

Original Research Article

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Bio-efficacy of Certain Selective Insecticides against Whitefly, (*Bemisia tabaci*) on Mungbean, (*Vigna radiata* L., Wilczek)

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A field experiment was conducted on mungbean to evaluate certain selective insecticidal molecules, viz., imidacloprid, dimethoate + triazophos, thiamethoxam, neem oil, dimethoate, oxy-demeton methyl, triazophos and NSKE against the field populations of *B. tabaci*, during Zaid and Kharif season of the year 2014. The results indicated that imidacloprid showed higher efficacy against *B. tabaci* in reducing pest population followed by dimethoate + triazophos. Triazophos and NSKE were found to be least effective.

Introduction

India has distinction of being world's largest producer of grain legumes by growing over a dozen of pulse crops. Legumes occupy an important place in human nutrition, especially among the low-income groups of people in developing countries (Osorio-Diaz *et al.*, 2003). India grows the largest varieties of pulses in the world accounting for about 32% of the area and 23% of the world production and thus holds the first rank in pulses production and consumption. Pulses production has registered a remarkable increase from 14.76 million tonnes in 2007-08 to a record level of 18.24 million tonnes in 2010-11. Productivity of pulses has increased from 625 kg per hectare in 2007-08 to 699 kg

per hectare in 2011-12. Amongst Kharif pulses, Mungbean, *Vigna radiata* (L.) Wilczek is one of the major pulse crops. India is the biggest producer of mung bean having about 3 million hectare cultivated land with a production of 1.42 million tonnes (Singh and Ahlawat, 2005). It is widely cultivated in various states of India and extensively grown in Uttar Pradesh, Madhya Pradesh, Rajasthan, Maharashtra, Orissa, Karnataka, Andhra Pradesh, Gujarat, Bihar, Haryana and Delhi during Kharif and Zaid season.

The losses due to insects and non-insect pests to pulses are of the major single factor responsible low yields as low as 5-6 q/ha (Lal

et al.,1980). In Jammu subtropics, 38 insect pests have been recorded, out of which 22 are regular visitors (Tikoo, 1996). The economically important pests are whitefly, *Bemisia tabaci* Gennadius; aphid, *Aphis craccivora* Koch; pod borer, *Maruca testulalis* Geyer; and Bihar hairy caterpillar, *Spilosoma oblique* Walker. Among these *B. tabaci* (Insecta: Hemiptera: Aleyrodidae) is an important cosmopolitan and polyphagous species. *Bemisia tabaci* is a phloem feeding insect and causing damage directly through feeding and indirectly through the transmission of plant pathogenic viruses, primarily begomoviruses (Oliveira *et al.*, 2001). Yellow mosaic virus causes irregular yellow and green patches on older leaves. Affected plants produce less number of pods and flowers and few seeds. It can cause yield losses of 30 to 70% (Marimuthu *et al.*, 1981).

Since whitefly infestations can easily go unnoticed until they reach high numbers, it is important to minimize potential infestations by employing all possible control tactics prior to chemical control. Initially all whitefly stages typically occupy the underside of leaves of infested plants. The more susceptible stages are the younger nymphs. The later stages, such as the fourth instar and red eye stage, are more difficult to control. Therefore, the best control is achieved when a maximum effort is made to contact the underside of leaves with repeated spray applications targeting the earlier, susceptible stages for a period of about three weeks. Heavier infestations may require more applications for a more extended period of time. Contact insecticides, including soaps and oils, may be more effective early in the growth cycle when the foliage is less dense and contact with young nymphs is more likely. Later in the cropping cycle, when dense foliage is present, a systemically acting material may be more efficient. In order to maintain the pest population under the

economical harming level, the treatments made beginning with the phase of seedlings have the role to avoid rapid multiplication of the fly. However, whitefly chemical control is challenging because it causes natural enemies mortality (Michaud and McKenzie, 2004) and insecticide resistance development to divergent classes of insecticides, especially organophosphates, pyrethroids, cyclodienes and relatively new group of chloro-nicotinyl insecticides. Insecticide resistance in whiteflies is well documented as a widespread phenomenon in those countries in which monitoring of resistance has been conducted (Denholm *et al.*, 2003). Hence there is need to use newer insecticides, which are selective and are also effective at low dose. The neonicotinoid insecticide, imidacloprid and the growth-regulating insecticides (IGRs), buprofezin and pyriproxyfen serve critical role in controlling whiteflies (*B. tabaci*) in arid regions of the world (Denholm *et al.*, 1998). In Jammu & Kashmir, no such work has been done on these aspects. Therefore, keeping in view the economic importance of the crop and the magnitude of the damage caused by insect pests, the present study has been proposed.

