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INVESTIGATION OF BIOLOGICAL PLANT PROTECTION IN PROTECTED CULTURE OF PEPPER

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ABSTRACT

The aim of the study was to determine the effectiveness of regularly applied biological control by continuous monitoring of pests with the help of color traps (sticky sheets) and flower tests with joint species identification of the useful insects to determine the extent to which native useful insects can settle next to the introduced predatory ones. The latter process is to be facilitated by growing a flowering mixture of annual plants at one of the experimental sites, which provides adequate feeding and hiding place for beneficial insects.

The experiment was carried out in Szentes. The peppers in protected cultivation were grown in two unheated polytunnels. The color traps were laid out in three different places in politunnels. A total of 11 color traps were collected from the experimental area (from April till September). During the experimental period, the main pests damaging peppers were western flower thrips (*Frankliniella occidentalis*) and tobacco thrips (*Thrips tabaci*). The highest thrips number (*F. occidentalis*, 40 pieces) was counted on 9th June in 2020. Useful insects in the experiment: predatory mites (*Amblyseius spp*.), predatory flower bugs (*Orius laevigatus*) and the banded thrips (*Aeolothrips spp.*). The highest useful insect's number (*Aeolothrips spp.*, 11 pieces) was counted in the 20th September in 2020.

Keywords: sweet pepper (*Capsicum annuum*), polytunnel, biological plant protection, western flower thrips (*Frankliniella occidentalis*), microscope

INTRODUCTION

Pepper (*Capsicum annum* L.) is one of the most popular vegetable plants, it is of great nutritional importance and its popularity is growing worldwide. Consumption in fresh and processed form is significant on the one hand for its pleasant taste and on the other hand due to its high vitamin C content. With an annual production of 180-200 thousand tons, Hungary is one of the most important pepper-growing countries in the European Union. About 80% of the quantity of Hungarian peppers currently comes from protected cultivation. Its peculiarity is that more than 20 types are grown, 50-55% of the greenhouse surface is provided by the so-called *Cecei* types. This is the only forced vegetable species that is grown predominantly with Hungarian varieties, which can compete with foreign varieties in terms of quality and disease resistance. Soilless protected cultivation introduced in the 1990s provided an opportunity for long-term cultivation, with which the average yield of cone-shaped varieties reaches 25 kg / m^2 / year (ZATYKÓ, 1993; TERBE AND SLEZÁK, 2019).

Peppers are very sensitive to precise control of heating, the minimum equipment required for cultivation is the heating and ventilation system. In unheated houses, only summer cultivation is possible, as it is sensitive to low temperatures, which cause a high degree of flower dropping and crop deformation. From the point of view of cultivation and climate control, large-air equipment is suitable in which, in cold weather during ventilation, the

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cold air does not come into direct contact with the plants. In summer, however, the upper leaves are not exposed to strong radiation. The planting requires a support system height of at least 2.5-3 m (SZŐRINÉ, 2007).

In the case of cultivation without soil, it is particularly important to observe optimal conditions in the root zone. For pepper production, the capacity of the irrigation system is 1-2 l / hour / drip, and the annual water demand is 800-900 l / m^2 / year. The transpiration water requirement of the adult plant is 1.6-2.6 ml / m^2 at 1 J / cm^2 and the dosage is 2.0-3.5 ml / m^2 per Joule. Peppers do not tolerate airless, aqueous media, high salinity and the accumulation of certain harmful elements in the root zone. In case of poor water quality, desalination of water is recommended. Humidity control in summer is greatly facilitated by a humidification system that also performs cooling functions (RESH, 1998; TERBE *ET AL.*, 2004; TERBE AND SLEZÁK, 2019).

Peppers are very demanding of the medium. It does not inhibit its development if it has the following characteristics:

- air capacity: 35-40% by volume
- water capacity: 45-50% by volume
- pore volume: 75-85% by volume.

