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ASSESSMENT OF POTENTIAL OF PREDATORY SPIDERS IN CONTROLLING THE COTTON JASSID (*AMRASCA DEVASTANS*) UNDER LABORATORY CONDITIONS

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ABSTRACT

A laboratory experiment was conducted to evaluate the predatory efficiency of aranied fauna against the insect pests of cotton. Predatory spider species collected from cotton fields were *Lycosa tista*, *L. kempi*, *L. machenziei* and *Pardosa berminica* and *Thomisus projectus*, *T. bulani* and *Thomisus* sp and their preys were adult and nymphs of jassid, white flies and jassid. Predator *L. tista* consumed 12.80 (19.21) adult and 17.0 (21.25%) nymphs jassid out of total consumption of adult jassid (66.60) and nymph jassid (79.7) whereas *L. kempi* consumed 12.80 (19.21%) white flies and 10.60 (25.80%) thrips. Predatory spider *T. projectus* showed least intention for consumption of 6.0 (9.0%) adults and 6.40 (8.0%) nymph jassid. White flies and thrips were consumed 3.80 (5.01%) and 3.20 7.61% by the *T. bulani* and *T. projectus*. The maximum nymph jassid (79.40) were consumed by all predatory spiders. Overall the highest consumption was observed in *L. kempi* (56) followed by *P. birminica* (53) and *Thomisus* sp (47). The current findings revealed that aranied fauna as an efficient predator of jassid could be used for the suppression of insect pests of cotton.

Keywords: spiders, predation, insects, pests, cotton, consumption.

INTRODUCTION

Cotton is an important cash crop of Pakistan, plays a pivoted role in the economy of the countries. It is grown almost all over the world from times immemorial and perhaps earlier that the time when Peruvian mummies were clothed in it. It remained a luxurious plant in China upto 600 A. D., later introduced by the Muslim Caliphs of Cordova in Spain and then it was taken to Europe about a thousand years ago (Khoso, 1994). Farmers have been growing cotton since 4,000 B.C. in India. In the new world, cotton production goes back well before Columbus landed in the Bahamas in 1942 (Dumka *et al.* 2004). Sindh is the second largest cotton producing province of Pakistan with a total area of 635 thousand hectares with annual production of 300 thousand bales. However, the seed cotton yield per hectare obtained in the country is 769 kg ha^{-1}, while in Sindh province it is 804 kg ha^{-1}. Per hectare yield obtained in the province is greater as compared to other three provinces of Pakistan (Anonymous, 2006). Cotton is attacked by number of pest species and suffers heavy losses. The yield of cotton crop in Pakistan is very low, 622 kg ha^{-1} (Channa *et al.* 2006). Traditional pest control through pesticides has disturbed the ecosystem and killed the natural enemies of the pests. Secondly, due to excessive use of pesticides, the pests have developed resistance against many pesticides. Keeping the above scenario in view, the work on-IPM techniques is being done all over the world including Pakistan.

Spiders are effective biological controlling agents, prey on several pests in agro-ecosystem (Hodge, 1999). Spider guilds having different ecological niches may collectively play an important role in suppressing the populations of insect pests (Ghafoor, 2002). Spiders are one of the most abundant predatory groups in the terrestrial ecosystems. They feed on insects, some other arthropods and play important role in pest control. 3500 species of spiders have been identified in the world (Ghavami *et al.* 2007). They are carnivorous arthropods, consume a large number of preys and do not damage plants. They have unique habitat and they live in almost all the environments. Spiders serve as buffers that limit the initial exponential growth of prey populations. The predatory spiders are classified into five major groups based on their foraging style. Prey searching ability, wide host range, ease in multiplication and poly-phagous in nature make them as a potential predator in biological pest suppression (Rajeswaran *et al.* 2005). In present experiment, the population of predatory spiders on cotton pests was carried out for first time in Sindh, Pakistan. The identification of spiders and their feeding potential on sucking insect pests will be helpful for the management of pests on cotton crop in future.

MATERIALS AND METHODS

Insect pests and aranied fauna were collected from fields of cotton variety Shahkar. The specimens were brought to the laboratory of Plant Protection

Department for identification purpose. Predators spiders belonged to Family Lycosidae were *Lysosa tista*, *L. kempi*, *L. machenziei* and *Pardosa berminica* while thomisidae consisted of *Thomisus projectus*, *T. bulani* and *Thomisus* sp. The insect pest of cotton used for predation purpose was adult and nymphs of jassid, white flies and thrips. Hand picking and nets were used for the capture of preys and predators. Both types of materials were brout to laboratory and identified by using the relevant literature (Diyal, 1937; Tikader, 1982). Collected specimens were of the same age and sex. Each of the five insects pests were introduced to each predator in a separate glass Petri-plate (6.0 cm, dia) Few pieces of chopped cotton leaves were put for study of their proper feeding and consumption behavior. A total of twenty five insect pests were introduced to each individual predator species. After twenty four hours their consumptions were observed. Each treatment was repeated by five times. Average temperature and relative humidity (%R.H.) during whole experiment remained 30±2^{o}C and 76±5.35% respectively. Collected data were subjected to analysis of variance (ANOVA) (Steel et al., 1997) and their means were compared using Duncan's new Multiple range test (Duncan, 1955).

