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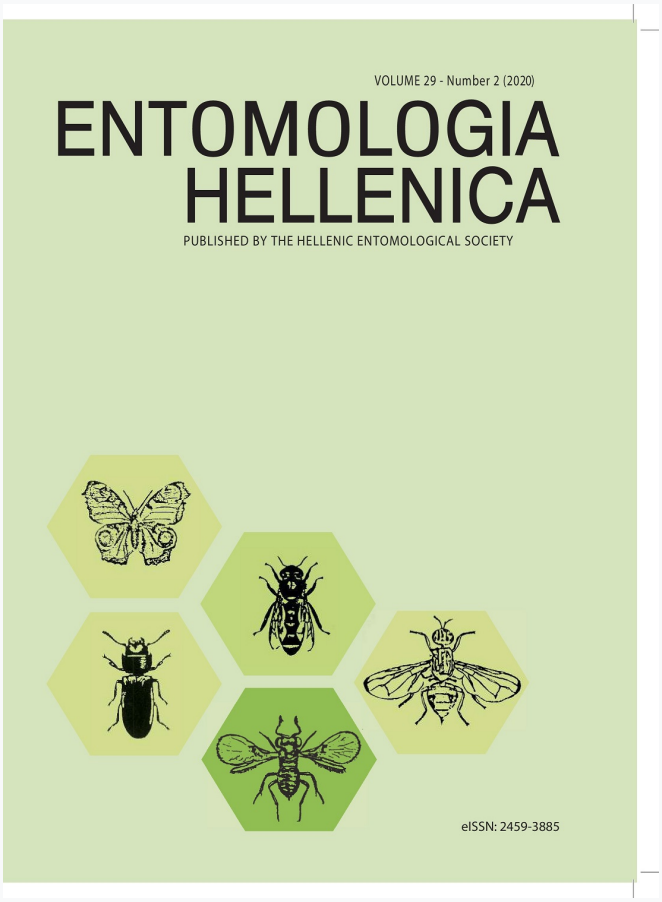

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Damage caused by *Cerambyx dux* (Coleoptera: Cerambycidae) in apple orchards in north-western Syria

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ABSTRACT

Results of a field study showed *Cerambyx dux* (Faldermann, 1837) (Coleoptera: Cerambycidae) to be a major economic pest of domestic apple orchards in north-western Syria. Higher levels of attack were detected on trees with larger trunk diameters. All trees with trunk diameters > 10 cm were infested (5 to 7 infestation holes per tree). For trees with trunk diameters 5 to 10 cm, the level of infestation was 87.8% (2 to 4 infestation holes per tree). No attack by the longhorn beetle *C. dux* was detected on trees with a trunk diameter < 5 cm.

KEY WORDS: economic pest, longhorn beetle, trunk diameter, Syria.

Introduction

Apple, *Malus domestica* (Rosales: Rosaceae), is a major fruit crop for local and export markets in Syria. Most of the production occurs in the coastal region of north-western Syria. Many wood borer pests attack apple trees in Syria. These include the leopard moth *Zeuzera pyrina* L. (Lepidoptera, Cossidae), which occurs throughout all apple-producing areas of Syria. Larvae bore into the trunks of trees and can kill the host; it is a particularly serious pest in apple nurseries (Katlabi 1989). In recent years, a large number of apple trees have been killed by longhorn beetles in coastal areas of western Syria. As a result, many farmers have replaced apple orchards to olive groves.

It is well known that *Cerambyx dux* (Falderman) (Coleoptera: Cerambycidae) is normally distributed all over the Eastern Mediterranean area up to Iran (Saliba 1974, Özdikmen & Turgut 2009, Slama 2015). Larvae feed and tunnel in the woody portion of the trunk and large branches of stone-fruit trees. The insect attacks almond (*Prunus amygdalus*), apricot (*P. armeniaca*), peach (*P. persica*) and plum trees (*P. domestica*) (Rosales: Rosaceae) in all cultivated regions in Syria (Al-Hariri 1984). Sharaf (2010) reported that, *C. dux* is an economically important borer as it damages 23.77% of cultivated almond trees in Jordan. *C. dux* is also a very serious pest of apricot, peach, and grafted and wild almond trees in Palestine (Jolles 1932) and it also attacks apple and pear trees in Malta (Saliba 1977). Sharaf (2010) reported that, *C. dux* is an economically important borer on stone fruits, where plum trees were more susceptible to colonization by *C. dux* than peach trees, whereas almond trees were the least susceptible.

