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BIO-EFFICACY OF THIOMETHOXAM 70WS AGAINST SHOOT PESTS IN WHEAT

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ABSTRACT

An experiment was conducted at the Agronomy Farm, Rajasthan College of Agriculture, MPUAT, Udaipur during two subsequent *rabi seasons* 2012-13 and 2013-14 to evaluate the efficacy of seed treatment of wheat with thiomethoxam 70WS against the shoot feeding insect pests. During both years the shoot feeding pests *viz*., shoot fly, thrips and aphids were observed in significant numbers in the untreated control. The shoot fly (*Atherigona* sp.) incidence began in the last week of December that continued until mid-January during both years with the maximum damage of 7 and 9.75 dead hearts/6 m-row in the last week of December during 2012 and 2013, respectively. Thrips were recorded in significant numbers during first week of February with the seasonal mean being 46.89 thrips per tiller in 2013, while 54.40 thrips per tiller in 2014. Aphids were in significant numbers later in the season with the peak of 184 and 346 aphids per tiller by the second week of March in 2013 and 2014, respectively. Seed treatment of wheat with thiomethoxam 70WS at 1.5g/kg seed and 1.75g/kg seed was effective in providing safety to the crop from the shoot pests (shoot fly, thrips and aphids) recording lowest damage to the crop. The maximum yield of wheat was obtained from the plots treated with 1.75g thiomethoxam 70WS (4.38 kg/plot or 36.11 q/ha) during 2012-13; while during 2013-14 from the plots treated with 1.5g thiomethoxam 70WS (6.37 kg/plot or 52.53 q/ha).

INTRODUCTION

Wheat is grown in India in an area of about 30 million hectares with a production of 93 million tonnes; the national productivity is about 2.98 tonnes/ha. The major wheat producing states are Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan, Bihar, Maharashtra, Gujarat, Karnataka, West Bengal, Uttarakhand, Himachal Pradesh and Jammu & Kashmir. These States contribute about 99.5 per cent of total wheat production in the country. The major wheat growing areas in India fall under assured irrigated zones during the *rabi* season. The more important insect pests of wheat in the country include the wheat thrips, shoot flies, termites, pink borer and cutworms. The sucking insects that infest the crop include the leaf hoppers, plant lice (aphids) and the pentatomid bugs. The others notable are the leaf roller, leaf beetles and weevils (David and Ramamurthy, 2001). The pink stem borer, *Sesamia inferens* (Walker) (Lepidoptera: Noctuidae) is emerging as an important pest of wheat in India due to change in tillage system. It causes severe damage by forming "dead hearts" at seedling stage and "white ears" at ear-head stage. Both tillage conditions and dates of sowing have significant effect on the incidence and damage caused of pink stem borer. It was higher in zero tillage if the crop was sown earlier or later than the recommended time period (Singh, 2012).

MATERIALS AND METHODS

The field trial was conducted at the Agronomy Farm, Rajasthan College of Agriculture, MPUAT, Udaipur for two subsequent *rabi seasons* 2012-13 and 2013-14 to evaluate the efficacy of seed treatment of wheat with thiomethoxam 70WS against shoot feeding insect pests. The trial was laid out in randomized block design (RBD), with four replications, following all the agronomic practices and fertilizer application as per the package of practices recommended for the zone. The row to row and plant to plant distance was maintained as 9 rows of wheat 22.5cm apart in a plot of 6.00 x 2.02 m^2. During both years, natural infestation of termites was not recorded; however, the other shoot feeding pests viz., shoot fly thrips, and aphids were observed.

Observations on the germination percentage and days for cent per cent germination were recorded after the seed treatment from the treated plots as well as the control. The population records for shoot fly incidence

were based on dead hearts per 6m-row from randomly observed 3 rows in a plot for dead hearts; whereas, the population of thrips and aphids were taken on per plant basis. Thrips were sampled by the sondage method collecting thrips on a sticky A-4 size yellow paper; whereas, aphids were counted visually on wheat ear from randomly selected 10 plants. Data thus obtained were expressed on a per plant basis. The yield of wheat per plot was recorded after threshing in the different treatments replication-wise. Samples of wheat, wheat straw and soil from the specified treatments and control were taken and sent for residue analysis as per protocol. Details of the seed treatment made have been presented in Table 1.

