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Management of wheat aphid (*Rhopalosiphum maidis* F.)

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Abstract
A field experiment was conducted at Wheat Research Station, S. D. Agricultural University, Vijaypur during 2018-19, 2019-20, 2020-21 and 2021-22 for evaluation of efficacy of different insecticides and bio-pesticides against aphid in wheat. The eight different treatments were evaluated. Based on pooled data of four years, the result revealed that minimum mean aphid population (1.76) was observed with foliar sprays of Thiamethoxam 25 WG @ 0.01% which was at par with all the other treatments except *Beauveria bassiana* @ ($1x10^9$ cfu/g) and untreated check. The grain yield (49.25q/ha) was also recorded higher with Thiamethoxam 25 WG @ 0.01% compared to control.

Keywords: Aphid, thiamethoxam, wheat, Gujarat and grain yield

Introduction
Wheat is the leading grain of the world and is grown wherever climatic and soil conditions are favorable in the temperate zone, especially in North America, Europe, China, North West India, Argentina and Australia. Wheat belongs to family Poaceae (Gramineae). There are 50 wild species of wheat, out of which four species *viz. Triticum aestivum, Triticum durum, Triticum diccocum* and *Triticum sphaerococcum* are under cultivation in India. *Triticum aestivum* is the most important species occupying more than 90 per cent of the total wheat area in country followed by *Triticum durum* (8-9%) and *Triticum dicocum* (< 1%). The important wheat growing states are Uttar Pradesh, Punjab, Haryana, Madhya Pradesh and Gujarat. In India, wheat has been under cultivation in 31.82 million hectares with production of 112.74 million tonnes with national average productivity of 35.43 q/ha. during the 2022-2023 (Anon. 2023) [1]. Wheat is grown as a major cereal crop in Gujarat state. Wheat is grown primarily as a food crop, its plant, seed, straw, and bran are used in industrial products as well as a feed of livestock. Wheat straw is used as fuel, animal bedding, and organic matter for soil (Wiese, 1987) [7]. The crop is infested by a number of insect pests, *viz*., armyworm, Termite, pink stem borer and, aphid. Among these insect pests, the aphid is most serious and regular insect pest of this crop. Aphid (Homoptera: Aphididae) are sucking insect pests of various field crops. The population of *Rhopalosiphum maidis* was the most abundant and it was the most important aphid species on wheat whose occurrence interfered with grain formation and grain filling (Kannan, 1997) [4]. Aphid is major pests of the crops causing wheat yield loss in many parts of the world. Most of them because of parthenogenesis, viviparation and polymorphism have very high reproduction rate in the absence of natural enemies. These insects become mature in a short time, so they can significantly increase its population in less time (Carver, 1989) [2]. Aphid pierce and suck sap from leaves, stems, and less frequently the developing kernels of wheat. Some inject toxic substances that destroy plant tissue while some are vectors of viruses that may cause widespread losses exceeding those attributed to the direct feeding damage (Gair *et al*., 1983) [3]. The decline in grain yield in various genotypes, ranging from 7.9 to 34.2% has also been reported by (Lal *et al*., 2010) [5].
Wheat (*Triticum aestivum* L.) is an imperative, nutritious and economical source for staple food in the world, which is utilized by >35% of global human population. Wheat production in India is highest after China. In addition, the country's popular states like Punjab, Haryana, U.P, Madhya Pradesh and Gujarat lead wheat crop production. It is a very important cereal crop that is high in dietary fibre and has high qualities of protein than other cereal grains like rice and maize. One of the important factors responsible for yield reduction is infestation of weeds and insect pests. High yielding wheat varieties were endorsed for North Gujarat agro climatic zone is highly susceptible to wheat aphid *Rhopalosiphum maidis* F. at booting stage of the crop.