Materials and Methods

Experiments were conducted at the Research field, Division of Entomology, Main Campus, Chatha, Jammu during Zaid and Kharif season of the year 2014. The seeds were sown under natural conditions without the application of any manures and fertilizer. The experiments were laid out in randomized block design (RBD) with three replications of each treatment. In view of severity of damage caused by whitefly on mungbean and mark available effective control measures, field trails on mungbean varieties were conducted. In all there were 9 treatments each replicated three times including an untreated control and their details are given below.

The mungbean varieties were sown with 30cm × 10cm spacing in the plot size of 3×2m. The treatments were given to the crop with help of knapsack sprayer. For recording observations, three leaves one each from top, middle and bottom were earmarked in each plot and observations were recorded at 24 hrs before spray and then 1 day, 3 days, 7 days and 14 days after spray. Spray was applied when whitefly population reaches 1-5 per leaf.

Results and Discussion

Zaid, 2014

Efficacy of the insecticides for the management of the pest revealed that all the insecticidal treatments at 1, 3, 7 and 14 days after spray were superior to control in reducing the pest population (Table 1). The data recorded on 1st day after spray revealed that imidacloprid (1.71 whitefly/plant) was found to be most effective treatment in reducing the whitefly population which was at par with dimethoate + triazophos (1.98 whitefly/plant). The next best treatment was thiamethoxam (3.00 whitefly/plant), neem oil (3.33 whitefly/plant), dimethoate (3.68 whitefly/plant) oxy-demeton methyl (4.00 whitefly/plant), triazophos (4.36 whitefly/plant), which were at par with each other. NSKE (4.67 whitefly/plant) was found to be least effective against the whitefly. The observations recorded on 3rd day after spray revealed imidacloprid (1.33 whitefly/plant) was found to be most effective treatment in reducing the whitefly population which was at par with dimethoate + triazophos (1.65 whitefly/plant). The next best treatment was thiamethoxam (2.68 whitefly/plant), neem oil (3.00 whitefly/plant), dimethoate (3.33 whitefly/plant), oxy-demeton methyl (3.70 whitefly/plant), which were at par with each other. Triazophos (4.00 whitefly/plant) and NSKE (4.23 whitefly/plant) were found to be

least effective against the whitefly. On 7th day after spray imidacloprid (2.00 whitefly/plant) was found to be most effective treatment in reducing the whitefly population which was at par with dimethoate + triazophos (2.71 whitefly/plant). The next best treatment was thiamethoxam (3.36 whitefly/plant), neem oil (3.67 whitefly/plant), dimethoate (4.01 whitefly/plant), oxy-demeton methyl (4.35 whitefly/plant), which were at par with each other. Triazophos (4.72 whitefly/plant) was found to be least effective against the whitefly followed by NSKE (5.00 whitefly/plant). The observations on 14th day after spray revealed that imidacloprid (2.69 whitefly/plant) was found to be most effective treatment in reducing the whitefly population which was at par with dimethoate + triazophos (3.35 whitefly/plant). The next best treatment was thiamethoxam (4.00 whitefly/plant), neem oil (4.38 whitefly/plant), dimethoate (4.70 whitefly/plant), oxy-demeton methyl (5.42 whitefly/plant), which were at par with each other. Triazophos (6.00 whitefly/plant) and NSKE (6.83 whitefly/plant) were found to be least effective against the whitefly.

