

Role of the dates volatiles compounds on the date moth *Ectomyelois ceratoniae* (Lepidoptera: Pyralidae) infestation

Arif Yaakoub¹, Lombarkia Nadia² And Laamari Malik³

1. National institute for agronomic research of Algeria (INRAA)

2&3. Batna University Algeria

yaksimya@yahoo.fr

ABSTRACT

The study conducted at the INRAA Sidi Mahdi - Touggourt station on the interaction between the dates moth *Ectomyelois ceratoniae* (Lepidoptera: Pyralidae) and some Algerian date palm varieties, namely Deglet Nour, Ghars and Degla-Beidha reached the following results: For all varieties combined, the rate of infestation by *Ectomyelois ceratoniae* is about 4%. Among the three varieties studied, the Deglet-Nour is the most infested with a rate of 7.75% and Degla-Beidha is the least infested with a rate not exceeding 1.5%, while Ghars variety, introduced a rate 4.5% of attack. The behavioral tests carried out by means of an olfactometric technical (flight tunnel), we have investigated the response of *E. ceratoniae* females for the various sources of odors; over 73% of those tested have been flying, 54% of females responded positively to various stimuli, whereas 19.42% of themes have sailed into the flight tunnel, but without choosing a source of odor. In addition, 26.28% of the individuals have shown no reaction to the fumes spread through the air flow sweeping varieties. Depending on the stimuli (positive response), the Deglet-Nour was attractive for 50% of females tested (175 individuals), followed by the Ghars variety with 36% and Degla-Beidha with 14% of individuals tested.

Concerning the volatiles compounds identified by GC. We found that the Deglet-Nour was rich with alcohols (2-propanol, ethanol, 1-propanol and 1-butanol) and the aldehyde (acetaldehyde). On the contrary, the Degla-Beidha was poor for some substances, specially the aromatic part presented by acetaldehyde, where the volatile mix contains only three alcohols included: 2-propanol, ethanol and 1-propanol. On the Ghars variety, in turn, it lacks the aromatic fraction (acetaldehyde), but it is provided with all the alcohol fraction targeted.

Keywords: dates variety, Deglet-Nour, Degla-Beidha, Ghars, flight tunnel, olfactometry.

INTRODUCTION

Date palm currently has an economic importance for Algeria to the extent that it is considered the second source of foreign exchange after oil. The Algerian phoenicicole Heritage is estimated more than 16 million date palm with a production of 492,188 tonnes (Anonyme., 2012).

Cultivars Deglet Nour, Ghars, Degla - Beidha and Mech-Degla occupy about 70% of phoenicicole heritage. The most productive areas are Oued-Righ, Zibans and Souf (Anonyme, 1996; Anonyme, 1999).

However, this culture faces several constraints, among other things, the Bayoud, which is an infectious vascular fungus called *Fusarium oxysporum* special form albedinis. In addition, the date moth *Ectomyelois ceratoniae*

Zeller (Lepidoptera: Pyralidae) is considered the most redoubtable pest dates and as the main constraint to the Algerian dates export (Doumandji, 1981).

In Algeria, the economic importance of *Ectomyelois ceratoniae* place it in the second ranks after the Bayoud disease (Doumandji, 1977). According to Munier (1973) *Ectomyelois ceratoniae* may cause damage that can sometimes reach 80 % of the harvest.

Ectomyelois ceratoniae is a polyphagous pest, may ingest multitude of fruits other than the dates. This polyphagia has encouraged more its geographical extension giving it the appearance of cosmopolitanism (Doumandji 1976; Doumandji, 1981). These authors add that, this moth is present in areas that extend from the Hawaiian Islands, Florida, the Caribbean, the northern part of Argentina, the Mediterranean basin (southern Europe, the Middle East and North Africa) the belt from the Sahara desert to Iran, around the Cape in South Africa and Madagascar (Doumandji 1976; Doumandji, 1981).

To better understand this subject, it is considered useful to conduct this study on three cultivars of dates most widespread in Algeria to determine the preferences of the date moth at the oviposition time.

Most of the works done on the interactions *Ectomyelois ceratoniae* - host plants, including the date palm, are focused on the pest - host plant relationships, describing mainly attack strategies developed by the pest, during its life cycle in response the biological needs (nutrition and oviposition). However, little is known about the factors and behavioral, physiological and / or chemical underlying these interaction mechanisms.

