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Population management of cotton Jassid, *Amrasca biguttula biguttula* Ishida through its biological control agent, *Arescon enocki* (Rao and Kaur) under field and laboratory conditions at upper Sindh, Pakistan

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Abstract

The research study was carried out under the cotton field conditions (kept free from insecticides) at SALU - Khairpur during, 2017. The data was taken on a weekly basis from randomly selected on 20 plants for pest population and it's proper biological control from seedling up to the harvest of the crop. The population of jassid was recorded from different parts of the plant (top, middle, and bottom portions). Thus, the biological control of jassid pest was confirmed under laboratory conditions with its proper emergence and percent population was also evaluated. Further, the results showed that the maximum population of jassid population was recorded in the month of August on top portion 4.34±0.87 and minimum in September on bottom portion 0.78±0.71 whereas; the biological control of jassid known as jassid endo-parasite, *Arescon enocki* is first time reported from this region (upper Sindh) which was observed in the month of July 30% and in October 18% under laboratory conditions at Department of Zoology, SALU - Khairpur. It was concluded that the population of *A. biguttula biguttula* was found fluctuated under field conditions and its proper biological control throughout the season. It is further recommended to encourage the biological control, *A. enocki* that may cause to get rid of from the vigorous jassid pest of the major cultivated cotton crop at the upper region of Sindh province.

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Introduction

Jassid, *Amrasca biguttula biguttula* (Hemiptera: Cicadellidae), is one of the sucking pests and causes alone 24.45% (Bhat *et al*., 1986), 18.78% (Ali, 1992). Currently, it has developed a serious insect pest on cotton crop in, Sindh - Pakistan. That is documented cause 19% reduction in the cotton crop (Ali, 1992). It infests up to 23.67% (Razaq *et al*., 2005) and found occurrence to reduce the yield from germination till harvest (Tomar and Rana, 1994). Mostly; damages during a dry period that causes the photosynthesis, yield and the quality of fiber (Cowland, 1947). Equally nymphs and adults of jassid infest and provide the loss to crop by injecting its poisonous saliva in plant tissues that may cause the cotton crop income with low-cost (Borah, 1995; Patel and Patel, 1998).

On cotton, the pests may cause considerable damage by feeding on the leaves, fruiting points, flower buds and, occasionally, also on bolls. In the early stage, sucking pests like a cotton aphid, *Aphis gossypii* Glover, leafhopper, *Amrasca biguttula biguttula* (Ishida), whitefly, *Bemisia tabaci* (Gennadius) and thrips, *Thrips tabacci* (Lind.) cause significant damage to the crop. The yield losses in cotton due to sucking pests alone were 46.5 percent (Panchabhavi *et al*., 1990). Cotton accounted for the use of 15% of the world's pesticides and 25 percent of the world's insecticides. The other response was the adoption of organic methods of cotton production by farmers through optimizing crop rotations, adoption of biopesticides for pest control and the use of biological control (Kousar *et al.,* 2018). To accomplish the said objectives the biological control agents either predators or parasitoids were screened and known to bear an active and predominant control agent having the potential to be used as a biocontrol of this menace pest (Rafique and Shah, 1998).

The occurrence of jassid parasite was found first time in Sindh, Pakistan at lower Sindh and Punjab. The two an egg parasitoid namely; *Arescon enocki* (Rao and Kaur) and *Anagrus* sp. remained noted from jassid eggs both on cotton and okra crop. No, any parasitoid found from nymphs and adults of jassid.

The generalists comprising; *Cheilomenes sexmaculatas* and *Chrysoperla carnea* were observed occasionally feeding on nymphs and adults on jassid. *Arescon enocki* remained dominant and had a significant role in controlling this pest in unsprayed field crops, however, it was rare on pesticides treated field (Sahito *et al*., 2011), this was the first report from lower, Sindh - Pakistan. *Arescon enocki,* the jassid naturally controlling has been extensively found on a cotton crop that should be reared with a huge population and released under cotton cultivated field conditions for better management. The current research study is further depicted on cotton jassid pest with its appropriate managing with biological control agent because of less research work has been done at upper, a hot region of Sindh, Pakistan.

Materials and methods

Experiments under field conditions

The study on sucking insect pest jassid and its naturally occurred parasite was evaluated on cotton crop cultivated at own researcher field on one acre at taluka Kotdiji during the summer season, 2017. The piece of the one-acre field has been kept free from insecticides and the naturally occurred population was observed on weekly interval basis from germination or first appearance of jassid till harvesting randomly selected on 20 plants of the cotton crop. From each observation, in each sampling, the data has been counted on mature and immature populations (nymphs and adult stages) on a leaf. For this purpose, we were taken 3 damaged veins up to the node of leaves on per plant, the first leaf as the top side of the plant, second leaf as mid-side of the plant as well as the third leaf as a bottom side to plant at the alternate plant. The data has been taking at 8: AM at morning to avoid the disturbance of soft-bodied jassid and its natural enemies because jassid was resting in the morning time and at noon these were active to find food and mating. The insect jassid population has been count up by support to 5x magnifier lens under field conditions.

