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FIELD EVALUATION OF BOTANICALS AND NEW MOLECULES ON THE INCIDENCE OF WHITEFLY POPULATION AND IMPACT OF YELLOW MOSAIC VIRUS

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ABSTRACT
Among the foliar spray of synthetic insecticides and plant products imidacloprid 17.8 SL (@ 0.005%) and thiamethoxam 25 WG (@ 0.025%) when applied thrice at fortnightly interval starting after one month of sowing, provided maximum protection to mung bean crop in minimizing whitefly population 1.9, 1.2 and 0.5 whitefly/ trifoliate leaf and 2.0, 1.5 and 0.9 whitefly/trifoliate leaf, respectively; as against 4.1, 6.6 and 4.8 whitefly/ trifoliate leaf in untreated control after first, second and third spraying, respectively. The lowest MYMV disease incidence 10.2 and 8.9 per cent was recorded with foliar application of imidacloprid 17.8 SL (@ 0.005%) at vegetative and reproductive stage, respectively which was at par to thiamethoxam 25 WG (@ 0.025%) as against 44.3 and 41.1 per cent disease incidence in untreated control at vegetative and reproductive stage, respectively. The highest seed yield of mung bean (10.8 q/ha) was obtained in imidacloprid but did not differ significantly with thiamethoxam (10.0 q/ha) as against 5.3 q/ha in untreated control. The investment in foliar application of imidacloprid 17.8 SL, profenophos 50 EC, thiamethoxam 25 WG, dimethoate 30 EC, YBSE 5% and cypermethrin 10 EC proved profitable in comparison to neem oil at 2%, at their test doses.

INTRODUCTION

Mung bean, *Vigna radiata* (L.) R. Wilczek belongs to the family Fabaceae with chromosome no 2n = 24. Depending upon the plant type and nature of crop being grown, central stems are more or less erect while side branched are semi erect, leaves are trifoliate with long petioles. Pods are 6-10 cm long, hairy and round having 7-10 seeds inside. Hilum is white and flat. Germination type epigeal and colour of cotyledons is yellow, Tiwari and Shivhare (2016). In India, it is mostly grown in summer and *Kharif* season in an area of 3.02 million ha, total production of 1.55 million tonnes with a productivity of 498 kg/ ha as against 0.168 million ha of the area, total production of 0.100 million tonnes with the productivity of 596 kg/ ha in Bihar (Anonymous, 2016). Mung bean contains Nutritive value, Carbohydrate (56%), Protein (24-25%), Fiber (4.1%), Minerals (3.5%), Fat (1.3%), Iron (7.3 mg/100g), Calcium (124 mg/100g), Phosphorus (326 mg/100g), Calorific value (334), Moisture (10%), Tiwari and Shivhare (2016). Despite its importance, the yield of mung bean is very low in Bihar as compare to other states and its area and production has not considerably increased. The main reason for the low yield is the susceptibility of the crop to insects and diseases. Most of these insects are polyphagous in nature and feed on wide range of leguminous and non-leguminous crops. According to Lal (1985) about 64 species of insects are known to attack this crop. Among sucking insect pests whitefly *Bemisia tabaci* (Hemiptera: Aleyrodidae) is of major importance. Moreover, about 500 plant species from Asia, Africa, America, Europe, Russia, Australia and pacific islands are known to be attacked and confirms its polyphagous nature (Latif and Akhtar, 2013). Apart from direct injury it also damages the crop indirectly as a vector transmitting a viral disease known as mung bean yellow mosaic virus (MYMV). The yellow mosaic virus disease of mung bean caused 30-70% yield loss (Marimuthu *et al.* 1981). Reduction in number of pods/plant, seeds/pod and seed weight are the main contributing factors for yield reduction (Dhingra and Chenulu, 1985). In changing climatic scenario, the incidence of whitefly and severity of yellow mosaic virus disease on mung bean are a major cause of unsuccessful cultivation of mung bean and low production in Bihar. Mamun and Ahmed (2011) reported that neem and tobacco have pest control properties and may be used as alternative of chemical pesticides. The low toxicity feature of neem extracts against the non target organism was also reported (Vimala *et al.* 2010). Yongkhamcha and Indrapichate (2012) reported that toxicity of yam bean seed has a great value as botanical insecticide to some important insect pests. Ali *et al.*, (2017) reported that against whitefly the first spray of neem extract, tobacco extract and datura extract showed 82.60, 75.95 and 73.99 per cent mortality, respectively while in the second spray it was 67.53, 56.43 and 42.25 per cent on mung bean, respectively. Utilization of various pyrethroid insecticides of 4th generation along with newer molecular insecticides can also efficiently reduce the pest activity, moreover pyrethroid insecticide such as cypermethrin are highly effective against the target species and posses low mammalian toxicity (Nagarjuna and Doss, 2009). Keeping in view above facts, the present study was undertaken to study the effect of different chemical insecticides against whitefly

