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EFFECT OF SOME ECOLOGICAL FACTORS ON POPULATION LEVEL OF *MACROTOMA PALMATA* L. (COL., CERAMBYCIDAE)

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Abstract

In Egypt, *Macrotoma palmata* F. (Col., Cerambycidae) is a very grave borer on manifold fruit and wood trees. At Alexandria area, it was found that casuarina (*Casuarina equistifolia*, orange (*Citrus sinenses*), apricot (*Prunus armeniaca*) and poinciana (*Poinciana regia*) are susceptible hosts of insect arranging descendingly as the rate of infestation.

In orange orchards, the following abstracts were concluded: The older trees harboured more infestation (2-8 beetles/tree) corresponding with younger trees which liabled (0-3 beetles/tree). The upper trunk, the lower trunk and the main branches were variably infested by *M. palmata;* resulting 1-5, 0-4 and 0-2 beetles/tree, respectively. The highest level of borer population (adult exit holes) was occurred on the eastern side in comparison with other cardinal directions of the orchard.

The adult beetles started to emerge during June and continued until September or October in 1996, 1997 and 1998. One peak of beetle emergence was recorded annually; in September 1996 (mean 2.90 beetles/tree), in August 1997 (mean 3.05 beetles/tree) under mean weather factors of 26.0-27.9°C and 70.0-73.2% R.H. The combined effect of day-maximum temperature, day-minimum temperature and daily-mean relative humidity highly affected beetle emergence. Repetition of infestation two years later raised the rate of infestation by 194%.

INTRODUCTION

Macrotoma palmata F. (Col., Cerambycidae) is very harmful and widely distributed borer on multi fruit, wood and ornamental trees in upper Egypt.

Larvae burrow deep longitudinal hudge tunnels into all wood tissues of trunk and thick branches of infested trees, causing their weakness, breakage and finally death.

Previous investigations on the biology, ecology and control of this pest were monitored by Mostafa (1977), El-Sebay (1984), Helal *et al.* (1987) and Tadros *et al.* (1993) and (1996). Mostafa found that adult beetles activity extended about 3 successive months from July to September on *Ficus nitida* at Alexandria. Tadros *et al.*

mentioned that *M. palmata* started to emerge during June and continued until October in apricot orchards at Alexandria and Giza Governorates and its development was influenced by temperature and relative humidity.

The present investigation was conducted to determine the effect of some ecological aspects including: host species, age, part and site of tree; as well as the influence of hygrothermic factors on the population level of *M. palmata* in orange orchards. This study contributes to apply good control on this insect-pest.

MATERIALS AND METHODS

The present work was generally conducted on apricot, casuarina and Poinciana trees and it was in ditail investigated in orange orchards in Alexandria district during the three consequtive years 1996 – 1998.

In order to study the population level of *M.palmata,* the following technique was monitored:

The estimated population levels of the insect was based on counting the exit holes which indicated number of emerged beetles. In late December 1995, the old exit beetle holes in all selcted trees of each experiment were painted with white paint. Starting from late January 1996, newly exit holes formed by recently emerged beetles were counted and the mean number of beetles/tree was determined at monthly intervals throughout the three successive years of 1996, 1997 and 1998.

Using the above technique the following points were investigated:

1. Effect of some ecological factors on the the population level of *M.palmata*

1.1. Effect of host tree: Four host spp. Of about 25 years old (orange; *Citrus sinenses*, apricot; *Prunus armeniaca*, casuarina, *Casuarina equistifolia* and poinciana; *Poinciana regia*) infested with *M. palmata* were subject for experimental work. In each year of study 1996, 1997 and 1998; hundred randomizely trees of each selected host were chosen to study the population level and to determine the host preference of insect.

1.2. Effect of age of tree: Three orchards of orange (*Citrus sinences*) of about; less than 10 years, 10-20 years and more than 20 years old were selected. In each year of study, 120 randomizely trees were marked in each orchard to determine the effect of tree age on its susceptibility to infestation.

