J. Plant Prot. and Path., Mansoura Univ., Vol.8 (12): 663 – 666, 2017

The Dominant True Spiders in Seed Watermelon Plantations, and Efficiency of Traps in Collecting Occurring Species

Refaei, E. A. ; Ekram A. Abdou and Amany A. Khalifa
Biological Control Res. Dept., Sakha Agric. Res. St., Plant Prot. Res. Inst., ARC, Egypt.

ABSTRACT

Seed watermelon, *Citrulus lanatus* (Thumb) is an early summer crop, which is a subject to infestations by several insect pests resulting in damage and losses in the crop production. A study was undertaken at Rasheed region, Beheira Governorate during 2015 and 2016 summer seasons to detect the true spider species occurring in seed watermelon plantations, and monitor the population fluctuation of the most dominant ones. In addition, a comparison study was conducted to find out the efficiency of traps, used in spider catch, as related with spider species. Six true spider species were surveyed beginning from first of May up to mid-July. *Paradosa* sp. and *Lycosa* sp. (Fam. Lycosidae) and *Thanatus albini* (Fam. Philodromidae) were captured throughout the season; May to July. On the other hand, *Clubiona* sp. (Fam. Clubionidae), *Singa* sp. (Fam. Araneidae) and *Thomisus* sp. (Fam. Thomisidae) were trapped only during July. The most dominant spider species in 2015 season was *Thanatus albini* (43.77%), followed by *Pardsoa* sp. (42.64%), and then *Lycosa* sp. (4.91%). A reverse situation was found in 2016 season, as the most dominant spider was *Pardosa* sp. (45.14%), followed by *Thanatus albini* (41.32%) and the third rank was occupied by *Lycosa* sp. (4.17%). However, the dominance percentages of the remaining spiders ranged between 0.17 and 4.17% in both seasons. Tools used for capturing spiders were variable in their efficiency. *Pardosa* sp. was captured mainly by pitfall traps, with values of 90.27 and 93.08%, out of total catch of different traps, in the first and second seasons, respectively. *Lycosa* sp. was not captured by the sweep net, and captured in low numbers by each of pitfall and water pan traps. *Thanatus albini* was captured by the sweep net (39.66 & 41.86%) and water pan trap (47.41 & 50.39%) in 2015 and 2016 seasons, respectively, but was captured in low numbers in the pitfall traps. *Clubiona* sp., *Singa sp*. and *Thomisus* sp. were all not detected in the pitfall traps, and were found in low numbers in each of sweep net and water pan traps.

INTRODUCTION

Crop intensification has become a necessity to enhance the income of the growers, particularly when the resources are limited, the case of Egypt. Seed watermelon, *Citrulus lanatus* (Thumb) is cultivated as an additional cash crop in the early spring. This crop is inserted in the crop rotation to be sown directly after harvest of winter crops, and before sowing of summer crops.

The climate conditions, during this period, are in favor of reproducing several insect pests, that results in damage and losses in many of cucurbitaceous plants, including seed-watermelon (Younes *et al*., 2010; Gallab, 2011; Gameel, 2012 and Abdel-Rahman, 2016).

The growers are usually worried about insect infestations in their crops and tend to use pesticides whatever the level of insect pest infestations (Heong and Escalada, 1997). These misuse applications destroy the natural balance in the agricultural ecosystems (Greenstone, 1999 and Sunderland, 1999).

In cucurbit plantations, several natural enemies, including true spiders, can regulate the insect pest populations if the applications of pesticides stopped or applied wisely (Platnick, 2015). Fortunately, the spiders can live in most microhabitats, causing a wide diversity of their assemblage (Oberg and Ekbom, 2006) especially the true spider species are the greatest group in animal kingdom as 44,000 spider species have been recorded (Platnick, 2015). Younes *et al*. (2010) recorded 12 true spider species from cantaloupe plantations belonging to nine families, at Quaha region, Qualiobia Governorate, and the most abundant species was *Thanatus albini* (Fam. Philodromidae). The 12 surveyed true spiders attacked cantaloupe leaves, except *Misumena vatia* (Fam. Thomisidae) that was related with the flowers.

