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EFFECTIVENESS OF NATURAL ESSENTIAL OILS ADDED TO YELLOW STICKY TRAPS IN THE MONITORING OF SCIARID FLIES (*SCIARIDAE*)

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ABSTRACT. In the presented studies it was found that tested natural essential oils are not attractive to sciarid flies (*Sciaridae*). In the majority of cases, on the sticky traps with the addition of aromatic substances a statistically insignificant drop of the number of trapped insects was recorded when compared with control combination. A significant decrease of trapped imagines (53.28%) in comparison to the control was found on yellow sticky traps with the addition of ginger oil. The results have demonstrated that ginger oil had a repellent effect on sciarid flies.

Key words: monitoring, yellow sticky traps, aromatic attractants, sciarid flies

Introduction

The change of plant production technology consisting in the substitution of the traditional substrates (earth, peat, bark) by inert substrates (mineral wool, etc.) has caused an increased harmfulness of sciarid flies (*Sciaridae*). The organic matter contained in the traditional substrate is a food source for these pests. When the organic matter is missing (inert substrate), the plants cultivated in this substrate become the main food of these insects (**Dankowska** 1997).

In the protection of greenhouse cultivations against sciarid flies, an early monitoring of that pest is of essential importance. It permits to control effectively the pest before any damage occurs on the plants (**Yano et al.** 1987, **Gillespie** and **Quiring** 1987, **Shipp** and **Zariffa** 1991, **Górski** 1999). The observed increased response of insects to definite colours inspired entomologists to apply coloured sticky traps in the monitoring of greenhouse pests. The action of these traps consist in the fact that their colour lures the flying forms of pest, which get stuck on the trap surfaces covered with insect glue (**Baranowski** and **Górski** 1991, **Górski** 1999, 2001).

In the Department of Plant Protection Methods of the Agricultural University in Poznań, studies have been carried out for many years on the increase of the effectiveness of sticky traps in the monitoring of greenhouse plant pests. Among others, it refers to the application of aromatic attractants to coloured sticky traps.

The objective of the present studies was the evaluation of the effectiveness of natural essential oils added to yellow sticky traps for the monitoring of the occurrence of sciarid flies (*Sciaridae*).

Material and methods

Studies of the effectiveness of natural essential oils in the monitoring of sciarid flies (*Sciaridae*) were carried out in the years 2002 and 2003 in the greenhouse of the Experimental Station "Marcelin" of the Horticultural Faculty, the Agricultural University in Poznań. The studied aromatic substances were added to yellow sticky traps. The traps were made of plastic and their size was: 4 × 6 cm. Before the application of essential oils, the lower part of the traps (1 cm stripe at the lower shorter edge) was protected with a paper tape, and then, the traps were sprayed with insect glue (Soveurode[®]) in aerosol. Subsequently, the protecting paper tape was removed and the uncovered area was covered with aromatic substance using a paintbrush. All essential oils were applied in the amount of 0.1 ml per one sticky trap. In the experiment, the following natural essential oils were tested: basil oil, clove oil, ginger oil, juniper oil, sage oil, spruce oil, sweet flag oil, tea-tree oil. Each substance was tested individually in separate chamber of 40 m² with tomato plants intensely attacked by sciarid flies. All aromatic substances used in the studies were produced by "Pollena Aroma" Co. in Warsaw. In the control combination, yellow sticky traps were used without any addition of natural essential oils. All investigated sticky traps were suspended in the culture in vertical position (the shorter edge upwards), at the height of 1 cm above the greenhouse floor. In each combination, five sticky traps were installed. Twice a week, the localization of traps in each chamber was changed in order to eliminate the influence of the suspension place on the number of trapped insects. After seven days from the moment of suspension, the traps were removed and the number of the imagines caught on sticky traps was counted. The experiment was repeated eight times. The obtained results were statistically analysed with the use of the Duncan's test at the significance level of $\alpha = 0.05$.

Results

The reaction of sciarid flies (*Sciaridae*) to natural essential oils applied on yellow sticky traps is shown in Table 1.

The results indicate that none of studied aromatic compounds exerted any attracting effect on sciarid flies. In the majority of cases, on the sticky traps with the addition of natural essential oils, a statistically insignificant drop of the number of trapped insects was recorded when compared with the control combination (without any addition of aromatic substances). The drop amounted from 1.51% to 28.96%.