For soil-less cultivation, stone wool, perlite and very good quality coconut husks are best.
In Hungary, two types of cultivation methods can be used:

- long-term cultivation (8-11 months in the cultivation equipment)
- short-term cultivation (4-6 months in the cultivation equipment)

One of the major issues in plant protection of peppers in protected cultivation is the solution of thrips control. The introduction of non-native predatory mites (*Amblyseius spp.*) and predatory flowering bugs (*Orius laevigatus*), which are commercially available in Hungary, offers a more efficient option than the use of pesticides. In addition to efficiency, biological control has a number of beneficial properties, one of the outstanding factors being that the abandonment of insecticides allows the settlement of native arthropods into shoots.

Settling animals from the paprika grower's point of view may be:

- useful: predators
- pests: animals feeding on peppers
- neutral: they do not feed on peppers or pepper pests

Of the "useful" group, native flower bugs are of outstanding importance, which, like *Orius laevigatus*, are able to regulate the number of thrips. They can eat 4-5 adults or 8-15 larvae a day. In addition to thrips, they can also feed on aphids, mites, moths or butterfly eggs. The largest number of specimens has the common flowering bug (*Orius niger*), which is common on flowering plants that provide it with prey, such as cultivated (e.g. alfalfa, corn, sunflower) or roadside plants (e.g. spotted burrs, nettles) in the vicinity of polytunnels from where it can migrate into the protected cultivation area. The first specimen can be observed as early as the end of May, but they do not grow en masse in peppers until June, where they are found continuously until the end of September.

Also, a common predatory species found in forced peppers is the banded thrips (*Aeolothrips intermedius*), which feeds mainly on phytophagous thrips and mites. It can eat 2-3 western flower thrips (*Frankliniella occidentalis*) or tobacco thrips (*Thrips tabaci*) larvae per day, while during its full development it can prey on up to 100 thrips or 300 spider mite larvae.

Western flower thrips (*F. occidentalis*) can reproduce both sexually and by

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parthenogenesis (AVAR AND DÉRI, 1989; JENSER, 1998). Females use their egg tubes to lay 20-40 eggs under the epidermis of the plants. The most ideal laying place for them is the flower. The first stage larva is still moving freely on the plant, the second stage larva is hiding. In forced peppers at 25 ºC it takes 16 days for the pest to develop. It can achieve the highest reproduction in a flowering plant producing abundant pollen at a temperature of 20-21 ºC and a relative humidity of 80-90%. (AVAR AND DÉRI, 1989; DELIGEORGIDIS *ET AL.*, 2006a). The number of annual generations is 12-15.

The female of the tobacco thrips (*Thrips tabaci*), after 2-5 days of embryonic development, places 40-100 eggs under the epidermis of the plant and then takes 5 days for the larvae to develop. These larvae are later found in flowers, leaves, mostly on the back of the leaf, along the leaf veins, and in the leaf sheath or other hidden place. Interestingly, the duration of generation development is a function of temperature (GUZMAN *ET AL.*, 1996; BOZSIK, 1997; JENSER, 1998; JENSER, 2003; DELIGEORGIDIS AND IPSILANDIS, 2004; JENSER AND SZÉNÁSI, 2004; ARRIECHE *ET AL.*, 2006; DELIGEORGIDIS *ET AL.*, 2006b). The higher the temperature, the shorter each stage will be: the time before laying; the chance of larvae surviving and laying their eggs decreases (DELIGEORGIDIS *ET AL.*, 2006b). Several generations can develop each year. In the open field, 4-5 generations and in the greenhouse up to 8-12 generations can develop in one year.

MATERIAL AND METHOD

The polytunnels experiment was set up in Szentes. Pepper planting time was early April 2020. The peppers in protected cultivation were grown in two unheated polytunnels with areas of 500-500 m^2.

