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Efficacy of insecticides against major insect-pests of soybean in gird region at central India

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Abstract
An Experiment comprising 08 treatment and including control was laid out variety RVS 2001-04 to manage girdle beetle and stem fly through seven new insecticides i.e. Thiamethoxam 25 WG @ 100 g/ha, Quinalphos 25 EC @ 1500 ml/ha, Imidacloprid 17.8 SL @ 500 ml/ha, Profenophos 50 EC @ 1000 ml/ha, Acetamiprid 20 SP @100 g/ha, Difenthiuon 50 WP @ 600 g/ha and Triazophos 40 EC @ 1000 ml/ha. The Infestation of girdle beetle was appeared on soybean crop at 30 days after germination. Before treatment plant infestation caused by girdle beetle was initially low ranged from 0.6 to 2.7 per cent. *All mean indicated that Triazophos 40 EC @ 1000 ml/ha recorded minimum plant damage (2.89%) followed by, Profenophos 50 EC @ 1000 ml/ha, Difenthiuron 50 WP @ 600 g/ha and Thiamethoxam 25 WG @ 100 g/ha, recorded 2.9, 3.1, 3.7 and 4.3 per cent plant damage, respectively.*

Quinalphos 25 EC @ 1500 ml/ha, Acetamiprid 20 SP @ 100 g/ha and Imidacloprid 17.8 SL @ 500 ml/ha also effective in reducing girdle beetle damage recorded only 5.0, 5.5 and 5.8 per cent plant damage. Whereas, control recorded maximum damage (11.6%). It is clear that the infestation of girdle beetle was found in increasing trend in all the treated plots as well as untreated control, because it was observed that girdle beetle remain active on soybean crop from 30 days after germination to till harvest of the crop and infest the crop during throughout the season. In comparison to control plant damage was less in all the treatment and yield was found to be significantly more in all the treated plots over control. It shows that treatment were effective to reduce the infestation of girdle beetle.

It is concluded that Thiamethoxam 25 WG @ 100 g/ha was the best treatment followed by Imidacloprid 17.8 SL @ 500 ml/ha, Acetamiprid 20 SP @ 100 g/ha, Quinalphos 25 EC @ 1500 ml/ha and Difenthiuon 50 WP @ 600 g/ha. Triazophos 40 EC @ 1000 ml/ha recorded the highest grain yield of 1441.66 kg/ha with 40.65% increase in yield over control. Other remaining treatments also recorded good range of yield i.e. 1333.10 to 1441.66 kg/ha with 30.08 to 40.65 per cent increase in yield over control. Treatment T_7 i.e. Triazophos 40 EC @ 1000 ml/ha was economical and most remunerative recorded (1:9.80) ICBR. This was followed by Thiamethoxam 25 WG @ 100 g/ha (1:6.14), Acetamiprid 20 SP @ 100 g/ha (1:5.71) and Difenthiuon 50 WP @ 600 g/ha was also economical and recorded 1:4.81 ICBR.

Keywords: insecticides, major insect-pests, soybean, gird, central India

Introduction
Soybean [*Glycine max* (L.) Merrill] is a cash crop and has occupied important place in agriculture and oil economy of the country. Soybean has occupied first rank among oil crops in India since 2005 onwards. The area under soybean cultivation has increased from 8.12 millions hectare to 8.87 million hectare 2006-07 to 2016-17 and production from 7.96 million tonne to 9.46 million tonne, this indication increase of about 9.2% and 18.7% in area and production, respectively. Madhya Pradesh, contributes about 67% area and 56% production in the country and is called as “Soya state”. India, soybean has acquired third position among the oil consumption after groundnut and mustard. During *Kharif* 2014 in India it was sown in 108.83 lakh hectare with production of 104.371 lakh million tonne and productivity was 959 kg/ha. In Madhya Pradesh during this year it was sown in 55.46 lakh hectare with production of 60.25 lakh million tonne and productivity of 1089 kg/ha. The major soybean producing states are Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Utter Pradesh, Andhra Pradesh, Gujarat, Madhya Pradesh and Maharashtra together contribute about 97% to the total area and 96% production of soybean in the country. In Madhya Pradesh, soybean occupies an area of 5.61 million hectare with production of 6.02 million tonne and productivity of 1086 kg/ha.

