ISSN: 2347-4688, Vol. 6, No.(3) 2018, pg. 365-371

Current Agriculture Research Journal

www.agriculturejournal.org/

Bio-efficacy of Different Insecticides Against Thrips (*Scirtothrips dorsalis* Hood) in Green Gram

SURBHI KANSAGARA, KALPIT D. SHAH*, ATUL R. RATHOD, MITESH K. GHELANI and MAHESH F. ACHARYA

Department of Entomology, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India.

Abstract

Investigation on the management of thrips, *Scirtothrips dorsalis* Hood infesting green gram was carried out under field condition during 2017 at Pulse Research Station, Junagadh Agricultural University, Junagadh, India. For the management of thrips, different combinations of seed treatments *viz.,* imidacloprid 30.5 SC @ 0.12%, clothianidin 50 WDG @ 0.20% and thiamethoxam 25 WG @ 0.01% and foliar application of insecticides profenophos 40% + cypermethrin 4% 44 EC @ 0.044%, spinosad 45 SC @ 0.0135% and flonicamid 50 WG @ 0.015% were evaluated against the pest. Based on pooled over periods, seed treatment of thiamethoxam 25 WG @ 0.10% and insecticidal spray of spinosad 45 SC @ 0.0135% was found most effective for the control of thrips. The highest (1066 kg /ha) seed yield was gained from the plots treated with thiamethoxam 25 WG @ 0.10% + spinosad 45 SC @ 0.0135% followed by imidacloprid 30.5 SC @ 0.12% + spinosad 45 SC @ 0.0135% (1025). Maximum yield loss can be avoided with spray application of thiamethoxam 25 WG @ 0.10% + spinosad 45 SC @ 0.0135% (90.64%) followed by imidacloprid 30.5 SC @ 0.12% + spinosad 45 SC @ 0.0135% (83.16%) as compared to control.

Article History

Received: 30 June 2018
Accepted: 10 September 2018

Keywords:
Chemical spray,
Green gram,
Scirtothrips dorsalis Hood,
Seed treatment,
Thrips.

Introduction

Among the different pulses, green gram, *Vigna radiata* (Linnaeus) Wilczek is an ancient and well known leguminous crop of Asia, belonging to Leguminosae family. It is one of the thirteen food legumes grown as third most important pulse crop of India after chickpea and pigeonpea. In India, area covered by pulses is 25.26 million hectares (mha) with production of 16.47 metric tones (mt) and productivity of 665 kg /ha.[1] About 70 per cent of the world's total production of green gram is produces in India whereas, it is cultivated annually in an area of 3.83 mha with total production and average productivity of 1.603 mt and 418 kg /ha, respectively.[2]

CONTACT Kalpit D. Shah kalpit195@jau.in Department of Entomology, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat, India.

Doi: http://dx.doi.org/10.12944/CARJ.6.3.15

Of late in India, the average productivity of green gram crop has rather remained static due to several reasons *viz.,* lack of suitable seed production techniques, cultural practices, inefficient harvest and post-harvest operations, improper storage management practices, etc. Apart from these, green gram seed is bound to show rapid and greater losses both quantitatively and qualitatively due to attack of several insect pests at both pre and post-harvest stages. Annually 2.0 to 2.4 mt of pulses with approximately monetary value of Rs.6000 corers are lost due to damage caused by insect pest.[3] Mung bean is being reported with nearly 60 insect's species.[4] Among the different sucking insect pests of green gram, thrips is the major problematic pest in the initial growth period of the crop. The pest suck the cell sap continuously, which leads to drying up of the small tender leaves and thus hinders the vegetative growth and development of green gram. In the situation of global climate change, living organisms are changing their living habitat as well as style, which directly affect their span of life. A dominant animal, insect, have capacity to change their behavior and habitat with the changing of the environment and so, the study was carried out to see the impact of changing pattern in abiotic factors on green gram thrips. Several chemical pesticides have been recommended for combating thrips. However, problems like residues in seeds and environmental contamination are the result of injudicious use of these chemical pesticides. Such reliance on insecticides has created many problems such as very frequent application of insecticides, excessive residues in the produce, which are the concerns of general consumer health and the environment, pesticide resistance, trade implications, poisoning, hazards to non-target organisms and increased production costs etc. Among the several avenues to overcome the insecticidal resistance problem and as this pest continued to attack the primary stage of the crop. Therefore, there is a need to check the effects of seed treatment along with foliar application of insecticides were one of the important considerations.

