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COMPARATIVE EFFICACY OF SOME NEWER INSECTICIDES AGAINST THRIPS, *MEGALUROTHRIPS SJOSTEDTI* TRYBOM COWPEA AGRO-ECOSYSTEM

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ABSTRACT
The study was conducted to determine efficacy of insecticides against Thrips, *Megalurothrips sjostedti* Trybom on cowpea. Field experiments were conducted at Breeder Seed Production Centre, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar 2015. Maximum reduction of thrips population after first spray was 47.43per cent in the seed treatment with fipronil @ 3 ml/kg + spray with fipronil @ 5 ml/lt and after second spray was 57.4per cent in the seed treatment with imidacloprid 17.8SL @ 10ml/kg + spray with imidacloprid 17.8SL @. Minimum reduction of thrips population were found 11.41 and 29.44 per cent in the seed treatment with imidacloprid 17.8SL @ 10ml/kg + spray with monocrotophos 36SL @ 2ml/lt up to 14th days after first and second spray application respectively. Result showed that highest yield was 9.30q/ha obtained in the seed treatment with fipronil @ 3 ml/kg + spray with fipronil @ 5 ml/lt and lowest was 6.40q/ha in the seed treatment with imidacloprid 17.8SL @ 10ml/kg + spray with monocrotophos 36SL @ 2ml/lt.

INTRODUCTION

Cowpea, *Vigna unguiculata* (Linnaeus) is one of the important leguminous crop also known as crowderapea, black-eyed bean, lobia etc, in various vernacular languages in India. Cowpea are major food legume crops in the semiarid tropics originated in Africa covering Asia, Africa, Southern Europe and central and south America (FAO, 2010; Fatokum *et al.*, 2000; Shaw, 2007). It is well known for its economic importance as food for humans, feed for livestock and for the enrichment of soil fertility (Singh and van Emden, 1997). Although cowpea is widely grown in Ghana, commercial production is restricted to the northern belt of the country (Tweneboah, 2000). Production level for seed grain has been estimated to range between 0.8 mt/ha and 2.0 mt/ha and this is still far below the national and world averages of 2.5 mt/ha and 3.2 mt/ha, respectively (FOA, 2007). Area under cowpea in India is 3.9 million hectare with a production of 2.21 million tonnes with the national productivity of 683 kg/ha. Insect pests pose the greatest threat to cowpea production.The important insect pests attacking cowpea crop during all growth stages include spotted pod borer (*Maruca vitrata* fabricius), thrips (*Megaleurothirps* spp.), aphid (*Aphis craccirora* Koch), leaf hopper (*Empoasca kerri* Purthi), whitefly (*Bemesia tabaci* Genn.), leaf miner(*Acrocercops caerulre* Meyrick), tobacco caterpillar (*Spodoptera litura* fabricius) and blue butterfly (*Euchrysops cnejus Cnejus*). Among the various insect pests of cowpea, post flowering insects such as and *Megalurothirps* spp. and *Maruca vitrata* have been implicated to have caused major economic loss.The cowpea thrips *M. sjostedti* Trybom is one of the most noxious post flowering pests of cowpea (Tamo *et al.*, 1993). Both adult and nymph cause destruction of shoots, flower buds and pollen of cowpea, damage generally done after 42 days from planting can responsible for significant yield losses.Thrips commonly attack cowpea flowers which resulting in flower abscission. Edema and Adipala (1996) attributed approximately 70% yield of cowpea's reduction is due to thrips alone. *M. sjostedti* nymphs and adults may damage the terminal leaf buds and bracts/stipules, causing the latter to become deformed with a brownish yellow mottled appearance (Ezueh, 1981). However, the principal point of plant attack is on the flower buds and later, on the flowers themselves (Singh and Taylor, 1978). Attacked flower buds become brown and eventually abort, leaving behind dark red scars (Akingbohungbe, 1982). Flower damage is characterized by a distortion, malformation, and discoloration of floral parts (Singh and Taylor, 1978). Flower thrips populations are higher during the dry season, which favors rapid multiplication of thrips (Agyen-Sampong, 1978; Ezueh, 1981). When the thrips population is very high, open flowers are distorted and discolored. Flowers fall early with the result that pods are not formed and causing yield losses between 20 and 70 % depending on the severity of infestation (Tamo *et al.,* 1993). The indiscriminate use of insecticides by the farmers to control the various pests have resulted hazardous effects to the environment. Unforeseen side effects such as toxicity to non-