1.3. Effect of part of tree: In each year of 1996, 1997 and 1998, out of 200 randomizely infested orange trees (about 25 years old) were used for that purpose. Each tree was marked into 3 parts, i.e., the lower trunk, the upper trunk and the main branches. Adult-exit holes were counted on each of tree marked part to defined the most part of tree which is obsessed for the insect.

1.4. Effect of site of tree: in 1996, an infested orange orchard (about 25 years old) was divided into 4 groups according to the cardinal directions (east, west, north and south). Hundred randomizely trees of each direction were utilized to check the direction which harboured the highest infestation. The same work was repeated in 1997 and 1998.

2. Population Fluctuation of *M. palmata*

Hundred heavily infested orange trees (*Citrus sinenses*) of about 25 years old were randomly selected during 1996-1998. Starting from January 1996 until December 1998, monthly inspections were carried out to count the newly holes of emerged beetles which were considered as the criteria for assessment of the beetles popuolation fluctuation. After each count, the old exit holes were painted to prevent count repeating.

The above experimental design was used to record:

2.1. First and last dates of adult emergence.

2.2. Peak of adult emergence.

2.3. Progress of infestation.

2.4. Effect of hygrothermic weather factors on the population level of adult emergence during the 3 years of study.

"C-multipliers formula" described by Fisher (1950) was used to explain the relation between temperature as well as relative humidity and rate of adult emergence. "F" test (Snedecor and Cochran, 1961) was calculated to check the relation between adult population and each of host tree, age of tree, part and site of tree.

RESULTS AND DISCUSSION

1. Effect of some ecological factors on the population level of *M. palmata*

Factors correlated with the age, part and site of tree, as well as the host species and their effect on the population level of *M. palmata* during the years 1996-1998 are shown in Table 1.

1.1. Effect of host species: Data indicated that casuarina: *Casuarina equistifoilia* was the most susceptible host for infestation (range 3-15, means 6.40-8.70 beetles/tree) followed by orange; *Citrus sinenses* was relatively less susceptible (range 1-8, means 3.60-4.80 beetles/tree) then apricot; *Prunus armeniace* (range 0-3, means 1.05-1.80 beetles/tree) and poiniciana; *Poinciana regia* (range 0-2, means 0.75-1.50 beetles/tree) were subjected for low infestation during the years of 1996, 1997 and 1998. Accordingly, casuarina is considered the most preferred host for insect.

Table 1. Effect of age, part and site of orange tree, as well as the host species on the population level of *M. palmata* in Alexandria during 1996-1998.

Years	Number of emerged adults/tree				F	P	L.S.D.	
	Age of tree/years							
	Less than 10	From 10 to 20		More than 20			0.05	0.01
1996	0.15 (0-1)	1.20 (0-3)		3.60 (1-6)	22.70	0.01	1.82	2.68
1997	0.10 (0-1)	1.50 (1-3)		4.35 (2-7)	23.63	0.01	2.58	3.80
1998	0.25 (0-1)	1.35 (1-3)		4.80 (2-8)	40.92	0.01	1.82	2.68
	Part of tree							
	Lower trunk	Upper trunk		Main branches				
1996	2.15 (1-4)	3.55 (2-5)		0.95 (0-2)	19.93	0.01	1.43	2.10
1997	1.35 (0-3)	3.15 (2-5)		0.60 (0-1)	46.42	0.01	0.94	1.39
1998	1.71 (1-3)	2.35 (1-4)		0.90 (0-2)	11.68	0.01	1.04	1.53
	Site of tree							
	North	South	East	West				
1996	0.80 (0-2)	0.90 (0-2)	2.05 (1-4)	0.70 (0-2)	11.10	0.01	0.90	1.30
1997	0.75 (0-1)	0.50 (0-1)	1.80 (1-3)	0.70 (0-2)	16.73	0.01	0.69	1.00
1998	1.00 (0-2)	0.80 (0-2)	2.40 (1-5)	0.60 (0-1)	36.08	0.01	0.66	0.95
	Host species							
	Orange	Apricot	Casuarina	Poinciana				
1996	3.60 (1-6)	1.80 (0-3)	6.60 (3-12)	1.15 (0-2)	26.38	0.01	2.29	3.32
1997	4.35 (2-7)	1.75 (0-3)	6.40 (4-13)	0.75 (0-1)	22.59	0.01	2.59	3.76
1998	4.80 (1-8)	1.05 (0-2)	8.70 (4-15)	1.50 (0-2)	46.06	0.01	2.52	3.65

