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IMPACT OF TEMPERATURE AND RELATIVE HUMIDITY ON POPULATION ABUNDANCE OF PREDATORY SPIDERS IN COTTON FIELDS

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ABSTRACT

An experiment on recording the predatory spiders from sprayed and unsprayed cotton grown at Agriculture Research Institute Tandojam was carried out during July-September 2008. The results revealed that seven species of predatory spiders were recorded from cotton and identified first time from Sindh. Lycosidae (513) and Thomisidae (210) families comprised of *Lycosa tista*, *L. kempi*, *L. machenziei* and *Pardosa berminica* and *Thomisus projectus*, *T. bulani* and *Thomisus* sp. Total capture in the months of July, august and September were 164 (24.94±2.24^{o}C, 78.86±4.40%R.H.), 444 (22.5±1.28^{O}C, 79.33±4.40%R.H.) and 98 (22.93±2.30^{O}C, 72.16±2.30%R.H.) respectively. From un-sprayed venue maximum predatory spiders plant^{-1} were *P. birminica* (6.65±0.51) followed by *Thomisus* sp (4.23) and *L. tista* (2.42±0.31). Similarly from sprayed fields were *P. berminica* (3.12±0.35) followed by *Thomisus* sp (2.35±0.30) and *L. tista* (1.46±0.20). In the month of July spiders plant^{-1} were 2.94±0.22 when temperature and R.H. were 24.94^{o}C and 78.6% respectively. Similarly in the month of August and September were 2.86±0.180 (22.5±1.28^{o}C, 79.33±4.40% R.H.) (r = 0.670**) and 1.45=0.34 (22.93±2.30^{o}C, 72.16±2.30%R.H.) (r = 0.477**).

Key words: temperature, population, predatory spider, sprayed, un-sprayed, Cotton.

INTRODUCTION

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 (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 control 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 pest insects (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. More than 35000 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 polyphagous in nature make them as a potential predator in biological pest suppression (Rajeswaran *et al.*, 2005). A study was programmed to evaluate the diversity of spider fauna in the sprayed and un-sprayed fields of cotton. In order to reduce the application of pesticides biological control method is one of those which is more approachable than others to control the insect pests of crops and vegetables.

MATERIALS AND METHODS

A standard commercial cotton variety Shahkar was sown on well-prepared bed in five blocks. Each block was consisted of 50 x 50 meters. The sowing was made by drilling method keeping 75 cm distance between row to row and 30 cm distance between plant to plant. Whereas, Niab-78 variety of cotton was grown on an area of one acre in CABI-Unit of IPM in the field of Entomology Section, Agriculture Research Institute, Tandojam. Agronomic practices were adopted in all the plots throughout the growing period according to the recommendations. Research cotton was sprayed with pesticides three times. Initially, Jozer 20cc and later two applications of Prophenophos 60cc in 120 liters of water were applied. Where, the cotton grown at CABI-Unit was not sprayed throughout the season. For recording observations, 50 plants were selected randomly in five

separate plots in both fields. Population density of spiders was examined carefully from whole plant of cotton. Observations were recorded from 3rd week of July 2008 to 2nd week of September on every alternate day at 8 to 10 a.m. Different species of cotton spiders were collected using hand net (14cm dia.) whereas, aspirator was used for collection of small species of spiders. These specimens were brought to the laboratory of Plant Protection Department for identification purpose. The agro-meteorological data on some weather factors were collected from Regional Agro-met Centre, Tandojam. The collected spiders were identified with the help of keys formulated by Diyal, (1937); Nentwig *et al.* (2003); Tikader, (1982) and Plantick (2004).

RESULTS

A total of 723 specimens of araneid fauna were captured from both of sprayed and un-sprayed fields of cotton. Predatory spiders collected from the sprayed fields were 243 belonged to families Lycosidae (175) and *Thomisidae* (68) while from un-sprayed fields were 480 comprised of Lycosidae (338) and *Thomisidae* (142) (Table 1). Family Lycosidae (175) collected from sprayed fields consisted of two genus lycosa and pardosa. Three species of genus Lucosa were 38 *L. tista* (16.65%), 27 *L. kempi* (11.11%) and 31 *L. machenziei* (12.75%) while 79 specimens belonged to *L. berminica* (32.51%). Similarly three species collected from sprayed fields belonged to family *Thomisidae* (68). Four specimens of *T. projectus* ((1.64%), three *T. bulani* (1.23%) and sixty related to *Thomisus* sp (25.10%) (Table 1). Predatory spiders collected from un-sprayed fields consisted of two families Lycosidae (338) and *Thomisidae* (142). Genus Lycosa comprised of 63 *L. tista* (13.12%), 49 *L. kempi* (10.20%) and 53 *L. machenziei* (11.04%) while genus pardosa had only one species *L. berminica* containing 173 specimens (36.04%). Three species linked to family *Thomisidae* (142) were 110 *Thomisus* sp (22.91%), 13 *T. projectus* (2.70%) and 19 *T. bulani* (3.95%) (Table 2).