MATERIALS AND METHODS

Two kinds of materials were used for this study. There are three varieties of date palm *Phoenix dactylifera* L. (Deglet-Nour, Ghars and Degla-Beidha) and date moth *Ectomyelois ceratoniae* Zeller (Lepidoptera, Pyralidae).

To get an idea of the action of cultivars on the oviposition behavior of *E. ceratoniae* in the field and in the laboratory, there shall monitor the rate of infestation of selected cultivars. It opted for the method of Warner (1988), which is a weekly sampling of 100 dates for the 20 palm representatives each cultivar. After identification and sexing caterpillars, a mass-rearing is made to have a sufficient biological material. Olfactometric tests under controlled conditions are recommended to study the action of plant odors on the behavior of insects. In this study, the behavioral tests of *E. ceratoniae* are made as proposed by Baker et al. (1991); Cosse et al. (1994); Mechaber et al. (2002); Dallaire (2003)

and Ingwild et al. (2007). The principle of these tests is to expose fertilized females of the *E. ceratoniae* located in a flight tunnel to airflow sweeping cultivars studied (in pairs) by selecting the following parameters: Flight orientation of moths and their flight duration; number of individuals which touching the odor source or landed at about 10 to 50 cm from the odor source. Each moth touching the odor source or landing at about 10 to 50 cm of this source is considered a positive response against various stimuli.

As to the flight tunnel, is a laboratory device used to measure and compare the behavioral responses of insects under controlled conditions. This tunnel is crafted according to the method described by Cosse et al. (1994). This is a Plexiglass tunnel whose dimension are 180 X 50 X 50 cm. Pure air flow come from an air pump, passes through a plastic hosepipe to a flow meter (rotameter) provides with an active carbon filter to control and purify its flow. It then passes through another micropore filter (0.2 µ) for further purification. This air then reaches the flask filled to 2/3 of its volume with distilled water to moisten it. The air flow is then conducted through two hosepipes to two jars containing the stimuli (dates) to be analyzed. These hosepipes are connected to the flight tunnel.

A comparative study of volatile compounds from three cultivars (varieties) of dates was conducted through a Gas Chromatography (GC), to explore the substances considered by Gothilf (1975); Coss et al. (1994) as oviposition stimulant for the *E. ceratoniae* specie. It is Ethyl Hexanoate, Acetaldehyde, Ethanol, 1-propanol, 2-propanol and 1-butanol.

In this study, statistical analysis methods applied are Factorial Correspondence Analysis (FCA) and Principal Component Analysis (PCA) using Gostat software.

RESULTS AND DISCUSSION

The results show a variation in infestation levels depending cultivars (varieties). Among the three cultivars studied, Deglet-Nour is the most infested, with a maximum rate of 7.75 %, followed by Ghars (4.5 %) and Degla-Beidha (1.5 %) (Fig. 1).

Behavioral testing via the olfactory technique (flight tunnel) have reviewing behavioral responses of mated females in position according to choose between two different odors combinations. 73, 42% of the individuals tested took flight, whose 54% responded positively to various stimuli, while 19.42% took the flight but no choice. In addition, 26.28 % of the individuals tested showed no reaction to the airflow sweeping three cultivars of dates. (Fig. 2).

Inactive females can be divided into two groups. There are those who have not responded to pure air (49 individuals), that to say 14%. There are also those who

remained inactive even though they are exposed to various stimuli (43 individuals) whether 12.28% (Tab.1) .

It is noticed that the activity of females is important when exposed to air flow from two stimuli (cultivars) compared to those from a single cultivar combined with pure air.

Moreover, it is noticed that in any combination, Deglet-Nour is the most attractive cultivar. Among the 350 females tested, approximately 50% are attracted by Deglet-Nour, 36% by Ghars and 14% by Degla-Beidha (Fig. 3) . Among the 350 females tested, 188 individuals (54%) responded positively to the air flow from the three cultivars of date. 59% of active females have reached the odor source, while 41% were landed at a distance of 10 to 50 cm from the source, the majority of females have completed their flight in an interval of 1-10 minutes.