Kharif, 2014

First spray

The data regarding management of whitefly, *Bemisia tabaci* during Kharif 2014 (Table 2) revealed that the observations recorded on 1st day after spray revealed that all the treatments proved significantly superior over control. Imidacloprid (8.00 whitefly/plant) was found to be most effective treatment in reducing the whitefly population which was at par with dimethoate + triazophos (8.69 whitefly/plant). The next best treatment was thiamethoxam (10.00 whitefly/plant), neem oil (11.36 whitefly/plant), dimethoate (13.00 whitefly/plant), triazophos (14.33 whitefly/plant) and oxy-demeton methyl

(16.00 whitefly/plant), which were at par with each other. NSKE (18.67 whitefly/plant) was found to be least effective against the whitefly. The observations recorded on 3rd day after spray revealed that all the treatments proved significantly superior over control. Imidacloprid (6.69 whitefly/plant) was found to be most effective treatment in reducing the whitefly population which was at par with dimethoate + triazophos (7.34 whitefly/plant). The next best treatment was thiamethoxam (8.67 whitefly/plant), neem oil (10.00 whitefly/plant), dimethoate (12.00 whitefly/plant), triazophos (12.67 whitefly/plant), which were at par with each other. Oxy-demeton methyl (14.00 whitefly/plant) and NSKE (16.68 whitefly/plant) were found to be least effective against the whitefly. The observations recorded on 7th day after spray revealed that all the treatments proved significantly superior over control. Imidacloprid (6.00 whitefly/plant) was found to be most effective treatment in reducing the whitefly population which was at par with

dimethoate + triazophos (6.67 whitefly/plant). The next best treatment was thiamethoxam (8.00 whitefly/plant), neem oil (9.00 whitefly/plant), dimethoate (11.33 whitefly/plant), triazophos (11.68 whitefly/plant), which were at par with each other. Oxy-demeton methyl (12.68 whitefly/plant) was found to be least effective against the whitefly followed by NSKE (15.70 whitefly/plant). On 14th day after spray revealed that all the treatments proved significantly superior over control. Imidacloprid (6.98 whitefly/plant) was found to be most effective treatment in reducing the whitefly population which was at par with dimethoate + triazophos (7.69 whitefly/plant). The next best treatment was thiamethoxam (9.00 whitefly/plant), neem oil (10.34 whitefly/plant), dimethoate (12.05 whitefly/plant), triazophos (12.78 whitefly/plant), which were at par with each other. Oxy-demeton methyl (13.33 whitefly/plant) and NSKE (17.00 whitefly/plant) were found to be least effective against the whitefly.

Treatments each replicated three times including an untreated control and their details

S.No.	Treatments	Dose/Concentration
T ₁	Dimethoate 30 EC	0.03 %
T ₂	Dimethoate 30 EC+Triazophos 40 EC	Seed treatment @ 5ml/kg + 0.04 % foliar spray respectively
T ₃	Oxydemeton methyl 25 EC	0.03 %
T ₄	Imidacloprid 17.8 SL	Seed treatment @ 3 ml / kg + 2 sprays @ 0.008 % at 15 days interval
T ₅	Triazophos 40 EC	0.04 %
T ₆	NSKE	5 %
T ₇	Thiamethoxam 25WG	0.0125%
T ₈	T8 Neem oil	0.15%
T ₉	T9 Water (Control)	-

Table.1 Bio-efficacy of certain selective insecticides against whitefly on mungbean during, Zaid season 2014

S.No.	Treatments	Concentration /Dose	Mean whitefly population/plant				
			1DBS*	1DAS*	3DAS	7DAS	14DAS
T₁	Dimethoate 30 EC	0.03 %	6.68 (2.76)	3.68 (2.13)	3.33 (2.08)	4.01 (2.24)	4.70 (2.37)
T₂	Dimethoate 30 EC+Triazophos 40 EC	Seed treatment @ 5ml/kg + 0.04 % foliar spray respectively	4.67 (2.38)	1.98 (1.70)	1.65 (1.69)	2.71 (1.91)	3.35 (2.08)
T₃	Oxydemeton methyl 25 EC	0.03 %	6.00 (2.34)	4.00 (2.26)	3.70 (2.16)	4.35 (2.31)	5.42 (2.54)
T₄	Imidacloprid 17.8 SL	Seed treatment @ 3 ml / kg + 2 sprays @ 0.008 % at 15 days interval	4.33 (2.30)	1.71 (1.68)	1.33 (1.52)	2.00 (1.73)	2.69 (1.90)
T₅	Triazophos 40 EC	0.04 %	6.67 (2.76)	4.36 (2.29)	4.00 (2.23)	4.72 (2.38)	6.00 (2.65)
T₆	NSKE 5 %	5 %	6.04 (2.64)	4.67 (2.38)	4.23 (2.29)	5.00 (2.45)	6.83 (2.79)
T₇	Thiamethoxam 25WG	0.0125%	6.34 (2.69)	3.00 (2.00)	2.68 (1.88)	3.36 (2.09)	4.00 (2.24)
T₈	Neem oil	0.15%	6.33 (2.71)	3.33 (2.06)	3.00 (2.00)	3.67 (2.13)	4.38 (2.30)
T₉	Water (Control)	-	6.67 (2.76)	6.00 (2.65)	6.67 (2.76)	6.70 (2.77)	7.89 (2.94)
	C.D at 5%	-	N.S.	0.484	0.394	0.403	0.375
	SE(m)		0.155	0.160	0.130	0.133	0.124

