Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2021; 9(1): 1266-1269

Received: 07-11-2020
Accepted: 09-12-2020

DN Kambrekar
Department of Agricultural Entomology, University of Agricultural Sciences, Dharwad, Karnataka, India

CP Mallapur
Department of Agricultural Entomology, University of Agricultural Sciences, Dharwad, Karnataka, India

Shivaleela Ullagaddi
Department of Agricultural Entomology, University of Agricultural Sciences, Dharwad, Karnataka, India

Corresponding Author:
DN Kambrekar
Department of Agricultural Entomology, University of Agricultural Sciences, Dharwad, Karnataka, India

Management of wheat insect pests with Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC under field condition

DN Kambrekar, CP Mallapur and Shivaleela Ullagaddi

Abstract
Field efficacy of the combi-product comprising of Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC against wheat insect pest complex was carried out at Main Agricultural Research Station, Dharwad during 2017-18 and 2018-19. The results revealed that Thiamethoxam 12.6% +Lambda Cyhalothrin 9.5% ZC at 175ml/ha and 150 ml/ha has found superior in reducing the aphids population, shoot fly incidence and dead heart caused by stem borer in wheat during both the spray schedules during both the years of investigations and remained statistically superior in containing the three insect pests occurring on wheat. Both the dosages of the insecticide recorded minimum aphid population and minimum dead hearts caused by both shoot fly in the initial stage of the crop and also the stem borer during the later crop stage. Further, the wheat grain yield (q/ha) recorded in different treatments during 2017-18 indicated maximum yield in the treatment with Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC @ 175 and 150 ml/ha where the yield recorded was 10.50 and 9.70 q/ha, respectively and both the treatments were found statistically on par with each other including the standard check Thiamethoxam 25% WG @ 50 ml/ha (10.0q/ha). While during 2018-19 also, maximum yield recorded with Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC @ 175 (10.40 q/ha). This clearly indicates that Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC @ 175 and 150ml/ha can be utilized in the management of insect pest complex in wheat for obtaining higher yields.

Keywords: wheat insect pests, management, Thiamethoxam+Lambda cyhalothrin

Introduction
Wheat (*Triticum aestivum* L.) is an important food crop of India ranking next to rice. It is stuff of life and has been considered as versatile food crop. It is also considered as "King of cereals" crop from the centuries. Wheat occupies the second position (next to rice) in production among all the cultivated crops in the world due to its feeding boon to mankind. Wheat is number one food directly consumed by human beings and is estimated that more than 35 percent of world's population depends on wheat [1] as its supplies nutrients particularly amino acids than any other single crop. Major wheat growing countries include China, India, USA, Russia, Canada and Maxico. The world average under wheat cultivation is 223.56 million ha. Major wheat growing states in India are Utara Pradesh, Madhya Pradesh, and Punjab [2].
Wheat is temperate crop, but still sustain well under various agro climatic condition. In India there are three species of wheat *viz.*, bread (*Triticum aestivum* L.), durum (*Triticum durum* D.) and dicoccum (*Triticum dicoccum* S.) are being grown. Wheat cultivation in Karnataka is unique where in all the three cultivated species are grown. Wheat is one of the important rabi crop grown mainly in north Karnataka both under rainfed and irrigated condition. The productivity is decreasing due to larger area of wheat is grown under rainfed, non adaptability of improved technologies and attack of many insect pests and diseases. Although damage caused by all the insects is either insignificant or limited to isolated area, other pests inflict serious yield and forage loses [3].
In the last few years shoot fly, stem borer and aphids are causing more damage in the various districts of north Karnataka. Shoot fly causing 26 per cent dead heart and pink stem borer cause 10 per cent dead heart at seedling stage and white ears heads at later crop growth stage, followed by aphids [4]. Although a complex of natural enemies including lady bird bettle, *Coccinella septumpunctata* Linnaeus, green lacewing, *Chrysoperla carnea* (Stephens) and syrphid flies are present in wheat ecosystem, yet the pests control is largely dependent on application of insecticides.

Therefore the present study is taken to evaluated the bio-efficacy of Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC against wheat insect pests under field condition.