1.2. Effect of age of tree: Results declared that age of orange tree affected greatly the level of insect population. During the consequent years of 1996, 1997 and 1998, trees less than 10, from 10 to 20 and more than 20 years old were infested by (range 0-1, means 0.10-0.25 beetles/tree), (range 0-3, means 1.20-1.50 beetles/tree) and (range 1-8, means 3.60-4.80 beetles/tree), respectively. Thus, the older trees were more susceptible to infestation than younger ones.

1.3. Effect of part of tree: Data showed that the wooden parts of orange tree (lower trunk, upper trunk and main branches) were exposed with variant levels of infestation. The upper trunk harboured the highest population (range 1-5, means 2.35-3.55 beetles/tree), while the main branches got the lowest population (range 0-2, means 0.60-0.95 beetles/tree), whereas population on the lower trunk was generally intermediate between upper trunk and main branches (range 0-4, mean 1.35-2.15 beetles/tree) during the 3 years of the study.

1.4. Effect of site of tree: An orchard of orange was devided into four locations according to the four cardinal directions (north, south, east and west). Results recorded during 1996, 1997 and 1998 showed that, trees cultivated at the east direction liabled the highest number of insects (range 1-5, means 1.80-2.40 beetles/tree) followed by trees at the north, south and west directions, which were subjected to low number of insects (range 0-2, means 0.75-1.00 beetles/tree), (range 0-2, means 0.50-0.90 beetles/tree) and (range 0-2, means 0.60-0.70 beetles/tree), respectively.

However, statistical analysis emphasized that all the factors (host species, age, wooden part and site of tree) significantly affected the population of *M. palmata*.

2. Population fluctuation of *M. palmata* beetles

Population fluctuation of *M. palmata* was studied on orange trees (*Citrus sinenses*) under prevailing weather factors in Alexandria district throughout the three successive years of 1996, 1997 and 1998.

2.1 Seasonal abundance: Data are given in Table 2 and the attendant figure indicated that the adult beetles emerged in orange orchards for a period of 4-5 months (June-September or October) under mean weather factors (21.9-27.9ºC and 68.0-75.5% R.H.). Hence, the adult beetles emergence stopped during a period from October or November to May during the three years of study. The population of *M. palmata* was generally low (0.50-0.90 beetles/tree) in June (23.8-24.4ºC and 68.0-69.5% R.H.) in 1996, 1997 and 1998 and in October (21.9-22.0ºC and 68.8-70.0% R.H.) in 1996

Table 2. Population fluctuation and cumulative numbers of *Macrotoma palmata* beetles emerged in orange orchards corresponding with hygrothermic weather factors in Alexandria during 1996, 1997 and 1998.