From the sprayed field in the month of July a total of 13 specimens were collected on 31st followed 12 each on 27th and 29th. Maximum relative humidity (R.H.) (88%) and temperature (25.7°C) and was recorded on 31st and 29th. In the month of August maximum spiders species (14) were collected on 4th followed by 6th (13) and 8th (12) of August (Table 2). The maximum (%)R.H. (89%) and temperature (26.5°C) recorded on 2nd and 12th August. A total 9 specimens were collected on 1st September followed by 3rd (8) and 7th (6) September (Table 1). From the un-sprayed fields of cotton a total of 31 specimens were recorded on 31st July when maximum temperature was 25.7°C. The highest R.H. (88%) was recorded at the end of July on 29th. In the month of August maximum specimens (29) and R.H. (89%) were observed on 2nd August while the highest temperature (26.5°C) found on 12th of the same month. On 1st September maximum predatory spiders (13) were collected from un-sprayed fields followed by 3rd (12) and 7th (11). The highest temperature (23.6°C) and (%) R.H. (84%) was recorded on 7th September (Table 2).

In the month of July predatory spiders plant^{-1} (2.94±0.22) were more in un-sprayed fields than sprayed fields (1.68±0.22). Similarly in August (2.86±0.180) and September (1.451±0.34) same trends were observed for un-sprayed than sprayed fields. Saltisidae family contained maximum numbers (*P. birmanica*, 6.65±0.51) of spiders plant^{-1} than *Thomisidae* (*Thomisus* sp, 4.23±0.01) in the un-sprayed fields. Similar observations were recorded for Saltisidae (*P. birmanica*, 3.12±0.35) and *Thomisidae* (*Thomisus* sp, 2.35±0.30) families in the sprayed fields (Table 1).

Table 1. Data of (mean±SD) predatory spider species plant^{-1} in sprayed and un-sprayed fields, temperature (°C) and relative humidity (%) in sprayed and un-sprayed fields of cotton in different months

Months and days of capture	Field types	Predatory spiders plant^{-1}	range	Temperature °C		Relative humidity (%)	
		Mean±SD		Mean ± SD	range	Mean ± SD	range
July (23-31) Captured	Un-sprayed	2.942±0.22^{a}	2.14-4.14	24.94±2.24^{a}	24-25.70	78.6±4.400^{a}	71-88
days (five)	sprayed	1.684±0.22^{b}	1.57-1.86				
August (2-30)	Un-sprayed	2.86±0.180^{a}	2.0-4.140	22.5±1.28^{b}	22.5-26.5	79.33±4.40^{a}	74-89
Captured days (fifteen)	sprayed	1.41±0.200^{c}	1.0-1.860				
September (1-11)	Un-sprayed	1.451±0.34^{bc}	1.14-1.86	22.93±2.30^{b}	22.5-23.6	72.16±2.30^{b}	52-84
Captured days (six)	sprayed	0.665±0.77^{d}	0.57-0.86				
Total of un-sprayed	68.14	102.99	-	-	-	-	-
Total of sprayed	34.85						

Similar letters in columns for respective parameter did not differ significantly (p>0.01)

Table 2. Data of (mean±SD) different predatory spider species plant^{-1} in the sprayed and un-sprayed fields of cotton

Families	Genus	Predatory Spider species	No. of spiders plant^{-1} in sprayed and un-sprayed fields of cotton			
			Un-sprayed fields		Sprayed fields total	
			mean±SD	total	mean±SD	total
Lysosidae	Lycosa	*L. tista*	2.42±0.31^{c}	63 (13.12%)	1.46±0.20^{c}	38 (16.65%)
		L. kempi	1.88±0.30^{cd}	49 (10.20%)	1.04±0.20^{c}	27 (11.11%)
		L. machenziei	2.04±0.30^{c}	53 (11.04%)	1.15±0.00^{c}	31 (12.75%)
	Pardosa	*P. birmanica*	6.65±0.51^{a}	173 (36.04%)	3.12±0.35^{a}	79 (32.51%)
Thomisidae	Thomisus	*Thomisus sp*	4.23±0.00^{b}	110 (22.91%)	2.35±0.30^{b}	61 (25.10%)
		T. projectus	0.50±0.14^{de}	13 (2.70%)	0.15±0.08^{c}	04 (1.64%)
		T. bulani	0.73±0.17^{de}	19 (3.95%)	0.12±0.07^{c}	03 (1.23%)

Similar letters in columns for respective parameter did not differ significantly (p>0.01).