Table 1

**Attractiveness of natural essential oils added to yellow sticky traps for sciarid flies
(*Sciaridae*)**

**Atrakcyjność dla ziemiórek (*Sciaridae*) naturalnych olejków eterycznych zastosowanych
na żółtych tablicach chwytnych**

Type of essential oil Rodzaj olejku eterycznego	Number of caught insects (no./trap) Liczba odłowionych owadów (szt./pułapkę)	Percentage decrease (–) or increase (+) in relation to control Procent obniżenia (–) lub wzrostu (+) w stosunku do kontroli
Ginger oil Olejek imbirowy	23.15 a	–53.28
Sweet flag oil Olejek tatarakowy	35.20 ab	–28.96
Sage oil Olejek szatwiowy	36.85 ab	–25.63
Tea-tree oil Olejek drzewa herbacianego	42.85 ab	–13.52
Clove oil Olejek goździkowy	45.05 ab	–9.08
Basil oil Olejek bazyliowy	48.00 ab	–3.13
Juniper oil Olejek jałowcowy	48.80 ab	–1.51
Spruce oil Olejek świerkowy	50.80 ab	+2.52
Control – yellow sticky trap without any addition of essential oil Kontrola – żółta tablica chwytna bez dodatku olejku eterycznego	49.55 b	–

Mean values marked with the same letter do not differ at the significance level $\alpha = 0.05$ according to the Duncan's test.

Średnie oznaczone tą samą literą nie różnią się istotnie na poziomie istotności $\alpha = 0,05$ według testu Duncana.

A significant decrease of trapped imagines amounting to 53.28% in comparison to the control was found on yellow sticky traps with an addition of ginger oil.

In the combination with spruce oil, an insignificant increase of caught insects (2.52%) was recorded in comparison to the control.

Discussion

Monitoring of pest population is one of the important factors determining the success of plant protection. Coloured sticky traps are suitable and efficacious tools for the monitoring of greenhouse pests. The attractiveness of traps for pests can be increased by using alluring flower odours in combination with the coloured sticky traps (Frey et al. 1994). Aldehydes found in flower oils were first described as thrips attractants (Howlett 1914). Catches of thrips by means of different aromatic aldehydes was investigated by several researchers (Brodsgaard 1990, Teulon and Ramakers 1990, Teulon et al. 1993, Frey et al. 1994, Górski 2001). Application of 4-methoxybenzaldehyde with an anise aroma (Brodsgaard 1990, Teulon and Ramakers 1990, Frey et al. 1994), benzaldehyde with an almond aroma (Teulon et al. 1993) and 3-phenylpropionaldehyde with a cinnamon aroma (Górski 2001) caused a statistically significant increase of adult thrips caught on blue sticky traps.

Researchers also tried to increase trap attractiveness for insects by using natural essential oils and their compounds. Several odours have been reported to be behaviourally attractive to greenhouse pests. Eugenol and geraniol, compounds of natural essential oils occurring in flower scent were attractive to western flower thrips (*Frankliniella occidentalis* Pergande). The addition of those compounds significantly increased the attractiveness of blue traps to adult thrips in laboratory experiments (Frey et al. 1994). In earlier studies carried out by the present author (Górski 2001) increased response of western flower thrips to coloured sticky traps with cinnamon oil, cypress oil and rosemary oil was found.

In the presented studies, this same author investigated the attractiveness of natural essential oils added to yellow sticky traps for sciarid flies (*Sciaridae*). The studies have shown that aromatic substances are not attractive to sciarid flies. In the majority of cases, on the sticky traps with the addition of natural oils, a statistically insignificant drop of the number of trapped insects was recorded when compared with control combination. A significant decrease of trapped imagines in comparison to the control was found on yellow sticky traps with the addition of ginger oil. The results have demonstrated that ginger oil had a repellent effect on sciarid flies.

In foreign literature, no data referring to the response of sciarid flies to aromatic substances have been found.

In earlier studies carried out by the Górski (2001), the usefulness of natural essential oils in the monitoring of sciarid flies was also determined. Observations were carried out on such essential oils as: anise oil, cinnamon oil, cypress oil, lavandin oil, orange oil, pine-needle oil and rosemary oil. These oils were applied both on yellow and blue sticky traps. Sciarid flies reacted most intensively to yellow traps with lavandin oil showing a 20.54% increase in the number of trapped imagines in comparison to the control (traps without any addition of essential oils). Also cinnamon oil and pine-needle oil exerted a luring effect on sciarid flies. The effectiveness of yellow sticky traps with an addition of these oils increased by 16.09% and 2.51% respectively. However, the increased number of insects trapped on yellow sticky traps with an addition of aromatic substances was not statistically significant.