Materials and Methods

The experiment was laid out in a Randomized Complete Block Design (RCBD) with factorial concept with three replications keeping plot size of 4.00 m x 2.70 m during summer 2017 at Pulse Research Station, Junagadh Agricultural University, Junagadh. Green gram variety GM 4 was sown at a spacing of 45 cm x 10 cm in February, 2017. All agronomic practices were adopted as per the recommendation in vogue. The seed treatment was done three hours before sowing with three different insecticides *viz.,* imidacloprid 30.5 SC @ 0.12%, clothianidin 50 WDG @ 0.20% and thiamethoxam 25 WG @ 0.01% and spraying was done using knapsack sprayer of three different insecticides viz., profenophos 40% + cypermethrin 4% 44 EC @ 0.044%, spinosad 45 SC @ 0.0135% and flonicamid 50 WG @ 0.015% for the control of thrips. As the population of thrips was heavy starting after the week of germination, the immediate spray was carried out to check the population. Second spray was carried out at 12 days after the first spray to combat the pest. The observations on thrips were recorded visually from five randomly selected and tagged plants from its upper, middle and lower leaves. Observations on thrips population were recorded at 1, 3, 5, 7 and 9 days after each spray. With a view to evaluate the effect of different pesticides on the green gram yield, crop was harvested from each net plot. The harvested yield was weighted and converted on hectare basis. The percentage increase in yield over control was calculated by using the following formula.[5]

$$\text{Percentage increase over control} = 100 \times \frac{T - C}{C}$$

Where,
T= Yield of respective treatment (kg/ha)
C= Yield of control (kg/ha)

Result

The data on mean thrips count after seed treatment and two applications of insecticides pooled over spray were presented in table 1 and 2. The periodical data showing the effects of seed treatment and insecticidal spray on infestation to green gram due to thrips on one, three, five, seven and nine days after spray (DAS) was also presented. The bio-efficacy of various insecticides had been adjudged based on pooled over spray.

The data on mean thrips count of pooled over spray presented in table 1 revealed that among three different seed treatment, thiamethoxam 0.10% had lowest thrips count (0.45 thrips /leaf). Next best

treatment was imidacloprid 0.12% (0.51) followed by clothianidin 0.20% (0.59) at one day after spray (DAS). On third, fifth, seventh and ninth DAS results were found to be non-significant. As the crop was sown during February, 2017, this kind of result may be due to lower efficacy of seed treatment after 27 days of sowing.

The data on mean thrips count of pooled over spray presented in table 1 revealed that among sprayed insecticides, spinosad 0.0135% (0.28) was found with lowest thrips count followed by flonicamid 0.015% (0.52) and profenophos + cypermethrin 0.044% (0.82) on first DAS. While on third DAS, spinosad 0.0135% was found best followed by flonicamid 0.015%, this was at par with profenophos + cypermethrin 0.044%. Similar pattern was observed for spinosad 0.0135% < flonicamid 0.015% < profenophos + cypermethrin 0.044% on fifth and seventh DAS i.e., 0.55 < 0.72 < 1.13 and 1.54 < 1.85 < 2.35, respectively. At ninth DAS spinosad 0.0135% was found at par with flonicamid 0.015% followed by profenophos + cypermethrin 0.044%.

Table 1: Effects of seed treatment along with foliar application of insecticides against thrips (pooled over sprays)

