

ECOLOGICAL STUDIES ON POPULATION DENSITY OF APHIDS INFESTING PEA PLANTS AND ITS YIELD IN SHARKIA GOVERNORATE, EGYPT

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ABSTRACT

Ecological studies on aphid species infesting pea plants were carried out under field condition at El-Zagazig region Sharkia Governorate, during two successive seasons 2000/2001 and 2001/2002, Obtained results could be summarized and clarified as follow:

- 1) The collected aphid species were *Acyrthosiphon pisum* (Harris), *Aphis craccivora* (Koch), and *Aphis gossypii* (Glover).
- 2) The seasonal abundance of the dominant aphid species can be summarized as follow:
 - a- Three peaks for *Acyrthosiphon pisum* (Harris) were noticed on pea plants in the third week of December, third week of January and end of February.
 - b- Three peaks of *Aphis craccivora* (Koch) were recorded on pea plants in the third week of December, third week of January and third week of February.
- 3) The effects of temperature and relative humidity revealed that the correlation coefficient was significant with temperature and insignificant with relative humidity, also path coefficient between temperature and relative humidity, show that temperature seemed to be affected on the population of aphids followed by relative humidity.
- 4) The effects of certain agricultural practices on the population density of aphids and yield can be summarized as follow:

The first sowing date (of 20th October) with variety (Lincoln) and fertilization (recommended) showed the lowest infestation by aphids in the two seasons, while the second sowing date (30th October) with variety (Little Marvel), and fertilization (recommended) showed the highest yield.

INTRODUCTION

Pea (*pisum sativum* L.) crop is one of the most important vegetable legume crop in Egypt. The cultivated area amounted 2923 feddan produced 10342 tons according to report of ministry of Agriculture (2000). In new reclaimed sandy soil, pea is cultivated to increase fertility of soil, beside the economic importance of the crop.

Pea plants are liable to attack by several insect pest which cause economic losses, and transmit several diseases. Some of them doubted to be due viral infection such as, pea mosaic virus (PMV), bean yellow mosaic virus (BYMV) (Hampton *et al.*, 1978) and Boswell and Gibbs, (1983). Which transmitted by aphids, Khatab (1995) and El-Sharkawy (2002), so after detect Bean yellow mosaic virus in pea plants in ten locations at EL-Sharkia Governorate (Khatab 1995), the present investigation was carried out with the aim of throwing more light and studying the following aspects:

1. Survey of aphid species infesting pea plants at El-Zagazig region.

2. Seasonal fluctuation of aphid species as well as the effect of mean temperature and relative humidity on the population density of these insects.
3. Effect of sowing dates, varieties and fertilizers on the population density of aphids and yield of pea plants.

MATERIALS AND METHODS

Survey and seasonal abundance of aphid species infesting pea plants variety (Little Marvel) were carried out at El-Zagazig region (Sheba Village), Sharkia Governorate, during two successive seasons 2000/2001 and 2001/2002. The normal agricultural practices were followed in due time and no chemical control. Also, study the effect of some climatic factors and effect of sowing dates, varieties and fertilizers on the population density of aphid species and yield pea plants. The experimental areas were half feddan. Sampling started when the age of plants 28 days and sample were taken weekly during the period from the beginning of November to end February of the next year.

1. Surveying:

Three methods of sampling were followed:

- A. **Plant samples:** Ten leaves were picked randomly from three levels from parts of plants (upper, middle and lower) and placed in paper bags and then transferred to the laboratory in the same day for inspection by the binocular microscope. The actual number of aphid (nymphs, apterous and alatal) on both leaf surfaces were counted and recorded.
- B- **Sticky board traps:** Yellow plastic board (20 x 20 cm), coated sticky material and hung on wood rods in the field among the plants according to the height of plants. Counts of captured aphids were recorded.
- C- **Yellow pan traps :** Yellow plastic pan 30 cm diameter and 10 cm deep, using water as a trapping liquid. These traps were also hung on wood rods in the fields among the plants according to the height of plants. Counts of captured aphids were recorded. Ten traps from both yellow sticky board and yellow pan traps were used. The captured insects were identified according to Habib and El-Kady (1961) ; and Blackman and Eastop, (1984) and counted to determine their population density.