and its impact on incidence of yellow mosaic virus disease of mung bean in the context of the agro-ecological situation of north Bihar.

MATERIALS AND METHODS

In order to determine the seasonal incidence and to explore the possibilities of management of whitefly on mung bean through foliar spray of insecticides and plant products a series of field experiments were conducted at research farm of Tirhut College of Agriculture, Dholi, Muzaffarpur, a campus of Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India during summer season, 2017. The research farm of Tirhut College of Agriculture, Dholi falls in the Gandak Command Area of North Bihar and is situated at 25.9° N latitude, 85.67° E longitude and at an altitude of 52.98 m above mean sea level. The climate of the experimental site is moderate and represents the Agro-climatic Zone-1 of Bihar. Texture of the soil is, most predominantly sandy loam and acidic in nature with pH ranging from 6.5 to 8.4. The irrigation was done after first weeding as per need. Proper drainage system was also developed for draining out excess water. Altogether eight treatments and each treatment were replicated thrice. The mung bean variety Pusa Vishal was grown as a test crop. The spray formulations prepared from the commercial available material except YBSE (Yam bean seed extract) and all the treatments were sprayed with manually operated Knap sack sprayer. All the management practices were followed to maintained healthy crop growth. Each of the treatment was applied thrice at fortnightly interval. The plot size, inter and intra row spacing were kept at 2×2 m, and 0.25 m and 0.10 m, respectively. A path of 30 cm width was maintained between each replication.

Observations pertaining to population of whitefly was recorded on five randomly selected plants, by observing three leaves (upper, middle and lower) randomly during early morning hours; the population of whitefly was counted during one day before spray (pre-count), three days and seven days after each spraying. The incidence of MYMV were recorded at vegetative stage (45 DAS) and reproductive stage (65 DAS) on five randomly selected plants at weekly interval starting form 15 days after sowing to maturity of the crop in each replication.

$$(\%)\ \text{reduction in whitefly population} = \frac{P_1 - P_2 \ldots\ldots P_8}{P_1} \times 100$$

Whereas,

P_1 = Whitefly population in untreated control.

$P_2 \ldots\ldots P_8$ = Whitefly population in treated control.