*DBS - Days before spray and DAS - Days after spray Values in parenthesis are square root transformed

Table.2 Bio-efficacy of certain selective insecticides against whitefly on mungbean during, Kharif season 2014

S.N o.	Treatments	Concentration/ Dose	Mean whitefly population/plant									
			1 st spray					2 nd spray				
			1DBS*	1DAS *	3DAS	7DAS	14DA S	1DBS	1DAS	3DAS	7DAS	14DAS
T₁	Dimethoate 30 EC	0.03 %	22.33 (4.83)	13.00 (3.74)	12.00 (3.60)	11.33 (3.51)	12.05 (3.60)	13.36 (3.77)	12.00 (3.61)	10.67 (3.41)	10.00 (3.31)	9.00 (3.14)
T₂	Dimethoate 30 EC+Triazophos 40 EC	Seed treatment @ 5ml/kg + 0.04 % foliar spray respectively	21.00 (4.69)	8.69 (3.10)	7.34 (2.88)	6.67 (2.76)	7.69 (2.94)	9.00 (3.17)	6.68 (2.75)	5.66 (2.56)	4.33 (2.30)	3.32 (2.06)
T₃	Oxydemeton methyl 25 EC	0.03 %	22.35 (4.83)	16.00 (4.12)	14.00 (3.87)	12.68 (3.69)	13.33 (3.78)	15.67 (4.07)	14.36 (3.91)	13.01 (3.73)	12.00 (3.60)	11.35 (3.50)
T₄	Imidacloprid 17.8 SL	Seed treatment @ 3 ml / kg + 2 sprays @ 0.008 % at 15 days interval	20.00 (4.58)	8.00 (3.00)	6.69 (2.77)	6.00 (2.64)	6.98 (2.79)	8.00 (2.99)	5.33 (2.51)	4.00 (2.22)	3.32 (2.07)	2.36 (1.82)
T₅	Triazophos 40 EC	0.04 %	23.67 (4.95)	14.33 (3.91)	12.67 (3.69)	11.68 (3.55)	12.78 (3.70)	14.69 (3.93)	13.00 (3.74)	11.68 (3.55)	10.68 (3.41)	10.00 (3.31)
T₆	NSKE 5 %	5 %	23.68 (4.97)	18.67 (4.43)	16.68 (4.20)	15.70 (4.08)	17.00 (4.25)	18.66 (4.43)	16.35 (4.16)	14.66 (3.95)	13.32 (3.78)	13.00 (3.73)
T₇	Thiamethoxam 25WG	0.0125%	21.33 (4.72)	10.00 (3.31)	8.67 (3.11)	8.00 (3.00)	9.00 (3.16)	10.68 (3.41)	8.32 (3.05)	7.00 (2.82)	6.33 (2.70)	6.00 (2.63)
T₈	Neem oil	0.15%	25.00 (5.10)	11.36 (3.51)	10.00 (3.31)	9.00 (3.16)	10.34 (3.36)	12.35 (3.64)	11.00 (3.46)	9.33 (3.20)	8.36 (3.05)	7.36 (2.87)
T₉	Water (Control)	-	23.67 (4.97)	24.68 (5.07)	25.67 (5.16)	26.69 (5.26)	28.00 (5.38)	28.34 (5.41)	27.67 (5.35)	28.00 (5.38)	28.33 (5.41)	29.33 (5.50)
	C.D at 5%	-	NS	0.295	0.301	0.316	0.309	0.477	0.299	0.391	0.304	0.547
	SE(m)		0.127	0.098	0.108	0.105	0.102	0.158	0.099	0.129	0.100	0.181