Treatments		1 DAS	3 DAS	5 DAS	7 DAS	9 DAS
1		2	3	4	5	6
Seed treatments (S)						
S_1	Imidacloprid 30.5 SC @ 0.12%	0.71b (0.51)	0.60 (0.36)	0.84 (0.71)	1.35 (1.83)	1.27 (1.62)
S_2	Clothianidin 50 WDG @ 0.20%	0.77c (0.59)	0.69 (0.48)	0.96 (0.93)	1.47 (2.16)	1.27 (1.61)
S_3	Thiamethoxam 25 WG @ 0.10%	0.67a (0.45)	0.60 (0.36)	0.85 (0.72)	1.32 (1.74)	1.21 (1.45)
		ANOVA				
	S.Em.±	0.02	0.03	0.04	0.05	0.02
	CD (0.05%)	0.04	NS	NS	NS	NS
Insecticidal spray (I)						
I_1	Profenophos 40% + Cypermethrin 4% 44 EC @ 0.044%	0.90b (0.82)	0.81b (0.65)	1.06c (1.13)	1.53c (2.35)	1.42b (2.02)
I_2	Spinosad 45 SC @ 0.0135%	0.53a (0.28)	0.47a (0.22)	0.74a (0.55)	1.24a (1.54)	1.14a (1.30)
I_3	Flonicamid 50 WG @ 0.015%	0.72ab (0.52)	0.61b (0.37)	0.85b (0.72)	1.36b (1.85)	1.18a (1.40)
	Mean	0.72	0.63	0.88	1.38	1.25
		ANOVA				
	S.Em.±	0.04	0.04	0.02	0.02	0.02
	CD(0.05%)	0.25	0.23	0.06	0.07	0.07
	CV%	13.80	9.75	13.99	11.10	12.0

Notes:

1. NS: Non significant and S: Significant
2. Figures in parentheses ( ) are retransformed values; those outside are transformed value.
3. Treatment mean with letter(s) in common are not significant at 5 % level of significance within a column.

The data in table 2 showed seed treatment with insecticidal spray interaction effect (S x I) was found to be non-significant on first, third and ninth DAS while, at 5 and 7 DAS the interaction effect was found to be significant at 5% of probability.

The order of treatment interaction on basis of thrips damage on green gram on fifth DAS given in bracket was: S_3I_2 (0.47) < S_1I_3 (0.55) < S_1I_2 (0.56) < S_2I_2 (0.63) < S_3I_3 (0.76) < S_2I_3 (0.89) < S_3I_1 (0.98) < S_1I_1 (1.09) < S_2I_1 (1.33). Among the different treatment combinations, S_3I_2 (thiamethoxam 0.10% + spinosad 0.0135%) was found significantly superior [0.47 thrips /leaf] but it was at par with S_1I_3 (imidacloprid 0.12% + flonicamid 0.015%) and S_1I_2 (imidacloprid 0.12% + spinosad 0.0135%)

followed by S_2I_2 (clothianidin 0.20% + spinosad 0.0135%). Further, S_2I_2 was found at par with S_3I_3 (thiamethoxam 0.10% + flonicamid 0.015%) and considered mediocre in their effectiveness. S_2I_3 (clothianidin 0.20% + flonicamid 0.015%), which was at par with S_3I_3, S_3I_1 (thiamethoxam 0.10% + profenophos + cypermethrin 0.044%) and S_1I_1 (imidacloprid 0.12% + profenophos + cypermethrin 0.044%) were found less effective in managing thrips. The least effective treatment combination was S_2I_1 (clothianidin 0.20% + profenophos + cypermethrin 0.044%).

Table 2: Interaction effect of different seed treatment along with foliar application of insecticides against thrips after pooled over sprays