DISCUSSION

Present study on population of predatory spiders on sprayed and un-sprayed fields of cotton 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. In the un-sprayed fields of cotton 480 araneid fauna were collected and identified belonged to Lycosidae (338) and *Thomisidae* (142) families as compared to both families (243) (Lycosidae,175; *Thomisidae*,68) from sprayed fields. The studies showed that the in order to observe the efficiency of spiders as biological control of pest avoid the applications of pesticides otherwise may killed the beneficial insects and required results can not be achieved and may cause the loss of economic benefits (Ghafoor *et al.*, 2011). From the un-sprayed fields 338 specimens of Lycosidae family were collected which were similar to the findings of Alvi, (2007) who collected 334 (32%) of the total capture. On the contrary Duffey (1962) gave the conclusive remarks based on his results that of the total Saltisids composed of 43% araneid fauna which consisted of cursorial species and cursorial spiders.

As the temperature was concerned from the un-sprayed fields 296 predatory spiders were gathered as compared to July (106) and September (61). Maximum specimens were observed in the month of August when temperature (25 ^{o}C) and R.H. (80%) both were high as compared to temperature 24.9 ^{o}C, 23.0^{o}C and R.H. 78%, 72% in the months of July and September respectively. Present findings were not in accordance with Ghafoo *et al*. (2011) who found 18 specimens when temperature and R.H. were 33.3^{o}C and 85% respectively. He observed 37 specimens in the month of June when temperature (35.1^{o}C) increased but R.H. (61.4%) decreased. Specimens collected from both types of fields were similar to the species collected by Ghafoor *et al*. (2002) from the cotton fields and by Maqsood, (2011) from citrus (20%) and guava gardens (6%). From the present study it was concluded that in the month of July 106 predatory spiders were collected at temperature 24.9 ^{o}C and R.H. 78.6% but different observations were recorded by *Alvi* (2007) who captured 53% from fruit gardens between the months of March and July. In the sprayed fields maximum 58 predatory spiders were observed when temperature 24.9^{o}C favored their population but in the month of September (37) population decreased when maximum temperature was 71.0^{o}C. Maximum spiders were collected on 31st march (r±0.968) when temperature was high as compared to other days of capture. On the contrary Ghafoor *et al* (2002) collected 15 specimens in the same month when temperature (21.95 ^{o}C), rainfall (28 mm) and R.H. (58%) were low. As compared to the month of September more aranied fauna was capture from both sprayed and un-sprayed fields at the same average R.H. (24.9%). From both the types of fields (sprayed, 37; un-sprayed, 61) in the month of September with the increase in temperature (71.1^{o}C, 72.16^{o}C) araneid fauna decreased.

Study further showed that in the sprayed fields lush green cotton with maximum number of sucking insects during July to August gathered maximum number of spiders 58 in the month of July and 27 in the month of September with positive correlation to temperature (r±0.987) and relative humidity (r±0.978). Both of the families Lycosidae (175) and *Thomisidae* (68) were less then found in the un-sprayed fields of cotton. In sprayed fields maximum aranied fauna marked as Lycosidae 175 and *Thomisidae* 68 out of 243 included t. projected 4 (1.64%), *T. bulani* 3 (1.23%) and *Thomisus*sp sp. 61(25.10%). Findings were not in agreement with Maqsood (2011) who identified lycosids 29.20% of total 254 captures. From sprayed fields In July (58) capture was double than found by Ghafoor *et al*. (2011) from the cotton fields. In the current study peak population was observed in the last days of July (13) and at very early days of August (13-14). Wang and Wang, (2000) in a study recorded predatory populations of various insects and gave the conclusive remarks that populations of

predators had two peak populations from 25 June-15 July and 25 July to 15 August.

From the sprayed fields a total of 243 and 480 were captured from un-sprayed fields of cotton. Ghafoor (2002) recorded 16 species of spiders after spraying the pesticides in cotton field at Faisalabad during August–December. They belonged to family Lycosidae 9 species and one species each to Salticidae, Oxyopidae and Clubionidae. A total of 64 specimens of spiders were caught in the un-sprayed fields of cotton. These results demonstrated that the population of spiders was more during the middle and maturity stage of crop. The population differed among the spider species genus *L. berminica*, 79; *Thomisus*sp, 68 from sprayed and from un-sprayed 173 and 110 of both genus respectively. Current results showed that more predatory spiders were captured from sprayed (58) and un-sprayed (106) fields in the month of July. The results of present study are in agreement with those of Rajeswaran *et al.* (2005) reported that spiders are cornivourous and poly phagous arthropods consume a large number of preys and do not damage plants. Family Lycosidae contained 175 while *Thomisidae* 68 in the sprayed fields. In the un-sprayed fields Lycosidae comprised of 338 and *Thomisidae* 142. on the contrary El-Heneidy *et al.* (1996) surveyed cotton field for spiders and found that the population of Aranidae family were highest during growing season but were highest during mid season. Population of predatory spiders plant^{-1} (2.94±0.22) during July in followed by in August (2.86±0.180) and September (1.45±0.34) in un-sprayed fields of cotton. Dippenaar *et al.* (1999) reported that spiders play an important role in keeping pests at endemic levels and preventing outbreaks when lush green fields are available attracting insect pests.

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