The analyzes results of volatiles compounds of the three dates varieties have been detected 5 volatiles compounds among the 6 sought. The cultivar Deglet-Nour is richer in volatile compounds emissions include alcohols (2-propanol, Ethanol, 1 -propanol and 1- butanol) and Aldehyde (Acetaldehyde). In the other side, Degla - Beidha proves poor in aromatic compounds and the volatile bunch includes only 2 - propanol, 1 - propanol and Ethanol . Regarding Ghars cultivar, it is devoid of the aromatic fraction (Acetaldehyde), but it is rich with the entire target alcoholic fraction.

The Factorial Correspondence Analysis (FCA) shows that of the 07 characters analyzed, 3 are discriminating, namely: the infestation rate (INFES), presence or absence of Acetaldehyde (ACTAL) and 1- butanol (1BUTA) . From the data shown in Table 5, it is found that the axis 1 which contains most of the information is explained mainly by the following characters: Acetaldehyde (ACTAL) and 1 -Butanol (1BUTA) who contributed to the inertia explained by axis 1 with 16.1% and 20.1 %, respectively. On the entire graphic, Acetaldehyde (ACTAL) and 1 -Butanol (1BUTA) contributed to the total inertia shown by weight of 13.25 and 10.60% (Table 5).

The cultivars studied are classified into three groups (Fig. 4) :

Group 1: represented by Deglet-Nour, characterized by a high rate of infestation (7.75 %) and the presence of volatile compounds : Acetaldehyde (ACTAL) and 1 -Butanol (1BUTA) .

Group 2: represented by Degla-Beidha, characterized by a low rate of infection (1.5%) and the absence of volatile compounds: Acetaldehyde (ACTAL) and 1 -butanol. (1BUTA) .

Group 3: represented by Ghars, characterized by means infestation rate (4.5) and by the presence of volatile compounds : 1 -Butanol (1BUTA) and the absence of Acetaldehyde (ACTAL) .

The most contributing factors to infection are Acetaldehyde (ACTAL) and

1 - Butanol (1BUTA) . Indeed, Deglet-Nour is more attacked (7.75 %) in that it contains two compounds that are oviposition stimulants for the *E.ceratoniae*.

Degla-Beidha recorded the lowest rate of infection (1.5%), this is probably due to the absence of Acetaldehyde (ACTAL) and 1 - Butanol (1BUTA).

Concerning Ghars cultivar, it presented a single compound, (1- Butanol) . This may explain its intermediate infestation rates between the Deglet-Nour and Degla-Beidha .

The infestation rate in the field and behavioral tests in the flight tunnel are perfectly consistent in varietal choice of this pest. Indeed, RENWICK and CHEW (1994) considered that in Lepidoptera, research, guidance and recognition are the first phase of selecting a suitable site for oviposition . Reactions orientations of females of this moth in flight tunnel reflect a fairly clear difference of the stimulants spectrum emitted by dates of each cultivar. The orientation of the females at the time of oviposition seems to be related to secondary metabolites emitted by ripe dates of each cultivar, which finally determines the rate of infestation.

From the results, it is found that the varietal selectivity of *E.ceratoniae* is apparently related to the composition of the volatile bunch and more particularly the amount of Acetaldehyde and 1-Butanol emitted by each variety.

CONCLUSION

The results of the study on the interaction between the date moth *Ectomyelois ceratoniae* and three cultivars of Algerian dates namely Deglet-Nour, Degla-Beidha and Ghars. This study allowed to retaining the following: The infestation rate in field and olfactometry laboratory tests are in complete concordance. Deglet-Nour is more infested in the field and the most attractive in the flight tunnel. The Ghars cultivar occupies 2nd rank and Degla-Beidha took the 3rd place.

Varietal selectivity of *E.ceratoniae* is apparently related to the composition of the volatile bunch emitted by ripe dates of each cultivar. It may be that the Acetaldehyde and 1 -butanol fraction as olfactory stimulant, is critical to the *E.ceratoniae* females orientation at the oviposition moment for choosing a laying eggs site.

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Table

Table 1. Effectifs et comportement des individus d'*E. ceratoniae* exposés aux différentes odeurs dans le tunnel de vol.