Experiment under laboratory conditions

As jassid exerts eggs in veins of leaves so the veins of cotton leaves were separated from the branch with node and kept on moist filter paper.

Those were kept separately in vials covered with cotton swamp and Muslim cloth for a weak or till the emergence of the parasite. When parasites were hatched those were identified from different Entomological experts of the CABI, Biosciences International, Rawalpindi- Pakistan and the percent parasitism (%) has been estimated by using the following formula:

$$\text{Parasitism (\%)} = \frac{\text{No. of mummified egg/ pest}}{\text{Total eggs/ pest per leaf}} \times 100$$

Statistical analysis

Finally, the data was statistical studied in associated its means of dissimilar restrictions as of statistical software learner package (Statistics- 8.1), USA then means were divided through LSD.

Results

Population fluctuation of jassid, Amrasca biguttula biguttula (I.) under field conditions

During the research period, the jassid pest population count was made on leaves of the cotton plant under cultivated researchers own field conditions in District: Khairpur during, 2017. The crop was kept free from insecticides in which there was aim to recognize the natural occurrence of pest and their natural enemy under field conditions of this region. In the four months data collection of July to October throughout cropping season, the population of jassid either male or female was counted from different parts of the plant such as; top, middle and bottom portions. In the month of July, the highest population was observed on a top portion of the cotton plant in the 4th week (2.25±1.45) per leaf whereas; least population was observed in the 2nd week (0.30±1.63), respectively. In the middle portion of the plant, the highest population remained in the 2nd week (2.95±1.00) whereas; the least population in the 1st week (0.60±2.66) of the same month. Thus, the highest population was observed in the 3rd week (1.45±0.60) per leaf in the bottom side of the plant whereas; the least population was observed in the 1st week (0.25±0.55) per leaf per plant. The maximum overall mean population was observed in the month of July on the top portion (1.51±0.77) per leaf of the plant whereas; the minimum mean population on the bottom side (0.80±0.77) per leaf of the cotton plant, respectively (Table 1).

In the month of August, the maximum population was observed on a top portion of the cotton plant in the 4th week (5.75±1.37) per leaf whereas; the minimum population was observed in the 2nd week (2.95±0.94). While on the middle side of the plant, the maximum population was in the 4th week (3.30±0.86) whereas; the minimum population was in the 2nd week (1.35±1.76) of the same month. Thus, the maximum population was observed in the 2nd week (3.20±1.24) per leaf in the bottom side of the plant whereas; the minimum population was observed in the 4th week (0.35±1.04) per leaf per plant. The maximum overall mean population was observed in the month of August on the top portion (4.34±0.87) per leaf of the plant whereas; the minimum population on the bottom side (1.78±1.36) per leaf of the cotton plant, respectively (Table 1).

In the month of September, the highest population was observed on the top side of a cotton plant in the 3rd week (5.45±0.69) per leaf whereas; least population was observed in the 2nd week (1.85±0.99). While on the middle side of the plant, the highest population was in the 2nd week (6.80±0.83) whereas; the least population was in the 3rd week (1.40±0.82) of the same month. Thus, the highest population was observed in the 3rd week (2.25±0.55) per leaf in the bottom side of the plant whereas; the least population was observed in the 1st week (0.20±0.41) per leaf per plant. The maximum overall mean population was in the month of September on the top side (3.71±0.97) per leaf of the plant whereas; the minimum population on the bottom side (0.78±0.71) per leaf of the cotton plant, respectively (Table 1).

In the month of October, the maximum population was observed on the top side of a cotton plant in the 4th week (3.90±1.54) per leaf whereas; the minimum population was observed in the 3rd week (2.45±1.11). While on the middle side of the plant, the maximum population was in the 1st week (3.45±1.34) whereas; the minimum population was in the 4th week (2.30±1.79) of the same month. Thus, the maximum population was observed in the 1st week (2.20±1.32) per leaf in the bottom side of the plant whereas; the minimum population was observed in the 2nd week (0.25±0.34) per leaf per plant.

