

International scientific conference
"Fruit flies and other dipterous plant pests"

July 9–12, 2012 Riga (Latvia)

Abstracts

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Content

International scientific conference "*Fruit flies and other dipterous plant pests*", July 9–12, 2012 Riga (Latvia)

<i>Conference information</i>	3
<i>Conference programme</i>	3
<i>Conference abstracts</i>	
Sunflower maggot (<i>Strauzia longipennis</i>) – a new invasive species in Germany and Europe	5
P. Baufeld, S. Lerche	
<i>Phytomyza gymnostoma</i> Loew, 1858 (Diptera, Agromyzidae) – onion leaf miner in the Banja Luka region (Republic of Srpska, Bosnia and Herzegovina)	6
Z. Đurić, S. Hrnčić	
Diptera in grain crops in Belarus	7
L. I. Trepashko, S. V. Boiko, O. F. Slabozhankina	
Dominant dipterous pests for greenhouse plants (Belarus)	8
T. Kondratenko	
Leaf miners (Agromyzidae) – dynamics and harmfulness on winter wheat in Poland	9
K. Roik	
<i>Rhagoletis</i> (Diptera: Tephritidae) fruit flies in Latvia	10
A. Stalažs	
Review of dipterous pests of cultivated and wild fruit plants in Latvia	11
A. Stalažs	
Comparison of biological aspects of safflower capsule fly, <i>Acanthiophilus helianthi</i> Rossi, 1794 (Diptera: Tephritidae) on safflower cultivars under laboratory conditions	12
K. Saeidi	
Ecofriendly management techniques against melon fruit fly, <i>Bactrocera (Zeugodacus) cucurbitae</i> (Coquillett, 1899) infesting bitter melon, <i>Momordica charantia</i> L.	13
S. K. Ghosh, T. Mandal, N. Laskar	
Effects of different insect growth regulators (IGR) on the vegetable leafminer <i>Liriomyza sativae</i> Blanchard, 1938 (Diptera: Agromyzidae)	14
K. Küçükakyüz, H. S. Civelek, O. Dursun, Ö. Kaban	
The parasitism rate of <i>Diglyphus isaea</i> (Hymenoptera: Eulophidae) on <i>Liriomyza sativae</i> Blanchard, 1938 (Diptera: Agromyzidae) in Mugla Province	15
H. S. Civelek, E. M. Yildirim, O. Dursun, Ö. Kaban	

Screening of 22 entomopathogenic or potential plant growth promoting fungal isolates for pathogenicity to cabbage root fly, <i>Delia radicum</i> (Linnaeus, 1758)	16
J. Razinger, M. Lutz, H.-J. Schroers, G. Urek, J. Grunder	
Preliminary studies on natural enemies of the safflower capsule fly, <i>Acanthiophilus helianthi</i> Rossi, 1794 (Diptera: Tephritidae)	17
K. Saeidi, A. Nuar Azura, D. Omar, F. Abood	
Development of integrated pest management techniques: insect pest management on safflower, <i>Carthamus tinctorius</i> L.	18
K. Saeidi, A. Nuar Azura, D. Omar, F. Abood	
Comparison of various traps and attractants for trapping the safflower capsule fly, <i>Acanthiophilus helianthi</i> Rossi, 1794 (Diptera: Tephritidae)	19
K. Saeidi	

Conference information

International scientific conference "Fruit flies and other dipterous plant pests"

July 9–12, 2012 Riga (Latvia)

Place of venue and address:

Conference hall of Natural History Museum of Latvia, Krišjāņa Barona iela 4, Rīga, Latvia

Organiser:

"RPD Science" IK

Seconding:

"Latvia State Institute of Fruit-Growing"

Conference language:

English

Scientific committee:

Arturs Stalažs, Latvia (coordinator)

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Conference programme

July 9, 2012

Registration

11:00 – 14:00

Session 1: Diversity, distribution and ecology of dipterous plant pests

14:00

Conference opening

Sunflower maggot (*Strauzia longipennis*) – a new invasive species in Germany and Europe

P. Baufeld, S. Lerche

Geographical distribution, seasonal abundances and host ranges of fruit flies in Gedarif & Sinnar States, Sudan (abstract not submitted)

E. H. Suliman

***Phytomyza gymnostoma* Loew, 1858 (Diptera, Agromyzidae) – onion leaf miner in the Banja Luka region (Republic of Srpska, Bosnia and Herzegovina)**

Z. Đurić, S. Hrnčić

Diptera in grain crops in Belarus

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Dominant dipterous pests for greenhouse plants (Belarus)

T. Kondratenko

Leaf miners (Agromyzidae) – dynamics and harmfulness on winter wheat in Poland

K. Roik

***Rhagoletis* (Diptera: Tephritidae) fruit flies in Latvia**

A. Stalažs

Review of dipterous pests of cultivated and wild fruit plants in Latvia

A. Stalažs

Comparison of biological aspects of safflower capsule fly, *Acanthiophilus helianthi* Rossi, 1794 (Diptera: Tephritidae) on safflower cultivars under laboratory conditions

K. Saeidi

Ecology, biology and behaviour of sorghum midge, *Contarina sorghicola*, In Gedarif State, Sudan (abstract not submitted)

E. H. Suliman

July 10, 2012

Session 2: Pest management strategies

10:00

Ecofriendly management techniques against melon fruit fly, *Bactrocera (Zeugodacus) cucurbitae* (Coquillett, 1899) infesting bitter melon, *Momordica charantia* L.