*DBS - Days before spray and DAS - Days after spray Values in parenthesis are square root transformed

Second spray

The data regarding management of whitefly, *Bemisia tabaci* during Kharif 2014 (Table 2) revealed that the observations recorded on 1st day after spray revealed that all the treatments proved significantly superior over control. Imidacloprid (5.33 whitefly/plant) was found to be most effective treatment in reducing the whitefly population which was at par with dimethoate + triazophos (6.68 whitefly/plant). The next best treatment was thiamethoxam (8.33 whitefly/plant), neem oil (11.00 whitefly/plant), dimethoate (12.00 whitefly/plant), triazophos (13.00 whitefly/plant) and oxy-demeton methyl (14.36 whitefly/plant), which were at par with each other. NSKE (16.35 whitefly/plant) was found to be least effective against the whitefly. The observations recorded on 3rd day after spray revealed that all the treatments proved significantly superior over control. Imidacloprid (4.00 whitefly/plant) was found to be most effective treatment in reducing the whitefly population which was at par with dimethoate + triazophos (5.66 whitefly/plant). The next best treatment was thiamethoxam (7.00 whitefly/plant), neem oil (9.33 whitefly/plant), dimethoate (10.67 whitefly/plant), triazophos (11.68 whitefly/plant), which were at par with each other. Oxy-demeton methyl (13.01 whitefly/plant) and NSKE (14.66 whitefly/plant) were found to be least effective against the whitefly. The observations recorded on 7th day after spray revealed that all the treatments proved significantly superior over control. Imidacloprid (3.32 whitefly/plant) was found to be most effective treatment in reducing the whitefly population which was at par with dimethoate + triazophos (4.33 whitefly/plant). The next best treatment was thiamethoxam (6.33 whitefly/plant), neem oil (8.36 whitefly/plant), dimethoate (10.00 whitefly/plant), triazophos (10.68 whitefly/plant), which were at par with each other. Oxy-demeton methyl (12.00 whitefly/plant) was found to be least effective against the whitefly followed by NSKE (13.32 whitefly/plant). On 14th day after spray revealed

that all the treatments proved significantly superior over control. Imidacloprid (2.36 whitefly/plant) was found to be most effective treatment in reducing the whitefly population which was at par with dimethoate + triazophos (3.32 whitefly/plant). The next best treatment was thiamethoxam (6.00 whitefly/plant), neem oil (7.36 whitefly/plant), dimethoate (9.00 whitefly/plant), triazophos (10.00 whitefly/plant), which were at par with each other. Oxy-demeton methyl (11.35 whitefly/plant) and NSKE (13.00 whitefly/plant) were found to be least effective against the whitefly. The efficacy and superiority of imidacloprid was observed in the present study is in line with the results obtained by Mohan and Katiyar (2000) who reported that imidacloprid was the most effective in suppressing the whitefly population and Dandale *et al.*, (2001) who also reported that imidacloprid (Gaucho 70 WS @ 5g/kg) as seed treatment was found effective for the control of sucking pests of cotton. Present findings are in agreement with that of Afzal *et al.*, (2002) who reported imidacloprid 25 WP @ 200g/acre as the most effective for the control of white fly. The present findings are in contradiction with Mandal (2015) who reported that the treatments comprising seed treatment with thiamethoxam 70 WS @ 3 g/kg seed followed by two foliar applications of imidacloprid 17.8 SL @ 0.4 ml/L at 15 days interval was found superior over all other treatment and Dar *et al.*, (2002b) who reported that endosulfan @ 0.07%, monocrotophos @ 0.04%, dimethoate @ 0.03%, NSKE @ 5% alone and in combination were effective and economic control of insect pest complex of green gram. They also reported that Dimethoate in combination with NSKE (5%) was found to be the most effective against whiteflies and jassids, while endosulfan proved to be the best against pod borers. NSKE (5%) in combination with all the insecticides included in the study showed increase in yield compared to when used alone.

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