The crop is infested by more than 275 insect pests on different plant parts of soybean throughout its growth stage and about a dozen of them have been reported causing serious damage to soybean from sowing to harvesting (Ramesh Babu, 2010). The grub of girdle beetle, *Obereopsis brevis*, (Swed) bores the main stem and branches resulting in stunting plant growth and sometime whole plant succumb to injury. The stem fly, *Melanagromyza sojae* attacks the soybean throughout the growing season, but the most vulnerable period is within 3-4 weeks after germination. The maggot may reduce the grain yield up to 33 per cent (Singh and Singh, 1992).
To tackle these pests' problems, it is the therefore essential to monitor the seasonal abundance of these pests so as to understand the factors involved in its build up and suppression. This knowledge is essential for planning and affective management strategy. Application of chemical insecticides is popular among the farming community due to quick and affective control of the pests. Many of the insecticide either have lost their efficacy or banned recently days due to development of resistance in the insect or their residual toxicity problems. There is always a need to know the activities of the pest in a cropping system and evaluate insecticides for effective and economical control of the pest. Hence, the present investigation is planned with the following objective:

1. To evaluate the efficacy of insecticides against major insect-pests of soybean

Material and Methods
The present studies on, "Efficacy of insecticides against major insect-pests of soybean in Gird region at central India", were conducted during the *kharif* season 2017-18 in the experimental field of Department of Entomology, College of Agriculture, Gwalior. The experimental area is having uniform topography, gentle slope and adequate drainage.

Location and climate
Gwalior is situated in Gird zone at the latitude of 26°13' North and longitude 76°14' east with an altitude of 211.52 meters from mean sea level, in Madhya Pradesh. This Region comes under semi-arid sub-tropical climate with extreme weather condition having hot and dry summer and cold winter. Generally monsoon sets in during the last week of June.
Annual rainfall ranges from 700 to 800 mm, most of which falls during last June to the middle of September. In this area winter rains are occasional and uncertain. The maximum temperature goes up to 45 ºC during summer and minimum as low at 5 ºC during winter.

Details of the experiment
1. Design: Randomized block design
2. Replication: Three
3. No. of Treatment: 8
4. Plot Size: 4m x 5m
5. Replication to replication distance: 1.0 m
6. Plot to plot distance: 1.0m
7. No. of plots: 24
8. Row to Row distance: 40cm
9. No. of row per plot: 10
10. Variety: RVS 2001-04

Detail of treatments

S. No	Treatments	Dose/ha
1	Triazophos 40 EC	1000 ml
2	Profenophos 50 EC	1000 ml
3	Difenthiuron 50 WP	600 g
4	Thiamethoxam 25 WG	100 g
5	Quinalphos 25 EC	1500 ml
6	Acetamiprid 20 SP	100 g
7	Imidacloprid 17.8 SL	500 ml
8	Untreated (Control)	-

Observations to be recorded
1. **Stem fly infestation:** Observation on stem fly infestation was recorded on five randomly selected plants per plot at 3, 7 and 14 days after treatment.
2. **Girdle beetle infestation:** Observations was recorded on five selected plants before treatment and at 3, 7 and 14 days after the treatment. Number of infested plant by girdle beetle was counted at five randomly selected plants per plot.

At harvest yield data was recorded and economics of different treatment was also being worked out.

Statistical analysis
The data were subjected to statistical analysis after transformation. The count data were transformed to √x values, while percentages were transformed to √x whose values ranges from 0 to 30 and 70 to 100 and into angular whose values ranges from 0 to 100. The skeleton of analysis of variance is given below.

Table 1: Skeleton of ANOVA

Source of variation	D.F	S.S	M.S.S	F cal	F tab
Replication	(r-1)	SSR	MSR	MSR/MSE	
Treatments	(t-1)	SSTr	MSTr	MStr/MSE	
Error	(r-1)(t-1)	SSE	MSE		
Total	(rt-1)				

r- Number of replications
t- Number of treatments

The 'F' test was used for testing the significant effect of various treatments.

$$SE(m) = \sqrt{\frac{\text{MSE}}{\text{r}}}$$

Where,
'r' is the number of replications.
CD = SE (m) x ± $\sqrt{2}$ × t value at 5% level of significance for error d.f.

