MORPHOLOGICAL AND HISTOLOGICAL CHANGES IN PEAR TREES DUE TO THE INFESTATION WITH *CACOPSYLLA PYRICOLA* (FOERSTER) (HEMIPTERA: PSYLLIDAE)

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Abstract

The pear psyllid, *Cacopsylla pyricola* (Foerster) Hemiptera: Psyllidae) was recorded for the first time on pear trees, *Pyrus communis* L. in some pear orchards in north Sinai and Ismailiya Governorates (Ahmed, 2007). Damages caused to pear trees due to infestation with the pest were described throughout morphological and histological changes in artificially infested potted pear seedlings. The morphological changes occurred on the leaf and stem. The histological changes in the tissues of leaf, stem and roots were also described from transverse sections. The abnormal growth in the infested pear seedlings may be due to the salivary toxin secretions excreted by the insect during feeding process. The honeydew secretions secreted by different stages of the pear psyllid during feeding process stimulate the growth of sooty mould. The histological changes due to infestation by *C. pyricola* showed distinct reduction, particularly plant height as well as the photosynthesis was greatly affected as a result of crumpling leaves and growth of the sooty mould on them.

INTRODUCTION

The pear psyllid, *Cacopsylla pyricola* (Foerster) (Hemiptera: Psyllidae) is one of the most economic insect in pear trees in Egypt. The pear psyllid, *C. pyricola* spread in many Egyptian Governorates causing severe damages to pear trees and fallen the fruits. The pest was recorded for the first time on pear trees, *Pyrus communis* L. in some pear orchards in north Sinai and Ismailiya Governorates (Ahmed, 2007).The nature of damages of pear psyllid to pear trees was recorded by several authors i.e. Burts (1970), Westigard and Zwick (1972). Also, in France, Spain, Italy and United State of America, *C. pyri* and *C. pyricola* have been reported as vectors of pear decline (Davies *et al.*, 1992). The present investigations are comprehensive studies on the morphological and histological changes occurred on different parts of pear tree variety Le-Conte which was found to be the most susceptible variety to infestation with this insect pest.

MATERIALS AND METHODS

The experiment was conducted in greenhouse under controlled conditions of temperature (25-28 ◦C), relative humidity (45-50 % R.H) and photoperiod (16L: 8D). Illumination was provided by fluorescent lamps. Ten potted pear seedlings, *Pyrus communis* cv. Le-Conte were chosen for experimental studies. The potted were sprayed with Phosmet 50% WP with rate of 10 g /10 liters water to keep the pear seedlings free from any insect infestation. The pear seedlings pots were kept under cage of muslin cloth to avoid any external infestation throughout the experimental period, observed daily and irrigated regularly. The seedlings pots received the same agricultural treatments during experimental period.

After 3 months, five pots were artificially infested with nymphs of *C. pyricola* (20 nymphs /plant) collected from pear orchard heavily infested with *C. pyricola* then kept under cage of muslin cloth. The other seedling pots were left as control under separated cages. Daily observation was conducted until appearance the symptoms of infestation. The morphological changes on pear seedlings caused by *C. pyricola* were observed by Olympus digital camera and compared with control ones. The morphological parameters were estimated *i.e*. height of the plant (cm), number of internodes, length of internodes (cm) and girth of stem (mm). To investigate the histological changes, samples of both infested and uninfested leaves, stems and roots were cut off and fixed in Carnoy's solution (glacial acetic acid + absolute ethanol) for 20-30 min. Permanent transverse sections were made according to the procedure described by O'Brien and McCly (1981). Sections were cut at 10-15 µ with a Reichert rotary microtome. The strips were then stuck on slides in 0.5 % gelatin solution at temperature 50 - 60◦C and dried at 40 ◦C. The specimens stained in safranin 0.5% and fast green 0.5%, preparations were treated with a series of 60 - 100 % ethanol solutions, rinsed twice in distilled water and mounted in Canada balsm. The serial sections were examined microscopically and photographed by Olympus digital camera fixed on light microscope for both infested and uninfested leaves, stems and roots.

RESULTS AND DISCUSSION

The damages caused to pear seedlings due to infestation with *C. pyricola* were investigated throughout, the morphological and histological changes in pear trees, *P. communis* cv. Le-Conte by comparing the infested seedlings with healthy ones. The morphological and histological changes can be summarized as follows:

1. Morphological changes:

The insect is gregarious in habit. Nymphs were moved up to the soft succulent apical portions of pear seedlings and settled on tender shoots and on leaves lamina. The symptoms of infestation were recorded as follows:

1.1. On leaves:

At the beginning of infestation, the infested leaves of pear show local lesions appearance due to pear psyllid feeding, then turned into dark blotches on the surface of leaves, then swelled up, crinkled and lost their symmetrical shape as a result of crumpling towards the lower side Fig.1 (A).The honey dew secreted by nymphs stimulates the growth of sooty mould on leaf surfaces. Finally, the premature leaves were dropping.

