

The Impact of the Leopard Moth *Zeuzera pyrina* L., (Lepidoptera: Cossidae) Infestation in Casuarina Trees on the Neighboring Pear Orchards in Egypt

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ABSTRACT

The impact and relative susceptibility and monitoring of the Leopard moth *Zeuzera pyrina* L., (Lepidoptera: Cossidae) infestation in pear orchards neighboring and non-neighboring to casuarina trees were evaluated at Borg el-Arab district, Alexandria Governorate, Egypt, during the two successive years 2015 and 2016. The mean rate of *Z. pyrina* infestation in pear trees neighboring to casuarina trees were 15 – 21% (mean, 18%). However, pear trees far away and not neighboring to casuarina trees showed significantly lower rate of the borer infestation (7 - 9%, mean 8%). On the other hand, the rate of *Z. pyrina* infestation in casuarina trees neighboring to pear trees 13 – 18% (mean, 15.5%). The degree of *Z. pyrina* infestation in casuarina trees surrounding pear trees was high (0.42 – 0.57, mean 0.5 moths / tree / year). The degree of infestation in pear trees surrounded by casuarina wind break trees was high (0.55 – 0.77, mean 0.66 moths / tree / year). The degree of infestation in pear trees not-surrounded by casuarina wind break trees was almost half degree (0.28 – 0.37, mean 0.325 moths / tree / year). In all cases, and during the two years of study, moths started to emerge in April and sometimes in May and continued mostly until November sometimes in October. Peaks of moths' emergency were mostly in August. Summer months showed that, the majority of moths' activity. Less mean numbers of emerged moths / tree were noticed in spring months, while autumn showed few numbers, and moths stopped emergence during winter months. The seasonal cycle of *Z. pyrina* moths consisted of 7 – 8 months of moths' activity in casuarina trees and pear orchards. Generally, infestation in pear orchards rapidly multiplied and increased more than twice at the end of only two years. These rapid increases impose the urgent need of control *Z. pyrina* in casuarina trees as well as in pear orchards especially when they are surrounded by infested casuarina wind break trees.

INTRODUCTION

In Egypt, pear (*Pyrus communis* L.) is highly local profitable investment and rank considerable fruit area and production; as well as is one of the most favorite popular. Pear are spread all-over Egyptian delta and reclaimed land Governorate s. Almost all pear orchards are surrounded by Casuarina trees (*Casuarina* sp.) as wind breaks.

However, pear trees are subjected to several insect and animal pests (El-Sherif *et al.*, 1999). The most serious stem boring insect pests in pear orchards at both old valley lands and new reclaimed lands are the leopard moth *Zeuzera pyrina* L., (Lepidoptera: Cossidae) (Mesbah *et al.*, 1994 and Tadros *et al.*, 2006), *Z. pyrina* also a destructive pest in several fruit orchards (apple, olive, pomegranate, fig, ... etc.) as well as some wood and ornamental trees (such as casuarina and poplar trees).

Tadros *et al.* (1993) and Tadros *et al.* (2006) gave some biological, ecological and control studies in Egypt on pear trees as well as some other fruit, wood and ornamental trees such as apple, olive, fig, etc., casuarina and poplar.

Eggs are laid mainly in groups of one layer directly in cracks of the bark of the stem and larger branches of host trees. Newly hatched larvae bore small narrow galleries, then become deep, longer and broader forming wide tunnels and cavities. Infestation causing weakness, breakage of tree branches, reducing the production, and finally death of the whole trees. Moths emerged mostly from June / July until September / October (Tadros *et al.*, 1993).

Horticultural (pruning), mechanical (worming) and mechano-chemical (injection) treatments were evaluated as means of reducing *Z. pyrina* infestation in apricot orchards (Tadros *et al.*, 1996).

The aim of the present investigation was to prevent the fruit and wood yield losses due to *Z. pyrina* infestation by predicting the incident of infestation in fruit orchards due to infested neighboring wind break wood trees, through studies on the rate and degree of infestation, seasonal fluctuation of the target pest population, the progress of infestation, the seasonal cycle, and the effect of the main weather factors.