target organisms, development of resistance in pests to the pesticides and environmental contamination greatly affect the entire food chain. Sucking pests have developed resistance to almost all conventional synthetic insecticides and also developing resistance to multiple classes of insecticides (Palumbo *et al*., 2001, Kady and Devine, 2003). Morever, conventional insecticides provide poor control of insect pests and generally lead to pest resurgence. Therefore, to overcome these problems the use of new generation chemical neonicotinoids is the ultimate alternative for effective pest management . Imidacloprid, thiamethoxam and acetamiprid are the three major neonicotinoid insecticides which are used against these pests. In addition to its effectiveness in pest management, these insecticides as seed treatment and foliar spray have been reported to exert growth promoting effects (phytotonic effects) such as increase in leaf area (Sreelatha and Divakar, 1997), plant height (Sitaramaraju *et al*., 2010), and number and weight of root nodules in various crops (Antu and Korat, 2016). An ideal insecticide used for seed treatment should not exert any adverse effects on seed germination and hence, the effect of neonicotinoid insecticides on seed germination needs to be investigated (Antu and Korat, 2016). Considering the importance of the insect pests of cowpea, the experiments have been planned to find out the field efficacy of neonicotiniods imidacloprid, thiamethoxam and chemical pesticides (fipronil and monocrotophos) against major field Thrips of cowpea.

MATERIALS AND METHODS

The field experiments were conducted at Breeder Seed Production Centre, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar.

Twenty four plots of cowpea varieties Pant lobia-1 were demarcated and arranged in randomized block design with three replication of eight treatments imidacloprid 17.8SL @ 5ml/lt (T1), thiamethoxam 25WG @1g/lt (T2), seed treatment with imidacloprid 17.8SL @ 5ml/kg + spray with imidacloprid 17.8SL @ 5ml/lt (T3), seed treatment with imidacloprid 17.8SL @ 5ml/kg + spray with thiamethoxam 25WG @ 0.5g/lt (T4), seed treatment with imidacloprid 17.8SL @ 10ml/kg + spray with imidacloprid 17.8SL @ 5ml/lt (T5), seed treatment with imidacloprid 17.8SL @ 10ml/kg + spray with monocrotophos 36SL @ 2ml/lt (T6), seed treatment with fipronil @ 3 ml/kg + spray with fipronil @ 5 ml/lt (T7), Control (T8) were evaluated against thrips and the average number of thrips/flower bud/ plant and % reduction in thrips population over control. The plot size was 4 × 2.25 m^2 with 45cm row spacing and plant to plant 20cm. The test crop was cowpea varieties Pant Lobia-1. Sowing of cowpea variety Pant Lobia-1 was done on 14th March 2015 during *Zaid*. For seed treatment, desired quantities of insecticides as per concentrations were thoroughly mixed with seeds. After treating, the seeds were kept for overnight drying in shade at room temperature, before sowing. All the treatments were imposed by using high volume knapsack sprayer @ 500 liters of spray solution per hectar. The experiments were carried out with eight treatments of various insecticides in randomized block design with three replications. The treatment details are given in above table. Estimation of population density of thrips was done by randomly selected ten flower buds per ten plants per plot from vegetative to harvesting crop stage. Similarly, the pretreatment observation of Thrips population , were taken one day before, while post treatments at 3, 7, 10 and 14 day after each spray.

