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The spreading of *Frankliniella occidentalis* (Pergande) over citrus orchards: the impact on pest thrips fauna and the evaluation of economic thresholds.

Since its introduction into Europe, at the end of 1980s through the horticultural trade in living plants, *Frankliniella occidentalis* (Perg.) (Thysanoptera , Thripidae) has become one of the most harmful pest to economic importance crops, in greenhouses and in open field. The species is highly polyphagous and this characteristic is responsible of its impact on the native thrips fauna and its influence on the agricultural systems of southern European regions (Marullo,2002). Relatively to citrus crops, *F.occidentalis* has not been reported in the past literature as the main pest thrips, comparing to other indigenous thrips species, as *Pezothrips kellyanus* (Bagnall), *Thrips flavus* Schrank, *T.major* Uzel and *T.tabaci* Lindeman (Marullo,1998). Only recently, results of surveys carried on in some specialized citrus areas in Spain, Turkey and Cyprus (Navarro et al.,2008; Teksam and Tunc,2009; Vassiliou,2008, 2010) have shown the spreading and colonization of citrus crops by WFT and the reducing of infestations by the native thrips species.

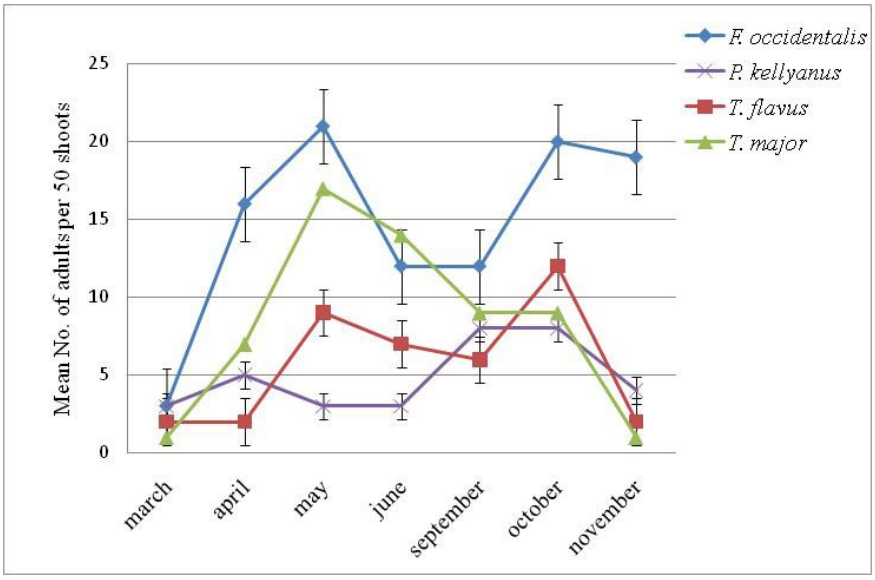
The aim of the present contribution is to demonstrate the spreading on citrus crops by WFT in some intensive growing areas of Calabria region (South Italy), the impact on infesting activity by indigenous pest thrips and to provide data for economic thresholds, in order to produce IPM protocols suitable for the investigated area. Comments on some biological and ecological patterns – available in literature - of the main pest thrips species studied, are also provided. In particular, the relationships between the seasonal abundance of thrips species and the host plant ranges, are discussed in order to explain the changes of the species composition in the ecosystem and the possible influence of wild plants as a potential source of infestation of the pest thrips for any susceptible citrus crop.

Surveys have been carried on , in 2010 and 2011 years, from March to November, on bergamot, lemon and orange crops in Reggio Calabria growing area. From each crop, a plot of 200 plants, homogeneous in variety and age, was selected and a sample was constitute by 50 shoots (as one shoot done by 1 flower or fruit with 1/2 leaves). Each sampling was taken every 15 days. The mean values of adults of each thrips species have been performed with statistic analysis.

