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POPULATION AGE STRUCTURE OF THE GREEN PEACH APHID, MYZUS PERSICAE (SULZER) (HOMOPTERA: APHIDIDAE) IN CUMIN FIELDS IN ASSIUT UPPER EGYPT

Mohamed A. A. Abdel-Rahman*, Azza M. A. Awad, Salah A. Abdel-Salam***, Mohamed A.K. Nasser**** and Nour El-Houda R Abdel-Hamed.*****

***Plant Protection Research Institute, ** Zoology Department, Faculty of Science, Assiut University, *** Plant Protection Department, Faculty of Agriculture, Assiut University**

ABSTRACT:

The present studies were carried out during 2011-2012 and 2012-2013 on cumin growing seasons. The main objective was to study population age structure of the green peach aphid, Myzus persicae (Sulzer) infesting cumin plants in Assiut, Upper Egypt. When using beginning of cumin planting as a starting date, data show that the migration of the green peach aphid from overwintering site into cumin fields occurred after about 50 days (nearly during the end of December). The population then increased to become 10% of the maximum number after 66 days (nearly during the first half of January). Maximum population density of the green peach aphid occurred after about 95 days. Therefore, the peak of abundance could be expected around the first half of February. After the population reached it's the highest level, it generally declined and reached 10% of the maximum after 121days. The population then vanished from the cumin field in about 132 days (toward the middle of March). The present results indicate that the number of green peach aphid was significantly higher in the second season 2013 (421.3 aphids / 10 plants), than that of the first season 2012 (249.30 aphids / 10 plants). The differences in levels of infestation between the two seasons might be attributed to the differences in weather factors (temperature, relative humidity) and / or the effect of the common natural enemies in each season.

Key words: *green peach aphid, population age-structure, cumin*

INTRODUCTION:

Cumin is the dried seed of the herb, *Cuminum cyminum* L., a member of the Parsley family. It's one of the most important medicinal plants cultivated in Assiut. Cumin seeds are used as a spice for their distinctive flavour and aroma. It helps to add an earthy and warming feeling to food, making it a staple in certain stews and soups, as well as spiced gravies such as chili. It is also used as an ingredient in some pickles and pastries (Nadeen and Riaz, 2012).

The green peach aphid, Myzus persicae (Sulzer) (Homoptera: Aphididae) is a pest on cumin plants and distributed throughout all temperate and worm regions of the world. Swailem et al. (1976) reported that M. persicae

is the most important insect pests that attack medicinal and ornamental plants in Egypt. Minks and Harrewijn (1989) reported that this aphid can damage their host plant directly by sucking the plant sap (Moran, 1992), induce gall formation (Qubbajet et al., 2004) and they can damage their host indirectly by transmitting plant viruses (Carter et al., 1980 and Conti, 1985; Blackman and Eastop, 1994 and 2000). This aphid is considered one of the most damaging and consistently present pests on cumin crops and other medicinal crops (Almatni ، 2008).

The present studies were conducted to obtain better knowledge about the population of M. persicae infesting cumin in Assiut area.

MATERIALS AND METHODS:

The present investigations were conducted at the Experimental Farm of the Faculty of Agriculture, Assiut University during two successive seasons of 2011-2012 and 2012-2013. An area of Ca. quarter feddan (about 1100 m2) was divided into plots of equal size (1/100 feddan) and was cultivated with cumin during the first week of November in both seasons. The normal agricultural practices were normally preformed and no insecticides were used during study period.

Aphid numbers (all forms) were visually recorded on samples each of one hundred plants (25 plants / replicate) taken weekly at random. The collected samples were brought back, in transparent polyethylene bag, to the laboratory for counting the green peach aphid. Samples were weekly taken when the migration of aphids, onto the crops, from overwintering sites began, and continued through the time till when aphid population and their natural enemies declined to a low or undetectable levels. The number of aphids (nymphs and adults) was counted and recorded at each inspection date.

Population age structure of M. persicae was described as d1, d2, d3, d4 and d5, used planting date as a starting count.

(d1) = Time (in days) until the first detection of aphid in cumin field.

(d2) = Time (in days) until the detection of 10% of the maximum population density.

(d3) = Time (in days) to attain the maximum population density.

(d4) =Time (in days) until the disappearance of 90% of the maximum population density, and

(d5) = Time (in days) until the absolute disappearance of aphids.

