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EVALUATION OF WHITE STICKY TRAPS FOR INSECTS MONITORING IN APPLE ORCHARDS DURING THE FRUIT RIPENING PERIOD

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Evaluation of white sticky traps for insects monitoring in apple orchards during the fruit ripening period. – Baranová B., Oboňa J. – *Sticky traps are easily available and widely used by the non-professional gardeners for the monitoring and elimination of thepests. The presence and abundance of the invertebrates captured by the white sticky traps, exposed during the six week period in 2021 at the apple orchard were assessed. More than 1200 specimens were identified at least up to order level. The sample was dominated by the Diptera, Mecoptera, and Hymenoptera orders, which together accounted more than 96% of the all captured specimens. On the other side, the target pests, i.e. sawflies, gallmidges or thrips were difficult or even impossible to be identified and counted, because of their heigh damage caused by the sticky substance as well as weather conditions during the time of exposition. Put into balance traps effectiveness in the monitoring and elimination of pests, and environmental damage they cause by capturing non-target organisms, including bees, their real effect is consequently more than disputable.*
Keywords: *white sticky traps, apple orchard, pests, pollinators, insects*
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Оцінка ефективності білих клейких пасток для моніторингу комах у яблуневих садах у період дозрівання плодів. – Баранова Б., Обоня Й. – *Клейкі пастки легко доступні і широко використовуються непрофесійними садівниками для моніторингу та знищення шкідників. В роботі представлені результати обліку чисельності комах з використанням білих клейових пасток. Білі липкі пастки були встановлені в яблуневому саду в приватному саду в селі Вишна Шебастова, Східна Словаччина. Фруктовий сад сформований з яблунь різного віку, висоти та сорту. Було визначено наявність та чисельність комах, відловлених з використанням білих клейких пасток, які експонувалися в саду протягом шести тижнів у 2021 році. Загалом понад 1200 особин комах було ідентифіковано принаймні до рівня ряду. У вибірці переважали особини з рядів Diptera (68%), Mecoptera та Hymenoptera, які всі разом становили понад 96% від кількості усіх відловлених екземплярів. З іншого боку, цільових шкідників, таких як пильщики, галиці або трипси було важко або навіть неможливо ідентифікувати та підрахувати через їх значні пошкодження, спричинені клейкою речовиною, а також погодними умовами під час збору. Виходячи з результатів, ми припускаємо, що використані білі липкі пастки завдають шкоди навколишньому середовищу, а не бажаного ефекту моніторингу та усунення шкідників. На підставі приналежності комах за їх екологічними функціями в саду можна зробити висновок, що в цей тип липких пасток потрапляють переважно комахи з нейтральною або позитивною екологічною функцією, тобто хижаки і запилювачі, у тому числі бджоли. Тому ми вважаємо, що білі липкі пастки є неефективними для моніторингу шкідників в яблуневих садах у період дозрівання плодів. Тому ефективність цих пасток для спостереження за комахами в яблуневих садах є більш ніж спірною.*
Ключові слова: *білі липкі пастки, яблуневий сад, шкідники, запилювачі, комахи.*
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Introduction

Sticky traps are widely used by the non-professional gardeners for the monitoring and elimination of the pests. Their use is without any official regulation, as they are freely accessible in the markets. The most of them work passively, i.e. flat of the trap is covered with the adhesive material causes fixation and immobilization of the organisms flying in the trajectory, with their consecutive perishing. In the most cases, fixative agents are without especial substances able to actively attract the target pests. Thus, the consequences could be supposed, that this non-selective access would lead to simultaneous capture of the non-target organisms, including representatives of the rare, endangered or pollinator groups (Kirk 1984; Wallis, Shaw 2008).Thus, their real effectiveness, putting in the balance capture of harmful pest organisms opposite to possibly beneficial insect including pest predators and pollinators, is more than disputable.

Traps are used for monitoring and elimination of sawflies, gall midges or thrips, as well as other potential pests as f. e. beetles (Graf et al. 1996; Hallett et al. 2007; Devi, Roy 2017). White coloured traps are predominantly used for plums, apple, pear orchards or ornamental flowers, but also for cowpea, tomato or cotton fields (Coli et al. 1992; Atakan, Pehlivan 2015; Tang et al. 2015; Prema et al. 2018). Sticky traps are also used as a sampling method for the collection of targeted zoological material within the research (Wallis, Shaw 2008; Abuel-Hassan et al. 2021). However, its should be taken into account, that the processing and following determination of such captured insect specimensis a difficult or even impossible because of their heigh damage caused by the sticky substance as well as weather conditions during the time of exposition.