S. K. Ghosh, T. Mandal, N. Laskar

Effects of different insect growth regulators (IGR) on the vegetable leafminer *Liriomyza sativae* Blanchard, 1938 (Diptera: Agromyzidae)

K. Küçükakyüz, H. S. Civelek, O. Dursun, Ö. Kaban

The parasitism rate of *Diglyphus isaea* (Hymenoptera: Eulophidae) on *Liriomyza sativae* Blanchard, 1938 (Diptera: Agromyzidae) in Mugla Province

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Development of integrated pest management techniques: insect pest management on safflower, *Carthamus tinctorius* L.

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Comparison of various traps and attractants for trapping the safflower capsule fly, *Acanthiophilus helianthi* Rossi, 1794 (Diptera: Tephritidae)

K. Saeidi

July 11, 2012

Technical excursion

International scientific conference "Fruit flies and other dipterous plant pests", July 9–12, 2012 Riga (Latvia)

Sunflower maggot (*Strauzia longipennis*) – a new invasive species in Germany and Europe

Peter Baufeld, Sandra Lerche

The sunflower maggot *Strauzia longipennis* (Wiedemann, 1830) is endemic in North America. First observations of the fruit fly in Europe were obtained in Berlin and dates back to 2010. Considering the adaptation of the species to climatic conditions in Central Europe and the status as quarantine pest an extensive survey regarding the distribution of the fruit fly was carried out in Berlin and in the surrounding Federal Land Brandenburg in 2011 with the exception of district Prignitz of the Federal Land because there was no field cultivation of sunflowers in 2011.

The infestation with *Strauzia longipennis* was investigated on sunflower (*Helianthus annuus* L.) as well as Jerusalem artichoke (*Helianthus tuberosus* L.). Therefore, plants were examined growing on fields i. e. sunflower fields and other crops (plants growing through or growing on the edges) as well as plants from a nursery, from experimental fields, backyards, allotments and roadsides.

In Brandenburg, on 27 locations mostly cultivated with *Helianthus annuus* were plants registered to be infested with sunflower maggot. Only in district Oberspreewald-Lausitz the sunflower maggot could not be detected. In Berlin infested plants were observed at 16 locations. The results verify the territorial wide distribution of the sunflower maggot within Berlin and the Federal Land Brandenburg. We assumed an introduction in Germany quite earlier than the first detection in Berlin in 2010. Furthermore, the study demonstrates the Jerusalem artichoke *Helianthus tuberosus* as another host plant of this fruit fly species.

Key words: fruit flies, *Helianthus*, miner, sunflower, quarantine pest, Germany

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International scientific conference "Fruit flies and other dipterous plant pests", July 9–12, 2012 Riga (Latvia)

***Phytomyza gymnostoma* Loew, 1858 (Diptera, Agromyzidae) – onion leaf miner in the Banja Luka region (Republic of Srpska, Bosnia and Herzegovina)**

Zorica Đurić, Snježana Hrnčić

Onion leaf miner (*Phytomyza gymnostoma* Loew, 1858, syn. *Napomyza gymnostoma* (Loew, 1858)) (Diptera, Agromyzidae) is species that feeds on various species of onions (*Allium*) and the greatest damages it makes on garden onion (*Allium cepa* L.) and leek (*Allium ampeloprasum* L. var. *porrum* (L.) J. Gay). Nowadays it is widespread in the whole Europe and considered one of the most important pests, especially on young plants in spring and autumn. According to unofficial data, in Bosnia and Herzegovina it is significantly present in the last fifteen years.

During 2006 and 2007, presence and damages of *Phytomyza gymnostoma* adult feeding were observed on onion, at seven different locations in the Banja Luka region. Onion plants were visually observed to find first damages of adult feeding. After determining the first damages, 20 plants in five places (total of 100 plants) in each plot were randomly selected and observed. On the base of observation, the percentage of damaged plants was determined at every location. During spring generation, the length of development stages was monitored at the entomological cages in the open field. Morphological characteristics of the species were studied at the entomological laboratory.

In 2006 the first damages of adult feeding were observed on 22nd April at the G1 location. The highest percentage of damages plants was determinate at A1 location (50%). In 2007 the first damages of adult feeding were observed on 5th April at the G2 location, while the highest percentage of damaged plants was determinate at B2 location (41%). Larval development lasted 29–34 days and pupa development lasted four months, including summer diapause.

