OLFA EZZINE ^a - EZZEDDINE SAADAOUÏ ^b - SAMIR DHAHRI ^b - SONIA HAMMAMI ^b
 MOHAMED LAHBIB BEN JAMÂA ^b

SHELTER BUILDING BY LARVAE OF *PHYCITA DIAPHANA* STAUDINGER, 1870 (LEPIDOPTERA PYRALIDAE) USING *RICINUS COMMUNIS* L. IN ARID ZONE

^a Laboratory of Forest Ecology (LR161INRGREF03), National Institute for Research in Rural Engineering Water and Forests, University of Carthage, Bp 10, 2080 Ariana, Tunisia.

^b Laboratory of Management and Valorization of Forest Resources (LR161INRGREF01), National Institute for Research in Rural Engineering Water and Forests, University of Carthage, Bp 10, 2080 Ariana, Tunisia.

Corresponding Author: Olfa Ezzine; olfa.ezzine@gmail.com

Ezzine O, Saadaoui E., Dhahri S., Hammami S., Ben Jamâa M.L. – Shelter building by larvae of *Phycita diaphana* Staudinger, 1870 (Lepidoptera Pyralidae) using *Ricinus communis* L. in arid zone.

In July 2017, in south-eastern Tunisia, larvae of *Phycita diaphana* were observed on seedlings of castor bean. Infested pointed lobes of the leaves are characterized by the presence of shelters or nests ranging from one to six shelters per leaf. The shelter area ranged from 1.01 to 28.27 cm². In each shelter, we found from one to nine larvae. We conclude that *Ph. diaphana* spends the whole larval stage protected without changing its feeding habits. The leaf roll may reduce leaf toughness and lower levels of plant defensive chemicals, and hence provides a more easily and more safely eaten food. Larvae of *Ph. diaphana* use the pointed lobe to build its shelter. As Castor bean is used in several fields of economy, mainly the production of biodiesel fuel, the monitoring of this pest will be important and interesting. Thereby, studying the life cycle of pests constitute a significant element of phytosanitary control.

KEY WORDS: *Ricinus communis*, *Phycita diaphana*, shelters, Tunisia.

INTRODUCTION

Castor bean (*Ricinus communis* L.) is a tropical perennial shrub that originated in Eastern Africa (Ethiopia), but is now cultivated in many tropical and subtropical regions around the world (LAKHANI *et al.*, 2015). The plants are shrubs that may reach 4-5 m in height with reddish to purple stems. The leaves are large (10-76 cm), shaped like an umbrella and may have between five and nine finger-like, pointed lobes; near their centers long purple leaf stems are attached (FALASCA *et al.*, 2012). Castor oil is used in medicine and cosmetics, plastic and lubricants as a substitute for petroleum, production of fiber optics, high resistance glass and bone prostheses (FALASCA *et al.*, 2013). This plant species is subject to several attacks of pests causing extensive defoliation, mainly Lepidoptera: *Xylomyges eridania* (TROCHAIN, 1930), *Achaea janata* (BUDATHA *et al.*, 2008), *Olepa* spp. belonging to the *ricini* species group as *O. ricini*, *O. clavatus*, *O. toulgoeti*, *O. koslandana* (ORHANT, 2000) and *O. schleini* (WITT *et al.*, 2005) and, three species of the genus *Phycita*: *Ph. poteriella*, *Ph. fuscopilella* and *Ph. diaphana* (BALACHOWSKY, 1972).

In July 2017, in Gabes (south-eastern Tunisia), seedlings of *R. communis* were defoliated by larvae of *Ph. diaphana*. This pest is a Mediterranean-Asian species, probably subtropical, described by STAUDINGER (1870) based on specimens from the Iberian Peninsula from Malaga, Huelva and Almería (YLLA *et al.*, 2008), occurring also in the South of Portugal (Algarve) (CORLEY *et al.*, 2000) and more widely distributed in Mediterranean Europe (including the Balearic Islands: Alcudia

Mallorca, and other Mediterranean islands: Malta, Cyprus), in coastal areas of South-East of France and Greece. Outside Europe it was recorded from Reunion Island and Mauritius (LERAUT, 2008). In Iraq (JABOORY, 1999), Asia Minor and North-east Africa (RUNGS, 1979; ARENBERGER & WIMMER, 2003) and in Tunisia, in the oasis of Tozeur (DUMONT, 1925). Larvae of *Ph. diaphana* feed on leaves and inflorescences of Castor bean (PÉREZ DE GREGORIO *et al.*, 2012) and on oilseed (BALACHOWSKY, 1972). In this work, we studied the behavior of larvae of *Ph. diaphana* in building their shelters using leaves of *R. communis* in an arid zone in south-eastern Tunisia.

MATERIALS AND METHODS

SAMPLING

In July 2017, a total of 15 seedlings of *R. communis* in the nursery (lat. 33°54' N, long. 10°02' E, alt. 9 m) belonging to the regional research station of Gabes were investigated to verify the occurrence of larvae of *Ph. diaphana*. Infested leaves (n=25) were collected and sorted. On each lobe (n=200), shelters tied by larvae were counted. Length and width of each one was measured (URBAN, 2010) and the area was calculated. Agglomerated lobes were separated to enumerate existing larvae.