We conducted this field study with a two-fold purpose. Firstly, we wanted to investigate the economic importance of the longhorn beetle *C. dux* on apple production in Tartous province of north-western Syria. Secondly, we wanted to assess the level of *C. dux* attack on trees of different size, in commercial apple orchards.

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Materials and Methods

To determine where *C. dux* was present, we sampled apple orchards at three locations in Tartous province; i.e., Safita (34°48'59.99"N - 36°06'60.00"E), Dreikisch (34°53'46.93"N - 36°7'52.97"E) and Al Schaykh Badr (35°02'41.71"N - 36°05'53.05"E). At each location, we collected large branches and trunks of dead and dying apple trees during August and September 2018. Longhorn larvae and pupae recovered from this material were reared at the Entomological Laboratory of the Tartous Research Centre at room temperature. Emerged adults were identified using the taxon key by Saliba (1974) and deposited in the insect collection.

We studied the effect of tree size on the attack, in an apple orchard (34°57'53.77"N - 36 °13'16.02"E; 700 m al) in the coastal area in Syria, Tartous during the summers of 2018 and 2019 (August and September). The orchard was surrounded by uncultivated fields and comprised 0.5 ha planted with 250 apple trees, 9 to 10 yrs of age. Fungicides had been applied to control the apple scab, *Venturia inaequalis* (Pleosporales: Venturiaceae). Otherwise, trees had been neglected with no history of either chemical or mechanical control for *Zeuzera pyrina* or other apple tree pests during the orchard's establishment phase. As a result, trees were heavily infested with wood-boring insects.

We randomly selected 134 apple trees within a study block (85 trees in 2018 and 49 trees in 2019). For each tree, we recorded trunk circumference (cm) and trunk diameter (cm) at ground level. We grouped these trees into three size categories based on trunk diameter; i.e., < 5 cm, 5-10 cm, 10-15 cm. No trees had a diameter exceeding 15 cm. For each category, we then compared the number of infestation holes per tree, the vertical distance (cm) between adjacent infestation holes within trees and the ratio of infested to healthy trees. The values of infestation holes between the groups were compared and analysed using one-way analysis of variance (ANOVA) followed by Tukey's HSD.

FIG. 1. Larva of *C. dux* inside the apple wood.

Results and Discussion

The laboratory results showed clearly that the reared larvae inside the sampled developed and emerged to longhorn beetles. All adult specimens reared in the laboratory were identified as *Cerambyx dux*. These include 18 specimens from Safita, 25 specimens from Dreikisch, and 8 specimens from Al Schaykh Badr and these were the main reason for the high damage and death on the apple tree (Fig. 1).

Trees infested with *C. dux* were readily identified by accumulations of sawdust at the base of the tree caused from larval feeding. Late-instar larvae also burrow deep into the wood (Fig. 2) and occasionally into the roots to create irregular tunnels that interfere with water and nutrient transport, which can cause rapid tree death. Adults were found on the stems and twigs, but the damage is usually not considered severe. Trees of larger size were more likely to have a higher level of attack (Table 1). No attack was detected on trees with a trunk diameter < 5 cm, which is significant to other insect groups. Trees with trunk diameters of 5-10 and 10-15 cm had 2-4 and 5-7 infestation holes, respectively ($F_{1,131}$= 207.60, P= < 0.0001, Table 1).

TABLE 1. Effect of trunk diameter of apple trees on the infestation of *C. dux*.