Key words: onion pests, onion, pest presence, damage, adult feeding

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International scientific conference "Fruit flies and other dipterous plant pests", July 9–12, 2012 Riga (Latvia)

Diptera in grain crops in Belarus

L. I. Trepashko, S. V. Boiko, O. F. Slabozhankina

In grain crop agrocenoses of Belarus there is a big variety of insects-phytophages from dipterous order (Diptera). The specialized pests from this order make 21.5% from all the phytophages. By species, number and harmfulness dominate five representatives of frit fly family (Chloropidae) – *Oscinella pusilla*, *Oscinella frit*, *Meromyza nigriventris*, *Meromyza variegata* and *Chlorops pumilionis*. Two species – barley midge (*Mayetiola destructor*) and *Opomyza florum* are only the background species but other phytophagous flies – *Delia coarctata*, *Delia platura*, *Hydrellia griseola* and *Tipula paludosa* in grain crops are met individually. Predatory flies from Syrphidae family are presented by for species: *Episyrphus balteatus*, *Eupeodes corollae*, *Sphaerophoria scripta* and *Syrphus ribesii*.

Under conditions of Belarus frit flies are of economic importance. Winter grain crop stem severity has made from 25–41%, oats 15–20%, grain – from 0.3–20.1%, barley – 10–18%, and 0.6–16.4%, accordingly, triticale – 22.7–49.0%.

In this connection chloropid fly biological features and harmfulness are studied in the share of grain crops. In spring barley and oats frit flies have two generations, in spring wheat and triticale crops the second generation does not develop.

In separate years from dipterous pests a considerable damage can be brought by black wheat leafminer (*Agromyza albipennis*), especially to spring barley and wheat crops, in insignificant degree – oats and triticale. At mass insect development barley losses have made from 2–8.5 cwt ha⁻¹.

The regulating role of agro-technical measures complex (sowing periods, fertilizers, varieties) on dipterous insects harmfulness decrease is studied. The estimation of insecticides efficiency at seed treatment and application during vegetation to control chloropid flies number and harmfulness is done. To substantiate carrying out the protective measures we have developed the ecological and economic expediency thresholds of insecticides application. These indicators change depending on a crop, its cultivar features and planned productivity. So, for example, in spring grain crops the first generation frit flies bring the greatest damage to oats, triticale, then barley and wheat, in winter grain crops – triticale, barley, to a lesser degree – to wheat and rye. Frit flies for every crop differs accordingly: At 1–2 oat and triticale leaves stage makes 10–15 flies, spring wheat – 15–20, barley – 20–25, winter triticale, wheat and rye – 25–30 per 100 net sweeps.

Key words: cereals (barley, oats, rye, triticale, wheat), important pests, biology, leafminers

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International scientific conference "Fruit flies and other dipterous plant pests", July 9–12, 2012 Riga (Latvia)

Dominant dipterous pests for greenhouse plants (Belarus)

Tatiana Kondratenko

The specific composition of dipterous pests of the order Diptera, identified in the greenhouses of Belarus is represented by five species from three families – sciarids (Sciaridae), moth flies (Psychodidae) and shore flies (Ephydriidae).

Studies of dipterous phytophages structure complex have shown that the dominant are sciarids (64%), but shore flies are 17.3% and moth flies – 18.7%. Dipterous pests distribution in crop plantings of different botanical families have shown that they are polyphages. Cucumbers, peppers, tomatoes, green crops are attractive for members of all three fly families (sciarids, moth flies and shore flies), ornamental crops – for sciarids and shore flies, fruit crops – for sciarids. In cucumber, tomato and green crops there is a high dipterous phytophages number (27 larvae per bait), in *Gerbera* a low dipterous pests number (3.4 larvae per bait) is observed.

The faunistic analysis of biological material collected in cucumber, tomato, pepper, eggplant, green and ornamental crops has shown that the phytophages of the order Diptera are represented by: *Bradysia fungicola* (Winnertz, 1867), *Bradysia difformis* Frey, 1948 (Sciaridae), *Scatella stagnalis* (Fallen, 1813) (Ephydriidae), *Psychoda cinerea* Banks, 1894 and *Psychoda gemina* (Eaton, 1904) (Psychodidae). The morphological features of sciarids, shore flies and moth flies also are specified.

In greenhouses of Belarus, the entomophage *Coenosia attenuata* Stein, 1903 (Diptera: Muscidae), which is a predator that feeds sciarid and shore fly adults and larvae is discovered for the first time. And also midge larvae parasites of the *Atheta* spp. (Coleoptera Staphylinidae) are found.

