University of Agriculture in Cracow

Faculty of Biotechnology and Horticulture

Department of Botany, Physiology and Plant Protection

Preference of *Thrips tabaci* Lind. to *Allium cepa* L., *Allium fistulosum* L., and *Allium roylei* Stearn.

Marta Olczyk [1], Elisabeth H. Koschier [2] and Maria Pobożniak [1]

m_olczyk@poczta.fm

[1] Department of Botany, Physiology and Plant Protection, Faculty of Biotechnology and Horticulture, University of Agriculture in Krakow, Krakow 31-425, Poland

[2] Division of Plant Protection, Department of Crop Sciences, University of Natural Resources and Life Sciences (BOKU)Vienna, Peter Jordan-Strasse 82, 1190 Vienna, Austria

INDRODUCTION

The onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae) is one of the key and most prevalent pests of plants of the genus *Allium* in Poland, as well as in many other regions of the world. These insects cause both direct and indirect damage to crops, reducing yield and quality. One of the directives in Integrated Pest Management is the use of resistant/tolerant cultivars. Onion breeding programs currently focus mainly on the improvement of existing cultivars, but other related cultivated and wild *Allium* species possess many desirable traits related to disease and pest resistance. For this purpose, bioassays were conducted to verify the preference of onion thrips to three different cultivars of *Allium cepa* L., namely, Alibaba, Bila, Tęcza, one cultivar Kroll of welsh onion, *A. fistulosum* L, and an unknown cultivar of *A. roylei*.

MATERIALS AND METHODS

Plant materials

Bioassays tests were conducted in the BOKU laboratory in Vienna in 2019. Onion plants used in the experiment were grown in a standard substrate in the plant's climatic chamber. The plants were regularly watered with tap water. Onion leaves of the respective cultivar and age (approximately 4 weeks) were used in all bioassays.

Rearing of *T. tabaci*:

A stock culture of *T. tabaci* was reared under laboratory conditions on white cabbage in a 0·5 litre glass jars covered with a fine mesh to ensure ventilation. Fresh pieces of white cabbage leaves were regularly added to thrips grown two or three times a week [Fig. 1a]. Thrips were cultured as well as bioassays were conducted in a climate chamber at 24 ± 1°C and 35 ± 5% relative humidity with a photoperiod of 16: 8 (L: D) h light: dark.

Isolation:

Pupae thrips were randomly taken from rearing jars and transferred to individual Petri dishes with fresh leek leaves [Fig. 1b]. After 48 hours, adult females were checked and the remaining pupae were removed. Females of known age were used 48 h post-emergence in the bioassays.

Methodology

Four centimetre long sections of onion leaves cut from the middle of the leaf. Then in order to protect the section of onion plants against loss of humidity and colonization of *T. tabaci* inside the plant, both sides of the leaf section were sealed by briefly dipping them in warm paraffin wax. Each section of the plant was placed separately on a thin film of 1 % water agar (Agar – Agar) in a small 60 mm diameter Petri dish.

Oviposition preference of female onion thrips was evaluated using a no-choice test [Fig. 2a]. Single females of known age were transferred to each glass Petri dish and placed in the central point of the leaf section for 24 hours. To prevent escape of *T. tabaci* female, the dishes were covered with perforated thin (14 µm) plastic film, which was perforated (one hole per cm^2 on average) by means of insect pins (0·4 mm diameter). After this time, the females were removed. The plant sections with eggs laid by females were left in a climatic chamber for 5 days. After this time, hatched larvae were counted under the stereo microscope.

