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MONITORING THE POPULATION OF THE SHOT-HOLE BARK-BEETLE, *SCOLYTUS AMYGDALI* GUER. (COLEOPTERA : SCOLYTIDAE) ON PEACH WITH SPECIAL REFERENCE TO ITS HOSTS IN EGYPT

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Abstract

The shot-hole bark-beetle, *scolytus amygdali* Guer. is a major polyphagous pest in Egypt attacking fruit, wood and ornamental trees. Peach orchards however are liable to attack by this pest. Hosts and rates of infestation in each governorate were recorded. The seasonal fluctuation in the population was monitored on peach trees in Alexandria and Giza governorates throughout the three successive years 1987, 1988 and 1989. Beetle emergence started during February - March and continued until December. Beetle emergence is affected with the temperature and relative humidity at the time of emergence as well as during 0.5 - 1.5 months before emergence. Periods of occurrence and peaks of annual broods were approximated.

INTRODUCTION

The shot-hole bark- beetle, *Scolytus amygdali* Guer. was first recorded in Egypt by Willcocks (1924) as a pest in peach, apricot, plum, almond, apple and pear orchards. The pest is also distributed allover the Mediterranean Sea area. *S. amygdali* was studied on almond by Abd -Allah (1978), on apricot by Tadros and Abd - Allah (1987) and on plum by Girgis (1987).

The present investigation deals with the ecology of this pest in peach orchards

aiming at estimating the rate of infestation on peach trees as well as on other fruit trees. This would help determine the proper time for insecticidal application in peach orchards.

MATERIALS AND METHODS

A. Host range and distribution of Infestation

During the period from 1980 to 1990, fruit trees hosting *S. amygdali* were recorded in the different governorates of Egypt. Five peach orchards in each governorate were subjected to the survey studies of infestation by counting the number of infested trees /100 randomly distributed trees in each orchard. The increase of rate of infestation was determined in 3 orchards in both Alexandria and Giza governorates. Infestation was assessed twice , the first during January 1987 and the second during January 1990.

B. Population Fluctuation

The follow up of the population fluctuation of *S. amygdali* took place from January 1987 until December 1989. The study was carried out on 10 infested peach trees of about 15 years-old located at Mariout, Alexandria and at El - Saff, Giza governorates. The criterion considered for the assessment of the population was the number of exit holes /1 meter/tree. In december 1986, all old exit and enterance holes on the stem and main branches of the selected trees were marked with spray paint. Population assessment was practiced twice a month (on the 15th $\pm$ 1 and the last $\pm$ 1 day of each month). To avoid repeated counting, the counted exit holes as well as enterance holes were marked with the paint after each inspection. In order to study the progress of infestation. the data were cumulated monthly, then each year.

C. Effect of Weather Factors on Beetle Emergence

The effect of three weather factors; the day - maximum temperature (DMxT), day - minimum temperature (DMnT) and daily-mean relative humidity (DMRH) on the rate of emergence of *S. amygdali* beetles were studied during the three successive years, 1987, 1988 and 1989. To smooth down the population frequence distribution curves to an almost normal form , 3-reading running means of

both population and weather data were worked out. To study the effect of the current, as well as previous weather conditions on the rate of beetle emergence , the direct effect (simple correlation), the precise effect (partial regression), analysis of variance and explained variane of the weather factors on the rate of beetle emergence were calculated at 0 (the same time of emergence) , 0.5, 1.0, 1.5, 2, 2.5, ... etc. months before beetle emergence according to the "C- multipliers " formula described by Fisher (1950) . Periods that revealed significant coefficients combined with maximum explained variance were regarded as the optima for the effect of the three weather factors on the rate of beetle emergence.

RESULTS AND DISCUSSION

A. Host Range and Distribution of Infestation

1. Host range

Table 1 shows the different host plants of *S. amygdali*, their scientific names, locations and recording dates. Willcocks (1924) recorded peach, apricot, plum, almond, apple and pear trees as host plants to the pest. Moreover, the present survey whcih was carried out during the period 1980-1990 represents the first record of *S. amygdali* on 11 hosts i. e., quince, nectarin, pecan, loquat, olive, pomegranate, annonas, sweet orange, carob, jujube and persimmon.

2. Distribution of infestation

Infestation with *S. amygdali* is prevailing in peach orchards allover the governorates of Egypt from the extreme north to the extreme south as well as Sinai where more than 80% of peach plantation exists .

