ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor,
Vol. 45(4): 1725-1734, (2007).

POPULATION FLUCTUATIONS OF THE TURNIP APHID *LIPAPHIS ERYSIMI* Kalt ON *AGERATUM HOUSTONIANUM* Mill IN RELATION TO BIOTIC AND ABIOTIC FACTORS

BY

El- Khouly, S.A.*; Nour El–Din, M.M.; Hammad, S.A.* and Darbin, S.M.S**.**
* Fac. of Agric., Al-Azhar Univ. Egypt.
** Plant Protection Research institute, Agric. Res. Center, Dokki, Giza, Egypt.

ABSTRACT

The present study was carried out at El–Zohreya garden, Cairo, governorate, Egypt, during two successive years (2003 & 2004) to determine the population fluctuation of Turnip Aphid, *Lipaphis erysimi* Kalt (Aphididae:Homoptera) and it's associated predators, on Floss flower, *Ageratum houstonianum* Mill. (Family : Asteraceae). Obtained results showed that the rate of infestation of Ageratum plants by *Lipaphis erysimi* during season 2003 was increased gradually from the mid. of January till the first of March (whereas, recorded 24.53 aphid/leaf), then decreased rapidly until the end of spring. In season 2004, aphids population was increased and fluctuated from the beginning of February till the end of the second decade of April, then decreased rapidly until the end of spring. Statistical analysis of data cleared that, there were significant correlation between *Lipaphis erysimi* population and each of maximum and minimum temperature in addition to predatory insect during the two successive seasons on both leaves and flowers of the host plant. Concerning insect predators which found associated with aphid species were *Coccinella undecimpunctata* L., *Chrysoperla carnea* steph., *Syrphus corollae* F., and *Aphidoletes sp.*

INTRODUCTION

Floss flower, *Ageratum houstonianum* Mill. (Family: Asteraceae) is one of winter annual ornamental plants. It can be used for edging or in containers. The taller cultivars may be used as cut flowers. Other uses are in rock gardens or as a winter house plant. Family *Asteraceae* has been countered to be one of the biggest botanical families which contain natural products. These products are now being considered as promising alternatives to the arsenal of synthetic compounds currently available (Dayan *et al.*, 1999). *Ageratum spp.* is an annual herbaceous plant and it has a history of the traditional medicine (Ming 1999). Bioactivity of plant extract has been reported against bacteria and insects (Durodola 1977). Insecticidal activity was exclusively studies against larvae of a broad range of insects (Sujatha *et al.*, 1988). Early studies on this plant has focused on its anti-juvenile hormone action on insects (Saxena *et al.*, 1992). A wide range of chemical compounds including alkaloids, flavonoids, chromenes, benzoflurans and terpenoids have been isolated from Ageratum conyzoides. Extracts and metabolites from this plant possess pharmacological and

insecticidal activities (Okunoda 2002). *A. houstonianum* accumulates the biologically active chromenes precocene I and II. The largest amounts of precocenes in flowering plants was detected in leaves, followed by flowering heads, while the stems and roots accumulate only the minor concentration (Siebertz *et al.*, 1990). The crude hexane extract from Ageratum conyzoids was active against housefly (*Musca domestica*) larvae (Gónzalez *et al.*, 1991 a). The essential oil of Ageratum species was also studied by (Wandji *et al.*, 1996, Suresh *et al.*, 1996, Chalchat *et al.*, 1997 and Sharma & Sharma 2001). *A. houstonianum* is infesting with various insect pests during it's growing season (from plantation to harvest), aphids are among them. The most important ones are *Aphis gossypii*, *Aphis craccivora, Myzus persicae* (Aphididae : Homoptera). This group of insects causes in certain cases qualitative and quantitative yield loss. Nymphs and adults suck sap from leaves, stem, flowers and pods resulting in poor pod formation and reduced oil content in grains. Aphids feed on their hosts sap. Large colonies of it can cause deformed to plants and the leaves curled, shriveled and yellowed (Metcalf, 1962). Turnip or mustard aphid, *Lipaphis erysimi* Kalt attacks several plants as *Lantana camara, Azadirachta indica, Cassia fistula, Ageratum convioidea, Ipomoea carnea* and *Thevetia neriifolia* (Pandey *et al.*, 1987). Description of *L. erysimi*: Wingless aphid females are yellowish green, gray green or olive green with a white waxy bloom covering the body. The winged females have a dusky green abdomen with dark lateral stripes separating the body segments and dusky wing veins (Blackman and Eastop, 1984).

