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The effect of Relative Humidity and Temperature on the Population Density and Abundance of Predatory Spiders in Citrus Fields

Ahmed H. S. K.[1], *Rashwan A.M.A.*[1]*

[1]*Department of Agricultural Zoology and Nematology, Faculty of Agriculture, Al-Azhar University, Assiut, 71524, Egypt*

Abstract

In July-September 2018, testing was performed out in Sohag Governorate to record predator spiders from sprayed and unsprayed citrus. Seven types of carnivorous spiders were found in oranges, according to the findings. *Hogna ferox, lycosa* sp., *Pardosa iniqua* and *Wadicosa Fidelis* belonged to the Lycosidae 513, while *Thomisus spinifer, Xysticus* sp and *Thomisus* sp. belonged to the Thomisidae 210 families. Comprised and Total capture in September, August, and July were, respectively, 98 (22.93±2.30^{O}C, 72.16±2.30%R.H.), 444 (22.5±1.28^{O}C, 79.33±4.40%R.H.), and 164 (24.94±2.24ºC, 78.86±4.40%R.H.). *Citrus nobills* (6.65±0.51) were the most numerous predatory spiders from plant-1 in the unsprayed area, subsequent to *Thomisus sp*. (4.23) and *Hogna ferox* (2.42±0.31). *Citrus nobills* (3.12±0.35), *Thomisus* sp (2.35±0.30), and *Hogna ferox* (1.46±0.20) were also collected from sprayed crops. In July, the temperature and relative humidity were 24.94oC and 78.6%, respectively, and the spiders' plant-1 was 2.94±0.22.

Keywords: Population, Predatory spiders, Sprayed, Un-sprayed, Citrus.

Full length article *Corresponding Author*, e-mail: mud194@azhar.edu.eg

1. Introduction

The fruit and vegetative parts of several landscapes and garden plants, as well as the bark of trees, will be consumed by the rats. Young trees may get totally girded by their feeding and gnawing. When oranges are still hanging on the tree, roof rats will frequently devour the pulp, leaving only the rind. Pesticides used in traditional pest management have disrupted the ecology and eliminated the pests' natural adversaries. Second, pests have evolved resistance to many insecticides as a result of excessive pesticide use. In light of the foregoing scenario, work on IPM approaches is being carried out all over the world. Spiders serve as biological pest controllers, that prey on a variety of pests in agroecosystems [1]. Spider guilds with varied ecological niches may have a significant role in controlling pest insect populations collectively [2]. In terrestrial habitats, spiders are one of the most abundant predatory groups. They eat insects and other arthropods, and they serve a crucial play in pest management. More than 35000 different species of spiders can be found worldwide [3]. These arthropods are carnivorous, meaning they consume a lot of food but do not damage plants. They have distinct habitats and can be found in almost every type of environment. Initially, spiders serve as a buffer, preventing the exponential increase in prey populations. Predatory spiders are categorized into five main kinds based on how they feed. Because of their high prey-finding abilities, wide host range, ease of replication, and polyphagous nature, they have the potential to be a predator in biological pest control [4]. Planning for a study to compare the richness of spider fauna in citrus fields that had been sprayed and those that had not been sprayed. To limit the use of pesticides, one of the more approachable biological control methods for controlling insect pests in vegetables and crops is biological control.

2. Materials and methods

On a 50 × 50 m plot, the study was conducted on a variety of conventional commercial citrus. The spacing between rows was 75 cm, meanwhile the space between plants was 30 cm. In the Sohag Governorate, a variety of citrus fruits were researched. Agricultural methods were followed in all plots during the growing season in accordance with the recommendations. Pesticides were applied three times to the fruit used in the study. Initially, Joxer Prophenophos was first applied in two applications of 20cc in 120 liters of water. The citrus groves were not treated at all during the growing season.