Key words: protected ground, greenhouse pests, Diptera, Ephydriidae, Psychodidae, Sciaridae, food specialization

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International scientific conference "Fruit flies and other dipterous plant pests", July 9–12, 2012 Riga (Latvia)

Leafminers (Agromyzidae) – dynamics and harmfulness on winter wheat in Poland

Kamila Roik

Leaf miners from the family Agromyzidae commonly occur in cereal crops in Poland. However their harmfulness is not considered as very high, locally they can cause losses of economic importance. In Poland there is more than a dozen species of leafminers. They may occur locally in large numbers, and cause substantial damage to the crops which reduce quality and quantity of the harvest. Larvae of the leafminer feed on the parenchyma, causing damages (so-called mines).

Effective methodology of fighting the insects with chemical means have not been developed yet. Studies carried out so far in terms of integrated methods of protection for cereals have shown that a good practical method of chemical signaling control these insects is to control the number of adults trapped on yellow traps. Monitoring of cereal leaf miner flights in winter wheat was carried out at in Poland in Wielkopolska district (Słupia Wielka) in vegetation seasons 2009/2010 and 2010/2011.

The traps were replaced once a week. Additionally, the abundance of leafminers was recorded on experimental plots and selected wheat plantations located in the proximity of the experiments in May, leaves with visible larvae or pupa inside were collected for rearing purpose to obtain imagines and identify leafminer species. Values monitored included the dynamics of flight for leafmining flies along with the speed of development of leaf beetles. The accuracy of the suggested dates was measured by the quantity of the yield obtained. During the years of the research, the biggest yields were obtained when both pest species were chemically treated during the period when the leaf mining flies were abundant with the oldest leaf beetle larvae reaching the size of about 2 mm.

The most common species were: *Chromatomyia nigra* (Meigen, 1830), *Chromatomyia fuscula* (Zetterstedt, 1838) and *Cerodontha (Poemyza) superciliosa* (Zetterstedt, 1860). The dynamics of flight of leafmining flies on the winter wheat plantations typically changes a lot, it is necessary to monitor particular plantations. It was also determined that the species composition of Agromyzidae damaging the winter wheat changes between particular years.

Key words: wheat, cereal pests, *Chromatomyia fuscula*, *Chromatomyia nigra*, *Cerodontha superciliosa* dynamics, harmfulness

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International scientific conference "Fruit flies and other dipterous plant pests", July 9–12, 2012 Riga (Latvia)

***Rhagoletis* (Diptera: Tephritidae) fruit flies in Latvia**

Arturs Stalažs

Several species of flies from genus *Rhagoletis* are serious and economically important pests of some fruit crops. In Europe this fruit fly genus is represented by seven native (*Rhagoletis alternata*, *Rhagoletis batava*, *Rhagoletis berberidis*, *Rhagoletis cerasi*, *Rhagoletis flavicincta*, *Rhagoletis meigenii* and *Rhagoletis zernyi*) and two introduced (*Rhagoletis cingulata* and *Rhagoletis completa*) species. Native European cherry fruit-fly (*Rhagoletis cerasi*) and invasive eastern cherry fruit-fly (*Rhagoletis cingulata*) are important pests of sweet cherries. Other non-European invasive species – *Rhagoletis completa* is serious pest of walnuts.

Until 2008 in scientific literature three *Rhagoletis* species are mentioned for Latvia territory. The first information (since the 19th century) is about *Rhagoletis alternata*. Other species – *Rhagoletis meigenii* as a new species for Latvia is reported in 1930. Only since 2005 published data about *Rhagoletis cerasi* are available although from scientific collections first findings of *Rhagoletis cerasi* are dated back to 1970.

Review of genus *Rhagoletis* in Latvia

Rhagoletis alternata (Fallen, 1814), host plants: *Rosa*. In Latvia this species is very common pest of roses where larvae feed in rose hips. During this research flies also are reared from larvae collected from rose hips (Dobele municipality). Potential economical significance in Latvia is not studied.

Rhagoletis batava Hering, 1938, host plants: common sea-buckthorn (*Hippophae rhamnoides*). In Latvia for the first time one adult fly is captured in 2011 (Salaspils municipality, on common sea-buckthorn). This is not native fly species for Latvia territory and as common sea-buckthorn is important fruit crop, *Rhagoletis batava* can be serious pest in future.

Rhagoletis cerasi (Linnaeus, 1758), host plants: sweet cherry (*Prunus avium*), sour cherry (*Prunus cerasus*), *Lonicera*. Total distribution of this species in Latvia until the end of the 20th century is unknown and during this period species was without economical significance. Since the beginning of the 21st century *Rhagoletis cerasi* become serious pest in sweet cherry plantations, especially in Kurzeme and Zemgale regions.

Rhagoletis meigenii (Loew, 1844), host plants: *Berberis*. For Latvia insufficiently known species and probably all later literature data based on work published in 1930 by O. John.