Because the predators work together to suppress the population densities of insect pests, it has become crucial to do our best to conserve these key natural enemies, this could be achieved mainly by reducing pesticide applications, and avoid as much as possible disturbing the agricultural ecosystems. Tawfik (1993) indicated that researchers have not given enough attention to study spiders and find out their role in managing insect pest populations, despite this group of predators are highly beneficial arthropods in biological control systems.

The objectives of current study were to detect the true spider species occurring in seed watermelon, *Citrullus lanatus* (Thumb.) plantations and monitor the population fluctuation of the most dominant ones. In addition, a comparison study was undertaken to find out the efficiency of traps, used in spider catch, as related with spider species.

MATERIALS AND METHODS

Site description:

The current study was undertaken at Rasheed region, Beheira Governorate during 2015 and 2016 summer seasons. Growers at Rasheed region are interested in, besides conventional crops, cultivating cucurbit crops, from which is seed watermelon that is benefited as a cash crop, with short development duration. Seed watermelon is usually sown after clover harvest.

Cultural practices:

The land of the experimental area (2000 m2) was prepared as recommended, and divided into four equal parts. Seed watermelon was sown on 15th of April in both seasons, at spaces of 30 cm between hills. All recommended cultural practices were adopted without pesticide applications, even the weeds were manually removed.

Sampling tools:

In addition to visual (naked eye and/or lens) examination, three sampling tools were used:

- Classic sweep net.
- Pitfall trap that consists of a glass jar (about 1/2 liter volume), with a 7- cm mouth. The jars were provided with 400 ml water, 20 ml detergent and 5 ml formaldehyde. The detergent was used to remove the water surface tension which facilitates capturing the fallen arthropods. Formaldehyde acts as a preservative material to avoid the decomposition of arthropod tissues.
- Water pan trap that consists of an aluminum pan (20 cm diameter, with a 7 cm edge). The pan was provided with contents as previously mentioned in pitfall traps.

Trap distribution:

Five pitfall traps and five water pan traps were fixed in each plot (500 m^2) among the plants of seed watermelon. The pitfall traps were embedded into the dikes of the field with the mouth of the jar even to the soil surface. The water pans were placed in the corners and center of each plot.

Sampling procedures:

Visual examination and trap catching were weekly conducted ten days after sowing up to harvest. In case of sweep net, 50 double strokes were carried out to collect arthropod specimens from each plot. The catch was emptied into glass jar, which was cap-closed and transferred to the laboratory. Catches of pitfall and water pan traps were emptied in glass jars by sieving through a fine plastic mesh to exclude the captured arthropods. Then, the traps were re-fixed with fresh water, detergent and formaldehyde.

In all cases, the obtained catches were labelled and prepared for identifications. Only the true spiders were considered in the current investigation.

Specimen identification:

Specimen identifications were achieved at Systematic Laboratory, Plant Protection Research Institute, Agricultural Research Center, as well as Biological Control Laboratory at Rice Research and Training Center, Sakha Agricultural Research Station. Identifications were performed with a kind aid of Prof. Dr. Ahmed S. Hendawy, Biological Control Specialist, Plant Protection Research Institute.

According to Abdel-Rahman *et al.* (2016), dominant and abundance degree of spiders were calculated according the following formulae:

Dominant degree (D):

$$D = t/T \times 100$$

Where:

(t): Total number of a species during collecting period

(T): Total number of all species during collecting period.

RESULTS AND DISCUSSION

1. Survey of spiders:

Six true spider species were surveyed (Table 1), beginning from first of May up to mid-July in 2015 and 2016 watermelon seasons. *Paradosa* sp., *Lycosa* sp. (Fam. Lycosidae) and *Thanatus albini* (Adu) (Fam. Philodromidae) were captured throughout the season; May to July. On the other hand, *Clubiona* sp. (Fam. Clubionidae), *Singa* sp. (Fam. Araneidae) and *Thomisus* sp. (Fam. Thomisidae) were trapped only during July. Sallam *et al.* (2009), at greenhouse at Dokki, Cairo, recorded nine spider families inhabiting cucumber plants, with gnaphosids being the most dominant. Gameel (2013) detected a spider species belonging to Phalangidae as associated with cucurbit plants at the New Valley. In addition, Younes *et al*. (2010) surveyed 12 spider species belonging to nine families from cantaloupe plants at Quaha, Qualiobia Governorate and the most abundant spider was *Thanatus albini* (Aud) that was captured as spiderlings and adults during August. All the 12 species were located at cantaloupe lweaves, except *Misumena vatia* (Fam. Thomicidae) which inhabited the plant flowers during July. In Brazil, lycosids were the most abundant spiders in watermelon plantations (Cunha *et al*., 2015).