RESULTS AND DISCUSSION

Observations on germination of wheat crop showed that 50 per cent germination was recorded on 03/12/2012 and 100 per cent germination was noted on 10/12/2012; Likewise, the next year, 50 per cent germination was recorded on 26/11/2013 and 100 per cent germination was noted on 30/11/2013. There were no visible phytotoxic symptoms under any of the treatments. Very few coccinellids, neuropteran grubs and nabid bugs, as aphid predators, were recorded on wheat crop; hence, there was no significant difference in the population levels in the control and treatments, moreover, the natural enemies were observed 3 months after seed treatment and the crop was practically safe for them.

Table 1. Treatment details of the trial with test chemicals and the dosage

Sl.No.	Treatments	Dose (g. a.i./kg seeds)	Dose (product/kg seeds)
1	Untreated check	---	---
2	Thiomethoxam 70WS	0.70	1.0g
3	Thiomethoxam 70WS	1.05	1.5g
4	Thiomethoxam 70WS	1.21	1.75g
5	Thiomethoxam 35 FS	1.00	3.3ml
6	Chlorpyrifos	0.80	4.0ml
7*	Thiomethoxam 70WS	2.42	3.5g

* Phytotoxicity dose

Table 1. Population of shoot feeding insect pests on untreated wheat (*rabi*, 2012-13)

Dates of Observations	Mean Atm. Temp. (°C)	Mean R. H. (%)	Wind Vel. (kmph)	Sunshine (Hrs.)	Mean Population of Major Shoot Pests		
					Shoot fly (DH/row)	Thrips/tiller	Aphids/tiller
27/12/2012	16.07	51.56	1.5	8.8	7.00	---	---
03/1/2013	13.50	52.50	1.3	8.3	6.50	---	---
10/1/2013	14.75	48.00	1.6	8.4	2.50	---	---
17/1/2013	18.60	59.50	1.7	5.2	2.25	---	---
24/1/2013	13.50	49.50	1.7	9.3	0	---	---
31/1/2013	18.20	45.00	1.0	3.5	0	---	---
Seasonal Mean					4.56	---	---
07/2/2013	16.35	47.50	3.2	8.5	---	52.50	---
14/2/2013	20.00	63.00	1.4	8.1	---	52.50	---
21/2/2013	18.00	54.00	2.1	9.0	---	56.25	---
28/2/2013	18.00	47.50	3.9	10.0	---	26.25	---
Seasonal Mean					---	46.89	---
07/3/2013	24.75	37.50	5.1	9.5	---	---	110.00
10/3/2013	26.00	44.94	3.4	9.5	---	---	184.00
17/3/2013	21.55	64.00	2.2	6.4	---	---	174.00
24/3/2013	25.75	45.50	5.8	10.0	---	---	176.00
31/3/2013	23.15	43.00	3.9	10.4	---	---	82.00
Seasonal Mean					---	---	145.20

Note: Data are means of four replications; shoot fly sampling: mean numbers of dead hearts observed per central row; thrips: mean numbers per 10 tillers collected at random in polythene bags; aphids: mean numbers per 10 tillers at random

Table 2. Population of shoot feeding insect pests on untreated wheat (*rabi*, 2013-14)

Dates of Observations	Mean Atm. Temp. (°C)	Mean R. H. (%)	Wind Vel. (kmph)	Sunshine (Hrs.)	Mean Population of Major Shoot Pests		
					Shoot fly (DH/row)	Thrips/tiller	Aphids/tiller
24/12/2013	13.90	63.50	2.1	7.7	9.75	---	---
31/12/2013	13.50	58.00	1.1	2.0	8.25	---	---
07/1/2014	13.95	60.00	1.6	8.3	2.50	---	---
14/1/2014	15.35	69.50	1.0	7.9	2.25	---	---
21/1/2014	17.00	95.00	1.5	1.0	0	---	---
27/1/2014	14.50	57.00	1.7	8.2	0	---	---
Seasonal Mean					**5.69**	---	---
03/2/2014	17.50	63.00	1.3	7.7	---	16.25	---
10/2/2014	14.00	49.00	1.9	9.2	---	61.25	---
17/2/2014	13.95	60.00	1.6	6.7	---	61.25	---
24/2/2014	15.75	73.00	4.0	6.9	---	78.75	---
Seasonal Mean					---	**54.40**	---
02/3/2014	16.00	52.50	2.3	9.6	---	---	226.00
09/3/2014	20.10	48.50	2.1	9.3	---	---	212.00
16/3/2014	23.65	38.00	1.7	8.8	---	---	346.00
23/3/2014	25.25	51.00	3.1	8.9	---	---	166.00
30/3/2014	26.30	40.00	3.2	9.4	---	---	74.00
Seasonal Mean					---	---	**204.80**