Results and Discussion
(A) Efficacy of insecticides against major insect-pests of soybean
An Experiment comprising 08 treatment and including control was laid out variety RVS2001-04 to manage girdle beetle and stem fly through seven new insecticides i.e. Thiamethoxam 25 WG @ 100 g/ha, Quinalphos 25 EC @ 1500 ml/ha, Imidacloprid 17.8 SL @ 500 ml/ha, Profenophos 50 EC @ 1000 ml/ha, Acetamiprid 20 SP @100 g/ha, Difenthiuon 50 WP @ 600 g/ha and Triazophos 40 EC @ 1000 ml/ha. One spray treatment was given at 35 days after germination when infestation of girdle beetle was started. Observations on plant

infestation of girdle beetle was recorded before treatment 3, 7 and 14 days after treatment and similarly stem fly infestation was recorded at 3, 7 and 14 days after germination. Results have been given is table 2 & 3 and graphical presentation of data shown by respectively.

Effect on Stem fly, *Melanagromyza sojae* infestation

At 3 days after germination

At 3 days after germination all the treatments were found significantly superior over control with regards to percent stem tunneling. The stem tunneling ranged from 0.6 to 1.6 per cent among all the insecticide treatments. Treatment T_1 (Thiamethoxam 25 WG @ 100 g/ha) recorded the lowest stem tunneling (0.6%) and at par with rest of the treatment except T_2 (Quinalphos 25 EC @ 1500 ml/ha,) T_6 (Difenthiuron 50 WP @ 600 g/ha) and control. Treatment T_7 (Triazophos 40 EC @ 1000 ml/ha) and T_4 (Profanophos 50 EC @ 1000 ml/ha) were also very effective treatment and recorded lesser stem tunneling ranged from 1.3 to 1.6 per cent. Control recorded the highest stem tunneling (8.2%).

At 7 days after germination

At 7 days after germination again all the treatments were found significantly superior over control. The Stem tunneling ranged from 1.3 to 3.7 per cent among all the treatments whereas control recorded maximum tunneling (9.9%). Further, T_1 (Thiamethoxam 25 WG @ 100 g/ha) recorded significantly the lowest stem tunneling (1.3%) and followed by T_3, T_5, T_2 and T_6 were also showed very good effect in reducing the stem tunneling caused by maggot of stem fly recorded 2.8, 3.0, 3.1 and 3.3 per cent stem tunneling, respectively. Treatment T_3 (Imidacloprid 17.8 SL @ 500 ml/ha) recorded 2.8 per cent tunneling and at par with T_5 (Acetamiprid 20 SP @ 100 g/ha) recorded 3.0 per cent tunneling. T_4 (Profanophos 50 EC @ 1000 ml/ha) was not much effective to control the infestation of stem fly recorded 3.7 per cent tunneling but not par with control. Control recorded the highest tunneling 9.9 per cent.

At 14 days after germination

At 14 days after germination again all the treatments were found significantly superior over control. The Stem tunneling ranged from 3.3 to 7.3 per cent among all the treatments whereas control recorded maximum tunneling (13.9%). Further, T_1 (Thiamethoxam 25 WG @ 100 g/ha) recorded significantly the lowest stem tunneling (3.3 %) and at par with T_3, T_5 and T_2 were also showed very good effect in reducing the stem tunneling caused by maggot of stem fly recorded 4.4, 4.4 and 4.9 per cent stem tunneling, respectively. Treatment T_4 (Profanophos 50 EC @ 1000 ml/ha) recorded 7.3 per cent tunneling and at par with T_7 (Triazophos 40 EC @ 1000 ml/ha) and T_6 (Difenthiuron 50 WP @ 600 g/ha) recorded 7.0 and 5.5 per cent tunneling, respectively. T_4 (Profanophos 50 EC @ 1000 ml/ha) was not much effective to control the infestation of stem fly recorded 7.3 per cent tunneling but not par with control. Control recorded the highest tunneling 13.9 per cent.