Key words: fruit flies, diversity, fruit plant pests, *Berberis*, *Hippophae*, *Prunus avium*, *Rosa*

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International scientific conference "Fruit flies and other dipterous plant pests", July 9–12, 2012 Riga (Latvia)

Review of dipterous pests of cultivated and wild fruit plants in Latvia

Arturs Stalažs

Some diptera can be serious pests of economically important plants, especially on field crops. Until the 21st century practical literature contains data only about some dipterous pests of fruit crops for Latvia territory and special attention to them research was not devoted. In the beginning of the 21st century practical situation in fruit crop plantations is changed and today some diptera (for example *Dasineura oxycoccana*, *Rhagoletis cerasi*) are serious pests for fruit crops in Latvia.

In this review on base of published data and field observations scientific information about dipterous pests of cultivated and wild fruit plants in Latvia is compiled for the first time. Available information is about dipterous pests of *Cornus mas*, *Corylus*, *Crataegus*, *Berberis*, *Fragaria*, *Hippophae*, *Lonicera caerulea*, *Malus*, *Prunus*, *Pyrus*, *Ribes*, *Rosa*, *Rubus*, *Sambucus*, *Sorbus*, *Vaccinium*, *Viburnum opulus* and *Vitis*. Most of pests are not with economically significant importance and only some diptera are important pests in local or all-country level. But some diptera (especially pests of non traditional fruit plants) are not sufficiently studied and there is no enough information about them distribution, significance and ecology.

Highest diversity of species is represented by family Cecidomyiidae (29 species) but in other families number of species is low – Tipulidae (2), Anthomyiidae (1), Agromyzidae (5) and Tephritidae (5). Today most problematic (locally or in country level) pests for fruit plant growers in Latvia are *Dasineura oxycoccana*, *Dasineura tetensi*, *Lasioptera rubi*, *Resseliella ribis*, *Resseliella theobaldi* (Cecidomyiidae), *Pegomya rubivora* (Anthomyiidae) and *Rhagoletis cerasi* (Tephritidae). Two species – *Dasineura oxycoccana* (Cecidomyiidae) and *Rhagoletis batava* (Tephritidae) are new incomers for fauna of Latvia which for the first time are found only in this century.

Key words: fruit crops, diversity of pests, important species

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Comparison of biological aspects of safflower capsule fly, *Acanthiophilus helianthi* Rossi, 1794 (Diptera: Tephritidae) on safflower cultivars under laboratory conditions

Karim Saeidi

The safflower capsule fly, *Acanthiophilus helianthi* Rossi, 1794 (Diptera: Tephritidae) is an important pest of safflower, *Carthamus tinctorius* L. Life cycle of this pest was surveyed on five cultivars of safflower under laboratory conditions at temperature $27 \pm 2^\circ \text{C}$, $70 \pm 5\% \text{RH}$ and 16 L : 8 D.

The results indicated that there is not any significant difference on the total developmental time of immature stages of safflower fly reared on five safflower cultivars. However, developmental time of larvae on two cultivars ('Sina' and 'Padideh') showed significant difference with those fed on 'Sogol', 'Semirom' and 'Lenjan'. The generation times estimated on 'Lenjan', 'Semirom', 'Sina', 'Sogol' and 'Padideh' were 88.19 ± 3.22 , 86.51 ± 3.76 , 81.69 ± 1.90 , 79.81 ± 1.35 and 77.51 ± 1.79 days respectively. The mean preoviposition period of the fly was 5.38 ± 0.42 days and the mean time for the female to mate once again was 8.02 ± 0.56 days. The female oviposition rate was affected by safflower cultivars. The mean number of the eggs laid by each female on safflower bolls varieties of 'Padideh', 'Sina', 'Sogol', 'Semirom' and 'Lenjan' was obtained 315 ± 57.5 , 229 ± 15.56 , 196.65 ± 33.27 , 178.14 ± 28.6 and 85.18 ± 39.32 , correspondingly. The mean longevity of the non-feeding male and female flies was estimated 2.38 ± 0.2 and 2.98 ± 0.19 days and it was 69.58 ± 5.99 and 78.12 ± 5.11 days for well-fed male and female flies with honey and water, respectively. The mean longevity of the well-fed male and female flies decreased to 47.29 ± 2.32 and 55.4 ± 3.12 days, respectively; as they had matting activity and safflower heads were presented to them for female oviposition.

Key words: *Carthamus tinctorius*, pest life cycle, cultivar influence

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International scientific conference "Fruit flies and other dipterous plant pests", July 9–12, 2012 Riga (Latvia)

Ecofriendly management techniques against melon fruit fly, *Bactrocera (Zeugodacus) cucurbitae* (Coquillett, 1899) infesting bitter gourd, *Momordica charantia* L.

S. K. Ghosh, T. Mandal, N. Laskar

Bitter gourd, *Momordica charantia* L. is an annual vegetable crop grown in tropical and sub-tropical areas of the globe. It is cultivated in India in a commercial scale but melon fruit fly, *Bactrocera (Zeugodacus) cucurbitae* (Coquillett, 1899) limits its cultivation, causing heavy damage to the fruits, the edible part. It is very difficult to control this pest because the fruit is harvested at frequent intervals and consumed after little cooking. This practice could lead to human health hazards arising from toxic residues in the fruit.

