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PRELIMINARY DATA ON PESTS OCCURRENCE ON SAFFLOWER CROP UNDER GREENHOUSE CONDITIONS

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Abstract

Safflower is a very important oilseed crop with multiple uses in food, pharmaceutic, cosmetic, varnish and paint industry. The quality of safflower flowers and seed yield rely on successful and integrated pest management solution. The safflower crop was tested in Romania in the last decades and the results show a high adaptability of this species to our pedoclimatic conditions, which led to a yield higher than 2000kg/ha, for the studied varieties. Our observations were carried out in the Research Greenhouse of University of Agronomic Science and Veterinary Medicine from Bucharest, in 2016, on Carthamus tinctorius L., which represent the first attempt in growing safflower in greenhouse conditions in our country. The most damaging pests that were identified were Tetranychus urticae Koch. and Trialeurodes vaporariorum Westood, two threatening polyphagous pest all around the world, causing serious yield losses, especially in greenhouses. Their presence was associated with the high temperature in June and July. Besides the introductory review of the most important safflower pest in the world, this study gives new and important insights about the safflower crop response to associated greenhouse pests and allowed a closer analyze using the electronic microscopy of the white fly eggs and eggs hatching characteristics. Our observation on safflower might be a premise for new control strategies against the white fly.

***Key words**: Carthamus tinctorius, Tetranychus urticae, Trialeurodes vaporariorum, mature eggs, eggs hatching.*

INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is a very important multipurpose crop, that is used in producing herbal drugs, cosmetics, natural food coloring, high oleic and high linoleic oil, natural dye, oil for painting and animal feed.
Safflower is a drought and salt-resistant oilseed crop. Safflower grows on various types of soils, but the highest yield may obtain on clay, sandy lands with neutral pH, well drained in depth. Safflower crops on lands with excessive humidity have a high risk of contacting specific diseases and pests (Kizil et al., 2008; Amini, 2014; Hussain et al., 2016).
The most important pest insects feeding inside the flower heads of safflower mentioned until the present moment are *Acanthiophilus helianthi*, *Chaetorellia carthami*, *Trellia luteola*, *Larinus flavescens*, *Larinus liliputanus and Helicoverpa peltiger* (Saeidi and Nur Azura, 2011).
The safflower fly, *Acanthiophilus helianthi* Rossi (*Diptera*: *Tephritidae*) is one of the most important pests of safflower allover the world. Larval feeding can causes important losses, disrupt plant metabolism with a negative influence on number of flower buds and decrease quality and quantity of the crop yield (Riaz and Sarwar, 2013; Saeidi et al., 2013). In Iran both safflower fly and Silver Y moth cause major damage to the safflower crops. (Saeidi et al., 2011; Esfahani et al., 2012).
Safflower anthodium can be infested with the tephritid fruit flies as *Acanthiophilus helianthi* Rossi and *Chaetorellia carthami* Stackelberg, but there are five associated hymenopteran parasitoid species, namely *Bracon luteator* Spinola; *B. intercessor* Nees (*Braconidae*); *Eurytoma varicolor* Silvestri; *E. rtellii* Domenichini (*Eurytomidae*) and *Torymus rubi* (Schrank) (*Torymidae*) that are keeping the tephiritid populations under control (Basheer et al., 2014).

In Iraq, Israel, and Kirgizstan, the species from the genus *Chaetorellia* (*Diptera*: *Tephritidae*), especially the *C. carthami* Stackelberg was reported as a safflower pest. (Saeidi et al., 2015).

The most important pest insects feeding outside the safflower anthodium are *Oxycarenus pallens*, *Oxycarenus hyalipennis, Lygus* sp. (Saeidi and Nur Azura, 2011; Esfahani et al., 2012).

The most important pest insects feeding on the whole safflower plant are *Uroleucon compositae*, *Pleotrichophorus glandolosus*, *Brachycaudus helichrysi*, *Neoaliturus fenestratus*, *Euscelis alsius*, *Macrosteles laevis*, *Psammotettix striatus*, *Circulifer haematoceps*, *Thrips tabaci*, *Aeolothrips collaris*, *Haplothrips sp*, *Helicoverpa peltigera* (Saeidi and Nur Azura, 2011; Esfahani et al., 2012). The safflower aphid (*Uroleucon compositae* Theobald) is the major safflower pest in India because in high infestations can damage the crop completely. The yield losses of safflower due to aphids are reported to be 24,2 - 72%. (Esfahani et al., 2012; Singh and Nimbkar, 2016). Among the 36 species of pests damaging safflower in India, the safflower aphid, the capsule borer, *Helicoverpa armigera* (Hubner) and leaf eating caterpillar, *Perigea capensis* (Walker) are considered to be the most important pests of the crop (Esfahani et al., 2012; Saeidi et al., 2015).

