

# Color Preference of *Frankliniella occidentalis* (Pergande) (Thysanoptera; Thripidae) and *Orius* sp. (Hemiptera; Anthocorridae) Populations on Two Rose Varieties

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## ABSTRACT

A study of the preferential choice of *Frankliniella occidentalis* Pergande revealed the presence of a phototropism of this pest towards the petal color of its host plant. The color of roses may influence infestation rates by Western Flower thrips. The white-cream rose variety 'Ociane' attracted more individuals of *F. occidentalis* than the red variety 'First-red' in the same greenhouse; 29.54 and 39.85 thrips/flower on 'Ociane' while only 12.40 and 29.59 thrips/flower recorded on 'First-red' on May 31<sup>st</sup> and June 14<sup>th</sup> 2007, respectively. In fact, those differences were highly significant almost throughout the entire study period. The predatory bug *Orius* sp. also showed a similar preference for the 'Ociane' than 'First-red', and thus followed the distribution of its prey.

**Keywords:** attraction, infestation degree, petals color, preferential choice, thrips

## INTRODUCTION

*Frankliniella occidentalis* (Pergande) is a polyphagous thrips species that attacks many plants belonging to several botanical families (Lewis 1973; Yudin *et al.* 1986). The origin of this pest is the Western part of the United States and specifically California. Its distribution was limited until the 1960s to the northwest part of the United States, Canada and Mexico. Thereafter, since 1970, it spread to many countries in different continents such as Europe, Africa, Asia and Oceania (Anonymous 2002; Kirk and Terry 2003). However, it is still considered a quarantine pest in Tunisia due to its ability to transmit viruses (Belharrath *et al.* 1994).

*F. occidentalis* may cause considerable damage to its host plant. On rose crops it is especially the inflorescences where damage is the most important. Generally this results in yellow spots and distortions of the attacked organ (Brun *et al.* 2004). Furthermore, during feeding of larvae and adults, scars are produced on leaves and white spots appear on petals, but these soon become brown, then dry and perforate. When scars affect flower buds these may not fully open. Attacked sepals become crimped and slightly discolored (Alford 1991; Brun *et al.* 2004).

Most thrips species have a preference towards certain varieties of the same host plant. This preference may be related to various parameters, among which is the wavelength of light reflected from the petals or leaves of the host (Bournier 1983; Hoddle *et al.* 2002). For flower-living thrips such as *F. occidentalis*, Walker (1974) recognized an order of decreasing preference for Thysanoptera: White, Yellow and then Red. This shows that certain species of thrips have a kind of positive phototropism which attracts them towards plant species over others. Plants that do not attract thrips due to the color of their flowers are thus less prone to attack (Gaum *et al.* 1994; Bournier 1983).

The aim of this study was to estimate the influence of two rose varieties petals color on the degree of infestation and the behavior of *F. occidentalis* and its predator, *Orius* sp., and to recognize the rose variety which attracts the

most thrips.

## MATERIALS AND METHODS

### Experimental site

The study was carried under a rose crop greenhouse in the region of Sahline (35°44'07.58"N, 10°43'36.69"E. Elevation: 14 m) which belongs to the Tunisian Central-Eastern coast during 2007 (from 19<sup>th</sup> April till 29<sup>th</sup> November 2007). Two varieties of rose crop were cultivated in the greenhouse: 'First-red' variety with red petals, and the variety 'Ociane' that has white-cream petals. Each variety is cultivated on two rows in the greenhouse: two rows laterally of the variety 'First-red' and two central ones for the variety 'Ociane'. The culture was conducted without treatments throughout the study period. Monitoring of temperature was provided through a weekly cycle thermo-hygrograph.

### Flower sampling

Each row in the rose crop greenhouse was divided into seven experimental fields, which make a total number of 28 plots. Three roses from different parts of the plant (apical, central and basal) were randomly sampled from each experimental field. 42 flowers were weekly cut from each variety of rose. Each sampled plant was marked that cannot be used for the following sampling.

### Study of the preferential choice in the laboratory

The study of the effect of petals' color of the host plant on the attraction of thrips and *Orius* sp. was made in the laboratory in bowls that each has a length of 35 cm and a width of 25 cm lined with white filter paper. In those bowls, one side was lined with petals of the variety 'First-red' and the other side was covered by petals of the variety 'Ociane'. Thirty thrips adults were released in the middle of each bowl, and their migration toward each side was recorded every hour. Same test was made for *Orius* sp. with same number of adults released in other bowls.