Duration of each phase (d1 – d5) was calculated from the beginning of planting first as starting date (3rd November). Coefficient of daily rate of population increase (α1) and decrease (α2) were calculated according to Freier (1983):

$$(\alpha 1) = 0.9 / d3 - d2,$$

$$(\alpha 2) = 0.9 / d4 - d3.$$

Temperatures (maximum and minimum) and relative humidities (maximum and minimum) were obtained from a meteorological station located at 100 m away from the experimental site in the field.

Results and Discussion :

Population of the green peach aphid infesting cumin plants was monitored during

2011-2012 and 2012-2013 seasons. Data of the population densities of the aphid species were expressed in terms of weekly numbers / 10 plants.

In 2012 season, the changes in the population densities of M. persicae on cumin plants are presented in Table 1. Data indicate that the nymphs and adults of the pest were detected on cumin plants in a relatively low level (1.50 aphids / 10 plants) during the third week of December when the plants were in the seedling stage. Thereafter, the population tended to increase gradually through January, February. The maximum level (55.10 aphids / 10 plants) was attained during first half of February when the plants were in the first stage of ripening. The number of aphids then showed a sharp decrease and approximately vanished from the field during the middle of March when the plants were in the middle of ripening stage.

Data in Table 1 show the seasonal abundance of the green peach aphid during 2013 season. The aphid started to appear on cumin plants in extremely low numbers (4.70 aphids / 10 plants) during the third week of December when the cumin plants were in the end of seedling stage. Its population reached a peak of 103.2 aphids / 10 plants around the middle of February, when the plants were in the ripening stage.

The population continued in relatively high numbers in the next week and vanished from the field during the end of March, when the plants were in ripening stage.

(In general, the green peach aphid appeared in the period lasted from the end of December up to the end of March with a peak of number during the middle of February, when the plants were in the ripening stage.

From the obtained results it is clear that the maximum population level of M. persicae was attained during the first half of February.

During 2012 and 2013 cumin growing seasons, respectively the population divided into five categories as follows:

Density 1 (d1): The initial population density of aphid was detected with an average of 50 days. Primarily alate migrants that have probably emigrated from their overwintering sites characterize this phase.

Density 2 (d2): In this phase the population of aphids increased slowly to reach 10% of the maximum level with 66 days. The lags in population growth might be expected because of the few colonizers and because temperatures were low compared with temperatures followed this phase. The daytime temperatures were relatively warm (ranged from 20 to 24°C) and slightly colder at night (ranged from 4 to 7 °C). It could be concluded from the data obtained that the population of the green peach aphid tended to establish on cumin plants after 66 days, about mid January. Ali and Rizk (1980) and Ali and Darwish (1990) and Abdel-Rahman (1997) obtained similar results on cereal aphids infesting wheat plants. They observed a gradual increase in the cereal aphid

populations on wheat plants early in the season and the aphid tended to establish on the wheat plants at the beginning of February.

Density 3 (d3): This is an exponential phase in the population growth. Aphid populations increased to a maximum level within an average of 95 days (14 weeks). This rapid increase probably resulted from the reproduction of apterae, which is most fecund morph. The nymphs born by the emigrants in the former phase have now become adults and began their nymphal production. However, the peaks of abundance have been attained nearly during the first half of February, where the maximum temperatures ranged from 24 to 27°C and the minimum ranged from 7 to 9°C with an average of 17°C. The average relative humidity in this time ranged from 51 to 55%. This condition seems to be the optimum range for the development and multiplication of the green peach aphid. Some of the previous studies confirmed the present results. Cartier and Painter (1956) found that the high temperature, longer period of sunlight and better growing conditions of the plants favored the reproduction of aphids. Dean (1974) found that R. padi population peaked in late August and early September when temperatures were in optimum range (20-25°C). Ali and Rizk (1980) reported that temperatures ranged from 17-19°C and RH within the range of 44% to 52% are the most favorable conditions for the activity of cereal aphid species. In addition, the rapid increase in this phase might be related to suitability of the host plant. In this phase the plants are at growth stage that provides an excellent source of nutrition. Campbell and Eikentlary (1990) found that the phloem sap in the stem elongation stage, is rich in assimilates such as sugars and amino acids and the aphids have a higher growth rate. Aalbersberg et al. (1989) showed that the exponential increased of Russian wheat aphid, D. noxia populations occurred between stem elongation and completion of ear emergence. Similar results were obtained by Kriel et al. (1984) and Girma et al. (1990), who found that D. noxia immature developed much faster, while feeding on plants in the jointing stage.