Materials and Methods

Evaluation on the efficacy of Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC on the management of wheat shoot fly, stem borer and aphid was carried out at Main Agricultural Research Station, Dharwad during *rabi* season 2017-18 and 2018-19. Dharwad is situated in the transitional tract of Karnataka state at 15°-26' North latitude and 75°-07' East longitude at an altitude of 761.8 meters above mean sea level. The materials used and methodologies followed in conducting the studies are described here under.

The field experiment was carried out using randomized block design with three replications. The popular wheat variety DWR-2 was sown over a plot size of 25m^2 (5m X 5m) at a spacing of 30cm between the rows and 10 cm between the plants. The crop was raised by following all the recommended package of practices with an exception of plant protection measures. A spray volume of 500 l/ha. Two sprays were given, first spray being at 25 days after sowing and second spray at 15 days after the first spray using a hand operated knapsack sprayer fitted with hallow cone nozzle.

Population of wheat aphids was recorded on the basis of number of aphids per plant and per cent dead heart of shoot fly and stem borer were recorded at 5, 10 and 15 days after each application of insecticides while pre-treatment count was done a day before spraying. The data on number of insects was subjected to $\sqrt{(x+0.5)}$ transformation before analysis. The pest population was assessed with suitable statistical analysis.

Results and Discussion

Efficacy of Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC on wheat aphids, shootfly and stem borer

Aphids: Before the spray, the population of aphids was uniform in all the treatments which ranged from 8.33 to 12.67 aphids per plant during 2017-18 (Table 1). At fifth day after first spray, the treatment with Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC @ 175ml/ha and 150 ml/ha has found superior in reducing the aphids population to the tune of 2.78 and 2.83 aphid per plant respectively and was statistically on par with the standard check, Thiamethoxam 25% WG @ 50 ml/ha (2.02 aphids/plant). Similar trend in the efficacy of different treatments was recorded at 10 and 15 days after first spray, where in the treatment with Thiamethoxam 12.6%+ Lambda Cyhalothrin 9.5% ZC @ 175 and 150 ml/ha recorded 3.08 and 3.23 aphids per plant respectively at 15 days after spraying and were found statistically superior over other treatments. Similar trend in the efficacy of treatments was recorded during second spray. During the second year of investigation, the treatment with Thiamethoxam 12.6%+ Lambda Cyhalothrin 9.5% ZC @ 175 and 150 ml/ha excelled in their performance in controlling the aphids in wheat during both the spray schedules.

Shoot fly: The efficacy of the different treatments during two sprays against shoot fly in wheat during 2017-18 and 2018-19 is presented in Table 2. Before the spray, the infestation of shoot fly and stem borer was uniform in all the treatments. At 10 days after the first spray, the treatment with Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC @ 175 and 150 ml/ha recorded lowest incidence of dead hearts caused by shoot fly with 5.69 and 5.73 percent respectively and both the treatments remained statistically on par with the standard check Thiamethoxam 25% WG @ 50 ml/ha (5.59% dead hearts). During the second spray schedule similar trend in the efficacy of treatments was recorded wherein, Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC @ 175 and 150 ml/ha recorded lowest incidence of dead hearts caused by shoot fly at 5, 10 and 15 days after the second application and remained on par with the standard check Thiamethoxam 25% WG @ 50 ml/ha. The same treatments were effective during second year of investigation in recording better performance against the shoot fly.

Stem borer: The efficacy of the different treatment during two sprays against stem borer in wheat during 2017-18 and 2018-19 is presented in Table 3. Against the stem borer, Thiamethoxam 12.6% + Lambda cyhalothrin 9.5% ZC @ 175 and 150 ml/ha recorded lowest incidence of dead hearts with 6.23 and 6.34 percent respectively and both the treatments remained statistically on par with the standard check, Thiamethoxam 25% WG @ 50 ml/ha (5.16% dead hearts). Among the treatments, highest incidence of stem borer was recorded in the treatment with Dichlorvos 76% EC @ 657 ml/ha (11.56%) and quinalphos 25% EC @ 1600 ml/ha (10.31%). However, highest incidence was recorded in the untreated check (15.01%). Similar observations were made after 10 and 15 days after the first spray where in the treatment with Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC @ 175 and 150 ml/ha recorded lower incidence of stem borer and were statistically on par with the standard check. During the second spray and also during the second year of investigation, Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC @ 175 and 150 ml/ha recorded lowest incidence of dead hearts caused by stem borer at 5, 10 and 15 days after application.