50 plants were chosen at random in five independent plots in both fields to record observations. The spider population density was thoroughly examined across the entire citrus plant. From the third week of July through the second week of September, observations were taken every other day from 8 to 10 a.m. A hand net (14cm diameter) was used to gather different species of citrus spiders, while an aspirator was utilized to collect spiders of a little size. The Plant Protection Department lab received these samples so they could be identified. The Regional Agro-met Centre provided agro-meteorological data on a few weather parameters. The spiders were identified using keys that had been devised by Nentwig (1988) and Tikader (1982) [5-6].

3. Results

Both treated and unsprayed citrus patches yielded a total of 723 araneid fauna specimens. The Lycosidae 175 and Thomisidae 68 families of predatory spiders were found in sprayed fields, while spiders collected from fields without spraying belonged to the Thomisidae 142 and Lycosidae 338 families (Table 1). The Lycosidae 175 family contained two genera, lycosa and pardosa, which were collected from sprayed fields. There were 38 *Hogna ferox* (16.65%), 27 *Lycosa* sp (11.11%), and 31 *Pardosa iniqua* (12.75%) specimens from the Lycosa genus, whereas 79 *Wadicosa fidelis* specimens were found 32.51 percent. Three species discovered in fields that had been sprayed also belonged to the Thomisidae family 68. Four *Thomisus spinifer* specimen's 1.64 percent, three *Xysticus* sp 1.23 percent, and sixty *Thomisus* sp. related specimens' 25.10 percent were found (Table 1). Two families of predatory spiders were found in un-sprayed fields. Thomisidae 142 and Lycosidae 338. In the genus Lycosa, there were 53 *Pardosa iniqua* (11.04%), 49 Lycosa sp. (10.20%), and 63 *Hogna ferox* (13.12%), while the genus Pardosa had only one species, *Wadicosa fidelis*, which had 173 specimens (36.04%). Three species correlated with the family Thomisidae 142 were 110 *Thomisus* sp 22.91%, 13 *Thomisus spinifer* 2.70%, and 19 *Xysticus sp* 3.95% (Table 2). On the 31st of July, 13 specimens were taken from the sprayed area, followed by 12 each on the 27th and 29th. On the 31st and 29th, the maximum relative humidity of 88% and temperature of 25.7ºC were recorded. Most spider species are found in August. 14 were collected on the 4th followed by the 6th 13 and 8th 12 of August (Table 2). The maximum R.H. 89% and temperature 26.5ºC were captured on tape on 2nd and 12th August. A total of 9 samples were taken, on 1st September after that on 3rd (8) and 7th (6) September (Table 1). An overall of 31 specimens were gathered from citrus fields that had not been treated. 31st July when the highest temperature reached 25.7ºC. The highest level of R.H. 88% ended up being documented at the end of July on the 29th. Maximum specimens were found in August. 29 and R.H. 89% were discovered on 2nd August the month with the greatest temperatures. 26.5ºC was found on the 12th throughout the same month. On 1st Predatory spiders are at their peak in September. 13 were taken from fields that had not been sprayed, followed by 3rd 12, and 7th 11. The most extreme temperatures 23.6ºC and R.H. 84% were captured on 7th September (Table 2). Predatory behavior was observed in July. Spiders' plant^{-1} 2.94±0.22 unsprayed fields had more than sprayed fields 1.68±0.22. In August, it was similar. 2.86±0.180 and September 1.451±0.34 Unsprayed fields showed the same tendencies as treated areas. Saltisidae The family had the most members. *Wadicosa fidelis*, 6.65±0.51 of spider's plant^{-1} than *Thomisidae Thomisus* sp, 4.23±0.01 in the fields that haven't been sprayed similar findings were made in the case of *Thomisidae Thomisus* sp, 2.35±0.30 and Saltisidae *Wadicosa fidelis,* 3.12±0.35 in the sprayed fields, families (Table 1).

