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Bio-ecologic Observations on Rhinoceros Beetle *Oryctes agamemnon* (Burmeister 1847) on the Palm Dates Oasis of Rjim Maatoug in South-western Tunisia

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Abstract: The culture of date palms (*Phoenix dactylifera* L.) plays a very important role in southern Tunisia both at socio-economic and ecological levels. It plays a major role in the national economy. However, palm trees are still facing many problems and constraints that have undoubtedly negative impacts on their normal growth and production. Today, a relatively new pest is assuming alarming proportions: the rhinoceros beetle, *O. agamemnon* Burm weakens the root system and renders the trees susceptible of falling off. *O. agamemnon* Burm is a *Coleoptera* insect of the family of *Scarabeidae*. The insect passes from egg into an adult by three larval instars, a prepupa and a pupa. The monitoring of the biological cycle of the insect at the laboratory and on ground showed that the pupal phase is carried out without hull. The sexual dimorphism is evident only with the big individuals. The most noticeable damage is caused by the larvae. The adult can cause damage on the trunk, on the trunk base and on other organs of the plant. The study of the stratification of the insect on the palm tree showed that the larvae are concentrated on the level of the collar and the root system, but also frequently set out along the trunk. The monitoring of the state of the infestation of manure showed that it is a very favourable medium for the multiplication of *Oryctes*. The study of population dynamics of adult revealed that the activity of adult of *O. agamemnon* in the oasis of the region starts by the beginning of June until mid-November.

Keywords: Adult activity, Date palm, Larva, Manure, *Oryctes agamemnon*

1. Introduction

The culture of date palms (*Phoenix dactylifera* L) plays a very important role in southern Tunisia both at socio-economic and ecological levels. It plays by now an undeniable role in maintaining human populations in arid regions where natural resources are limited and living conditions are difficult. So it is a stabilizer of economy in these regions, allowing the survival of about 4.5 million people worldwide (Dutuit *et al.*, 1991). In Tunisia there are about 10% of the population who earn their living from the palm dates' sector (EL Hadrami *et al*., 1998). Date Palms play a crucial role in the struggle against desertification, maintaining an ecological balance and contributing to the conservation of a fragile ecosystem. In addition, this tree can grow under conditions of temperature ranging from 12 to 50 ˚C with little or no moisture and can be irrigated with very alkaline water (Leroy, 1958). It is also a shelter for many indigenous plant and animal species. Moreover, the Tunisian oasis is characterized by a considerable genetic wealth as evidenced by the presence of at least 250 cultivators listed (Rhouma, 1994). In spite of the great efforts to optimize production, palm trees are still facing many problems and constraints that have without any doubt negative impacts on their normal growth and production. Those problems include water stress, excess of salinity, drainage and many diseases and pests. Some major pests of date palms are present in Tunisia (Dhouibi, 1991). The mite *Oligonychus afrasiaticus* affects essentially the fruit. The white scale *Parlatoria blanchardi* colonizes all parts of the tree. The larva of the moth *Ectomyelois ceratoniae* infests the dates internally. Several fungal diseases of date palms are known in Tunisia. *Mycosphaerella tassiana* causes brown spots on midribs, leaflets and thorns. *Diplodia phoeniceum* affects essentially leaves of offshoots and the lethal disease: "Brittle leaf disease" or, in French, "Maladie des feuilles cassantes" (MFC) that has affected or killed up to 40,000 date palm trees in the Djerid region of Southern Tunisia since the 1980s (Takrouni *et al.*, 1988; Triki *et al*., 2003). Today, a relatively new pest, is assuming alarming proportions: the rhinoceros beetle, *O. agamemnon* weakens the root system and renders the trees susceptible of falling off. Rhinoceros beetle of the genus *Oryctes* are important pests of palms, in Southeast Asia, North Africa and some Pacific islands. (Hallet *et al*., 1995; Rochat *et al*., 2004). *O.*

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agamemnon (*Coleoptera*, *Scarabaeidae*) was accidentally introduced in the southwestern oases of Tunisia. It was identified for the first time in 1995 in Tozeur (Khoualdia *et al*., 1997), and introduced to Rjim Maatoug after the creation of new oases. Its introduction without the natural controlling factors allows it to reproduce quickly and spread to become a serious pest. Thus, it is necessary to study the bio-ecology of *Oryctes* in order to develop methods that may help fight this pest.