Grain Yield (q/ha): The wheat grain yield (q/ha) recorded in different treatments during 2017-18 and 2018-19 indicated in Table-4. There was a statistical difference in the treatments with a yield range of 7.00 to 10.50 q/ha during 2017-18. Maximum yield was recorded in the treatment with Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC @ 175 and 150 ml/ha where the yield recorded was 10.50 and 9.70 q/ha respectively and both the treatments were found statistically on par with each other including the standard check Thiamethoxam 25% WG @ 50 ml/ha (10.0q/ha).<Similar trend in the yield was recorded during the second year of study.

During the present investigations, among the treatments, Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC @ @ 175 and 150 ml/ha was effective in reducing the aphids, shoot fly and stem borer population and has recorded higher yield. Since the aphids appear first on borders of the crop, thiamethoxam 25 WG found significantly superior in reducing the population of aphids [5]. Lambda-cyhalothrin insecticide has activity as a contact and stomach poison. Foliar applications of this insecticide also kill both adult shoot flies and larvae that are exposed to it [6,7] in spring wheat. The present findings are also in line with insecticide formulation which consists of thiamethoxam 12.6% and lambda cyhalothrin 9.4%, which exhibits exceptional systemic characteristics and provides excellent control of a broad range of commercially important pests of wheat. Thiamethoxam is effective against paddy white backed plant hopper [8], which is also used as seed treatment as well as foliar application to control aphids, jassids and thrips and well suited for modern integrated pest management programmes [9].

Table 1: Bio-efficacy of Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC against aphids in wheat during 2017-18 & 2018-19

Tr. No.	Insecticides	Dose (ml/ha)	2017-18							2018-19						
			1st spray (No of Aphids/ plant)				2nd spray (No of Aphids/plant)			1st spray (No of Aphids/ plant)				2nd spray (No of Aphids/ plant)		
			DBS*	5DAS*	10DAS	15DAS	5DAS	10DAS	15DAS	DBS	5DAS	10DAS	15DAS	5DAS	10DAS	15DAS
1	Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC	125	10.33	4.87 (2.32)	5.91 (2.53)	9.33 (3.14)	6.20 (2.59)	4.70 (2.28)	5.13 (2.37)	11.00	4.93 (2.33)	3.67 (2.04)	7.67 (2.86)	4.67 (2.27)	3.13 (1.91)	3.07 (1.89)
2	Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC	150	10.50	2.83 (1.82)	0.62 (1.06)	3.23 (1.93)	2.03 (1.59)	0.58 (1.04)	0.63 (1.06)	10.50	3.58 (2.02)	0.86 (1.17)	3.20 (1.92)	1.77 (1.51)	0.59 (1.04)	0.57 (1.03)
3	Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC	175	8.33	2.78 (1.81)	0.72 (1.10)	3.08 (1.89)	1.87 (1.54)	0.51 (1.00)	0.53 (1.01)	9.33	3.41 (1.98)	0.65 (1.07)	3.05 (1.88)	1.10 (1.26)	0.52 (1.01)	0.50 (1.00)
4	Thiamethoxam 25% WG	50	10.13	2.02 (1.59)	0.53 (1.01)	3.13 (1.90)	2.10 (1.61)	0.63 (1.06)	0.67 (1.08)	9.67	2.91 (1.85)	0.53 (1.01)	3.23 (1.93)	1.53 (1.43)	0.58 (1.04)	0.55 (1.03)
5	Lambda cyhalothrin 5%EC	500	10.67	5.49 (2.45)	6.86 (2.71)	9.33 (3.14)	5.63 (2.48)	6.63 (2.67)	7.23 (2.78)	10.00	5.04 (2.35)	3.95 (2.11)	7.67 (2.86)	4.00 (2.12)	3.77 (2.07)	3.30 (1.95)
6	Quinalphos 25%EC	1600	12.67	7.61 (2.85)	7.68 (2.86)	11.93 (3.53)	7.20 (2.77)	8.67 (3.03)	9.00 (3.08)	11.33	6.09 (2.57)	4.43 (2.22)	9.67 (3.19)	6.00 (2.55)	4.60 (2.26)	4.33 (2.20)
7	Dichlorvos 76%EC	657	9.67	5.06 (2.36)	7.36 (2.80)	10.00 (3.24)	5.73 (2.50)	8.27 (2.96)	8.43 (2.99)	10.67	5.69 (2.49)	4.09 (2.14)	10.67 (3.34)	6.10 (2.57)	5.00 (2.35)	4.77 (2.29)
8	Untreated control	-	10.50	8.91 (3.07)	10.09 (3.25)	13.67 (3.76)	12.00 (3.54)	11.67 (3.49)	12.50 (3.61)	11.00	9.36 (3.14)	7.61 (2.85)	12.67 (3.63)	12.00 (3.54)	10.67 (3.34)	9.67 (3.19)
	S. EM±		-	0.13	0.11	0.503	0.25	0.313	0.219	-	0.06	0.26	0.511	0.272	0.32	0.25
	CD @ 0.05		NS	0.39	0.34	1.52	0.759	0.948	0.884	NS	0.19	0.78	1.55	0.824	0.98	0.75
	CV @ 5%		-	9.27	10.83	10.94	8.19	10.39	9.14	-	10.82	9.86	12.25	10.12	12.34	12.80