Year	Date	Monthly no. of beetles emerged / tree		Mean weather factors			
				Temperature, °C			R.H.
		Actual	Cumulative	Max.	Mean	Min.	%
1996	May	0.00	0.00	27.0	22.4	17.8	67.3
	Jun.	0.75 (0-1)	0.75	27.7	23.8	19.8	69.5
	Jul.	1.10 (0-2)	1.85	29.7	25.7	21.7	71.4
	Aug.	2.30 (1-3)	4.15	29.8	26.0	22.2	72.8
	Sep.	2.90 (1-5)	7.05	30.5	26.5	22.5	73.2
	Oct.	0.50 (0-1)	7.55	26.2	22.0	17.8	70.0
	Nov.	0.00	7.55	23.8	19.3	14.8	66.2
1997	May	0.00	7.55	26.7	21.2	15.7	67.0
	Jun.	0.65 (0-1)	8.20	28.0	24.3	19.6	69.5
	Jul.	1.80 (1-3)	10.00	28.9	25.6	22.2	74.3
	Aug.	3.05 (2-5)	13.05	29.7	26.0	22.3	70.5
	Sep.	1.10 (0-2)	14.15	27.8	22.9	18.0	70.0
	Oct.	0.50 (0-1)	14.65	26.8	21.9	16.9	68.8
	Nov.	0.00	14.65	23.8	19.3	14.7	64.0
1998	May	0.00	14.65	27.8	23.2	18.5	64.3
	Jun.	0.90 (0-2)	15.55	28.2	24.4	20.5	68.0
	Jul.	2.05 (1-3)	17.60	30.9	26.9	22.9	75.5
	Aug.	3.50 (1-6)	21.10	31.5	27.9	24.2	72.3
	Sep.	1.10 (0-2)	22.20	30.6	26.6	22.9	70.0
	Oct.	0.00	22.20	28.3	23.8	19.2	67.5

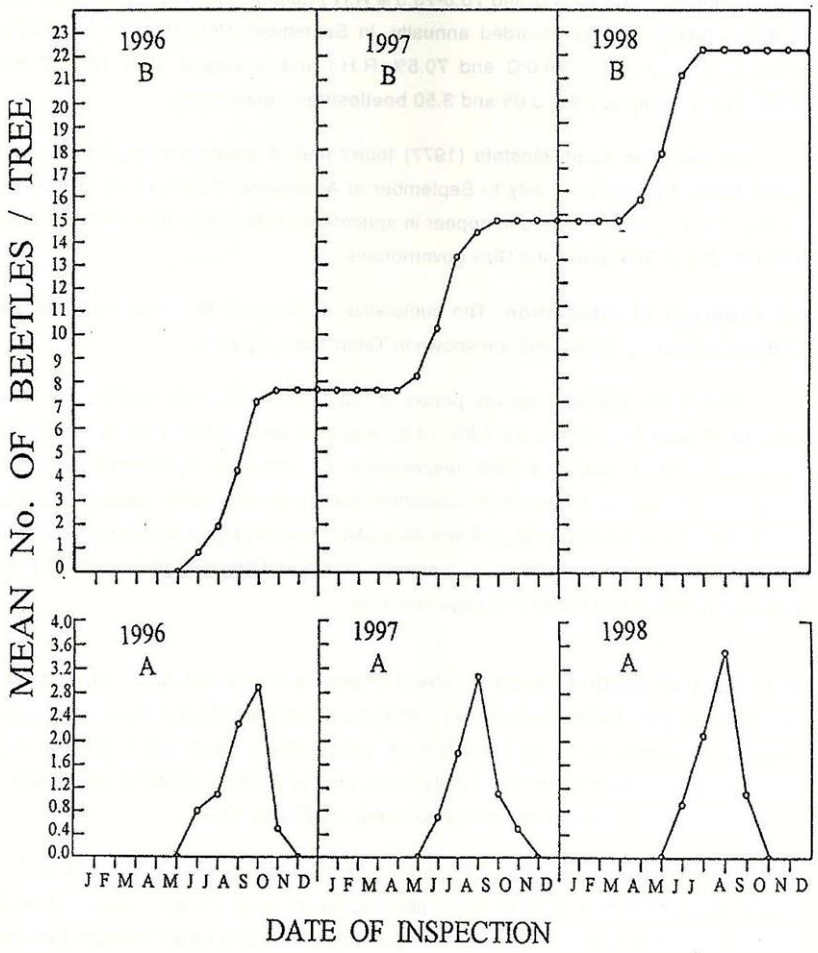

Fig.1. Actual (A) and Cumulative mean numbers (B) of *Macrotoma palmata* on orange trees in Alexandria during 1996-1998.

and 1997. The main period of adult emergence (1.10-3.50 beetles/tree) occurred in July-September (22.9-27.9°C and 70.0-75.5% R.H.) during 1996-1998. One peak only of adult emergence was recorded annually, in September 1996 (26.5°C and 73.2% R.H.), in August 1997 (26.0°C and 70.5% R.H.) and in August 1998 (27.9°C and 72.3% R.H.) resulting 2.90, 3.05 and 3.50 beetles/tree, respectively.