2. Effect of certain climatic factors on the population density of the dominant aphid species.

Daily recorded of both temperature and relative humidity were obtained from the Agrometeorological Station at EL-Zagazig district, which is located closely to the experimental areas during the two seasons.

Statistical analysis:

The data were statistically analyzed at each season according to

Gomez and Gomez (1984), treatment means were compared using LSD test at 5% probability level. Also, the path coefficients study to show effect of each factor (temperature and relative humidity) on the population density of the dominant aphids was calculated following the procedure outline by Li (1975).

3. Effect of certain agriculture practices on the infestation of pea plants by aphid species and its yield:

The experimental design used in all growing seasons of pea plants was a split-split plot design with three replications. Treatments were distributed as split-split plot within replications each sub-sub plot consisted of four ridges (4 meters long and 70 cm wide) one side of the ridges the plants were spaced at 10 cm within ridges with an area of 12 m².

- 1- **Sowing date:** Including three sowing dates (20th October, 30th October and 10th November) during the two seasons.
- 2- **Pea varieties:** Using in this experimental three pea varieties (Little Marvel, Lincoln and Alaska) these varieties are commonly cultivated for local consumption.
- 3- **Fertilization:** In addition to the recommended chemical fertilizers two foliar fertilizers namely stumo-Green and Novitrin were applied alone using the recommended rates of application.

a) Soil applied fertilizers (recommended)

- 1- Ammonioium sulphate (NH₄)₂ SO₄ contain (20.5% N) used at 100 Kg/Fed. in two equal portions (50 Kg/Fed. at preparing the soil and 50 Kg/Fed. after two weeks from sowing).
- 2- Calcium supper phosphate contain (15.5% P₂O₅) applied at 100 Kg/Fed. during preparing the soil.
- 3- Potassium sulphate (K₂SO₄) contain (48% K₂O) applied at 50 Kg/Fed. during preparing the soil.

b) The foliar fertilizers

1. Stumo-Green contain (15% N-10% K-1.5% P- 0.20% Fe- 0.15% Mg- 0.17% Mn- 0.30% Zn and 0.05% Cu) applied at 4 Kg/ Fed at three foliar sprays, the first spray was done after 30 days from planting, the second one was after 21 days later and the third after 14 days later.
2. Novitrin contain (5% N- 5% K- 5% P- 1.5% Fe- 1.5% Zn- 0.05% B and 0.02% Mo) applied at one litter Novitrin/250 litter water/Fed at two foliar sprays, the first spray was done after 30 days from planting and the second one was after 21 days later.

RESULTS AND DISCUSSION

1. Surveying :

Survey Study on pea plants in El-Zagazig region, Sharkia Governorate revealed the presence following aphid species:

In the present work, the following aphid species were found on pea plants.

1. *Acrysiphum pisum* (Harris).
2. *Aphis craccivora* (Koch).
3. *Aphis gossypii* (Glover).

Data in Table (1) revealed that the plant samples were attractive to aphid species than the other one, during the two successive seasons of investigation. These results agree with the finding of Hegab *et al.*, (1988) and El-Sharkawy (1989, and 1996), who showed the plant samples seemed to be the most attractive to aphid species in fruit trees.

It is worth to mention that the most extensive infestation by *A. pisum* and follow by *A. craccivora* but *A. gossypii* was rare. These results agree with finding of Megahed (1994) who mention that the *A. gossypii* was found in winter plantation on lentil plants with a few number.

Table (1) : Total number of aphid species infesting pea plants variety (Little Marvel) in El-Zagazig region, Sharkia, Governorate collected by plant samples, yellow board and yellow pan traps during 2000/2001 and 2001/2002 seasons.