The attractiveness of natural essential oils applied on blue sticky traps was similar to the yellow ones. Sciarid flies reacted most intensively to blue sticky traps with the addition of lavandin oil and those traps caught a significantly greater number (increased by

59.92%) when compared with the control combination. Also cinnamon oils and pine-needle oil exerted a luring effect on sciarid flies increasing the efficacy of traps by 19.69% and 14.54% respectively. However, the number of insects trapped with use of these aromatic substances did not show a statistically significant difference in comparison with the control.

In the another study carried out by the same author (Górski 2001), the luring potential was determined in reference to the following essential oils: bergamot oil, lemon oil, rose-tree oil, geranium oil, melissa oil and patchouli oil. Also in this case, the aromatic substances were used on both yellow and blue sticky traps. Studies have shown that all tested aromatic substances, independent of the colour of the sticky traps, caused an increase in the number of trapped sciarid flies. The insects reacted particularly strongly to yellow sticky traps with the addition of patchouli oil and lemon oil showing a significant increase in the number of trapped imagines (44.17% and 41.07% respectively) in comparison to the control.

The attractiveness of natural essential oils applied on blue sticky traps was similar to the yellow ones. Sciarid flies reacted particularly intensively to lemon oil and patchouli oil, showing a significant increased number of trapped insects (by 86.90% and 85.91% respectively).

At the same time, it was found that the colour of sticky traps and the aromatic attractants cooperate in the stimulation of the insects' responses. This fact has been confirmed by a definite absence of sciarid flies reaction to essential oils applied on colourless (transparent) sticky traps, in contrast to an increased reaction to coloured sticky traps (Górski 2001).

Conclusions

1. The application of natural essential oils to yellow sticky traps did not exert any attracting effect on sciarid flies (*Sciaridae*).
2. It is recommended to continue further studies in order to investigate the attractiveness of natural essential oils applied on blue sticky traps for sciarid flies (*Sciaridae*).
3. The observed repellent action of ginger oil may have a significant importance in the protection of crops against sciarid flies (*Sciaridae*). However, further studies are necessary to verify the usefulness of this aromatic substance in the plant protection against these insects.

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SKUTECZNOŚĆ NATURALNYCH OLEJKÓW ETERYCZNYCH ZASTOSOWANYCH NA ŻÓŁTYCH TABLICACH CHWYTNYCH W MONITOROWANIU ZIEMIÓREK (*SCIARIDAE*)

S t r e s z c z e n i e

Badania nad skutecznością naturalnych olejków eterycznych w monitorowaniu występowania ziemiórek (*Sciaridae*) przeprowadzono w latach 2002 i 2003 w szklarni znajdującej na terenie Stacji Doświadczalnej „Marcelin” Wydziału Ogrodniczego Akademii Rolniczej w Poznaniu. Określono atrakcyjność dla szkodników takich olejków eterycznych, jak: bazyliowy, drzewa herbacianego, goździkowy, imbirowy, jałowcowy, szałwiowy, świerkowy i tatarakowy. Substancje zapachowe stosowano pojedynczo, w oddzielonych od siebie kamerach o powierzchni 40 m². W poszczególnych kamerach uprawiano rośliny pomidora silnie zaatakowane przez ziemiórki. Testowane olejki eteryczne nanoszono na żółte tablice chwytne o wymiarach 4 × 6 cm. Substancje zapachowe stosowano w dawce 0,1 ml/1 pułapkę chwytą. Wszystkie badane naturalne olejki eteryczne były produkowane przez firmę „Pollena Aroma” z Warszawy. Kontrolę stanowiły żółte tablice bez dodatku substancji zapachowych. Tablice wieszano w uprawie w pozycji pionowej, tj. krótszą krawędzią skierowaną ku górze tak, aby ich dolna krawędź znajdowała się na wysokości 1 cm od podłoża. Określono liczbę imagines odłowionych na powierzchniach chwytnych pułapek. Doświadczenie powtarzano ośmiokrotnie.

Badania wykazały, że żaden z badanych związków zapachowych nie działał nęcąco na ziemiórki. Na żółtych tablicach chwytnych z dodatkiem naturalnych olejków eterycznych w większości wypadków zanotowano nieistotny statystycznie spadek liczby odłowionych owadów w porównaniu z kombinacją kontrolną (pułapki chwytne bez dodatku substancji zapachowych). Spadek ten wynosił 1,51-28,96%. Stwierdzono istotnie mniejszą skuteczność działania pułapek, wynoszącą 53,28% w odniesieniu do kontroli, gdy stosowano tablice chwytne z dodatkiem olejku imbirowego. Wyniki te wskazują na działanie repelentne olejku imbirowego w stosunku do ziemiórek.