Statistical analysis

The obtained data from various experiments were subjected

Table 1: Efficacy of some treatments on the population of cowpea thrips, *Megalurothrips sjostedti* Trybom in cowpea var. Pant lobia-1 during *Zaid* season of the year 2015

Treatments	Pre spray count	Average number of Thrips*/flower bud/plant							
		Days after first application				Days after second application			
		3	7	10	14	3	7	10	14
Imidacloprid 17.8SL @ 5ml/lt (T1)	6.43^{a}	3.40^{a}	3.73^{a}	4.30^{a}	5.09^{a}	3.50^{a}	3.10^{a}	3.00^{ab}	2.86^{a}
	(2.63)*	(-1.97)	(-2.04)	(-2.18)	(-2.35)	(-1.99)	(-1.89)	(-1.85)	(-1.83)
Thiamethoxam 25WG @1g/lt (T2)	6.40^{a}	3.25^{a}	3.66^{a}	4.00^{a}	4.32^{a}	3.40^{a}	3.26^{a}	3.03^{ab}	2.90^{a}
	(-2.62)	(-1.92)	(-2.03)	(-2.12)	(-2.18)	(-1.97)	(-1.92)	(-1.86)	(-1.84)
Seed treatment with Imidacloprid 17.8S	6.36^{a}	3.33^{a}	3.70^{a}	4.13^{a}	5.00^{a}	3.60^{a}	3.20^{a}	3.33^{ab}	2.76^{a}
L @ 5ml/kg + spray with Imidacloprid	(-2.61)	(-1.94)	(-2.04)	(-2.15)	(-2.34)	(-2.02)	(-1.92)	(-1.95)	(-1.79)
17.8SL @ 5ml/lt (T3)									
Seed treatment with Imidacloprid 17.8SL	6.46^{a}	3.70^{a}	4.22^{a}	4.52^{a}	5.13^{a}	3.19^{a}	3.16^{a}	3.29^{ab}	2.80^{a}
@ 5ml/kg + spray with Thiamethoxam	(-2.63)	(-2.03)	(-2.16)	(-2.24)	(-2.36)	(-1.92)	(-1.91)	(-1.94)	(-1.81)
25WG @ 0.5g/lt (T4)									
Seed treatment with Imidacloprid 17.8SL 6.40^{a}		3.30^{a}	3.86^{a}	4.16^{a}	5.00^{a}	3.00^{a}	3.02^{a}	2.52^{a}	2.59^{a}
@ 10ml/kg + spray with Imidacloprid	(-2.62)	(-1.93)	(-2.07)	(-2.14)	(-2.33)	(-1.85)	(-1.87)	(-1.73)	(-1.75)
17.8SL @ 5ml/lt (T5)									
Seed treatment with Imidacloprid 17.8SL 6.33^{a}	5.39^{b}	5.95^{b}	6.30^{b}	7.10^{b}	5.23^{b}	4.90^{b}	4.16^{b}	4.26^{b}	
@ 10ml/kg + spray with	(-2.61)	(-2.42)	(-2.53)	(-2.60)	(-2.75)	(-2.38)	(-2.31)	(-2.15)	(-2.18)
Monocrotophos 36SL @ 2ml/lt (T6)									
Seed treatment with Fipronil @ 3 ml/kg	6.16^{a}	2.80^{a}	3.33^{a}	3.70^{a}	4.10^{a}	3.00^{a}	2.96^{a}	3.13^{ab}	2.66^{a}
+ spray with Fipronil @ 5 ml/lt (T7)	(-2.58)	(-1.81)	(-1.94)	(-2.04)	(-2.13)	(-1.85)	(-1.84)	(-1.90)	(-1.77)
Control (T8)	6.50^{a}	7.03^{c}	7.40^{c}	7.85^{c}	8.23^{c}	7.77^{c}	7.29^{c}	6.95^{c}	6.53^{c}
	(-2.64)	(-2.74)	(-2.80)	(-2.88)	(-2.95)	(-2.87)	(-2.79)	(-2.72)	(-2.65)
CV	15.07	18.05	20.95	13.5	16.5	16.59	17.59	19.38	12.17
SEM±	0.555	0.419	0.542	0.379	0.523	0.391	0.392	0.411	0.24
CD at 5%	1.68	1.27	1.64	1.15	1.58	1.18	1.19	1.24	0.729
	-0.32	-0.31	-0.37	-0.24	-0.33	-0.28	-0.28	-0.31	-0.19
F-value	Ns	**	**	**	**	**	**	**	**

