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Role of the bupreste Olivia festiva L. (Coleoptera, Buprestidae) in the dieback of Thyua (Tetraclinis articulata) in the Western Traras Mountains (Algeria)

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Abstract: Damages of Ovalisia festiva to Tetraclinis articulata is caused by the action when building their galleries under the bark. The group effect in populations of wood eating causes browning and death of branches and consequently a total decline of the attacked Tetraclines. The statistical study showed that there is close correlation between borer and characteristics of the tree, also between the height, age and thickness of the bark.

Key words: *Tetraclinis articulata*, Ovalisia festiva, damage, Traras Western Mountains

INTRODUCTION

On a total area of 9017.69 km², the wilaya of Tlemcen covers a total forest area of around 137,217 ha of forests and the rest composed of maquis and brush.

The forest area occupied by the Western Traras region is estimated at 6453 ha including 60% Aleppo pine, 15% Eucalyptus, 10% Thuya, 5% Cypress and 10% other formations (Nichane, 2011).

Softwoods, in particular Thuya, are a better example of studying the strategies offered by this species in relation to the attacks faced by existing plant structures.

Tetraclinaies play a very important role in the social and economic life of local populations (Hadjadj, 1995). The overexploitation of its populations, regularly or clandestinely, is the best proof of this. Its various product categories are at the origin of the development of several artisanal and commercial activities, constituting a source of income and thus contributing to social development (Fennane, 1987; Fennane, 1988).

In addition to the vicissitudes of the climate and anthropogenic action, these forests are subject to several factors of degradation (overgrazing, fire, diseases and parasites) (Anonymous, 2009).

Certain species of insects can present abundant outbreaks and cause significant damage, it was essential to carry out, in a minimum period of time, a study as precise as possible on the behavior and relationship of the insect with respect to the host plant, (Khous, 1992).

To our knowledge, this is the first time that damage from this buprest has been observed on the Tetraclines of the study area. For this, the objective of this work is to deepen our knowledge on the biological behavior of the insect with a view to developing a protection strategy throughout the national territory.

MATERIALS AND METHODS

Presentation of the study area

The Traras Mountains are located on the south-western edge of the Mediterranean basin. They belong to the coastal chains of Orania (fig. 1). The Traras massif is a mountainous region with an average altitude varying from 500 to 1,000 m. These mountains are subject to a hot semi-arid Mediterranean climate with an average annual precipitation of 300 mm and an average temperature of 18°C. The horography of the region is very characteristic, with a parallel elongation of the coast of the main reliefs, thus forming relatively continuous barriers, on the path of air masses coming from the sea, giving rise to very favorable topographical conditions for capture atmospheric humidity. This characteristic is also advantaged by the layout of the hydrographic network (Medjahdi, 2001). The main groups constituting the bedrock are carbonate formations, non-carbonate formations, volcanic formations and quaternary formationsb (Nichane, 2011).

The interplay of lithology, relief and climate allows ecological stratification, consequently significant biological diversity original to the region (Medjahdi, 2001).

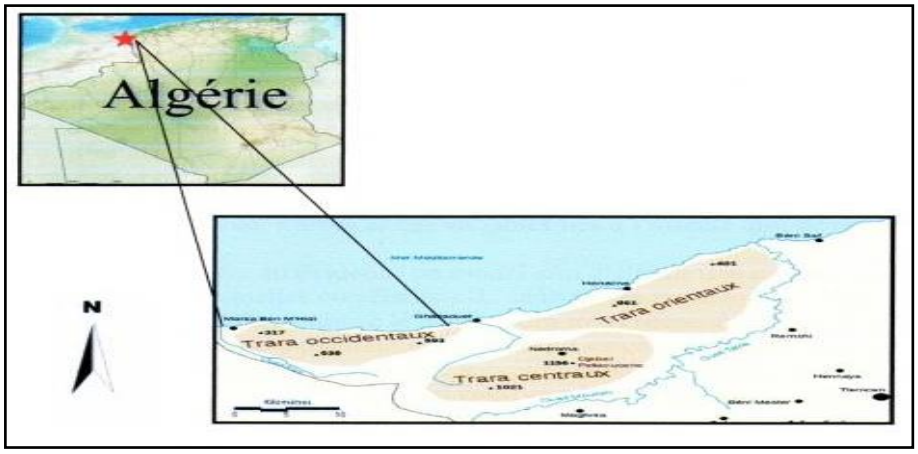


Figure. 1. Location of the study area, (Medjahdi et al., 2008)