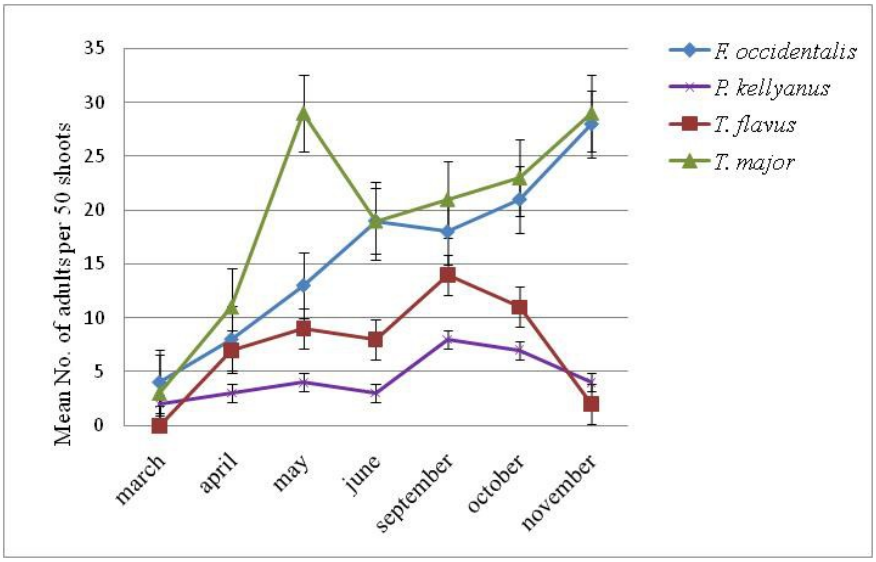
Four thrips species were recorded: *F. occidentalis*, *P. kellyanus*, *T. flavus* and *T. major*. The abundance of adults of each species, found on bergamot, lemon and orange is reported in Figs. 1-2. Results have shown the most abundance of WFT on bergamot and lemon, during end of spring/summer and autumn (with peaks of 21 adults in May on the former crop and 28 adults in November on the latter). *T.major* represents the main pest thrips on orange (showing a peak of 29 adults/sampling in May 2010 and an amount of 17 adults/sampling in September 2011) but WFT's adults were over in the next months (Figs. 1b-2b). Also on lemon crop, *T.major* is the main pest thrips in spring/summer, surpassed by WFT's infestations only in autumn (Figs. 1c-2c). In a similar way, *P.kellyanus* is more abundant on lemon (16 adults collected in May and September in 2010 and a peak of 17 adults in June 2011) than bergamot and orange (with an highest peak of 8 adults in September). These results demonstrate that WFT spreading is favoured by the re-flowering and winter flowering citrus crops (lemon and bergamot), which provide suitable oviposition sites (ovaries and inner parts of the flowers) to the pest. Also, the field data on lemon show that the most abundance of *F.occidentalis* and *P. kellyanus* adults on the crop, corresponds to high values of damages or symptoms on flowers and fruits. The relationships between abundance of the two thrips species and damage symptoms on flowers/fruits of lemon is highly significant (Figs. 3 - 4). In this way, Kelly's thrips can still considered a pest on lemon crop, even if *Frankliniella* spreading is heavy increasing. Instead, the relationships between abundance of thrips and damages on bergamot is not significant for *kellyanus,* showing that the species is supplanting by WFT. However, the results obtained from samplings on bergamot need to be increased, mainly during the flowering period, to check the role of wild plants on the colonization of the crop by *Frankliniella*. Instead, the abundance of *T. major* on orange crop is favour by diffusion of adults from wild host plants on the new shoots of the crop, during late spring, and only in this season its presence might produce some significant injuries. In autumn the adults flight on new host plants to winter.

The evaluation of economic threshold is reported for WFT, considering as new pest of lemon and bergamot; the obtained results might consider 1 adult/flower or shoot as threshold value for both crops. This value derives from two main considerations which limit the acceptable percentage of damage: the biological characteristic of the species (the high number of eggs laid by each female, shortness of life cycle, preference for flowers and their inner parts) and the destination of products (market or industry).The field data on seasonal abundance of the thrips species and the recognition of the phenological stages of citrus plants which are more susceptible to their attacks might indicate the most important periods to apply chemical treatments, in order to carry on a sustainable IPM strategy of control. Two main applications might be useful : one before flowering and another at petals fall. A third treatment might be request during the fruits growing. Low environmental impact products have to be suggested, mainly to preserve the natural enemies. Each treatment needs field monitoring of pest thrips and also the evaluation of some climatic factors (UR, mean temperature, rains, winds) which influence the movements of thrips inside the crops.