The present study concerned with the population fluctuation of *L. erysimi* and its associated predators on *A. houstonianum*. The relationship between aphid population and each of associated predators and prevailing weather factors.

MATERIALS AND METHODS

Population of *L. erysimi* were monitored on *A. houstonianum* at El–Zohreya garden located at Cairo governorate from January 2003 to June 2004. The experimental area received all the usual agricultural practices except any pest control measures.

Estimating of Turnip aphid, *L. erysimi* began as soon as the plants appeared above the ground and continued until the end of spring. Sampling of fifteen leaves and 15 flowers (when present) were selected at random from each plot. Each plot size was about 24 m^2 and replicated three times two inspections were carried out per week. Collected samples were transferred in polyethylene bags to the laboratory for sorting, identification and counting for the aphids and associated predators which were directly counted on plants.

Data of weather factors; temperature and relative humidity and wind velocity were obtained from the Meteorological Station, Agric. Research Center, located at Giza. This station is located 3 Km from the study area. These factors were calculated for a week earlier before inspection time. Simple correlation and partial regression were used to elucidate the effect of these factors on the aphid's population and its associated predators. Statistical analysis was conducted using Proc Reg. and ANOVA in SAS (SAS Institute, 1988).

RESULTS AND DISCUSSION

Seasonal fluctuation of *L. erysimi:*

Data presented in Tables (1 & 2) show the mean number of *L. erysimi* (per/leaf or/flower) of *A. houstonianum* during the two seasons of 2003 and 2004 (with relation of some biotic and abiotic factors). Four predators associated with *L. erysimi* were collected during the investigation period. These predators were: *Coccinella undecimpunctata* L., (Coleoptera : Coccinellidae) *Chrysoperla carnea* Steph. (Neuroptera : Chrysopidae), *Syrphus corollae* F. (Diptrera : Syrphidae) and *Aphidoletes* sp. (Diptera : Cecidomyiidae) whereas, *Aphidoletes* sp. and *C. undecimpunctata* were the most abundant species.

On leaves:

During the first season (2003), the mustard aphid began to attack *A. houstonianum* on 18 Jan., with average number of 1.8 aphids/leaf. Infestation ended on 24th May, with average number of 0.46 aphids/leaf. The population fluctuated and reached the highest peak on first Mar., with average number of 24.53 aphids/leaf, at maximum temp., minimum temp., relative humidity, and wind velocity averages of 19.73°C, 8.83°C, 54, 86% and 1.04 m/sec, respectively. Corresponding Predator's began to appear at 5th Feb. (0.13 predator/leaf) and reached its maximum 5.53 predators/leaf on 16th April (Table, 1).

Data obtained in the second season (2004) revealed that individuals of *L. erysimi* began to attack its host plant from 10th Feb., with average number of 2.5 aphids/leaf. Infestation ended by June. 12, 2004 with average number of 0.4 aphids/leaf. The population increased gradually to reach its peak on April 13, with average number of 16.27 aphids/leaf. At the same time number of predators was 4.8 predators/leaf, when maximum temp., minimum temp., relative humidity and wind velocity were 29°C, 15°C, 51.3% (R.H) & 1.3 m/sec, respectively (Table, 2).

Generally, it could be concluded that infestation by *L. erysimi* on *A. houstonianum* leaves was higher in 2003 season than in 2004, with average number of 9.36 aphids/leaf during 2003 season and 7.23 aphids /leaf during 2004.

On flowers:

During the first season, 2003 the aphid infestation on flowers began at 5th Mar., with average number of 3.87aphids/ flower. Aphid population declined throughout the following 10 days, suddenly it increased to reach its peak (4.2 aphids/flower) on 15th Mar. when maximum temp., minimum temperatures, relative humidity, and wind velocity were 23.27, 12.33°C, 47.24% & 0.99 m/sec, respectively. Then the population fluctuated between increase and decrease until the end of the season, 24th May. Number of Predators at this time was 0.9 predators/flower (Table, 1).

