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Bioefficacy of a new insecticide Spirotetramat 150 OD against cotton aphid *Aphis gossypii* (Glover)

B. VINOTH KUMAR, S. KUTTALAM AND T. SRINIVASAN
Department of Agric. Entomology, Tamil Nadu Agricultural University, Coimbatore-3

Abstract : Studies were conducted to evaluate spirotetramat 150 OD as foliar application for its bioefficacy against the cotton aphid *Aphis gossypii* (Glover) in Tamil Nadu Agricultural University, Coimbatore during 2007. Three field experiments were conducted in farmers field locations in Coimbatore and Erode districts. The results of the studies revealed that spirotetramat 150 OD at 75 g a.i./ha was highly effective in checking the population of aphids and was on par with the standard check, imidacloprid 200 SL at 25 g a.i./ha. The spirotetramat 150 OD @ 75 g a.i./ha treated plots registered a population of 7.0, 3.3 and 0.9 aphids/ 3 leaves in the first, second and third trials respectively, while the untreated check in the respective trials registered a population of 335.8, 58.6 and 17.2 aphids/ 3 leaves. All the spirotetramat treatments also resulted in increased seed cotton yield under field conditions.

Key words: Spirotetramat 150 OD - cotton - aphids- bioefficacy

Introduction

Cotton *(Gossypium hirsutum* Linn.) plays a key role in Indian economy with an export worth of Rs.38,000 crores (Dhawan, 1998). It is grown in an area of 85.6 lakh ha, with a production of 223 lakh bales (Dhawan, 2000). Damage due to insect pests is one of the major concerns hindering productivity of cotton and about 200 pests have been recorded in India. In the early stage, sucking pests like cotton aphid, *Aphis gossypii* Glover), leafhopper, *Amrasca biguttula biguttula* (Ishida), whitefly, *Bemisia tabaci* (Gennadius) and thrips, *Thrips tabaci* Lind. and in the later stage, bollworm complex cause significant damage to the crop. The yield loss in cotton due to sucking pests alone was estimated at 46.5 per cent (Panchabhavi *et al.*, 1990). In the recent past, synthetic pyrethroids have been extensively used for the control of aphids of cotton. However, their indiscriminate use has created a number of problems such as pests developing resistance to insecticides, pest resurgence, and bio concentrations of pesticide residues in consumable produce at harvest. The use of synthetic pesticides in Indian agriculture cannot be dispensed with in view of the targets of food requirements projected for 2020 AD. So, efforts are on to develop chemicals with novel modes of action. In this array, spirotetramat 150 OD is one of the novel and superior chemicals introduced by Bayer Crop Science Pvt Ltd. with an aim to replace the highly effective broad spectrum compounds, which were restricted due to their high mammalian toxicity and other side effects on non-target organisms.

Spirotetramat is a novel insecticide, belonging to the chemical class of ketoenols and is

Table 1. Effect of spirotetramat 150 OD on the population of aphids in cotton

Treatment	Dose (g a.i./ha)	Number of aphids per three leaves														
		Trial I (Sengalipalayam)					Trial II (Nariyampallipudur)					Trial III (Bhavanisagar)				
		PTC	Mean of I spray	Mean of II spray	Mean of III spray	Pooled mean	PTC	Mean of I spray	Mean of II spray	Mean of III spray	Pooled mean	PTC	Mean of I spray	Mean of II spray	Mean of III spray	Pooled mean
Spirotetramat 150 OD	45	354.3	70.7^{c}	25.3^{c}	17.5^{b}	37.9	52.5	27.6^{de}	20.6^{e}	6.9^{C}	18.4	18.7	10.2^{d}	6.4^{d}	1.9^{d}	6.2
Spirotetramat 150 OD	60	392.6	41.3^{b}	15.3^{b}	13.3^{b}	23.3	61.2	18.4^{bc}	9.7b^{c}	3.0^{b}	10.4	16.3	5.5^{C}	2.1^{C}	0.5^{c}	2.7
Spirotetramat 150 OD	150	329.5	15.0^{a}	3.4^{a}	2.6^{a}	7.0	57.6	8.2^{a}	1.6^{a}	0.1^{a}	3.3	19.5	2.3^{a}	0.4^{a}	0.0^{a}	0.9
Monocrotophos 36 SL	450	388.5	58.2"°	43.9^{d}	34.3^{d}	45.4	48.1	18.0"°	12.8°*	3.3"	11.4	17.5	6.2^{C}	2.4^{C}	0.5^{c}	3.0
Imidacloprid 200 SL	25	328.2	21.2^{a}	1.9^{a}	1.0^{a}	8.0	60.5	9.9^{a}	2.7^{a}	0.2^{a}	4.3	18.6	2.2^{a}	0.4^{a}	0.0^{a}	0.8
Acetamiprid 20 SP	20	356.2	70.2°	24.5^{C}	18.6"°	37.8	55.3	16.5"	9.1"	3.4"	9.6	19.4	4.1"	1.3"	0.3"	1.9
Methyl demeton 25 EC	125	368.3	98.5^{d}	29.3°	20.3"°	49.3	46.2	22.5^{cd}	14.7^{d}	5.8^{C}	14.3	18.3	6.6^{C}	2.3^{C}	0.5^{c}	3.1
Dimethoate 30 EC	150	355.2	114.9^{d}	33.5"^{1}	26.0^{cd}	58.1	53.5	29.0^{e}	21.5^{e}	7.6°	19.3	19.3	9.7^{d}	6.2^{d}	1.8^{d}	5.9
Untreated check	-	369.5	355.5^{e}	332.3^{e}	319.6^{e}	335.8	54.3	57.6^{f}	58.8^{f}	59.4^{d}	58.6	19.1	20.1^{e}	19.7^{e}	11.9^{e}	17.2
CD (0.05)	-	-	1.28	0.91	0.85	-	-	0.64	0.53	0.39	-	-	0.36	0.27	0.17	-
CV (%)	-	-	8.42	8.93	9.14	-	-	7.94	8.36	9.36	-	-	8.02	8.62	9.59	-