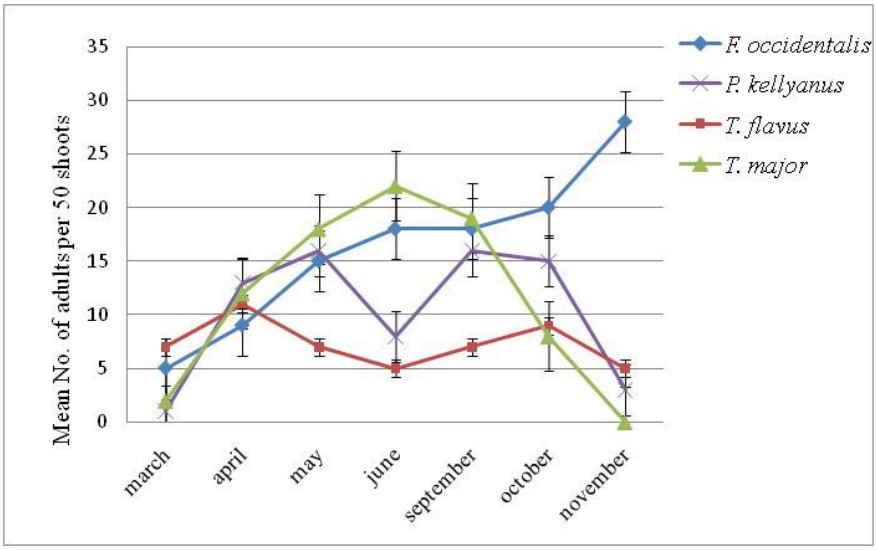
Moreover, each control program needs also to consider the cultural practices (weedkilling, cutting) which contribute to keep lower the field abundance of pest thrips.



1a)

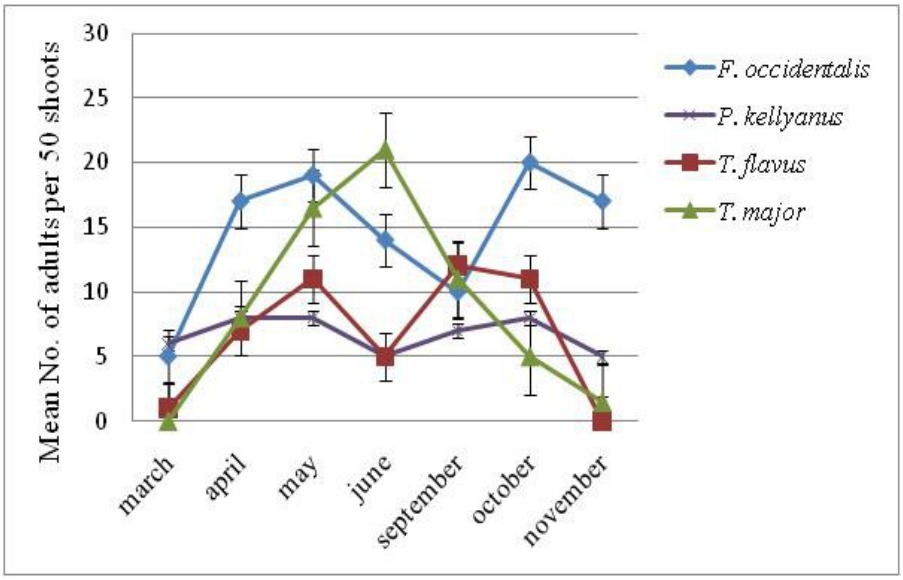


1b)

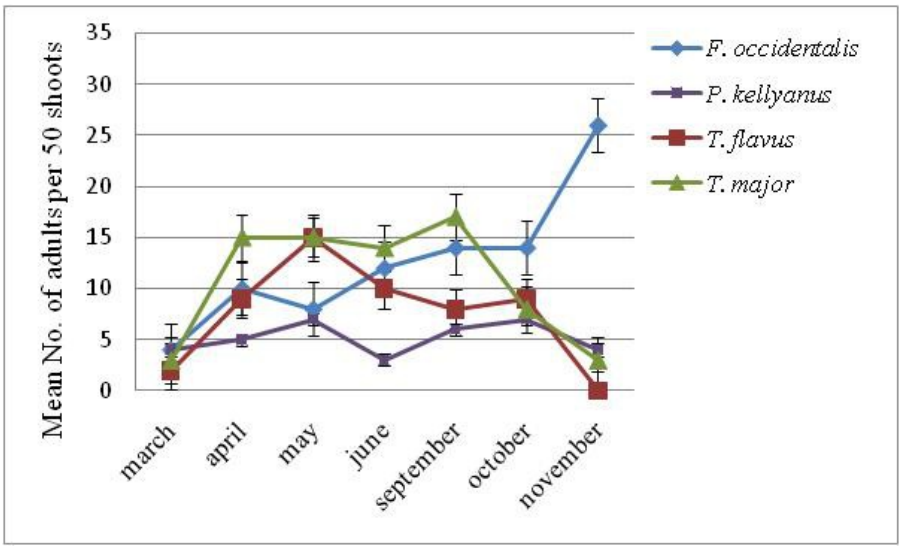


1c)

