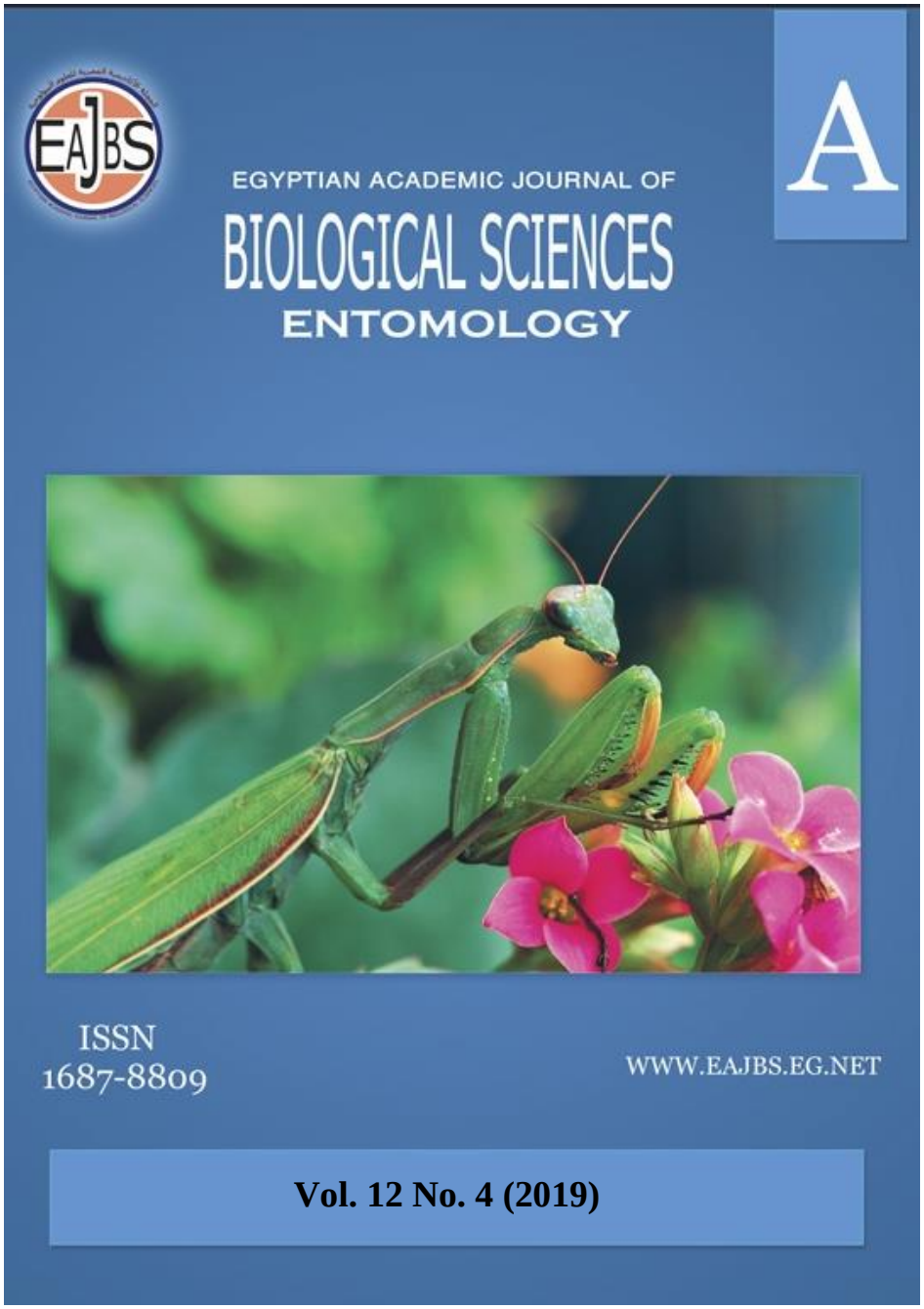

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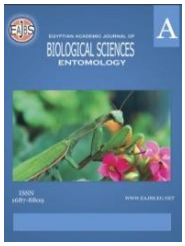

Effect of Watering Practice on the Infestation Severity of Fig Tree Borer, *Trichoferus griseus* (Fabricius), Under the Rainfed Agriculture Conditions

