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Seasonal Incidence and Eco-friendly Management of Jassids in Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub]

Ranjana Bali [1*], Amit Kumar Singh[2], P. K. Kumawat[3], Talim Hussain[3], Monika Singh[1], R. N. Sharma[4], Subhash Bajiya[3] and Sardar Singh Kakraliya[5]

[1]Ph.D. Scholar, Division of Entomology,
Sher-e- Kashmir University of Agricultural Sciences and Technology, Jammu, Chatha-180009 (J&K), India.
[2]Associate Professor, Division of Entomology,
Sher-e- Kashmir University of Agricultural Sciences and Technology, Jammu, Chatha-180009 (J&K), India.
[3]M.Sc. Entomology, Division of Entomology,
Sher-e- Kashmir University of Agricultural Sciences and Technology, Jammu, Chatha-180009 (J&K), India.
[4]Ph.D. Scholar, Department of Entomology,
Sri Karan Narendra Agriculture University, Jobner, Jaipur 303329 (Rajasthan), India.
[5]Ph.D. Scholar, Division of Plant Pathology,
Sher-e- Kashmir University of Agricultural Sciences and Technology, Jammu, Chatha-180009 (J&K), India.

*(Corresponding author: Ranjana Bali *)*
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ABSTRACT: The field trial was conducted in Sher-e- Kashmir University of Agricultural Sciences and Technology, Jammu, Chatha, for investigating the seasonal incidence and eco-friendly management of jassids in correlation with the weather parameters. From the experiment it was estimated that the cluster bean is attacked by number of insect pest but sucking pests like jassids (*Amrasca biguttula biguttula,* Ishida) was seen to cause more damage to the crop in sub tropic Jammu. The study showed that the jassid population was at its peak in the 17th standard week during 2020. The correlation study shows that jassids had positive correlation with temperature whereas it shows negative correlation with relative humidity and rainfall. For eco-friendly management of jassid in clusterbean the following insecticides were selected such as neem oil, garlic oil, pongamia oil, novulran, *Bacillus thuringiensis, Beauvaria bassiana, Metarrhizium anisopliae,* spinosad. Among sprayed eco-friendly insecticides for the management of jassid it was found that after two sprays Spinosad 45 EC it gave best results and found best in reducing the jassid population by 48.80 per cent in the field of cluster bean in sub-tropical Jammu region, followed by Novaluron 10 EC which gave reduction of 36.80 per cent and neem oil with 32.67 per cent. The study was concluded with considering jassid as the major sucking pest in sub- tropics of Jammu region and spinosad as the most promising eco-friendly insecticide against jassids and other sucking pest. This study therefore recommends spinosed for more effective jassid control. There should be a need for identifying Jassid effective cluster bean production in Jammu region.

Keywords: Eco-friendly, Novaluron, Spinosad, Jassid, Cluster bean, Incidence

INTRODUCTION

Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] is a drought hardy, summer annual legume and is a deep rooted plant of Leguminosae (Fabaceae) family. This crop is known for its drought and high temperature tolerance (Kumar and Rodge, 2012). Basically, guar is a summer annual legume crop and on the basis of wild species, the centre of origin is Tropical Africa (Gillett, 1958). It is mainly cultivated as vegetable and green manure crop. Further, cluster bean meal and seeds are used as high protein cattle feed (Rai and Dharmatti, 2013). The cluster bean is mainly grown during rainy (*Kharif*) season, but it can be grown during summer season under irrigation conditions. Sowings can be taken up from 2nd week of July to 1st week of August and during summer from last week of February to 1st week of March. Seed rate of 15-20 kg /ha is usually optimum. India accounts for 80 per cent of the total cluster bean seed production in the world (Tripathy and Das, 2013). The major cluster bean cultivating countries are India, Pakistan, USA, Italy, Morocco, Germany, and Spain (Punia *et al*., 2009). In India, guar is being grown mainly in arid and semiarid regions of North Western states like Rajasthan, Gujarat, Haryana, and Punjab, parts of Uttar Pradesh, Madhya Pradesh and Tamil Nadu (Kumar, 2005). According to an estimate, India produces 9 lakhs tones of cluster bean annually and contributes to around 80 per cent share in the world's total production. As a leguminous crop,

cluster bean is highly responsive to nitrogenous fertilizer application especially in its early stage.