RESULTS

Lysosa tista consumed 12.80 adult jassid which was 19.21% out of total consumption followed by *L. kempi* (9.80) and *Thomesus* sp (9.60). Overall mean consumption was 11.20±1.20. Maximum consumption of nymph jassid (17.00) was also performed by *L. tista*. It was 21.25% of the total consumption by all predatory spider species ($p<0.01$). *Pardosa birmanica* consumed 14.40 (17.5%) and 12.80 (15%). The predator *L. kempi* gathered white flies 12.80 ($p<0.01$) followed by 12.60 *Thomesus* sp (19.35) and 11.20 *L. tista* (17.7%). The insect pest 10.60 thrips (25.80%) ($p<0.01$) became the part of food of *L. kempi*, 10.0 of *L. machenzeie* (24.80%) and 3.20 of *T. projectus* (7.61%). The least 6.0 (9.00%) adult jassid, 6.40 (8.0%) nymph jassid ($p<0.01$) and 3.20 (7.61%) thrips were consumed by *T. projectus*. Overall among all araneid fauna least 3.80 (5.01%) of white flies were preyed by *T. bulani* ($p>0.01$) whereas *L. kempi* (11.20±2.30) performed maximum mean consumption followed by *L. tista* (11.20±1.20) and *P. berminica* (10.80±0.22). Among all preys maximum consumption was observed for nymph jassid (79.4) followed by adult jassid (66.6) and white flies (63.6) while least consumption of thrips (43.8). Maximum introduced insect pest were consumed by *L. kempi* (56) followed by *P. berminica* (54) and *Thomesus* sp (47) ($p<0.01$) whereas least trend for consuming insect pests observed in *T. projectus* (26.5) ($p>0.01$).

Table 1. Data (mean±SD) for the consumption of insect pests of cotton by different predatory Araneid fauna

Spiders species	Mean number of insect pests consumed				Mean
	Adult jassid	Nymph jassid	Whitefly	Thrips	
L. tista	12.80^{a}	17.00^{c}	11.20^{ab}	3.80^{b}	11.20±1.20^{a}
L. kempi	9.80^{b}	11.60^{c}	12.80^{a}	10.60^{a}	11.20±2.30^{a}
L. mackenziei	7.80^{cd}	8.40^{de}	9.60^{bc}	10.00^{a}	8.95±2.44^{cd}
Thomisus sp. nov.	9.60^{bc}	12.80^{bc}	12.60^{b}	2.60^{b}	9.40±1.88^{b}
P. birmanica	11.80^{a}	14.40^{b}	8.00^{cd}	9.00^{a}	10.80±0.22^{ab}
T. projectus	6.00^{d}	6.40^{e}	5.60d^{e}	3.20^{b}	5.30±0.44^{f}
T. bulani	8.80^{bc}	8.80^{d}	3.80^{e}	4.60^{b}	6.50±0.33^{e}

Similar alphabets in columns and rows for respective cotton pests did not differ significantly ($p<0.01$)

Table 2. Analysis of variance (ANOVA) for consumption of insect pests of cotton by different predatory spider species.

SOV	df	Mean sum of squares			
		Adult jassid	Nymp jassid	White fly	Thrips
Predators	6	26.590**	69.247**	60.123**	59.914**
Preys	5	20.45**	51.87ns	72.65ns	67.42ns
Predators X Preys	10	5.98**	54.38ns	36.98**	31.98**
Errors	13	0.971	1.08	2.500	1.257
Total	34	27.561	175.33	172.3	158.25
C.V. (%)		4.48	4.86	17.40	17.92

****,** Statistically significant differences ($p<0.01$); NS, non-significant differences ($p>0.01$).

The predators *L. kempi* (14.71%) and (14.41%) *Thomesus* sp consumed about similar number of adult jassid likewise *L. machenziei* (10.0%) and T. bulani (10.0%) preferred nymph jassid as a whole. Similarly *L. kempi* and (20.3%) and *Thomisus* sp (19.35%) showed their same intentions for predation on whitefly of cotton. Both the species *L. kempi* (25.80%) and *L. machenziei* (24.85%) of genus Lycosa found attracted towards thrips as regarding the total consumption of thrips (43.8). From the results it was revealed that most of the araneid fauna preferred predation on nymph jassid (79.4) followed by adult jassid (66.6) applied prey species.