Note: Data are means of four replications; shoot fly sampling: mean numbers of dead hearts observed per central row; thrips: mean numbers per 10 tillers collected at random in polythene bags; aphids: mean numbers per 10 tillers at random

Table 3. Insect pest infestation records under seed treatment in wheat during two crop seasons

S.No.	Treatments (Dose/kg seed)	2012-13			2013-14		
		Shoot fly (Dead heart %)	Thrips (Mean /tiller)	Aphids (Mean / tiller)	Shoot fly (Dead heart %)	Thrips (Mean/ tiller)	Aphids (Mean / tiller)
1.	Untreated Control	15.50^{d} (7.32)	46.88^{b}	145.20^{b}	16.69^{c} (8.49)	54.38^{b}	204.80
2.	1.0g Thiomethoxam 70WS	7.35^{c} (1.64)	3.25^{a}	13.00^{a}	9.96^{b} (3.02)	5.63^{a}	24.00
3.	1.5g Thiomethoxam 70WS	4.84^{ab} (0.71)	2.56^{a}	7.25^{a}	3.97^{a} (0.48)	2.69^{a}	21.35
4.	1.75g Thiomethoxam 70WS	6.27^{bc} (1.20)	2.19^{a}	6.80^{a}	5.24^{a} (0.84)	3.25^{a}	24.70
5.	3.3ml Thiomethoxam 30FS	4.46^{a} (0.61)	2.19^{a}	8.55^{a}	4.34^{a} (0.57)	0.88^{a}	26.65
6.	4.0ml Chlorpyrifos 20 EC	6.85^{c} (1.43)	2.94^{a}	9.10^{a}	5.29^{a} (0.85)	3.00^{a}	24.70
7.	3.5g Thiomethoxam 70WS	4.75^{ab} (0.69)	1.38^{a}	4.60^{a}	3.97^{a} (0.48)	1.44^{a}	20.95
	S. Em. ±	0.575	9.37	31.08	0.759	10.71	65.11
	C. D. (5%)	1.708	27.85	92.34	2.253	31.83	NS

* Figures in parentheses are retransformed per cent values; ** Data with similar letters are statistically at par

The shoot fly (*Atherigona* sp.) incidence was noticed in the last and second last week of December during the year 2012-13 and 2013-14, respectively (Tables: 1 & 2). During both years, the maximum dead heart of 7 dead hearts/6 m-row and 9.75 dead hearts/6 m-row was recorded in the last week of December in the respective years of study. Likewise, the thrips were recorded in significant numbers during first week of February of both years, ranging from 26.25 to 56.25 thrips per tiller with the seasonal mean of 46.89 thrips per tiller and 16.25 to 78.25 thrips per tiller with the seasonal mean of 54.40 thrips per tiller during 2012-13 and 2013-14, respectively. Aphids were observed to be in significant numbers later in the season from the first week of March, with the peak population of 184/tiller and 346/tiller by the middle of March during both years.

Earlier studies indicate that the shoot fly *Atherigona naqvii* Steyskal was most active on wheat under Udaipur conditions from middle of January to middle of March (Kishore *et al*., 1977); whereas, Khan and Singh (1980) observed that the shootfly was more active from the second fortnight of October to mid-December and again during February and March under Jaipur (Rajasthan) conditions. The crop sown between mid-November and mid-December was almost free from shootfly; but, early and late sown crops remained prone to its attack.