Trunk diameter	No. of inspected trees	Trunk circumference (avr. cm)	Trunk diameter (avr. cm)	Number of holes (avr.)	Distance between holes (avr. cm)
0-5	30	13.6 ± 0.82	4.33 ± 0.26	0a*	9 ± 10.8
5-10	82	21.7 ± 3.64	6. 92 ± 1.16	1.65 ± 1.23b	14.9 ± 2.35
10-15	22	38.0 ± 1.73	12.11 ± 0.55	5.45 ± 0.52c	9 ± 10.8

*Values in a column followed by different letter are significantly different (Tukey's HSD test, $P < 0.05$).

FIG 2. Death of apple tree caused by *C. dux*.

A similar pattern was reported by Sharaf (2010) for stone fruit trees, who found that trees attacked by *C. dux* were usually more than 6 cm in diameter or > 5 years old, and also reported that the mean number of infestation holes per tree ranged from to 2.9 for trees with a trunk diameter 6-10 cm, to 5.75 for trees with a trunk diameter > 10 cm.

Furthermore, in this study it was concluded that trees with previous attacks were more susceptible to future infestation. This is consistent with the findings of Li and Wu (1993) who noted that the females of the Asian longhorn beetle *Anoplophora glabripennis* (Motschulsky) (Coleoptera: Cerambycidae) do not lay eggs under the bark of branches that are less than 5 cm in diameter, let alone complete development. Also, Ali et al. (2014) reported that the fig stem borer *Batocera rufomaculata* (DeGeer) (Coleoptera: Cerambycidae) attack fig trees with a diameter larger than 5 cm. Larger trees also were more likely to have been killed by *C. dux*. Susceptibility of the apple trees to the attack of the beetle was calculated as a ratio of infested to the total number of studied trees for each trunk diameter group. Infestation ratio was very high in the second group of trees with diameter between 5 to 10 cm. Additionally, all trees of the third group, which had a trunk diameter between 10 and 15cm, were infested and the mortality was very high (Table 2). These results demonstrated that old trees with a large diameter are more susceptible to the attack of *C. dux* than trees with a smaller diameter, while no apple tree can reach a diameter more than 15 cm and survive this kind of infestation under natural conditions. This study indicates that the longhorn beetle *C. dux* is a highly destructive pest in apple orchards in northwestern Syria and this is the first manifestation of the attacks in Syria, therefore cultural and biological and other control measures should be rapidly used to control the beetle.

TABLE 2. Number and ratio (%) of infested and dead apple tress caused by *C. dux*.

Trunk diameter	No. of inspected trees	No. of trees infested with *C. dux*	Ratio of trees infested with *C. dux* (%)	No. of dead trees due to *C. dux*	Ratio of dead trees due to *C. dux* (%)
0-5	30	0	0	0	0
5-10	82	72	87.8	14	17.07
10-15	22	22	100	18	81.8

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Προσβολή από το είδος *Cerambyx dux* (Coleoptera, Cerambycidae) σε οπωρώνες μηλέας στην βορειοδυτική Συρία

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ΠΕΡΙΛΗΨΗ

Τα αποτελέσματα μιας μελέτης πεδίου έδειξαν ότι το *Cerambyx dux* (Faldermann, 1837) (Coleoptera: Cerambycidae) αποτελεί έναν υψηλής οικονομικής σημασίας εχθρό σε οπωρώνες μηλέας στην βορειοδυτική Συρία. Υψηλότερα επίπεδα προσβολών παρατηρήθηκαν σε δένδρα με μεγαλύτερη διάμετρο κορμού. Όλα τα δένδρα με διάμετρο κορμού μεγαλύτερη των 10 cm προσβλήθηκαν (5 έως 7 οπές ανά δέντρο). Για δένδρα με διάμετρο κορμού 5 έως 10 cm, το επίπεδο προσβολής ήταν 87.8% (2 έως 4 οπές ανά δένδρο). Καμία προσβολή από το συγκεκριμένο κολεόπτερο δεν παρατηρήθηκε σε δένδρα με διάμετρο κορμού μικρότερη των 5 cm.