DBS* Days before spraying, DAS* Days after spraying, Figures in parenthesis are square root transferred values

Table 2: Bioefficacy of Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC against wheat shoot fly during 2017-18 & 2018-19

Tr. No.	Insecticides	Dose (ml/ha)	2017-18							2018-19						
			1st spray (% Dead heart)				2nd spray (% Dead heart)			1st spray (% Dead heart)				2nd spray (% Dead heart)		
			DBS*	5DAS*	10DAS	15DAS	5DAS	10DAS	15DAS	DBS	5DAS	10DAS	15DAS	5DAS	10DAS	15DAS
1	Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC	125	24.10	18.50 (25.46)	10.35 (18.76)	8.35 (16.79)	6.28 (14.51)	5.53 (13.60)	4.13 (11.72)	16.10	13.10 (21.21)	8.48 (16.92)	7.15 (15.50)	6.03 (14.21)	6.46 (14.72)	5.41 (13.44)
2	Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC	150	22.15	17.85 (24.98)	5.73 (13.84)	5.21 (13.19)	3.56 (10.87)	2.76 (9.56)	2.01 (8.15)	14.56	12.30 (20.52)	7.07 (15.41)	6.34 (14.58)	4.85 (12.72)	2.39 (8.89)	1.71 (7.51)
3	Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC	175	19.80	16.60 (24.03)	5.69 (13.79)	4.91 (12.80)	4.80 (12.65)	2.65 (9.37)	1.85 (7.81)	17.23	10.41 (18.82)	6.98 (15.31)	6.18 (14.39)	4.61 (12.39)	2.32 (8.76)	1.68 (7.44)
4	Thiamethoxam 25% WG	50	21.21	9.12 (17.57)	5.59 (13.67)	4.05 (11.61)	3.05 (10.05)	2.52 (9.13)	1.21 (6.31)	21.32	8.91 (17.36)	7.71 (16.11)	7.12 (15.47)	5.13 (13.09)	2.23 (8.58)	1.08 (5.96)
5	Lambda cyhalothrin 5%EC	500	24.50	18.56 (25.51)	10.98 (19.34)	9.58 (18.02)	7.12 (15.47)	6.18 (14.39)	4.16 (11.76)	20.69	16.10 (23.65)	9.68 (18.12)	8.34 (16.78)	8.10 (16.53)	7.58 (15.97)	5.45 (13.49)
6	Quinalphos 25%EC	1600	22.78	16.65 (24.07)	12.68 (20.85)	10.13 (18.55)	9.50 (17.94)	8.07 (16.50)	6.43 (14.68)	18.96	14.13 (22.07)	10.98 (19.34)	9.41 (17.86)	9.01 (17.46)	8.79 (17.24)	6.13 (14.33)
7	Dichlorvos 76%EC	657	20.40	15.04 (22.81)	13.45 (21.51)	11.6 (19.90)	10.13 (18.55)	9.08 (17.53)	7.09 (15.44)	19.25	13.65 (21.67)	11.65 (19.95)	10.56 (18.96)	9.86 (18.29)	9.07 (17.52)	6.95 (15.28)
8	Untreated control	-	18.95	19.05 (25.87)	18.74 (25.64)	15.01 (22.79)	13.56 (21.60)	11.02 (19.38)	10.81 (19.19)	20.35	18.93 (25.78)	17.54 (24.75)	15.34 (23.05)	14.65 (22.50)	13.33 (21.41)	10.31 (18.72)
	S.E M±			0.51	0.30	0.28	0.26	0.17	0.16		0.27	0.24	0.19	0.20	0.20	0.10
	CD @ 0.05			1.52	0.91	0.85	0.78	0.52	0.47		0.82	0.73	0.57	0.61	0.61	0.31
	CV @ 5%			16.79	15.90	17.96	19.84	15.98	18.82		10.94	13.01	11.66	14.31	17.55	11.90