Density 4 (d4): The fourth phase includes the population declination, which usually starts shortly as the population peaked. The present data show that the population declined to reach 10% of the maximum level with an average of 120.50 days (17 weeks). The eventual declined of aphid populations at the end of March was associated with a rapid drop in the suitability of the crop, accompanied by much alate emigration.

However, natural enemies usually achieved their highest population levels during the period of the highest aphid density. Campell and Eikenbary (1990) reported that it is normally after flowering emergence that the aphid declines. They added that, this decline occurs regardless of the initial population size and is, in part, likely to be an effect of the aging plant becoming increasingly unsuitable as a food source. Thus, there is strong evidence

to suggest that a decrease in food quality, as an effect of an aging cumin plant, can lead to a decline in the aphid population. However, it was found that changes in the level of intraspecific competion (crowding) could affects a number of population parameters including fecundity and migration. Wiktelius (1989) reported that analysis of field data for R. padi showed that although crowding stimulates wing formation during early growth stages in cereals, almost 100% of the fourth instar nymphs become alatiform after ear emergence had began regardless of aphid density. He showed also that the proportion of the aphid population moving on the ground increased rapidly after the population's peak and can reach 50% during the decline phase. This behavior is probably also an effect of changing of host plant quality by walking also contributes to population decline. Several authors have pointed out natural enemies may also contribute to population decline. In the present study coccinellids and some hymenopterous parasitoids were existed in association with cereal aphids in relatively high population density particularly during the high aphid's density.

Ali and Rizk (1980), Abdel-Rahman (1997) and Ali and Abdel-Rahman (2000) attributed the decline in the cereal aphid's population in wheat field during late March to the predators and parasitoids.

Density 5 (d5): disappearance of aphids from cumin fields that has been observed within an average of 132.50 days, from the beginning of planting date. The disappearance of aphids is mainly due to the plant maturity and migration of aphids. Similarity, Ali and Darwish (1990) and Abdel-Rahman (1997) indicated that cereal aphids completely leave the wheat plants during the nearly ripening stage.

It could be generally concluded that those weather factors (mainly temperature) and the host plant quality, intra-specific competition and natural enemies were the most decisive factors affecting the population growth of cereal aphids on wheat crop. However, these ecological measures will eventually helps in pest management decision in wheat ecosystem.

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Table 1. Population of the green peach aphid infesting cumin plants, Assiut 2011-2012 and 2012-2013 seasons, Assiut.

Inspection date	Plant age (days)	Mean no of aphids / 10 plants			
		2012	2013	Total	Average
Dec. 23	50	1.50	4.70	6.20	3.10
30	57	2.00	10.00	12.00	6.00
Jan. 6	64	4.40	8.40	12.80	6.40
12	70	9.80	19.70	29.50	14.70
20	78	14.50	39.50	54.00	27.00
27	85	36.50	76.30	112.80	56.40
Feb. 2	91	55.10	92.60	147.70	73.80
10	99	51.70	103.20	154.90	77.40
17	106	33.00	51.90	84.90	42.40
25	123	26.00	9.50	35.50	17.70
Mar. 3	130	14.80	5.50	20.30	10.10
Total	-	249.30	421.30	670.60	335.30
(%)		37.18	62.82	100	

Table 2. Population age structure of M. persicae (in days) and maximum number of individuals / 10 plants occurred on cumin plants during 2012 and 2013.

Season	(d1)	(d2)	(d3)	Max. No. (10 plants)	(d4)	(d5)
2012	50	64	91	55.1	125	135
2013	50	68	99	103.2	116	130
Total	100	132	190	158.3	241	265
Mean	50	66	95	79.15	120.50	132.50

Table 3. Coefficient of daily rate of population increase (ά1) and decrease (ά 2) of M. persicae and duration of each age (in days).

Season	(d3-d1)	(ά1)	(d3-d2)	(ά2)	(d5-d3)	(d5-d1)	(d4-d2)
2012	41	0.033	27	0.020	44	85	61
2013	49	0.029	31	0.029	31	80	48
Total	90	0.062	58	0.049	75	165	109
Mean	45	0.031	29	0.0245	37.5	82.5	54.5

Table 4. Population of M. persicae infesting cumin plants in relation to some abiotic and biotic factors, during 2011-2012, Assiut.

