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Chemical control of blackgram whitefly, *Bemisia tabaci* (Gennadius) with newer insecticidal molecules

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Abstract
During *kharif* 2016 and *rabi* 2016-17, two field trials were conducted at National Pulses Research Centre, Tamil Nadu Agricultural University, Vamban to evaluate some newer insecticidal molecules against whitefly, *Bemisia tabaci* in blackgram. The treatments included seed treatment with imidacloprid 600 FS @ 5 g/kg seed, thiamethoxam 25 WG @ 0.2 g/lit, thiamethoxam 25 WG @ 0.3 g/lit, acetamiprid 20 SP @ 0.2 g/lit, acetamiprid 20 SP @ 0.3 g/lit, clothionidin 50 WDG @ 0.05 g/lit, clothionidin 50 WDG @ 0.1 g/lit, triazophos 40 EC @ 1 lit/ha, novaluron 10 EC @ 1 ml/ lit, buprofezin 25 SC @1 ml/ lit and untreated control. In blackgram, whitefly population will be more during the vegetative stage so, a spray was given with the test insecticides at 20 days after sowing and pretreatment and post treatment counts were taken. The results of the two season trials concluded that clothionidin 50 WDG @ 0.1 g/l was effective in reducing the population of whiteflies in blackgram followed by thiamethoxam 25 WG @ 0.2 g/l.

Keywords: Blackgram, whitefly, *Bemisia tabaci*, clithionidin and thiamethoxam

Introduction
Blackgram is the most important pulse crop having high nutritive value and is native to India. In pulse cultivation, insect pest damage is a serious limiting factor leading to reduced production and productivity. Blackgram is damaged by an array of insect pests from sowing to harvest in the field as well as in the harvested produce in storage [12]. Among these, during the vegetative stage, whitefly, *Bemisia tabaci* is the major sucking insect occurring in blackgram. As whitefly is the vector of yellow mosaic virus, this was considered as a major threat in blackgram cultivation leading to yield reduction to the tune of 25 to 78 per cent [23]. Yellow mosaic virus is the most destructive viral disease that occurs in blackgram. In severe cases, even pods and seeds within also becomes yellow thus reducing the marketability of the produce. Management of yellow mosaic virus primarily involves the management of whitefly which is the vector of this virus. Among various integrated pest management strategies, chemical control is an indispensable component and plays a major role in the management of whitefly population and YMV disease incidence. Hence, the present investigation was carried to study the efficacy of some newer insecticide molecule in the management of blackgram whiteflies in early vegetative growth stage itself to prevent the transmission of yellow mosaic virus through whiteflies.

Materials and Methods
Two field trials were conducted during *kharif* 2016 and *rabi* 2016-17 seasons with the variety VBN (Bg) 3 at National Pulses Research Centre, Tamil Nadu Agricultural University, Vamban, Tamil Nadu. The experiment was conducted in a randomized block design and replicated thrice.

Population of blackgram whitefly, *Bemisia tabaci* was counted by bell-jar method. In this method, the individual plant is covered with a glass jar and the flying insects were counted. As the whitefly population occurs mostly during the vegetative stage, a single spray was given with the test insecticides at 20 days after sowing in the respective treatments. In the treatment *i.e.*, seed treatment with imidacloprid 600 FS @ 5gm/kg seed, no insecticidal spray was given. Before spraying, pre treatment count was taken on the number of whiteflies in all the treatments. After spraying, post treatment counts were taken at 3 and 7 days after spraying.

The treatments are as following:

S. No.	Particulars
1	Seed treatment with imidacloprid 600 FS @ 5gm/kg seed
2	Thiamethoxam 25 WG @ 0.2g/lit
3	Thiamethoxam 25 WG @ 0.3g/lit
4	Acetamiprid 20 SP @ 0.2g/lit
5	Acetamiprid 20 SP @ 0.3g/lit
6	Clothionidin 50 WDG @ 0.05g/lit
7	Clothionidin 50 WDG @ 0.1g/lit
8	Triazophos 40 EC @ 1 lit/ha
9	Novaluron 10 EC @1ml/ lit
10	Buprofezin 25 SC @1 ml/ lit
11	Untreated Control

Results and Discussion

Kharif 2016

Before the spray, number of whiteflies in various treatments ranged from 8.00 to 8.87 per plant. On 3rd day after spraying, less than 1 whitefly per plant was recorded in the treatments clothionidin 50 WDG @ 0.1 g/l (0.87/plant), thiamethoxam 25 WG @ 0.2 g/l (0.93/plant) and clothionidin 50 WDG @ 0.05g/lit (0.93/plant) (Table 1). Among these treatments, clothionidin 50 WDG @ 0.1 g/l was ranked best and rest of the two treatments were on par in efficacy with this treatment. In untreated control, 8.00 whiteflies/plant were observed. On 7 days after spraying, whitefly population was less in the treatment, clothionidin 50 WDG @ 0.1 g/l (2.00/plant). Clothionidin 50 WDG @ 0.05g/lit (3.27/plant) and thiamethoxam 25 WG @ 0.2 g/l (3.20/plant) were found to be next effective treatments in reducing the whitefly population and were on par with each other. In the treatmental plots in which seeds are treated with imidacloprid 600 FS @ 5g/kg seed, 3.00 and 5.53 whiteflies/plant were observed on 3 and 7 days after spraying respectively (Table 1).