Table 2 indicates that the rate of infestation ranged from 0 to 99% with a general average of 21.6% . The maximum rates of infestation (37.0 - 56.6%) were reported from Dakhlia, Menofia and Behera governorates. Moderate infestations were found in Giza , Qalubia, Alexandria, North Sinai, Ismailia and Sharkia governorates (20.8 - 31.4%) . The other governorates showed light infestation (4.4 - 18.6%).

During January 1987, the rate of infestation was 14.3 and 12.3 % in Alexan-

Table 1. Host Plants of *S. amygdali* in Egypt.

No.	English name	Scientific name	Locality.	Author	Year
1	Peach	*Prunus persica*	---	Willcocks	1924
2	Apricot	*Pr. arminiaca*	---	"	"
3	Plum	*Pr. Triflora*	---	"	"
4	Almond	*Pr. amygdalus*	---	"	"
5	Apple	*Pyrus Malus*	---	"	"
6	Pear	*Py. Communis*	---	"	"
7	Quince	*Py. Cydonia*	Damietta	Present survey	1980
8	Nectarin	*Pr. persica nectarina*	Giza	" "	1981
9	Pecan	*Carya illinoesis*	Qalubia	" "	"
10	Loquat	*Eriobotrya japonica*	Alexandria	" "	1985
11	Olive	*Olea europea*	Fayoum	" "	1986
12	Pomegranate	*Punica granatum*	Matrouh	" "	"
13	Annonas	*Annona squamosa*	Alexandria	" "	"
14	Sweet orange	*Citrus sinensis*	Suez	" "	"
15	Carob	*Ceratonia siliqua*	Alexandria	" "	1987
16	Jujube	*Zizyphus vulgaris*	Suez	" "	1989
17	Persimmon	*Diospyrus Kaki*	Behera	" "	1990

Table 2. Percentages of *S. amygdali* infestation in peach orchards allover the governorates of Egypt.

Governorate	% Infestation		Governorate	% Infestation	
	Average	Range		Average	Range
Matrouh	16.2	0 - 32	Giza	31.4	12 - 49
Alexandria	28.6	15 - 43	Fayoum	4.4	0 - 8
Kafr El-Sheikh	9.6	0 - 17	Beni-Seuf	6.8	0 - 19
Damietta	10.4	0 - 18	Minia	3.2	0 - 6
Behera	37.0	19 - 87	Assiut	5.0	0 - 7
Gharbia	42.2	18 - 64	Sohag	14.6	6 - 23
Dakahlia	56.6	12 - 81	Quena	18.6	0 - 35
Skarkia	20.8	0 - 66	Aswan	6.8	0 - 10
Ismailia	25.2	0 - 72	North Sinai	25.4	0 - 46
Menofia	35.4	8 - 99	South Sinai	7.4	0 - 12
Qalubia	29.6	13 - 46			

General average : 21.58 %
General range : 0 - 99%

dria and Giza governorates , respectively.

Repeated inspection in the same localities during January 1990, showed respective increase in the rate of infestation , reaching 82.3 and 79.7%. Thus, infestation increased almost 5.8 and 6.5 times throughout the three years. Such wide range of hosts and wide spread of the pest in peach orchards is a serious indication for an urgent control programme in peach orchards.

B. Population Fluctuation

Figure 1 shows the average number of exit holes / selected tree (the average number of emerged beetles /tree) as well as the cumulative averages of exit holes / tree in peach orchards in Alexandria and Giza governorates throughout the three years of study (1987, 1988 and 1989).

1. Seasonal abundance

The average number of emerged beetles / tree (represented by 1 meter long) / year was relatively higher in Giza (55.8, 51.2 & 63.2 beetles) than in Alexandria (45.0 , 41.6 & 52.7 beetles) during 1987, 1988 and 1989, respectively .

The first and last dates of beetle emergence as well as the peaks of emergence in the two considered localities for the three years are presented in Table 3. Data showed that *S. amygdali* beetles started to emerge during February in mid - Egypt (Giza) and March in north -Egypt (Alexandria) . Beetles ceased to emerge during January in Giza and January and February in Alexandria. There were 4-5 peaks during the year existing mostly during April - May , May - July, July - August , August - September and October - November.

Accordingly , the best timing for insecticidal application in peach orchards would be in early March in mid - Egypt, and extending to late March or early April in the north.