The aim of our study was to:

- determinate abundance of the organisms captured on the 10 white sticky traps exposed at an apple orchard in the 6 week period in the 2021;
- evaluate the percentage of the separate taxa as well as groups based on their expected ecological function in the orchard;
- asses traps effectiveness in connection to target organisms listed by the manufacturer and, abundance of the non-target organisms;
- estimate real traps effectiveness based on the comparison of these two groups.

Material and methods

Traps exposition

White sticky traps were exposed in the 2021, at the apple orchard within the private garden in the Vyšná Šebastová village, Eastern Slovakia, GPS: 49° 0' 36.7377883" N, 21° 19' 52.3414707" E, 372 m altitudes above sea level, mildly warm and humid climatic region, with slightly skeleton pseudogley soils, of middle slope and north exposition. Orchard consists of the apple trees of various ages, height and variety (Fig. 1), surrounded by the gardens and arable land shelterbelt of mixed tree species.

Fig. 1. Monitored apple orchard in the Vyšná Šebastová village, Eastern Slovakia

White sticky traps were of the oblong shape and dimensions 240×180 mm, with the active adhesive substance, *polyisobutylene*, – colorless, odorless, and tasteless viscoelastic chemical applied to the both of trap sides. According to the manufacturer, traps are targeted to capture following pests:

– *Hoplocampa minuta* (Christ, 1791), *H. flava* (Linnaeus, 1761), *H. testudinea* (Klug, 1816), *H. brevis* (Klug, 1816) (Hymenoptera: Tenthredinidae);

– *Contarinia nasturtii* (Kieffer, 1888), *C. pyrivora* (Riley, 1886) (Diptera: Cecidomyiidae);

– *Frankliniella occidentalis* Pergande, 1895, *Thrips tabaci* Lindeman, 1888 (Thysanoptera).

White coloured traps are recommended to be exposed before the flowering period till the fruit harvest and changed every 6 weeks, if necessary sooner. The sticky traps should be freely hanged on tree branches, using strings. Ten till twelve sticky traps are recommended to be exposed per 100 m^2 of orchards. According to the manufacturer, the level of risk for the nontarget invertebrates and the bees is acceptable.

Ten sticky traps were exposed according to manufacturer recommendation, in the mutual distance approximately 5 meters from each other,

since the beginning of the trees flowering. After the six week period, traps were removed and lab processed (Fig. 2).

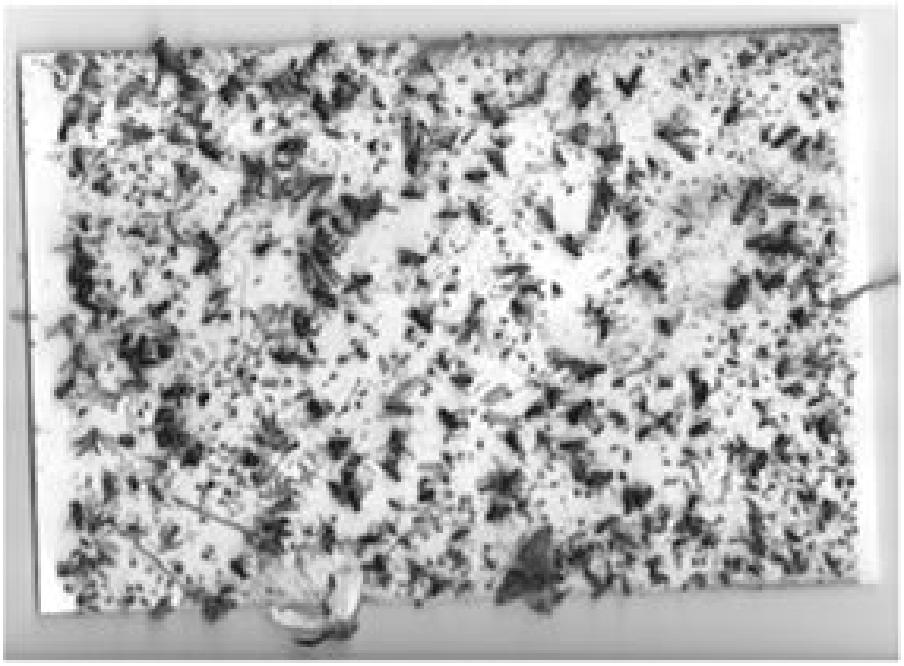

Fig. 2. The white sticky trap after the exposition

Samples processing

From the practical point of view, it was impossible to identify several of the individuals because of their heigh damage/glueing and similarly because of their small dimensions. We assumed them as an "*uncountable group"*, when the absolute numbers were not determined and only the presence of the group is mentioned as the + within the summary.