Aphid species	Total number of aphid/sample					
	2000/2001			2001/2002		
	Plant S.	Y.S.B.T	Y.P.T	Plant S.	Y.S.B.T	Y.P.T
<i>A. pisum</i>	642	77	59	854	85	31
<i>A. craccivora</i>	173	19	13	209	13	18
<i>A. gossypii</i>	19	2	0	23	3	1
Total	834	98	72	1086	101	50

2. Seasonal abundance of the dominant aphid species

1. *Acrysisphum pisum*

The pea aphid *A. pisum* was the most abundant species where the occurrence number was (642 and 854) individuals for the two seasons in whole period of study recording 76.5% & 78.3% of all surveyed aphid species for the two seasons respectively.

The following discussion on population density are based on the record of plant samples.

Data presented in Figs (1 and 2) shown that the first observation of Aphid *A. pisum* on pea plants during two seasons occurred in the third week of November. The total number at the initial occurrence was only 2 and 1 at a mean temperature 17.6C°, 18.9C° and mean humidity, 68.2%, 58.4% R.H. for the two seasons respectively. There after the insect population increased gradually recording three peaks. The first one was obtained at the third week of December with a total number of 16 & 22 aphids/sample at means of 14.6C°, 16.2C° and 64.7% , 70.9% R.H. for the two seasons respectively. The second peak took place at the third week of January with a total number of 80 & 91 aphids/sample at means of 14.8C°, 14.1C° and 63.7%, 59.9% R.H. for the two seasons respectively.

The third peak noticed. at the end of February with a total number of 119 & 173 aphids/sample at means of 18.1C°, 14.2C° and 60.7% , 63.7% R.H. for the two seasons respectively.