Sampling methodology

The method chosen consists of a systematic inventory by plots following a 100 x 100 m mesh network, i.e. one plot per 1 ha. The inventory includes 2 study plots installed in the Souk Tleta forest massif. The technique used to harvest this insect is that of debarking. It makes it possible to possibly collect specimens under cortex of this buprestid which uses this place as a refuge or as a habitat (fig. 2).

Fig. 2. Debarking, (Nichane, 2011)

A population of 20 Tetraclinis articulata trees was taken into consideration. To cover the entire period of activity of this bupreste, the felling operation was carried out in two periods; spring period and summer period. From the base of the felled tree, we note the diameter of the tree at different levels over 4 meters in height. The chosen diameter is noted every 45 to 50 cm.

Holes are counted in increments of 1 meter. The distribution of attacks according to height was carried out for each tree. The attack rate is one of the parameters that is easy to measure and gives reliable results on the health status of the stand.

Statistical analysis

All data collected from the field is subject to statistical analysis. These data were analyzed by adopting graphical approaches and statistical analysis procedures using ANOVA analysis of variance, using SPSS software.

RESULTS AND DISCUSSION

The main symptoms observed are, in chronological order, browning of the leaves, drying and falling of the leaves, then total dieback of the tree.

Investigations carried out at the laboratory level on the specimens collected show that this damage is due to a xylophagous insect, in this case, a buprestid in a dangerous proliferation phase. Hundreds, or even more, individuals of this xylophagous are abundant on Thuya and Cypress. The identification of this insect was made in collaboration with Pr. BOUHRAOUA (forest zoology laboratory), it is Ovalisia festiva.

Summary description of the insect

Origin

Insect located in France, Portugal, Spain, Switzerland, Austria, Germany, Italy, Yugoslavia, Bulgaria, Hungary, Greece, Crete, Morocco, Algeria and Tunisia.

The Thuya buprestid is a beetle belonging to the super order Polyphaga, the infra order Elateriformia, the super family Buprestoidae, the family Buprestidae, the subfamily Buprestinae, the tribe Dicercini and the genus Ovalisia, (Anonymous, 2010).

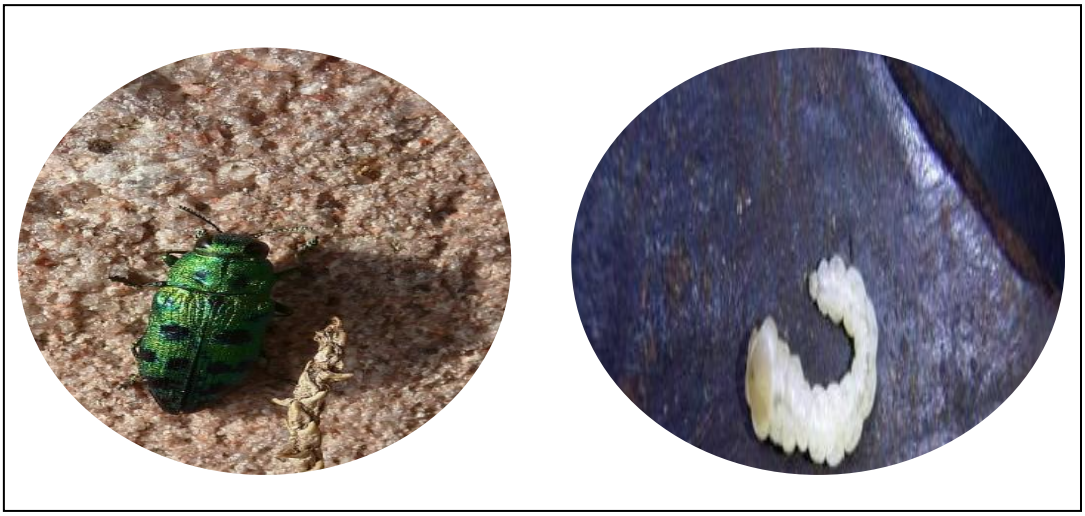
The Thuya buprest has various Latin synonyms and in particular:

Lampra festiva, Ovalisia festiva, Palmar festiva, Scintillatix festiva.