Table 1. Spider species (order: Araneae) collected from seed watermelon plantations, during 2015 and 2016 summer seasons, Rasheed region, Beheira governorate.

Family	Species	Common name	Period of occurrence
Lycosidae	*Pardosa* sp. *Lycosa* sp.	Wolf spider	May-July
Philodromidae	*Thanatus albini (Adu)*	Running crap spider	May-July
Clubionidae	*Clubiana* sp.	Leaf curling spider	June
Araneidae	*Singa* sp.	Orb. weaver spider	June
Thomisidae	*Thomisus* sp.	Crab spider	June

In the current study, six spider species were surveyed. Richert and Lawrence (1997) concluded that assemblage of several species of predators may be more effective in controlling insect pests than single or few species augmentation.

2. Population fluctuation of spiders:

Data presented in Tables (2 and 3) show the population fluctuations of six true spider species inhabiting seed water melon plantations at Rasheed region.

In 2015 season:

Total number of *Pardosa* sp. was 113 spiderlings and adults collected by 220, 220 and 550 catches of pitfall traps, water pan traps, and sweep net, respectively (Table 2). One peak of the spider species was found; on June 15th with number of 21 individuals. *Thanatus albini* was detected with relatively higher number; 116 spiderlings and adults, with two peaks of occurrence; on May 30th and June 30th and the spider numbers were 17 and 19, respectively. The third rank of occurrence was occupied by *Lycosa* sp. (13 individuals). However, very few numbers were recorded for *Clubiona* sp., *Singa* sp. and *Thomisus* sp. Regardless of spider species, June witnessed the highest population density of spider complex (32-42 spiderlings and adults), while the lowest numbers were obtained during July.

Table 2. Population fluctuation of spiders inhabiting seed watermelon plants, Rasheed region, Beheira governorate, during 2015 season.

Sampling date	*Pardosa* sp.	*Lycosa* sp.	*Thanatus albini*	*Clubiona* sp.	*Singa* sp.	*Thomisus* sp.	Total
May 1	13	2	3	0	0	0	18
7	10	0	6	0	0	0	16
15	6	0	9	0	0	0	15
22	9	0	16	0	0	0	25
30	4	1	17	0	0	0	22
June 7	17	2	10	1	1	1	32
15	21	3	12	1	2	3	42
22	19	2	10	1	5	2	39
30	4	3	19	2	2	2	32
July 7	6	0	9	0	0	0	15
15	4	0	5	0	0	0	9
Total	113	13	116	5	10	8	265
Av+SE	10.27 ±1.92	1.18 ±0.37	10.55 ±1.45	0.45 ±0.21	0.91 ±0.48	0.73 ±0.33	
Dominance %	42.64	4.91	43.77	0.17	0.34	0.28	

Numbers of spiders were collected by 220, 220 and 550 catches of pitfall traps, water pan traps and sweep net, respectively.

In 2016 season:

Total number of *Pardosa* sp. was 130 individuals with three peaks of occurrence (Table 3); on May 7th, June 7th and June 22nd, as the spider numbers were 16, 20 and 20 individuals, respectively. *Thanatus albini* population density came in the second rank, with a total population of 119 individuals and two peaks were recorded; on May 22nd (15 individuals) and June 22nd (22 individuals). Similar to the first season, numbers of *Clubiona* sp., *Singa* sp. and *Thomisus* sp. were recorded scarcely throughout the season. However, *Thomiasus* sp. was detected in 14 individuals throughout the season. The highest population densities of the spider complex, regardless of species, were recorded in June.

Table 3. Population fluctuation of spiders inhabiting seed watermelon plants, Rasheed region, Beheira governorate, during 2016 season.