Treatments	1 DAS		3 DAS		5 DAS		7 DAS		9 DAS		Pooled over periods	
1	2		3		4		5		6		7	
S_1I_1	1.00 (1.00)		0.76 (0.57)		1.04f (1.09)		1.53e (2.34)		1.39 (1.93)		1.14e (1.30)	
$S1I_2$	0.54 (0.29)		0.54 (0.29)		0.75ab (0.56)		1.28bc (1.63)		1.17 (1.38)		0.85b (0.72)	
S_1I_3	0.60 (0.36)		0.51 (0.26)		0.74ab (0.55)		1.26b (1.58)		1.26 (1.58)		0.87b (0.76)	
$S2I_1$	0.83 (0.68)		0.87 (0.76)		1.15g (1.33)		1.68f (2.82)		1.46 (2.12)		1.20f (1.44)	
S_2I_2	0.65 (0.42)		0.48 (0.23)		0.79bc (0.63)		1.32bcd (1.73)		1.22 (1.50)		0.89b (0.79)	
S_2I_3	0.83 (0.69)		0.72 (0.52)		0.94de (0.89)		1.41cde (1.99)		1.13 (1.27)		1.00d (1.00)	
S_3I_1	0.88 (0.77)		0.79 (0.63)		0.99ef (0.98)		1.40cde (1.95)		1.42 (2.01)		1.10d (1.21)	
S_3I_2	0.40 (0.16)		0.41 (0.16)		0.69a (0.47)		1.14a (1.30)		1.03 (1.06)		0.73a (0.53)	
S_3I_3	0.74 (0.54)		0.60 (0.36)		0.87cd (0.76)		1.42de (2.01)		1.17 (1.37)		0.96c (0.92)	
Mean	0.72 (0.52)		0.63 (0.40)		0.88 (0.77)		1.37 (1.88)		1.25 (1.56)		0.97 (0.96)	
	S.Em. +	CD 0.05%	S.Em. +	CD 0.05%	S.Em. +	CD 0.05%	S.Em. +	CD (0.05%)	S.Em. +	CD (0.05%)	S.Em. +	CD (0.05%)
Seed Treatment (S)	-	-	-	-	-	-	-	-	-	-	0.009	0.024
Insecticides (I)	-	-	-	-	-	-	-	-	-	-	0.009	0.024
Periods (P)	-	-	-	-	-	-	-	-	-	-	0.011	0.031
Spray (Sp)	-	-	-	-	-	-	-	-	-	-	0.007	0.02
S x P	-	-	-	-	-	-	-	-	-	-	0.019	0.054
I x P	-	-	-	-	-	-	-	-	-	-	0.019	0.054
S x I	0.06	NS	0.05	NS	0.03	0.09	0.04	0.13	0.07	NS	0.015	0.041
Sp x P	-	-	-	-	-	-	-	-	-	-	0.016	0.044
Sp x S	-	-	-	-	-	-	-	-	-	-	0.012	0.034
Sp x I	-	-	-	-	-	-	-	-	-	-	0.012	NS
S x I x P	-	-	-	-	-	-	-	-	-	-	0.033	0.093
Sp x S x I	-	-	-	-	-	-	-	-	-	-	0.021	0.059
Sp x P x S	-	-	-	-	-	-	-	-	-	-	0.027	NS
Sp x P x I	-	-	-	-	-	-	-	-	-	-	0.027	0.076
S x I x P x Sp	-	-	-	-	-	-	-	-	-	-	0.047	0.059
CV %	13.8		9.75		13.9		11.1		12		8.42	

Notes:

1. NS: Non significant and S: Significant
2. Figures in parentheses ( ) are retransformed values; those outside are transformed value.
3. Treatment mean with letter(s) in common are not significant at 5 % level of significance within a column.
4. Seed treatments: Imidacloprid 0.12% (S_1), Clothianidin 0.20% (S_2) & Thiamethoxam 0.10% (S_3)

Foliar application: Profenophos + Cypermethrin 0.044% (I_1), Spinosad 0.0135% (I_2) & Flonicamid 0.015% (I_3)

Similar pattern was observed on seventh DAS, the order of treatment interaction on basis of thrips damage on green gram given in bracket was: S_3I_2 (1.30) < S_1I_3 (1.58) < S_1I_2 (1.63) < S_2I_2 (1.73) < S_3I_1 (1.95) < S_2I_3 (1.99) < S_3I_3 (2.01) < S_1I_1 (2.34) < S_2I_1 (2.82). Lowest thrips population was found in S_3I_2 (1.30 thrips /leaf). The next best combination was S_1I_3, which was at par with S_1I_2 and S_2I_2. S_3I_1, S_2I_3, S_3I_3 and S_1I_1 were less effective against thrips and also at par with each other. The least effective treatment was S_2I_1, which was found with highest thrips population. The data on mean thrips count of pooled over spray and periods presented in table 12 and column 7. The order of combination of seed treatment with foliar application treatments based on thrips count on green gram damage due to S. dorsalis given in bracket was: S_3I_2 (0.53) < S_1I_2 (0.72) < S_1I_3 (0.76) < S_2I_2 (0.79) < S_3I_3 (0.92) < S_2I_3 (1.00) < S_3I_1 (1.21) < S_1I_1 (1.30) < S_2I_1 (1.44).

The lowest thrips population (0.53 thrips /leaf) over the period of sprays was recorded in the treatment of S_3I_2 (thiamethoxam 0.10% + spinosad 0.0135%), which was found significantly superior. The next best combinations were S_1I_2 (imidacloprid 0.12% + spinosad 0.0135%), S_1I_3 (imidacloprid 0.12% + flonicamid 0.015%) and S_2I_2 (clothianidin 0.20% + spinosad 0.0135%) as at par with each other.