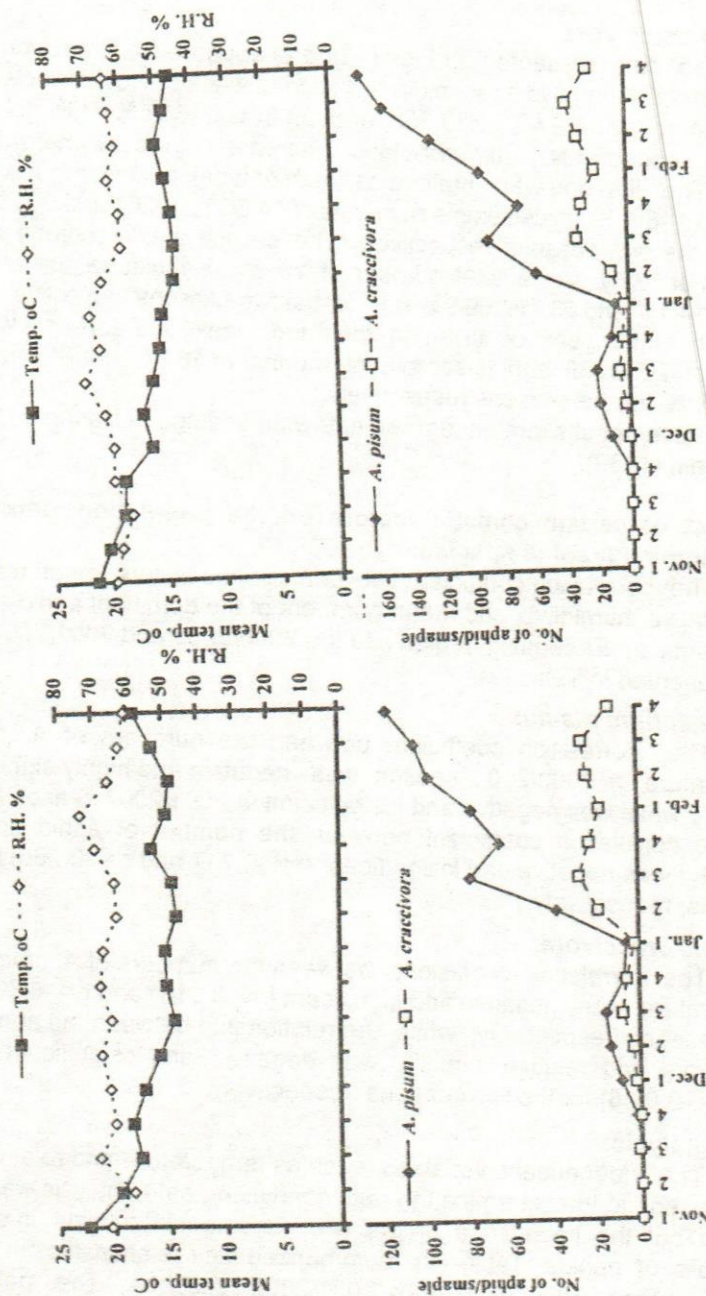


Fig. (1): Seasonal abundance of aphid *A. pisum* and *A. craccivora* infesting pea plants collected by plant samples at El-Zagazig region, Sharkia Governorate, Egypt during 2000/2001 season.

Fig. (2): Seasonal abundance of aphid *A. pisum* and *A. craccivora* infesting pea plants collected by plant samples at El-Zagazig region, Sharkia Governorate, Egypt during 2001/2002 season.

2. *Aphis craccivora*

Also date presented in Figs (1 and 2) appeared *A. craccivora* firstly in low number during two seasons in the second week of November was only 0 and 1 at means 19.4C°, 20.3C° and 58.57% , 61.5% R.H. for the two seasons respectively. After population increased gradually recording three peaks. The first one was obtained at the third week of December with a total number of 8 & 7 aphids/sample at means of 14.6C°, 16.2C° and 64.7% , 70.9% R.H for the two seasons respectively. The second peak recorded at the third week of January with a total number of 28 & 33 aphids/sample at means of 14.8C°, 14.1C° and 63.7% , 59.9% R.H. for the two seasons respectively.

The third peak occurred in the third week of February with a total number of 26 & 39 aphids/sample at means of 16.5C°, 14.8C° and 62.4% , 62.7% R.H. for the seasons respectively.

These results are in agreement with findings of Hashem (1997) and Hassanein (1989).

3. Effect of certain climatic factors on the population density of the dominant aphid species:

The correlation coefficient between climatic factors (mean temperature and relative humidity) and mean numbers of the dominant aphid species on pea plants in El-Zagazig region during 2000/2001 and 2001/2002 seasons was presented in Table (2).

a. *Acrysiophum pisum*:

The correlation coefficient between the numbers of *A. pisum* and temperature in 2000/2001 season was negative and highly significant ($r = -0.673^{**}$) while was negative and insignificant in 2001/2002 season ($r = -0.288$), but the correlation coefficient between the number of aphid and relative humidity was negative and insignificant ($r = -0.247$ and $r = -0.280$) for the two seasons, respectively.

b. *Aphis craccivora*:

The correlation coefficient between the numbers of *A. craccivora* and temperature was negative and significant ($r = -0.518^*$ and $r = -0.696^*$) for the two seasons respectively, while the relationship between the numbers of *A. craccivora* and relative humidity was negative and insignificant ($r = -0.049$ and $r = -0.035$) for the two seasons, respectively.

Path analysis:

The independent variables such as temperature and relative humidity were used to determine the path coefficient, path analysis was designed to find out the importance of the two variables in relation to contributing numbers of aphids. Table (2) summarized their relationships in El-Zagazig region during 2000/2001 and 2001/2002 seasons. The path analysis indicated that the temperature was the most importance affecting on the numbers of aphid.

Similar findings were reported by El-Sharkawy (1989) and El-Gindy (1997), and disagree with Megahed (1994) who mentioned that relative humidity had positive significant with homopterous insects.