Rao (1995) reported that cluster bean fixes around 30-70 kg/ha atmospheric nitrogen which had a residual effect of ~15-20 kg /ha. It has the ability to fix nitrogen and thus is good for planting in different 4 cropping systems. The first month after the sowing of the cluster bean is crucial for weed control and good control of weeds at this stage results in better growth and higher yields (Yadav, 1998). Nitrogen promotes the vegetative growth and also increases the protein content of the crop. The phosphorous serves dual purpose in legume crop by increasing the yield of current as well as succeeding crop. An adequate supply of phosphorous has been reported beneficial for better growth and yield (Sammauria *et al.,* 2009). Sensible applications of fertilizers are known to be effective in managing the pests. Fertilizer applications also changed the 5 proportion of nutrient composition in plant tissues and consequently their nutritive value helped in the management of sucking pests (Ram and Gupta, 1992 and Rustamani *et al.*, 1999).

To provide a sound base to the IPM strategy against a pest of cluster bean, it is obligatory to study the quantitative estimation of population of pests and their natural enemies with the key abiotic factors of the environment. The cluster bean is attacked by a large magnitude of insect pest such as aphids, (*Aphis craccivora* Koch); jassids, (*Empoasca fabae* (Harris); (*E. krameri* Ross & Moore and *E. kerri* Pruthi); white fly, [*Bemisia tabaci* (Genn.)], hairy caterpillars [*Ascotis imparta* (WaIk.)] bihar hairy caterpillar, [*Spilosoma obliqua* (Walk.)], stem fly [*Ophiomyia phaseoli* (Tryon)], pod borer, [*Etiella zinckenella* (Treit.)] and so many. Among these, jassids have been reported as the major sucking pests of cluster bean in sub tropic of Jammu (Chatha). The present study explores the seasonal incidence of jassids and its management with eco-friendly insecticides.

MATERIAL METHODS

Seasonal incidence of jassids in cluster bean: To check the seasonal incidence and pest population of the aphid on cluster bean, the experimental trial on cluster bean variety PNB 181 raised in plots of 10X10 m^2, at Entomology experimental field of SKUAST-J, Chatha. The seasonal abundance of major insect pests during the crop season was recorded. During the period of recording data, fifteen plants were selected and tagged randomly and the data was recorded from three leaves *i.e*. one from twig, one from middle canopy and another from lower plant canopy by counting the aphid number. The weekly mean population of aphid was recorded and correlated with the weather parameters.

Bio-efficacy of eco-friendly pesticides for managing the jassid of cluster bean: The bio-efficacy of eco-friendly pesticides were checked, for this the field was raised in Randomized Block Design consist of eight plots with one control with plot size 3×2.5 m. The crop was sprayed twice at 15 days interval. There were 9 treatments including control which were replicated thrice. For recording the observations five plants were selected randomly from each plot. The observation on aphid was recorded from 3 leaves (*i.e*.) one from twig, one from middle and one from lower plant canopy. Population of aphid was counted before spray and after 1, 3, 7 and 14 days of spray.

Data analysis: The data collected in respect of jassid count, undamaged fruit and yield were subjected to analysis of variance (ANOVA). Fisher's least significant Difference (RBD) was used to separate the treatment means.

RESULT AND DISCUSSION

A. Seasonal incidence of jassids, Amrasca biguttula biguttula (Ishida)

The jassid population increased from 10^{th} (0.31 jassid $leaf^{-1}$) to 17^{th} standard week (17.65 jassid $leaf^{-1}$) and the peak value was observed in 17^{th} standard week (17.65 jassid $leaf^{-1}$), when mean maximum and minimum temperature, mean relative humidity (morning and evening) and rain fall were 32.4 and 18.6 $^{\circ}$C, 69.3 and 38.9 per cent and 4.0 mm, respectively. Thereafter, jassid population decreased and reached to 10.30 jassids per leaf during 24^{th} standard week when mean maximum, minimum temperature, mean relative humidity (morning and evening) and rainfall were 39.4 and 23.8°C, 58.00 and 28.9 per cent and 1.0 mm, respectively. The correlation matrix between seasonal incidence of jassid and weather factors revealed that mean maximum and minimum temperature had positive and highly significant effect on jassid population with 'r' values (r = 0.80** and r = 0.79**). On the other hand mean relative humidity (morning and evening) had highly significant but negative effect on the jassid population with 'r' values (r = -0.82** and r = -0.71**), while as mean rainfall had negative but significant effect on the jassid population with 'r' value (r = - 0.63*).

Yadav *et al*. (2016) and Kharde *et al*. (2018) studied on effect of abiotic factors on jassid and reported that maximum and minimum temperatures showed significantly positive correlation whereas, the relative humidity revealed negative significant correlation with jassid population which is in agreement with our study. However, Yadav *et al*. reported significantly positive correlation of jassid population with rainfall which contradicts with our study it might be due to change in the sowing time and climatic conditions. In contrary Dhatonde *et al*. (2014) reported that the temperature had highly significant negative influence on jassid population that might be due to difference in crop, sowing time and climatic variability.