Less effective treatments were S_3I_3 (thiamethoxam 0.10% + flonicamid 0.015%) followed by S_2I_3 (clothianidin 0.20% + flonicamid 0.015%), S_3I_1 (thiamethoxam 0.10% + profenophos + cypermethrin 0.044%) and S_1I_1 (imidacloprid 0.12% + profenophos + cypermethrin 0.044%). The highest thrips population (1.44) was observed in S_2I_1 (clothianidin 0.20% + profenophos + cypermethrin 0.044%).

Table 3: Effectiveness of various insecticides on green gram seed yield due to thrips

Treatments	Seed Yield(kg /ha)	Percentage yield increase over control
1	**2**	**3**
S_1I1	619.77d	10.75
S_1I_2	1025.00ab	83.16
S_1I_3	876.62bc	56.64
S_2I_1	610.69d	9.12
S_2I_2	931.67bc	66.48
S_2I_3	720.19c	28.69
S_3I_1	657.50d	17.49
S_3I_2	1066.90a	90.6
S_3I_3	1008.80ab	80.26
Control (No Spray)	559.63d	-
Mean	807.68	-
	ANOVA	
S. Em. +	49.833	-
C D (0.0 5%)	148.07	-
C V%	10.69	-

Notes:

1.Treatment mean with letter(s) in common are not significant at 5 % level of significance within a column

2. Yield increased over control = Yield of treatment – Yield of control

3.Seed treatments: Imidacloprid 0.12% (S_1), Clothianidin 0.20% (S_2) & Thiamethoxam 0.10% (S_3)

Foliar application: Profenophos + Cypermethrin 0.044% (I_1), Spinosad 0.0135% (I_2) & Flonicamid 0.015% (I_3)

In nut-shell, *S. dorsalis* can be effectively managed by seed treatments of thiamethoxam and imidacloprid up to 27 days after sowing of green gram crop. Whereas, among the foliar spray treatments, spinosad and flonicamid were showed the satisfactory control of thrips. Concern to the overall effect of different combinations of seed treatments and foliar application, thiamethoxam + spinosad and imidacloprid + spinosad found effective against thrips infesting green gram. However, clothianidin and profenophos + cypermethrin were failed to provide satisfactory control of thrips in green gram crop.

The data on seed yield harvested from the different treatments are summarized in table 3 (Column 2) revealed that all insecticidal formulations recorded significantly higher seed yield than control. The chronological order of yield kg /ha in comparison to control given in bracket was: S_3I_2 (1066.9) > S_1I_2 (1025) > S_3I_3 (1008.8) > S_2I_2 (931.67) > S_1I_3 (876.62) > S_2I_3 (720.19) > S_3I_1 (657.5) > S_1I_1 (619.77) > S_2I_1 (610.69) > control (559.63). The highest (1066 kg /ha) seed yield harvested in the plots treated with S_3I_2 (thiamethoxam 0.10% + spinosad 0.0135%) but it was at par with S_1I_2 (imidacloprid 0.12% + spinosad 0.0135%) (1025) and S_3I_3 (thiamethoxam 0.10% + flonicamid 0.015%) (1008.8). Further, S_3I_3 was found at par with S_2I_2 (clothianidin 0.20% + spinosad 0.0135%) (931.67) and S_1I_3 (imidacloprid 0.12% + flonicamid 0.015%) (876.62). The next treatment was S_2I_3 (clothianidin 0.20% + flonicamid 0.015%) (720.19), was at par with S_2I_2 and S_1I_3. The S_3I_1, S_1I_1 and S_2I_1 were comparatively yielded lower (610.69 to 657.5 kg /ha), at par with each other. The per cent increase over control in seed yield was also worked out and presented in Table 3 (Column 3). The chronological order of various treatments based on the per cent increase in yield over control given in bracket was: S_3I_2 (90.64) > S_1I_2 (83.16) > S_3I_3 (80.26) > S_2I_2 (66.48) > S_1I_3 (56.64) > S_2I_3 (28.69) > S_3I_1 (17.49) > S_1I_1 (10.75) > S_2I_1 (9.12). Maximum yield loss could be avoided with spray application of S_3I_2 (thiamethoxam 0.10% + spinosad 0.0135%) (90.64) followed by S_1I_2 (83.16), S_3I_3 (80.26) and S_2I_2 (66.48). Even though the yield and yield increase over control was very low in the treatments i.e., S_1I_3, S_2I_3, S_3I_1, S_1I_1 and S_2I_1 they increased the yield in range of 9.12 to 56.64 per cent.