During the second season 2004, this pest began to appear on *A. houstonianum* plants at the end of March with average number of 3.0 aphids/ flower. The infestation ended on 12th June, with average number of 0.2 aphids/ flower. The population fluctuated and reached the highest peak on May 11, 2003 with average

number of 4.17 aphids/flower, when maximum temp., minimum temperature, relative humidity, and wind velocity were 34.8°C, 21.6°C, 34.8% &1.0 m/sec, respectively. Predator's count at peak time of aphids was 1.67 predators/flower (Table, 2).

In contrast to infestation on leaves, it is noticed that the infestation on flowers was higher in 2004 season than in 2003 with average number of 2.37 aphids/ flower during 2004 season and 1.90 aphids/flower during 2003. Discussing the foregoing results, it could be reported that these results agreed with those obtained by Prasad (2003) who stated that, the number of aphids at peak and the time of reaching peak also differed in different years.

Aphid population in relation to some biotic and abiotic factors:

Results of statistical analysis of *L. erysimi* population fluctuations in relation to some biotic and abiotic factors are presented in (Table, 3). These factors were maximum, minimum temperatures, relative humidity, wind velocity (as abiotic factors) and insect predators (as biotic one).

On leaves:

Correlation between maximum temperature and population of aphids in the 1st season, was negative significant (r= - 0.551, p = 0.0004), while in the 2nd season it had a non-significant negative relationship (r = -0.172, p = 0.316). In case of partial regression, it was insignificant negative in the 1st season, (b =-0.756, p =0.150), while in the 2nd season it was insignificantly positive (b = 0.039, p = 0.828). Regarding the relation between minimum temperature and population, it was significantly negative in the two years (r = - 0.565, p = 0.0003, and r = - 0.324, p = 0.054, respectively). In case of partial regression, it was insignificant negative in the first season (b = - 0.969, p = 0.187), while it was significantly negative (b= -0.493, p = 0.046) in the second one. Regarding the relation between relative humidity and observed population fluctuation in the 1st season, it was insignificant positive (r= 0.220, p= 0.191). This relation was insignificantly negative (r= -0.011, p= 0.951) in the 2nd year. However, partial regression was significantly negative (b = - 0.384, p = 0.058) in the first season, while, it was insignificantly negative (b = - 0.100, p = 0.102) in the 2nd season, relation between wind velocity and aphid population in the 1st season was insignificantly positive (r = 0.098, p = 0.563), while in the 2nd season, it was non-significant and negative relationship (r = -0.232, p = 0.173). In case of partial regression, it was insignificant negative in the 1st season, (b = -1.761, p = 0.714), while in the 2nd season, it was insignificantly positive (b = 0.272, p = 0.887). Results also, proved that the relation between predators activity and aphid population was insignificant and negative in the 1st season, (r= -0.132, p = 0.436), while, it was significantly positive relationship (r = 0.891, p= 0.0001) in the 2nd season. Partial regression was insignificant and negative (b= -1.087, p = 0.062) in the first season, while, it was significantly positive with (b = 2.320, p = 0.0001) in the 2nd season. The combined effect (E.V %) of the five mentioned factors was 73% and 96 % during the two seasons, respectively.

On flowers:

Correlation between maximum temperature and population of aphid in the 1st season, was significant and negative (r = -0.657, p = 0.001), while, it was a non-