One flower box containing annual plants was placed in front of and behind the first polytunnels (treated) to lure pest insects away from the sprouted peppers, the second polytunnels was assigned as control. Flower sampling was collected twice from the crates, dated 1st July and 3rd August 2020, respectively. In the polytunnels, color traps were laid out in three different places: at the beginning of the, in the middle of the, and at the end of the polytunnels.

A total of 11 x 3 color traps were collected from the experimental area. The dates were: April 26, May 11, May 26, June 9, June 25, July 8, July 22, August 3, August 24, September 6, and September 20.

In addition to collecting color traps, we also collected pepper flower samples in protected cultivation (treated polytunnel). A total of three samples were taken, with dates of 8th June, 1st July, and 3rd August.

RESULTS

The color traps were placed a total of 11 times in the two polytunnels. The first polytunnels was the 1, the second polytunnels was the 2. The insects (thrips) collected by the color traps are shown in *Figure 1.*, *Figure 2.* and *Figure 3.*

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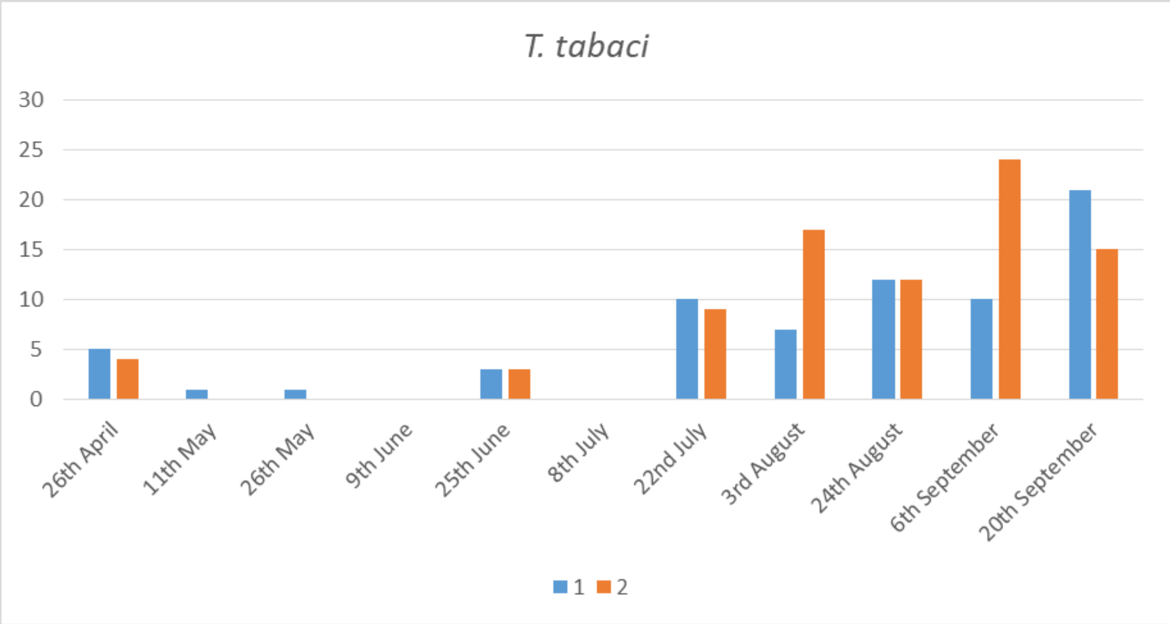

Figure 1. Show are the date of collection and the number of *Thrips tabaci*.