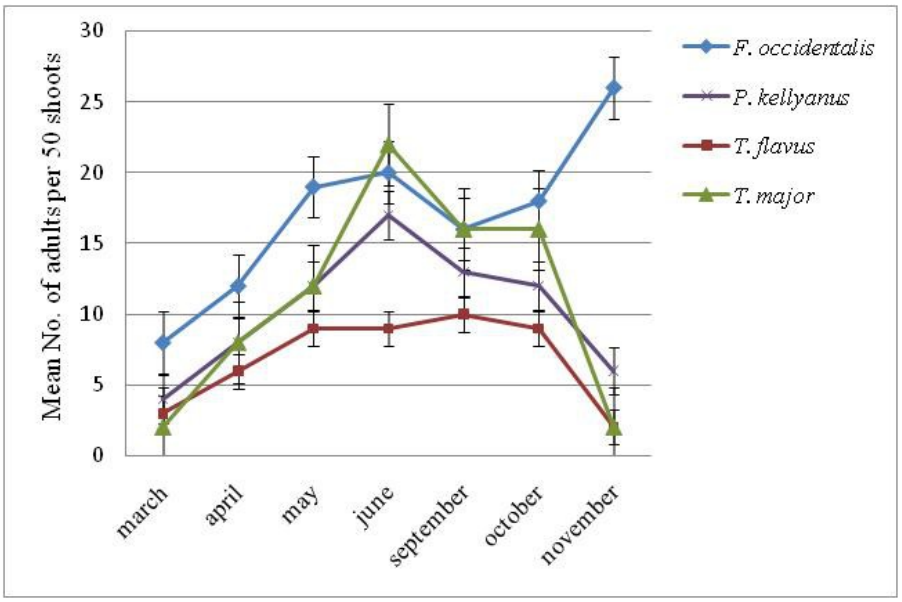
Figs. 1. Mean of specimens of each thrips species on bergamot (1a),orange (1b) and lemon (1c) in 2010 surveys.



2a)



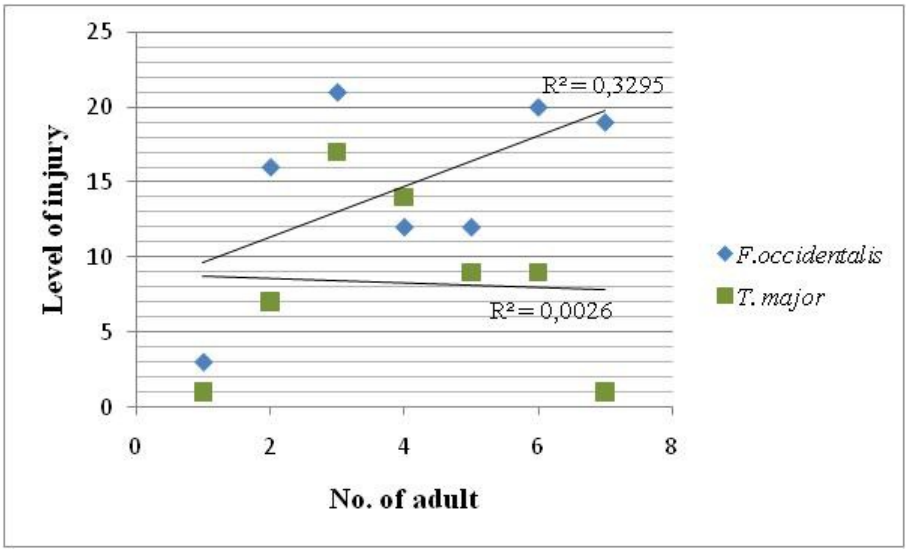
2b)