Overall mean

From the overall mean it is concluded that Thiamethoxam 25 WG @ 100 g/ha was the best treatment followed by Imidacloprid 17.8 SL @ 500 ml/ha, Acetamiprid 20 SP @ 100 g/ha, Quinalphos 25 EC @ 1500 ml/ha and Difenthiuon 50 WP @ 600 g/ha.

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Dahiphale *et al.* (2007) [2] reported that reduction in tunneled stem length due to stem fly (*Melanagromyza sojae*) was greatest with the soil application of phorate 10 G Whereas, Debjani *et al.* (2008) repoted that thiamethoxam 70 WS, imidacloprid 70 WS, thiamethoxam 500 FS all the three treatments were reduced stem tunneling by *M. sojae* resulting in significant increase in grain yield.

Kumar *et al*. (2010) and Patil and Phadv (2014) [5] reported that triazophos 40 EC @ 800 ml/ha was found most superior in reducing the damage of both girdle beetle and stem fly in soybean.

In present study acetamaprid 20 SP @ 100 ml/ha was very effective in reducing infestation of stem fly even up to harvest of the crop recorded only 6.38 per cent stem tunneling. Difenthuran 50 WP @ 600 ml/ha was also showed very good effect in reducing stem tunneling recorded only 8.60 per cent. Similar finding was also reported by Balaji Vikram *et al.* (2012) [1], who tested Bio-efficacy of new molecules against major pests of soybean and found difenthiuron 50 WP, profenophos 50 EC and emamectin benzoate 5 SG were found to be highly effective against stem fly.

Effect of insecticides on girdle beetle infestation

The Infestation of girdle beetle was appeared on soybean crop at 30 days after germination. Before treatment plant infestation caused by girdle beetle was initially low ranged from 0.6 to 2.7 per cent.

3 days after treatment

At 3 days after treatment, all the treatments were found effective is reducing the plant damage caused by the girdle beetle. Treatment T_7 (Triazophos 40 EC @ 1000 ml/ha) and T_4 (Profenophos 50 EC @ 1000 ml/ha) recorded significantly the lowest plant damage (2.1%) and at par with rest of the treatments except T_1 (Thiamethethom 25 WG @ 100 g/ha), T_2 (Quinalphos 25 EC @ 1500 ml/ha), T_5 (Acetamiprid 20 SP @ 100 g/ha) and T_3 (Imidacloprid 17.8 SL @ 500 ml/ha) and control. T_6 (Difenthiuron 50 WP @ 600 g/ha) are next best effective treatment recorded 3.6 per cent plant damage. The control recorded significant the highest plant damage.

7 days after treatment

Similar trend in effect of treatments was observed. Treatment T_7 (Triazophos 40 EC @ 1000 ml/ha) further recorded significantly lowest plant damage (2.9%) followed $T_{4,}$ T_6 and T_1.

Treatment T_6 (Difenthuran 50 WP @ 600 g/ha) was next best treatment recorded only 3.4% plant damage caused by grub of girdle beetle. T_6 (Difenthiuron 50 WP @ 600 g/ha) and T_1 (Thiamethoxam 25 WG @ 100 g/ha) were equally effective, recorded 4.1 and 4.7 per cent plant damage respectively. T_2 (Quinalphos 25 EC @ 1500 ml/ha) and T_5 (Acetamiprid 20 SP @ 100 g/ha) were also effective and at recorded lesser plant damage ranged from 5.9 at 6.7 per cent. T_2 and T_5 both were at par but differed from control. Control recorded again highest plant damage (15.4%).

14 days after treatment

At 14 days after treatment again all the treatments were effective recorded 6.0 to 9.6 per cent plant damage against 21.1 per cent in control. Triazophos 40 EC @ 1000 ml/ha again recorded lowest plant damage (6.0 per cent) and at par with rest of the treatment except T_1 (Thiamethoxam 25 WG @ 100 g/ha), T_2 (Quinalphos 25 EC @ 1500 ml/ha), T_5 (Acetamiprid 20 SP @ 100 g/ha), T_3 (Imidacloprid 17.8 SL @ 500 ml/ha) and control. T_1, T_2, T_5 and T_3 were also effective recorded only 8.0, 8.7, 9.4 and 9.6 per cent plant damage, respectively.