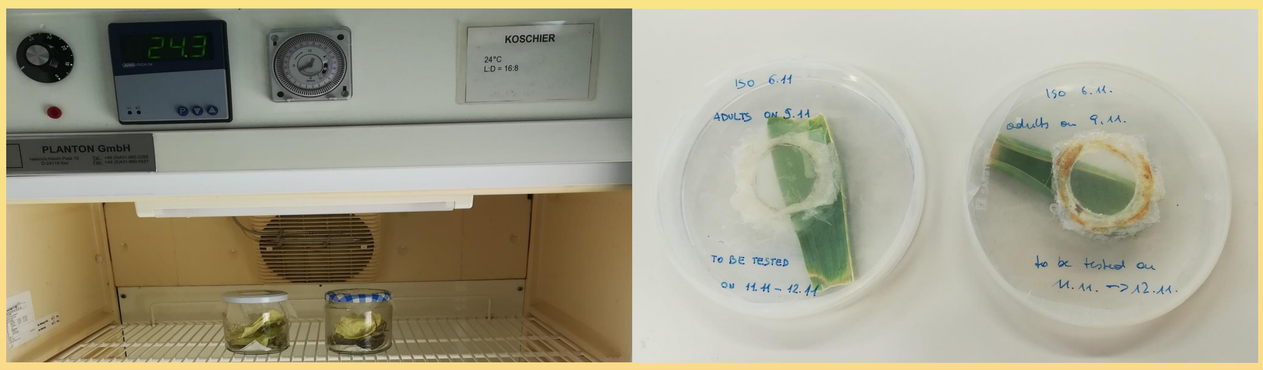

Figure 1a. (left side) – Rearing of *T. tabaci* in a climatic chamber; Figure 1b. (right side) – Isolation of thrips pupae.

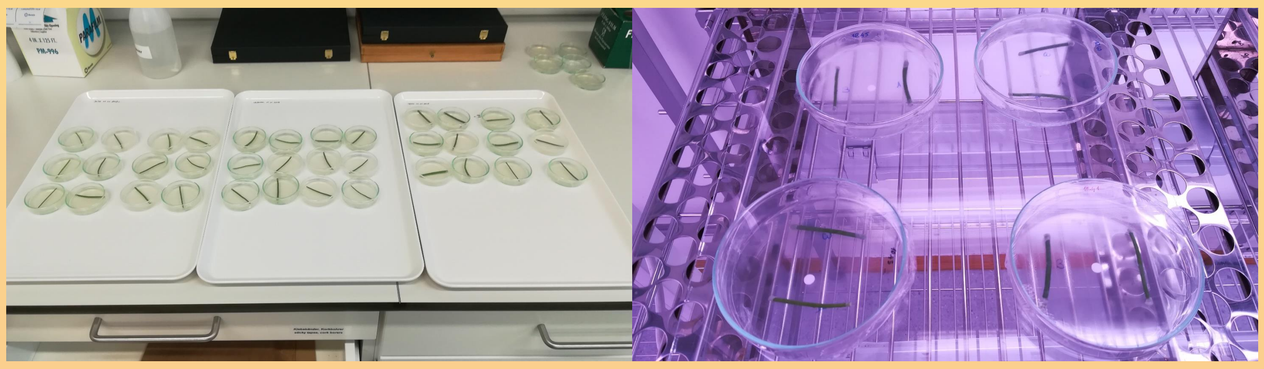

Figure 2a. (left side) – Oviposition preference test; Figure 2b. (right side) – Settling preference test.

The settling preference test was evaluated using a choice test [Fig. 2b]. Eight pairs were compiled for this test: Tęcza × Alibaba; Tęcza × Bila; Tęcza × Kroll; Tęcza × A. roylei, Alibaba × Bila; Alibaba × Kroll; Bila × Kroll; and Kroll × A. roylei. A pair of 4 centimetres sections of onion leaves were placed across the glass bottom of a Petri dish (diameter 9 cm). Ten females of onion thrips at an unknown age were placed between the two leaf sections as neutral starting points. The number of thrips found on either leaf section was counted after 10, 30, 60, 120, and 180 min.

Statistical analyses were performed with Statistica 13 software (Dell Inc. 2016). One-way ANOVA (the factor was onion cultivar/species) was performed on the hatched thrips larvae. The data were normalized with log10(x+1). The Shapiro–Wilk test was used to check the distribution of the data, and Levene's test was used to check homogeneity of variance. Multiple comparisons were computed by using Duncan's multiple range test ($p < 0.05$). The results for the settling preference test were analysed using the Student's t-test at $p < 0.05$.

RESULTS

Significant variability of cultivars/species was found in terms of the mean number of hatched thrips larvae from eggs laid by thrips females on onion leaves ($F = 27.158$; $df = 4$; $p < 0.000$). Significantly the highest number of larvae hatched from eggs laid on Tęcza in comparison with the other cultivars except for Bila [Fig. 3]. In contrast, the least number of larvae hatched on *A. roylei* followed by Kroll.