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ABSTRACT

Fig tree borer, *Trichoferus griseus* (Fabricius) (Coleoptera: Cerambycidae), is one of the very dangerous pests of fig trees at the Egyptian Northwestern coast. The prevailing environmental conditions at this coastal area (low precipitation, rainfed agriculture, soil salinity and hot summer season) support the population buildup of this pest to induce inestimable infestation. The current study aims to quantify the severity of the infestation of fig tree borer under the different soil moisture contents (moist and non-moist sites) and to estimate the influence of fig trees watering practice on the survival of *Trichoferus* larvae. Significant variation has been detected by comparing the mean infestation incidence between both sites on the monthly and annual levels. Under the annual watering practice, barely fluctuation in the counted numbers of exit holes was recorded through the study period, which, in turn, reflected on the corrected infestation percentages that recorded a noticeable reduction (2.04%) in 2018 year compared with the previous years. Rising moisture content in the internal fig tissues may hinder the colonization capability of *Trichoferus* larvae. The continuity of annual watering practice could affect *Trichoferus* infestation, especially when engaged in the integrated program dedicated to combating this pest..

INTRODUCTION

Fig and olive groves are the main cultivated plants in the Egyptian Northwestern coast. The rain-fed conditions besides the prevailing environmental factors (soil salinity and high temperature at the summer seasons) are the main reasons for their expansion due to the capability of both plants to withstand these harsh conditions. The situation got more implications under the climatic change phenomenon that led to less precipitation, more drought and hottest summer seasons. These environmental stresses may render fig trees vulnerable to attack by more than one economic insect pest (Young and Zhang, 1998; Hoskovec *et al*. 2006; Imam and Hassan, 2012 and Imam and Porcelli, 2017). Tree borers like phloem and cambium borers (Koricheva *et al*., 1998 and Hanks *et al*. (1999) and bark beetles (Mattson and Haack 1987a) are the most consistent species in benefiting from such

environmental stresses, *i.e*., inducing severe infestations. Egyptian Northwestern coast receives ~100 mm. annual sporadic and erratic precipitation that declines drastically in the inland areas. Both mid- and down-streams of the valleys (wadis) catch the high amount of rainwater either in the reservoirs and cisterns that constructed mainly for this purpose or through the percolated amount in the soil. Out of such areas, the topographic nature (the natural inclination and the low soil depth) and the anthropogenic activity (urbanization and construction of paved roads that cut the run off-path) are the main obstacles that decrease the water catching capacity of the soil (Yousif *et al*. 2013). Fig orchards are cultivated everywhere, and the trees barely get their water requirements from the percolated water in the soil (rainfed irrigation). Such drought stress at the Egyptian Northwestern coast, especially after the rainy seasons becomes in the favor of the fig tree borer, *Trichoferus griseus* (Fabricius) (Coleoptera: Cerambycidae), that vigorously attack woody branches of the fig trees and their larvae find out suitable host to induce inestimable infestation. Genus *Trichoferus* has more than one species. Hegyessy and Kutasi (2010) classified 6 species that differ in their morphological features and host plants. Most *Trichoferus* species are polyphagous on a wide range of hosts including oak, walnut and Acacia trees whereas *T. spartii* prefers hosts of family Fabaceae (Haack 2006, Tsherepanov 1981). *T. griseus* had been recorded in the Mediterranean basin and most of the North African countries attacking fig trees and several other hosts (Balachowsky, 1962 and Hegyessy and Kutasi, 2010). *T. griseus* is a univoltine species deposits eggs singly or in small batches on the woody parts of the fig tree. Newly hatched larvae penetrate the bark and mine along both sap and deep woods. Such boring behavior could either induce direct infestation through the breakage of the attacked branches or open the way for the entrance of secondary pathogens (Everatt *et al*. 2015). The sporadic precipitation events in the Egyptian Northwestern coast during winter seasons, besides the high temperature during the summer seasons (US National Climatic Data Center) and the unwillingness of the local farmers to soil tillage practice decrease the water holding capacity of the soil that put the trees under the drought stress to be suitable refuge for *Trichoferus* larvae. The implications for its larval boring behavior in the fig tree trunks in rainfed orchards are stated by Mifsud *et al*. (2012); Deghiche-Diab *et al*. (2015) and Imam and Porcelli (2017). Water deficiency or drought stress under the rainfed agriculture conditions predispose fig trees to be vulnerable to attack by *T. griseus*. Hanks (1999) and Hanks *et al*. (1999) stated that the potentiality of host plants to resist the invasion of cerambycid beetles has been associated with the high moisture content of the soil and their internal tissues as well. So, the current study aims to quantify the severity of infestation of fig tree borer under different soil moisture contents at the Egyptian Northwestern coast and to estimate the influence of watering practice on the survival of *Trichoferus* larvae within fig trees.

