ECOLOGICAL STUDIES ON POPULATION DENSITY OF APHIDS INFESTING PEA PLANTS AND ITS YIELD IN SHARKIA GOVERNORATE, EGYPT
El-Sharkawy, H. M.
Dept. of Plant Protection, Institute of Efficient Productivity, Zagazig University, Egypt.

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 Acrysiphum pism (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 Acrysiphum pism (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, besides 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 Gibb, (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 alataal) 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 Agrometerological 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 Novitirin were applied alone using the recommended rates of application.
   a) Soil applied fertilizers (recommended)
   1- Ammonium 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. Novitirin contain (5% N- 5% K- 5% P- 1.5% Fe- 1.5% Zn- 0.05% B and 0.02% Mo) applied at one litter Novitirn/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. Acrysisiphum pism (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.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. pisum</td>
<td>642</td>
<td>77</td>
<td>59</td>
<td>854</td>
<td>85</td>
</tr>
<tr>
<td>A. craccivora</td>
<td>173</td>
<td>19</td>
<td>13</td>
<td>209</td>
<td>13</td>
</tr>
<tr>
<td>A. gossypii</td>
<td>19</td>
<td>2</td>
<td>0</td>
<td>23</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>834</td>
<td>98</td>
<td>72</td>
<td>1086</td>
<td>101</td>
</tr>
</tbody>
</table>

2. Seasonal abundance of the dominant aphid species
1. *Acrypsiphum 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 Aphis *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 17.6°C, 18.9°C 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 14.6°C, 16.2°C 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 14.8°C, 14.1°C 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 18.1°C, 14.2°C 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 19.4°C, 20.3°C 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 14.6°C, 16.2°C 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 14.8°C, 14.1°C 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 28 & 39 aphids/sample at means of 16.5°C, 14.8°C 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. **Acyrthosiphum 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 in 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.
El-Sharkawy, H. M.

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 leguminous aphids A. craccivora and pea aphid M. pism 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 been 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>
<thead>
<tr>
<th>Aphids</th>
<th>Simple correlation</th>
<th>Explain variation (R²)</th>
<th>Effect of weather factors</th>
<th>Residual factors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T.C°</td>
<td>R.H.%</td>
<td>T.C°</td>
<td>R.H.%</td>
</tr>
<tr>
<td>A. pisum</td>
<td>-0.673**</td>
<td>-0.288</td>
<td>43.2</td>
<td>37.5</td>
</tr>
<tr>
<td>A. craccivora</td>
<td>-0.518*</td>
<td>-0.696*</td>
<td>-0.049</td>
<td>-0.035</td>
</tr>
</tbody>
</table>

** High significant  * Significant  Insignificant


<table>
<thead>
<tr>
<th>Sowing date</th>
<th>Mean of aphid numbers / sample</th>
<th>Mean of yield kg/plot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\bar{x} \pm SE$</td>
<td>$\bar{x} \pm SE$</td>
</tr>
<tr>
<td>D₁ (20th October)</td>
<td>96.9*** ± 4.81 a</td>
<td>114.3 ± 4.07 a</td>
</tr>
<tr>
<td>D₂ (30th October)</td>
<td>120.8 ± 5.05 b</td>
<td>145.6 ± 4.22 b</td>
</tr>
<tr>
<td>D₃ (10th November)</td>
<td>139.6 ± 5.20 c</td>
<td>161.6 ± 4.31 c</td>
</tr>
</tbody>
</table>

*** 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 V₂ (lincoln) and the other two varieties V₁ (Little
Marvel) and V₃ (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 V₃, V₁ and V₂ 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 Nosser (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 V₁ (Little Marvel) was
(25.07 & 20.34) and the lowest values for V₂ (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 F₃ (Novetrin) treatment for the two
seasons respectively, while the lowest mean population density of aphids
recorded by F₁ (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
F₁ (recommended) and the lowest yield was (19.74 and 16.53) kg/plot with F₃
(Novetrin) while F₂ (Stumo-green) gives moderate yield (22.41 and 17.64)
kg/plot for two seasons respectively.