Morphology

Adults are 7 to 11 mm long, elongated and ovoid in shape. They are green with metallic highlights. The pronotum has a dark purple spot in each of the two lateral depressions. The elytra have small spots at their base and apical part and large macula in the middle. They also have well-marked striations and finely denticulated lateral edges. The head, partly engaged under the prothorax, is perpendicular to the body and not very mobile. The antennae are short and made up of 11 articles. The tarsi have 5 articles. The flat, legless larvae, measuring up to 25 mm long with a large head. The nymphs are naked, white, very soft, flat and hairless,

(fig. 3).



Adult Larva

Figure. 3. Ovalisia festiva, (Nichane, 2011)

Biology

The larvae develop at the base of the branches and in the trunk by digging subcortical galleries, which affect the conductive tissues. These galleries are sinuous, flattened and wide. The larvae pupate at the end of March and beginning of April in the sapwood after having turned over or in the bark when it is thick.

Adults emerge from May to August. Heliophiles and thermophiles, they are very active in full sun during the hot hours of the day. The rest of the time they take shelter and remain motionless. The adults fly in the sun and rest at the ends of the branches.

After mating, egg laying immediately follows. Females lay eggs in cracks in the bark of stems or trunks. The insect cycle is annual with passage from winter to the larval state (Akiyama, 1987).

By digging galleries (the larvae), they prevent the circulation of sap and cause yellowing and then browning of the branches which eventually dry out. With a little attention, we can observe oval holes corresponding to the bupreste on the branches extending from the trunk (Fig. 4).

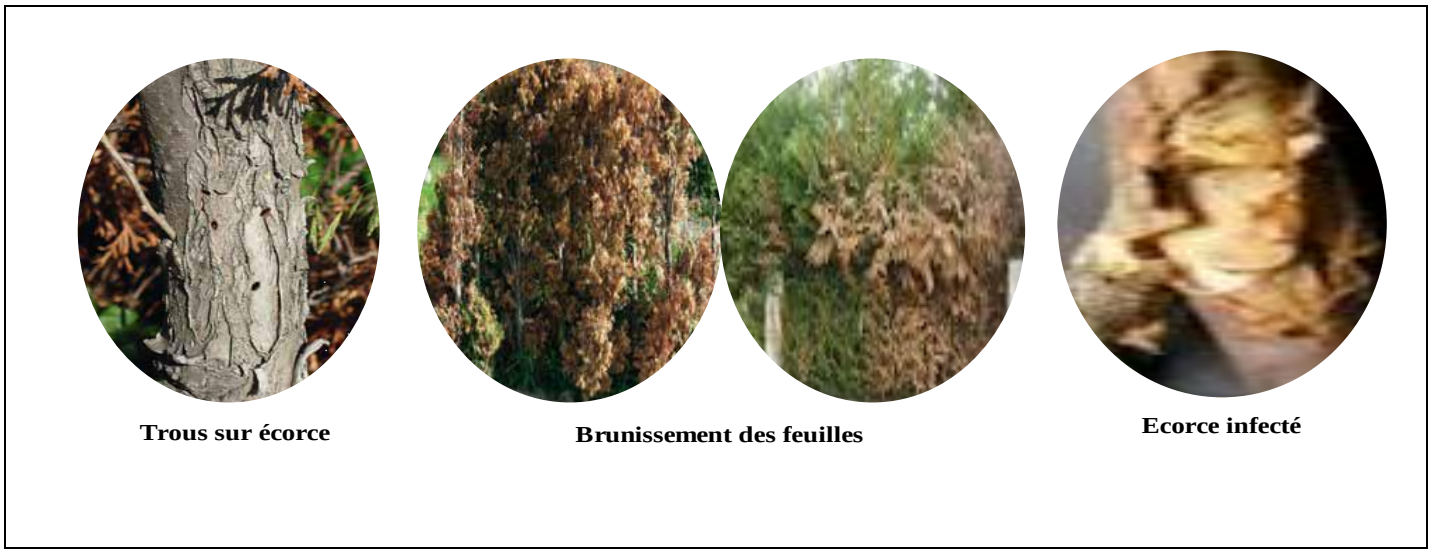


Figure. 4. Damage of the bupreste Ovalisia festiva on Thuya, (Nichane, 2011)

Variability of attack rate in relation to stationary parameters

The station factors taken into consideration for the analysis of variance at the 95% threshold are: altitude, exposure, microrelief, slope.