It harbors in leaf whorl and suck sap from the leaf there by affecting the yield of the crop. Systemic insecticide like dimethoate and phosphamidon are found to be effective against aphid in wheat crop. The increasing concern for environmental awareness of pesticides hazards has evoked a worldwide interest in pest control agents of biopesticides. These biopesticides are safer to be in pest control programme and may prevent several adverse effects caused due to synthetic insecticidal application. Therefore, the present investigation was proposed to determine the efficacy of biopesticides as an alternative to insecticides in the management of aphid in wheat crop.

Materials and Methods

Wheat crop (*var*. GW 322) was raised following standard agronomical practices adopting flood irrigation method on Wheat Research Station, S. D. Agricultural University, Vijapur. The experiment was laid out in a randomized block design with eight treatments including untreated control with three replications. The planting was done at row spacing of 22.5 cm. The recommended dosage of fertilizers 120 kg N and 60 kg P per hectare was applied. The first spray of respective treatments was applied on initiation of pest and tag five shoots in each plot randomly. Count all the aphids on the tagged shoots one day before the pesticides application and 1, 2, 7 and 15 days after the pesticides sprays and give number of aphids per shoot in final table 1. At harvest record grain yield from the net plot and convert it into q/h.

Table 1: Treatment Details

Sr. No.	Treatments	g/ml per 10 liter water
1	*Lecanicillium lecanii* ($1x10^9$ cfu/g)	40
2	*Metarhizium anisopliae* ($1x10^9$ cfu/g)	40
3	*Beauveria bassiana* ($1x10^9$ cfu/g)	40
4	Azadirachtin 1500 ppm	50
5	NSKS 5%	500
6	Thiamethoxam 25 WG @ 0.01%	4
7	Acetamiprid 20 SP @ 0.006%	3
8	Untreated Check	-

Results and Discussion

Effect of treatments on aphid population

During *rabi*, 2018-19 the results on aphid population before spraying of treatments were non-significant among all the treatments (Table 2). After 1 DAS, the treatment of *Metarhizium anisopliae* ($1x10^9$ cfu/g) recorded minimum population of aphid (7.60). After 2 DAS Thiamethoxam 25 WG recorded minimum population of aphid (4.78). After 7 DAS lowest population of aphid recorded in Acetamiprid 20 SP (3.60) treatment. After 15 DAS all the treatments recorded lowest aphid population. In case of pooled over spray showed that all the treatments were found significantly superior to the control and lowest population of aphid was found in Thiamethoxam 25 WG (3.68) which was at par with *Metarhizium anisopliae* ($1x10^9$ cfu/g), Acetamiprid 20 SP, *Lecanicillium lecanii* ($1x10^9$ cfu/g) and Azadirachtin 1500ppm. The treatment of untreated check plot recorded maximum aphid population (14.50).

During *rabi*, 2019-20 the results on aphid population before spraying of treatments were non-significant among all the treatments (Table 3). After 1 DAS, the treatment of Thiamethoxam 25 WG (7.53) found minimum aphid. After 2 DAS same trends followed Thiamethoxam 25 WG recorded minimum population of aphid (2.60). After 7 DAS lowest population of aphid recorded in Acetamiprid 20 SP (0.80) treatment. After 15 DAS all the treatments recorded lowest aphid population except control. In case of pooled over spray lowest population of aphid was found in Thiamethoxam 25 WG (2.87) which was followed by Acetamiprid 20 SP (3.55). The treatment of untreated check plot recorded maximum aphid population (21.52).

During *rabi*, 2020-21 the results on aphid population before spraying of treatments were non-significant among all the treatments (Table 4). After 1 DAS, the treatment of Thiamethoxam 25 WG (5.40) found minimum aphid populations. After 2 DAS same trends followed Thiamethoxam 25 WG recorded minimum population of aphid (3.33). After 7 DAS lowest population of aphid recorded in Thiamethoxam 25 WG (1.53). After 15 DAS all the treatments recorded lowest aphid population over control. In case of pooled over spray lowest population of aphid was found in Thiamethoxam 25 WG (2.62) which was followed by Acetamiprid 20 SP (4.28). The treatment of untreated check plot recorded maximum aphid population (12.60).