DISCUSSION

Present study on population of predatory spiders on cotton pests at Tandojam revealed that seven species of predatory spiders were identified for first time in Sindh. The information on the number of predatory spider species showed that there is potential for knowing number of predators in various crops, fruits and vegetable plants. The studies showed that the predators were polyphagous (preys) in nature and can be exploite for biological control of sucking pests. Better adaptations of body parts of spider proved them better predators for their preys. Spiders are very effective biological control agents and preyed on several pests in numerous agro-ecosystem (Hodge, 1999). Spider guilds having different ecological niches may collectively play an important role in suppressing the populations of insect pests (Ghafoor, 2002). Spiders are one of the most widely occurring and frequent predatory groups in the land ecosystems. The study also showed that there were only two types of predatory spider viz., crab and wolf spider prevailing in cotton agro-ecosystem at Tandojam. Current species of spiders proved better controlling of insect pests of cotton, specially, preferred nymph jassid than adults. predation on adults might be difficult in handling as compared to nymphs. Most of the spider species consumed more specimens of nymph jassid than other preys. Slow movement and less resistance offered great advantages to predators.

Role of spiders for biological control of insect pests of cotton were studied by many researchers (Ghafoor, 2002; Ghafoor *et al*., 2011; Alvi, 2007, Maqsood, 2011; Rajeswaran *et al*., 2005; Gustavo and Joas, 3003). Sebastian and Sudhikumar (2003) evaluated feeding potential of fourteen predatory spider species of cotton in laboratory on *Aphis craccivora* infesting cotton. The feeding efficiency varied with the life stage and sex of the spiders. Adult females consumed more number of preys than adult males and sub-adults. Among all species tested, *Lysosa poonaensis* and *L. tista* consumed the highest number of prey and *Oxyopes chitrae* and *Phidippus pateli* consumed the least number of preys. Least consumption might be due to the more adaptability and mimic behavior of pest against the predators. Similarly in the current studies *L. tista* consumed 12.80 adult jassid (19.21%) and overall its consumption was 44.8 insect pests. Further studies revealed the fruitful results of using spiders as a best biological controlling tool for insect pests of cotton. Predatory spider species can used to reduce in infestation of insect pests of crops, fruits and vegetables in order to reduce the huge economic losses and economic inflations. In such laboratory conditions spiders proved best enemy for reducing the insect pests of cotton. In current experiments *L. tista* consumed maximum 12.80 (19.21%) adult jassid and 17.00 (21.25%) nymph jassid among all pests introduced. It might be due to their special body part and special characteristics for capturing ability for their preys and therefore, consumed more preys than other araneid fauna. Those results were in accordance with conclusive remarks of Sebastian and Sudhikumar (2003) who concluded that *L. tista* consumed the highest number of preys whereas *Oxyopes chitrae* and *Phidippus pateli* least.

Present investigation showed that all predatory spiders consumed at least on of their prey pests at controlled laboratory conditions. However, some spider species consumed more efficiently than others competitive. The current studies can be exploited by using the pest control in field conditions by releasing the predators and pests in controlled conditions/cages. The studies may be included on IPM of pests so that adverse effects on pesticides may be excluded for the coming generations. It was proved from the studies that at the start of jassid development and growth the release of predators might be more advantageous than at the adult stages.

The spider *L. tista* consumed maximum of 12.80 (19.21%) adult jassid and 17.0 (21.25%) nymph jassid among all introduced insect pests. The species *L. kempi* (56) showed maximum intention for consumption of cotton pests. It might be due to their best adaptations of body part for hunting than other araneid fauna. The role of predatory spider species for the consumption of insect pests of cotton were in agreement with those of Rajeswaran *et al.* (2005) who reported that spiders are carnivorous and poly-phagous arthropods consume a large number of preys and do not damage plants. El-Heneidy *et al.* (1996) who surveyed cotton field for spiders and found that the population of Aranidae was highest during growing season but were lower during the mid season. Dippenaar *et al.* (1999) reported that spiders play an important role in keeping pests at endemic levels and preventing outbreaks. Gustavo and Joao (2003) reported that spiders prey on arthropods belonging to several guilds but spiders showed a preference for wingless prey. The predator *P. birmanica* consumed moderate number of specimens of all applied prey species than others. Sebastian *et al.* (2003) found that *P.*

birmanica is one of the dominant spider observed in cotton ecosystem the predation was found varying in different developmental stages and between the sexes adult female were found to the having a higher feeding capacity on four insect pests (Aphid, *Amrasca biguttula*, *Thricertrus bicolor, Heliothis armegera* and *Helicoverpa armigera*. Laboratory conditions are always the controlled conditions and we can achieve the desired results by adopting the appropriate methodologies. More accurate and precise results, which would be more practical, can be achieved by applying them in the natural field conditions. Current finding revealed that such methodologies might be proved helpful in determining the predatory efficiency of spider against insect pest, specially jassid, in the fields.

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