2. Materials and methods

Our investigations started at the beginning of 2003 in the oasis of Rjim Maatoug. It is an area which lies within 120 kilometres in the south west of kebili. It is characterized by a continental Saharan climate, an average rainfall lower than 100 mm/year, an average temperature of 21˚C with extremes of +55˚ in summer in the shade and -7 ˚C in winter, ETP = 2200 to 4300 mm/year and a very filtered sandy ground. Our study reached the entire oasis of production in this area (Rjim Maatoug 1 and 2, Ferdaws 1 and 2 and Nasr 1 and 2), occupying a total surface area of 1452 hectares. The study of bio-ecology of the *Oryctes* was carried out by visiting the oasis to follow the state of the infestation, to collect the various stages of the insect and carry out a research about their different biotopes. The larvae and adults were collected alive in plastic vats. The rearing of larvae and adults collected was undertaken at the laboratory on an artificial substrate. The dynamics of the populations of the insect in the oasis ecosystem was conducted based on the capture of the adults using a luminous trap over the year 2005. The collection of trapped adults was realized every week. In what concerns measurements of different biological stages of *Oryctes,* we used a rule and a binocular magnifying glass type Euromex.

3. Results and discussion

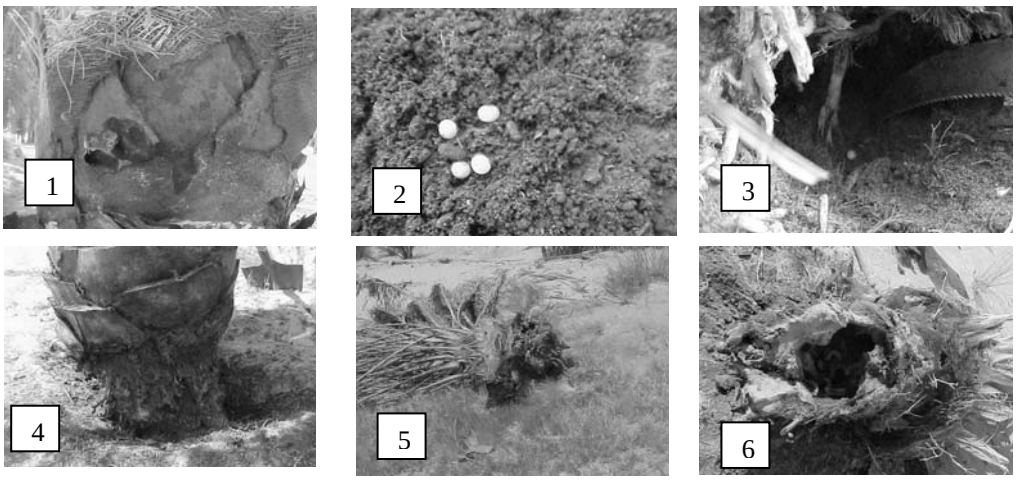
3.1. Description and biology of *Oryctes*

Oryctes is an insect with complete metamorphosis. Its reproductive cycle consists in five instars: the egg, the larva, the prepupa, the pupa and the adult. The insect has brown shining colour. It is cylindrical, lengthened and very convex. It also possesses a characteristic cephalic horn which is larger for males. Measurements carried out on some adults at the level of laboratory showed that males have these dimensions: 25-39mm long and 13-19 mm breadth whereas females are 22-38mm long and 12-19 mm breadth. Our observations at the laboratory confirm what is said by, Rochat (unpublished), that the sexual dimorphism is not obvious only for the bigger individuals and it is possible to recognize undoubtedly the male and female through the examination of the end of the abdomen ventral face. For the male the last segment is narrow with more or less parallel edges and with a notch in the middle of the posterior edge, whereas for the female the last segment is clearly triangular with a point in the middle of the posterior edge. The egg is of white opaque colour and oval form to the laying. Progressively with incubation it becomes almost round. Its sizes are on average 3.14 mm length and 2.22 mm width. The eggs are generally found either lonely or grouped (2 to 4) in the same galleries on the level of the collar and the base of the dry petiole on the stem (**Fig. 2**). The larva of *Oryctes* is lengthened, cylindrical and thick, curved in arc of circle having three pairs of thoracic leg and crushing mouth. Measurements at the laboratory showed that its length varies between 6.4 and 87 millimetres. The prepupa is a stage of preparation to the pupal phase and the shift to this stage is marked by the absence of sloughing. Thus, we can say that, when the larvae reach the maximum growth point in the late third instar phase, they stop feeding and begin the preparation for the pupal phase. This cessation of breeding is accompanied by many transformations such as the regression of size, a contraction of the legs etc.. This stage was not mentioned by Lepesme (1947), but during our work either on field or at the laboratory we met this stage, as indicated by Balachowsky (1962) and Soltani *et al*. (2008 a). The pupa is characterized by the differentiation of the majority of the external bodies and a white colouring which changes gradually into yellow then into orange and at the end reaches clear brown. According to taken measurements we note that the nymph can reach a 40.8 mm length and a width of 16,8mm. According to Lepesme (1947), the phase of pupa occurs in hulls built from remains agglomerated by the larva of the last stage; or our observations on fields and at the level of rearing at the laboratory did show that the phase of pupa is carried out without a pupal cell. We noted only the presence of tegument of the prepupa after his metamorphosis into nymph and the tegument of the nymph following his transformation into an adult. The follow-up of the insect on oases shows that the larvae of this beetle