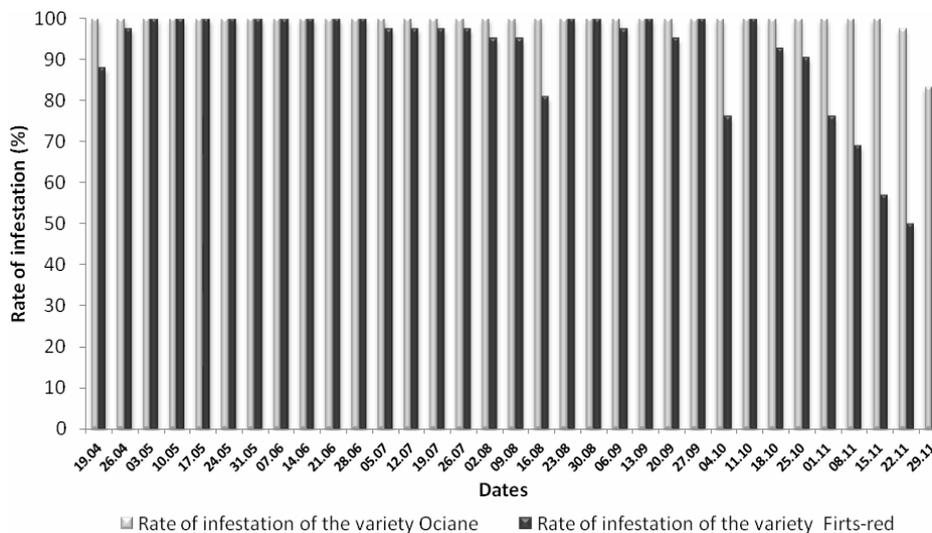


Fig. 1 Infestation rate of both varieties flowers in rose crop greenhouse in the region of Sahline (Tunisia) in 2007.

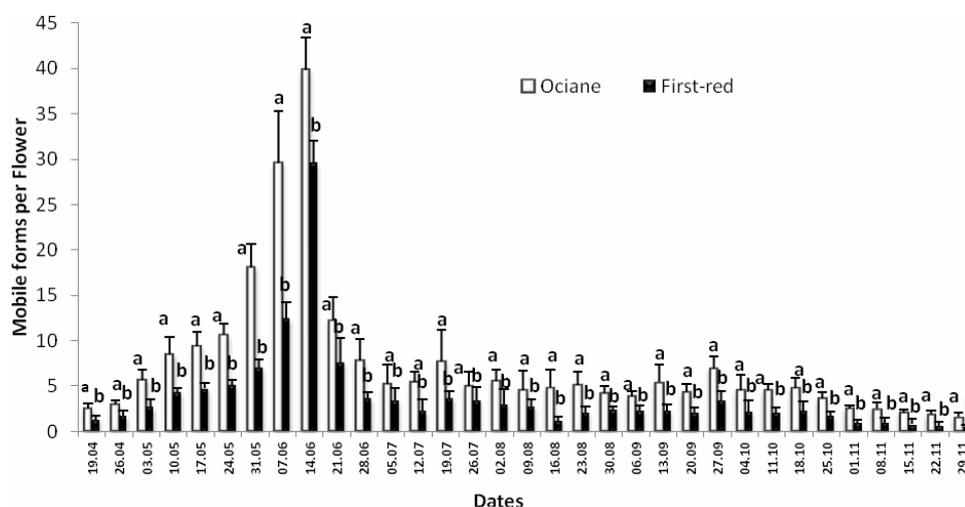


Fig. 2 Mean number of *F. occidentalis* mobile forms (larvae and adults) on both varieties in rose crop greenhouse in the region of Sahline (Tunisia) in 2007 (Means followed by the same letter are not significantly different  $p=0.05$ ).

## Statistical analysis

The statistical analyses were done by the statistical software program SPSS 17 (Statistical Package for the Social Sciences version 17) (SPSS 2008). This program was used for analysis of variance (ANOVA) and Duncan test to determine differences between individuals counted on each variety at  $P = 0.05$ .