4. Discussion

The number of predatory spiders was counted on sprayed and unsprayed citrus fields, and in Sohag, seven new species of predatory spiders were identified for the initial time. Given the variety of crops and fruits, as well as vegetable plants, there are several predatory spider species that could be identified. Unsprayed areas were used to capture araneid fauna citrus 480 fields and identified as belonging to the Thomisidae (142) and Lycosidae (338) families, as opposed to both families 243 (Lycosidae,175; *Thomisidae*,68) fields that have been sprayed The investigations revealed that by observing the effectiveness of spiders as biological pest management, pesticides can be avoided without killing beneficial insects, resulting in the failure to achieve the desired objectives and the damage of economic value [7]. 338 Lycosidae specimens were gathered from un-sprayed areas, which matched the findings of the previous study gathered 334 32% of the overall capture. On the other hand, based on Duffey (1962) findings, concluded that the overall Saltisidae fauna comprised 43 percent araneid, which included cursorial animals and cursorial spiders [8]. In terms of temperature, 296 predatory spiders came from fields that hadn't been sprayed, compared to 106 in July, and September (61). Most specimens were found in August when the temperature was at its highest (25ºC) and R.H. (80%) Both were hot, especially when contrasted to the temperatures of the previous week 24.9ºC, 23.0ºC, and R.H. 78%, 72% each, in July, and September. The current results weren't in line with the previous ones. Ghafoor *et al.* (2011) noted 18 samples where temperature and R.H. were 33.3ºC and 85% consecutively [7]. In June, when the temperature was at its highest, he saw 37 specimens (35.1ºC) increase but R.H. 61.4% lowered. both of these fields yielded specimens that were identical to the species sampled by Ghafoor et al., (2002) from the citrus fields from citrus 20% and guava gardens 60% [2]. According to the findings of this investigation, 106 predatory spiders were gathered in July at a temperature of 24.9C and R.H. 78.6%. However, numerous observations were made between March and July, they took 53 percent from fruit gardens. A maximum of 58 predatory spiders were detected in the sprayed fields while the temperature was 24.9ºC, but the number declined in September (37) when the highest temperature was 71.0ºC. On this day, most spiders were captured 31st march (r±0.968) when the temperature was very high in comparison to other capture days. Quite the contrary, Ghafoor et al., (2002) 15 samples were obtained in the same month when the temperature was at its highest 21.95ºC, rainfall 28 mm ,and R.H. 58% were low [2]. At the same average rate as September, more arranged wildlife was taken from both treated and un-sprayed fields R.H. (24.9%). With the increase in temperature in September from both types of fields sprayed, 37; un-sprayed, 61, (71.1ºC, 72.16ºC).

