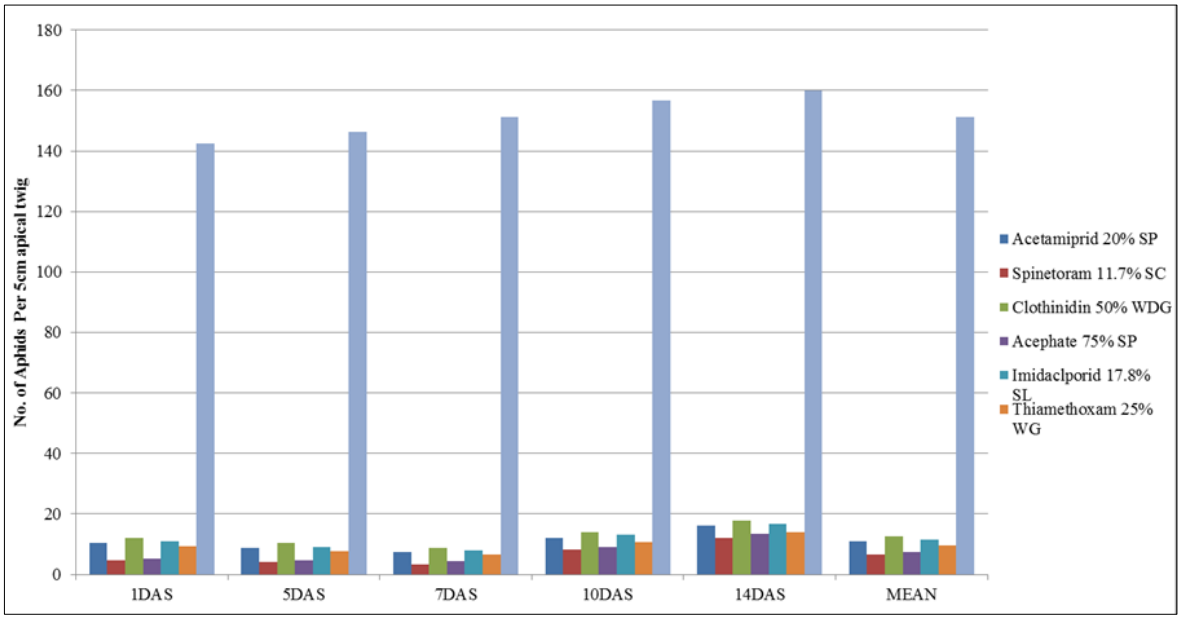

Fig 2: Effect of insecticides on safflower aphid (2 nd Spray)

Yield

The yield of safflower had been observed at range from 5.80 to 14.50 q/ha. Compared to untreated control, all insecticidal treatments reported a significantly higher yield of safflower seeds. The highest yield of safflower seed obtained from plots treated with spinetoram 11.7% SC (14.50 q/ha) than all other treatments. Acephate 75% SP (14.06 q/ha), thiamethoxam 25% WG (13.19 q/ha), imidacloprid 17.8% (12.76 q/ha), acetamiprid 20% SP (11.60 q/ha) and clothianidine 50% WDG (11.46 q/ha) were the other treatments in order of merit. Untreated controls (5.80 q/ha) registered the lowest yield.