RESULTS AND DISCUSSION

The data on mean number of whitefly population/trifoliate leaves recorded one day prior to first spraying of the all test products and at third and seventh days after each spraying. The data revealed that whitefly population recorded one day before of first spray schedule showed non significant difference among various treatments varied from 2.8 to 3.3 whitefly/trifoliate leaf indicating uniform distribution of whitefly in experimental plot. However, there were significant differences between the treatments after each of the three sprays in respect of whitefly population. The mean number of whitefly population/trifoliate leaves ranged between 1.0 to 4.2 and 1.4 to 4.8 whitefly/trifoliate leaf at third and seventh days after first spraying with minimum and maximum population been recorded in imidacloprid 17.8 SL (@ 0.005%) and untreated control, respectively (Table 1). Among various treatments under test, foliar application of imidacloprid 17.8 SL applied at @0.005%/was found to be the most effective in minimizing the whitefly population (1.0 and 1.4 whitefly population/ trifoliate leaf) at third and seventh day after first spraying which was at par with thiamethoxam 25 WG (@ 0.025%/) recording 1.3 and 1.7 whitefly population/trifoliate leaf at third and seventh day. All the plant products were less effective in comparison to rest of the chemical insecticides but they were significantly superior over untreated control. Among the plant products, foliar application of yam bean seed extract (@ 5%) showed a better performance in recording lower number of whitefly on mung bean (2.4 and 2.9 whitefly/trifoliate leaf at third and seventh day after spraying, respectively). All treatments were found significantly superior over untreated control (4.2 and 4.8 whitefly/trifoliate leaves at third and seventh day after spraying, respectively). The data on cumulative mean of whitefly population at third and seventh day of after first spraying revealed that all the treatments were significantly superior over untreated control. Among the different treatments, foliar application of imidacloprid 17.8 SL (@ 0.005%) was found to be the most effective in controlling the whitefly population (1.9 whitefly/trifoliate leaf) which was at par with thiamethoxam 25 WG (@ 0.025%) with 2.0 whitefly population/trifoliate leaf as against 4.1 whitefly/trifoliate leaf in untreated control. These treatments were effective in reducing the whitefly population to the tune of 53.6 and 52.1 per cent over untreated control in case of imidacloprid and thiamethoxam, respectively at their test doses. All the treatments under test were also found significantly superior over untreated control in minimizing whitefly population at third and seventh day after second spraying. The data presented in Table 2 revealed that after second spray the whitefly population varied from 1.5 to 6.4 and 0.8 to 6.8 whitefly/trifoliate leaf with minimum and maximum in imidacloprid 17.8 SL (@ 0.005%) and untreated control at third and seventh day after second spraying, respectively. Among the remaining treatments thiamethoxam 25 WG (@ 0.025%) and profenophos 50 EC (@ 0.05%) showed better performance in recording lower number of whitefly (1.8, 1.2 and 2.2, 1.3 whitefly/trifoliate leaf at third and seventh day after second spraying, respectively) and were at par with imidacloprid at third and seventh day

Treatment no.	Insecticides	Dose (%)
T_1	Imidacloprid (17.8SL)	0.005%
T_2	Thiamethoxam (25WG)	0.025%
T_3	Profenophos (50EC)	0.05%
T_4	Dimethoate (30EC)	0.03%
T_5	Cypermethrin (10EC)	0.005%
T_6	Neem oil	2%
T_7	Yam bean seed extract	5%
T_8	Untreated control	-

Table 1: Relative efficacy of synthetic insecticides and plant products against whitefly (*Bemisia tabaci* Genna.) on mung bean after 1st spraying

Treatment	Dose (%)	Mean no. of whitefly / trifoliate leaf after 1st spraying at			Mean no. of whitefly /trifoliate leaf	Mean % reduction in whitefly population over control
		1DBS*	3DAS**	7DAS		
T_1- Imidacloprid (17.8 SL)	0.005%	3.3	1.0	1.4	1.9	53.6
T_2- Thiamethoxam (25 WG)	0.025%	2.9	1.3	1.7	2.0	52.1
T_3- Profenophos (50 EC)	0.05%	3.2	1.6	2.0	2.3	44.8
T_4- Dimethoate (30 EC)	0.03%	3.1	2.0	2.6	2.6	37.5
T_5- Cypermethrin (10 EC)	0.005%	3.0	2.2	3.0	2.7	33.4
T_6- Neem oil	2%	2.8	2.6	3.2	2.9	30.2
T_7- Yam bean seed extract	5%	3.1	2.4	2.9	2.8	31.7
T_8- Untreated control	-	3.3	4.2	4.8	4.1	-
S.Em (±)		0.178	0.17	0.11	0.15	-
CD at 5%		NS	0.5	0.3	0.3	-
CV (%)		-	13.6	7.2	6.9	-

*DBS - Days before spray, **DAS - Days after spray

Table 2: Relative efficacy of synthetic insecticides and plant products against whitefly (*Bemisia tabaci* Genna.) on mung bean after 2nd spraying