## RESULTS

### Estimation of the infestation rate

The infestation rate of sampled flowers was made by monitoring attacked flowers number compared with the total number of observed flowers for each variety, knowing that a flower is recognized as infested if at least one mobile form of the insect is present in it.

The infestation of rose crop flowers by *F. occidentalis* was obvious throughout the study period with an infestation reaching often 100% of sampled flowers (Fig. 1) except during last few weeks of prospecting where the infestation rate has decreased. Concerning the rose varietal sensitivity toward *F. occidentalis* attacks, the variety 'First-red' with red petals is less attacked than the variety 'Ociane'. Indeed, the infestation rate at the variety 'Ociane' was higher than the variety 'First-red' and remains of around 100% during almost all the study period.

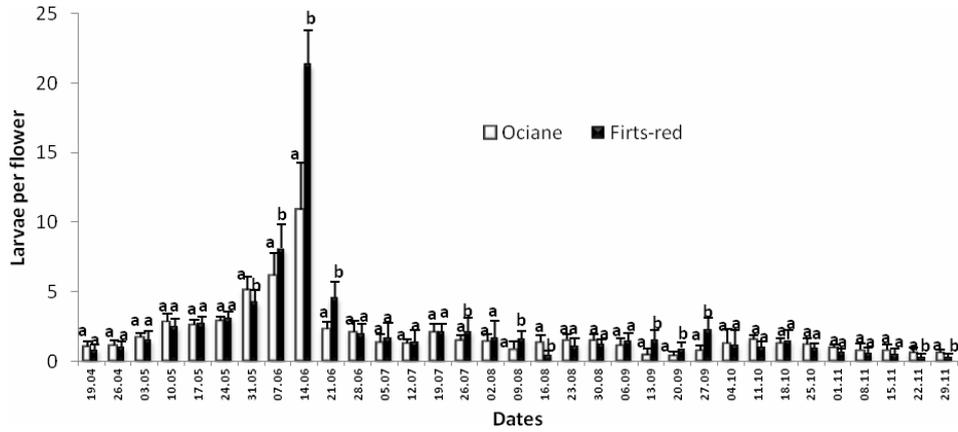
### *F. occidentalis* populations on both varieties

During this study, the variety 'Ociane' was the most damaged by the Western Flower thrips and represented the highest number of *F. occidentalis* mobile forms with a maximum average of 39.85 individuals on 14<sup>th</sup> June 2007, while in the variety 'First-red' only 29.59 individuals were noted for the same date (Fig. 2). This difference between both varieties, according to number of thrips, was highly significant throughout the study period showing thus the preference of *F. occidentalis* individuals to the variety 'Ociane' over the variety 'First-red'.

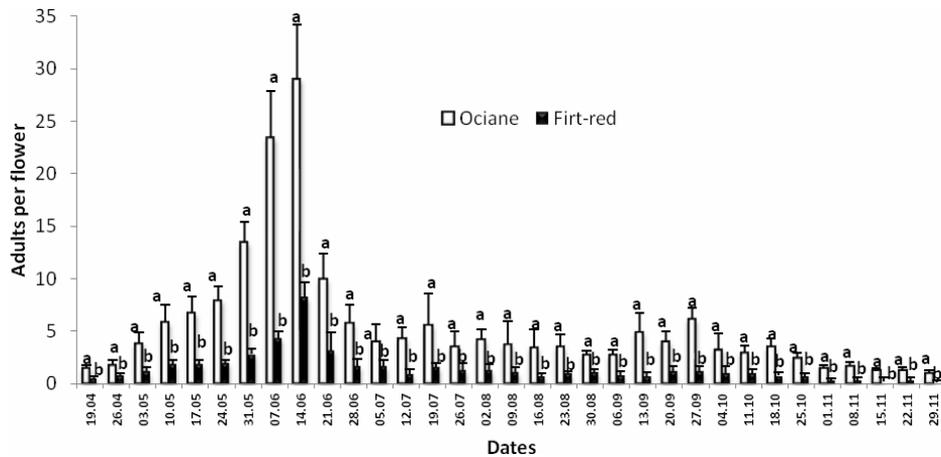
Concerning larvae and adults evolution, results did not reveal important differences between number of larvae on both varieties for almost the entire prospecting period (Fig. 3) except from 7<sup>th</sup> to 21<sup>st</sup> June 2007 where a highly significant difference was reported for the variety 'First-red' on which more larvae were encountered than on the variety 'Ociane'. Unlike larvae, adults are able to fly and to migrate from flower to another or even from plant to another (Bournier 1983). Throughout all the study period, the variety 'Ociane' hosted the highest number of *F. occidentalis* adults with highly significant differences compared to the variety 'First-red' (Fig. 4).