MATERIALS AND METHODS

The present study focused on the relative susceptibility and the effect of *Zeuzera pyrina* infestation in

the surrounded casuarina wood trees on neighboring the fruit trees in pear orchards.

Infestation studies (rate, degree and progress of infestation) as well as the seasonal cycle of the target borer, *Z. pyrina*, were carried out during the two successive seasons 2015 and 2016 in a pear orchard (about 100 feddans area, more than 20 years old) located at Borg el-Arab district, Alexandria Governorate in relation to *Z. pyrina* infestation in the surrounded casuarina wood trees. The old pupal skins on 100 randomly distributed infested trees in the pear orchard as well as 100 randomly distributed trees of casuarina were removed during December 2014.

Comparison was applied in 100 randomly distributed infested pear trees not-surrounded by casuarina wood trees.

1. Rate of *Z. pyrina* infestation in pear and casuarina trees:

During 2015 and 2016, the rates of *Z. pyrina* infestation were assessed by comparing the percentage numbers of the borer in 100 randomly distributed infested casuarina trees on the surrounding the pear trees. In the meantime, the percentage numbers of the borer in 100 randomly infested pear trees surrounded and non-not-surrounded by casuarina trees were also assessed.

2. Degree of *Z. pyrina* infestation in pear and casuarina trees:

The degree of infestation was estimated by the mean number of *Z. pyrina* adult moths completed their life cycle and emerged (indicated by the new pupal exuvia skins) per each randomly distributed 100 pear trees surrounded and not-surrounded by casuarina wood trees. Counting was applied each year four times at the end of each season (winter, spring, summer and autumn). To avoid repeated counting, new pupal exuvia skins were immediately removed at the end of each month and season. Seasons were as follow; winter (January to March), spring (April to June), summer (July to September) and autumn (October to December).

3. Progress of infestation and seasonal cycle:

Data of the rate, degree of infestation and seasonal cycle were accumulated each year and for the two successive years together from January 1st 2015 until December 31st 2016. Progress of infestation indicated the increase in the borer infestation year after another.

RESULTS AND DISCUSSION

The relative susceptibility to *Z. pyrina* and the

population density (rate and degree of population) on pear trees, compared with the rate and degree of infestation in the surrounding casuarina wind break trees compared with pear trees not surrounded with casuarina trees were studied during the two successive seasons 2015 and 2016 at Borg el-Arab district, Alexandria Governorate.

1. Rate of *Z. pyrina* Infestation:

The rate of *Z. pyrina* infestation highly varied from pear orchard neighboring or not-neighboring to casuarina trees. Pear trees neighboring to casuarina were obviously higher susceptible to the borer infestation showing 15 – 21%, with a mean of 18% (Table 1).

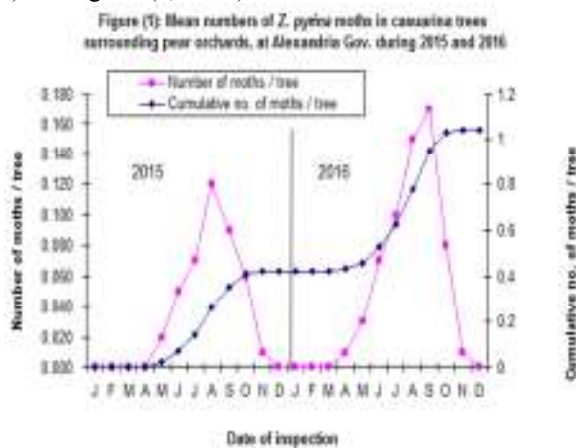
Table 1. Rate of *Z. pyrina* infestation in pear orchards neighboring and not-neighboring to casuarina trees at Borg el-Arab, Alexandria Governorate during 2015 and 2016 activity seasons.

Pear trees neighboring and not-neighboring to casuarina trees	Rate of infestation (%)		
	2015	2016	Mean
Mean casuarina trees infestation neighboring to pear trees	13	18	15.5
Mean pear trees infestation neighboring to casuarina trees	15	21	18
Mean pear trees infestation not neighboring to casuarina trees	7	9	8

On the contrary, pear trees far away and not neighboring to casuarina trees showed significantly lower rate of the borer infestation. The rate of infestation in pear trees not neighboring to casuarina trees ranged 7 – 9%, with a mean of 8%.