Studies were made to evaluate some lure in bait spraying and biophysical bases of resistance or non-preference against melon fruit fly. Molasses, sugar and alcohol were used for baiting preparation at varying dosages and *Endosulfan* 35 EC was used as toxicant. Four low volume sprays at 10-day intervals were made, starting with the initiation of flowering. Nine cultivars of bitter gourd including hybrid, open pollinated and local were selected for the study. The observation of percent fruit infestation was recorded during each harvest. The experiments were laid down in randomized block design and replicated thrice.

Baiting spray provided significant reduction in fruit infestation and percent fruit infested was ranged from 2.43 to 4.91 against 10.41% in control and 6.10% in *Endosulfan* without baiting material. Among the different baiting spray, molasses found most effective for reduction of fruit infestation. Fruit infestation in kharif season was higher as compared with rabi season. Among the cultivars evaluated 'Peyarafuli Local' recorded lowest infestation followed by 'Garbeta' local and 'Vivek' F1 recorded highest followed by 'Sasya' F1. Local cultivars showed least preference crop (1–25 % fruit damage) to the pest. Resistant crop cultivation and baiting spray have less or no hazardous effects on human health and the environment can be incorporated in integrated pest management programmes and organic farming in vegetable cultivation.

Key words: baiting spray, cultivars, vegetable IPM, organic farming

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Effects of different insect growth regulators (IGR) on the vegetable leafminer (*Liriomyza sativae* Blanchard, 1938) (Diptera: Agromyzidae)

K. Küçükakyüz, H. S. Civelek, O. Dursun, Ö. Kaban

Insecticides with growth regulating properties (IGR) may adversely affect insects by regulating or inhibiting specific biochemical pathways, or processes essential for insect growth and development. The five insecticides with growth regulating properties (Lufenuron (Lufenox, Syngenta, 100 ml 100 L⁻¹); Diflubenzuron (Dimilin, Cansa, 20 g 100 L⁻¹); Pyriproxyfen (Admiral, Sumitomo, 50 ml 100 L⁻¹), Neem Azal T/S (Trifolio-M GmbH, Lahnau, Germany, 4 L 100 L⁻¹) and Cyromazine (Trigard 75 WP, Syngenta, 20 g 100 L⁻¹) were tested against pupae and larvae of *Liriomyza sativae* Blanchard on infested tomato, *Solanum lycopersicum* 'Jaledo', in the laboratory, in 2006. The IGRs were applied according to the manufacturer's recommendations. Each treatment in trials was conducted twice with five replicates. The numbers of adult leafminers emerging from samples of pupae in each treatment were compared.

According to the laboratory test results, pyriproxyfen, cyromazine, neem and lufenuron showed higher effects on the number of the emerging adults from pupae. In larvae trials, all IGRs significantly reduced leafminers as compared to non-treated control. As a result of the study, lufenuron, neem and pyriproxyfen would likely be a valuable insecticide for control of *Liriomyza sativae*.

Key words: *Liriomyza sativae*, insect growth regulators (IGR), tomato, *Solanum lycopersicum*

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The parasitism rate of *Diglyphus isaea* (Hymenoptera: Eulophidae) on *Liriomyza sativae* (Diptera: Agromyzidae) in Mugla Province

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Liriomyza sativae Blanchard, 1938 (Diptera: Agromyzidae) is an important pest on bean in Turkey. *Diglyphus isaea* (Walker, 1838) (Hymenoptera: Eulophidae) is one of the most common parasitoid of *Liriomyza sativae*.

The aim of this study was to determine the natural parasitism rate of *Diglyphus isaea* on *Liriomyza sativae*. This study was carried out during autumn seasons of 2006 and 2007 in six bean fields in Mugla province. No insecticide treatment was applied in all experimental fields throughout the production period in all experimental fields. The emerging leafminers and parasitoid adults were obtained and counted in the weekly sample leaves at laboratory.

The parasitism rates were 32.01% for 2006 and 32.97% for 2007. The correlation coefficient was significantly positive between *Liriomyza sativae* and *Diglyphus isaea* population in both years ($P < 0.01$).

Key words: *Liriomyza sativae*, *Diglyphus isaea*, parasitoid, parasitism ratio

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Screening of 22 entomopathogenic or potential plant growth promoting fungal isolates for pathogenicity to cabbage root fly, *Delia radicum* (Linnaeus, 1758)

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Entomopathogenicity of nine entomopathogenic or potentially plant growth promoting fungal species was assessed against cabbage root fly (CRF) in soil and *in vitro* laboratory bioassays. The fungal strains were isolated from various substrata in Slovenia and Austria. The soil experiments mimicked natural exposure pathways of the various insect life stages to the fungal strains. Spore concentrations used in soil tests were comparable to economic rates for in-furrow application (3.85×10^6 spores g^{-1} dry soil). In *in vitro* tests, spore suspensions with a concentration of 1×10^8 spores ml^{-1} were applied directly to CRF eggs. The short term in-vitro tests lasting 14 days were designed to screen aggressiveness of the various isolates to CRF.