MATERIALS AND METHODS

Experimental Sites:

All observations and collected data were carried out along the Egyptian Northwestern coast through three successive years from 2016 till 2018. To fulfill our aims, the selected fig tree plots were chosen to cover the mid- and down-stream areas of Sidi Henash wadi, Ras El-Hekma district (31° 9′ 58.57″ Lat. and 27° 36′ 41.32″ Log.) that receive high precipitation rate and consequently having high moisture content (moist site) and the areas that their soils catch barely amount of rainwater were represented at Zawet Haaron, Ras El-Hekma district (31° 8′ 31.7″ Lat and 27° 40′ 39.20″) and denoted as the non-moist site.

Estimation of *T. griseus* Infestation:

The intensity of infestation was quantified according to the described method of El-Shafie and Mohammed (2016). Where the number of exit holes of the adult cerambycid beetles was counted in an area of 1000 cm^2 (20 cm. width x 50 cm. length) on the main trunk of each selected fig tree in the whole study plots. These exit holes are the only measurable parameter for the induced infestation since there is no other sign that could be considered to estimate *Trichoferus* infestation, *i.e*., each slot attested to the success of one larva to complete its larval and pupal stages and eventually emerges as an adult. In each experimental site, 3 plots each has 10 fruitful fig trees aged ~ 20 years old were randomly selected and marked (30 fig trees per each study site). Estimation of *T. griseus* infestation was carried out 4 times per each year from July till October, this period represents the peak flight period of the adult and consequently will give a realistic estimation for the infestation (Imam and Porcelli, 2017).

Influence of Watering Practice on the Survival of *Trichoferus* Larvae:

Two cohorts, each of 10 fig trees were chosen and marked at Zawet Haaron (non-moist) experimental site, *i.e*., 20 total fig trees. Fig tree cohorts were watered during June month to soil saturation (Hanks *et al*., 1999). Soil saturation treatment is applied in June month due to it is the beginning of the summer season which is characterized by high temperature and drought conditions that represent the ideal survival conditions of *Trichoferus* larvae. Accordingly, soil watering during this period will raise the moisture content of the fig tree and consequently may resist the larval survivorship, which is the intended aim to measure from this trial. To increase soil potentiality to conserve water, the soil underwent 2 tillage practices in July and August months (El-Shafie and Mohammed, 2016). In October month, the exit holes of the adult had been counted by the previously described procedure. The influence of watering treatment on the survivor of *Trichoferus* larvae was calculated according to (Henderson and Tilton, 1955).

Statistical Analysis:

Infestation in both moist and non-moist sites was compared through independent t-test, using SPSS statistical program. Graphically represented data were done using Microsoft Excel.

RESULTS

Estimation of *T. griseus* Infestation under the Rain Fed Conditions:

Infestation of fig tree borer, which is represented by the counted numbers of the emergence slots of adult beetles, is estimated and illustrated in Table (1). The recorded data at the moist (Sidi Henash wadi) and non-moist (Zawet Haaron) sites showed slight progress in the incidence of the mean monthly infestation. Whereas the significant variation has been detected upon comparing the mean infestation incidence between both sites on the monthly and annual levels. *I*.e., fig tree borer has the potentiality to induce signification infestation progress under the rainfed conditions (Fig. 1).

Influence of Watering Practice on the Survival Potentiality of *Trichoferus* Larvae:

The influence of moisture content on the survivorship of *T. griseus* larval stage was investigated and the obtained data were tabulated in Table (2). The exit holes of *Trichoferus* beetles are the real indication for the success of the growth schedule of the larvae to pupate and eventually emerge as adults. Under the annual watering practice, barely fluctuation in the counted numbers of exit holes was recorded through the study period (from 2016 to 2018), which, in turn, reflected on the corrected percentages of infestations. Where the infestation percentage in 2018 year recorded a noticeable reduction (2.04%) when compared by the previous years.