On the other hand, the rate of *Z. pyrina* infestation in casuarina trees neighboring to pear orchards ranged 13 – 18%, with a mean of 15.5% (Table 1).

The degree of *Z. pyrina* infestation showed obvious variation between different pear trees if they neighboring or non-neighboring casuarina wind break trees (Tables 2, 3 and 4) and Figures (1, 2 & 3).



2.The degree of *Z. pyrina* infestation in casuarina and pear trees:

a. The degree of *Z. pyrina* infestation in casuarina trees surrounding pear trees:

Data presented in Table (2) and Figure (3) indicated that casuarina trees are highly infested with *Z. pyrina* as they are susceptible host to the pest. Moths started emergency sometimes in April 2016 and in May 2015 and continued until November. Peak of moths emergency were in August with a mean of 0.12 moths / tree during 2015 but in September 2016 with a mean of 0.17 moths / tree.

Summer months showed that, the majority of moths' activity as the mean numbers of emerged moths were 0.28 and 0.42 pupal skins (emerged moths) / tree during 2015 and 2016, respectively. Less mean numbers of emerged beetles / tree were noticed in spring (0.07 and 0.11 moths / tree) and autumn (0.07 and 0.09 moths / tree) during the respective two years of study. Moths stopped emergence during winter months.

The grand means of emerged moths / tree / year were 0.42 and 0.57 pupal skins during the respective two years. The grand means of emerged moths / tree / season were 0.11 and 0.14 moths during the respective two years

Table 2. Mean number of *Z. pyrina* moths in casuarina trees surrounding pear orchards, at Borg el-Arab, Alexandria Governorate during 2015 and 2016 activity seasons.

Date of inspection	Mean no. of moths \ 100 casuarina trees surrounding pear orchards			
	2015	2016		
Winter	January	0	0	42
	February	0	0	42
	March	0	0	42
	Mean	0	0	
Spring	April	0	1	43
	May	2	3	46
	June	5	7	53
	Mean	7	11	
Summer	July	7	10	63
	August	12	15	78
	September	9	17	95
	Mean	28	42	
Autumn	October	6	8	103
	November	1	1	104
	December	0	0	104
	Mean	7	9	
Grand Total	42	57	104	
Grand Mean / tree / year	0.42	0.57	1.04	
Grand Mean/tree / season	0.105	0.1425	0.26	

b. The degree of *Z. pyrina* infestation in pear trees surrounded by casuarins trees:

Data obtained in Table (3) and Figure (1) revealed that pear trees highly infested with *Z. pyrina* when surrounded by casuarina trees as they are susceptible host to the pest as pear trees. Moths started emergency from pear trees (surrounded by casuarina trees) during April during the two years of study and continued mostly until November. Peak of moths emergency were mostly during August recording 0.16 and 0.19 moths / tree during 2015 and 2016, respectively.



Summer months recorded that the majority of moths' activity as the emerged moths were 0.36 and 0.50 moths / tree during 2015 and 2016, respectively. Less numbers of emerged moths / tree were noticed in spring (0.10 to 0.17) and autumn (0.09 to 0.10) in 2015 and 2016, respectively.

Moths stopped emergence during winter months.

The grand means of emerged moths / tree / year were 0.55 and 0.77 pupal skins during the respective two years. The grand means of emerged moths / tree / season were 0.14 and 0.19 pupal skins during the respective two years.

Table 3. Mean number of *Z. pyrina* moths in pear orchards, surrounded with casuarina trees, at Borg el-Arab, Alexandria Governorate during 2015 and 2016 activity seasons.

Date of inspection	Mean no. of moths \ 100 pear trees surrounding casuarina trees		
	2015	2016	
Winter	January	0	55
	February	0	55
	March	0	55
	Mean	0	0
Spring	April	1	57
	May	3	62
	June	6	72
	Mean	10	17
Summer	July	9	85
	August	16	104
	September	11	122
	Mean	36	50
Autumn	October	7	131
	November	2	132
	December	0	132
	Mean	9	10
Grand Total	55	77	132
Grand Mean / tree / year	0.55	0.77	1.32
Grand Mean / tree / season	0.1375	0.1925	0.33

c. The degree of *Z. pyrina* infestation in pear trees not-surrounded by casuarina trees:

Data presented in Table (4) and illustrated Figure (2) indicated that pear trees not-surrounded by casuarina trees are less infested with *Z. pyrina* than those surrounded by casuarina trees. Moths started emergency from pear trees (not-surrounded by casuarina trees) during April during the two years of study and continued mostly until October 2015 but November 2016. Peak of moths emergency were always during August recording 0.09 and 0.10 moths / tree during 2015 and 2016, respectively.