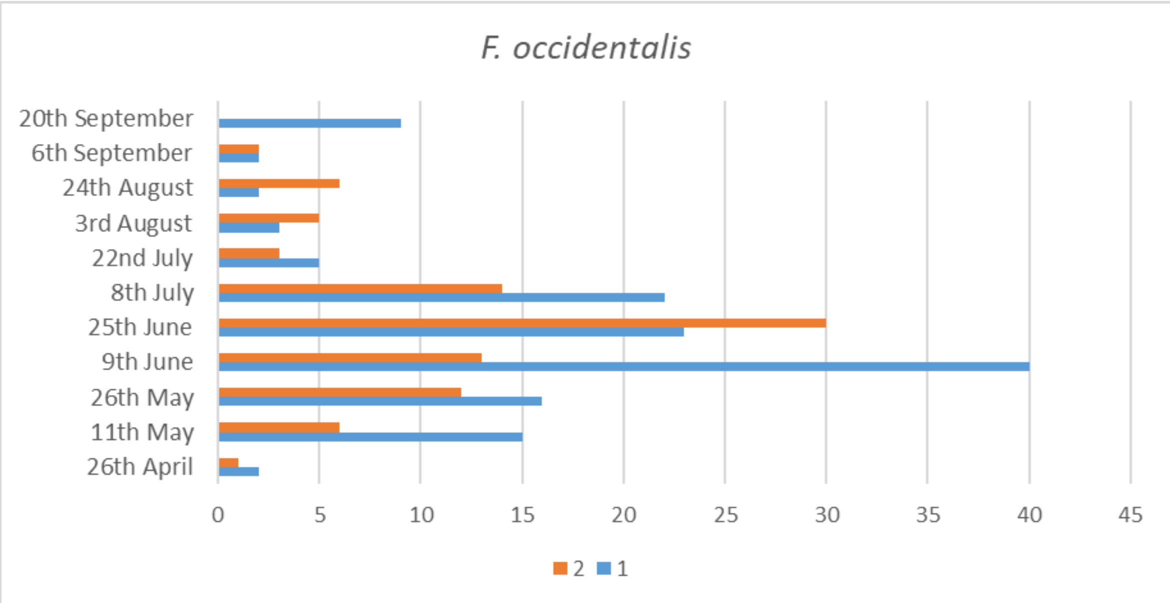

Figure 2. Show are the date of collection and the number of *Frankliniella occidentalis*.

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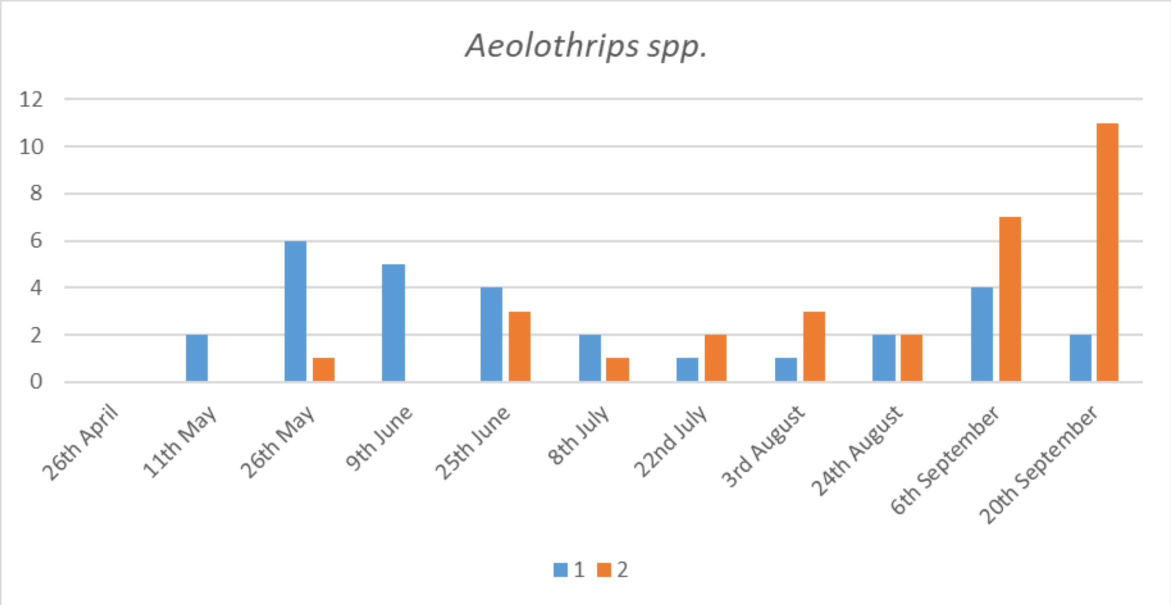

Figure 3. Show are the date of collection and the number of *Aeolothrips spp*.