When the mean population was taken in to consideration, in the plots sprayed with clothionidin 50 WDG @ 0.1 g/l, comparatively less whitefly population (1.40/plant) was noted and this was followed by thiamethoxam 25 WG @ 0.2 g/l with 2.10 whiteflies/plant. In untreated control a mean population of 8.50 whiteflies/plant was recorded. The neonicotinoid insecticide, thiamethoxam 25 WG @ 0.0125% was effective in reducing the infestation of cotton sucking insect pest *viz.*, leaf hopper (*Amrasca biguttula biguttula* Ishida) on cotton variety, RCH-2 Bt (BG-II) [1]. During *kharif* 2016, highest per cent reduction of whitefly population (83.53) was recorded in the treatment, clothionidin 50 WDG @ 0.1 g/l. The efficacy of clothianidin 50 WDG @ 20 g a.i./ha in reducing the population of sucking pests on Bt cotton supported the present findings[10]. Next to this, 75.29 per cent reduction of whitefly population was recorded in two treatments i.e., thiamethoxam 25 WG @ 0.2 g/l and clothionidin 50 WDG @ 0.05g/lit. Another two treatments which have recorded more than 70 per cent population reduction were thiamethoxam 25 WG @ 0.3g/lit (70.94%) and novaluron 10 EC @1ml/ lit (70.59%). Clothianidin 50 WDG @ 60 g a.i./ha and thiomethoxam 25 WG @ 180 g a.i./ha were effective against whitefly and jassids & thrips respectively in greengram[19]. Earlier clothianidin has been evaluated by many researchers and reported as effective against rice leaf hopper, *Nephotettix virescens* [13], grapes leaf hopper, *Empoasca fabae* [22], Indian bean leaf hopper, *Empoasca kerri* [3] and cluster bean leaf hopper [14].

Table 1: Effect of newer molecules against whitefly, *Bemisia tabaci* of Blackgram (*kharif*, 2016)

S. No.	Treatment	Whitefly population (No./ plant)				% reduction over control
		Precount	3DAS	7 DAS	Mean	
1	Seed treatment with imidacloprid 600 FS @ 5gm/kg seed	--	3.00 (1.73)^{h}	5.53 (2.35)^{i}	4.30	49.41
2	Thiamethoxam 25 WG @ 0.2g/lit	8.87	0.93 (0.96)^{ab}	3.20 (1.79)^{b}	2.10	75.29
3	Thiamethoxam 25 WG @ 0.3g/lit	8.00	1.13 (1.06)^{cd}	3.80 (1.95)^{e}	2.47	70.94
4	Acetamiprid 20 SP @ 0.2g/lit	8.87	1.07 (1.03)^{bc}	4.60 (2.14)^{g}	2.84	66.59
5	Acetamiprid 20 SP @ 0.3g/lit	8.87	1.67 (1.29)^{fg}	4.40 (2.10)^{f}	3.04	64.24
6.	Clothionidin 50 WDG @ 0.05g/lit	8.00	0.93 (0.96)^{ab}	3.27 (1.81)^{b}	2.10	75.29
7	Clothionidin 50 WDG @ 0.1g/lit	8.27	0.87 (0.93)^{a}	2.00 (1.41)^{a}	1.40	83.53
8.	Triazophos 40 EC @ 1 lit/ha	8.00	1.53 (1.24)^{ef}	4.93 (2.22)^{h}	3.23	62.00
9.	Novaluron 10 EC @1ml/ lit	8.27	1.33 (1.15)^{de}	3.67 (1.92)^{d}	2.50	70.59
10.	Buprofezin 25 SC @1 ml/ lit	8.87	1.80 (1.34)^{g}	3.40 (1.84)^{c}	2.60	69.41
11.	Untreated control	8.27	8.00 (2.83)^{i}	9.00 (3.00)^{j}	8.50	--
	CD (0.05)		0.0987	0.0283	--	--
	SEd		0.0473	0.0136	--	--

Rabi 2016 - 17

During this season, pretreatment counts of whitefly ranged from 8.00 to 8.60/plant. On 3rd day after spraying, whitefly population was less in clothionidin 50 WDG @ 0.1 g/l sprayed plots (0.93/plant). Next to this treatment, less whitefly population was recorded in thiamethoxam 25 WG @ 0.2 g/l (1.13/plant) while in the control 9.13 whiteflies were observed per plant (Table 2). Thiamethoxam 25 WG @ 0.2 g/l was highly effective against whitefly, *B. tabaci* by recording minimum population (11.4/10 plants) at 15 days after spraying in mungbean [7]. Thiamethoxam 25 WG @ 0.005% was highly effective with a lower population of 2.60 whiteflies/plant and low MYMV incidence (10.7%) in mungbean [15, 8]. Thiamethoxam 25 WG @ 0.3g/lit with 1.23 whiteflies/plant was on par with the second best treatment *i.e.*, thiamethoxam 25 WG @ 0.2 g/l.