meet on the base of the trunk of the palm trees (collar) and on the stem. They are particularly harmful to the roots; especially the third instar; since it is the longest developmental stage of larvae; which can devour the tissue and the root on the level of the collar anyway and constitutes larger holes (**Figs. 3** and **4**). The repetition of the phenomenon, over many years, constitutes a potential danger to the whole palm tree and can result in an unbalance by the weakening of its basal support, and as a consequence, increasing the risk of collapse (**Fig. 5**). They are also harmful to the new planted offshoots by reducing the percentage of resumption (**Fig. 6**). We met damage on the basis of the palms, into the base of cluster of fruits. This damage might be caused by the adult which, according to Lepersme (1947), seeks the tender wood.

3.2. Stratification of damage

When the problem first appeared, all the orientations were concentrated on the buried zone of the palm tree (Figs. 3 and 4) where we met the greatest number of larvae and where the damage is easier to observe; especially at an advanced attack; following the appearance of a brown powder similar to compost, that was scattered on the ground at the level of the trunk base. For this reason, the intervention by collection and destruction of various bio-stages of the beetle was exclusively at this level. But our investigations revealed that the larvae are distributed along the stem by arranging galleries (**Fig. 1**) which pass unperceived, especially that they are protected by the dry base leaf. This prevents us from determining the trunk situation, whether it is infested or not. Our results correspond to the results cited by Soltani *et al*. (2008 b) that the existence of larvae in the stem is not very dangerous to the palm tree but it constitutes a nest for the breeding of this insect.



Figs. 1 to 6. (1) damage of larvae on the dry petiole and sheath at the level of stem; (2) eggs on the stem; (3 and 4) damage of larvae at the base of stem; (5) collapse of date palm; (6) offshoots damage.

3.3. Control of the state of manure infestation

The manure is largely used in the oasis by the farmers to fertilize their oasis. To explore the different biotopes of the insect, we gave a special attention to this. The analysis on the level of the manure put in the trench in the oasis showed us the presence of larvae of *Scarabeidae* which have a very great similarity to the larvae of *Oryctes*. In order to determine the species, we collected some larvae which reared at the laboratory. In a few weeks, the larvae have become adults. This result enabled us to confirm that this is the *Oryctes*, specifically *O. agamemnon.* As such, the manure and organic matter in a general way is a favourable environment for the development of *Oryctes* and is very dangerous since it increases the spread of the insect.

3.4. Adult activity

Population monitoring has been carried along the year 2005 (**Fig. 7**). A total of 740 beetles were captured by one luminous trap. Weekly captures, which were nil in January, February, March, April, and

May have increased from the beginning of June until the mid-July. Then, they have oscillated around that level until the third week of September with a sharp peak of capture at the beginning of August (135 beetles) and decreased regularly to become again nil at mid-November.

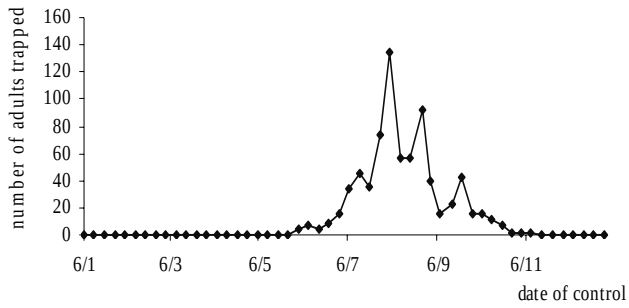


Fig. 7. Activity of the adults of *Oryctes agamemnon.*

4. Conclusion

The culture of palm dates plays a very important role in the southern part of Tunisia both at the socio-economic and ecological scales. It is a stabilizer for the economy in these regions, and a real front against the wandering desert. However, palm trees are still facing many problems and constraints that have without any doubt negative impacts on their normal growth and production. A relatively new pest is leading to alarming proportions: the root borer, *O. agamemnon* weakens the root system, and renders the trees susceptible of falling off. The observations that we have undertaken on *Oryctes* show that the larvae of the insect exist on palm trees throughout the year and they are more harmful to the tree than adults. Manure is a favourable environment for the proliferation of *Oryctes* and is a very dangerous means of propagation of this pest. The study of adult dynamics has shown that the adult population of *O. agamemnon* in the oases begins from the beginning of June until mid-November. Currently we are interested in an indigenous entomopathogenic nematode which is the subject of a study that can be used in an integrated Program to fight against the pest.

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