During *rabi*, 2021-22 the results on aphid population before spraying of treatments were non-significant among all the treatments (Table 5). After 1 DAS, the treatment of Thiamethoxam 25 WG (5.33) found minimum aphid populations. After 2 DAS Acetamiprid 20 SP recorded minimum population of aphid (3.67). After 7 DAS lowest population of aphid recorded in Thiamethoxam 25 WG (1.93). After 15 DAS all the treatments recorded significantly lower aphid population than control. In case of pooled over spray lowest population of aphid was found in Thiamethoxam 25 WG (2.98) which was at par with Acetamiprid 20 SP (3.60) and NSKS 5% (4.37). The treatment of untreated check plot recorded maximum aphid population (11.54).

Pooled over year

The pooled over year data of 2018-19, 2019-20, 2020-21 and 2021-22 presented in Table 6 concluded that Thiamethoxam 25 WG (3.04) recorded the least aphid infestation which was at part with Acetamiprid 20 SP (3.83), Azadirachtin1500ppm (4.29), NSKS 5% (4.52), *Lecanicillium lecanii* $1x10^9$ cfu/g (4.50) and *Metarhizium anisopliae* $1x10^9$ cfu/g (4.67). Results confirmed with findings of Walkunde *et al.* (2019) [6] reported that Thiamethoxam 25 WG was very effective for the control of wheat aphids.

Impact on grain yield

The results on grain yield of wheat presented in Table 7 revealed that the wheat crop sprayed with Thiamethoxam 25 WG imparted maximum grain yield (49.25 q/ha.) which was at par with all treatments except *Beauveria bassiana* ($1x10^9$ cfu/g) and untreated check.

Table 2: Effect of different treatments on aphid population in year 2018-19

Tr. No.	Treatment	g or ml /10 L of water	Before spray	No. of aphids/shoot				Pooled Mean
				1 DAS	2 DAS	7 DAS	15 DAS	
T_1	*Lecanicillium lecanii* ($1x10^9$ cfu/g)	40	3.55 (12.13)	3.04^{bcd} (8.80)	2.37^{b} (5.20)	1.70^{bc} (2.47)	0.94^{b} (0.40)	2.01^{b} (4.12)
T_2	*Metarhizium anisopliae* ($1x10^9$ cfu/g)	40	3.39 (11.00)	2.83^{d} (7.60)	2.38^{b} (5.20)	1.73^{bc} (2.53)	0.95^{b} (0.40)	1.97^{b} (3.83)
T_3	*Beauveria bassiana* ($1x10^9$ cfu/g)	40	3.65 (12.87)	3.23^{b} (10.00)	2.69^{b} (6.80)	1.91^{bc} (3.20)	1.01^{b} (0.53)	2.21^{b} (5.00)
T_4	Azadirachtin 1500 ppm	50	3.61 (12.67)	2.94^{bcd} (8.20)	2.52^{b} (5.93)	1.85^{bc} (2.93)	0.91^{b} (0.33)	2.06^{b} (4.27)
T_5	NSKS 5%	500	3.63 (12.73)	3.20^{bc} (9.73)	2.63^{b} (6.47)	1.99^{b} (3.47)	0.92^{b} (0.40)	2.18^{b} (4.92)
T_6	Thiamethoxam 25 WG @ 0.01%	4	3.44 (11.33)	2.86^{cd} (7.67)	2.29^{b} (4.73)	1.68^{bc} (2.33)	0.94^{b} (0.40)	1.94^{b} (3.68)
T_7	Acetamiprid 20 SP @ 0.006%	3	3.63 (12.67)	3.00^{bcd} (8.60)	2.35^{b} (5.07)	1.51^{c} (1.80)	0.91^{b} (0.40)	1.94^{b} (3.87)
T_8	Untreated Check	-	3.72 (13.40)	4.06^{a} (16.00)	4.50^{a} (19.80)	4.76^{a} (22.20)	5.04^{a} (24.93)	4.59^{a} (14.50)
S.Em.±	T		0.16	0.11	0.16	0.14	0.08	0.235
	P		-	-	-	-	-	0.045
	T x P		-	-	-	-	-	0.127
C.D. at 5%	T		NS	0.34	0.48	0.43	0.25	0.69
	T x Y		-	-	-	-	-	0.36
C.V.%			7.88	6.23	10.04	11.37	9.85	9.28