Treatment	Dose (%)	Mean no. of whitefly/trifoliate leaf after 2nd spraying at		Mean no. of whitefly/ trifoliate leaf	Mean % reduction in whitefly population over control
		3DAS	7DAS		
T_1- Imidacloprid (17.8 SL)	0.005%	1.5	0.8	1.2	81.8
T_2- Thiamethoxam (25 WG)	0.025%	1.8	1.2	1.5	77.3
T_3- Profenophos (50 EC)	0.05%	2.2	1.3	1.8	72.7
T_4- Dimethoate (30 EC)	0.03%	2.7	2.4	2.6	60.6
T_5- Cypermethrin (10 EC)	0.005%	2.9	3.2	3.1	53.0
T_6- Neem oil	2%	3.4	3.8	3.6	45.4
T_7- Yam bean seed extract	5%	3.0	3.4	3.2	51.5
T_8- Untreated control	-	6.4	6.8	6.6	-
S.Em (±)		0.15	0.37	0.21	-
CD at 5%		0.5	0.1	0.3	-
CV (%)		8.5	7.4	7.1	-

after spraying except profenophos at seventh day after spraying. Among the plant products, YBSE (@ 5%) continued to perform better as compared to neem oil in minimizing whitefly population (3.0 and 3.4 whitefly/trifoliate leaf) but was less effective as compared to the chemical insecticides but significantly superior over untreated control. On the basis of cumulative mean, all the treatments were found significantly superior over untreated control. The mean whitefly population varied from 1.2 to 6.6 whitefly/trifoliate leaf with minimum and maximum in imidacloprid 17.8 SL (@ 0.005%) and untreated control, respectively. Foliar application of thiamethoxam continued to perform better with mean number of whitefly 1.5 whitefly/trifoliate leaf. These two treatments were found most effective in reducing whitefly population (81.8 and 77.3%) over untreated control at their test doses after second spraying. Among the plant products, the mean per cent reduction in whitefly population over untreated control varied from 51.5 to 45.4 per cent with maximum and minimum in YBSE (@ 5%) and neem oil (@ 2%), respectively. On the third spray, the data presented in Table 3 revealed that more or less similar trend was observed in suppressing the whitefly population on mung bean at third and seventh day after third spraying. On the basis of cumulative mean of whitefly population at third and seventh day after third spraying it was found that lowest whitefly population (0.50 whitefly/trifoliate leaf) was recorded in imidacloprid 17.8 SL (@ 0.005%) which was statistically at par with thiamethoxam 25 WG (@ 0.025%) (0.9 whitefly/trifoliate leaf) as against untreated control (4.8 whitefly/trifoliate leaf). Once again neem oil (@ 2%) and YBSE (@ 5%) were less effective against whitefly in comparison to chemical insecticides but were significantly superior over untreated control. The maximum reduction in whitefly population over untreated control was recorded in imidacloprid (89.5%) treatment followed by thiamethoxam (81.3%), profenophos (79.2%), dimethotae (72.9%), cypermethrin (68.8%), YBSE (86.3%) and neem oil (43.8%) after third spraying. Several workers have reported the efficacy of various synthetic insecticides and plant products used as a foliar spray against whitefly on mung bean in particular and other crops in general in different parts of country. The results of the present study are in accordance with the findings of Khaliq *et al.,* 2017 who reported that that imidacloprid showed higher efficacy against *B. tabaci* in reducing pest population as compared to other insecticidal treatments with a minimum per cent population of 6.98/plant and 2.36/plant after 1st and second spray respectively.