2. Progress of infestation

Figure 1 illustrates the seasonal cycle of *S. amygdali* beetles in peach orchards which consists of an activity season that lasted for about 10-11 months (from February or March to December)followed by an inactivity period for about 1-2 months (January or both January and February).

The initial number of beetles that emerged from samples collected from peach tree in December 1987 was 45.0 and 55.8 beetles / sample / tree in Alexandria and

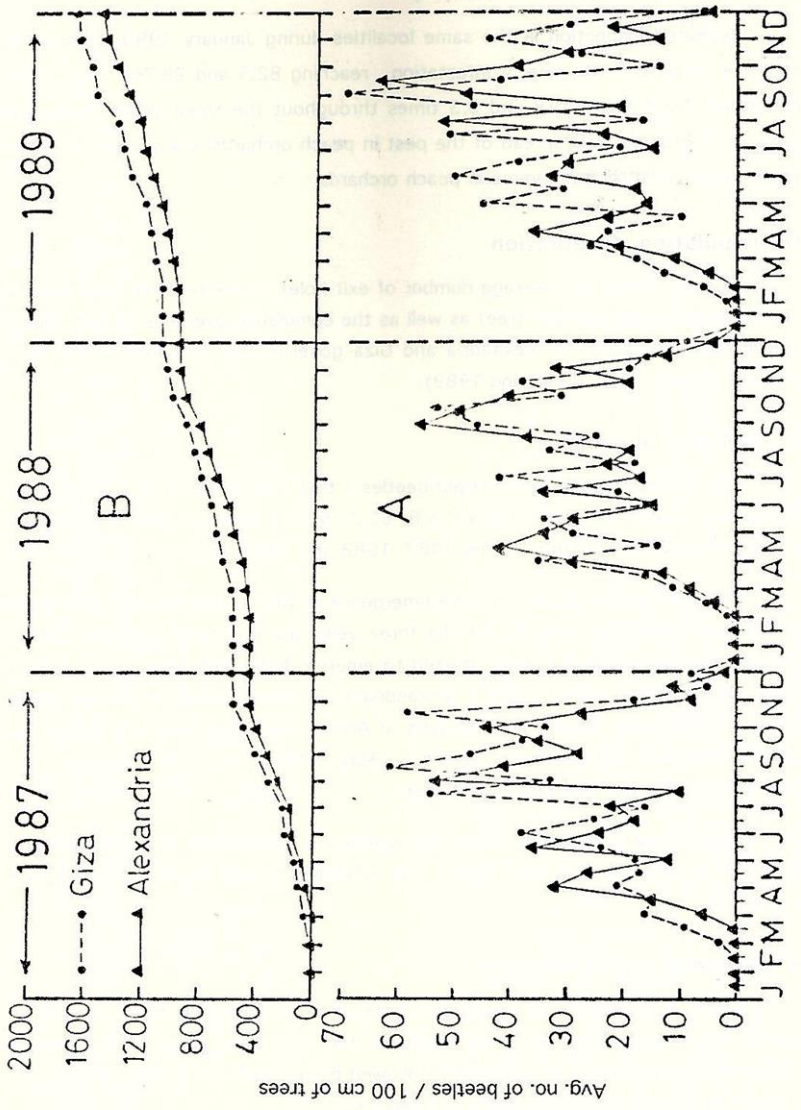

Fig. 1. Actual (A) and Cumulative (B) number of *S. amygdali* beetles during 1987, 1988 & 1989 in Giza and Alexandria.

Table 3. First , peaks and last dates of beetle emergence of *S. amygdali* in Giza and Alexandria governortes.

Year	First date	Last date	Peaks
Giza governorate :			
1987	Feb. (2)	Dec. (2)	Apr. (2) , Jun (2). Aug. (1), Sep. (1) & Nov. (1)
1988	Feb. (2)	Dec. (2)	Apr. (2), Jun (1) July (2), Aug. (2) & Oct. (1)
1989	Feb. (1)	Dec. (2)	Apr. (1), May (2) June -(2) Aug. (1), Sep.(2) & Nov (2)
Alexandria governorate :			
1987	Mar. (2)	Dec. (2)	Apr. (2) , Jun (1). Aug. (2), & Oct. (2)
1988	Mar. (1)	Dec. (2)	May. (1), Jul (1) Aug. (1) , Sep. (2) & Nov. (2)
1989	Mar. (1)	Dec. (2)	Apr. (2), Jun (2) Aug. (2), & Oct. (1)

(1) = First half of the month (1-15)
(2) = Second half of the month (16-30).