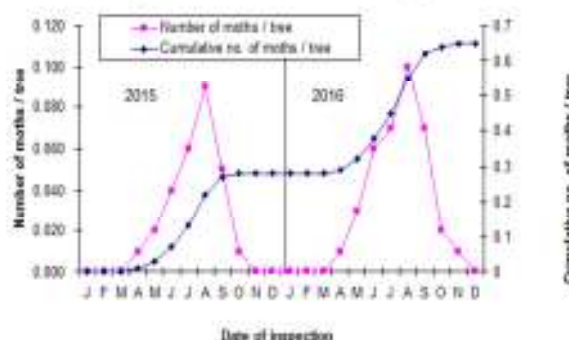
Table 4. Mean number of *Z. pyrina* moths in pear orchards, not-surrounded with casuarina trees, at Borg el-Arab, Alexandria Governorate during 2015 and 2016 activity seasons.

Date of inspection	Mean no. of moths \ 100 pear trees not surrounding casuarina trees		
	2015	2016	
Winter	January	0	28
	February	0	28
	March	0	28
	Mean	0	0
Spring	April	1	29
	May	2	32
	June	4	38
	Mean	7	10
Summer	July	6	45
	August	9	55
	September	5	62
	Mean	20	24
Autumn	October	1	64
	November	0	65
	December	0	65
	Mean	1	3
Grand Total	28	37	65
Grand Mean / tree / year	0.28	0.37	0.65
Grand Mean / tree / season	0.07	0.0925	0.1625

Summer months showed the majority of moths' activity as the emerged moths were 0.20 and 0.24 moths / tree during 2015 and 2016, respectively. Less numbers of emerged moths / tree were noticed in spring (0.07 to 0.10) and least in autumn (0.01 to 0.03) in 2015 and 2016, respectively. Moths stopped emergence during winter months.

The grand means of emerged moths / tree / year were 0.28 and 0.37 pupal skins during the respective two years. The grand means of emerged moths / tree / season were 0.07 and 0.0925 pupal skins during the respective two year

Figure (3). Mean numbers of *Z. pyrina* moths in pear orchards not-surrounded by casuarina trees, at Alexandria Gov. during 2015 and 2016.



3. Progress of infestation:

a. Progress of infestation in casuarina surrounding pear orchards:

Infestation in casuarina trees surrounding pear orchards much increased from one year to another. Table (2) and Figure (3) showed that the general mean number of emerged moths / tree / year increased from 0.42 at the end of 2015 season to 1.04 at the end of 2016 season. Thus infestation more than doubled (2.47 times) through only one year.

b. Progress of infestation in pear orchards surrounded by casuarina wind break trees:

Infestation in pear trees surrounded by casuarina wind break tree much increased from one year to another. Table (3) and Figure (1) showed that the general mean number of emerged moths / tree / year increased from 0.55 at the end of 2015 season to 1.32 at the end of 2016 season. Thus infestation more than doubled (2.40 times) through only one year.

c. Progress of infestation in pear orchards not-surrounded by casuarina wind break trees:

Infestation in pear trees not-surrounded by casuarina wind break tree also increased from one year to another. Table (4) and Figure (2) recorded that the general mean number of emerged moths / tree / year increased from 0.28 at the end of 2015 season to 0.65 at the end of 2016 season. Thus infestation more than doubled (2.32 times) through only one year.

Generally, infestation in pear orchards rapidly multiplied and increased more than twice at the end of only two years. These rapid increases impose the urgent need of control *Z. pyrina* especially when pear orchards are surrounded by infested casuarina wind break trees.