On 7 days after spraying, whitefly population was less in clothionidin 50 WDG @ 0.1 g/l treatment (2.13/plant) followed by thiamethoxam 25 WG @ 0.2 g/l which recorded 3.20 whiteflies/plant. In untreated control, 9.50 whiteflies/plant were noted. With regard to the mean whitefly population, the first and second best treatments *i.e.*, clothionidin 50 WDG @ 0.1 g/l treatment (2.13/plant) and thiamethoxam 25 WG @ 0.2 g/l have recorded 1.54 and 2.16 whiteflies/plant respectively. Among the tested chemicals, only clothionidin 50 WDG @ 0.1 g/l has recorded more than 80 per cent reduction of population over control. Next to this, thiamethoxam 25 WG @ 0.2 g/l recorded 76.82 per cent reduction over control. Thiamethoxam 25 WG @ 0.025 % was effective against brinjal sucking insects and clothianidin 50 WDG @ 0.025% was of mediocre efficacy in controlling the brinjal sucking insects [18].

Table 2: Effect of newer molecules against whitefly, *Bemisia tabaci* of Blackgram (*rabi*, 2016-17)

S. No.	Treatment	Whitefly population (No./ plant)				% reduction over control
		Precount	3DAS	7 DAS	Mean	
1	Seed treatment with imidacloprid 600 FS @ 5gm/kg seed	-	3.00 (1.73)^{h}	5.50 (2.34)^{i}	4.25	54.40
2	Thiamethoxam 25 WG @ 0.2g/lit	8.60	1.13 (1.06)^{bc}	3.20 (1.79)^{b}	2.16	76.82
3	Thiamethoxam 25 WG @ 0.3g/lit	8.00	1.23 (1.11)^{cd}	4.00 (2.00)^{f}	2.62	71.89
4	Acetamiprid 20 SP @ 0.2g/lit	8.00	1.33 (1.15)^{de}	4.80 (2.19)^{h}	3.07	67.06
5	Acetamiprid 20 SP @ 0.3g/lit	8.20	1.80 (1.34)^{g}	4.30 (2.07)^{g}	3.05	67.27
6.	Clothionidin 50 WDG @ 0.05g/lit	8.20	1.53 (1.24)^{f}	3.80 (1.95)^{e}	2.67	71.35
7	Clothionidin 50 WDG @ 0.1g/lit	8.10	0.93 (0.96)^{a}	2.13 (1.46)^{a}	1.54	83.48
8.	Triazophos 40 EC @ 1 lit/ha	8.00	1.43 (1.20)^{ef}	4.90 (2.21)^{h}	3.17	65.99
9.	Novaluron 10 EC @1ml/ lit	8.60	2.00 (1.41)^{g}	3.40 (1.84)^{c}	2.70	71.03
10.	Buprofezin 25 SC @1 ml/ lit	8.00	1.93 (1.39)^{g}	3.53 (1.88)^{d}	2.73	70.71
11.	Untreated Control	8.20	9.13 (3.02)^{i}	9.50 (3.08)^{j}	9.32	--
	CD(0.05)		0.0854	0.0277	--	--
	SEd		0.0409	0.0133	--	--

Conclusion

Based on the two season's trial, it can be concluded that *viz.*, clothionidin 50 WDG @ 0.1 g/l was effective in reducing the population of whiteflies in blackgram followed by thiamethoxam 25 WG @ 0.2 g/l. Both the clothionidin and thiamethoxam, reported as effective insecticides in the present study are neonicotinoid insecticides which gave good control against whiteflies and aphids respectively [11, 5]. Two sprays of clothianidin 50% WDG @ 25 g a.i./ha offered very good protection to cotton crop against the early season sucking pests. Significantly highest seed cotton yield (11.29 q/ha) was harvested from the clothianidin 50% WDG @ 25 g a.i./ha treated plots [16]. In castor, clothianidin 50WDG @ 25 g a.i./ha treatment gave higher per cent reduction of leafhopper (*Empoasca flavescens*) over control (99.2%). Clothianidin has also provided 95.1 per cent reduction in castor thrips (*Retithrips syriacus*) population [6].

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