*Figures in parenthesis are retransformed values of square root transformation, Treatment mean with common letter(s) are not significant by DNMRT at 5% level of significance

Table 3: Effect of different treatments on aphid population in year 2019-20

Tr. No.	Treatment	g or ml /10 L of water	Before spray	No. of aphids/shoot				Pooled Mean
				1 DAS	2 DAS	7 DAS	15 DAS	
T_1	*Lecanicillium lecanii* ($1x10^9$ cfu/g)	40	4.02 (15.73)	2.97^{b} (8.33)	2.82^{b} (4.80)	1.72^{b} (2.53)	1.01^{b} (0.53)	2.00^{b} (4.05)
T_2	*Metarhizium anisopliae* ($1x10^9$ cfu/g)	40	4.21 (17.33)	3.06^{b} (9.00)	2.27^{bcd} (4.67)	1.74^{b} (2.53)	0.98^{b} (0.47)	2.01^{b} (4.17)
T_3	*Beauveria bassiana* ($1x10^9$ cfu/g)	40	3.96 (15.33)	3.10^{b} (9.13)	2.45^{bc} (5.60)	1.74^{b} (2.60)	0.98^{b} (0.47)	2.07^{b} (4.45)
T_4	Azadirachtin 1500 ppm	50	4.14 (16.67)	3.14^{b} (9.47)	2.39^{bc} (5.33)	1.61^{b} (2.13)	0.91^{b} (0.33)	2.01^{b} (4.32)
T_5	NSKS 5%	500	4.10 (16.40)	3.12^{b} (9.27)	2.32^{bcd} (5.07)	1.70^{b} (2.47)	0.94^{b} (0.40)	2.02^{b} (4.30)
T_6	Thiamethoxam 25 WG @ 0.01%	4	4.18 (17.07)	2.83^{b} (7.53)	1.76^{d} (2.60)	1.20^{c} (0.93)	0.94^{b} (0.40)	1.68^{b} (2.87)
T_7	Acetamiprid 20 SP @ 0.006%	3	4.09 (16.33)	3.15^{b} (9.40)	2.02^{cd} (3.60)	1.14^{c} (0.80)	0.95^{b} (0.40)	1.81^{b} (3.55)
T_8	Untreated Check	-	3.99 (15.47)	4.43^{a} (19.20)	4.59^{a} (20.67)	4.76^{a} (22.27)	4.94^{a} (23.93)	4.68^{a} (21.52)
S.Em.±	T		0.20	0.17	0.20	0.13	0.08	0.21
	P		-	-	-	-	-	0.05
	T x P		-	-	-	-	-	0.15
C.D. at 5%	T		NS	0.52	0.60	0.38	0.24	0.61
	T x Y		-	-	-	-	-	0.43
C.V.%			8.35	9.18	13.75	11.24	9.24	11.43

*Figures in parenthesis are retransformed values of square root transformation, Treatment mean with common letter(s) are not significant by DNMRT at 5% level of significance