The araneid fauna has declined. The study also discovered that the greatest number of spiders, with 58 in July and 27 in September, were located in sprayed citrus fields with the highest concentration of sucking insects from July to August. These findings showed a positive correlation with temperature (r±0.987) and relative humidity (r±0.978). Lycosidae 175 and Thomisidae 68, the two families in question, were less numerous than those found in citrus areas that had not been treated. In sprayed fields, the most densely organized fauna is labeled as Lycosidae 175 and *Thomisidae* 68 out of 243 incorporated 4 projected 1.64%, *Xysticus sp* 3 1.23%, and *Thomisussp* sp. 6125.10%. The outcomes were not in line with the predictions made by Maqsood (2011), who found lycosids in 29.20% of the 254 captures in total. July 58 capture from sprayed fields was twice as high as that found in the orange orchards by Ghafoor et al., (2011) [7]. In the current study, peak population was seen in the final days of July 13 and the first few days of August (13–14). In a study, Wang and Wang (2000) monitored predatory populations of several insects and concluded that predatory populations had two peak populations (25 June) (25 July) and (15 August). A total of 243 and 480 citrus plants were taken from sprayed areas and un-sprayed fields, respectively. After spraying insecticides in a citrus field in Faisalabad from August to December, Ghafoor (2002) discovered 16 kinds of spiders [2]. They belonged to the Lycosidae family, with nine species, and one each to the Salticidae, Oxyopidae, and Clubionidae families. A total of (64) spiders were discoveredht on citrus crops that had not been treated. These findings revealed that spider populations were higher during the crop's middle and maturity stages. The population of each spider species-genus varied *Wadicosa Fidelis*, 79; *Thomisus sp*, 68 173 and 110 of both genera were obtained from sprayed and un-sprayed samples, respectively. The most recent results show that in July, more predatory spiders were collected from 58 sprayed and 106 unsprayed locations. The results of this investigation align with previous research findings [4]. Reports state that spiders are polyphagous, carnivorous arthropods that devour a large variety of prey with minimal harm to plant life. In the sprayed fields, the Lycosidae family had 175 members, whereas the Thomisidae had 68. Lycosidae accounted for 338 of the un-sprayed fields, whereas Thomisidae accounted for (142). Conversely, El-Heneidy et al., (1996) found that the Aranidae family was most abundant throughout the growing season, but not during midseason, when they searched a citrus field for spiders [9]. In unsprayed citrus fields, the plant-1 predatory spider population was 2.94±0.22 in July, 2.86±0.180 in August, and 1.45±0.34 in September [10]. When lush green fields attract insect pests, spiders serve crucial reducing outbreaks and maintaining endemic pest populations, according to reports. Spiders, in contrast, can feed and eat phytophagous mites as well as helpful lepidopteran insect larvae. Many studies explored the ecological features and taxonomic significance of numerous species of spiders from various fruit orchards (i.e., citrus, apple, grape, fig, guava, and mango fruit gardens) Sallam, 1996, Mohafez, 2000, Metwally *et al.*, 2012, Amal- Abo Zaed and Mansour (2019) [11-13].

Table 1: Temperature, relative humidity, and mean spiders of the predatory plant-1 in sprayed and unsprayed citrus fields during different month.

Months and days of capture	Field types	Predatory spiders plant ^{1}		Temperature °C		Relative humidity (%)	
		Mean±SD	Range	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 parameters did not vary significantly (p>0.01).

Table 2: Data of means several predatory spider species plant-1 in citrus fields with and without spraying.

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

Similar letters in columns for respective parameters did not vary significantly (p>0.01).

4. Conclusions

In the study area, using zinc phosphide results in high bit counts in rodent species. When compared to the other weeks of treatment, the rodent species can eat a higher amount of bait during the first week. The totality, proximity, and availability of food are factors in rodent control, which can also be utilized to regulate the density of rodent populations through integrated pest management (IPM). Also, Destruction of burrows and nests as mechanical control. The reduction in the population density of rodents determined by the amount consumed of wheat bait proved that the destruction of burrows and nests concentration gave efficiency less than the event of the use of highly toxic rodenticides and anticoagulant rodenticides which was more efficient and effective. This may be due to the fact that the rodents take the banks of the river Nile for a safe dwelling among the weeds, where they make burrows and nests near sources of food and water at the same time, which makes it difficult to reach them and demolish their burrows and nests and control them as they feed on citrus fruits and then return again to their burrows and nests among the weeds. Also, results proved that chemical control of rodents by using acute rodenticides has been successful with higher percentages in rodent control compared to anticoagulants and destruction of burrows and nests in citrus farms conditions without danger as employees at the farm and priced appropriate. But prefer not to use chemical control in citrus farms only if absolutely necessary.

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6. Authors' contributions

Rashwan AMA conducted experiments and collected data. Ahmed HSK planned the experiments and contributed to analysis and manuscript arrangement. All the authors have read and agreed the final manuscript.

7. Availability of data and materials

The datasets applied throughout the current study are accessible on reasonable request.

8. Declarations

8.1. Ethics approval

NA.

8.2. Competing interests

The authors have no competing interests to declare that are relevant to the content of this article.

8.3. Authors' contributions

Rashwan AMA conducted experiments and collected data. Ahmed HSK planned the experiments and contributed to analysis and manuscript preparation. All the authors have read and approved the final manuscript.

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8.5. Ethics approval
Not Applicable.

8.6. Competing interests
The authors have no competing interests to declare that are relevant to the content of this article.

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