significantly negative relationship (r = -0.124, p = 0.582) in the 2nd season. Partial regression was insignificant negative value in the two years (b = -0.102, P = 0.355 & b = -0.082, P = 0.549) respectively. The relation between minimum temperature and aphid population, was significantly negative during the two years (r = -0.565, p = 0.000 & r = -0.324, p = 0.054). Also, partial regression was insignificant negative during the two years (b= -0.108, p= 0.480 & b = -0.036, p = 0.840, respectively). Regarding the relation between relative humidity and aphid population fluctuations, it was insignificantly positive in the 1st and 2nd season (r = 0.220, p= 0.191, & r = 0.054, p = 0.951, respectively). Partial regression, was insignificantly negative (b = -0.044, p = 0.294) in the first season, while, it was significantly negative (b= -0.114, p= 0.020) in the 2nd season. Relation between wind velocity and aphid population in the 1st season, was insignificant positive (r= 0.098, p = 0.563), while in the 2nd season, it had a non-significantly negative relationship (r = -0.232, p = 0.173). Partial regression was insignificantly positive during the two years (b = 0.807, P = 0.433, 1st season & b = 0.289, P =0.842, in 2nd season). Results also, indicate that the relation between number of predators and aphid population, it was insignificant and positive in the both years (r = 0.216, P = 0.311, in 1st season & r = 0.285, P = 0.198, in 2nd season). Partial regression, was insignificant positive during the two years (b = 0.078, P = 0.511, in 1st season & b = 0.089, P = 0.636, in 2nd season). The combined effect (E.V %) of the five tested factors was 50 % in 1st season and 36 % in the 2nd one. In this respect, Parsad (2003) found that, weather factors like maximum & minimum temperature and relative humidity were also recorded to find out their impact on this aphid population. Increasing of temperature and R.H% caused insignificant increasing of aphids population. Liu and Meng (2000) studied the development period from birth to adult of the turnip aphid, *Lipaphis erysimi*, at 14 constant, 15 alternating and 15 natural temperature regimes to determine the aphid development under a wide range of natural conditions. Atwal and Sethi (1963) studied the population dynamics of the aphid *Lipaphis erysimi*, and predacious beetle *Coccinella septempunctata* L. Their results was relatively agree with our results, *Coccinella* is not only important factor concerned in the ultimate decline to the population of *Lipaphis*.

Generally, there are negative and significant correlation between max. and min. temperature and population density of this pest during the first season (2003), while the associated predators gave positive and highly significant correlation with the population of aphids only on plant leaves during the second season (2004). This in means that max. and min. temperature were above the optimal range and the predators were below the optimal range of population activity. The other factors gave insignificant correlation with the population of aphids, that means, these factors were within the optimal range of population activity of the insect, Table (3). The combined effect of all factors was 73.3 and 96.7% on leaves and 49.8 and 36.3 on flowers during the two seasons, respectively.

Table (1): Weekly mean numbers of *Lipaphis erysimi* on *Ageratum houstonianum* accompanied with associated predators and some weather factors during season 2003, at EL-Zohreya Garden, Cairo Governorate.

Date of sample	Aphids No. /Leaf	Aphids No. /Flower	No. of Predators	T. MAX	T.MIN	R.H	W.V
18/01	1.80	.	0.00	18.77	10.30	66.68	0.65
22	2.28	.	0.00	18.83	11.38	68.42	0.59
25	3.17	.	0.00	20.73	9.07	58.17	0.64
29	3.86	.	0.00	19.58	10.13	46.67	0.89
01/02	5.10	.	0.00	21.77	9.33	48.30	0.52
05	5.61	.	0.13	18.20	10.38	41.30	1.08
08	7.94	.	0.13	20.70	9.93	50.34	1.02
12	10.46	.	0.20	17.85	9.38	59.39	0.72
15	13.59	.	0.13	18.47	9.37	61.29	0.76
19	18.47	.	0.07	22.10	11.63	43.67	1.06
22	20.80	.	0.13	18.77	9.67	50.45	1.08
26	22.53	.	0.47	16.70	7.95	58.28	1.26
01/03	24.53	.	0.07	19.73	8.83	54.86	1.04
05	24.24	3.87	0.47	23.08	11.78	51.20	0.95
08	21.72	2.91	0.80	19.87	12.23	59.89	1.05
12	19.77	2.52	0.87	19.38	10.33	60.04	0.89
15	18.38	4.20	0.87	23.27	12.33	47.24	0.99
19	15.98	2.87	1.13	20.93	12.20	50.71	1.36
22	14.73	2.46	1.07	18.50	10.33	52.63	0.84
26	13.41	2.04	1.47	16.73	8.20	63.04	1.12
29	11.31	1.64	2.40	20.37	10.47	59.81	0.84
02/04	9.06	2.10	3.07	26.75	13.88	44.69	0.93
05	7.44	1.79	2.00	36.67	20.00	48.50	1.02
09	6.19	2.21	3.20	25.53	16.80	52.31	1.38
12	5.61	3.72	4.00	24.27	13.47	59.51	1.44
16	5.32	2.87	5.53	24.88	14.50	59.32	1.00
19	4.84	1.00	5.07	30.43	16.83	40.30	0.97
23	4.52	1.24	3.36	25.83	14.40	49.64	0.87
26	5.26	1.29	2.53	29.90	18.30	40.96	1.22
30	3.80	1.47	0.53	25.25	14.38	50.93	1.21
03/05	4.29	0.51	0.40	30.73	15.90	53.35	1.42
07	3.11	0.73	0.53	32.58	17.33	47.90	1.19
10	2.42	1.17	0.47	32.37	18.33	48.41	1.34
14	1.81	1.19	0.20	33.68	18.80	47.50	0.94
17	1.57	0.87	0.47	34.90	20.57	40.27	0.88
21	1.04	0.57	0.13	32.73	21.35	47.24	1.08
24	0.46	0.27	0.07	33.53	21.93	41.04	0.93
Total	346.42	45.50	41.96	894.28	491.95	1896.34	37.14
Mean	9.36	1.90	1.13	24.17	13.30	51.25	1.00