### Proportion of *Orius* sp. on both rose varieties

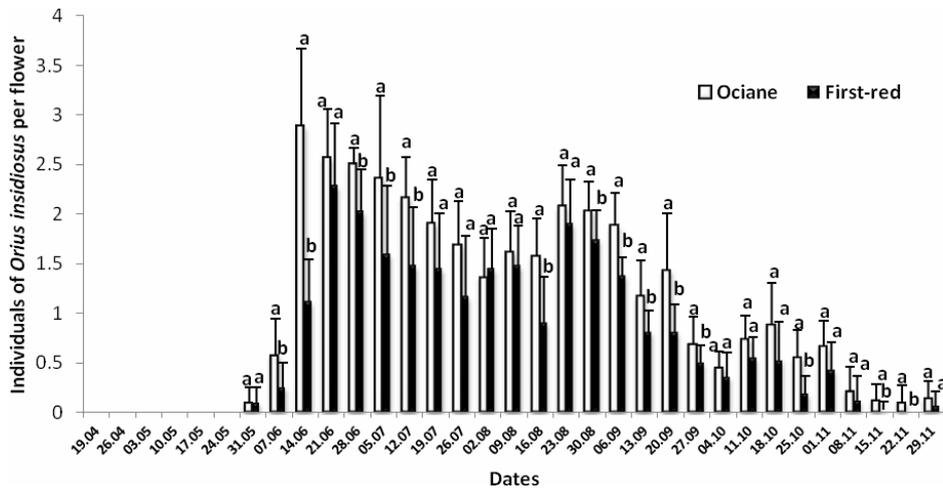
Monitoring of *Orius* sp. population on both varieties revealed that it made its appearance during the week of the



**Fig. 3** Mean number of *F. occidentalis* larvae on both varieties ‘First-red’ and ‘Ociane’ in rose crop greenhouse in the region of Sahline (Tunisia) in 2007. (Means followed by the same letter are not significantly different  $p=0.05$ ).



**Fig. 4** Mean number of *F. occidentalis* adults on both varieties ‘First-red’ and ‘Ociane’ in rose crop greenhouse in the region of Sahline (Tunisia) in 2007. (Means followed by the same letter are not significantly different  $p=0.05$ ).



**Fig. 5** Mean number of *Orius* sp. on both varieties ‘First-red’ and ‘Ociane’ in rose crop greenhouse in the region of Sahline (Tunisia) in 2007. (Means followed by the same letter are not significantly different  $p=0.05$ ).

31<sup>st</sup> of May 2007 with low values that increased during the rest of the study period (Fig. 5).

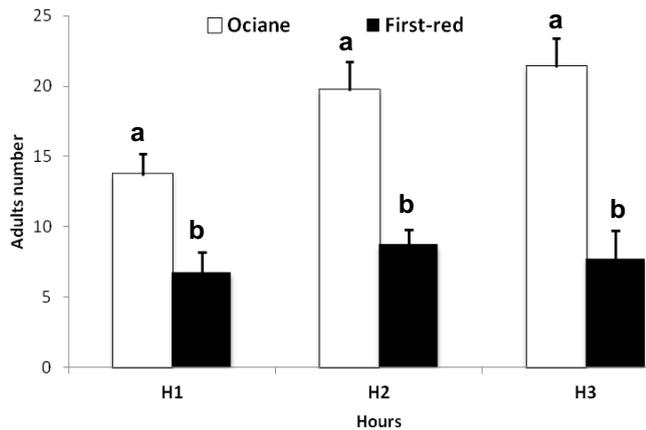
During the first week of its introduction into the greenhouse, individuals’ number of *Orius* sp. did not show a significant difference between both varieties. However, since the second week and till the end of the study period, the highest individuals’ number was observed in the variety ‘Ociane’ with significant differences reported during the majority cases of observations. However, number of times during which no significant differences between numbers of *Orius* sp. reported on each variety is higher than in *F. occidentalis* case.

