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Management of mungbean flower thrips with newer insecticide molecules under field conditions of hot arid Rajasthan

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Abstract

Mungbean (*Vigna radiata* L.), due to its short duration and low water requirement, is one of the important crops of Jaisalmer. Agroecology of arid region has been changed due to numerous factors including IGNP and groundwater irrigation. Climatic factors have increased the activities of many insect-pests which were either minor or never occurred before. Among various insect pests, Flower thrips is an important insect pest of mungbean crop which demanding control interventions. Therefore, the purpose of this study was to evaluate the effectiveness of different pesticides against mungbean flower thrips. Thrips population was observed initially during the first half of August and reached their peak in the latter half of August. Among various insecticides, Diafenthiuron reduced 74.7 and 75.2 percent population of thrips after first and second spray, respectively followed by Tolfenpyrad (66.0 and 66.5 percent). The data revealed that the significantly highest yield was recorded in T₂ Diafenthiuron (12.88 q/ha) followed by Tolfenpyrad 15 EC (12.30 q/ha) and Thiamethoxam (11.75 q/ha). Among all the treatments, control treatment was recorded the lowest yield of 8.77 q/ha. The highest net profit of Rs 31896.5 per hectare was attained in Diafenthiuron 50 WP followed by Tolfenpyrad 15 EC fetching 24651.0 per hectare and Thiamethoxam 25 WG with net return of 23728.6 per ha. However, the maximum B:C ratio of 10.89 was attained with Thiamethoxam followed by Diafenthiuron (8.7). This study provides the use of alternative insecticides in effective pest management programme of mungbean thrips.

Keywords: Mungbean, thrips, management, arid Rajasthan

Introduction

Mungbean crop is one of the most important pulse crop India. In Rajasthan, mungbean crop grown in an Area 23.35 Lakh ha with production of 11.79 Lakh Tennes. However, the productivity of green gram lies around 505 kg/ha which is lower than national average (663 kg/ha) and much below the Maharashtra (1135 kg/ha) (DES, GoI, Min. of Agri. & FW (DA&FW) 2022-23).

Unfortunately, green gram productivity remains lower mainly limited by abiotic and various biotic factors associated including insects. Among several biotic constraints, the thrips, *Megalurothrips usitatus* (Thysanoptera: Thripidae) is a major field insect pest inflicting threats to the crop yield. Duraimurugan & Tyagi (2014) identified the flower thrips *M. usitatus* as most devastating. Both larvae and adults feed on pollen and rasp flower parts and also suck the plant fluid leaking from the wounded plant parts. The *M. usitatus* induces necrosis and early shedding of flower buds and blooms as a result of oviposition and feeding, which inhibits pod development, lowers the market value of the crop, and reduces yield output (Fan *et al.*, 2013) [3].

During the vegetative stage, *M. usitatus* prefers to suck plant juice from terminal buds and rasps the top unopened trifoliate leaves, which can quickly migrate to flowers, once formed during the flowering stage (Gitonga, 1999) [4]. In addition, *Megalurothrips usitatus* can act as vector of the tobacco streak virus (TSV) to groundnut, cowpea, and sunflower, causing peanut stem necrosis disease (PSND), which is a major disease of groundnut (Prasada Rao *et al.*, 2003, Shukla *et al.*, 2005) [7, 8]. Mostly commonly applied insecticides for the control of sucking insect-pests are systemic in nature. These includes Thiamethoxam, Imidacloprid, Acetamiprid etc. Thiamethoxam 25 WDG is very popular insecticide among farmers

commonly called as Bhujia due to its granules appearance to Bhujia. There has been reports of residues of these insecticides in spice crops in Rajasthan (Anonymous, 2024) [1].

Despite, hazards associated with pesticide uses, control of insect-pests with insecticides is still preferred by the farmers because of its quick action, effectiveness and adaptability to various situations. The effectiveness and impact of insecticides on target pests are affected by a mix of factors related to the insects, the insecticides used, and the surrounding environment. Therefore, the purpose of this study was to evaluate the effectiveness of different novel insecticides against flower thrips under field conditions of hot arid Rajasthan.

Materials and Methods

Field studies were conducted at the Research Farm of ICAR Central arid zone research institute Regional Research Station Jaisalmer (Lat 26.923636°; Long 70.973181°) Rajasthan during *khariif* 2021 and 2022. IPM 2-3 variety of mungbean was sown during Second week of July following the recommended agronomic practices of the region (Godara *et al.*, 2022) [5] except plant protection measures.

The experiment consisted of eight insecticide treatments representing different IRAC mode of action groups, *i.e.* (<https://irac-online.org/documents/moa-classification/>).