Table (2): Weekly mean numbers of *Lipaphis erysimi* on *Ageratum houstonianum* accompanied with associated predators and some weather factors during season 2004, at EL-Zohreya Garden, Cairo Governorate.

Date of sample	Aphids No. /Leaf	Aphids No. /Flower	No. of Predators	T.MAX	T.MIN	R.H	W.V
10/02	2.51	.	0.07	19,10	13,07	75,32	0,94
14	3.22	.	0.00	18,20	10,20	53,46	1,02
17	3.88	.	0.00	19,97	7,93	48,97	0,68
21	5.78	.	0.00	17,88	9,28	62,48	0,77
24	4.17	.	0.00	21,30	9,73	44,27	0,72
28	6.00	.	0.00	29,20	12,53	47,99	0,58
02/03	5.96	.	0.00	29,33	16,20	54,28	0,94
06	6.23	.	0.27	29,33	15,80	45,59	0,86
09	7.62	.	0.13	17,80	10,23	52,82	1,39
13	7.99	.	0.60	22,28	11,90	55,13	0,96
16	7.76	.	0.93	19,97	11,70	56,33	1,14
20	8.50	.	1.67	20,08	10,63	57,05	0,97
23	8.96	.	3.07	22,37	11,30	56,92	1,30
27	12.08	.	3.00	24,40	12,95	61,59	1,05
30	11.57	2.97	3.93	26,73	14,23	62,25	1,09
03/04	12.31	1.94	3.87	29,65	17,73	50,13	0,89
06	13.44	1.70	3.67	23,03	14,10	55,32	1,17
10	14.77	2.67	4.33	22,45	13,23	54,01	1,34
13	16.27	2.20	4.80	29,10	14,93	51,37	1,38
16	14.91	3.68	5.13	28.45	15.60	43.99	1.09
20	14.62	2.28	5.13	24.77	14.40	53.76	0.78
24	13.29	2.97	5.20	26.10	16.28	50.03	1.02
27	11.01	2.61	3.27	28.20	16.43	40.86	0.99
01/05	8.06	2.17	3.20	28.85	17.70	44.39	1.06
04	6.79	1.61	1.73	28.57	17.30	48.04	1.03
08	5.83	2.37	1.40	32.78	19.18	52.34	0.95
11	5.38	4.17	1.67	34.87	21.60	54.58	1.06
15	4.54	1.96	2.27	26.05	17.03	56.83	1.13
18	4.00	3.18	1.07	29.39	18.72	44.25	0.87
22	3.69	3.06	0.87	28.63	19.39	47.58	1.11
25	2.83	3.12	0.40	28.62	17.45	48.04	1.21
29	2.02	3.11	0.53	32.09	19.00	45.06	1.22
01/06	1.80	1.61	0.27	33.52	20.50	41.74	0.99
05	1.19	2.16	0.20	30.46	19.43	52.45	1.28
08	0.86	0.43	0.07	34.74	21.93	45.78	1.26
12	0.40	0.20	0.07	30.95	20.50	52.73	1.10
Total	260.22	52.14	62.80	892.89	519.98	1860.13	34.68
Mean	**7.23**	**2.37**	**1.74**	**24.80**	**14.44**	**51.67**	**0.96**

Table (3): Simple correlation and partial regression values of four weather factors and predators numbers with their significant levels and percentages of explained variance on the population activity of *Lipaphis erysimi* on *Ageratum houstonianum* at El-Zohreya Garden, Cairo Governorate.