STATISTICAL ANALYSIS

Descriptive statistics was performed using the SPSS

-10.0 software package for Windows and were reported as mean $\pm$ standard error of mean (MSE). Number of larvae in each lobe was statistically evaluated by using χ^2 non parametric test. Pearson's correlation coefficient was calculated for the area of lobe and the number of larvae.

RESULTS

HOST PLANT INFESTATION

All examined seedlings were infested by larvae of *Ph. diaphana*. Infested pointed lobes are characterized by the presence of shelters or nests. The number of shelters varied from one to six shelters/leaf (average 2.79 shelters/leaf). The shelter length ranged from 0.8 to 5.3 cm (average 2.89 ± 0.13 cm), while the shelter width

ranged from 0.3 to 2.9 cm (average 0.85 ± 0.05 cm). The shelter area ranged from 1.01 to 28.27 cm² (average 7.96 ± 0.91 cm²).

LARVAE DENSITY

The difference of the number of larvae was highly significant between shelters ($\chi^2=59.33$, $P<0.001$). In each shelter we can find between 1 to 9 larvae (average 2.3 ± 0.29) of several instars. About 47.6 % of lobes hold only one larva, for the rest it ranged between 2.4 % and 23.8% (Fig. I). Pearson correlation between the area and the number of larvae in each lobe varied highly ($r=0.392$, $P=0.007$). Difference between instars larvae in each lobe was significant ($F_{(1,4)}=3.73$, $P=0.006$). Almost we find all instars larvae in the same shelter, the frequency of the 2nd instar was the most important (Fig. II).

Fig. I - Number of larvae in each lobe of the leaf.

Fig. II - Average number (Mean $\pm$ SE) of larvae of each instar in each lobe of the leaf. Within each larval instar, the values labeled with different superscript letters are significantly different from each other ($P<0.05$).

DISCUSSION

Shelter building is an insect-plant interaction which almost always means a benefit for the species that acquires the shelter. Many lepidopteran larvae build shelters by rolling, folding, or tying leaves together with silk (GREGORY *et al.*, 2000). The leaf roll may reduce leaf toughness and lower levels of plant defensive chemicals, and hence provides more easily and more safely eaten food (LEWIS, 1979; SAGERS, 1992). Some tortricids feed on St. Johns wort (*Hypericum perforatum*) by rolling leaves to avoid direct sunlight that would activate plant defenses (SANDBERG & BERENBAUM, 1989).

Leaf rolls may be important as refuges from predators (DAMMAN, 1987; ALTEGRIM, 1992). In north-western Tunisia, MANNAI *et al.* (2010, 2018) captured four species belonging to the Tortricidae family: *Tortrix viridana*, *Archips xylosteana*, *Pammene splendidulana* and *P. giganteana* on *Quercus* spp. (Fagaceae) rolling only one leaf of its host. In northern Tunisia, the gelechiid *Anacamptis scintillella* folds 4 to 17 leaves of its host plant *Halimium halimifolium* (Cistaceae) (EZZINE *et al.*, 2018). In our study (south-eastern Tunisia), larvae of *Ph. diaphana* used the pointed lobe to build its shelter. In the same leaf we can find 1-6 rolled leaf blades that sometimes are linked with numerous web linkages. URBAN (2010) showed that the inner linkages reinforce the leafrolls from the inside, outer linkages from the outside. In addition to the number of used leaves, shelters' area, length and width differs greatly from one species to another. Leafrolls built by larvae of *A. scintillella* using *H. halimifolium* are on average 2.89 cm long and 0.85 cm wide (EZZINE *et al.*, 2018). In our study, the shelter length ranged from 0.8 to 5.3 cm (average 2.89 ± 0.13 cm), while the shelter width ranged from 0.3 to 2.9 cm (average 0.85 ± 0.05 cm). Leaves of average size provided sufficient food to the caterpillars. In Brno (Czechia), caterpillars of *A. populella* rolled up leaves of an area of 7 to 25 (on average 15.5) cm² (Urban, 2010). In our study, the area rolled by larvae of *Ph. diaphana* ranged from 1.01 to 28.27 cm² (on average 7.96 cm²).

Using the same host plant (castor bean), the behaviour changes from one family to another. First instar larvae of the arctiid *Olepa schleiini* are grouped in dense clusters on a silky web attached to the plant. Second instar larvae formed smaller groups attached to the plant with a single thread, and left consumed leaves and the third instar spread indiscriminately over the leaves and consumed all the tissues including the main veins. Larvae of the 4th, 5th and the 6th instars are solitarily feeding all the parts of the leaves (MÜLLER *et al.*, 2006). Due to their continuous and uninterrupted movement, larvae of the pyralid *Ph. diaphana* united in large numbers on the same inflorescence, inducing a vast network of silk threads forming a nest on which the faeces of the caterpillars are agglutinated. Each larva lives separately in a long white silky gallery starting from the attacked part of the plant and ending outside the network (DUMONT, 1925). In our study, in the same shelter we found up to nine larvae. DUMONT (1925) indicates that this kind of nest contains caterpillars belonging to different egg

depositions because all sizes and all molting instars are represented.

As Castor bean is used in several industrial sectors, mainly biodiesel fuel (ULUSOY *et al.*, 2004, ÖZCANLI *et al.*, 2012), the monitoring of this pest will be important and interesting. Studying the life cycle of pests constitutes a significant element for phytosanitary control.

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