Giza governorates, respectively. One year later, in 31 December 1988, the respective cumulative number became 96.6 and 107 beetles , showing an increase of about 2.1 and 1.9 times throughout one year. In 31 December 1989 , the respective number jumped to 149.3 and 170.2 beetles, indicating that the rate of emerged beetles increased almost 3.3 and 3.1 times throughout the two years.

C. Effect of Weather Factors on Beetle Emergence

Although there is an obvious effect of weather factors at or just before - the time of beetle emergence on the rate of emergence which is mainly dirceted to the pupal stage; yet, the larvae of *S. amygdali* spend their duration (about 22-87 days) under the bark, thus non - exposed to the direct effect of weather. Therefore, it is speculated that the role of the weather at or just before the time of beetle emergence on the rate of emergence is somewhat limited. Apparently, beetle emergence seems to be more likely affected with the weather conditions prevailing before emergence. Trials to spot the optimun period preceding beetle emergence that revealed the strongest effect on the rate of emergence indicated that this rate was much influenced with temperature and relative humidity 0.5 - 1 and 1 - 1.5 months before emergence in Alexandria and Giza governorates, respectively.

Table 4 shows the simple correlation (r) , partial regression (P. reg.), analysis of variance (F) and percentages of explained variance (E.V.) of the DMxT, DMnT and DMRH on the rate of *S. amnygdali* beetles which emerged during 1987, 1988 and 1989 at the two localities.

1. Effect of day - maximum temperature (DMxT)

Table 4 indicates that the direct effect (r) of DMxT at the same time or 0.5 - 1.5 months before emergence on the rate of emergence was positive and significant throughout the three years of study at the two localities.

The true effect (P. reg.) of DMxT at the same time of emergence on the rate of emergence was insignificant during the three years at the two localities except during 1988 in Giza . During the period of maximum effect of DMxT on emergence (at 0.5 - 1.5 months before emergence), the effect was significant during 1987 and 1988 in Giza , while the other years showed insignificant differences.

2. Effect of the day - minimum temperature (DMnT)

As shown in Table 4 , the direct effect (r) of DMnT at the same time or 0.5 -

1.5 months before emergence on the rate of emergence was positive and significant throughout the three years of study in the two localities.

Partial regressions emphasized that the real effect of DMnT at the same time of beetle emergence on beetle emergence was insignificant during the three years at the two localities, except during 1988 in Giza. When combined with the maixmum explained variance, the real effect of DMnT at 0.5 - 1.5 months was only signifcant during 1987 and 1988 in Giza, while the other periods were insignificant.

3. effect of the daily - mean relative humidity (DMRH)

Data in Table 4 indicate that the direct effect (r) of DMRH at the same time of emergence or 0.5 - 1.5 months before emergence was insignificantly positive or negative except during 1988 at 1.5 months before emergence in Giza (Significant and negative).

True effect (P.reg.) of DMRH at the same time of beetle emergence on the rate of emergence was significant during 1987 in Alexandria and during 1987 and 1988 in Giza. The other years however were insignificant. When matched with the maximum explained variance , the true effect of DMRH at 0.5 - 1.5 months before emergence was significant during 1987 and 1988 in both Alexandria and Giza, while 1989 showed insignifcant difference.

4. The combined effect of the three weather factors

The simultaneous effect of DMxT, DMnT and DMRH at the same time of beetle emergence as well as at 0.5 - 1.5 months before emergence on the rate of emergence was highly significant during the three years of study at the two localities (Table 4). Almost 45 - 71 % and 63 - 91% of the variability in the rate of beetles emergence could be attributed to the changes in the three tested weather factors at the same time of emergence and 0.5 - 1.5 months before emergence, respectively. These results indicate that the activity of *S. amygdali* beetles is related to the combined action of the weather factors rather than to the single effect of each factor separately.

It can be concluded that the effect of temperature and relative humidity is mainly directed to the pupal stage and the beetles during the hardening period in the pupal chamber just before emergence (during February in mid - Egypt and March in the north). At 0.5 - 1.5 months before emergence, the effect of the weather factors is mainly directed to the larvae (during January in mid - Egypt and February in the

Table 4. Simple correlation (r) , partial regression (P. reg.), analysis of variance (F) and Percentages of explained variance (E.V.) of DMxT, DMnT and DMRH on the number of emerged beetles of *S. amygdali* in Alxexndria and Giza governorates during 1987 - 1989 and 1989.