*Data present on parenthesis are square root transformed value;*Mean value of thrips/10 flower bud/plot;** Significant at P (0.05

to analysis of variance (ANOVA) using Randomized Block Design (RBD) (Gomez and Gomez, 1984). Significant means were compared using Duncan's Multiple Range Test (DMRT) at 5% probability test (Duncun, 1955).

RESULTS AND DISCUSSION

Comparative efficacy of some newer insecticides against thrips, *Megalurothrips sjostedti* Trybom. in cowpea during *Zaid* season of the year 2015

In present investigation, efficacy of total seven insecticides were evaluated against *Megalurothrips sjostedti* Trybom The result showed that there was significantly higher thrips population on the cowpea flowers before insecticide application. The insecticidal treatments drastically reduce ($p > 0.05$) thrips population compared with the untreated control. Results presented in the tables 1 and 2 revealed that after 3 days of 1st application the significantly highest per cent reduction in thrips population was recorded in the plot treated with treatment T7 (57.97 per cent) and lowest thrips population 2.80 thrips/flower bud/plant. The per cent reduction in the plots treated with treatments T2, T5, T3 and T1 was ranged from 51.10-52.90 per cent and found statistically at par with each other. Whereas, significantly lowest per cent reduction in thrips population was recorded in the treatment T6 with 21.12 per cent (5.39thrips/flower bud/plant) over control. The per cent reduction in thrips population was significantly higher ($p < 0.05$) in the treatment T7, T5, T3, T2 and T1 as compared to T4 and T6. The observation at 7 days indicated that the number of thrips was slightly increased in all treatments. Although, significantly highest reduction in thrips population was observed in the treatments T7 with 52.51 per cent and lowest 3.33 thrips/flower bud/ plant. The per cent reduction in the plots treated with treatments T2, T1, T3 and T5 was ranged from 47.02-49.75 per cent and found statistically at par with each other. Although, the lowest reduction was recorded in T6 with 17.71 per cent and 5.95 thrips/flower bud/plant which was significantly lower ($P > 0.05$) than the untreated check which had 7.40 thrips/flower bud/plant. After 10 days of 1st application, it was recorded that the significantly highest reduction in thrips population was 50.32 per cent in the treatment T7 with lowest population of 3.70 thrips/ flower bud/plant followed by the treatment T2 (48.31 per cent) with 4.00 thrips/flower bud/plant. However, treatments T3 and T5 were recorded 46.29 and 46.24 per cent reduction in thrips population with 4.13 and 4.16 thrips/flower bud/plant, respectively and found statistically at par with each other. Although, the lowest reduction was found in the treatment T6 with 17.68 per cent (6.30 thrips/flower bud/plant) which was significantly lower ($P > 0.05$) than the untreated check (7.85 thrips/ flower bud/plant). The observations after 14 days of 1st application showed that the significantly highest reduction in thrips population was 47.43 and 46.68 per cent in the treatment T7 and T2, respectively having thrips population ranged from 4.10-4.32 thrips/flower bud/plant. However, there was no significant difference in the per cent reduction

Table 2: Efficacy of some treatments on the per cent reduction of cowpea thrips population during *Zaid* season-2015