Significantly more onion thrips females settled on leaf sections of *A. roylei* in comparison with Tęcza and Kroll over each observational period [Fig. 4]. In the combinations of *A. cepa* cultivars with the cultivar Kroll (*A. fistulosum*), in two from three pairs, *A. fistulosum* species was being significantly more preferred than cultivars of *A. cepa* by *T. tabaci*. In the case of *A. cepa* cultivars Alibaba and Bila, no significant differences in onion thrips preference were observed. These cultivars paired cultivar Tęcza were differently preferred by *T. tabaci*. Significantly more thrips settled on Alibaba in comparison with Tęcza, while substantially more females settled on Tęcza than on Bila.

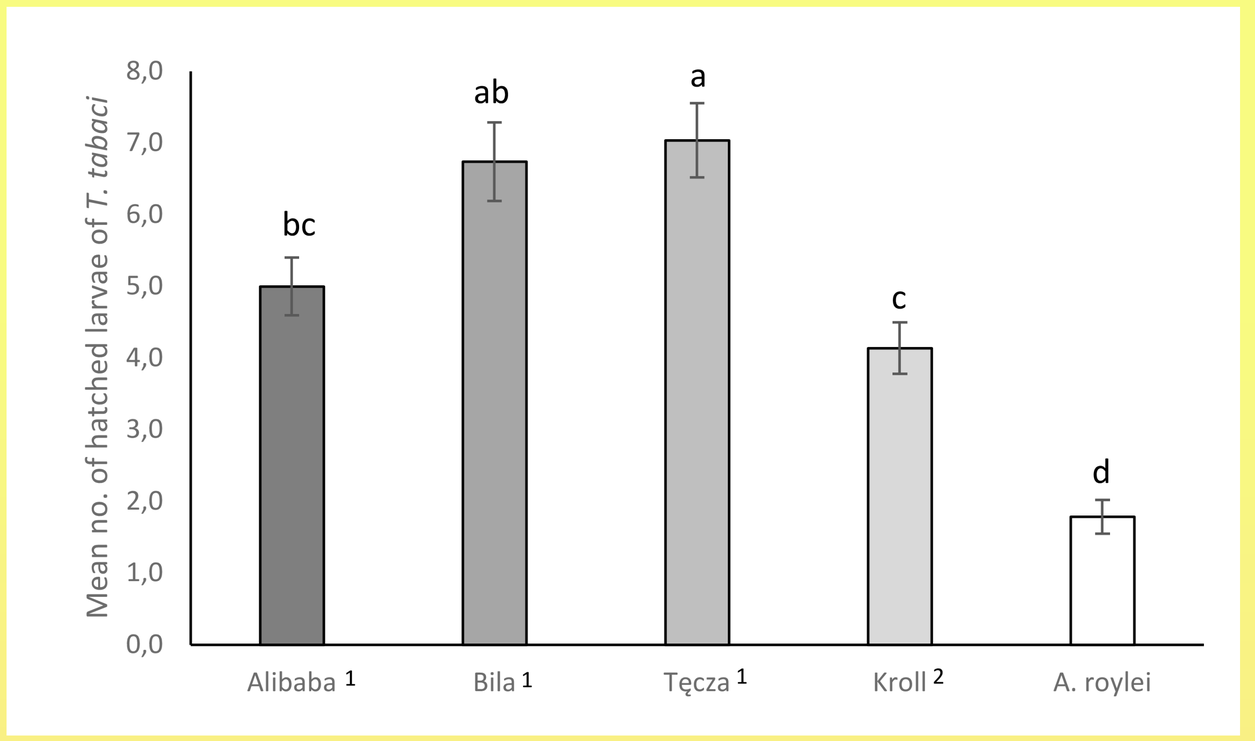

Fig. 3. Mean number of hatched larvae of *T. tabaci* [1] – *Allium cepa*, [2] – *Allium fistulosum*.