Sampling date	*Pardosa* sp.	*Lycosa* sp.	*Thanatus albini*	Clubiona sp.	*Singa* sp.	Thomisus sp.	Total
May 1	15	1	5	0	0	0	21
7	16	2	9	0	0	0	27
15	7	1	7	0	0	0	15
22	8	0	15	0	0	0	23
30	9	0	6	0	0	0	15
June 7	20	1	14	0	1	0	36
15	8	2	19	1	2	4	36
22	20	3	22	3	4	8	60
30	5	1	6	1	1	2	16
July 7	8	1	9	0	0	0	18
15	14	0	7	0	0	0	21
Total	130	12	119	5	8	14	288
Av+SE	11.82 ±1.72	1.09 ±0.28	10.82 ±1.83	0.45 ±0.28	0.73 ±0.38	1.27 ±0.77	
Dominance %	45.14	4.17	41.32	1.74	2.78	4.86	

Numbers of spiders were collected by 220, 220 and 550 catches of pitfall traps, water pan traps and sweep net, respectively.

3. Dominance percentage:

According to Abdel-Rahman *et al*. (2016), the most dominant spider species in 2015 season (Table 2) was *Thanatus albini* (43.77%), followed by *Pardsoa* sp. (42.64%), and then *Lycosa* sp. (4.91%). A reverse situation was found in 2016 season (Table 3), as the most dominant spider was *Pardosa* sp. (45.14%), followed by *Thanatus albini* (41.32%) and the third rank was occupied by *Lycosa* sp. (4.17%). However, the dominance percentages of the remaining spiders ranged between 0.17 and 4.17% in both seasons.

The fluctuations of spider population densities may be due to their behavior as well as to the environmental conditions. Unfortunately, cultural practices and pesticide applications affect negatively on spider populations (Oberg and Ekborn, 2006), but the spiders have high mobility which allow them to recolonize after environmental disturbance. In addition, Khan (2003) explained another advantage of spiders which make them an effective biocontrol agent against insect herbivores, as the spiders are relatively long-lived and do not migrate in large numbers when their prey become rare. However, these beneficial arthropods should be strictly conserved to work altogether to manage insect pests, which reflects better crop yields (Van den Bosch *et al*., 1982). Web (2007) indicated that cucurbits cannot achieve seed set without cross pollination due to visits of honeybee and other pollinators to the flowers. Thus, it has become very necessary to avoid pesticide application on cucurbits during flowering, particularly in the early morning, when the pollinators, insect predators and spiders are active on the flowers.

5. Sampling tool efficiency in capturing spiders:

Tools used for capturing spiders were variable in their efficiency (Tables 4 and 5).

Pardosa sp. was captured mainly by pitfall traps, with values of 90.27 and 93.08%, out of total catch of different traps, in the first and second seasons, respectively. *Lycosa* sp. was not captured by the sweep net, and captured in low numbers by each of pitfall and water pan traps. *Thanatus albini* was captured by the sweep net (39.66 & 41.86%) and water pan trap (47.41 & 50.39%) in 2015 and 2016 seasons, respectively, but was captured in low numbers in the pitfall traps. *Clubiona* sp., *Singa sp*. and *Thomisus* sp. were all not detected in the pitfall traps, and were found in low numbers in each of sweep net and water pan traps.

Table 4. Tool efficiency for collecting spiders from seed watermelon plantations, Rasheed region, Beheira Governorate, 2015 season.

Spider species	Sweep net (550 catches)		Pitfall trap (220 catches)		Water pan trap (220 catches)		Total
	No.	%	No.	%	No.	%	
Pardosa sp.	3	2.65	102	90.27	8	7.08	113
Lycosa sp	0	0.00	7	53.85	6	46.15	13
Tahnatus albini	46	39.66	15	12.93	55	47.41	116
Clubiona sp.	3	60.00	0	0.00	2	40.00	5
Singa sp.	6	60.00	0	0.00	4	40.00	10
Thomisus sp.	6	75.00	0	0.00	2	25.00	8

Table 5. Tool efficiency for collecting spiders from seed watermelon plantations, Rasheed region, Beheira Governorate, 2016 season.