Table 4: Effect of different treatments on aphid population in year 2020-21

Tr. No.	Treatment	G or ml/10 L of water	Before spray	No. of aphids/shoot				Pooled Mean
				1 DAS	2 DAS	7 DAS	15 DAS	
T_1	*Lecanicillium lecanii* ($1x10^9$ cfu/g)	40	4.11 (16.47)	2.79^{bc} (7.33)	2.34^{bc} (5.13)	2.06^{bc} (4.07)	1.16^{bc} (0.87)	2.09^{bc} (4.35)
T_2	*Metarhizium anisopliae* ($1x10^9$ cfu/g)	40	4.17 (16.93)	2.81^{bc} (7.80)	2.77^{b} (7.40)	2.16^{bc} (4.33)	1.27^{b} (1.13)	2.25^{bc} (5.17)
T_3	*Beauveria bassiana* ($1x10^9$ cfu/g)	40	4.41 (19.27)	3.28^{b} (10.47)	2.60^{b} (6.47)	2.43^{b} (5.60)	1.08^{c} (0.67)	2.35^{b} (5.80)
T_4	Azadirachtin 1500 ppm	50	4.01	2.71^{bc}	2.37^{bc}	2.20^{bc}	0.88^{d}	2.04^{c}

			(15.60)	(6.87)	(5.13)	(4.33)	(0.27)	(4.15)
T_5	NSKS 5%	500	4.06 (16.07)	2.71^{bc} (6.87)	2.48^{b} (5.67)	2.25^{bc} (4.60)	1.16^{bc} (0.87)	2.15^{bc} (4.50)
T_6	Thiamethoxam 25 WG @ 0.01%	4	4.22 (17.33)	2.40^{c} (5.40)	1.91^{c} (3.33)	1.39^{d} (1.53)	0.83^{d} (0.20)	1.63^{d} (2.62)
T_7	Acetamiprid 20 SP @ 0.006%	3	4.32 (18.20)	3.02^{bc} (8.67)	2.52^{b} (5.87)	1.66^{cd} (2.33)	0.87^{d} (0.27)	2.02^{c} (4.28)
T_8	Untreated Check	-	4.40 (18.87)	4.31^{a} (18.13)	3.81^{a} (14.00)	3.44^{a} (11.40)	2.71^{a} (6.87)	3.57^{a} (12.60)
S. Em.±	T		0.20	0.22	0.18	0.20	0.06	0.09
	P			-	-	-	-	0.06
	T x P			-	-	-	-	0.18
C.D. at 5%	T		NS	0.67	0.56	0.61	0.19	0.25
	T x Y		-	-	-	-	-	NS
C.V.%			8.06	12.79	12.30	15.95	8.86	13.72

*Figures in parenthesis are retransformed values of square root transformation**,** Treatment mean with common letter(s) are not significant by DNMRT at 5% level of significance

Table 5: Effect of different treatments on aphid population in year 2021-22

Tr. No.	Treatment	g or ml /10 L of water	Before spray	No. of aphids/shoot				Pooled Mean
				1 DAS	2 DAS	7 DAS	15 DAS	
T_1	*Lecanicillium lecanii* ($1x10^9$ cfu/g)	40	3.21 (9.87)	2.95^{bc} (8.27)	2.71^{b} (6.90)	2.18^{bc} (4.27)	1.70^{b} (2.40)	2.39^{bc} (5.46)
T_2	*Metarhizium anisopliae* ($1x10^9$ cfu/g)	40	3.33 (10.80)	3.13^{bc} (9.40)	2.78^{b} (7.27)	2.01^{bc} (3.67)	1.46^{bcde} (1.67)	2.34^{bcd} (5.50)
T_3	*Beauveria bassiana* ($1x10^9$ cfu/g)	40	3.52 (12.00)	3.33^{ab} (10.67)	3.02^{b} (8.67)	2.36^{b} (5.07)	1.60^{bc} (2.13)	2.58^{b} (6.63)
T_4	Azadirachtin 1500 ppm	50	3.49 (12.07)	3.03^{bc} (8.73)	2.27^{c} (4.67)	1.96^{bc} (3.33)	1.60^{bc} (0.87)	2.11^{cde} (4.40)
T_5	NSKS 5%	500	4.10 (16.33)	3.12^{bc} (9.33)	2.36^{c} (5.07)	1.81^{cd} (2.80)	0.87^{f} (0.27)	2.04^{def} (4.37)
T_6	Thiamethoxam 25 WG @ 0.01%	4	3.16 (9.67)	2.41^{d} (5.33)	2.19^{c} (4.33)	1.55^{d} (1.93)	0.91^{f} (0.33)	1.77^{f} (2.98)
T_7	Acetamiprid 20 SP @ 0.006%	3	3.09 (9.07)	2.70^{cd} (6.80)	2.04^{c} (3.67)	1.79^{cd} (2.73)	1.30^{ce} (1.20)	1.96^{ef} (3.60)
T_8	Untreated Check	-	3.26 (10.13)	3.61^{a} (12.57)	3.76^{a} (13.67)	3.45^{a} (11.47)	2.98^{a} (8.47)	3.45^{a} (11.54)
S.Em.±	T		0.24	0.16	0.12	0.13	0.10	0.11
	P			-	-	-	-	0.05
	T x P			-	-	-	-	0.13
C.D. at 5%	T		NS	0.49	0.38	0.38	0.32	0.33
	T x Y		-	-	-	-	-	0.37
C.V.%			12.23	9.13	8.20	10.24	12.12	9.72