PTC- Pretreatment count

In a column, means followed by a common letter are not significantly different by LSD (P = 0.05)

Table 2. Effect of spirotetramat 150 OD on seed cotton yield

Treatment	Kapas yield (q ha^{-1})		
	Field trial I	Field trial II	Field trial III
Spirotetramat 150 OD @ 45 g a.i./ha	17.00^{bc}	13.27"	14.19^{d}
Spirotetramat 150 OD @ 60 g a.i./ha	20.64^{ab}	16.1	16.53^{bcd}
Spirotetramat 150 OD @ 75 g a.i./ha	22.59^{a}	la”	18.47^{ab}
Monocrotophos 36 SL @ 450 g a.i./ha	19.33^{a}	18.13^{a}	16.07^{bcd}
Imidacloprid 200 SL @ 25 g a.i./ha	„	14.40"	19.13^{a}
Acetamiprid 20 SP @ 20 g a.i./ha	22.73^{a}	19.20^{a}	17.80^{abc}
Methyl demeton 25 EC @ 125 g a.i./ha	20.93^{ab}	16.47^{a}	15.80^{cd}
Dimethoate 30 EC @ 150 g a.i./ha	19.55^{a}	„	14.73^{d}
Untreated check (Water spray)	„	14.13"	10.67^{e}
CD (0.05)	17.13^{bc}	13.60"	0.66
CV (%)	12.53C	9.80c	4.33

In a column, means followed by a common letter are not significantly different by DMRT (P = 0.05)

a tetramic acid derivative effective against a wide spectrum of sucking insects including aphids (Combs and Reissig, 2008), thrips (Alston *et al.*, 2008), psyllids (Fischer, 2008), mealy bugs (Varela *et al.*, 2008), *etc*. It is said to interfere with lipid biosynthesis, leading to death of juveniles within two to ten days after application (Palumbo, 2007). It is systemic in action, xylem and phloem mobile, allowing acropetal and basipetal translocation in the plant. However, very limited information is available on the foliar spray of spirotetramat against aphids of cotton. It is highly essential to understand the long term implications of usage of this compound for understanding its efficacy under field conditions. Therefore, the present study was carried out to know the potentiality of spirotetramat 150 OD in controlling the aphids of cotton.

Materials and Methods

a. Bioefficacy

Three field trials were conducted one each at Sengalipalayam (Experiment I) and Nariyampallipudur (Experiment II) near Annur, Coimbatore district and Erankattur (Experiment III) near Bhavanisagar, Erode district of Tamil Nadu in randomized block design (RBD) to evaluate the bioefficacy of spirotetramat against aphids in cotton. The first trial was

conducted from September 2006 to February 2007 using cotton variety Super Bunny, second from March to June 2007 using cotton cultivar, MCU 5 and the third from June to August 2007 using cotton cultivar, Brahma. Standard agronomic practices as per the recommendations of Tamil Nadu Agricultural University were followed but without any insecticidal treatments. The treatments were imposed when the pests attained ETL. All the treatments were replicated three times with the plot size of 25 m^2. Spraying was done using a pneumatic knapsack sprayer with 750 litres of spray fluid per hectare. Three rounds of spraying was taken up on 35, 68 and 83 days after sowing (DAS). The treatments used in the present investigation and their dosages are presented in Table 1. The population of aphids were recorded on three leaves one each at top, middle and bottom portions from 10 randomly tagged plants per plot prior to spraying and on 1, 3, 5, 7, 10 and 14 days after spray. The population of aphids on different days was pooled to arrive at mean population of aphids after first, second and third sprayings.

b. Yield assessment

Cotton yield per plot was recorded from each picking and pooled to arrive at the total yield which was expressed as quintals ha^{-1}.

c. Statistical analysis

The data were subjected to square root transformation ($\sqrt{x + 0.5}$) before statistical analysis. The data obtained from field experiments were analysed in randomized block design (RBD) (Gomez and Gomez, 1984) and analysis of data was done using AGRES and IRRISTAT packages.