DBS* Days before spraying, DAS* Days after spraying, Figures in parenthesis are arc sign transferred values

Table 3: Bio-efficacy of Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC against wheat stem borer during 2017-18 & 2018-19

Tr. No.	Insecticides	Dose (ml/ha)	2017-18							2018-19						
			1st spray (% Dead heart)				2nd spray (% Dead heart)			1st spray (% Dead heart)				2nd spray (% Dead heart)		
			DBS*	5DAS*	10DAS	15DAS	5DAS	10DAS	15DAS	DBS	5DAS	10DAS	15DAS	5DAS	10DAS	15DAS
1	Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC	125	12.25	8.31 (16.75)	5.91 (14.06)	5.01 (12.93)	4.57 (12.34)	3.65 (11.01)	2.05 (8.23)	11.23	8.13 (16.56)	7.47 (15.86)	5.23 (13.21)	4.25 (11.89)	3.75 (11.16)	2.01 (8.15)
2	Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC	150	13.80	6.34 (14.58)	4.41 (12.12)	4.10 (11.68)	2.95 (9.89)	2.08 (8.29)	1.09 (5.99)	12.65	5.53 (13.60)	4.85 (12.72)	3.51 (10.79)	2.68 (9.42)	1.23 (6.36)	1.09 (5.99)
3	Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC	175	14.00	6.23 (14.45)	4.39 (12.09)	3.98 (11.50)	3.07 (10.09)	2.01 (8.15)	1.04 (5.85)	12.35	5.43 (13.47)	4.81 (12.66)	3.49 (10.76)	2.53 (9.15)	1.19 (6.26)	1.07 (5.93)
4	Thiamethoxam 25% WG	50	13.50	5.16 (13.12)	4.31 (11.98)	3.51 (10.79)	2.53 (9.15)	1.92 (7.96)	0.58 (4.37)	13.25	5.55 (13.62)	4.88 (12.76)	3.05 (10.05)	2.99 (9.95)	1.02 (5.79)	0.51 (4.09)
5	Lambda cyhalothrin 5%EC	500	14.05	9.38 (17.83)	5.38 (13.41)	5.01 (12.93)	4.98 (12.89)	4.06 (11.62)	2.41 (8.93)	12.85	6.31 (14.54)	5.23 (13.21)	5.03 (12.96)	4.86 (12.73)	4.16 (11.76)	2.35 (8.81)
6	Quinalphos 25%EC	1600	12.95	10.31 (18.72)	6.46 (14.72)	5.13 (13.09)	4.81 (12.66)	3.97 (11.49)	2.01 (8.15)	13.87	10.2 (18.62)	9.74 (18.18)	6.58 (14.86)	5.36 (13.38)	4.67 (12.48)	3.18 (10.27)
7	Dichlorvos 76%EC	657	13.50	11.56 (19.87)	9.74 (18.18)	8.61 (17.06)	6.13 (14.33)	4.51 (12.26)	3.13 (10.19)	13.25	11.35 (19.68)	10.04 (18.47)	8.36 (16.80)	7.35 (15.72)	5.71 (13.82)	4.69 (12.50)
8	Untreated control	-	14.00	15.01 (22.79)	16.27 (23.78)	13.15 (21.25)	10.51 (18.91)	8.93 (17.38)	6.98 (15.31)	13.99	15.25 (22.98)	14.56 (22.42)	13.08 (21.19)	10.21 (18.63)	8.69 (17.14)	5.32 (13.33)
	S. EM±			0.30	0.17	0.22	0.18	0.08	0.08		0.21	0.16	0.18	0.11	0.07	0.06
	CD @ 0.05			0.89	0.50	0.66	0.54	0.25	0.24		0.63	0.48	0.55	0.33	0.20	0.17
	CV @ 5%			17.77	12.73	19.70	20.00	11.92	19.17		13.46	11.30	16.69	12.13	10.15	12.78