Inspection date	No / 10 plants	Temperature (ºC)			Relative humidity (%)		
		Max.	Min.	Avg.	Max.	Min.	Avg.
Dec. 23	1.5	20.50	7.50	14.00	75.00	18.33	16.67
30	2.0	20.71	8.71	14.70	74.14	24.27	49.29
Jan. 6	4.4	20.00	6.71	13.39	69.86	20.11	50.29
12	9.8	18.83	4.83	11.83	74.17	14.00	44.33
20	14.5	18.25	4.50	11.38	79.38	17.13	48.38
27	36.5	20.57	5.71	13.07	75.00	19.86	47.71
Feb. 2	55.1	18.83	7.83	13.33	69.83	22.17	46.17
10	51.7	19.17	7.83	13.50	63.50	13.83	38.67
17	33.0	20.43	9.43	15.93	74.29	18.00	42.71
25	26.0	22.88	7.13	15.00	78.88	23.00	51.13
Mar. 3	14.8	21.00	7.57	14.29	72.43	17.00	44.86

Table 5. Population of M. persicae infesting cumin plants in relation to some abiotic and biotic factors, during 2012-2013, Assiut.

Inspection date	No / 10 plants	Temperature (ºC)			Relative humidity (%)		
		Max.	Min.	Avg.	Max.	Min.	Avg.
Dec. 23	4.7	23.33	7.50	15.42	78.83	11.67	43.00
30	10.0	25.00	11.71	18.76	80.29	27.11	54.14
Jan. 6	8.4	22.86	9.86	16.36	79.29	20.86	50.14
12	19.7	19.20	7.00	13.10	77.00	18.15	49.33
20	39.5	23.00	9.63	15.70	74.63	18.00	46.40
27	76.3	26.86	14.29	20.60	78.00	26.14	52.14
Feb. 2	92.6	25.20	13.00	18.42	82.50	28.20	55.14
10	103.2	28.33	13.20	19.83	76.20	21.70	49.00
17	51.9	26.86	11.86	19.40	73.60	18.00	45.90
25	9.5	30.40	12.80	21.60	85.90	15.90	51.00
Mar. 3	5.5	25.40	10.30	17.90	57.42	9.00	33.30

الملخص العربي

التركيب العمري لتعداد حشرة من الخوخ الأخضر في حقول الكمون فى أسيوط – مصر العليا

محمد علاء الدين احمد عبد الرحمن ☆، عزة محمد عبد المنعم عوض ☆☆،

صلاح الدين عبد الرؤوف عبد العزيز ☆☆، محمد عبد الكريم عبد الناصر☆☆☆☆،

نور الهدى محمد رسمي عبد الحميد☆☆☆☆

*** معهد بحوث وقاية النباتات – مركز البحوث الزراعية ** قسم علم الحيوان – كلية العلوم – جامعة أسيوط**

***** قسم وقاية النبات – كلية الزراعة – جامعة أسيوط**

أجريت هذه الدراسة خلال أعوام ٢٠١١– ٢٠١٢، ٢٠١٢– ٢٠١٣ على الكمون. استهدفت الدراسة وصف التركيب العمري لتعداد حشرة من الخوخ الأخضر التي تصيب الكمون بأسيوط.

أوضحت النتائج أن حشرة من الخوخ الأخضر تبدء في الهجرة من أماكن تواجدها إلى أن تصيب نباتات الكمون بعد ٥٠ يوما منذ بداية الزراعة (تقريبا مع نهاية شهر ديسمبر). وذلك عند استخدام تاريخ بداية زراعة نباتات الكمون في الحقل كتاريخ بداية ثم يعد ذلك يأخذ التعداد في الزيادة التدريجية ليصل إلى ١٠% من أعلى كثافة عددية (الكثافة العددية أثناء فترة الذروة) بعد حوالي ٦٦ يوما منذ بداية الزراعة (تقريبا خلال النصف الأول من شهر يناير). بلغ المجموع الحشري أقصى تعداد له بعد ٩٥ يوما منذ بداية الزراعة (خلال النصف الأول من شهر فبراير). ثم بدأ المجموع الحشري في الانخفاض ليصل إلى ١٠% من أقصى تعداد له بعد حوالي ١٢١ يوما. ثم بعد ذلك اختفت حشرات المن من على نباتات الكمون بعد حوالي ١٣٢ يوما من بداية زراعة الكمون وأشارت النتائج إلى إن تعداد حشرات من الخوخ الأخضر خلال الموسم الثاني (٢٠١٣) كان عاليا بدرجة معنوية عنة في الموسم الأول (٢٠١٢) وهذا راجع إلى الظروف البيئية السائدة في المنطقة من حرارة ورطوبة نسبية بالإضافة إلى الأعداء الحيوية المنتشرة.