Table (1): Monthly and annual progress of *T. griseus* infestation (number of adult emergence holes) at the Egyptian Northwestern Coast (2016:2018 years)

Inspection period	July		August		September		October		Mean annual infestation	
	Moist	Non-moist	Moist	Non-moist	Moist	Non-moist	Moist	Non-moist	Moist	Non-moist
2016	4.37± 0.26	9.90± 0.21	4.97± 0.23	10.30± 0.21	5.13± 0.17	10.70± 0.35	5.63± 0.18	11.30± 0.35	5.03± 0.26	10.55± 0.30
2017	5.97± 0.13	11.67± 0.35	6.50± 0.06	12.17± 0.32	6.70± 0.06	12.27± 0.35	6.90± 0.10	12.47± 0.43	6.52± 0.20	12.15± 0.17
2018	7.13± 0.12	12.83± 0.41	7.30± 0.23	13.23± 0.27	7.37± 0.20	13.43± 0.33	7.37± 0.20	13.67± 0.38	7.29± 0.06	13.29± 0.18
Mean monthly infestation	5.83± 0.80	11.47± 0.85	6.26± 0.68	11.90± 0.85	6.40± 0.66	12.13± 0.79	6.63± 0.52	12.48± 0.68	6.28± 0.17	12.00± 0.21
t-statistic (df)	9.177 (16)		9.850 (16)		10.439 (16)		12.240 (16)		7.811 (6)	
P-value	0.000		0.000		0.000		0.000		0.000	

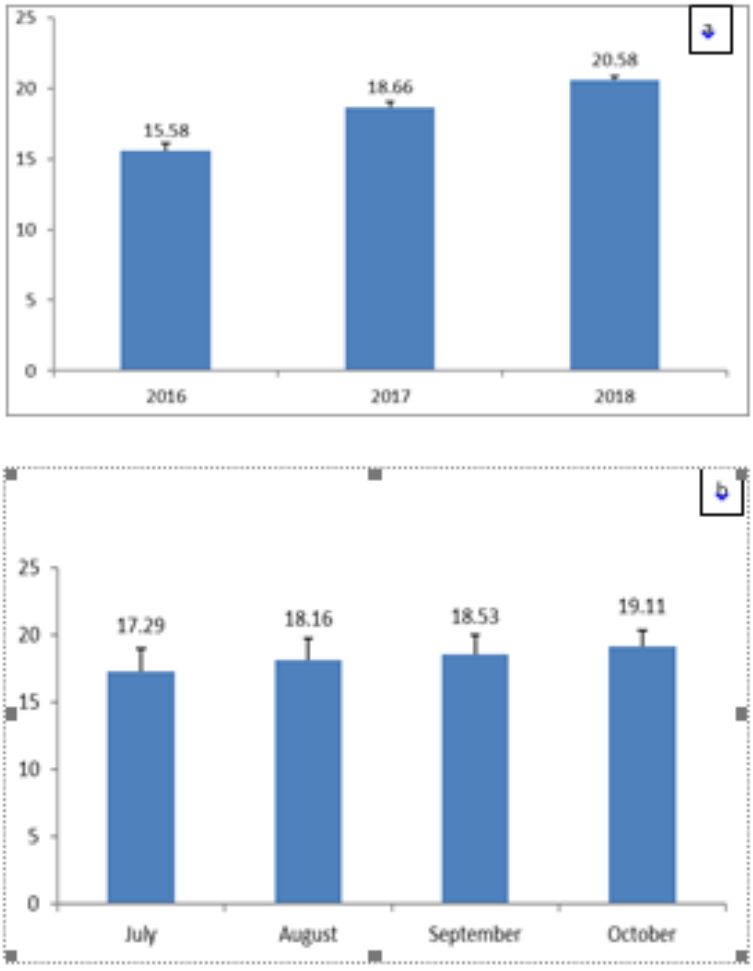

Fig. (1): The mean infestation incidence of *T. griseus* at the Egyptian Northwestern Coast. A: mean monthly infestation, b: mean annually infestation.

Table (2): Influence of watering practice on the survival potentiality of *Trichoferus* larvae at the Egyptian Northwestern coast (2016: 2018 years).