1.2. On stem:

In the heavily infested pear seedlings, the apical growth was arrested. Results in Table (1) revealed that, the height of infested seedlings was significantly less than the uninfested ones (65.4 ± 1.7 cm & 83.6 ± 3.9 cm), respectively. The average number of internodes was significantly increased; it reached to 30.0 ± 0.51and 20.0 ± 0.82 internodes in infested and uninfested plants, respectively. The average length of internodes of infested plants was significantly shorter than the uninfested ones (2.8 ± 0.2 and 4.3 ± 0.6 cm.), respectively. The linear growth of pear seedlings showed thickening of the affected portions of the stem (Fig. (2).The girth of the stem was 14.6 ± 1.6 mm on the infested plants compared to 33.4± 2.7 mm for the uninfested seedlings. From the above mentioned results, it can be concluded that the diagnoses of the pear psyllid infestation were pronounced by the retardation of the linear growth of stem, increase the number of internodes, decrease the length of internodes and thickening their girth.

These results are in harmony with those obtained by Sertkaya *et al.* (2005) they stated that the symptoms observed in the field were rolling of leaves, chlorotic and sometimes leaf dropping in pear. Also, CABI and EPPO (2001) in data sheets on quarantine organisms reported that the pear psyllid *Cacopsylla pyricola*, which was introduced to the USA from Europe around 1832, not only transmits pear decline, but also causes damage by injecting phytotoxins in its saliva into leaves as it feeds.

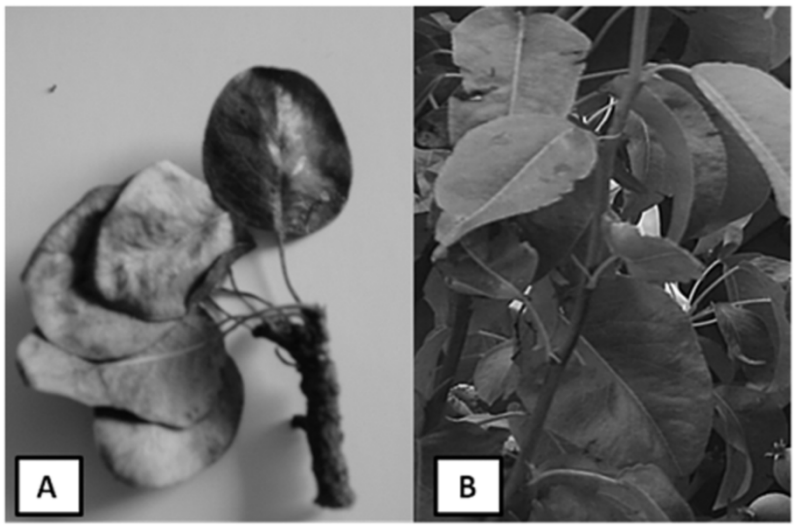

Fig. (1): The leaves of pear, *Pyrus communis* cv. Le-Conte

A: Infested leaves with *C. pyricola* B: Uninfested leaves

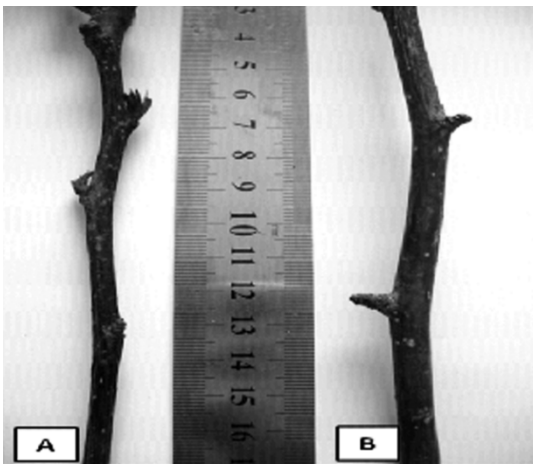

Fig. (2): Internodes of *Pyrus communis* cv. Le-Conte stem

A: Infested stem B: Uninfested stem

Table 1. The effect of infestation with *C. pyricola* on some characters of pear seedlings in comparison with uninfested ones.