The maximum overall mean population was in the month of October on the top portion (2.96±0.82) per leaf of the plant whereas; the minimum population on the bottom side (1.28±1.25) per leaf of the cotton plant, (Table 1). The analysis of variance shows the significant results when compared the overall mean population of jassid throughout the season on a weekly basis (DF= 3, 1; F= 8.44; P= 0. 004). There was also found the non-significant results among the different parts of the plant as top, middle and bottom (DF= 2, 1; F= 0.27; P= 0. 846). Thus; the significant difference was observed on monthly basis (DF= 3; F= 3.00; P= 0. 041) and group in July (b), August (a), September (a) and October (ab) at (P<0.05), respectively.

Table 1. Population dynamics of cotton jassid under cotton cultivated field conditions.

Weeks	July			August		
	Top	Middle	Bottom	Top	Middle	Bottom
1st	1.35±0.59	0.60±2.66	0.45±1.88	4.35±1.72	2.60±1.93	0.65±1.39
2nd	0.30±1.63	2.95±1.00	0.55±0.89	2.95±0.94	1.35±1.76	3.20±1.24
3rd	2.15±1.23	0.65±0.81	1.45±0.60	4.30±1.13	3.15±1.18	2.90±0.91
4th	2.25±1.45	0.70±0.92	0.75±0.79	5.75±1.37	3.30±0.86	0.35±1.04
Mean±S.E	1.51±0.77	1.23±0.93	0.80±0.77	4.34±0.87	2.60±0.89	1.78±1.36
	September			October		
1st	3.65±0.93	1.45±0.60	0.20±0.41	2.65±0.67	3.45±1.34	2.20±1.32
2nd	1.85±0.99	6.80±0.83	0.25±0.44	2.85±1.26	2.80±0.61	0.25±0.34
3rd	5.45±0.69	1.40±0.82	2.25±0.55	2.45±1.11	2.40±0.73	1.25±0.68
4th	3.90±0.97	3.30±0.66	0.40±0.60	3.90±1.54	2.30±1.79	1.40±0.64
Mean±S.E	3.71±0.97	3.24±0.66	0.78±0.71	2.96±0.82	2.74±1.22	1.28±1.25

The population of jassid and its parasite under laboratory conditions

During the research period, the jassid parasite hatched out under laboratory conditions in the months from July to October during, 2017. In the month of July, the highest jassid (3.25±1.88), parasite mean (1.00±1.22) and its percent (30.77±0.25) populations were observed in the 4th week whereas; the least population of jassid (2.00±1.73), parasite mean (0.50±1.22) and percent (25.00±0.71) populations were observed in the 1st week of the same month. The maximum overall mean percent population was observed in the month of July (25.52±0.90) whereas; the minimum mean population of jassid was observed (2.75±0.78) in the same month, respectively (Table 2).

In the month of August, the maximum jassid (6.00±3.00), parasite (1.50±2.12) and its percent (25.00±0.65%) populations were observed in the 3rd week, and whereas; the minimum population of jassid (3.75±2.02) and parasite (0.75±1.73) was observed in the 1st week and the minimum percent population was observed in the 2nd week (17.39±0.33) of the same month. The maximum overall mean percent population was observed in the month of August (20.86±0.97) whereas; the minimum mean population of jassid was observed (5.06±0.89) in the same month, respectively (Table. 2).

In the month of September, the highest jassid (4.75±2.28), parasite (1.25±1.17) and their percent population (26.32±0.28) were observed in the 3rd week and the least population of jassid (3.00±1.50), parasite (0.50±1.22) and their percent population (16.67±0.24) were observed in the 1st week of the same month. The maximum overall mean percent population was observed in the month of September (21.32±0.94) whereas; the minimum mean population of jassid was observed (4.00±0.87) in the same month, respectively (Table. 2).

In the month of October, the maximum jassid (4.25±2.15), parasite (1.25±2.24) and their percent population (29.41±0.61) were hatched in the 1st week whereas; the minimum population of jassid (2.75±1.73), parasite (0.25±1.00) and their percent population (9.09±0.20) were hatched in the 3rd week of the same month. The maximum overall mean percent population was observed in the month of October (18.79±1.21) whereas; the minimum mean population of jassid was observed (3.44±1.06) in the same month, (Table. 2). The analysis of variance shows the non-significant results when compared the overall mean population of jassid and their parasite % under laboratory conditions throughout the season in weekly basis (DF= 3, 1; F=0.01; P= 0. 999) thus, the non-significant difference was observed in the monthly basis (DF= 3; F= 0.14; P= 0. 0.936) at (P<0.05), respectively.

Table 2. The population of jassid and its parasite under laboratory conditions.