Overall mean

Over all mean indicated that Triazophos 40 EC @ 1000 ml/ha recorded minimum plant damage (2.89%) followed by, Profenophos 50 EC @ 1000 ml/ha, Difenthiuron 50 WP @ 600 g/ha and Thiamethoxam 25 WG @ 100 g/ha, recorded 2.9, 3.1, 3.7 and 4.3 per cent plant damage, respectively.

Quinalphos 25 EC @ 1500 ml/ha, Acetamiprid 20 SP @ 100 g/ha and Imidacloprid 17.8 SL @ 500 ml/ha also effective in reducing girdle beetle damage recorded only 5.0, 5.5 and 5.8 per cent plant damage. Whereas, control recorded maximum damage (11.6%).

From the table 2 it is clear that the infestation of girdle beetle was found in increasing trend in all the treated plots as well as untreated control, because it was observed that girdle beetle remain active on soybean crop from 30 days after germination to till harvest of the crop and infest the crop during throughout the season. In comparison to control plant damage was less in all the treatment and yield was found to be significantly more in all the treated plots over control. It shows that treatment were effective to reduce the infestation of girdle beetle.

The Infestation of girdle beetle was appeared on soybean crop at 30 days after germination. Before treatment plant infestation caused by girdle beetle was initially low ranged from 0.6 to 2.7 per cent.

From the results it is indicated that Triazophos 40 EC @ 1000 ml/ha recorded minimum plant damage (2.89%) followed by, Profenophos 50 EC @ 1000 ml/ha, Difenthiuron 50 WP @ 600 g/ha and Thiamethoxam 25 WG @ 100 g/ha, recorded 2.9, 3.1, 3.7 and 4.3 per cent plant damage, respectively.

Quinalphos 25 EC @ 1500 ml/ha, Acetamiprid 20 SP @ 100 g/ha and Imidacloprid 17.8 SL @ 500 ml/ha also effective in reducing girdle beetle damage recorded only 5.0, 5.5 and 5.8 per cent plant damage. Whereas, control recorded are maximum damage (11.6%).

The infestation of girdle beetle was found in increasing trend in all the treated plots as well as untreated control, because it was observed that girdle beetle remain active on soybean crop from 30 days after germination to till harvest of the crop and infest the crop during throughout the season In comparison to control plant damage was less in all the treatment and yield was found to be significantly more in all the treated plots over control. It shows that treatment were effective to reduce the infestation of girdle beetle.

Earlier, Parsai *et al.* (1990) [4] tested the efficacy of 11 insecticide tested against cerambycid, *Obereopsis brevis* on soybean and found that crop damage was lowest with Quinalphos (2.9%), followed by phosalone (3.19%) and endosulfan (4.53%). Whereas, Rajput *et al.* (1996) [6] tested the efficacy of 10 insecticides against major insect pest of soybean and found that Quinalphos (0.05%) and moncrotophos (0.05%) were highly effective against the girdle beetle infestation. In present study, Quinalphos 25 EC @1500 ml/ha also very effective recorded is only 6.52% plant damage.

Jain and Sharma (2011) [3] reported that the girdle beetle, *Obereopsis brevis* (Swed.) has been a constant menace to the farmers. The infestation recorded in protected plants was 5.42 per cent and in the unprotected 21.40 per cent in soybean. Commonly recommended insecticides Triazophos 40 EC (0.04%) sprayed twice at an interval of 15 days were found most effective with 70.04 per cent reduction in girdle beetle infestation, as compared to control.

In present study, Thiacloprid 21.7SC @750 ml/ha, Imidaclopride 48 FS 1.25/kg seed + thiamathoxam 25 WG @ 100 g, Difenthiuon 50 WP @ 600 l/ha, Pyriproxyfen 10 EC @ 1000 ml/ha and Imidacloprid 17.8 SL @ 500 ml/ha were very effective treatment against girdle beetle recorded lesser plant damage ranged from 2.74 to 4.79 per cent. Results for corroborate with the similar finding of Balaji Vikram *et al.* (2012) [1] who reported that new insecticides difenthiuron 50 WP, profenophos 50 EC and emamectin benzoate 5 SG were found to be highly effective against stem fly and girdle beetle. Patil and Phadv (2014) [5] tested bio-efficacy of triazophos 20 EC along with new insecticides chlorantraniliprole 18.5 SC, chlorpyriphos 20 SC, spinosad 45 SC, indoxacarb 14.5 SL, flubendiamide 39.35 SC and novaluron 10 EC against girdle beetle and found that triazophos 40 EC @ 800 ml/ha was most superior in reducing the damage of both girdle beetle and stem fly. In the contrary of these findings in present finding all the tested new insecticides were was also very effective in reducing girdle beetle infestation recorded lesser plant damage over control.