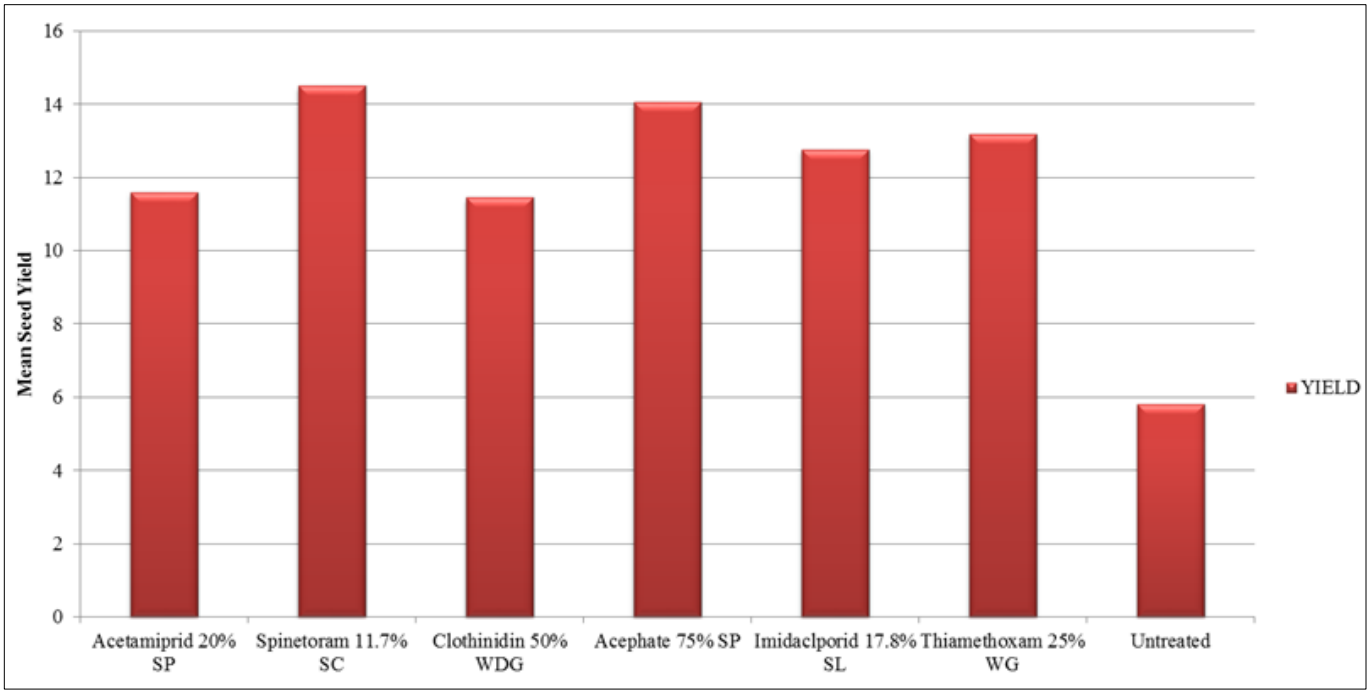

Fig 3: Yield

ICBR: (Incremental cost benefit ratio)

The data showed that thiamethoxam 25% WG and imidacloprid 17.8% SL treatments showed higher net profit with a cost benefit ratio of (1:71.50) and (1:56.09). Acephate 75% SP (1:44.68), acetamiprid 20% SP (1:32.45), spinetoram 11.7% SC (1:12.01) and clothianidin 50% WDG (1:4.80) were the other treatments in order of their merit.

Table 3: Incremental cost benefit ratio of effect of insecticides on safflower aphid (*Uroleucon compositae*)

Tr. No	Treatments	Yield (q/ha)	Increased yield over control (q/ha)	Value of additional yield	Total cost of plant protection	Net profit	ICBR Ratio
T1	Acetamiprid 20% SP	11.60	5.82	24360	1710	22650	1:32.45
T2	Spinetoram 11.7% SC	14.50	8.25	34650	2500	30040	1:12.01
T3	Clothianidin 50% WDG	11.16	5.36	22512	3880	18632	1:04.80
T4	Acephate 75% SP	14.06	8.25	34650	2240	32410	1:44.68
T5	Imidaclporid 17.8% SL	12.76	6.96	29232	1760	27432	1:56.09
T6	Thiamethoxam 25% WG	13.19	7.39	31,038	1710	29328	1:71.50
T7	Untreated	5.80	--	--	--	--	--

Conclusion

It is revealed from experiment that all insecticidal treatments Acetamiprid 20% SP, Spinetoram 11.7% SC, Clothinidin 50% WDG, Acephate 75% SP, Imidaclporid 17.8% SL, Thiamethoxam 25% WG evaluated against safflower aphid were superior in reducing the aphid population over untreated control.

The highest yield of safflower seed obtained from plots treated with spinetoram 11.7% SC (14.50 q/ha) than all other treatments. Acephate 75% SP (14.06 q/ha), thiamethoxam 25% WG (13.19 q/ha), imidacloprid 17.8% (12.76 q/ha), acetamiprid 20% SP (11.60 q/ha) and clothianidine 50% WDG (11.46 q/ha) were the other treatments in order of merit. Untreated controls (5.80 q/ha) registered the lowest yield.

Thiamethoxam 25% WG and imidacloprid 17.8% SL treatments showed higher net profit with a cost benefit ratio of (1:71.50) and (1:56.09). Acephate 75% SP (1:44.68), acetamiprid 20% SP (1:32.45), spinetoram 11.7% SC (1:12.01) and clothianidin 50% WDG (1:4.80) were the other treatments in order of their merit.

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