	July			August		
Weeks	Jassid	Parasites	%	Jassid	Parasites	%
1st	2.00±1.73	0.50±1.22	25.00±0.71	3.75±2.02	0.75±1.73	20.00±0.86
2nd	2.75±1.73	0.75±1.73	27.27±0.25	5.75±1.91	1.00±1.22	17.39±0.33
3rd	3.00±2.12	0.85±1.73	28.33±0.30	6.00±3.00	1.50±2.12	25.00±0.65
4th	3.25±1.88	1.00±1.22	30.77±0.25	4.75±2.28	1.00±1.22	21.05±0.31
Mean±S.E	2.75±0.78	0.78±0.71	25.52±0.90	5.06±0.89	1.06±0.87	20.86±0.97
	September			October		
1st	3.00±1.50	0.50±1.22	16.67±0.24	4.25±2.15	1.25±2.24	29.41±0.61
2nd	4.25±2.15	1.00±2.22	23.53±0.28	3.00±2.12	0.50±1.22	16.67±0.22
3rd	4.75±2.28	1.25±1.17	26.32±0.28	2.75±1.73	0.25±1.00	9.09±0.20
4th	4.00±2.45	0.75±1.73	18.75±0.35	3.75±2.02	0.75±1.73	20.00±0.31
Mean±S.E	4.00±0.87	0.88±1.00	21.32±0.94	3.44±1.06	0.69±1.29	18.79±1.21

Discussion

In our research study, the pest jassid, *A. biguttula biguttula* population first appeared at the beginning of cotton plant growing to July onward, the highest mean population of jassid was reached in August. Further, our results are agreed with Simwat and Gill, (1992); Abro *et al*., (2004) and Solangi *et al*., (2008) who stated to the highest mean population of jassid on host plant also in August. Our results were contrary also agreed with Shah *et al*., (2015) who reported that jassid damage percentage was observed in the cotton crop from June, August, September, and October, respectively. In our research field under cotton field there was prohibited the application of insecticides against this pest so our results were compared with the Sultana *et al*., (2012) who reported that use of botanical spray for the decreasing of jassid population in ornamentals plants and the use of neem oil as an alternative procedure to chemical insecticides in terms of unsafe and effect on environment, cost rate and natural enemies.

In our research cotton field observed only one parasite of jassid on cotton crop and this parasite was *Arescon enocki*. Our results were agreed with Afzal and Ali, (1983) who reported that in Pakistan there was no research work has been done on its natural enemy of jassid. According to Rao *et al*., (1965) who reported that in India there were six species of parasitoids containing *Anagrus emphasize* (Doz.), *A. enocki* Subha Rao and Kaur, parasitizing up to 66% eggs of *Amrasca biguttula biguttula*. In our research under cotton field was kept free from pesticides because for aiming to the emergence of parasite of jassid that was first reported from upper Sindh, district: Khairpur that was namely; *A. enocki* that infested the jassid as biological control and percent parasitism reached up to 25.52%, respectively. Our results were well supported by Bari and Sardar, (1998); Tscharntke, (2000); Thacker, (2002) and Gray *et al*., (2009) who reported that in advanced countries, farmers have been used the insecticide

latter on diverted to the biological pest control. According to Tscharntke, (2000) who reported that our estimation of *A. biguttula biguttula* parasitized (38.6 percent) remains only rather larger too as empirically assessed the slightest threshold of 32 to 36 percent as natural resistor achievement. According to Sahito *et al.*, (2011) who reported that parasitoid *A. enocki* was predominant on *A. biguttula biguttula* and *Anagarus* sp., that was the first report throughout Pakistan that's why our results were well supported by Sahito *et al.*, (2011) who further reported that from India there were 6 species of parasites related by eggs also few sucking on nymphs and adults of this pest has remained stated. Here may be several beneficial insects related to *A. biguttula biguttula* so an intense assessment of natural enemies of this pest in Pakistan is required. The current study showed that *Arescon enocki* is the main parasitoid and it's affecting the jassid population. In cotton field kept free insecticides then pest jassid was in control. In our results showed that parasite of jassid *Erescon enocki*, was the natural enemy of this pest and this parasite showed an essential part to reduce the population of jassid. Our results were also well supported by Singh *et al.*, (1993) who reported that related observation was made by, *Anagarus* sp., a parasitoid observed on jassid. This parasite was observed as a main natural enemy of jassid, *A. biguttula biguttula*.

Conclusion

It is concluded that the sucking insect pests namely; jassid attacked the cotton crop from germination till its maturity and caused considerable damage to cotton crop. In control plot (without insecticides) this insect pest found with a severe infestation in starting with the less natural enemies appearance, when the natural enemies (Predators and Parasites) found in the huge population, ultimately the pest population reduced. *Arescon enocki* was found the dominant parasitoid of jassid and better bio-control agent of jassid in a cotton crop field. The present investigation may be supportive in the identification of an efficient parasite for its utilization as one of the important and eco-friendly tools for the management of jassid in IPM.

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