Treatments	Per cent reduction in thrips population over control							
	Days after first application				Days after second application			
	3	7	10	14	3	7	10	14
Imidacloprid 17.8SL @ 5ml/lt (T1)	51.10^{d}(45.63)*	49.04^{d}(44.44)	44.69^{cd}(41.95)	37.35^{c}(37.67)	56.31^{cd}(48.62)	57.07^{c}(49.06)	49.11^{d}(44.49)	53.35^{c}(46.92)
Thiamethoxam 25WG @1g/lt (T2)	52.90^{d}(46.66)	49.75^{d}(44.86)	48.31^{de}(44.03)	46.68^{d}(43.09)	57.36^{cde}(49.23)	54.64^{c}(47.66)	48.35^{d}(44.05)	52.48^{c}(46.42)
Seed treatment with Imidacloprid 17.8SL @ 5ml/kg + spray with Imidacloprid 17.8SL @ 5ml/lt (T3)	51.58^{d}(45.90)	48.89^{d}(44.36)	46.29^{d}(42.86)	37.90^{c}(37.98)	54.57^{c}(47.62)	55.19^{c}(47.97)	65.69^{e}(54.15)	54.50^{c}(47.58)
Seed treatment with Imidacloprid 17.8SL @ 5ml/kg + spray with Thiamethoxam 25WG @ 0.5g/lt (T4)	47.04^{c}(43.30)	42.48^{c}(40.67)	42.13^{c}(40.47)	37.34^{c}(37.66)	60.24^{def}(50.91)	56.44^{c}(48.70)	66.90^{e}(54.89)	54.55^{c}(47.61)
Seed treatment with Imidacloprid 17.8SL @ 10ml/kg + spray with Imidacloprid 17.8SL @ 5ml/lt (T5)	52.32^{d}(46.32)	47.02^{d}(43.29)	46.24^{d}(42.84)	38.28^{c}(38.22)	62.38^{f}(52.17)	57.98^{c}(49.59)	34.55^{c}(35.98)	57.40^{c}(49.25)
Seed treatment with Imidacloprid 17.8SL @ 10ml/kg + spray with Monocrotophos 36SL @ 2ml/lt (T6)	21.12^{b}(27.33)	17.71^{b}(24.88)	17.68^{b}(24.86)	11.41^{b}(19.73)	33.69^{b}(35.46)	31.07^{b}(33.87)	05.23^{b}(13.06)	29.44^{b}(32.85)
Seed treatment with Fipronil @ 3 ml/kg + spray with Fipronil @ 5 ml/lt (T7)	57.97^{e}(49.58)	52.51^{e}(46.43)	50.32^{e}(45.18)	47.43^{d}(43.52)	60.91^{ef}(51.30)	57.21^{c}(49.15)	68.12^{e}(55.63)	54.72^{c}(47.72)
Control (T8)	0.00^{a}(0.00)	0.00^{a}(0.00)	0.00^{a}(0.00)	0.00^{a}(0.00)	0.00^{a}(0.00)	0.00^{a}(0.00)	0.00^{a}(0.00)	0.00^{a}(0.00)
CV	4.70	4.30	5.46	5.74	4.59	4.82	5.71	5.60
SEM±	1.13	0.954	1.16	1.06	1.27	1.28	1.39	1.44
CD at 5%	3.43(2.07)	2.89(1.69)	3.53(2.05)	3.22(1.97)	3.87(2.27)	3.90(2.26)	4.22(2.91)	4.37(2.53)

*Data present on parenthesis are angular transformed value

Table 3: Effect of some insecticides on the grain yield of cowpea during *zaid* season of the year 2015

