

ROMUALD GÓRSKI

EFFECTIVENESS OF NATURAL ESSENTIAL OILS ADDED TO BLUE STICKY TRAPS IN THE MONITORING OF THE OCCURRENCE OF SCIARID FLIES (*Sciaridae*)

*From Department of Plant Protection Methods
The August Cieszkowski Agricultural University of Poznań*

ABSTRACT. The presented studies proved the usefulness of spruce oil in the monitoring of the occurrence of sciarid flies (*Sciaridae*). The addition of this oil on blue sticky traps caused significant increase of the caught insects, i.e. by 61.77% in comparison with the control (sticky traps without any aromatic substance).

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

Introduction

The observed increased response of insects to definite colours inspired entomologists to apply coloured sticky traps in plant protection. Coloured sticky traps are suitable and efficacious tools for the monitoring of greenhouse pests. The action of these traps consists in the fact that their colour lures the flying forms of insects which in turn get stuck to the traps whose catching surfaces are covered with entomological glue (**Baranowski and Górski 1991, Górski 1999, 2001**). The attractiveness of traps for pests can be increased by using 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 were 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 in adult thrips trapped 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. For example, greenhouse whitefly (*Trialeurodes vaporariorum* Westwood) reacted most intensively to lemon oil. Pea leafminer (*Lirimyza huidobrenses* Blanchard) responded positively to natural essential oils, i.e. spruce oil (Górski and Jezior 2004), basil oil, clove oil and juniper oil (Górski and Pawłowska 2005). At the same time, it was found that the colour of sticky traps and aromatic attractants cooperate in the stimulation of the insects' responses. This fact has been confirmed by a definite absence of western flower thrips and greenhouse whitefly reaction to essential oils applied on colourless (transparent) sticky traps, in contrast to an increased reaction of these pests to coloured sticky traps (Górski 2001).

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

Material and methods

Studies on the effectiveness of natural essential oils in the monitoring of the occurrence of sciarid flies (*Sciaridae*) were carried out in the years 2003 and 2004 in the greenhouse at the Experimental Station "Marcelin" of the Horticultural Faculty Agricultural University of Poznań. The studied aromatic substances were added to blue sticky traps. The traps were made of plastics 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 surface. In the chambers tomato plants were cultivated. The plants were strongly attacked by sciarid flies. All aromatic substances used in the studies were produced by "Pollena Aroma" Co. in Warsaw. In the control combination, blue sticky traps were used without any addition of natural essential oils. All investigated sticky traps were suspended among cultivated tomato plants 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. The localization of traps was changed in each chamber twice a week in order to eliminate the effect 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 trapped imagines was counted. The experiment was replicated eight times. The obtained results were statistically analysed using the Duncan's test at the significance level $p = 0.05$.

Results

The results of the effect of natural essential oils on the number of caught imagines of sciarid flies (*Sciaridae*) on blue sticky traps are shown in Table 1.

Table 1
Attractiveness of natural essential oils added to blue sticky traps for sciarid flies (*Sciaridae*)
Atrakcyjność dla ziemiórek (*Sciaridae*) naturalnych olejków eterycznych zastosowanych na
niebieskich tablicach chwytnych

Type of essential oil Rodzaj olejku eterycznego	Number of trapped insects (no./trap) Liczba odłowionych owadów (szt./pułapkę)	Percentage increase (+) or decrease (–) number of trapped insects in relation to control Procent zwiększenia (+) lub zmniejszenia (–) liczby odłowionych owadów w stosunku do kontroli
Spruce oil Olejek świerkowy	31.95 e	+61.77
Tea-tree oil Olejek drzewa herbacianego	24.75 d	+25.32
Sage oil Olejek szalwiowy	21.15 cd	+7.09
Juniper oil Olejek jałowcowy	19.65 cd	–0.51
Clove oil Olejek goździkowy	17.70 bc	–10.38
Basil oil Olejek bazyliowy	17.00 bc	–13.92
Ginger oil Olejek imbirowy	12.70 ab	–35.70
Sweet flag oil Olejek tatarakowy	11.00 a	–44.30
Control – blue sticky trap without any addition of essential oil Kontrola – niebieska tablica chwytna bez dodatku olejku eterycznego	19.75 cd	–

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

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

Sciarid flies reacted most intensively to spruce oil. The addition of this oil on blue sticky traps caused a statistically significant increase of the trapped insects in comparison with the control combination without any aromatic substance. The effectiveness increased by 61.77%.

Also tea-tree oil was attractive to sciarid flies. After application of this oil, the effectiveness of blue sticky traps increased by 25.32%. However, the observed increase of the number of caught imagines was not statistically significant in comparison to the control combination.

Also the addition of sage oil on sticky traps caused 7.09% statistically insignificant increase of the trapped insects.