Effectiveness of synthetic insecticides and plant products on incidence of Mung bean yellow mosaic viral disease

The impact of synthetic insecticides and plant products on incidence of MYMV infested at vegetative stage (45DAS) and reproductive stage (65 DAS) is shown in Table 4. The mean per cent disease incidence was significantly higher (44.3% at vegetative stage and 41.1% at reproductive stage) in untreated control. However, the lowest MYMV disease incidence (10.2% at vegetative stage and 8.9% at reproductive stage) was

Table 3: Relative efficacy of synthetic insecticides and plant products against whitefly (*Bemisia tabaci* Genna.) on mung bean after 3rd spraying

Treatment	Dose (%)	Mean no. of whitefly /trifoliate leaf after 3rd spraying at		Mean no. of whitefly/ trifoliate leaf	Mean % reduction in whitefly population over control
		3DAS	7DAS		
T_1- Imidacloprid (17.8 SL)	0.005%	0.6	0.4	0.5	89.5
T_2- Thiamethoxam (25 WG)	0.025%	1.0	0.8	0.9	81.3
T_3- Profenophos (50 EC)	0.05%	1.2	0.8	1.0	79.2
T_4- Dimethoate (30 EC)	0.03%	1.6	1.0	1.3	72.9
T_5- Cypermethrin (10 EC)	0.005%	1.7	1.2	1.5	68.8
T_6- Neem oil	2%	2.6	2.8	2.7	43.8
T_7- Yam bean seed extract	5%	2.0	2.2	2.1	56.3
T_8- Untreated control	_	5.2	4.4	4.8	-
S.Em (±)		0.15	0.10	0.18	-
CD at 5%		0.5	0.3	0.4	-
CV (%)		12.1	9.1	8.6	-

Table 4: Effect of synthetic insecticides and plant products on the incidence of MYMV disease on mung bean at vegetative and reproductive stage of crop growth during summer season, 2017

Treatment	Dose (%)	MYMV disease incidence at	
		Vegetative stage(45 days after sowing)	Reproductive stage(65 days after sowing)
T_1- Imidacloprid (17.8 SL)	0.005%	10.2	8.9
T_2- Thiamethoxam (25 WG)	0.025%	12.2	10.0
T_3- Profenophos (50 EC)	0.05%	15.6	11.1
T_4- Dimethoate (30 EC)	0.03%	17.8	14.1
T_5- Cypermethrin (10 EC)	0.005%	13.3	12.2
T_6- Neem oil	2%	26.1	23.3
T_7- Yam bean seed extract	5%	23.3	21.1
T_8- Untreated control	-	44.3	41.1
S.Em (±)		0.85	1.34
CD at 5%		2.6	4.11
CV (%)		7.3	3.1

Table 5: Economics of synthetic insecticides and plant products used as foliar for the management of whitefly and MYMV on mung bean

Treatment	Dose	Additional yield over control (q/ha)	Price of additional yield (Rs/ha)	Cost of treatment (Rs/ha)	Net profit over control (Rs/ha)	B:C ratio
T_1- Imidacloprid (17.8 SL)	0.005%	5.5	30662	4272	26390	6.17:1
T_2- Thiamethoxam (25 WG)	0.025%	4.7	26202	6772	19430	2.86:1
T_3- Profenophos (50 EC)	0.05%	4.0	22300	3272	19028	5.81:1
T_4- Dimethoate (30 EC)	0.03%	3.2	17840	3402	14438	4.24:1
T_5- Cypermethrin (10 EC)	0.005%	2.2	12265	3492	8773	2.51:1
T_6- Neem oil	2%	0.3	1672	3222	-1549	-0.48:1
T_7- Yam bean seed extract	5%	1.8	10035	3072	6963	2.26:1
T_8- Untreated control	-	-	-	-	-	-

MSP of green gram: Rs. 5575.0/q, Cost of imidacloprid (17.8 SL) = 1500/lit, thiamethoxam (25 WG) = 4000/kg, profenophos (50 EC) = Rs. 500/lit, dimethoate (30 EC) = Rs. 630/ lit, cypermethrin (10 EC) = Rs. 720/lit, neem oil (2%) = Rs. 450/lit, and yam bean seeds = Rs. 300/kg, respectively. No. of labors per ha = 3, wages of labors per ha (3 sprays and 9 labors/ ha) Rs. 2772/- @ Rs. 308/day