Results and Discussion

In the first experiment at Sengalipalayam, Coimbatore district, foliar treatments were given when the population of aphid was more than 300 per three leaves. Spirotetramat 150 OD at 75 g a.i./ha reduced the aphid population significantly and the mean population after first spray was 15.0 per three leaves, and was on par with imidacloprid 200 SL at 25 g a.i./ha (21.2 per three leaves) and was followed by spirotetramat 150 OD at 60 g a.i./ha (41.3/ 3 leaves) (Table 1) while the untreated control recorded 355.5 aphids per three leaves. After second spray imidacloprid was found to be the best treatment (1.9/ 3 leaves) and was on par with spirotetramat 150 OD at 75 g a.i./ha (3.38/ leaves), whereas the untreated check recorded as high as 332.3 aphids per three leaves. After third round of spray a similar trend was observed with imidacloprid the best treatment (1.0/3 leaves) and was on par with spirotetramat @ 75 g a.i./ha (2.6/ 3 leaves), while the control registered an aphid population of 319.6 per three leaves. The efficacy of spirotetramat in combination with imidacloprid against cotton aphid was also proved by Duvaresch *et al.* (2008).

A similar trend in the insecticidal efficacy was noticed in the trials at Nariyampallipudur, Coimbatore district, also. The pooled mean population of aphids after three rounds of spraying was found to be least in plots treated with spirotetramat at 75 g a.i./ha (3.3/3 leaves) followed by imidacloprid at 50 g a.i./ha (4.3/ 3 leaves) while the untreated check registered 58.6 aphids per three leaves (Table 1). The order of efficacy of different treatments was spirotetramat at 75 g a.i./ha > imidacloprid at 25 g a.i./ha > acetamiprid at 20 g a.i./ ha > spirotetramat at 60 g a.i./ha > monocrotophos @ 450 g a.i/ha > methyl demeton @ 125 g a.i./ha > spirotetramat at 45 g a.i./ha > dimethoate at 150 g a.i./ha.

In the third trial at Bhavanisagar, Erode district, the pretreatment observation made before the first spray indicated the aphid population varying between 16.3 and 19.5 per three leaves crossing the economic threshold level (>15 per cent of plants infested with aphids). After the first round of spraying imidacloprid @ 25 g a.i./ha and the higher dose of spirotetramat (75 g a.i./ha) recorded the least mean population of aphids (2.2 and 2.3/ 3 leaves, respectively), followed by acetamiprid at 20 g a.i./ha (4.1/ 3 leaves) with the untreated check registering a population of 20.1 aphids per three leaves. A similar trend was observed after second and third spray also (Table 1). Based on the mean population of aphids in different treatments after three sptays, the order of efficacy of different treatments is as follows: imidacloprid at 25 g a.i./ha > spirotetramat at 75 g a.i./ ha > acetamiprid at 20 g a.i./ha > spirotetramat at 60 g a.i./ha > monocrotophos 450 g a.i./ ha > methyl demeton at 125 g a.i./ha > dimethoate at 150 g a.i./ha >spirotetramat at 45 g a.i./ha (Table 1).

All the insecticidal treatments recorded significantly higher yield (13.27 - 22.73 q ha^{-1}) compared to untreated check (9.80 - 12.53 q ha^{-1}) in three field experiments. Spirotetramat 150 OD at 75 g a.i. ha^{-1} recorded an yield of 22.59, 18.13 and 18.47 q ha^{-1}, respectively in first, second and third field trials, and was on par with imidacloprid at 25 g a.i./ha (22.73, 19.20 and l9.13 q ha^{-1} at first, second and third trials, respectively) (Table 2).

To conclude, the results of the studies have indicated that foliar treatment with spirotetramat can be recommended based on the population level of aphids in the field (at ETL) since, spirotetramat 150 OD exhibits excellent physiological selectivity through its systemic transport and interferes with the lipid synthesis, thereby leaving its adverse effects only on the plant sap sucking insects and thus likely to have lesser influence on other fauna. Further, the performance of spirotetramat was comparable with imidacloprid 200 SL which is considered an effective insecticide for the control of sucking insects in a variety of field crops. Both imidacloprid and spirotetramat treatments resulted in increased seed cotton yield. Hence the newer tetramic acid derivative, spirotetramat can be considered for checking aphids in cotton.

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