In the Mediterranean region there were reports about *Acanthiophilus helianthi*, *Heliothis peltigera* SchiV. (*Noctuidae*), *Chaetorellia carthami* Stackelberg, *Ch. jaceae* R.D., *Terellia luteola* Wiedemann, *Urophora mauritanica* Macquart (*Tephritidae*), *Larinus grisescens* Gyll., *Larinus syriacus* Gyll., *Larinus orientalis* Cap., and *Larinus ovaliformis* Cap. (*Curculionidae*) on the Xower heads; and *Lixus speciosus* Mill. (*Curculionidae*), Agapanthia sp. (*Cerambycidae*), four *Chloridea* spp., *Plusia gamma* L. (*Noctuidae*), *Pyrameis cardui* L. (*Nymphalidae*), and *Cassida palaestina* Reiche (*Chrysomelidae*) damaging the safflower (Smith et al., 2006).

In central and northern Greece, *Botanophila turcica* (*Diptera*: *Anthomyiidae*) was reported recently for the first time on safflower. The larvae of this fly tunnel through the rosette meristem and root of the developing host plant, causing deformation of the developing leaves and occasionally plant losses. *B. turcica* has been reported to attack only rosettes of the invasive saffron thistle *Carthamus lanatus* L. and has, therefore, been suggested as a potential biological control agent of *C. lanatus* (Tsialtas et al., 2013).

Other reported pests with low impact are scarab beetle *Epicometis hirta*), Egyptian cotton leaf, *Spodoptera littoralis*), wireworms, *Limonius* spp., cotton boll worm, *Heliothi obsoleta Lasioderma serricorne*, *Stegobium penliceum and Trogodema* (Esfahani et al., 2012).

Another important pest category is represented by mites. They cause damage by sucking cell contents from leaves. At first, the damage shows up as a stippling of light dots on the leaves; sometimes the leaves take on a grey, yellow or bronze colour. Necrotic spots occur in the advanced stages of leaf damage. Spider mites are highly polyphagous pests (Godfrey, 2011; Fasulo and Denmark, 2016). *Tetranychus urticae* Koch (*Acari*, *Tetranychidae*) is an notorious mite species causing serious yield losses almost all over the world. It is considered to be a temperate zone species, but it is also found in the subtropical regions (Esfahani et al., 2012; Fasulo and Denmark, 2016; Jiao et al., 2016; Rector et al., 2016).

For an integrated pest management a very important key are the natural enemies that limit pests. In Egypt, the safflower capsule fly is attacked by three species of parasitoid wasps from the families of *Eulophidae* (*Pronatalia* sp.), *Torymidae* (*Antistrophophlex conthurnatus*) and *Pteromalidae* (*Pteromalus* sp.) (Saeidi et al., 2015).

The source of tolerance to aphids can be present in the locally available germplasm. Aphid resistance in safflower is reported to be under the control of both additive and nonadditive gene actions with a predominance demonstrated for nonadditive gene action (Singh and Nimbkar, 1993). Breeding for aphid resistance has been initiated recently in India since it is the most economical, time-tested, and eco-friendly method for controlling aphids. Aphid tolerant safflower keeps the environment safe by way of avoiding chemical usage (Esfahani et al., 2012; Singh and Nimbkar, 2016).