Specimens of larger dimensions (>2mm) were identified at least up to the order level according to appropriate determination keys (Steyskal 1988; Oosterbroek 2006) and assumed as a "*countable group"*, when the absolute numbers were determined. Nevertheless, it must be emphasized, that this group was also severely damaged and glued. Consequently, each group, if possible, was then characterized based on its expected ecological function in the orchard and the following "ecological categories" were specified:

neutral – without closer relationship to the cultivated trees;

positive – with an expected positive relationship to cultivated trees, f.e. pollinators, predators of pests, etc.;

negative – with an expected negative relationship to cultivated trees-especially pests, vectors of phytopathogens, etc.

Thereafter, dominance was determined on the base of the percentage representation as well as the ratio (%) of the "ecological categories".

Results and discussion

Checklist of the identified taxa with the indication of the absolute numbers or presence of the specimens from ten white sticky traps at the apple orchard during the six week period in 2021 is listed in the Table 1.

Uncountable group

Within the group of small insects (>2mm) strongly glued, destroyed and therefore unable to be identified properly, the presence of the following taxa were determined: gall midges (Cecidomyiidae), long-legged flies (Dolichopodidae), dance flies (Hybotidae) and dark-winged fungus gnats (Sciaridae) as the representatives of the Diptera order, aphids (Hemiptera: Aphididae) and thrips (Thysanoptera).

Countable group

We were able to identify in total more than 1200 specimens.

The dipterans were the most numerous group with the overall representation more than 68%, followed by mecopterans and hymenopterans. These three orders accounted together more than 96% of the all captured specimens. The rest of the determined orders shoved subrecedent representation (<2%) (Fig. 3).

Within the Diptera order, the most numerous were blow flies, i.e. members of the Caliphoridae family (38% of Diptera order / 26% of the whole sample). The metallic colouring adult are

occasional pollinators, larvae of the most species are scavengers of carrion and dung (Goodman 1964; Rognes 1991). Their ecological function in the orchard could be characterized as neutral to positive. The second most numerous were dagger flies – family Empididae representatives (19% of Diptera order / 13% of the whole sample). Adults are predators capturing arthropod prey (Smith 1980), so their ecological function in the orchard could be characterized as positive. Adults of the third most numerous dipterans family Anthomyiidae – root maggot flies (13% of Diptera order / 9% of the whole sample) are occasional pollinators. The larvae are found in the stems and roots of various plants, some also feed on the decaying plant material. Some species in the family are significant agricultural pests (Suwa, Darvas 1998), so their ecological function in the orchard could be characterized as neutral to negative (with the need for further research). The most commonly observed was genus *Anthomyia* (Meigen, 1803).

Table 1. Checklist of the identified taxa with the indication of the absolute numbers or presence of the specimens

Order	**Family / species**	**Abundance / presence**
Araneae		2
Mecoptera	Panorpidae	256
Neuroptera		3
Plecoptera		2
Dermaptera		1
Lepidoptera		17
Coleoptera		19
Hymenoptera	indet.	42
	Apis mellifera	39
Diptera	Anthomyiidae	108
	Asilidae	2
	Caliphoridae	313
	Empididae	157
	Limoniidae	5
	Muscidae	97
	Sarcophagidae	40
	Stratiomyidae	3
	Syrphidae	95
	Tabanidae	3
	Cecidomyiidae	+
	Dolichopodidae	+
	Hybotidae	+
	Sciaridae	+
Hemiptera	Aphididae	+
Thysanoptera		+

Hoverflies (family Syrphidae) and house flies (family Muscidae) were both with the representation about 11% within the dipterans and, with 8% within the whole sample.

Hoverflies are pollinators and larvae are predators feeding especially on aphids (Van Veen 2010), so their ecological function in the orchard could be characterized as positive.

House flies adults can be predatory, saprophagous, or feed on a number of types of plant and animal exudates, larvae occur in various habitats including decaying vegetation, dry and wet soil, nests of insects and birds, freshwater, and carrion. In the general, their ecological function in the orchard could be characterized as neutral.

Flesh flies (Sarcophagidae) were with the representation 4.8% within the Diptera order and, with 3.3% of the whole sample. Adults feed on the fluids from animal bodies, nectar, sweet foods, fluids from animal waste, and other organic

substances. Juveniles may be laid on carrion, dung or sweet plant foods. Thus, ecological function in the orchard could be characterized as neutral to positive.