On the other hand, Mostafa (1977) found that *M. palmata* emerge from *Ficus nitida* during a period from July to September at Alexandria. Tadros *et al.* (1993) recorded that *M. palmata* started to appear in apricot orchards during June and continued until October at Alexandria and Giza governorates.

2.2 Progress of infestation: The cumulative numbers of *M. palmata* beetles per orange tree during 1996-1998 are shown in Table 2 and figure 1.

During the seasonal activity period of adult emergence, the cumulative mean number of adult emerging were 7.55, 14.65 and 22.2 beetles/tree throughout the initial years of 1996, 1997 and 1998, respectively. So, repetition of infestation one and two years later increased the adult population level by 94 and 194%, respectively. This great increase in the rate of *M. palmata* infestation year after year is danger parameter of this pest on fruit and wood trees, that needs rapid and effective management to reduce the population of insect in orange orchards.

2.3 Effect of weather factors: Table 3 shows the simple correlation (r), simple regression (b), partial regression (p. reg.), analysis of variance (F) and the percentage of explained variance (E.V.) of the effect of day-maximum temperature (DMxT), day-minimum temperature (DMnT) and daily-mean relative humidity (DMRH) on the rate of *M. palmata* beetle emergence throughout 1996, 1997 and 1998.

2.3.1. Effect of DMxT: The direct effect (simple correlation "r") of DMxT on beetle emergence was positive and highly significant in the three seasons of study. Simple regression values indicated that an increase of 1°C in DMxT increased the rate of adult emergence by 0.15-0.18 beetles/tree during 1996-1998.

The true effect (partial regression p. reg.") of the DMxT on the rate of adult emergence was insignificant in 1996, 1997 and 1998.

2.3.2 Effect of DMnT: The direct effect of (r) of DMnT on beetle emergence was positive and highly significant during the three years of investigation. Simple regression values showed that an increase of 1°C in DMnT increased the population by

0.14-0.16 beetles/tree during 1996, 1997 and 1998. Partial regression indicated that the real effect of DMnT on beetle emergence was insignificant in 1996 and 1998, while it was significant in 1997.

2.3.3. Effect of DMRH: The direct effect (r) of DMRH on beetle emergence was also positive and highly significant during each year of study. Simple regression coefficients showed that an increase of 1% R.H. raised the insect population by 0.22, 0.14 and 0.18 beetles/tree in 1996, 1997 and 1998, respectively. The true effect (p. reg.) of DMRH was insignificant during 1996-1998.

2.3.4. The combined effect of DMxT, DMnT and DMRH: The analysis of variance (F) for the combined effect of three weather factors (DMxT, DMnT and DMRH) together on the rate of adult emergence were highly significant during 1996, 1997 and 1998. Concerning the percentage of explained variance (E.V.), it could be emphasized that the three weather factors roled distinct effect on the rate of beetle emergence ranged from 67.2 to 73.2% in orange orchards during 1996-1998. There is no doubt that, the present ecological results could be good helpful for control managements against this insect pest in orange orchards.

Table 3. Simple correlation (r), simple regression (b), partial regression (p. reg.), analysis of variance (F) and percentage of explained variance (E.V.) of day-maximum termperature (DMxT), day-minimum temperature (DMnT) and daily-mean relative humidity (DMRH) affecting the rate of *M. palmata* adult beetles emerged in orange orchards, Alexandria, during 1996, 1997, 1998.