4. Seasonal cycle of *Z. pyrina* beetles activity months:

The seasonal cycle of *Z. pyrina* moths consisted of 7 – 8, 8, and 7 - 8 months of moths activity in casuarina wind break tree, pear orchards surrounded and not-surrounded with casuarina trees, respectively.

DISCUSSION AND CONCLUSION

Studies on the population fluctuation of insect pest, progress of infestation and seasonal cycle of *Z. pyrina* are essential to achieve effective "Integrated Control Programs" for the management of boring insect pest.

In Egypt, several authors gave biological, monitoring and control studies on *Z. pyrina*: Mokhtar (1978), Tadros et al. (1993), Shehata et al. (1995), Tadros et al. (2006-b), Tadros and Voerman (1994) and Tadros et al. (2006-a). In Israel, Moore and Navon, 1966, Navon, 1977, Vettori and Pasqualini (1997) and Navon et al. (1997), in Italy, Natale and Pasqualini (1999), Pasqualini et al. (1999) Vettori and Pasqualini (1997), in Greece Tsourgianni, 1995 and in Spain Garcia and Hero 1989.

Mostly, *Z. pyrina* started emergency during April / May, until October.

The present study affirmed the rapid increases and severity of *Z. pyrina* infestation were when pear orchards are surrounded by infested casuarina wind break trees; therefore they impose the urgent need of control of the borer in casuarina as well as in pear orchards.

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تأثير الإصابة بحفار ساق التفاح (*Zeuzera pyrina* (Lepidoptera: Cossidae) في أشجار الكازورينا علي حدائق الكمثرى المحيطة بها في مصر

راضي محمدي عبد المعطي ، صلاح محروس هاشم و أنطون ولسن تادرس
معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الجيزة - مصر

تم دراسة تأثير الحساسية النسبية للإصابة بحفار ساق التفاح بمعدل الإصابة (النسبة المئوية لعدد الأشجار المصابة) ودرجة الإصابة (عدد الفراشات التي أكملت دورة حياتها وخرجت من الأشجار المصابة خلال شهور السنة) في أشجار الكازورينا المحيطة بحدائق الكمثرى، وفي أشجار الكمثرى المجاورة لأشجار الكازورينا والأشجار الغير مجاورة لأشجار الكازورينا في منطقة برج العرب، محافظة الإسكندرية علي مدار عامين متتاليين (2015 & 2016). بلغ معدل الإصابة بالحفار في أشجار الكمثرى المجاورة لأشجار الكازورينا العام 18% (15 – 21%)، في حين انخفض معدل الإصابة بالحفار في أشجار الكمثرى الغير مجاورة لأشجار الكازورينا حيث بلغ 8% (7 – 9%)، أما معدل الإصابة بالحفار في أشجار الكازورينا المجاورة لأشجار الكمثرى فقد بلغ 15.5% (13 – 18%)، أما درجة الإصابة بالحفار في أشجار الكازورينا المحيطة لأشجار الكمثرى فقد كانت مرتفعة (0.5 فراشة / شجرة)، وأشجار الكمثرى المحاطة والغير محاطة بالكازورينا (0.66 & 0.325 فراشة / شجرة، علي التوالي). في جميع الأحوال وخلال علمي الدراسة بدأ خروج الفراشات خلال شهر أبريل وأحيانا في شهر مايو، واستمر حتي نوفمبر ونادرا خلال أكتوبر. تلاحظت معظم قم نشاط الفراشات خلال أغسطس، ونادرا سبتمبر. سجلت شهور الصيف أعلي نشاط للفراشات، في حين سجلت شهور الربيع أعدادا متوسطة، وشهور الخريف تعدادا متواضعا، أما شهور الشتاء فلم تسجل أي نشاط للحفار. تكونت الدورة الموسمية لنشاط الفراشات من 7 – 8 شهور فقط في حدائق الكمثرى وعلي أشجار الكازورينا علي حد سواء. وعموما فإن الإصابة بالحفار قد تضاعفت بسرعة أكثر من مرتين خلال عامين فقط في حدائق الكمثرى. هذه الزيادة السريعة والمطررة للإصابة تستوجب مكافحة هذه الآفة في حدائق الكمثرى وخاصة تلك المحاطة بمصدات الرياح من الكازورينا شديدة القابلية للإصابة بالحفار.