Attack rate – altitude relationship

A possible attack rate – altitude relationship is highlighted through one-way analysis of variance at the 95% significance level. It appears that the attack rate presents significant variability in relation to altitude to the extent that observed “F” is significantly greater than theoretical “F”. In fact, the attack rate decreases as altitude increases.

Table 1. Analysis of the variance of the attack rate in relation to altitude at the 95% significance level

	F observed	**theoretical F**	**Meaning**
Attack rate	6. 41230011	4.01870267	Significant

Attack rate – exposure relationship

The analysis of the variance of the attack rate in relation to the exposure presents significance. Despite this low variability, we note that trees exposed to relatively high periods of sunshine are the most likely to be attacked by this buprestid. Nearly ¾ of the inventoried trees judged to be susceptible to this insect are exposed in the E – NE direction.

Table 2. Analysis of the variance of the attack rate in relation to exposure at the 95% significance level

	F observed	**theoretical F**	**Meaning**
Attack rate	3. 54895322	3.05213008	Significant

Attack rate – microrelief relationship

The structure of a microrelief contributes more, compared to the relief as a whole, to stationary differences essentially in temperature, humidity and light (Guinier, 1995). Through the analysis of attacks (i.e. 65%) is recorded at the level of an intermediate microrelief.

Table 3. Analysis of the variance of the attack rate in relation to the microrelief at the 95% significance level

	F observed	**theoretical F**	**Meaning**
Attack rate	3. 00110800	2.83116901	Significant

Attack rate – slope relationship

The degree of inclination of the terrain determines the stability of the soil and water retention (Khanfouci, 2005).

Analysis of the results shows an increasing rate in relation to the slope of the land. In fact, the attack rate is high in uneven terrain (over 25°).

Table 4. Analysis of the variance of the attack rate in relation to the slope at the 95% significance level

	F observed	**theoretical F**	**Meaning**
Attack rate	3. 89567345	3.01342678	Significant

Variability of the attack rate in relation to the dendrometric parameters of the tree

The dendrometric parameters of the tree taken into account in this study are: height, circumference at 1.30 m and density.

Attack rate – tree height relationship

The variability of the attack rate in relation to the height of the tree is significant (observed F > theoretical F). The average attack rate calculated on trees varies from 16% at the first meter to 37% at the third meter. At four meters the rate decreases to 21%, where the crown generally begins to form, the thickness of the bark at this time is thin limiting the penetrations of the bupreste.

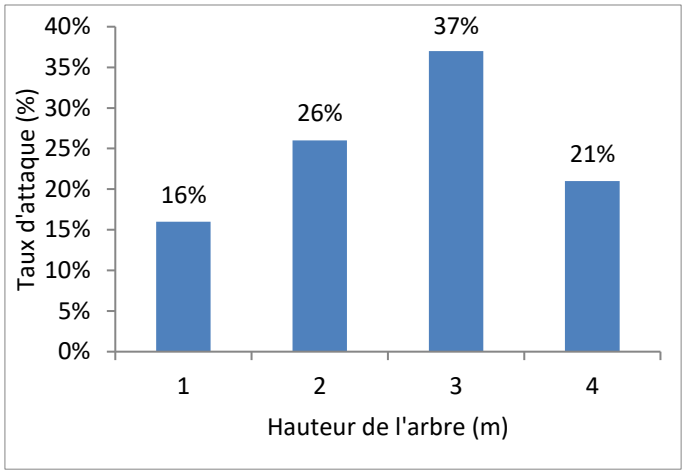


Figure. 5. Average attack rate depending on tree height

Table 5. Analysis of the variance of the attack rate in relation to the height of the tree at the 95% significance level

	F observed	theoretical F	Meaning
Attack rate	3.00023510	2.45327601	Significant

Attack rate relationship – circumference 1.30 m

The one-way analysis of variance at the 95% significance level indicates significant significance, as it was noted that large trees are the most attacked. This allows us to affirm that the diameter and its chemical constituents largely explain the choice of females for the emission of their eggs.