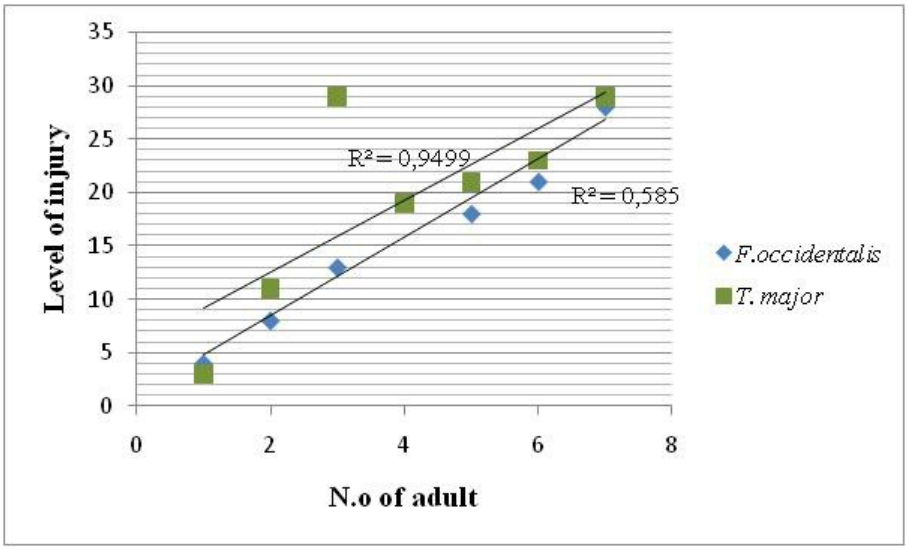
2c)

Figs. 2. Mean of specimens of each thrips species on bergamot (2a),orange (2b), lemon (2c) in 2011 surveys.

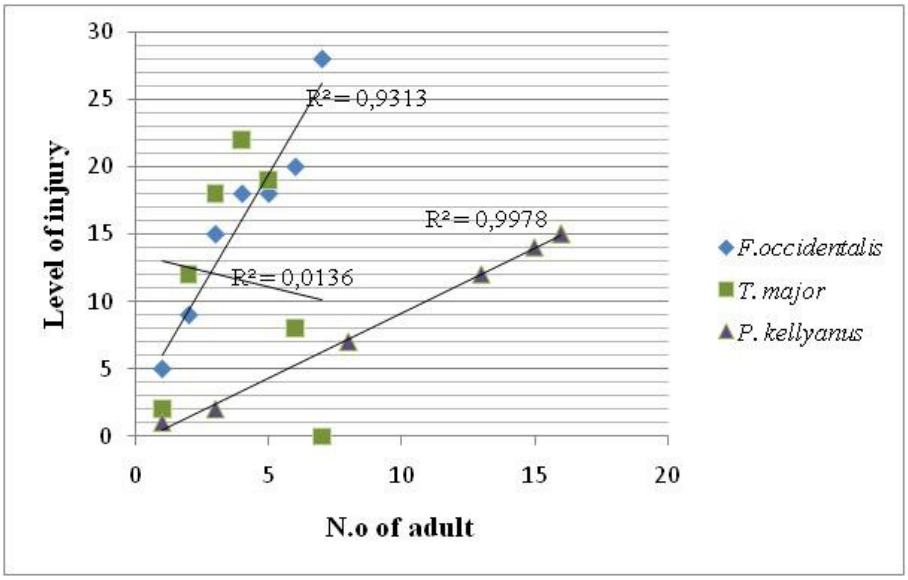
3a)


Level of injury
No. of adult
R² = 0,3295
R² = 0,0026
F.occidentalis
T. major

3b)

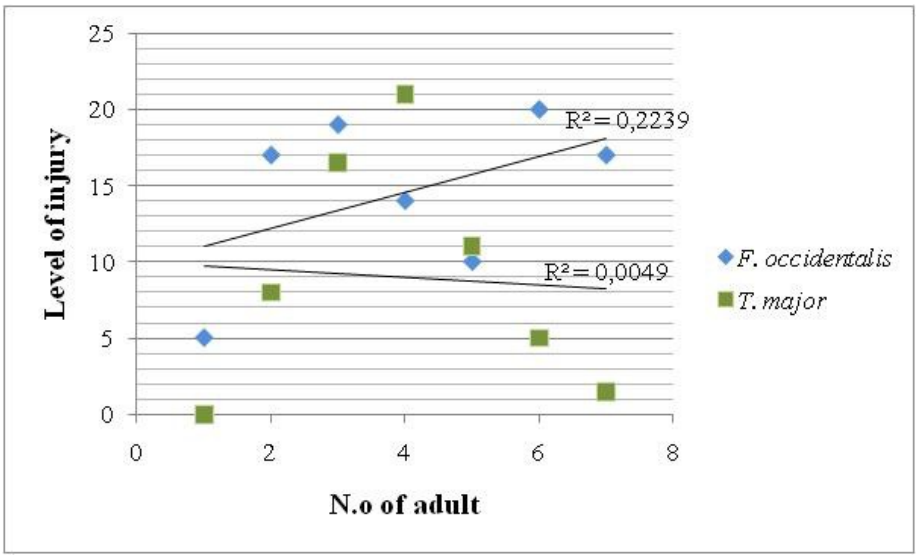

Level of injury
N.o of adult
R² = 0,9499
R² = 0,585
F.occidentalis
T. major

3c)