The following fungal species were tested: *Trichoderma atroviride* (2 isolates), *Trichoderma koningiopsis* (1), *Trichoderma gamsii* (3), *Beauveria brongniartii* (1), *Beauveria bassiana* (3), *Metharhizium robertsii* (2), *Metharhizium anisopliae* (6), *Purpureocillium lilacinum* (2) and *Clonostachys solani* (2). All isolates tested were infective to one or more of the tested life stages of CRF (eggs, larvae, imago or pupae). Abbott's corrected mortality in soil experiments ranged from $20.0 \pm 13.2\%$ to $75.0 \pm 13.2\%$ and in the short term in-vitro experiments from $12.8 \pm 9.4\%$ to $47.6 \pm 9.0\%$.

Additional long term in vitro tests lasting 35 days were performed with four Slovenian isolates of *Trichoderma* – *Trichoderma atroviride* (1) and *Trichoderma gamsii* (3) and Austrian isolates – *Metharhizium robertsii* (1), *Metharhizium anisopliae* (2) and *Beauveria bassiana* (1), to see the effect these fungal strains have on the whole life cycle of CRF.

In these tests *Trichoderma* spp. isolates exhibited low entomopathogenic activity, with the exception of *Trichoderma gamsii* isolate 1, and no mycosis was observed on any of the CRF's life stages. Of the Austrian isolates, *Beauveria bassiana* produced sporulating mycelium on eggs, *Metharhizium robertsii* and *Metharhizium anisopliae* isolate 1 on larvae, whereas *Metharhizium anisopliae* isolate 2, in addition to larvae, also produced sporulating mycelium on pupae. The use of different fungal isolates in integrated CRF management programs is discussed.

Key words: biological control, entomopathogenic fungi, BCA, biological control agents, dipterous insect pests

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Preliminary studies on natural enemies of the safflower capsule fly, *Acanthiophilus helianthi* Rossi, 1794 (Diptera: Tephritidae)

K. Saeidi¹, A. Nuar Azura¹, D. Omar¹, F. Abood²

Safflower, *Carthamus tinctorius* L. is an important oilseed crop and an essential component of cropping systems in the dry regions and marginal areas of the world. Like other crops, safflower suffers from various diseases and pests, and safflower capsule fly, *Acanthiophilus helianthi* Rossi, 1794 (Diptera: Tephritidae) is one of them.

Investigations were made from March 2008 to August 2009 in Gachsaran and Yasooj (Iran) to record the natural enemies' status safflower capsule fly. A total of eleven arthropod species were recorded as natural enemies' safflower capsule fly. Out of 25 farms surveyed, and all of them had the incidence of natural enemies' safflower capsule fly.

After the formation of the flower head, the intended fields were visited and ten samples, each of which had 30 flower heads, were randomly collected. In the laboratory, the samples were inspected under the microscope and flower heads of safflower from the middle part opened and then pupae were taken out. Then every one hundred pupae were placed into special containers. In the next step, after the departure parasitoids was attempting to identify them.

Among the natural enemies safflower capsule fly were found to cause considerable damage to the safflower capsule fly, while others not at effective. Among the natural enemies, parasitoids like *Bracon hebetor*, *Bracon luteator*, *Colotrechnus viridis*, *Antistrophoplex conthurnatus*, *Microdontomenus annulatus*, *Ormyrus orientalis*, *Eurytoma acroptilae*, *Pronotalia carlinarum*, *Pteromalus* sp. and *Isocolus tinctorius* were found to be associated with the pests of safflower.

Key words: safflower pests, arthropod enemies, Iran

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Development of integrated pest management techniques: insect pest management on safflower, *Carthamus tinctorius* L.

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Acanthiophilus helianthi Rossi, 1794 (Diptera: Tephritidae) is a pest of safflower and managing it is a challenge because of its fecundity and concealed larval habitat. Potential components of an integrated pest management program for *Acanthiophilus helianthi* were investigated at the Gachsaran Agricultural Research Station, in southern Iran from November 2008 to July 2009. For the life cycle studies, the infected flower heads were collected from an experimental field plot and were developed from egg to adult under laboratory conditions.

The results showed that the first adults emerged gradually in mid April 2009. Female *Acanthiophilus helianthi* had a pre-oviposition period of 5.8 ± 1.0 days and the average fecundity was 27 ± 3.2 eggs. The eggs were laid in the bracts of flower heads singly or in clusters of 3–18. The incubation period was 3.8 ± 0.6 days under field conditions and 3.4 ± 0.6 days under cage conditions. Three larval instars occurred, and the larval phase was 7–10 days. Males emerged earlier than females, but the longevity of the adult females (12 ± 3.0) was significantly greater than that of males (8 ± 1.0). Analysis of aggregated male and female sampling data showed that the sex ratio was 1:1.28.