Years	Weather factor	r	b	p. reg.	F	E.V. %
1996	DMxt	+ 0.76196**	+ 0.178	- 0.43387	11.995**	72.7
	DMnt	+ 0.78677**	+ 0.156	+ 0.26166		
	DMRH	+ 0.84027**	+ 0.221	+ 0.57157		
1997	DMxt	+ 0.73322**	+ 0.150	- 0.55617	12.267**	73.2
	DMnt	+ 0.82952**	+ 0.145	+ 0.75227*		
	DMRH	+ 0.66003**	+ 0.141	- 0.00067		
1998	DMxt	+ 0.66033**	+ 0.146	- 0.48929	9.300**	67.2
	DMnt	+ 0.73329**	+ 0.142	+ 0.52551		
	DMRH	+ 0.78399	+ 0.176	+ 0.23317		

** Highly significant * Significant

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تأثير بعض العوامل الإيكولوجية على نشاط حفار ساق السنط *Macrotoma palmata* F.

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يشتمل هذا البحث على دراسة تأثير بعض العوامل البيئية الهامة على نشاط حفار ساق السنط على بعض عوائله من الأشجار الخشبية وأشجار الفاكهة مع التركيز على أشجار البرتقال فى منطقة الإسكندرية خلال الأعوام ٩٦، ٩٧، ١٩٨٨ .

أوضحت نتائج الدراسة أن العوامل الخاصة بنوع العائل، وعمر الأشجار، والجزء المعرض للإصابة من الشجرة وكذلك موضع الأشجار فى الحديقة تأثيراً معنوياً عالياً على تعداد الحشرة على الأشجار. فقد وجد أن أشجار الكازوارينا أكثر العوائل تفضيلاً للحشرة يليها أشجار البرتقال ثم أشجار المشمش، بينما كانت أشجار البوانسيانا أقلهم حساسية للإصابة.

وفى دراسة لنشاط هذا الحفار فى حدائق البرتقال تبين الآتى:

كانت الأشجار الأكبر عمراً أكثر تعرضاً للإصابة (٢ - ٨ حشرة/الشجرة) مقارنة بالأشجار صغيرة العمر (صفر - ٣ حشرة/الشجرة). كذلك تفاوتت درجة الإصابة تبعاً للجزء من الشجرة القابل للإصابة، فكان تعداد الحفار كبيراً فى الجزء العلوى من الجزع يليه الجزء السفلى منه أما الأفرع الرئيسية كانت أقلهم إصابة حيث سجلت نتائج التعداد (١ - ٥)، (صفر - ٤)، و(صفر - ٢) حشرة/الشجرة على الترتيب. تبين أيضاً أن الأشجار المزروعة فى الناحية الشرقية من الحديقة قد أختصت بأعلى درجة إصابة مقارنة بالأشجار الموجودة فى الجهات الرئيسية الأخرى فى نفس البستان.

وعن النشاط الموسمى لهذا الحفار فى حدائق البرتقال خلال سنوات الدراسة الثلاثة، وجد أن بداية خروج الحشرات الكاملة فى يونيو ويستمر حتى سبتمبر أو أكتوبر، وفى خلال هذه المدة سجلت قمة نشاط واحدة تراوح فيها متوسط تعداد الحشرات الكاملة، ٢,٩٠ - ٣,٥٠ /الشجرة خلال أغسطس أو سبتمبر من كل عام عند متوسطات الحرارة والرطوبة ٢٦,٠ - ٢٧,٩ م° و ٧٠,٠ - ٧٣,٢ ٪. هذا وقد تأثر معدل خروج الحشرات الكاملة تأثراً معنوياً كبيراً تحت التأثير المشترك لعوامل الحرارة والرطوبة معاً. وجد كذلك أن تكرار الإصابة لمدة عامين متتالين أدى إلى إرتفاعها بنسبة ١٩٤ ٪ وهذا يبين مدى خطورة هذا الحفار وضرورة التدخل السريع للحد من انتشاره فى حدائق البرتقال.