Pepper flower samples were collected during protected cultivation. A total of three samples were collected: 8th June, 1st July and 3rd August in 2020. The sampling was performed in 3 replicates and 2 samples.

- 1st pepper flower sampling (June 8, 2020): The time of recording was between 8:20 and 10:20. At the first survey, useful insects were not identified on the flower samples. Quantity of harmful insects: *F. occidentalis* 19 ind; *T. tabaci* 1 pc; *M. persicae* 3 pieces.
- 2nd pepper flower sampling (1st July, 2020): The time of recording was between 13:30 and 15:30. At the second survey, no useful insect was recorded after processing the collected flower samples. Quantity of harmful insects: *F. occidentalis* 9 pieces; *M. persicae* 1 pc.
- 3rd pepper flower sampling (03/08/2020): The time of recording was between 14:00 and 16:00. At the third survey, a total of 3 useful insects were detected on the pepper flower samples: *O. niger* 2 pcs; *Aeolothrips intermedius* (banded thrips) 1 piece. Quantity of harmful insects: *F. occidentalis* 6 pieces; *M. persicae* 5 pcs; *A. fabae* 1 pc.

Flower sample results from the flower box:
Sampling of flowers from the flower box in front of the 1st polytunnels (01.07.2020):

- *F. occidentalis* (10 pcs)
- *M. persicae* (1 pc)
- *A. intermedium* (1 pc)

Sampling of flowers taken from the flower box behind the 1st foil (01.07.2020):

- *F. occidentalis* (3 pcs)
- *O. niger* (2 pcs)

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Result of the second flower sampling (03.08.2020) taken from the flower box in front of the 1st polytunnels:

- *H. armigera* worm (1 pc)

Result of the second flower sampling taken from the flower box behind the 1st foil (03.08.2020):

- *M. persicae* (1 pc)
- *O. niger* (2 pcs)

CONCLUSIONS

From the color traps that we collected 11 times, it can be concluded that the number of *Thrips tabaci* individuals ranged from 0 to 5 for color traps 1, 2, 3, and 5. At the collection of color traps 4 and 6, 0 tobacco thrips were detected. In the case of collected color traps number 7 through 11., the highest value of *T. tabaci* varied between 10 and 24 pieces, showing an increasing trend. For the first three adhesive sheets collected, most *Frankliniella occidentalis* data ranged from 1 to 16. In the collected color traps numbered 4-6, the western flower thrips showed a value between 13 and 40 pieces. In the case of collected adhesive sheets 7-11., *F. occidentalis* ranged from 1 to 9. For the first color traps collected, the number of *Aeolothrips spp*. was the lowest, namely 0 (in both replicates). For the collected color traps 2 through 9, values between 0 and 6 were calculated for the banded thrips. In the case of collected adhesive sheets 10 and 11, the highest banded thrips value varied between 7 and 11 pieces.

In the experimental area in the first two samplings, no useful insects (*O. niger, A. intermedius*) were detected, only at the third time. In terms of harmful insects, *F. occidentalis* was the most common pest insect (34 pieces).

T. tabaci was present in small amounts (1 pc) in the experimental areas.

The effectiveness of the lure flower ensemble is inferred from the fact that in the boxes placed in front of and behind the polytunnels, the annual plants lured the harmful insects away from the sprouted peppers. This is especially true for the pest insect *Frankliniella occidentalis* (western flower thrips): a total of 13 pieces were counted in the two flower samples. If more boxes were placed around the polytunnels in larger quantities, the lure efficiency of annuals could be more successful.

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