Spider species	Sweep net (550 catches)		Pitfall trap (220 catches)		Water pan trap (220 catches)		Total
	No.	%	No.	%	No.	%	
Pardosa sp.	2	1.54	121	93.08	7	5.38	130
Lycosa sp	0	0.00	8	66.67	4	33.33	12
Tahnatus albini	54	41.86	10	7.75	65	50.39	129
Clubiona sp.	3	60.00	0	0.00	2	40.00	5
Singa sp.	5	62.50	0	0.00	3	37.50	8
Thomisus sp.	12	85.71	0	0.00	2	14.29	14
Total	76	25.50	139	46.64	83	27.85	298

Merrett and Snazell (1983) indicated that pitfall traps are more efficient in capturing ground-active spiders, from which is *Pardosa* spp. These traps can provide more taxa than methods target the foliage (e.g. D-vac or sweep net). However, they recommended using all methods of capturing as complementary techniques. Canard (1982)

reported that collecting spiders by hand (visual searching), while favours taxa in the foliage, can be high with respect to the total number of species taken, but low in terms of the labor required and the effects of poor weather. Muma (1975) recommended methods other than pitfall traps to collect web-spinner spiders. Utez and Unzicker (1976) reported that pitfall traps captured higher numbers of targeted spiders than those captured by hand.

ACKNOWLEDGEMENT

The authors thank Dr. Ahmad S. Hendawy for assistance in identifying spider specimens, as well as to valuable comments on the manuscript.

REFERENCES

Abdel-Rahman, M.A.A.; M.A.A. Ali; A.M.A. Awad; A.M.H. Sahea and G.H. Abdel-Rahem (2016). Co-existence of pests and their associated predators inhabiting cantaloupe plants, Cucumis melo L. in Assiut, Egypt. Ass. Univ. Bull. Environ. Res., 18(2): 1-9.

Canard, A. (1982). Utilisation comparee de quelques methodes d'echantillonnage pour l'etude de la distribution des araignees en landes. Atti Soc. Tosc. Sci. Nat. 88, 84–94.

Cardosa, P.; S. Pekar; R. Jocque and J.A. Coddington (2011). Global patterns of guild composition and functional diversity of spiders. PlosOne, 6: 1-10.

Cunha, J.A.S.; E.B. Andrade; P.R.R. Silva and R.F.A. Barros (2015). Araneofauna (Arachnida: Araneae) in conventional and organic crops of watermelon (Citrullus lanatus) in northeastern Brazil. Rev. Colomb. Entomol., 41(1).

Francais, A.D. and A. Randy (2003). Spider predation in Agroecosystems: can spiders effectively control pest populations. Technical Bulletin, 190: 1070-1524.

Gallab, M.M.; H.N. Habashy; A.K.F. Iskandar and M.A. Rizk (2011). Sensitivity of four cucumber cultivars to some piercing sap sucking pests infestation and their impact on yield. Egypt J. Agric. Res., 89: 1363-1371.

Gameel, S.M.M. (2013). Species composition of piercing-sucking arthropods pests and associated natural enemies inhabiting cucurbit fields at the New Valley in Egypt. Egypt Acad. J. Biolog. Sci., 6(2): 73-79.

Greenstone, M.H. (1999). Spider population: how and why we study it. J. Arachnol., 27: 332-342.

Heong, K.L. and M.M. Escalada (1997). Perception change in rice pest management: A case study of farmers' evaluation of conflict information. Journal of Applied Communications, 81(2): 3-17.

Khan, A.A. (2013). Evaluation of the biological control efficiency of four spiders using functional response experiments. The Bioscan, 8(4): 1123-1128.

Merrett, p. and R. Sanzell (1983). A comparison of pitfall trapping and vacuum sampling for assessing spider faunas on heathland at Ashdown Forest, south-east England. Bull. Br. arachnol.Soc., 6 (1): 1-13

Muma, M. H. 1975. Long term can trapping for population analyses of ground-surface, arid-land arachnids . Florida Entomol ., 58 :257-270.

Oberg, S. and B. Ekbom (2006). Recolonization and distribution of spiders and carabids in cereal fields after spring sowing. Annals of Applied Biology, 149: 203-211.

Platnick, N.I. (2015). The world spider catalog, version 15.0. American Museum of Natural History. Available in: http://research.amnh.org/iz/spidrs/catalog-15.0/indx.html (Review date: April 2015)

Richert, S.E. and K. Lawrence (1997). Test of predation effects of single versus multiple species of generalist predators: Spiders and their insect prey. Entomol. Exp. Appl., 84: 147-155.