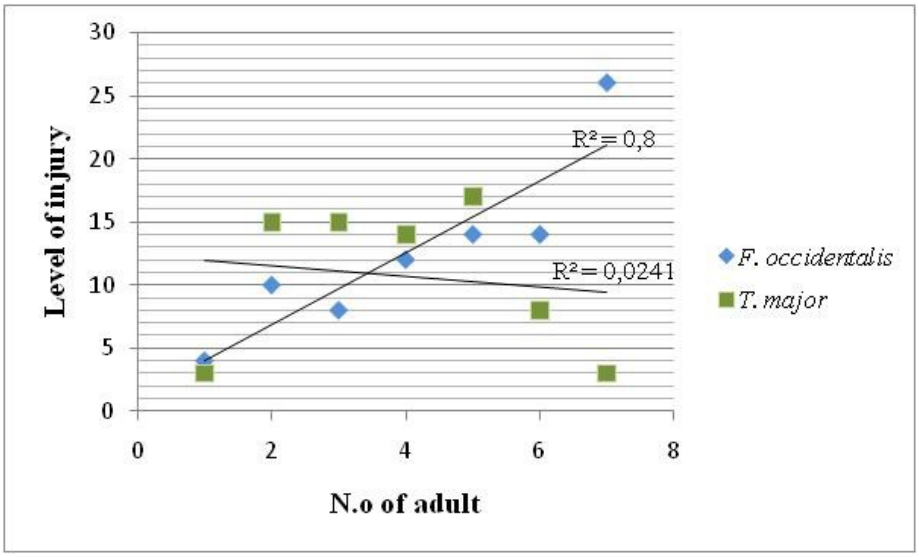

Level of injury
N.o of adult
R² = 0,9313
R² = 0,9978
R² = 0,0136
F.occidentalis
T. major
P. kellyanus

Figs. 3. Relationships between adult specimens of *F. occidentalis* and *T. major* on bergamot (3a),orange (3b), and between *F. occidentalis*, *T. major* and *P. kellyanus* on lemon (3c), and the level of injury of fruits/shoots in 2010 surveys.

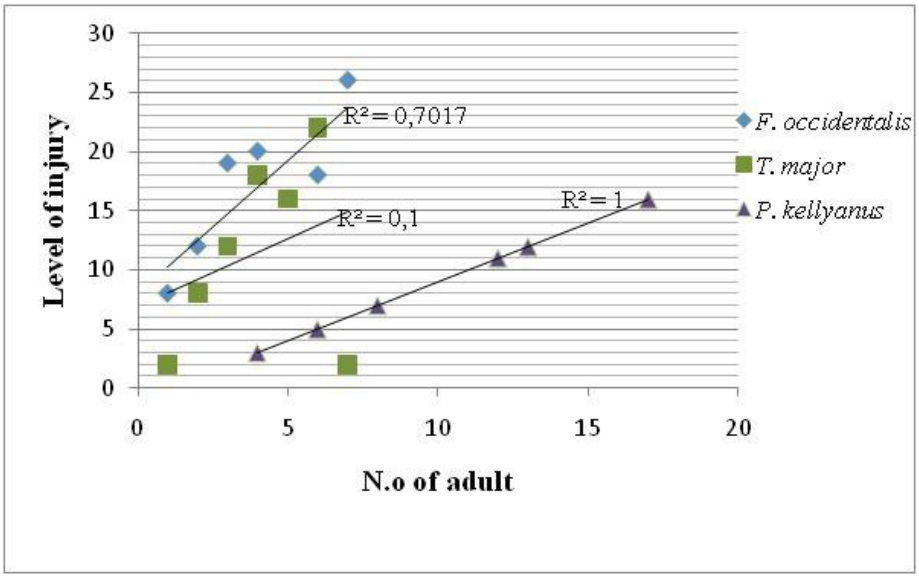
4a)



4b)



4c)



Figs. 4. Relationships between adult specimens of *F. occidentalis* and *T. major* on bergamot (3a),orange (3b), and between *F. occidentalis*, *T. major* and *P. kellyanus* on lemon (3c), and the level of injury of fruits/shoots in 2011 surveys.

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