Table (1) consists of details of each insecticide such as trade name and dosage used. Treatments imposed twice at 15 days interval following the Randomized Block Design (RBD) along with three replications. Knapsack sprayer was used for application of treatments. Sprayer tank was thoroughly washed after application of each insecticidal treatment. In each treated plot 3 plants were randomly tagged. Population of thrips was counted on five flowers of each tagged plant. First observation was made one day before spray and later on 1, 3 and 7 days after both sprays. Grain yield was recorded from each plot at crop maturity to assess the impact of insecticidal treatments. Data recorded were analyzed using One way analysis of variance OP stat software Developed by HAU, Hissar. The reduction percentage was calculated according to Henderson and Tilton (1955) with the following equation:

$$1 - \left(\frac{\text{Number of insects in control before spray} \times \text{Number of insects in treatment after spray}}{\text{Number of insects in control after spray} \times \text{Number of insects in treatment before spray}} \right) \times 100$$

The cost of treatment was estimated based on retail price of insecticides. Net profit was estimated based on the income of grain yield and the cost per hectare from treatments.

Results and Discussion

Efficacy of different insecticides against flower thrips

In mungbean, Diafenthiuron reduced 74.7 and 75.2 percent thrips population with yield of 12.88 q/ha and treatment Emamectin benzoate was least effective (efficacy of 43.6 and 45.6) with yield of 9.62 q/ha. Flower thrips occurred on the mungbean crop during both the years. Pretreatment population of thrips ranged between 2.35-2.63 and 2.52-2.80 thrips plant⁻¹ during I and II spray, respectively (Table 2). Following the application of insecticides, after one day of spraying reduction of thrips population was recorded highest in the treatment of Diafenthiuron with 38.7% reduction. Treatment Diafenthiuron remained maximum efficacious up

to 3, 5 and 7 days after spray. Maximum efficacy of Diafenthiuron was obtained at 5 DAFS. There was surge in thrips population after 5th days Treatment Spinosad recorded the lowest reduction at 1 DAFS (17.7 per cent), at 5 DAFS (35.6 percent) and 7 DAFS (38.0 percent). However, at 3DAFS the lowest reduction of thrips was recorded in Emamectin benzoate (up to 25.6 percent). Similarly during second spraying, Thrips population was homogenous and ranged from 2.52-2.80 thrips per flower in various plots. Treatment Diafenthiuron followed the similar trend like first spraying and stood most efficacious among all the treatments at 1, 3, 5 and 7 DAFS with 42.5, 57.9, 75.2 and 72.3 percent reduction, respectively. Treatment Spinosad showed the lowest efficacy at 1, 3, 5 and 7 DAFS with 21.4, 32.0, 39.1 and 39.2 percent reduction, respectively. Next best treatments during both the sprays were Thiamethoxam (71.2 and 70.8) and Tolfenpyrad (66.0 and 66.5) in terms of percent thrips population reduction.

The results of Karel *et al.*, (2016) experiment revealed that Diafenthiuron 50 WP was most promising treatment in reducing population of flower thrips (*Caliothrips indicus*) followed by Spiromesifen 240 SC @ 150 g a.i./ha as compared to standard checks Thiamethoxam 25 WG. Panigrahi *et al.*, (2024) [6] found that Diafenthiuron 50 WP at 250 g a.i./ha exhibited the highest efficacy, resulting in more than 82.33% reduction in thrips population followed by treatments included thiamethoxam 25 WG @ 25 g a.i./ha with efficacy of 77.29 per cent reduction.

Impact of different insecticides on Yield and net returns

The data (Table 3) revealed that the significantly highest yield was recorded in T₂ Diafenthiuron (12.88 q/ha) followed by T₁ namely Tolfenpyrad 15 EC (12.30 q/ha). Next best effective treatment which recorded maximum yield was Thiamethoxam 25 WG which recorded a yield of 11.75 q/ha. Among all the treatments, control treatment was recorded the lowest yield of 8.77 q/ha.

Present findings are partly in confirmation with the Tanwar *et al.* 2024 [11] who reported the maximum yield of 10.15 q/ha in the plots treated with thiamethoxam 25 WG providing efficacy of 96 percent. Yasmin *et al.*, (2019) recorded Stargate 48 SC (clothianidin) with yield of 1026.91 followed by Actara 25 WG (thiamethoxam) with yield of 970.22 q/ha.

The data of economics depicted that the highest net return of Rs 31896.5 per hectare was attained in T₂-(Diafenthiuron 50 WP) followed by T₁ fetching 24651.0 per hectare (Tolfenpyrad 15 EC) and T₇ (Thiamethoxam 25 WG) with net return of 23728.6 per ha. The minimum net return was given by treatment T₄ (Spinosad 2.5 SC) with Rs 1697.0.

The present study get the support from the findings of Tanwar *et al.* (2024) [11] who reported net return of 21000 q/ha with spraying of Thiamethoxam 25WG.

The cost benefit ratio was workout the best and economical treatment was T₇ (Thiamethoxam 25 WG) with B:C ratio 1:10.89 followed by T₂ (Diafenthiuron 50 WP) with 1:8.70 and T₁ (Tolfenpyrad 15 EC) with 1: 4.91 (Table 1). Spinosad 2.5 SC was recorded to be least economical treatment in terms of C:B ratio of 1.19.

Tanwar *et al.* 2024 [11] recorded The highest benefit cost ratio (1:6.91) was obtained from the plot treated with dimethoate 30EC followed by thiamethoxam 25WG (1:4.23) which does not support the present findings.