Characters	Mean ± s.e		"t" value	Prob. At 5%
	Uninfested	Infested		
Plant height (cm)	83.6 ± 3.9	65.4 ± 1.7	9.2	5%
Number of internodes	20.0 ± 0.82	30.0 ± 0.51	15.3	5%
Length of internodes (cm)	4.3 ± 0.6	2.8 ± 0.2	10.3	5%
Girth of stem (mm)	33.4± 2.7	14.6 ± 1.6	7.91	5%

2. Histological changes:

2.1. The leaves:

At the beginning of the infestation, there was a weakly crumpling in the leaf. The depth of the palisade tissue the length of palisade cells were decreased in the infested leaves and the spongy tissues were distorted. In heavy infestation, the uniform thickness of the leaf blade was lost. This was attributed to the shrinkage which occurred in the spongy cells. At the same time an increase in the width of palisade cells as well as the extension of the epidermal cells were observed. All these effects led to the crinkling of the leaves. In addition, the spongy tissue of the lower epidermis was so severely compact that it could be noticed in Fig. (3).

2.2. The stem:

Microscopic observation of stained, radial sections of stem strips from the vicinity of the graft union of infested trees will reveal excess phloem formation with associated small sieve tube elements and marked sieve tube necrosis. Some of the cortical cells prolonged in the infested stem than in the normal one. This prolongation occurred in the radial direction and it was more obvious in the outer cortical cells or the collenchyma tissue. This phenomenon was also observed in the vascular cylinder and more detected in the xylem tissues. The changes in the stem tissues ultimately led to the decrease of the stem girth Fig. (4).

2.3. The roots:

The histological changes which noticed on roots was blockage of the phloem vessels, preventing tree - synthesized nutrients from reaching to the roots and resulting in starvation of the roots results in a loss of nutrients to the roots, parts then the root system died.

From the above mentioned results it can be concluded that the affected leaves failed to attain their normal shape and size because of distortion and retardation in normal growth of the mesophyll cells. In addition, the affected stem showed a decreasing in the girth of the stem due to the cambial activity. This activity showed a decrease in the all dimension. This abnormality in growth in both leaf and stem tissues may be due to the salivary toxin secretions, excreted by different stages of pear psyllid, *C. pyricola* during feeding into the infested plants tissues Fig. (5). It can be concluded that the infested pear trees by *C. pyricola* showed that a distinct reduction, particularly plant height as well as the photosynthesis was greatly affected as a result of crumpling leaves and growth of the sooty mould on them.

These results are in harmony with those obtained by Sertkaya *et al.* (2005) who mentioned that Phytoplasma were observed in the phloem, even if their detection by

TEM was difficult because of the presence of large areas of necrosis and vacuolar phenolic accumulations, which darken the cellular lumen. Also, Liu *et al*. (2011) stated that Transmission Electron Microscopic examinations revealed phytoplasma bodies in the sieve tubes and phloem parenchyma cells of diseased pears and in the intestinal wall cells of pear psyllid.

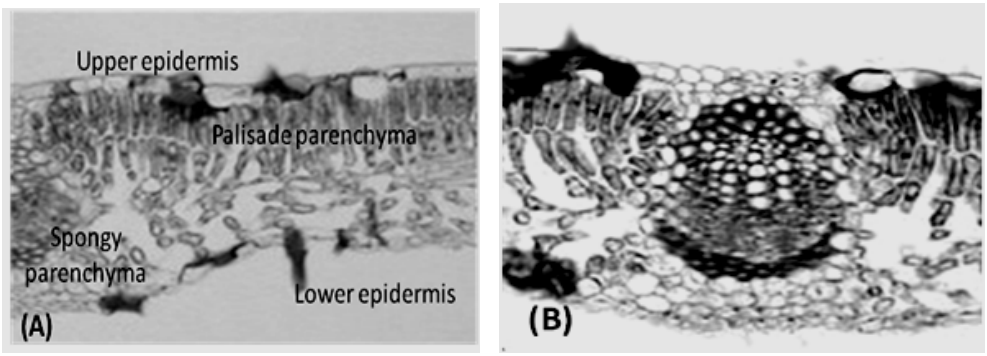

Fig. (3): T.S. in blades of pear leaf.