*Figures in parenthesis are retransformed values of square root transformation**,** Treatment mean with common letter(s) are not significant by DNMRT at 5% level of significance

Table 6: Effect of different treatments on aphid population in pooled over year

Tr. No.	Treatment	g or ml /10 L of water	Before spray	No. of aphids/shoot				Pooled Mean
				2018-19	2019-20	2020-21	2021-22	
T_1	*Lecanicillium lecanii* ($1x10^9$ cfu/g)	40	3.72	2.01^{b} (4.12)	2.00^{b} (4.05)	2.09^{bc} (4.35)	2.39^{bc} (5.46)	2.12^{bc} (4.50)
T_2	*Metarhizium anisopliae* ($1x10^9$ cfu/g)	40	3.77	1.97^{b} (3.83)	2.01^{b} (4.17)	2.25^{bc} (5.17)	2.34^{bcd} (5.50)	2.15^{bc} (4.67)
T_3	*Beauveria bassiana* ($1x10^9$ cfu/g)	40	3.88	2.21^{b} (5.00)	2.07^{b} (4.45)	2.35^{b} (5.80)	2.58^{b} (6.63)	2.30^{b} (5.47)
T_4	Azadirachtin 1500 ppm	50	3.81	2.06^{b} (4.27)	2.01^{b} (4.32)	2.04^{c} (4.15)	2.11^{cde} (4.40)	2.05^{bc} (4.29)
T_5	NSKS 5%	500	3.97	2.18^{b} (4.92)	2.02^{b} (4.30)	2.15^{bc} (4.50)	2.04^{def} (4.37)	2.10^{bc} (4.52)
T_6	Thiamethoxam 25 WG @ 0.01%	4	3.75	1.94^{b} (3.68)	1.68^{b} (2.87)	1.63^{d} (2.62)	1.77^{f} (2.98)	1.76^{c} (3.04)
T_7	Acetamiprid 20 SP @ 0.006%	3	3.78	1.94^{b} (3.87)	1.81^{b} (3.55)	2.02^{c} (4.28)	1.96^{ef} (3.60)	1.93^{bc} (3.83)
T_8	Untreated Check	-	3.84	4.59^{a} (14.50)	4.68^{a} (21.52)	3.57^{a} (12.60)	3.45^{a} (11.54)	4.07^{a} (15.04)
S. Em.±	T		0.10	0.24	0.21	0.09	0.11	0.14

	P							0.05
	Y		0.07	0.05	0.05	0.06	0.05	0.03
	P x T		-	-	-	-	-	0.12
	Y x P		-	-	-	-	-	0.05
	Y x T		0.20	0.13	0.15	0.18	0.13	0.21
	Y x P x T		-	-	-	-	-	0.15
C.D. at 5%	T		NS	0.69	0.61	0.25	0.33	0.41
	Y x T		NS	0.36	0.43	NS	0.37	0.15
	Y x P x T		-	-	-	-	-	0.42
C.V.%			9.11	9.28	11.43	13.72	9.72	11.34