DBS* Days before spraying, DAS* Days after spraying, Figures in parenthesis are arc sign transferred values

Table 4: Yield of wheat as influenced by Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC during 2017-18 & 2018-19

Tr. No.	Insecticides	Dose (ml/ha)	Yield (q/ha	
			2017-18	2018-19
1	Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC	125	8.25	8.20
2	Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC	150	9.70	9.60
3	Thiamethoxam 12.6+ Lambda cyhalothrin 9.5% ZC	175	10.50	10.40
4	Thiamethoxam 25% WG	50	10.00	10.10
5	Lambda cyhalothrin 5% EC	500	8.25	8.10
6	Quinalphos 25% EC	1600	8.20	7.95
7	Dichlorvos 76% EC	657	8.20	7.80
8	Untreated control	-	7.00	7.10
	S.EM±		9.85	9.55
	CD @ 0.05		0.80	0.92
	CV @ 5%		9.79	9.91

Conclusion

From the present study it is concluded that Thiamethoxam 12.6%+ Lambda cyhalothrin 9.5% ZC @ @ 175 and 150 ml/ha was effective in reducing the aphids, shoot fly and stem borer population and can be incorporated in the Integrated pest management in wheat.

Reference

1. Borlauge E. Wheat breeding and its impact on World Food Supply. Public lecture at the Third International Wheat Genetics Symposium, Canberra August 1968, 5-9.
2. Akhtar LH, Hussain M, Iqbal RM, Amer M, Tariq AH. Losses in grain yield caused by Russian wheat aphid *Diuraphis noxia* (mordvilko). Journal of Agriculture 2010;26:3-4.
3. Miller RH. Pike KS. Insects in wheat based systems. In: Curtis BC, Rajaram S, Gómez Macpherson H, (eds) Bread wheat: improvement and production, plant production and protection series no. 30, FAO, Rome, 2002, 367-393.
4. Anonymous. Hundred years of wheat research in India. Directorate of wheat research, Kernal, India 2013, 171-172.
5. Katare SA, Patel A, Acharya S. Bio-efficacy of some newly insecticides against foliage feeding barley aphids (*Rhopalosiphum maidis*). Journal of Wheat Research 2015;7(2):29-33.
6. Maienfisch PH, Huerlimann A, Rindlisbacher L, Gsell H, Dettwiler J, Haetten schwiler E *et al*. The discovery of thiamethoxam: a second-generation neonicotinoid. *Pest* Management Science 2001;57:165-176.
7. Elbert A, Hassa M, Springer B, Thielert W, Nauen R. Applied aspects of neonicotinoid uses in crop protection. Pest Management Science 2008;64:1099-1105.
8. Javaregowda, Naik LK. Bioefficacy of thiamethoxam 25 WG against Paddy white backed plant hopper (WBPH) and their natural enemies. Pestology 2005;29:31-33.
9. Srinivasa Babu K, Sharma AK. Bioefficacy of a new molecule, thiamethoxam against foliar aphids of wheat (Triticum aestivum). Indian Journal of Agricultural Sciences 2003;73:574-575.