(A): Infested leaf (150X) (B): Uninfested leaf (100X)

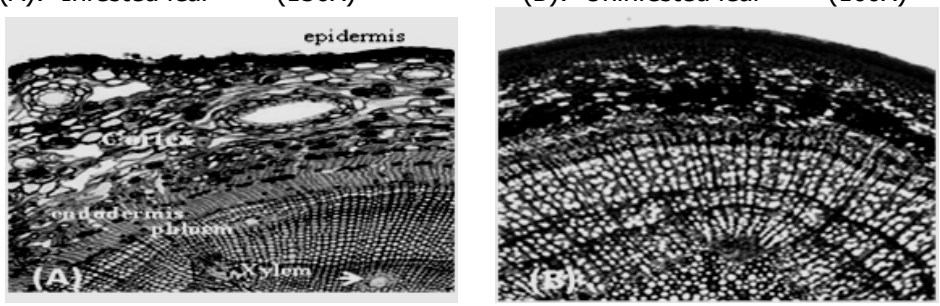

Fig. (4): T.S. in the stem of pear tree

(A): Infested stem (200 X) (B): Uninfested stem (200 X)

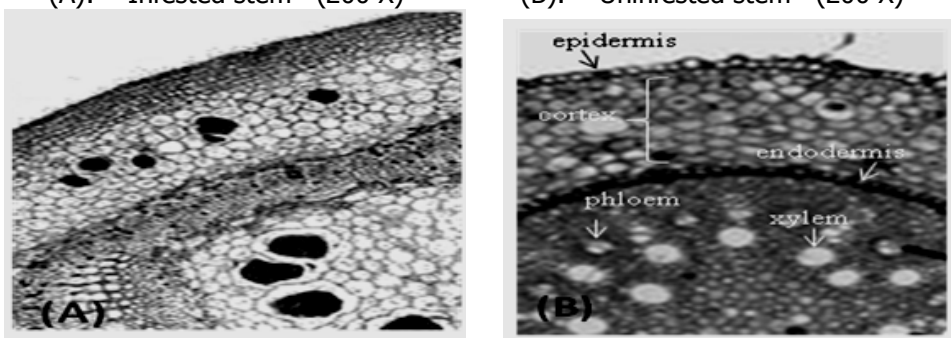

Fig. (5): T.S. in the roots of pear tree

(A): Infested roots (100X) (B): Uninfested roots (100X)

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التغيرات الظاهرية والتشريحية فى أشجار الكمثرى نتيجة الأصابة بحشرة سيلد الكمثرى *Cacopsylla pyricola* (Foerster)

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سجلت حشرة سيلد الكمثرى للمرة الأولى فى مصرعام ٢٠٠٧ فى بعض مزارع الكمثرى بمحافظتى شمال سيناء والإسماعيلية ، حيث تسببت الأصابة فى تساقط الأوراق والثمار قبل وصولها لمرحلة النضج ، وفى بعض المزارع أدت لموت بعض أشجارالكمثرى ، وتهدف الدراسة الحالية معرفة التغيرات الظاهرية والتشريحية التي تحدث فى الأوراق والسيقان والجذور نتيجة الأصابة بحشرة سيلد الكمثرى *C. pyricola* ، وقد أتضح من نتائج الدراسات الظاهرية ظهور بقع موضعية على الأوراق فى بداية تغذية الأطوارغير الكاملة نتيجة أفراز اللعاب السام من الحشرة ثم ظهور بقع داكنة اللون غير منتظمة الحواف تمتد فى معظم أجزاء اسطح الأوراق المصابة نتيجة نمو فطرالعفن الأسود على الندوة العسلية الناتجة عن تغذية الحشرة ، تفقد الورقة شكلها الطبيعى وتتساقط قبل اكتمال نموها مما يؤثر على حالة الأشجار.

كما أظهرت الدراسات التشريحية لأوراق الكمثرى قصر واضح فى خلايا النسيج العمادى وتلف وتضخم فى النسيج الأسفنجى مما يسبب زيادة فى سمك نصل الورقة وكذلك خلايا البشرة مما يسبب إلتواء الورقة حول العرق الوسطى ، أما بالنسبة للتغيرات التشريحية فى الساق لوحظ أستطالة أنسجة القشرة فى الأتجاه الشعاعى مما يؤثر على الأنسجة الكولنشيمية ، كذلك أمتد التأثير إلى الحزم الوعائية خاصة أنسجة اللحاء مما تسبب فى تلف الأنابيب الغربالية وهذا ربما يفسر موت أنسجة الجذور نتيجة لتوقف تدفق العصارة إلى منطقة الجذور ، وعموما ربما تعزى التغيرات فى أنسجة الأوراق والساق إلى اللعاب السام الذى تفرزه الحشرة أثناء مراحل التغذية ، أما التغيرات فى أنسجة الجذور فربما ترجع لأحد المسببات المرضية التى تنقلها الحشرة أثناء التغذية وتسبب تلف أنسجة اللحاء مما يعيق سريان العصارة من أعلى لأسفل فتحرم الجذور من التغذية وتؤدى لموتها.