Treatments	Inspection dates	2016	2017	2018
Treated tree cohorts	June (watered)	10.80±0.47	11.60±0.54	12.20±0.51
	October	11.30±0.56	11.80±0.55	12.40±0.48
Control tree cohorts	June (un-watered)	10.80±0.47	12.20±0.42	13.30±0.37
	October	11.80±0.44	13.00±0.42	13.80±0.44
Corrected infestation %		4.24 %	4.54 %	2.04 %

DISCUSSION

Fig tree borer like other cerambycid borers is one of the destructive pests that have the potentiality to wipe out or kill its host (Paine *et al*. 1995 and Hill, 2008). The destructive power of this insect group, although its low population density in the natural habitat (Imam and Sawaby, 2013 and Iwata *et al*., 1997), is supported by its biological and behavioral features (internal boring behavior and vascular bundle feeder) besides its capability to experience the environmental stresses (Broschat 2013). The drought stress at the rainfed conditions of the Egyptian Northwestern coast is an ideal factor predisposing fig trees vulnerable to attack by *Trichoferus* beetle (Imam and Porcelli, 2017). The current findings declared that the emergence of *Trichoferus* adults either monthly or annually is of slow incidence pattern, which means that the infestation severity of fig tree grooves is of a cumulative nature. Drought stress besides the unawareness of the local communities in terms of the best practices to combat this pest are, actually, the key factors for such infestation outbreak. The natural difference in the infestation severity between the moist and non-moist sites declares the effective role of the moisture content to hinder the population buildup of the larval stage. Hanks (1999) stated that excessive moisture content may enhance the self-immune systems of the plant host against cerambycid beetles. Watering practice of drought suffering site in the context of the current study showed a promising role in hindering the larval colonization and consequently the infestation percentages. The worthy point is that the highest infestation reduction percentage was fulfilled 3 years post-treatment, *i.e*., infestation reduction due to *Trichoferus* borer is also of a cumulative trend. Accordingly, this practice could be exploited as an effective tool in the integrated pest program of this pest but without repetition (don't apply more than one/ each year) due to the scarcity of water and in the same time to conserve the quality of fig fruits that produced under the rainfed conditions.

Finally, management of *T. griseus* pest under the rainfed conditions of the Egyptian Northwestern coast requires a long-term strategy with 2 cornerstone practices; the first is to prevent or at least decrease the egg deposition through mass trapping of adult stages and to deter the adults away from the trees (repellent agents). The second action is concerning with targeting the larval stages via the trunk injection technique to decrease the number of emerged beetles. The practices such as pruning, strengthening the trees, increase the awareness of local communities….*etc*. play an equally important role to alleviate the economic losses of this pest.

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ARABIC SUMMARY

تأثير ممارسة ترطيب التربة على شدة الإصابة بآفة حفار ساق التين تحت ظروف الزراعة المطرية

أحمد إبراهيم إمام

قسم وقاية النبات – مركز بحوث الصحراء – المطرية – القاهرة – مصر

تعتبر آفة حفار ساق التين من أخطر الآفات الحشرية التى تصيب أشجار التين بمنطقة الساحل الشمالى الغربى لجمهورية مصر العربية. حيث تشكل الظروف الجوية السائدة فى هذه المنطقة الساحلية (قلة معدل سقوط الأمطار – الزراعة المطرية - ملوحة التربة – ارتفاع درجات الحرارة صيفا) ظروفاً مثالية لزيادة تعداد جمهور هذه الآفة وبالتالى تفشى أضرارها. وتهدف هذه الدراسة الى تقييم شدة الإصابة بهذه الآفة تحت معدلات مختلفة من المحتوى الرطوبى للتربة وأيضا إلى تقييم كفاءة ممارسة ترطيب التربة على بقاء يرقاتها على قيد الحياة. وقد أظهرت النتائج تأثيرات معنوية بين متوسطات الإصابة التى تم رصدها فى المواقع ذات المحتوى المرتفع من الرطوبة مقارنة بمثيلاتها ذات الرطوبة المنخفضة. وبإجراء ممارسة ترطيب التربة تم تسجيل تغير طفيف فى تعداد ثقوب خروج الطور البالغ لآفة حفار ساق التين والتى إنعكست على النسب المئوية للإصابة والتى حققت إنخفاض ملحوظا (2.04%) خلال موسم 2018 مقارنة بالمواسم السابقة. وقد أدى رفع المحتوى الرطوبى لأنسجة الأشجار الداخلية الى إعاقة قدرة يرقات الحفار على المعيشة. واستمرار ممارسة الترطيب السنوى لأشجار التين من الممكن أن يؤثر على إصابة هذه الآفة وخصوصا بإدراج هذه المعاملة ضمن برنامج المكافحة المتكاملة الموجهة لمكافحة هذه الآفة.