Yield and economic

There was significant difference were obtained in yield among the insecticidal treatment. The higher grain yield was obtained in all the insecticidal treatment ranged from 1333.10 to 1441.66 kg/ha in comparison to control (1024.99 kg/ha). Triazophos 40 EC @ 1000 ml/ha recorded the highest grain yield of 1441.66 kg/ha with 40.65% increase in yield over control. Other remaining treatments also recorded good range of yield i.e. 1333.10 to 1441.66 kg/ha with 30.08 to 40.65 per cent increase in yield over control. Treatment T_7 i.e. Triazophos 40 EC @ 1000 ml/ha was economical and most remunerative recorded (1:9.80) ICBR. This was followed by Thiamethoxam 25WG @ 100 g/ha (1:6.14), Acetamiprid 20 SP @ 100 g/ha (1:5.71) and Difenthiuon 50 WP @ 600 g/ha was also economical and recorded 1:4.81 ICBR (table-4 & Fig 6).

There was significant difference were obtained in yield among the insecticidal treatment. The higher grain yield was obtained in all the insecticidal treatment ranged from 1333.10 to 1441.66 kg/ha in comparison to control (1024.99 kg/ha). Triazophos 40 EC @ 1000 ml/ha recorded the highest grain yield of 1441.66 kg/ha with 40.65% increase in yield over control. Other remaining treatments also recorded good range of yield i.e. 1333.10 to 1441.66 kg/ha with 30.08 to 40.65 per cent increase in yield over control. Treatment T_7 i.e. Triazophos 40 EC @ 1000 ml/ha was economical and most remunerative recorded (1:9.80) ICBR. This was followed by Thiamethoxam 25WG @ 100 g/ha (1:6.14), Acetamiprid 20 SP @ 100 g/ha (1:5.71) and Difenthiuon 50 WP @ 600 g/ha was also economical and recorded 1:4.81 ICBR.

Salunke *et al.* (2004) [8] also reported that carbosulfan 25 DS @ 30 g/kg seed, followed by thiamethoxam 70 WS @ 3 g/kg seed gave the highest yield of soybean (27.57 q/ha).

Rajput *et al.* (1996) [6] reported that two insecticide Quinalphos (0.05%), followed by monocrotophos (0.05%) gave maximum grain yield ranged from 20.80 to 22.43 q/ha. Dahiphale *et al.* (2007) [2] reported that the highest seed yield of soybean (2231 kg/ha) was obtained with phorate 10G. In present investigation Imidaclopride 48 FS 1.25 /kg seed + thiamathoxam 25 WG @ 100 g gave the highest grain yield of soybean with 51.76% yield increased over control. Balaji Vikram *et al.* (2012) [1] reported that difenthiuron 50 WP, profenophos 50 EC and emamectin benzoate 5 SG were found to be highly effective against stem fly which resulted in higher grain yield of 2800.00 to 3,100.00 kg/ha. In present study Difenthiuon 50WP @600 g/ha also effective and recorded good yield i.e. 1416.66 with 38.21% increased over control.

Raju *et al*. (2013) [7] spraying of recommended insecticide Quinalphos 25 EC @ 1500 ml/ha was economical and most remunerative recording (1:5.09). Similarly, in present study Quinalphos 25 EC @ 1500 ml/ha was economical and recorded 1: 9.80 ICBR.