Treatment	Yield/plot (kg)	Yield/ha (q)	Yield increase over control (%)
Imidacloprid 17.8SL @ 5ml/lt (T1)	0.74(1.11)*	8.25(2.95)	65.66
Thiamethoxam 25WG @ 1g/lt (T2)	0.76(1.12)	8.50(2.99)	70.68
Seed treatment with Imidacloprid 17.8SL @ 5ml/kg + spray with Imidacloprid 17.8SL @ 5ml/lt (T3)	0.77(1.12)	8.59(3.01)	72.48
Seed treatment with Imidacloprid 17.8SL @ 5ml/kg + spray with Thiamethoxam 25WG @0.5g/lt (T4)	0.75(1.12)	8.44(2.98)	69.47
Seed treatment with Imidacloprid 17.8SL @ 10ml/kg + spray with Imidacloprid 17.8SL @ 5ml/lt (T5)	0.74(1.11)	8.22(2.95)	65.06
Seed treatment with Imidacloprid 17.8SL @ 10ml/kg + spray with Monocrotophos 36SL 2ml/lt (T6)	0.58(0.89)	6.47(1.98)	29.91
Seed treatment with Fipronil @ 3 ml/kg + spray with Fipronil @ 5 ml/lt (T7)	0.84(1.15)	9.30(3.12)	86.74
Control (T8)	0.44(0.89)	4.98 (1.94)	
CV (%)	19.12	13.56	
SEM±	0.720	0.569	
CD at 5%	0.218(0.100)	1.72(0.339)	

*Data present on parenthesis are square root transformed value

of thrips population between treatment T5, T3, T1 and T4 with 38.28, 37.90, 37.35 and 37.34 per cent, respectively.Following 2nd application after 3 days, the treatments T5, T7 and T4 were observed significantly highest per cent reduction with 62.38 per cent, 60.91 per cent and 60.24 per cent and lowest thrips population varied from 3.00-3.19 thrips/flower bud/plant. Whereas, the lowest per cent reduction in thrips population (33.69 per cent) was recorded in the treatment T6 with 5.23 thrips/flower bud/plant and were significantly lower (P>0.05) than the untreated check (7.77 thrips/flower bud/plant). At 7 days, it was observed that the significantly highest per cent reduction in the plots treated with treatments T5, T7, T1, T4, T3 and T2 ranging from 54.64-57.98 per cent and found statistically at par with each other. However, significantly lowest reduction in the thrips population was obtained in treatment T6 with 31.07 per cent (4.90 thrips/flower bud/plant). Similarly, at 10 days significantly highest per cent reduction in thrips population was obtained in the treatment T7 with 68.12 per cent (3.13 thrips/flower bud/plant) followed by T4 with 66.90 per cent (3.29 thrips/flower bud/plant) and T3 with 65.69 per cent (3.33 thrips/flower bud/plant) and found statistically at par with each other. However, significantly lowest per cent reduction was obtained in treatment T6 (05.23 per cent) with highest thrips population (4.16 thrips/flower bud/plant). After 14 days of 2nd application the highest per cent reduction was recorded in the plots treated with treatments T5, T7, T4, T3, T1 and T2 ranged from 52.48-57.40 per cent with thrips population varied from 2.59-2.90 thrips/flower bud/plant and found statistically at par with each other. However, significantly lowest reduction in the thrips population was obtained in treatment T6 with 29.44 per cent and highest thrips population 4.26 thrips/flower bud/plant but significantly lower (P>0.05) than untreated check (6.53 thrips/flower bud/plant). Pachundkar *et al*. (2013) reported that Fipronil 5 SC (0.005%), acephate 75 SP (0.075%) and carbosulfan 25 EC (0.025%) effectively managed thrips on cluster bean. MahaLakshmi *et al*. (2015) reported that spinosad 45 SC and fipronil 5 SC which were proved very effective against thrips in different crops were also included to assess their efficacy against whiteflie. Inaccordance with the present findings, Ahmad *et al*. (2002) also observed that imidacloprid 25 WP @ 200 gm/acre, proved to be the best against black thrips, *Caliothrips indicus* after first application with mean population of 2.33 black thrips/ leaf. After second spray, imidacloprid showed the same results with 3.50 black thrips/ leaf. The overall of two sprays revealed imidacloprid with 2.75 black thrips/leaf as the best treatment. The above results are also similar with Patel *et al*. (2012) who reported that the seed treatment of imidacloprid 70 WS @ 5g/kg seeds and fipronil 5%SC @ 4 ml/kg seeds found superior in reducing the population of thrips and leafhopper. Significantly higher grain yield was harvested from imidacloprid 70 WS @ 5g/kg seeds and fipronil 5% SC @ 4 ml/kg seeds**.** However, the above findings is in partial agreement with the findings of Iqbal *et al*. (2013) who reported that the lowest number of thrips population was found in acetamiprid treatment (1.64 and 2.33 per flower) followed by imidacloprid with 3.00 thrips per flower and thiamethoxam with 3.68 thrips per flower as against 4.57 thrips per flower in control treatment. imidacloprid against *M. distalis* noticed in present study is in conformity with the report of Dalwadi (2005) who showed superior performance of this insecticide against thrips infesting Indian bean. Similarly, better performance of clothianidin and acetamiprid against thrips infesting Indian bean tend to support the finding of Patil *et al*. (2007) who proved effectiveness of these insecticides against thrips infesting cotton The application of insecticide sprays immediately enhanced the mortality of the pests, whereas, the effect of seed-treatment and detergent did not show distinctive effect on the pests population. Khattak *et al*. (2004) repoted that actara 25WG proved an excellent controlling insecticide against thrips. In the present study effectiveness of actara was minimum which supports the finding of Koenig *et al*. (2001)