Year	Period (month)	DMxT		DMnT		DMRH		F	E. V. (%)
		(r_1)	P_1. reg	(r_2)	P_2. reg	(r_3)	P_3. reg		
Alexandria governorate:									
1987	0	+ 0.75**	+ 1.48	+0.69**	+1.17	+0.002	- 1.34 *	21**	71
	0.5	+ 0.78**	+ 2.25	+0.75**	+0.59	+0.16	- 1.08 *	20**	71
1988	0	+ 0.59**	+3.90	+0.52**	- 1.87	- 0.27	-0.81	7**	45
	1	+ 0.64**	- 3.86	+0.65**	+ 5.85*	+0.03	-2.64**	14**	63
1989	0	+0.64 **	+ 8.36	+ 0.61 **	-5.36	+0.09	+1.89	8**	47
	0.5	+ 0.78 **	+6.31	+ 0.74 **	- 3.29	+0.13	+1.02	14**	63
Giza governorate									
1987	0	+ 0.63**	+ 3.83	+0.69 **	- 1.64	+0.12	+ 1.23 *	13**	59
	1	+0.87**	- 4.69**	+0.92 **	+7.06**	- 0.03	- 0.75*	87**	91
1988	0	+ 0.57**	+12.1 **	+ 0.59 **	- 10 .6 *	-0.04	+ 2.79**	13**	59
	1.5	+0.79**	-7.02	+ 0.82	+ 8.38 **	-0.46*	- 1.40*	30**	77
1989	0	+ 0.64**	+3.19	+0.72 **	- 1.19	+0.01	+1.11	13**	59
	1	+0.83**	- 4.42	+0.84 **	+ 6.24	- 0.38	- 1.14	27**	75

0 month = at the same time of beetle emergence .
0.5 - 1.5 month = 0.5 , 1 & 1.5 months before beetle emegence.
* & ** = significant & highly significant differences , respectively.

north). Thus, according to the weather factors of January and February (or 0.5 - 1.5 months before emergence) one can predict the possible activity of *S . amygdali* beetles afterwards.

REFERENCES

1 . Abd - Allah, F. F. 1978. Studies on the shot- hole borer, *Scolytus amygdali* Guer., and its control. M. Sc. Thesis, Fac. of Agric., Cairo Univ.

2 . Fisher, R. A. 1950. Statistical methods for research workers. Oliver and Boyd Ltd., Edinburgh, London.

3 . Girgis, G.N. 1987. Studies on some Scolytids in Egypt. Ph. D. Dissertation , Fac. of Agric., Menofia Univ.

4 . Tadros, A. W. and F. F. Abd -Allah 1987. The seasonal fluctuation in the population density of the shot - hole bark- beetle, *S. amygdali* on apricot in Egypt. 12th International Cong. for Statistics, Computer Science, Social and Demographic Res. Bull., pp. : 391 - 400.

5 . Willcocks, F.C. 1924. A survey of the more important economic insects and mites of Egypt. Bull Sul. Agric. Soc. Tech., 1.

تتبع تعداد خنافس قلف الحلويات *Scolytus amygdali* علي اشجار الخوخ وعوائل الحشرة المختلفة في مصر

انطون ولسن تادرس

معهد بحوث وقاية النبات – مركز البحوث الزراعية – الدقي

تعتبر خنافس قلف الحلويات من الافات الحشرية متعددة العوائل في مصر ، حيث تهاجم اشجار الفاكهة والزينة والاشجار الخشبية، هذا وتعاني حدائق الخوخ من اصابات شديدة خاصة في مناطق تركيز زراعتها. سجلت العوائل المختلفه للخنافس في حدائق الفاكهة، كما قدرت معدلات الاصابه بالخنافس في محافظات الجمهوريه المختلفه ، تم تتبع التذبذب الموسمي في تعداد الخنافس علي اشجار الخوخ في محافظتي الاسكندرية والجيزة خلال ثلاث سنوات متتاليه هي١٩٨٧ ، ١٩٨٨ ، ١٩٨٩ . بدأ خروج الخنافس خلال فبراير / مارس واستمر حتي ديسمبر . وقد تأثر خروج الخنافس بدرجات الحراره والرطوبة النسبية خلال نفس ميعاد خروج الخنافس وأيضا قبل خروجها بنصف إلي شهر ونصف . كما قدرت فترات تواجد وقمم الحضنات السنوية.