Year		Factor	Simple Correlation		Partial regression				
			r	P	b	P	F	P	EV %
On leaves	(2003)	T MAX	-0.551	0.0004	-0.756	0.150	9.866	0.0001	0.7327
		T MIN	-0.565	0.0003	-0.969	0.187			
		RH	0.220	0.191	-0.384	0.058			
		WV	0.098	0.563	-1.761	0.714			
		PR.	-0.132	0.436	-1.087	0.062			
	(2004)	T MAX	-0.172	0.316	0.039	0.828	93.31	0.0001	0.9668
		T MIN	-0.324	0.054	-0.493	0.046			
		RH	-0.011	0.951	-0.100	0.102			
		WV	-0.232	0.173	0.272	0.887			
		PR.	0.891	0.0001	2.320	0.0001			
On flowers	(2003)	T MAX	-0.657	0.001	-0.102	0.355	3.578	0.0202	0.4984
		T MIN	-0.565	0.000	-0.108	0.480			
		RH	0.220	0.191	-0.044	0.294			
		WV	0.098	0.563	0.807	0.433			
		PR.	0.216	0.311	0.078	0.511			
	(2004)	T MAX	-0.124	0.582	-0.082	0.549	1.827	0.1644	0.3634
		T MIN	-0.324	0.054	-0.036	0.840			
		RH	0.054	0.951	-0.114	0.020			
		WV	-0.232	0.173	0.289	0.842			
		PR.	0.285	0.198	0.089	0.636			

"r" : Simple correlation " b" : Partial regression coefficient value
"P" : Probability level E.V.(%) : Explained variance.
PR : Predators.

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التغيرات العددية لحشرة مَنْ اللفت على نبات البرجمان وعلاقة ذلك ببعض العوامل الحية وغير الحية.

عبدالمنعم سليمان الخولى*، محمد محمود نور الدين، سعيد عبدالعليم حماد*، سالم محمد دربين****

* قسم وقاية النبات – كلية الزراعة جامعة الأزهر.

** معهد بحوث وقاية النبات – مركز البحوث الزراعية – وزارة الزراعة – مصر.

أجريت هذه الدراسة فى حديقة الزهرية بمحافظة القاهرة – جمهورية مصر العربية خلال موسمين متتاليين وهما ٢٠٠٣، ٢٠٠٤ على التوالى لمعرفة تذبذب المجموع الحشرى لحشرة مَنْ اللفت *Lipaphis erysimi* من عائلة Aphididae ورتبة Homoptera وكذلك المفترسات المرتبطه به على نبات البرجمان *A. houstonianum* وقد أوضحت النتائج أن درجة إصابة النبات بهذا النوع من المَنْ خلال موسم ٢٠٠٣ زادت تدريجياً من منتصف يناير حتى نهاية مارس ثم لا تلبث أن تتناقص سريعاً فى نهاية الربيع. أما خلال موسم ٢٠٠٤ فإن الاصابة تبدأ أول فبراير وتزداد حتى نهاية شهر أبريل ثم تتجه نحو التناقص السريع مع نهاية الربيع. وقد أوضحت التحليلات الاحصائية للنتائج أن هناك تأثير معنوى لكل من درجة الحرارة العظمى والصغرى والرطوبة النسبية وسرعة الرياح والمفترسات على تعداد المَنْ خلال الموسمين وذلك على كلا من الأوراق والأزهار وذلك من خلال تقدير معامل الأرتباط والأنحدار. وفيما يتعلق بالمفترسات التى وجدت مصاحبة للمَنْ هى أبو العيد ذو الأحدى عشر نقطة، وأسد المن ونبابة السرفس و *Aphidoletes sp.*. وقد تبين أن العوامل الاكثر إرتباطاً بتعداد المن هى درجة الحرارة العظمى والصغرى حيث كان الإرتباط سالباً ومعنوياً وكذلك المفترسات كان الارتباط بها موجباً وعالى المعنوية، أما باقى العوامل فكانت فى المستوى الأمثل لنشاط تعداد هذه الحشرة.