Discussion

It was observed that green gram thrips, S. dorsalis can be effectively managed by seed treatments of thiamethoxam and imidacloprid up to 27 days after sowing of green gram crop. Spinosad and flonicamid exhibited satisfactory protection against thrips throughout the infestation. The obtained results are in conformity with the submission of the earlier workers as[6] proved effectiveness against thrips as thiamethoxam @ 4.3 g /kg and 8.6 g /kg up to 30 days of germination in green gram. Similarly,[7] found thiomethoxam 0.03 kg a.i. /ha as most promising treatment against thrips followed by spinosad 0.07 kg a.i. /ha. In onion, spinosad 45 SC @ 0.0135% was found best insecticide against thrips.[8] According to,[9] imidacloprid @ 200 g/acre was the most effective insecticide, while[10] found that the combination of imidacloprid as a seed treatment with foliar spray of acephate gave the best result for the control of thrips in mung bean. Thiamethoxam was found most effective in managing the pest.[11] Spinosad found to be superior for the management of thrips population in asparagus bean.[12] Green gram is affected by thrips species *viz., Megalurothrips distalis, Thrips tabaci, Scirtothrips dorsalis* etc. However, literature related to management of Scirtothrips dorsalis infesting green gram is scanty. Hence, in the present investigation the results are nearer to the earlier findings but not the same.

Acknowledgements

The authors would like to thank Department of Entomology, College of Agriculture, Junagadh Agricultural University, Junagadh for the continuous support during the experiment.

References

1. Naik B. B., Rani P. L., Sreeniwas G. Effect of fertilizer levels and weed management practices on weed growth and yield of summer mung bean. Proceedings: Volume

III (Poster Papers). 25th Asian-Pacific Weed Science Society Conference, Hyderabad. 2015;

2. Anonymous. Agriculture – Statistical Year Book India. Ministry of statistics and program implementation, 2017. [http: //mospi.nic. in/statistical-year-book-India /2017 /177], Accessed on 30/06/2018.
3. Reddy A. A. Pulses production technology: Status and way forward. *Econ. Political Weekly.* 2009;44:73-80.
4. Lal S. S., Ahmad R. Integrated insect pest management present status and future strategies in pulses. In: Pulses for Sustainable Agriculture and Nutritional Security (Eds. M. Ali, S.K. Chaturvedi and S.N. Gurha), IIPR, Kanpur. 2002;101-110.
5. Pradhan S. Insect Pests of Crops. National Book Trust, New Delhi, India. 1969;80.
6. Somasundar U., Kumar N. N., Prasad P. R. Studies on new seed dressing insecticides against insect pests of green gram. *Int J of Agri Innov Res.* 2016;4(6):1062-1064.
7. Mishra I. O. P., Mukherjee S. K. Field efficacy of newer molecules on sap feeders of green gram *Vigna radiate* (L.) Wilzeck. *J of Eco-friendly Agri.* 2015;10(2):155-156.
8. Patil S. D., Chandela A. G., Wayal C. B., Game B. C. Efficacy of different newer chemicals and bio-insecticides against onion thrips in *kharif* season. *Int J of Pl Prot.* 2009;2(2):227-230.
9. Afzal, M., Ahmad, T., Bashir, M. H. Relative toxicity of different insecticides against whitefly, *Bemisia tabaci* (Genn.) and black thrips, *Caliothrips* indicus on NM-92 mungbean, *Vigna radiata* (L.). *Pak J of Agri Sci.* 2002; 39(3):224-225.
10. Iqbal J., Nadeem M., Saddique A. M., Malik M. F., Muhammad W. H. Comparative efficacy of some insecticides against sucking insect pests on mungbean, *vigna radiata* (L.) Wilczek. *Gomal Uni J of Res.* 2013;29(1): 31-37.
11. Sasmal A., Kumar S. Effect of insecticides against major sucking pests of green gram in coastal Odisha. *Annals Pl Prot Sci.* 2016;24(2):276- 282.
12. Regmi R., Tiwari S., Poudel S., Bhandari G., Kafle L. Eco friendly management of thrips (*Megalurothrips sjostedti* Trybom) in asparagus bean in chitwan, *Nepal Agric Biol J N Am.* 2015;6(6):168-173