	Number of individuals tested = 50/test						
	Air pur	D.Nour /Air pur	D.Beidha /Air pur	Ghars / Air pur	D. Nour / Ghars	D. Nour / D. Beidha	D. Beidha /Ghars
Active	0	35	19	32	40	33	30
Inactive	49	6	21	8	2	2	4
Sans choix	1	9	10	10	8	15	16

Figures

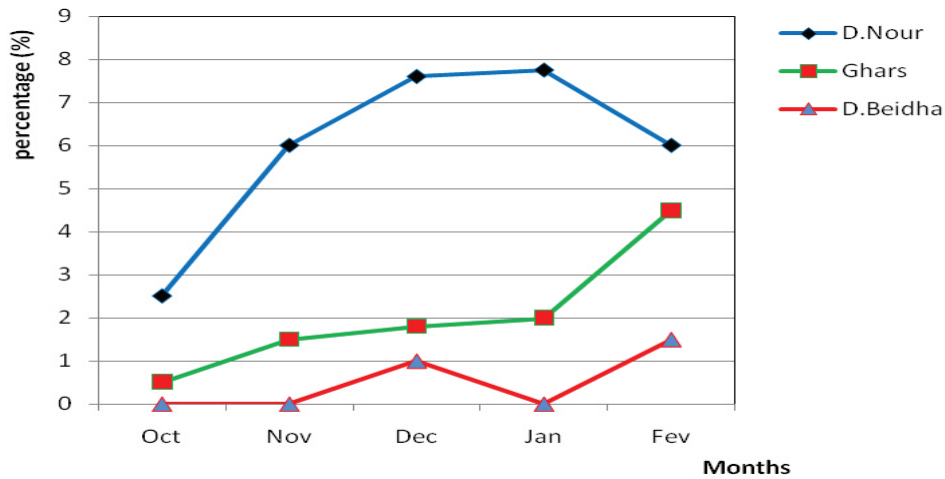


Fig1. Infestation level of the dates by *E.ceratoniae* in function of the three Algerian dates varieties

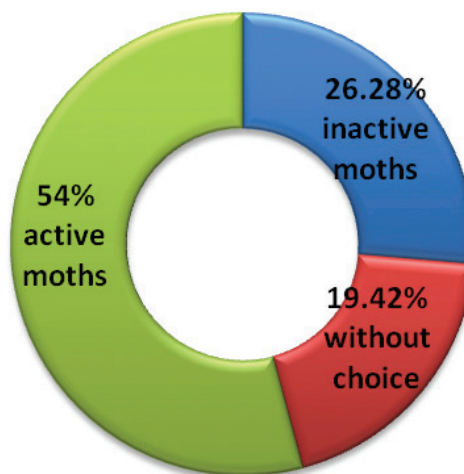


Fig. 2 Behavior of the *E.ceratoniae* individuals exposed to the odors of three dates varieties in the flight tunnel

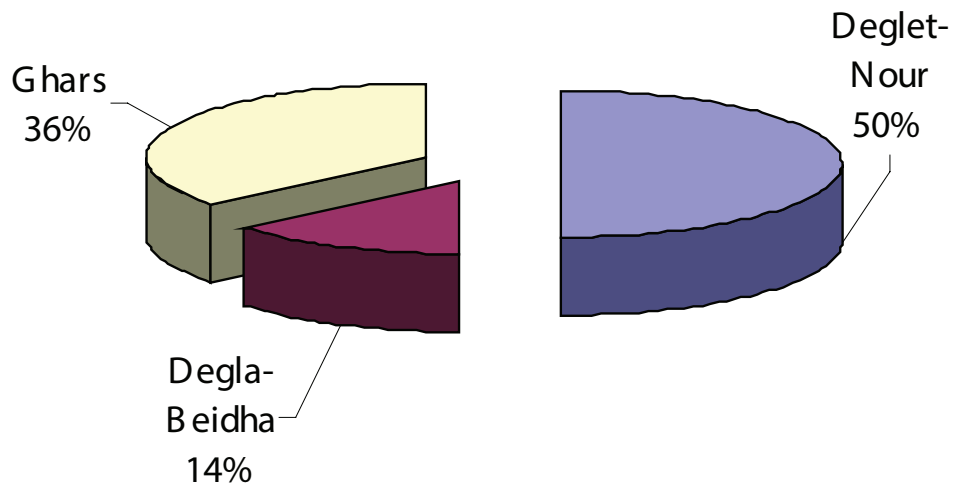


Fig. 3. Distribution of the active *E. ceratoniae* females as a function of the odors emanate from three cultivars of dates in the flight tunnel.



Fig. 4. Simultaneous representation of cultivars (observations) and variable