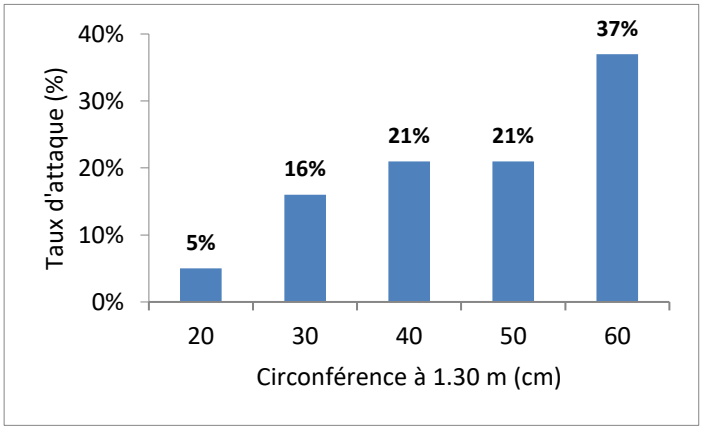


Figure. 6. Average attack rate depending on circumference at 1.30 m

Table 6. Analysis of the variance of the attack

rate in relation to the circumference at 1.30 m at the 95% significance level

	F observed	**theoretical F**	**Meaning**
Attack rate	3.41409152	3.30138061	Significant

Attack rate – density relationship

Density is an excellent criterion expressing the level of competition between individuals in a given population. Based on density stratification, analysis of variance at the 95% significance level reveals a significant difference. This is the notion of living space.

Table 7. Analysis of the variance of the attack rate in relation to the population density at the 95% significance level

	F observed	**theoretical F**	**Meaning**
Attack rate	3.41409152	3.30138061	Significant

Conclusion

The attack of this buprestid causes browning and death of the branches or the entire plant. Under the bark are galleries filled with brown sawdust, dug by the larvae directed towards the top of the tree. Attacks vary from one tree to another. However, the gradient of attacks observed as a function of height on the trees considered is comparable for certain subjects and remains variable for several other trees. Trees are infested to relatively different degrees. Significant population movements occur during the annual cycle and over time. These movements allow for great variability in the distribution from one year to the next. The calculated attack rate is 58.33%, clearly showing the favorable conditions for the development of this insect.

By means of one-way analysis of variance at the 95% significance level, we seek to assess the appearance of the attack rate in relation to the various stationary and dendrometric variables. It appears that :

- The attack rate exhibits significant variability with altitude, as altitude increases the attack rate becomes less frequent.
- The attack rate varies slightly with exposure, almost ¾ of the inventoried trees judged to be attacked by this insect are exposed in the E – NE direction.
- The attack rate presents a significant variability in relation to the microrelief, (i.e. 65%) is recorded at the level of an intermediate microrelief.
- The attack rate presents a low variability in relation to the degree of inclination of the terrain. In fact, the attack rate is high in uneven terrain (over 25°).

- The attack rate shows significant variability in relation to the height of the tree. Between the third and fourth meter of the tree, the insect attack rate observed is high (37%).
- The attack rate varies significantly in relation to the circumference at 1.30 m. We note that from a diameter of 60 cm, the attack rate is significant.
- The attack rate shows significant variability in relation to density. In fact, the 150 plants/ha class is the one where the attack rate is the most recorded (41%).

To implement a strategy to protect these ecosystems against parasitic attacks, research must focus on various multidisciplinary approaches (biological, physiological, pedological, mycological, etc.). On the other hand, it must be supplemented by several sanitation actions, including the removal of dead trees from the forest to avoid their contamination or reduce insect population levels below an epidemic threshold. Reforestation of areas stripped of the same type of trees and maintaining permanent intervention by the forester are even more effective measures. Overall, monitoring and precautions are necessary to maintain the health of Tetraclines.

Studies on forest tree pests have mainly concerned species of the Pinacea family. Whereas, the study of Cupressaceae entomofauna is very limited. For this, it would be interesting for this work to remain as a link for other work to be coordinated in the future aimed at identifying certain parameters such as the detailed study on the attack strategy of this bupreste.

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