Important genera include the predatory mites, *Amblyseius*, *Metaseiulus*, and *Phytoseiulus*; the lady beetles, *Stethorus picipes*; the minute pirate bugs, *Orius*; *Scolothrips sexmaculatus, Leptothrips*; and the lacewing larvae, *Chrysopa*. *Galendromus occidentalis*. In greenhouses, the ghost ant, *Tapinoma melanocephalum* (Fabricius), a pest in itself, was also reported as a significant predator (Godfrey, 2011; Fasulo and Denmark, 2016).
Other pests control strategies could be: a very good sanitation, that is a key for controlling pests in greenhouses, weed control, clean up all debris from previous crops, temporary quarantine and inspection of all plants upon arrival from other greenhouse, and regular monitoring of stock plants used for propagation, seed selection and proper seed rate, respecting proper sowing time, varietal selection and crop rotation; insect grow regulators are a least-toxic pesticide control option for pests, bio rational pesticides and fertilizers levels (Greer and Diver, 1999; Gupta and Gupta, 2016).
The aim of this work is to present the associate arthropod pests identified on safflower crop grown in greenhouse in 2016.

MATERIALS AND METHODS

The observations were made in the Research Greenhouse of University of Agronomic Sciences and Veterinary Medicine from Bucharest on *Carthamus tinctorius* L. crop in greenhouse. For our country, it is a novelty to obtain safflower crop in the greenhouse. The sowing was done in 19 April 2016 and the harvest on 12 July 2016. During the growing period, we observed several pests affecting the leaves and anthodia. Both the pests and the infested leaves were collected in entomological jars once a week and after each inspection, the pests were immediately analysed at the stereomicroscope. After drying at room temperature, the samples with whitefly eggs exuvia were kept in laboratory, in plastic Petri dishes. The safflower infected leaves and anthodia were analysed with a Leica S8 APO stereomicroscope and with the Scanning Electron Microscope SEM FEI Inspect S50. For both observation methods, there is no sample preparation needed.

RESULTS AND DISCUSSIONS

***Trialeurodes vaporariorum* eggs analyse**

The first greenhouse whitefly eggs were noticed immediately after the leaf emergence. Heavy infestations, between 27 and 48 eggs/cm^{-1} have been observed on 10 May, at 20 days after sowing (figure 1), in the 8 real leaves phenological growing stage.

Figure 1. Heavily infested safflower leaves with greenhouse whitefly eggs

The leaves were also very soon infested by *Tetranychus urticae* Koch (figure 2), the silk webbing on infested leaves being easily detectable and the spherical and translucent eggs being visible at the stereomicroscope. A density of 2 to 5 adult mites and 6 to 12 mite eggs on cm^{-1} has been estimated at the same phenological growing stage.

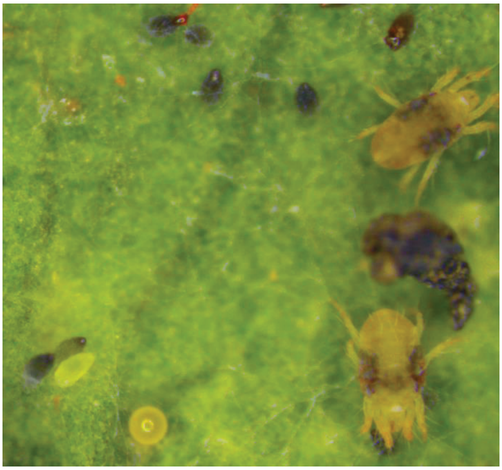

Figure 2. *Tetranychus urticae* eggs, adults and greenhouse whitefly eggs

In the literature it is often cited that the eggs of greenhouse whitefly are pale yellow when first laid and turn to darker colour, until black before hatching (figure 3).

We found no data about the whitefly eggshell neither about its description or its opening structures. This fact is usually undetected, as the leaves are usually covered by sooty mould.

The humidity and temperature conditions correlated with the morpho-anatomical safflower cuticle allowed *T. vaporariorum* eggs to remain on the lamina after the eggs hatching, so that we could observe and analysed the eggs shells opening with the Scanning Electron Microscope (figures 4 and 5).

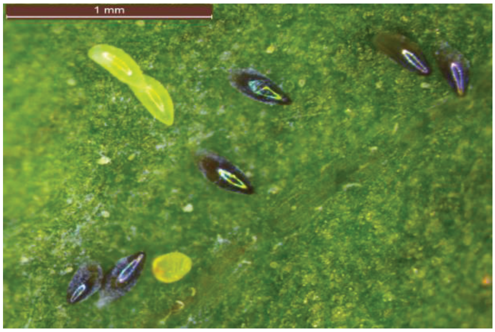

Figure 3. Newly laid greenhouse whitefly eggs (translucent colour) and more mature ones (dark colour)