Generally, from the previous results, the following conclusion could be discussed as follows: the temperature had negative effects with all dominant aphid species insects, because the temperature effect on developmental rate, activity, dispersal and immigration, also the temperature effect on size and length of the plant (Erwin and Heins 1995), so if the area leaf (food of insects) decrease the total number of insects will be decrease as a result. On the other hand mean relative humidity has little effects.

4. Effect of certain agriculture practices on the infestation of pea plants by aphid species and its yield:

1. Sowing date:

a) Effect on the population density of aphids:

Three sowing dates were carried out at (20th October- 30th October- 10th November) during two successive seasons 2000/2001 and 2001/2002 at (Sheba Village) El-Zagazig region.

Data given in Table (3) show that the infestation with aphids in different sowing dates was highly significant with aphids was more obvious in the second season than that recorded in first season. During the first, second and third sowing date the mean total number of aphids was 96.9, 120.8, 139.6) and (114.3, 145.6, 161.6) aphids/sample for the two seasons respectively. In general, the first sowing date recorded the lowest mean number but the third sowing date recorded the highest mean number. Therefore, it can be stated that sowing pea plants much early was very suitable to pea cultivate, since aphid population was the lowest. These findings are agreement with Hashem (1997), also agree with Awaadalla (1994) who mentioned that sowing date lentil early was effective in reducing the infestation with whit fly, leaf miners and aphids, also agree with Abu-Salih *et al.* (1973) who recorded that the population density of the lequuminous aphids *A. craccivora* and pea aphid *M. pisum* on broad bean were highly significantly by changing times of sowing.

b) Effect on mean yield (Kg/plot):

The data of yield are presented in Table (3). The data show that were highly significant differences between the three sowing dates for yield in both seasons. The result show that the mean yield was increased with the second sowing date than the first and the third sowing date recorded the lowest values, where is mean yield (Kg/plot) was in the first sowing date (23.3 & 19.9), the second sowing date (25.4 & 20.8) and the third sowing date (19.2 & 15.7) for the two seasons respectively. Similar results were obtained by Hashem (1997) and partially agree with Abu-Salih *et al.* (1973) who mentioned that delaying sowing date of been make yield of *vicia faba* lower and disagree with Hassanein (1994) who recorded that sowing date broad bean early at the end of September proved to be more suitable for crop production. This differences may be due to the crop, locality, weather factors, pests and the yield in the same crop effect by plant higher, number of branches, number of green leaves, leaf area seed length, seed width (Abdel Shafie 1995).

Table (2) : Effect of mean temperature and relative humidity on the population density of dominant aphid species infesting pea plants at El-Zagazig region, Sharkia Governorate, during 2000/2001 and 2001/2002 seasons.

Aphids	Simple correlation				Explain variation (R ²)				Effect of weather factors				Residual factors			
	T.C°		R.H.%		2000/2001		2001/2002		T.C°		R.H.%					
	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002	2000/2001	2001/2002
<i>A. pisum</i>	-0.673**	-0.288	-0.247	-0.280	43.2	37.5	42.42	37.39	0.787	0.11	54.8	62.5				
<i>A. craccivora</i>	-0.518*	-0.696*	-0.049	-0.035	36.8	21.9	36.66	21.88	0.120	0.02	63.2	78.1				

** High significant * Significant Insignificant

Table (3): Effect of sowing dates on the infestation by aphids along with yield during 2000/2001 and 2001/2002 seasons.

Sowing date	Mean of aphid numbers / sample		Mean of yield kg/plot	
	2000/2001	2001/2002	2000/2001	2001/2002
	$\bar{X} \pm SE$	$\bar{X} \pm SE$	$\bar{X} \pm SE$	$\bar{X} \pm SE$
D ₁ (20 th October)	96.9*** ± 4.81 a	114.3 ± 4.07 a	23.3 ± 0.47 a	19.9 ± 0.51 a
D ₂ (30 th October)	120.8 ± 5.05 b	145.6 ± 4.22 b	25.4 ± 0.77 b	20.8 ± 0.57 b
D ₃ (10 th November)	139.6 ± 5.20 c	161.6 ± 4.31 c	19.2 ± 0.36 c	15.7 ± 0.44 c