*Figures in parenthesis are retransformed values of square root transformation**,** Treatment mean with common letter(s) are not significant by DNMRT at 5% level of significance

Table 7: Effect of different treatments on grain yield of wheat

Tr. No.	Treatment	g or ml /10 L of water	Yield q/ha				Pooled Mean
			2018-19	2019-20	2020-21	2021-22	
T_1	*Lecanicillium lecanii* ($1x10^9$ cfu/gm)	40	58.22^{a}	54.28^{a}	36.85^{a}	39.72^{bc}	47.27^{a}
T_2	*Metarhizium anisopliae* ($1x10^9$ cfu/gm)	40	53.15^{ab}	53.98^{a}	36.89^{a}	40.72^{bc}	46.19^{a}
T_3	*Beauveria bassiana* ($1x10^9$ cfu/gm)	40	50.22^{ab}	53.55^{a}	38.77^{a}	39.31^{bc}	45.46^{a}
T_4	Azadirachtin 1500 ppm	50	56.96^{ab}	57.83^{a}	37.69^{a}	41.93^{b}	48.60^{a}
T_5	NSKS 5%	500	55.83^{ab}	55.22^{a}	40.07^{a}	41.97^{b}	48.27^{a}
T_6	Thiamethoxam 25 WG @ 0.01%	4	54.09^{ab}	58.48^{a}	38.61^{a}	45.82^{a}	49.25^{a}
T_7	Acetamiprid 20 SP @ 0.006%	3	53.95^{ab}	59.53^{a}	36.52^{a}	38.11^{c}	47.11^{a}
T_8	Untreated Check	-	47.54^{b}	51.23^{a}	36.20^{a}	33.41^{d}	42.10^{b}
S. Em.±	T		3.11	3.32	1.19	1.00	1.18
	Y		-	-	-	-	0.85
	T x Y		-	-	-	-	2.40
C.D. at 5%	T		NS	NS	NS	3.04	3.31
	T x Y		-	-	-	-	NS
C.V.%			10.02	10.34	5.46	4.33	8.90

*Treatment mean with common letter(s) are not significant by DNMRT at 5% level of significance

Table 8: Economics of various treatments

Tr. No.	g or ml /10 L of water	Material require for a spray (lit./ha)	Cost of material (Rs./ha)	Labour cost (Rs.)	Total cost of treatment (Rs.)	Yield (q/ha)	Gross realization (Rs./ha)	Net realization (Rs./ha)	Net gain (Rs./ha)	PCBR
T_1	40	2	300	710	1010	47.27	118175	12925	11915	1:11.80
T_2	40	2	300	710	1010	46.19	115475	10225	9215	1:9.12
T_3	40	2	300	710	1010	45.46	113650	8400	7390	1:7.32
T_4	50	2.5	1125	710	1835	48.60	121500	16250	14415	1:7.86
T_5	500	25	500	710	1210	48.27	120675	15425	14215	1:11.75
T_6	4	0.2	200	710	910	49.25	123125	17875	16965	1:18.64
T_7	3	0.15	225	710	935	47.11	117775	12525	11590	1:12.40
T_8	-	-	-	-	-	42.10	105250	-	-	-

Labour cost: Rs. 710/- (2 labour/ ha for one spray) Wheat: Rs. 25/kg

Conclusion

For effective management of aphids in wheat, applications of Thiamethoxam 25 WG @ 4 g/10L of water or Acetamiprid 20 SP @ 3 g/10L of water or Azadirachtin 1500 ppm @ 50 ml/ 10 lit. of water or NSKS 5% @ 500 gm/10 lit. of water or *Lecanicillium lecanii* ($1x10^9$ cfu/g) @ 40 gm/10 lit. of water or *Metarhizium anisopliae* ($1x10^9$ cfu/g) @ 40 gm/10 lit. of water at initiation of aphid infestation.

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