The less numerous dipterans families (>1%) were as follows: Asilidae, Limoniidae, Stratiomyidae and Tabanidae. In the general, their ecological function in the orchard could be characterized as neutral.

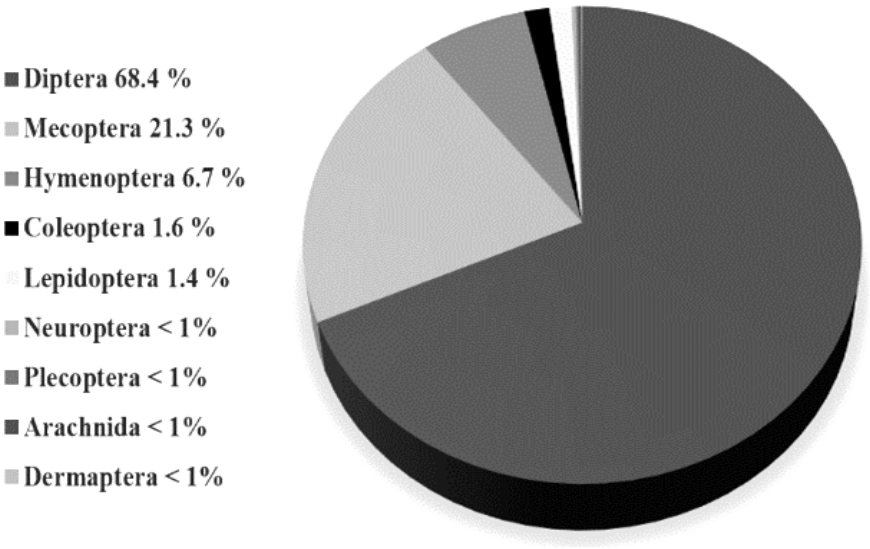

Fig. 3. Percentage representation of the determined orders within the whole sample

Mecoptera, or scorpionflies, all representatives of family Panorpidae, was the second most numerous order (Fig. 3), easily recognizable on the white sticky traps. Adults feed mostly on dead or dying insects, rarely on fruit or nectar, larvae are scavengers, feeding on soft-bodied dead insects. In general, their ecological function in the orchard could be characterized as neutral to positive.

Hymenoptera represented more than 6% of all samples, since almost half of them were honey bees (*Apis mellifera* Linnaeus, 1758). Their ecological function in the orchard could be undoubtedly characterized as very positive. Other hymenopterans were represented by ants with neutral to negative ecological function, especially due to their relationship between to aphids.

Both, Coleoptera and Lepidoptera had representation >1% of all samples.

Orders with the representation <1% were Araneae, Dermaptera, Neuroptera, and Plecoptera.

Closer determination of mentioned groups was not possible, therefore, it is difficult to evaluate their possible ecological function in the orchard.

What was alarming, feathers of the woodpecker were found on one of the traps too.

Summarily, we did not notice a significant presence of Cecidomyiidae and Thysanoptera – the pest groups, which are targeted to be monitored by the using of these white sticky traps. So, it is very paradoxical, that just these groups were practically very difficult to identify from the traps and so evaluate the real effectiveness of the traps to eliminate them.

On the other hand, the traps simultaneously and predominantly captured specimens, which can be finally characterized as with neutral or positive ecological function in the orchard, concretely more than 90% from all countable insects' samples, including predatory families as Dolichopodidae or Hybotidae, which can feed on the targeted pests, especially on gall midges or thrips. Only less than 10% were classified as negative (family Anthomyiidae), however, most of the recorded taxa from this family belonged to the genus *Anthomyia,* so strict negativity is therefore questionable.

Conclusion

After the exposition of ten white sticky traps at selected apple orchard during six week period, more than 1200 specimens were identified, with the absolute dominance of the Diptera order (68.4%), followed by Mecoptera and Hymenoptera. On the other side, the target Cecidomyiidae and Thysanoptera pest groups were barely noticed.

Based on the results, we suppose, that used white sticky traps cause environmental damage rather than the desired pest monitoring and eliminating effect. The effectiveness of these traps for insects monitoring in apple orchards during the

fruit ripening period is consequently more than disputable. We assume that in closed greenhouses may be justified for early detection of the presence of a pests. On the bases of the insect affiliation according their ecological functions in the orchard it seems, that this type of sticky traps captures mainly insects with neutral to positive ecological function i.e. predators and pollinators including bees. We therefore assume, that white sticky traps for pest monitoring in apple orchards during the fruit ripening period are inefficient and harmful. Using the other type of eco-friendly protection. i.e. plant extracts including essential oil or the traps actively attracting pests should be preferably used.

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