Table 1: Correlation between seasonal population incidence of jassid, *Amrasca biguttula biguttula* (Ishida) and abiotic factors.

Insect pest	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	Morning	Evening	
jassid, *Amrasca biguttula biguttula*	0.80**	0.79**	-0.82**	-0.71**	-0.63*

** Significant at the 0.01 level, * Significant at the 0.05 level

Table 2: Regression equations and co-efficient of multiple determination (R^2) of jassid, *Amrasca biguttula biguttula* (Ishida) in relation to abiotic factors.

Regression linear equations of jassid	Multiple correlation (R)	Co-efficient of determination (R^2)	F-value (P-value)
$Y = 67.772 - 1.14X_1 + 1.07X_2 - 0.49X_3 - 0.09X_4 - 0.08X_5$	0.84	0.73	4.25

Where, Y= Mean number of aphid population / leaf; X_1=Maximum temperature; X_2=Minimum temperature; X_3= RH morning; X_4= RH evening; X_5= Rainfall (mm)

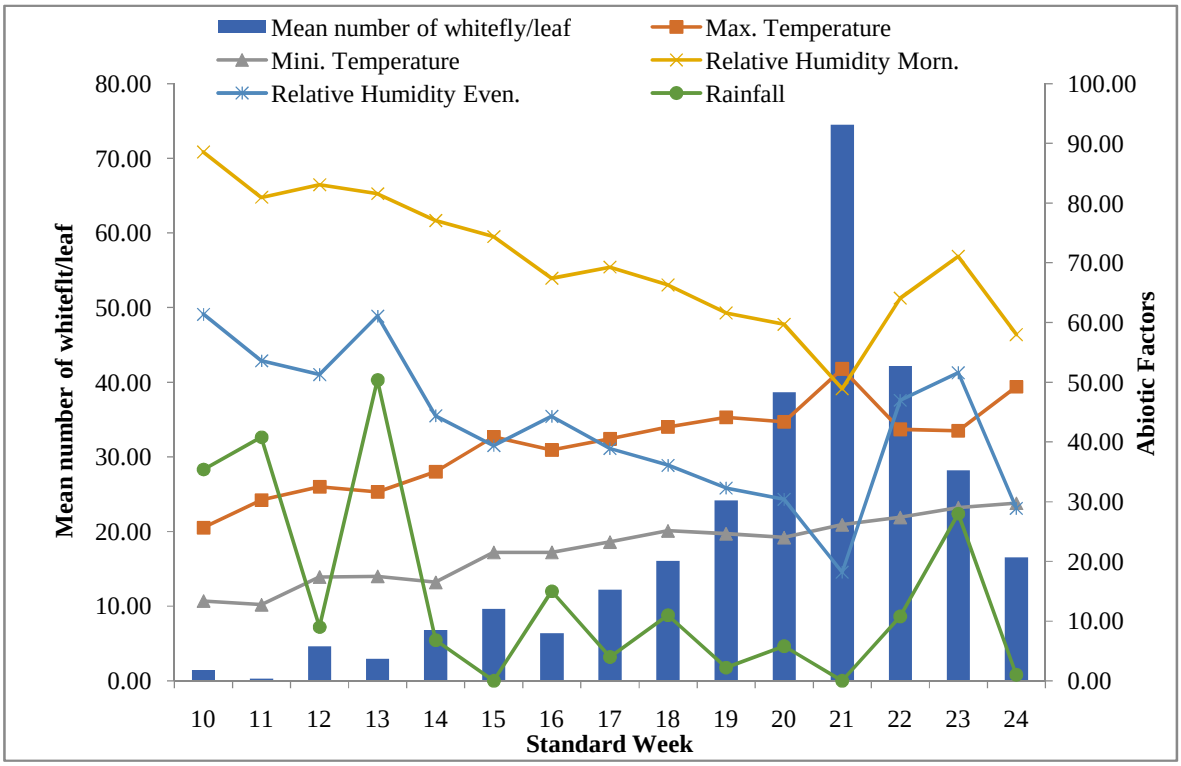

Fig. 1. Seasonal population fluctuation of aphid on cluster bean in relation to abiotic factors.