In the remaining combinations with the use of natural essential oils, the effectiveness of the sticky traps decreased by 0.51-44.30%.

Discussion

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. In case, when the organic matter is unavailable (inert substrate), then the plants cultivated in this substrate become the main alternative food of these insects (**Dankowska** 1997).

In the protection of greenhouse cultivations against sciarid flies, an early monitoring of these pests has an essential importance. Coloured sticky traps signal precisely the appearance of sciarid flies on cultivations and thereby permit to control them effectively still before any damages occur on the plants (**Yano et al.** 1987, **Gillespie and Quiring** 1987, **Shipp and Zariffa** 1991, **Górski** 1999). In the monitoring of sciarid flies occurrence, only yellow sticky traps are used. The studies carried out by the present author indicate, however, that sciarid flies, next to their response to the yellow colour, do also react to other colours including the blue one (**Górski** 2001). The attractiveness of traps for *Sciaridae* can be increased using smell attractants in combination with the coloured sticky traps. In the presented studies, the author investigated the attractiveness of natural essential oils added to blue sticky traps for sciarid flies. The studies proved the usefulness of spruce oil in the monitoring of the occurrence of sciarid flies. The addition of this oil on blue sticky traps caused significant increase of the caught insects number in comparison with the control combination without any aromatic substance.

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

In earlier studies carried out by **Górski** (2001), the usefulness of natural essential oils in the monitoring of sciarid flies was also determined. Observations were performed on such essential oils as: anise, cinnamon, cypress, lavandin, orange, pine-needle and rosemary. These oils were applied both on blue and yellow sticky traps. Sciarid flies reacted most intensively to blue sticky traps with the addition of lavandin oil and on those traps a significantly greater number of these pests (increased by 59.92%) was caught in comparison with the control combination. Also cinnamon and pine-needle oils 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.

The attractiveness of natural essential oils applied on yellow sticky traps was similar to the blue ones. Sciarid flies reacted most intensively to the traps with lavender oil indicating a 25.54% increase in comparison to the control. The effectiveness of yellow sticky traps with an addition of cinnamon and pine-needle 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.

In another study carried out by the same author (Górski 2001), the luring potential was determined in reference to the following essential oils: bergamot, lemon, rose-tree, geranium, melissa and patchouli. Also in this case, the aromatic substances were used on both blue and yellow sticky traps. Studies have shown that all the tested aromatic substances, independently of the colour of the sticky traps, caused an increase in the number of trapped sciarid flies. The insects reacted particularly strongly to blue sticky traps with the addition of lemon oil and patchouli oil showing a significant increase in the number of trapped imagines (86.90% and 85.91% respectively) in comparison to the control.

In case of yellow sticky traps, there was a significant increase of the caught insects in reference to all aromatic substances. Similar as in case of blue sticky traps, sciarid flies reacted particularly intensively to patchouli and lemon oils, showing an increased number of trapped insects (by 44.17% and 41.07% respectively).

Conclusions

1. The addition of spruce oil on blue sticky traps increased significantly the number of caught insects.
2. The effectiveness of the monitoring of sciarid flies (*Sciaridae*) in glasshouse crops can be increased by using blue sticky traps in combination with natural essential oil such as spruce oil.

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SKUTECZNOŚĆ NATURALNYCH OLEJKÓW ETERYCZNYCH ZASTOSOWANYCH NA NIEBIESKICH TABLICACH CHWYTNYCH W MONITOROWANIU WYSTĘPOWANIA ZIEMIÓREK (*Sciaridae*)

Streszczenie

Skuteczność naturalnych olejków eterycznych w monitorowaniu występowania ziemiórek (*Sciaridae*) badano w latach 2003 i 2004, w szklarni znajdującej na terenie Stacji Doświadczalnej „Marcelin” Wydziału Ogrodniczego Akademii Rolniczej w Poznaniu. Określono atrakcyjność dla tych 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 наносono na niebieskie tablice chwytny o wymiarach 4 × 6 cm. Substancje zapachowe stosowano w dawce 0,1 ml/1 pułapkę chwytną. Wszystkie badane naturalne olejki eteryczne były produkowane przez firmę „Pollena Aroma” z Warszawy. Kontrolę stanowiły niebieskie 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.

W badaniach stwierdzono przydatność olejku świerkowego w monitorowaniu występowania ziemiórek. Zastosowanie tego olejku na niebieskich tablicach chwytnych spowodowało istotne zwiększenie liczby odłowionych owadów, tj. o 61,77% w stosunku do kontroli (tablice chwytny bez dodatku substancji zapachowej). Ziemiórki również silnie reagowały na tablice chwytny z dodatkiem olejku drzewa herbacianego. Wzrost efektywności tych pułapek nie był jednak statystycznie istotny i wyniósł 25,32%.