**Preferential choice of *F. occidentalis* and *Orius* sp. adults in the laboratory**

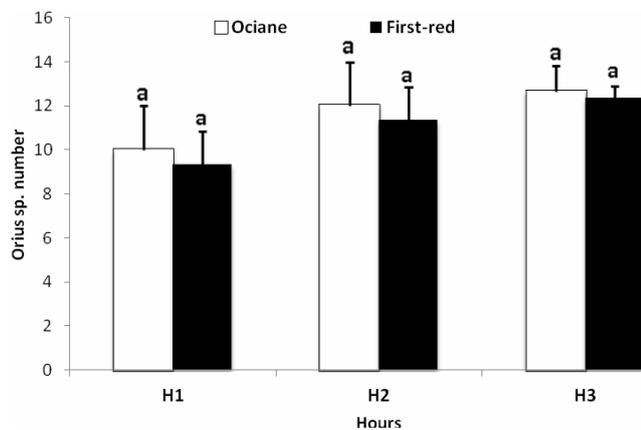
Thrips adults’ number count on the petals of the variety ‘Ociane’ after one hour revealed highly significant differences compared to adults found on ‘First-red’ petals (Fig. 6) with an increase of individuals’ number in ‘Ociane’ petals side against a slight decrease in the ‘First-red’ petals side during the 2<sup>nd</sup> and 3<sup>rd</sup> hours after thrips release.

Concerning *Orius* sp., though adults’ number counted on the variety ‘Ociane’ exceeded slightly that of the variety ‘First-red’, no significant differences were reported between

both varieties (Fig. 7).



**Fig. 6** *F. occidentalis* adults' migration towards petals of both varieties of rose in bowls in the laboratory (Legend: H1: 1<sup>st</sup> hour, H2: 2<sup>nd</sup> hour, H3: 3<sup>rd</sup> hour). (Means followed by the same letter are not significantly different  $p=0.05$ ).



**Fig. 7** *Orius* sp. adults' migration towards petals of both varieties of rose in bowls in the laboratory (Legend: H1: 1<sup>st</sup> hour, H2: 2<sup>nd</sup> hour, H3: 3<sup>rd</sup> hour). (Means followed by the same letter are not significantly different  $p=0.05$ ).

## DISCUSSION

These results show the preference of *F. occidentalis* individuals to the variety 'Ociane' over the variety 'First-red'. In fact, this preference depends on the color of flowers petals, which is consistent with results obtained by Walker (1974) showing that white color and generally clear colors are the most preferred by thrips.

On the other hand, for polyphagous thrips species generally there is a choice toward different colors like those of trap colors used to control or to monitor thrips populations, and that the pest is attracted especially toward clear colored traps such as white or yellow traps (Teulon and Penman 1992). Furthermore, the majority of thrips species attacking especially flowers, including *F. occidentalis*, have a preference toward white traps that have a better reflection of light than the other traps colors such as blue or yellow (Hodde *et al.* 2002). Cloyd (2009) mentioned also that *F. occidentalis* adults are attracted to certain flower colors such as yellow, blue and white.