B. Efficacy of different treatments on the population of jassids, Amrasca biguttula biguttula (Ishida) on Cluster bean

The data on jassid population was recorded weekly and is depicted in Table 3. The pre-treatment population of jassid ranged from 14.73 to 15.67 per plant in different plots. After fourteen days of second spray, the best effect was given by spinosad which reduced the jassid population by 48.80 per cent. This was followed by the treatment of Novaluron in different plots, causing a reduction of 36.80 per cent. Application of neem oil resulted in 32.67 per cent reduction while in case of *Metarrhizium anisopliae*, it was 31.37 per cent application of *Beauveria bassiana* resulted in 28.00 per cent reduction followed by pongamia oil with reduction of 7.00 per cent. Whereas, *Bacillus thuringiensis* was at par with pongamia oil which caused a suppression of 6.53 per cent over control. Garlic oil was the least effective but at par with *Bacillus thuringiensis* after fourteen days of second spray and gave a reduction of 5.53 per cent of jassid population. Similar, findings have been reported by Gayathri and Geetha (2019). They found that spinosid was effective for managing the jassid population up to 14 days by reducing the jassid population 73.20 per cent on cluster bean.

Table 3: Evaluation of field bio-efficacy of botanical / insecticide against jassid, *Amrasca biguttula biguttula* (Ishida) during 2020.

S. No.	Pesticide(s)	First spray					Second spray			
		1DBS	Per cent reduction of jassid population				Per cent reduction of jassid population			
			1 DAS	3 DAS	7 DAS	14 DAS	1 DAS	3 DAS	7 DAS	14 DAS
1.	Neem oil	**15.67**	42.33 (40.57)*	52.80 (46.59)	50.47 (45.25)	33.00 (35.05)	40.33 (39.41)	54.33 (47.47)	48.80 (44.29)	32.67 (34.84)
2.	Garlic oil	**15.60**	19.17 (25.95)	27.93 (31.89)	32.67 (34.83)	5.53 (13.55)	19.17 (25.95)	27.93 (31.89)	32.67 (34.83)	5.53 (13.55)
3.	Pongamia oil	**14.93**	25.40 (30.24)	29.60 (32.95)	36.20 (36.97)	7.00 (15.33)	25.40 (30.23)	29.60 (32.95)	36.20 (36.97)	7.00 (15.33)
4.	Novaluron	**15.27**	50.80 (45.44)	65.47 (53.99)	58.60 (49.93)	35.47 (36.54)	48.67 (44.22)	64.13 (53.19)	59.33 (50.36)	36.80 (37.33)
5.	*Bacillus thuringiensis*	**14.73**	6.33 (14.57)	30.27 (33.36)	34.33 (35.85)	6.53 (14.80)	6.33 (14.57)	30.27 (33.36)	34.33 (35.85)	6.53 (14.80)
6.	*Beauvaria bassiana*	**15.20**	18.00 (25.07)	34.33 (35.85)	46.47 (42.96)	26.47 (30.94)	17.67 (24.82)	32.53 (34.76)	44.93 (42.07)	28.00 (31.93)
7.	*Metarrhizium anisopliae*	**15.40**	21.13 (27.35)	35.73 (36.69)	49.67 (44.79)	32.03 (34.45)	18.80 (25.68)	34.60 (36.01)	48.13 (43.91)	31.37 (34.04)
8.	Spinosad	**14.87**	19.07 (25.88)	48.27 (43.99)	72.67 (58.46)	48.80 (44.29)	19.07 (25.88)	48.27 (43.99)	72.67 (58.46)	48.80 (44.29)
9.	Control (water spray)	**15.27**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SeM ±		0.69	0.63	0.56	0.67	0.54	0.52	0.45	0.68	0.46
CD at 5 %		N. S.	**1.95**	**1.73**	**2.07**	**1.66**	**1.61**	**1.38**	**2.09**	**1.41**

*Figures in parenthesis angular transformed values
N. S. = Non-Significant; DBS=Days before Spray, DAS=Days after spray

CONCLUSION

The cluster bean is attack by large magnitude of insect pest among them the entire sucking pest like, jassids cause more damage to the crop and can be considered as the major pest of the crop. The study concluded that the jassid population was at its peak in the 17th standard week with 17.65 jassid leaf. Weather parameters play a crucial role in the insect-pest attack which requires the development of sustainable management strategy. correlation matrix between seasonal incidence of jassid and weather factors revealed that mean maximum and minimum temperature had positive and highly significant effect on jassid population. On the other hand mean relative humidity (morning and evening) and rainfall showed highly significant but negative effect on the jassid population. The evaluation of field bio-efficacy of botanicals, microbial insecticides, insect growth regulator and chemical insecticide against jassid, revealed that after two sprays spinosad 45 EC was found to be the best treatment in reducing the jassid population 48.80 per cent on cluster bean followed by novaluron 10 EC (36.80 %) and neem oil 32.67 per cent, respectively.

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