*** means having different letters differ significantly (P < 0.05).

2. Effect of varieties:

a) Effect on the population density of aphids:

The data listed in Table (4) pointed out that, the differences between mean numbers of aphids on the three tested pea varieties were statistically highly significant between V_2 (Lincoln) and the other two varieties V_1 (Little Marvel) and V_3 (Alaska), while was between Little Marvel and Alaska insignificant. The most suitable cultivate was Alaska followed by Little Marvel, while Lincoln cultivate was the lowest suitable. The mean total number of aphids recorded for V_3 , V_1 and V_2 was (135.22 & 132.78 & 39.41) and (165.7 and 161.4 and 109.05) aphids/sample for two seasons respectively. Similar results were obtained by Nossor (1996), but these results disagree with the obtained by Hashem (1997) who reported that aphid infestation on three tested pea varieties (Perfection, Little Marvel and Victory Freezer) were statistically insignificant during the two seasons of study 1995 and 1996.

b) Effect on the mean yield (Kg/plot):

The results recorded in Table (4) indicated that there were highly significant differences between the three tested varieties for yield in both seasons. The results show that the highest values for V_1 (Little Marvel) was (25.07 & 20.34) and the lowest values for V_2 (Lincoln) was (20.05 & 17.36) for the two seasons respectively.

These results were agreement with those findings of Hashem (1997), Helaly *et al.* (1982) and Metwally (1989) who reported that varieties of peas plants had a great effect on the yield, also agree with Abdel Shafie (1995).

3. Fertilization:

a) Effect on the population density of aphids:

The recommended rates (as soil fertilization) and two foliar fertilizers were applied separately to clarify their effects on the population density of aphids during the two seasons 2000/2001 and 2001/2002. The data given in Table (5) show that the highest mean numbers of aphid (134.7 and 161.66) aphids/sample occurred by using the F_3 (Novetrin) treatment for the two seasons respectively, while the lowest mean population density of aphids recorded by F_1 (recommended) treatment with (102.4 and 123.17) aphids/sample for the two seasons respectively. Also, the data indicated that there were highly significant affect between the three fertilizers treatment and mean numbers of aphids. The obtained results are in agreement with those obtained by Mostafa *et al.* (1983), Hassanein (1994) and Hashem (1997) who recorded that the incidence of aforementioned homopterous insects on Leguminous plants varied greatly according to the applied fertilizers.

b) Effect on the mean yield (Kg/plot):

Data recorded in Table (5) clearly emphasized that, effect of tested fertilizers treatment on the yield of pea plants was highly significant in the two seasons. The highest yield was (25.78 and 21.98) kg/plot was recorded with F_1 (recommended) and the lowest yield was (19.74 and 16.53) kg/plot with F_3 (Novetrin) while F_2 (Stumo-green) gives moderate yield (22.41 and 17.64) kg/plot for two seasons respectively.

Table (4) : Effect of varieties on the infestation by aphids along with yield during 2000/2001 and 2001/2002 seasons.

Variety	Mean of aphid numbers / sample		Mean of yield kg/plot	
	2000/2001 X ± SE	2001/2002 X ± SE	2000/2001 X ± SE	2001/2002 X ± SE
V ₁ (Little Marvel)	132.78 ± 5.28 ***a	161.4 ± 4.12 a	25.07 ± 0.91 a	20.34 ± 0.63 a
V ₂ (Lincoln)	39.41 ± 3.85 b	109.05 ± 3.18 b	20.05 ± 0.67 b	17.36 ± 0.52 b
V ₃ (Alaska)	135.22 ± 4.04 a	165.7 ± 3.23 a	22.77 ± 0.72 c	18.93 ± 0.48 c

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Table (5) : Effect of fertilizers on the infestation by aphids along with yield during 2000/2001 and 2001/2002 seasons.