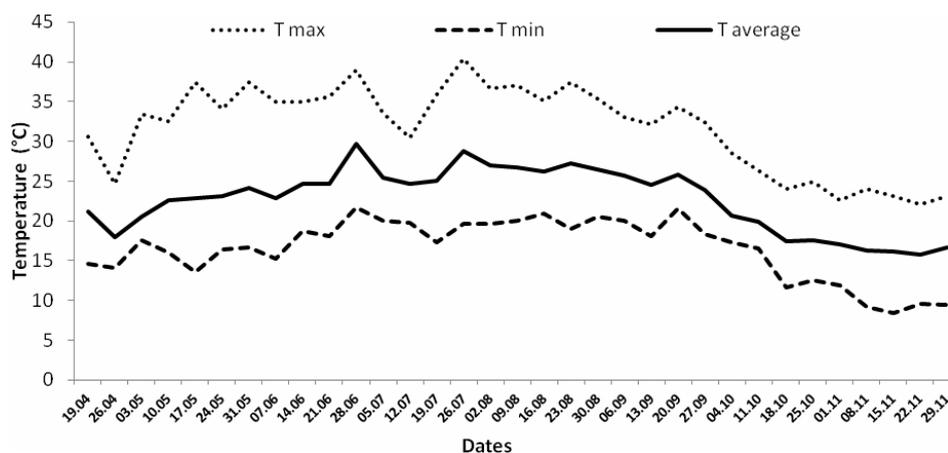
In addition, the action of temperature and photoperiod may intensify this preference (Bournier 1983). Indeed, the difference between numbers of individuals in each variety was very obvious throughout the monitoring period. The difference became higher during spring and summer which coincides with periods during which temperature became elevated (Fig. 8) and photoperiod more prolonged (Table 1). Actually, the high temperature is not only an essential factor of development of the pest and amelioration of its biotic potential such as oviposition (Brødsgaard 1989; Loomans and Van Lenteren 1995) but it also allows the flight of the insect (Bournier 1983) and thus a possible migration from one plant to another that is most appreciated. Concerning prolonged photoperiods, like those prospected during spring and summer, they permit a long and better light reflection emitted by the substrate which is petals flower for this study.

Monitoring of mobile forms evolution proves the preference of adults, whether born in the greenhouse or migrating from the outside, for the variety 'Ociane' or more precisely to its white petals. These results are consistent with those cited by Walker (1974), Bournier (1983), Teulon and Penman (1992) and Hodde *et al.* (2002) who mentioned that clear colors such as yellow or white are the most preferred color for the majority of thrips species; white color reflects much more light than the other colors and which attract especially adults. Moreover, the reflectance spectra of yellow Transvaal daisy flowers (*Gerbera jamesonii*) are very similar to yellow sticky traps used for monitoring and controlling *F. occidentalis* (Blumthall *et al.* 2005).

**Table 1** Photoperiod (h) during months of the study period (from April 2007 to November 2007) (\*NIMT, 2007).

Months	April	May	June	July	August	Sept.	Oct.	Nov.
Photoperiod (Hours/month)	228	276	303	338	304	240	211	189

\*NIMT: National Institute of Meteorology of Tunisia.



**Fig. 8** Temperature (Min, Max and average) in the rose crop greenhouse in the region of Sahline (Tunisia) in 2007.

It follows from the results obtained from the study of the preferential choice of *F. occidentalis* in the laboratory, that the variety 'First-red', being the less infested by *F. occidentalis*, is resistant toward this pest through its petals color that does not attract the insect as the case for the variety 'Ociane'. These results are consistent with those of Gaum *et al.* (1994) who worked on the resistance of some rose varieties against *F. occidentalis* by various parameters such as the color of their petals. Thus, they reported that the varieties of roses with clear colored petals, such as yellow, white or white cream, are the most contaminated by *F. occidentalis* and represent much more damages than varieties with red petals. However, the physiological characteristics of different varieties can also intervene and play an important role in the attraction of the thrips in addition to the color of the petals because color and odor are considered as the most important attractants for flower visiting-insects (Teulon and Penman 1992), and that majority of thrips species may distinguish between different colors and odors of the host plants flower, or other parts of the plant, and of sticky traps in case of a pest control (Frey *et al.* 1994).

Concerning the predator *Orius* sp., its appearance coincides with the favorable condition for the development of the bug and its installation in the rose crop greenhouse such as high temperatures that reached values close to 24 and 25°C (Loomans and Van Lenteren, 1995; Guerineau 2003). The distribution of this bug on both rose varieties was obviously marked with high individuals' numbers on the white-cream petals variety 'Ociane'. However, during the period where the variety 'Ociane' was the most infested and represented the highest number of *F. occidentalis* individuals with high significant differences (during late June, July and early August), no significant differences were reported in the majority cases of observations for *Orius* sp. between both varieties. The study of *Orius* sp. preferential choice in the laboratory showed that no significant differences were reported between both rose varieties, in other sense, *Orius* sp. repartition probably do not depend on the color of the host plant but other factors such as presence and abundance of its prey. In fact, these results show that *Orius* sp. distribution follows more or less the same way as that of its prey on rose varieties.

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