2684

<table>
<thead>
<tr>
<th>Variety</th>
<th>Mean of aphid numbers / sample</th>
<th>Mean of yield kg/plot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X ± SE</td>
<td>X ± SE</td>
</tr>
<tr>
<td>V1 (Little Marvel)</td>
<td>132.78 ± 5.28 ***a</td>
<td>161.4 ± 4.12 a</td>
</tr>
<tr>
<td>V2 (Lincoln)</td>
<td>39.41 ± 3.85 b</td>
<td>109.05 ± 3.18 b</td>
</tr>
<tr>
<td>V3 (Alaska)</td>
<td>135.22 ± 4.04 a</td>
<td>165.7 ± 3.23 a</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Fertilizers</th>
<th>Mean of aphid numbers / sample</th>
<th>Mean of yield kg/plot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X ± SE</td>
<td>X ± SE</td>
</tr>
<tr>
<td>F1 (Recommended)</td>
<td>102.4 ± 5.22 ***a</td>
<td>123.17 ± 4.18 a</td>
</tr>
<tr>
<td>F2 (Stumbo-green)</td>
<td>120.3 ± 5.52 b</td>
<td>147.02 ± 4.32 b</td>
</tr>
<tr>
<td>F3 (Novetrin)</td>
<td>134.7 ± 5.71 c</td>
<td>161.66 ± 4.47 c</td>
</tr>
</tbody>
</table>

*** 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 been effected by nitrogen and phosphorus fertilization.

REFERENCES


دراسات بيئولوجية على الكثافة العددية لحشرات المين التي تصبب نباتات البسلة
وكمية المحصول ومنطقة الزقاقيق - محافظة الشرقية - مصر
حمزة السيد الشرقاوي
قسم وقاية النباتات - معهد الكفاءة الإنتاجية - جامعة الزقاقيق - مصر

الوفرة الموسمية لأنواع المين التي تصبب نباتات البسلة بمنطقة الزقاقيق بمحافظة الشرقية؛ وكذلك
تأثير بعض العوامل الجوية (الحرارة والرطوبة النسبية) وأيضا بعض العمليات الزراعية على
الكثافة العددية لأنواع المين السائدة وكمية المحصول للنباتات البسلة.
ويمكن تخصيص النتائج المحصلة عليها كما يلي:
أنواع المين التي تم حصرها:

Acrysiphum pismum (Harris), Aphis craccivora (Koch), and Aphis gossypii (Glover)

كما سجلت نتائج الوفرة الموسمية لأنواع المين السائدة ما يلي:

1 - وجد للنوع A. pismum ثلاثة أجيال في (الأسبوع الثالث من ديسمبر - الأسبوع الثالث من يناير - الأسبوع الرابع من فبراير).

2 - وجد للنوع A. craccivora ثلاثة أجيال في (الأسبوع الثالث من ديسمبر - الأسبوع الثالث من يناير - الأسبوع الثالث من فبراير).

وأوضح نتائج تأثير العوامل الجوية (الحرارة والرطوبة النسبية) على تعداد أنواع المين السائدة أنه توجد علاقة معنوية بين متوسط درجة الحرارة وعداد المين بينما توجد علاقة غير
معنوية بين الرطوبة النسبية وعداد المين وذلك عند دراسة معامل الارتباط البسيط بينما عند دراسة
معامل المرونة أوضحت النتائج أن درجة الحرارة تقع في المرتبة الأولى من حيث تأثيرها على
تعداد المين بل bãiا الرطوبة النسبية.

أما نتائج تأثير بعض العمليات الزراعية (مبيد الزراعة - الأصناف - التنسيم) على
تعداد المين وكمية المحصول كانت كالالتالي:
سجل مبيد الزراعة الأول (20 أكتوبر) والصنف (الننكولن) والسماد الموسمي به أقل تعداد
من المين بينما سجل مبيد الزراعة الثاني (30 أكتوبر) والصنف لثل مارفل والسماد الموسمي به
أعلى إنتاجية من محصول البسلة وذلك خلال موسم الدراسة.

2688