Sallam, G.M.E.; N.A.I. Abd El-Azim and M.M. Abd-Elaal (2009). Seasonal occurrence of spiders (Araneida) in open and green house fields of cucumber and pepper in Egypt. Egypt. Acad. J. Biolog. Sci., 1(1): 23-36.

Sunderland, K. (1999). Mechanisms underlying the effects of spiders on pest populations. J. Arachnol., 27: 308-316.

Tawfik, M.F. (1993). Biological control of the insect pests. Ministry of Agriculture and Land Reclamation, Egypt. 772 pp (in Arabic).

Utez, G.W. and J.D. Unzicker (1976). Pitfall trapping in ecological studies of wondering spiders. J. Arachnol. 3: 101-111.

Van den Bosh, R.; P.S. Messenger and A.P. Gutierrez (1982). An introduction to biological control. Plenum Press, New York.

Webb, S.E. (2007). Insect management for cucurbits (cucumber, squash, cantaloupe and watermelon). Entomology and nematology Department, Florida Cooperative Extension Service, University of Florida.

Younes, M.W.F.; I.I.A. El-Sebaey; A.R.I. Hanafy and Y.N.M. Abd-Allah (2010). Survey of pests and their associated natural enemies on sex cantaloupe, Cucumis melo L. varieties in Qaha region, Qualioia Governorate, Egypt. Egypt J. Agric. Res., 88(3): 739-754.

الوفرة العددية للعناكب الحقيقية فى زراعات بطيخ اللب ، وكفاءة المصائد فى جمع الأنواع المختلفة

السيد عبد الحميد رفاعى ، إكرام عبد المنعم عبده و أمانى عبد الحكيم خليفة

قسم بحوث المكافحة الحيوية – معهد بحوث وقاية النباتات – مركز البحوث الزراعية

يزرع بطيخ اللب فى أوائل موسم الصيف ، وينعرض للإصابة بالعديد من الآفات الحشرية، التى تصب ضررا وخسائر فى المحصول. أجرى البحث الحالى فى منطقة رشيد- محافظة البحيرة ، فى عامى 2015 ، 2016 لحصر أنواع العناكب السائدة فى حقول بطيخ اللب ، وكذا مراقبة تقلبات تعداد الأنواع السائدة .كما أجريت دراسة لمقارنة كفاءة المصائد المختلفة فى جمع أنواع العناكب. أوضحت نتائج البحث وجود ستة أنواع من العناكب الحقيقية خلا الفترة من مايو حتى منتصف يوليو. وجدت الأنواع*Thanatus Pardosa* sp , *Lycosa* sp خلال الفترة من مايو حتى منتصف يوليو. كما تم تسجيل الأنواع *Clubiona* sp خلال يوليو فقط. فى موسم 2015، كان أكثر الأنواع تواجدا هو *Thanatus albini* (43.77 %) تلاه النوع *Pardosa* sp (42.4%) ثم *Lycosa* sp (4.91%) وفى موسم 2016 كان أكثر الأنواع تواجدا هو *Pardosa* sp (45.14%) تلاه (41.22%) ثم *Lycosa* sp (4.17%). وتراوح وجود باقى الأنواع بين 0.17 ، 4.17% فى كلا الموسمين. تم اصطياد النوع *Pardosa* sp بصفة أساسية باستخدام مصائد الحفرة بقيم 90.27 ، 93.08 من المجموع الكلى فى الموسم الأول والثانى على التوالى. لم يتم جمع النوع *Pardosa* sp باستخدام شبكة جمع الحشرات ، ولكن تم جمعه بأعداد قليلة باستخدام كل من مصائد الحفرة والمصائد المائية تم اصطياد النوع *Thanatus albini* باستخدام شبكة جمع الحشرات (39.66 ، 41.86%) والمصائد المائية (47.41 ، 50.39%) فى الموسم الأول والثانى على التوالى ، كما تم اصطياده بأعداده قليلة فى مصائد الحفرة. لم يتم اصطياد الأنواع *Singa* sp.، *Thomisus* sp.، *Clubiona* sp. باستخدام مصائد الحفرة ، ولكنها جمعت بأعداد قليلة بشبكة الجمع والمصائد المائية.