To evaluate the efficiency of different methods of fruit fly control on safflower, a field experiment was carried out. Five diverse methods, insecticides, baiting, cultural, Integrated Management and no treatment were assessed on weight of one thousand seeds, percentage of oil, percentage seed damage and yield per ha. Integrated Management and insecticide control indicated best results with harvest potential of 1850 and 1723 kg ha⁻¹ with a least damage of 5% and 8% respectively. Since use of selective insecticides is one of the most important methods for pest management, we evaluated the efficacy of six insecticides against *Acanthiophilus helianthi* infesting safflower. Among the treatments *Endosulfan 35% EC* at 0.03% proved more effective followed by *Chlorpyrifos* and *Monochrotophos*.

The means achieved for the integrated management with respect to the measures of harvest (kg ha⁻¹) and percentage of oil were observed economically prosperous. Furthermore, the integrated management method, based on the results achieved, revealed to be ecologically promising. The integrated pest management treatment can be used as a safe insecticidal to the environment. It builds better conditions for growth of plant and could decrease pest population and damage; hence, it can increase crop harvest. The relatively high percentage of damage under no intervention condition (39%) compared to the acceptable level of 5% damage under the integrated management method would justify the necessity to utilize the economically proven and ecologically verified integrated management method in order to improve the crop produce and decrease the percentage of damage.

Key words: *Acanthiophilus helianthi*, damage, insecticides, integrated management, efficacy, Gachsaran (Iran)

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Comparison of biological aspects of safflower capsule fly, *Acanthiophilus helianthi* Rossi, 1794 (Diptera: Tephritidae) on safflower cultivars under laboratory conditions

Karim Saeidi

The safflower capsule fly, *Acanthiophilus helianthi* Rossi, 1794 (Diptera: Tephritidae) is an important pest of safflower, *Carthamus tinctorius* L. Life cycle of this pest was surveyed on five cultivars of safflower under laboratory conditions at temperature $27 \pm 2^\circ \text{C}$, $70 \pm 5\% \text{RH}$ and 16 L : 8 D.

The results indicated that there is not any significant difference on the total developmental time of immature stages of safflower fly reared on five safflower cultivars. However, developmental time of larvae on two cultivars ('Sina' and 'Padideh') showed significant difference with those fed on 'Sogol', 'Semirom' and 'Lenjan'. The generation times estimated on 'Lenjan', 'Semirom', 'Sina', 'Sogol' and 'Padideh' were 88.19 ± 3.22 , 86.51 ± 3.76 , 81.69 ± 1.90 , 79.81 ± 1.35 and 77.51 ± 1.79 days respectively. The mean preoviposition period of the fly was 5.38 ± 0.42 days and the mean time for the female to mate once again was 8.02 ± 0.56 days. The female oviposition rate was affected by safflower cultivars. The mean number of the eggs laid by each female on safflower bolls varieties of 'Padideh', 'Sina', 'Sogol', 'Semirom' and 'Lenjan' was obtained 315 ± 57.5 , 229 ± 15.56 , 196.65 ± 33.27 , 178.14 ± 28.6 and 85.18 ± 39.32 , correspondingly. The mean longevity of the non-feeding male and female flies was estimated 2.38 ± 0.2 and 2.98 ± 0.19 days and it was 69.58 ± 5.99 and 78.12 ± 5.11 days for well-fed male and female flies with honey and water, respectively. The mean longevity of the well-fed male and female flies decreased to 47.29 ± 2.32 and 55.4 ± 3.12 days, respectively; as they had matting activity and safflower heads were presented to them for female oviposition.

Key words: *Carthamus tinctorius*, pest life cycle, cultivar influence

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Boiko, S. V.	4, 7
Civelek, H. S.	4, 14, 15
Đurić, Z.	3, 6
Dursun, O.	4, 14, 15
Ghosh, S. K.	4, 13
Grunder, J.	4, 16
Hrnčić, S.	3, 6
Kaban, Ö.	4, 14, 15
Kondratenko, T.	4, 8
Küçükakyüz, K.	4, 14
Laskar, N.	4, 13
Lerche, S.	3, 5
Lutz, M.	4, 16
Mandal, T.	4, 13
Nuar Azura, A.	4, 17, 18
Omar, D.	4, 17, 18
Razinger, J.	4, 16
Roik, K.	4, 9
Saeidi, K.	4, 12, 17, 18, 19
Schroers, H.-J.	4, 16
Slabozhankina, O. F.	4, 7
Stalažs, A.	4, 10, 11
Suliman, E. H.	3, 4
Urek, G.	4, 16
Yildirim, E. M.	4, 15
Trepashko, L. I.	4, 7