In our observations, shoot fly infestation was the maximum in untreated check/ control plot. It was evident that seed treatment had a significant effect on shoot fly infestation with the lowest per cent dead heart being recorded for 3.3ml thiomethoxam 35 FS (0.61%) in 2013; while for 1.5g thiomethoxam 70WS (0.48%) and 3.5g thiomethoxam 70WS (0.48%) during 2014. Since the shoot fly activity period is short, seed treatment gives complete protection. Similarly, the bio-efficacy of seed treatment had a significant negative effect on the mean

Table 4. Mean wheat yield under seed treatment during *rabi*, 2012-13 and 2013-14

S.No.	Treatments	Wheat Yield 2012-13		Wheat Yield 2013-14	
		Kg/plot	Q/ha	Kg/plot	Q/ha
1.	Untreated Control	2.94[a]	24.27	4.79	39.51
2.	1.0g Thiomethoxam 70WS	3.91[bc]	32.27	5.64	46.54
3.	1.5g Thiomethoxam 70WS	3.94[bc]	32.51	6.37	52.53
4.	1.75g Thiomethoxam 70WS	4.38[c]	36.11	6.30	52.01
5.	3.3ml Thiomethoxam 30FS	3.58[ab]	29.54	5.49	45.27
6.	4.0ml Chlorpyrifos 20 EC	4.21[b]	34.69	5.62	46.40
7.	3.5g Thiomethoxam 70WS	4.54[c]	37.46	5.07	41.82
	S. Em. ±	0.267		0.426	
	C. D. (5%)	0.793		NS	

Table 5. Effect of different treatments on the population of associated natural enemies on wheat

S.No.	Treatments	Mean /tiller During 2012-13		Mean /tiller During 2013-14	
		Coccinellids	Nabid bugs	Coccinellids	Nabid bugs
1.	Untreated Control	1.50	1.00 (0.00)	2.75	1.10 (0.22)
2.	1.0g Thiomethoxam 70WS	1.75	1.10 (0.22)	2.25	1.18 (0.40)
3.	1.5g Thiomethoxam 70WS	2.00	1.29 (0.66)	2.25	1.00 (0.00)
4.	1.75g Thiomethoxam 70WS	1.25	1.18 (0.40)	1.50	1.18 (0.40)
5.	3.3ml Thiomethoxam 30FS	1.25	1.10 (0.22)	2.25	1.18 (0.40)
6.	4.0ml Chlorpyrifos 20 EC	2.00	1.31 (0.72)	2.00	1.39 (0.93)
7.	3.5g Thiomethoxam 70WS	2.25	1.37 (0.87)	2.25	1.37 (0.87)
	S. Em. ±	0.303	0.142	0.321	0.158
	C. D. (5%)	NS	NS	NS	NS

population of thrips and aphids during the first year, but was significant only for thrips the next year. Among the recommended doses for seed treatment, the lowest population of thrips per tiller was 2.19 and that of aphids were 6.80 when seeds were treated with 1.75g thiomethoxam 70WS during 2012-13; whereas, the population of thrips was lowest (2.69 thrips/tiller) at the dose of 1.5g thiomethoxam 70WS during 2013-14 (Table 3). The overall effect of seed treatment was notable for shoot fly infestation and thrips when compared with the untreated control under situations when no other pesticide was applied (Table 4).

A comparison for the yield among the different treatments during the first year of trial (2012-13) indicated a significant effect of the seed treatments with the maximum yield (4.38 kg/plot or 36.11 q/ha) from the plots treated with 1.75g thiomethoxam 70WS though the yield was a little more (4.54 kg/plot or 37.46 q/ha) with the yield from the plots treated with 3.5g thiomethoxam 70WS, but was statistically at par. Similarly, during the second year (2013-14) the maximum yield (6.37 kg/plot or 52.53 q/ha) was recorded from the plots treated with 1.5g thiomethoxam 70WS that was at par with that from the plots treated with 1.75g thiomethoxam 70WS (Table 4). The yield of wheat was relatively more during 2013-14 than that in the previous season (2012-13) possibly due to the rainfall received during *rabi* season of 2013-14, earlier sowing and consequent 100 per cent germination being early in 2013-14 than in the previous year, 2012-13. The natural enemies recorded included coccinellids (both adults and their grubs), nabid bugs and very few grubs of *Chrysoperla*. The table 5 presents the effect of seed treatment on the population of associated natural enemies that happened to be non-significant irrespective of the treatment. It was logical as the seed treatment was done 3 months before the visits by natural enemies to feed their prey on the crop by the time wheat crop was safe; hence, seed treatment did not have a detrimental effect on the natural enemies.

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