recorded with imidachloprid 17.8 SL (@ 0.005%) which was statistically at par with thiamethoxam 25 WG (@ 0.025%) (12.2% at vegetative stage and 10.0% at reproductive stage). However, two synthetic insecticides viz., profenophos and cypermethrin showed better performance at reproductive stage in recording lower MYMV disease incidence (11.1 and 12.2%, respectively) and found at par with the imidacloprid. Among plant products, YBSE (@ 5%) recorded lower disease incidence (23.3 and 21.1% at vegetative and reproductive stage, respectively) as compared to neem oil (@ 2%) (26.1 and 23.3% disease incidence at vegetative and reproductive stage, respectively) with no significant difference between them. The results indicated that foliar application of synthetic insecticides and plant products reduce the MYMV disease incidence on mung bean although their performance was difference. imidacloprid 17.8 SL showed the best performance followed by thiamethoxam 25 WG with no significant difference among them. The application of insecticides and plant products reduce the population of whitefly on mung bean and thus reduce the mosaic infection. The results are in agreement with Jayappa et al., 2017 who reported that when application of two sprays of imidacloprid at 0.5 ml/l at 25 and 40 days after sowing (DAS) or two sprays of imidacloprid at 0.5 ml/l alone at 25 and 40 DAS were found effective in reducing the incidence of MYMV (41.86 per cent) and its vector (3.5 per plant). Seed treatment with imidacloprid at 5 ml/kg seeds plus two sprays of neemazal at 3 ml/l was also effective in management of MYMV (45.20 per cent) and its vector (3.7 per plant).

Benefit-cost analysis of synthetic insecticides and plant products used as crop protectant

Field efficacy of synthetic insecticides and plant products used as foliar spray under test was finally assessed and compared on the basis of benefit realized in monetary term and the data pertaining to the economic parameters are presented in Table 5. The gross income accrued due to different treatments was the highest (Rs. 30662.00/ha) in case of imidacloprid 17.8 SL (@ 0.005%) and lowest (Rs. 1672.00/ha) in foliar application of Neem oil (@ 2%). Remaining treatments occupied intermediate position with wide difference in this respect. The net profit derived out of different treatments got affected since the cost involved in these treatments ranged from a minimum of Rs. 3072.00/ha to the maximum of Rs. 6772.00/ha. The net profit derived under different treatments varied widely and it was the highest (Rs. 26390.00/ha) in case of imidacloprid 17.8SL (@ 0.005%) and the lowest (Rs. -1549.00/ha) in neem oil (@ 2%). Consequently, benefit-cost ratio of various insecticides used as foliar spray differed remarkably. It was the highest (6.17:1) in case of imidacloprid 17.8 SL (@ 0.005%) closely followed by profenophos 50 EC (@ 0.05%) with benefit-cost ratio of 5.81:1. Among the remaining treatments, dimethoate 30 EC (@ 0.03%), thiamethoxam 25 WG (@ 0.025%), cypermethrin 10 EC (@ 0.005%), YBSE (@ 5%), Neem oil (@ 2%) recorded benefit-cost ratio of 4.24:1, 2.86:1, 2.51:1, 2.26:1 and -0.48:1, respectively. On the basis of above findings, it became obvious that the investment in foliar application of imidacloprid 17.8 SL (@0.005%) and profenophos 50 EC (@0.05%) proved most profitable. This might be due to less cost involved in spraying of these insecticides as compared to thiamethoxam (Rs. 6772.00/ha). Few reports are available in literature about management of *Bemisia tabaci* (Genna.) on mung bean. (Prodhan *et al.,* 2008) reported that in mung bean seed treatment with imidacloprid (5 gm/kg seed) + spray with poultry manure (3 t/ha) + quinalphos @ 1 ml/ l of water recorded seed yield of 1316 kg/ ha with benefit cost ratio of 1.84. Rajashri *et al.* (2009) reported that profenophos @ 500 g a.i/ha and thiamethoxam @ 25 g a.i/ha effectively controlled the whitefly population and reduced the ToLCV incidence and improved the yield of the tomato fruits. Higher net returns of Rs. 83070.00/- and 79580.00/- were also realized with profenophos and thiamethoxam sprays with maximum cost: benefit ratio of 1:5 and 1:4.95, respectively. More or less similar results were obtained by other workers (Gupta and Pathak, 2009).