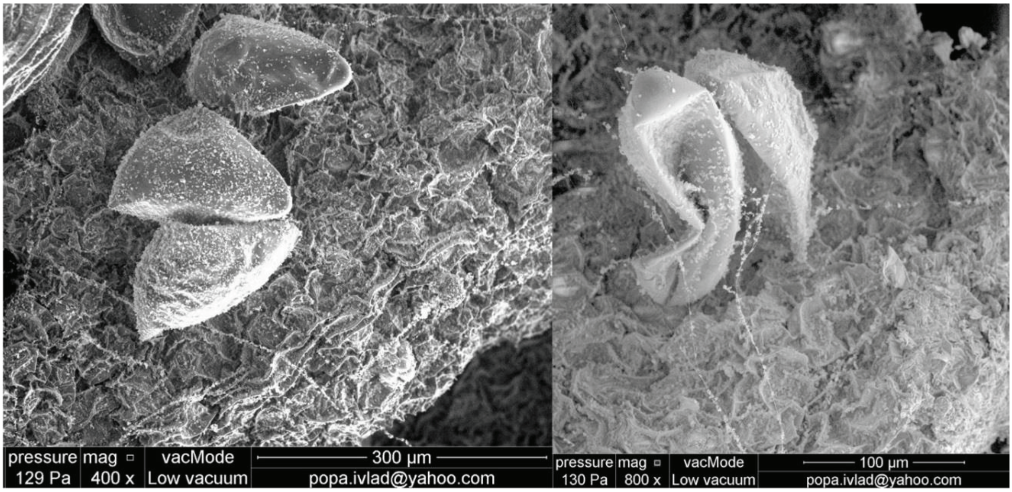

Figure 4. Greenhouse whitefly eggs and details of the safflower lower cuticle

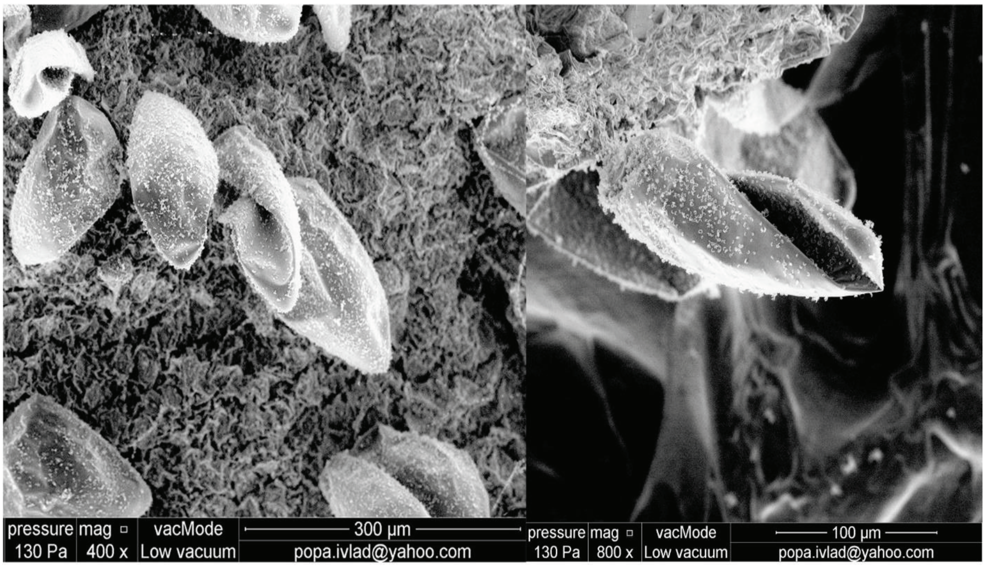

Figure 5. The opening pattern of greenhouse whitefly eggs during hatching

The observed longitudinal opening of the egg shell could offer new insights for the integrated control measures against the greenhouse whitefly. On our knowledge, this aspect hasn't been discussed so far, so further studies are needed.

CONCLUSIONS

The humidity and temperature conditions proved to be an important factor, high temperatures facilitating the observation of new morphological aspects. In the same time, the morpho-anatomical safflower cuticle surface proved to be a perfect medium in preserving the whitefly egg shells.

This new information about the pests associated with *Carthamus tinctorius* L. crop are very useful in the context of food and nutritional safety and sustainable production of safflower in our country and new strategies are required to raise safflower productivity sustainably.

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