who investigated that actara 25 WG lost its efficacy against thrips 240 hour after spray. The effectiveness of imidacloprid 0.005 per cent (84.94 % reduction) and thiamethoxam 0.025 per cent (81.32 % reduction) against *E. motti* was reported by Brar *et al*. (1999).

Effect of some insecticides on the grain yield of cowpea crop

The data presented in Table -3 indicated that the grain yield during *Zaid* season of cowpea var. Pant lobia-1 in different insecticidal treatments applied against the insect pests of cowpea varied significantly from 4.98 to 9.30 q/ha. Maximum grain yield (9.30 q/ha) was recorded from the plots treated with T7 *i*.e. seed treatment with fipronil @ 3 ml/kg + spray with fipronil @ 5 ml/lt followed by treatment T3 (8.59 q/ha) *i*.e. seed treatment with imidacloprid 17.8SL @ 5ml/kg + spray with imidacloprid 17.8SL @ 5ml/lt, T2 (8.50 q/ha) *i*.e. thiamethoxam 25WG @ 1g/lt and T4 (8.44 q/ha) *i*.e. seed treatment with imidacloprid 17.8SL @ 5ml/kg + spray with thiamethoxam 25WG @0.5g/lt. However, lowest yield was obtained in the treatment T8 and T6 with 4.98 and 6.47 q/ha respectively. Highest per cent increase in yield over control (86.74%) was recorded in the plots treated with seed treatment with fipronil @ 3 ml/kg + spray with fipronil @ 5 ml/lt (T7) followed by (T3) seed treatment with seed treatment with imidacloprid 17.8SL @ 5ml/kg + spray with imidacloprid 17.8SL @ 5ml/lt (72.48%). The present findings are in close conformity with Patel *et al*. (2012) reported similar impact of seed treatment of imidacloprid 70 WS @ 5g per kg seeds and seed treatment of fipronil 5% SC @ 4 ml per kg seeds with grain yield of 8.70 q/ha and 7.77 q/ha, respectively. Dobbes *et al*. (2006) reported that seed treatments with Gaucho 4FS at 0.25 lb ai/100 lb seed produced significantly higher lint yield of cotton (1.32 t/ha) than the untreated control (0.48 t/ha).

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