REFERENCES

Ali, S. S., Ahmed, S. S., Rizwana, H., Bhatti, F., Khoso, A. G., Mengal, M. I., Jatoi, J. H., Bugti, A., Rind, M. A. and Shahwani, S. A. 2017. Efficacy of different bio-pesticides against major sucking pests on brinjal under field conditions. *J. Basic and Applied Sci.* **13:** 133-138.

Anonymous 2016. All India Coordinated Research Project on MULLaRP, ICAR. Project Coordinators Report (Mung bean and Urdbean). IIPR, Kanpur. p. 31.

Dhingra, K. L. and Chenulu, V. V. 1985. Effect of yellow mosaic on yield and nodulation of soybean. *Ind. Phytopatho.* **38(2):** 248-251.

Gupta, M. P. and Pathak, R. K. 2009. Bio-efficacy of neem products and insecticides against the incidence of whitefly, yellow mosaic virus and pod borer in black gram. *Nat. Prodt. Rad.* **8(2):** 133-136.

Jayappa, H. K., Ramappa. and Devamani, B . D. 2017. Management of Mung bean Yellow Mosaic Virus (MYMV) in Mung bean (*Vigna radiata* L.). *J. Ent. and Zoo. Stud.* **5(5):** 596-601.

Khaliq, N., Koul, V., Shankar, U., Ganai, S. A. and Norboo, T. 2017. Bio-efficacy of Certain Selective Insecticides against Whitefly, (*Bemisia tabaci*) on Mung bean, (*Vigna radiata* L., Wilczek). *Int. J. Cur. Microbio. Appld Sci.* **6(7):** 2344-2351.

Lal, S. S. 1985. A review of insect pests of mung bean and their control in India. *Trop. Pest Managemt.* **31:** 105-114.

Latif, M. A. and Akhter, N. 2013. Population dynamics of whitefly on cultivated crops and its Management. *Int. J. Bio-resource and Stress Managemt.* **4(4):** 576-581

Mamun, M. S. A. and Ahmed, M. 2011. Prospects of indigenous plant extracts in tea pest management. *Int. J. Agric. Res. Innovatn. and Tech.* **1(1&2):** 16-23.

Marimuthu, Subramanian, C. L. and Mohan, R. 1981. Assessment of yield loss due to yellow mosaic infection in mung bean. *Pulse Crops News.* **1:** 104.

Nagarjuna, A. and Doss, P. J. 2009. Cypermethrin - induced alteration in protein metabolic profiles in liver tissue of albino rats. *The Bioscan.* **4:** 25-29.

Prodhan, Z. H., Altaf M., Hosna, K., Mollah M. K. U. and Rahman, M. H. 2008. Development of integrated management approaches against insect pest complex of mung bean. *J. Soil and Nat.* **2(3):** 37-39

Rajashri, M., Vijaylakshmi, Prasad, R. and Reddy, L. 2009. Management of *Bemisia tabaci* and consequent spread of tomato leaf curl virus with certain insecticides in tomato. *Ind. J. Plt. Protect.* **37(1&2):** 123-126.

Tiwari, A. K. and Shivhare, A. K. 2016. Pulses in India: retrospect and prospects, Director, Govt. of India, Ministry of Agri. & Farmers Welfare (DAC&FW), Directorate of Pulses Development, Vindhyachal Bhavan, Bhopal, M.P - 462004. **2:** 62-68.

Vimala, B., Murugan, K., Deecaraman, M., Karpagam, S., Vijayalakshmi, M. and Sujatha, K. 2010. The toxic effect of neem extract, spinosad and endosulfan on the growth of aphids and its predator.*The Bioscan.* **5:** 383-386.

Yongkhamcha, B. and Indrapichate, K. 2012. Insecticidal efficacy of mint weed, yam bean and celery seed extraction (*Aedes ageypti* L.). *Int. J. Agric. Sci.* **4(3):** 207-212.