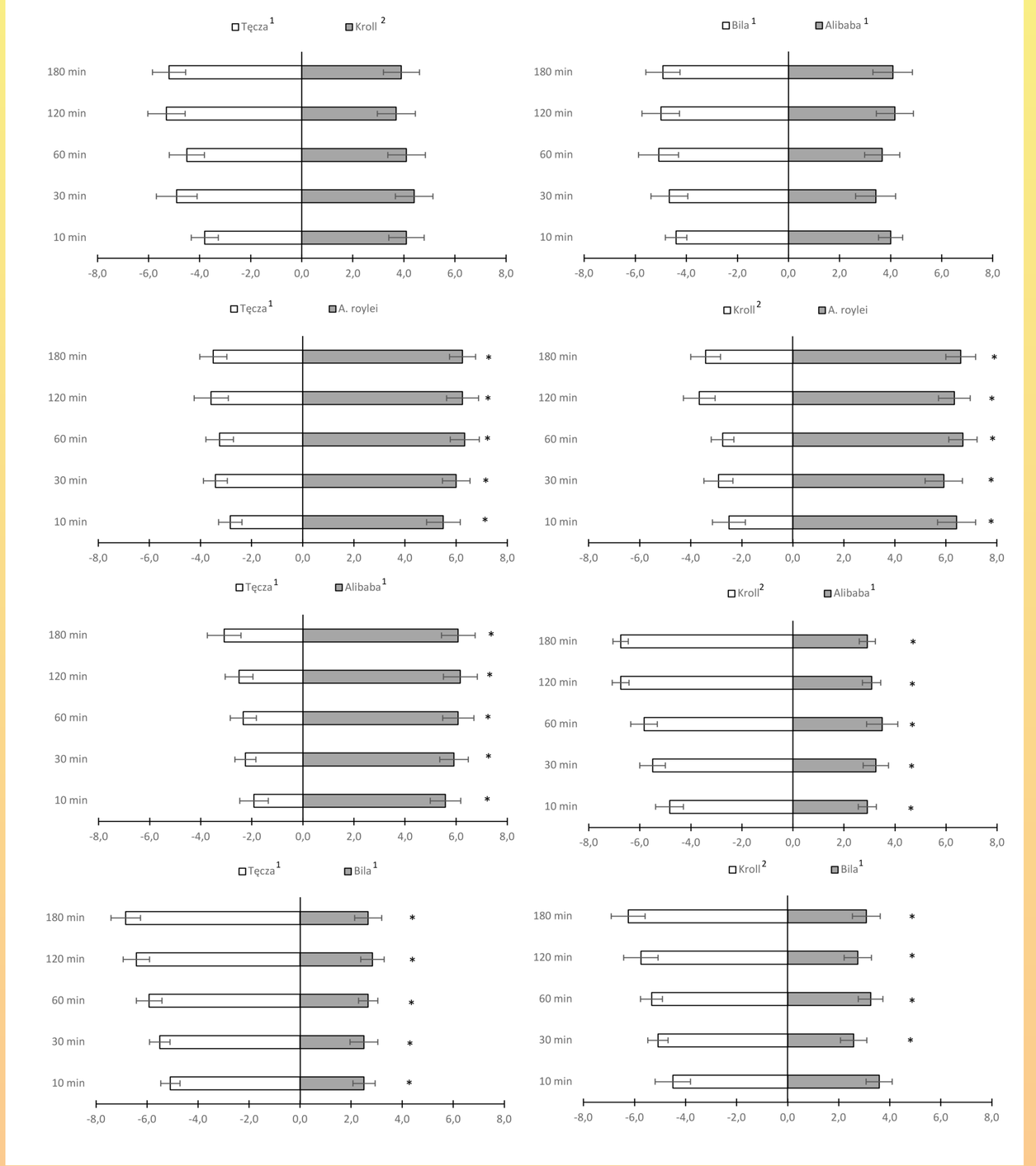

Fig. 4. Mean number of *T. tabaci* females after 10 minutes, 30 minutes, 60 minutes, 120 minutes and 180 minutes during the settling preference [1] – *Allium cepa*, [2] – *Allium fistulosum*.

CONCLUSIONS

Significant species and cultivar differences were found in bioassay on oviposition preference of *T. tabaci* on three different onion species. Analysis of the oviposition preference data indicated, that *T. tabaci* females laid significantly more eggs on the leaves cultivars of *A. cepa*, especially on cultivar Tęcza. It was also concluded that, *A. cepa* cultivars were less preferred in the settlement preference tests, than remain tested species of onion. It was noted that, the wild species *A. roylei* was significantly the most preferred by *T. tabaci* females, among the onion species tested, but laid significantly the fewest eggs on this onion species.

The results presented above may contribute to optimising breeders' selection cultivars of onion in the future. Furthermore, the results obtained suggest that onion cultivars from wild species may be characterised by different features influencing the settlement and oviposition behaviour of *T. tabaci* females, which requires further studies.

Keywords: bioassay, oviposition, settling preference