Table 2: Effect of insecticide on the incidence of girdle beetle in soybean during *kharif*, 2017-18

Treatments		Dose ml/ha	Plant damage caused by girdle beetle			
			3 DAT	7 DAT	14 DAT	Mean
T_1	Thiamethoxam 25 WG	100 g	1.10 (5.91)*	3.62 (10.88)	4.65 (12.36)	4.34 (11.94)
T_2	Quinalphos 25 EC	1500 ml	1.60 (6.93)	3.80 (11.18)	5.93 (14.00)	5.01 (12.84)
T_3	Imidacloprid 17.8 SL	500 ml	1.60 (6.94)	4.69 (12.42)	7.10 (15.40)	5.76 (13.79)
T_4	Profenophos 50 EC	1000 ml	0.60 (4.34)	2.10 (8.19)	3.40 (10.48)	3.14 (10.11)
T_5	Acetamiprid 20 SP	100 g	1.60 (7.00)	4.12 (11.58)	6.72 (14.98)	5.45 (13.43)
T_6	Difenthiuron 50 WP	600 g	0.60 (4.34)	3.60 (10.77)	4.10 (11.57)	3.69 (11.03)
T_7	Triazophos 40 EC	1000 ml	0.60 (4.34)	2.10 (8.19)	2.86 (9.50)	2.89 (9.66)
T_8	Control	-	2.70 (9.42)	7.22 (15.49)	15.40 (23.08)	11.61 (19.87)
SE(m)±			(1.12)	(0.86)	(0.86)	
CD at 5%			(NS)	(2.61)	(2.61)	

*Figures in parenthesis are angular transformed values.

Table 3: Effect of insecticide on infestation of stem fly on soybean during Kharif, 2017-18

Symbols/Treatments		Dose ml/ha	% stem tunneling caused by maggot stem fly			
			3 DAT	7 DAT	14 DAT	Mean
T_1	Thiamethoxam 25 WG	100 g	0.62 (4.12)	1.32 (6.33)	3.34 (10.22)	1.35 (6.33)
T_2	Quinalphos 25 EC	1500 ml	1.02 (5.64)	3.10 (9.86)	4.86 (12.51)	2.35 (8.50)
T_3	Imidacloprid 17.8 SL	500 ml	0.74 (4.55)	2.78 (9.24)	4.40 (11.78)	2.02 (7.82)
T_4	Profanophos 50 EC	1000 ml	1.57 (7.10)	3.69 (10.86)	7.32 (15.60)	3.40 (10.50)
T_5	Acetamiprid 20 SP	100 g	0.86 (5.10)	3.02 (9.77)	4.40 (11.78)	2.12 (8.16)
T_6	Difenthiuron 50 WP	600 g	1.10 (5.90)	3.27 (10.19)	5.48 (13.46)	2.61 (9.15)
T_7	Triazophos 40 EC	1000 ml	1.28 (6.35)	3.48 (10.53)	7.03 (15.30)	3.15 (10.12)
T_8	Control	-	8.19 (16.54)	9.84 (18.16)	13.85 (21.82)	9.23 (17.58)
SE(m)±			(0.36)	(0.19)	(0.97)	
CD at 5%			(1.10)	(0.57)	(2.94)	

Figures in parenthesis are angular transformed values.

Table 4: Yield and Economic of insecticides during Kharif 2017-18

Treatments		Dose ml/ha	Yield (Kg/ha)	Yield Increased over control	% Yield Increased over control	Additional return (Rs/ha)	Cost of treatment (Rs/ha)	Net returns	Incremental cost benefit ratio (ICBR)
T_1	Thiamethoxam 25WG	100 g	1416.66	391.67	38.21	11760	1645	10115	6.14
T_2	Quinalphos 25 EC	1500 ml	1399.99	375.00	36.58	11250	900	10350	11.5
T_3	Imidacloprid 17.8 SL	500 ml	1361.10	336.11	32.79	10080	705	9375	13.29
T_4	Profenophos 50 EC	1000 ml	1333.32	308.33	30.08	9240	1030	8210	7.97
T_5	Acetamiprid 20 SP	100 g	1383.32	358.33	34.95	10740	1600	9140	5.71
T_6	Difenthiuon 50 WP	600 g	1416.66	391.67	38.21	11760	2022	9738	4.81
T_7	Triazophos 40 EC	1000 ml	1441.66	416.67	40.65	12480	1155	11325	9.80
T_8	Control	-	1024.99						
SE(m)±			35.78						
CD at 5%			108.53						

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