Table 1: Treatment Details

Treatments	Insecticide name	Dose/Con	Trade name	Class
T ₁	Tolfenpyrad 15 EC	2.0 ml/lit	Keefun	METI
T ₂	Diafenthiuron 50 WP	1.0 ml/lit	Pager	Diafenthiuron
T ₃	Chlorantraniliprole 18.5 SC	0.2 ml/lit	Coragen	Diamide
T ₄	Spinosad 2.5 SC	2.0 ml/lit	Spino 25	Spinosyns
T ₅	Emamectin benzoate 5 SG	0.20 g/lit	Bold	Avermectins
T ₆	Spiromesifen 22.9% SC	1.0 ml/lit	Oberon	Ketoenol
T ₇	Thiamethoxam 25 WG	0.1g/lit	Thiamex	Thionicotinyl
T ₈	Control	-		

Table 2: Efficacy of different insecticides against thrips in mungbean crop

Treatments	Ist Spray (Mean reduction %)					IInd Spray (Mean reduction %)				
	PTP	1DAFS	3DAFS	5DAFS	7DAFS	PTP	1DAFS	3DAFS	5DAFS	7DAFS
Tolfenpyrad	2.60	33.8 (35.54)	50.3 (45.14)	66.0 (54.30)	66.4 (54.57)	2.52	41.8 (40.29)	53.1 (46.77)	66.5 (54.64)	65.0 (53.79)
Diafenthiuron	2.50	38.7 (38.48)	55.4 (48.10)	74.7 (59.81)	70.5 (57.08)	2.54	42.5 (40.68)	57.9 (49.54)	75.2 (60.12)	72.3 (58.26)
Chlorantraniliprole	2.35	24.1 (29.40)	31.9 (34.39)	43.0 (40.94)	47.4 (43.48)	2.57	26.9 (31.26)	32.7 (34.86)	45.2 (42.23)	47.7 (43.67)
Spinosad	2.54	17.7 (24.81)	25.7 (30.37)	35.6 (36.65)	38.0 (38.04)	2.74	21.4 (27.48)	32.0 (34.47)	39.1 (38.69)	39.2 (38.73)
Emamectin benzoate	2.56	19.2 (26.00)	25.6 (30.27)	39.0 (38.62)	43.6 (41.31)	2.57	25.6 (30.41)	34.2 (35.77)	43.1 (41.03)	45.6 (42.45)
Spiromesifen	2.39	25.0 (29.97)	39.4 (38.84)	51.5 (45.87)	51.3 (45.75)	2.52	26.5 (30.97)	42.5 (40.68)	56.5 (48.72)	54.5 (47.61)
Thiamethoxam	2.59	31.7 (34.28)	49.0 (44.40)	71.2 (57.55)	66.9 (54.89)	2.54	38.8 (38.52)	53.1 (46.77)	70.8 (57.30)	69.6 (56.56)
Control	2.63	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	2.80	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)
CD		2.02	2.72	2.17	3.34		2.72	2.21	2.66	2.57

Table 3: Yield and net returns (/ha) of green gram.

Treatments	Dose/Conc	Quantity of insecticide for 1 spray	Cost of insecticide one spray	Total protection cost 2 sprays (@ 500/labour)	Yield	Increased yield over control %	added yield over control q/ha	Gross returns Rs/ha	added return over control Rs/ha	Net return Rs/ha	C:B ratio
Tolfenpyrad 15 EC	2.00	1000	2150	6300	12.3	40.25	3.53	107846.4	30951.0	24651.0	4.91
Diafenthiuron 50 WP	1.00	500	1070	4140	12.88	46.86	4.11	112931.8	36036.5	31896.5	8.70
Chlorantraniliprole 18.5 SC	0.20	100	1200	4400	10.4	18.59	1.63	91187.2	14291.8	9891.8	3.25
Spinosad 2.5SC	2.00	1000	3500	9000	9.99	13.91	1.22	87592.3	10697.0	1697.0	1.19
Emamectin benzoate 5 SG	0.20	100	600	3200	9.62	9.69	0.85	84348.2	7452.8	4252.8	2.33
Spiromesifen 22.9 SC	1.00	500	3250	8500	10.25	16.88	1.48	89872.0	12976.6	4476.6	1.53
Thiamethoxam 25 WG	0.10	75	200	2400	11.75	33.98	2.98	103024.0	26128.6	23728.6	10.89
Control	-	-		0	8.77	0.00	0	76895.4	0.0	0.0	

Conclusion

Insecticide difenthiuron provided the maximum efficacy, yield and net returns over control and commonly used insecticide thiamethoxam. Therefore, difenthiuron may be used as alternative insecticide to thiamethoxam to overcome the problem of insecticide residues. Diafenthiuron is a pro-insecticide, meaning it is converted to its active form after absorption by the pest. Diafenthiuron degrades into an urea derivative, which has a phytotonic effect (promoting plant health) and is selective towards beneficial insects, making it suitable for integrated pest management (IPM) programs. Advantage of insecticides use with different mode of action reduces the chances of resistance development in insects and checks the insecticide residues below their residual limits.

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