Fertilizers	Mean of aphid numbers / sample		Mean of yield kg/plot	
	2000/2001 X ± SE	2001/2002 X ± SE	2000/2001 X ± SE	2001/2002 X ± SE
F ₁ (Recommended)	102.4 ± 5.22 ***a	123.17 ± 4.18 a	25.78 ± 0.81 a	21.98 ± 0.58 a
F ₂ (Stumo-green)	120.3 ± 5.52 b	147.02 ± 4.32 b	22.41 ± 0.69 b	17.64 ± 0.47 b
F ₃ (Novetrin)	134.7 ± 5.71 c	161.66 ± 4.47 c	19.74 ± 0.64 c	16.53 ± 0.43 c

*** means having different letters differ significantly (P< 0.05).

Generally, in all treatments, the mean yield in the first season of 2000/2001 was higher than that obtained in the second seasons of 2001/2002.

These results are in agreement with those obtained by Hashem (1997), Abdel Shafie (1995) Kotb *et al.* (1990) and Zeidan and Abd El-Lateef (2001) who recorded that the yield and its components of faba bean effected by nitrogen and phosphorus fertilization.

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دراسات إيكولوجية على الكثافة العددية لحشرات المن التي تصيب نباتات البسلة
وكمية المحصول بمنطقة الزقازيق - محافظة الشرقية - مصر
حمزة محمد السيد الشرقاوى
قسم وقاية النبات - معهد الكفاية الإنتاجية - جامعة الزقازيق - مصر

أجريت تلك الدراسة فى موسمى ٢٠٠٠/٢٠٠١ و ٢٠٠١/٢٠٠٢ بهدف حصر ودراسة
الوفرة الموسمية لأنواع المن التي تصيب نباتات البسلة بمنطقة الزقازيق بمحافظة الشرقية وكذلك
تأثير بعض العوامل الجوية (الحرارة والرطوبة النسبية) وأيضا بعض العمليات الزراعية على
الكثافة العددية لأنواع المن السائدة وكمية المحصول لنباتات البسلة.
ويمكن تلخيص النتائج المتحصل عليها كما يلى :
أنواع المن التي تم حصرها :

Acrypsiphum pisum (Harris), *Aphis craccivora* (Koch), and *Aphis gossypii*
(Glover)

كما سجلت نتائج الوفرة الموسمية لأنواع المن السائدة ما يلى :

١ - وجد للنوع *A. pisum* ثلاثة أجيال فى (الأسبوع الثالث من ديسمبر - الأسبوع الثالث من
يناير - الأسبوع الرابع من فبراير) .

٢ - وجد للنوع *A. craccivora* ثلاثة أجيال فى (الأسبوع الثالث من ديسمبر - الأسبوع الثالث
من يناير - الأسبوع الثالث من فبراير) .

وأوضحت نتائج تأثير العوامل الجوية (الحرارة والرطوبة النسبية) على تعداد أنواع المن
السائدة أنه توجد علاقة معنوية بين متوسط درجة الحرارة وتعداد المن بينما توجد علاقة غير
معنوية بين الرطوبة النسبية وتعداد المن وذلك عند دراسة معامل الارتباط البسيط بينما عند دراسة
معامل المرور أوضحت النتائج أن درجة الحرارة تقع فى المرتبة الأولى من حيث تأثيرها على
تعداد المن يليها الرطوبة النسبية .

أما نتائج تأثير بعض العمليات الزراعية (ميعاد الزراعة - الأصناف - التسميد) على
تعداد المن وكمية المحصول كانت كالتالى :

سجل ميعاد الزراعة الأول (٢٠ أكتوبر) والصنف (لنكولن) والسماذ الموصى به أقل تعداد
من المن بينما سجل ميعاد الزراعة الثانى (٣٠ أكتوبر) والصنف لتل مارفل والسماذ الموصى به
أعلى إنتاجية من محصول البسلة وذلك خلال موسمى الدراسة .