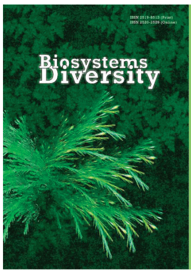

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New findings of pest sciarid species (Diptera, Sciaridae) in Ukraine, with the first record of *Bradysia difformis*

A. I. Babytskiy[1,2], M. S. Moroz[2], S. O. Kalashnyk[3], O. O. Bezsmertna[4,5], I. D. Dudiak[6], O. V. Voitsekhivska[5]

[1]I. I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, Kyiv, Ukraine
[2]National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine
[3]O. V. Fomin Botanical Garden, Kyiv, Ukraine
[4]Kivertsi National Natural Park "Tsumanska Puscha", Kivertsi, Ukraine
[5]Taras Shevchenko National University of Kyiv, Kyiv, Ukraine
[6]Mykolaiv National Agrarian University, Mykolaiv, Ukraine

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I. I. Schmalhausen Institute of Zoology of National Academy of Sciences of Ukraine, B. Khmelnytskogo st., 15, Kyiv, 01030, Ukraine.
Tel.: +38-096-777-44-13.
E-mail: andriybabytskiy@gmail.com

National University of Life and Environmental Sciences of Ukraine, Heroiv Oborony st., 13, Kyiv, 03041, Ukraine.
Tel.: +38-063-842-99-67.
E-mail: mykolamoroz@i.ua

O. V. Fomin Botanical Garden, S. Petliury st., 1, Kyiv, 01032, Ukraine.
Tel.: +38-097-783-43-96.
E-mail: kalashniks@ukr.net

Kivertsi National Natural Park "Tsumanska Puscha", Nezalezhnosti st., 18, Kivertsi, 45200, Ukraine.
Tel.: +38-066-940-86-87.
E-mail: olesya.bezsmertna@gmail.com

Taras Shevchenko National University of Kyiv, Volodymyrska st., 60, Kyiv, 03127, Ukraine.
Tel.: +38-067-908-47-58.
E-mail: matushka@i.ua

Mykolaiv National Agrarian University, Georgiya Gongadze st., 9, Mykolaiv, 54020, Ukraine.
Tel. +38-093-126-92-70.
E-mail:ivan.dudyak@ukr.net

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Sciarids (Diptera, Sciaridae) or black fungus gnats are small, mainly dark coloured insects whose larvae usually develop in rotting plant remains permeated by fungal hyphae. Typical habitats for sciarids are shaded forests and wet meadows, but some species can migrate from natural biotopes to anthropogenic ecosystems and live as synanthropes. Synanthropic sciarid species in the case of their larvae mass development, may cause significant damage to agricultural plants and mushrooms and are considered as pests. The information on pest activities of sciarids in the literature is provided for 34 species, but only 7 species can be considered as dangerous pests. In the framework of taxonomic and ecological research on Sciaridae in Ukraine, some chorological and faunistic peculiarities of pest sciarids have been studied. We collected material during the expeditions and excursions in different biotopes of Ukraine from 2012 to 2018 using the Malaise trap, by the method of non-count sweeping with entomological net and with exhauster directly from substrate. The collected imagoes were placed into 5 mL vials with 70% ethanol. In the lab, the fixed material was dehydrated in absolute ethanol and mounted on slides in Euparal. All of the studied material is kept in Andriy Babytskiy's Private Collection, Kyiv (PABK) and mostly availible to the public on the UkrBIN. In Ukraine 4 species of harmful sciarid pests from 3 genera are recorded, namely *Bradysia brunnipes* (in Crimea), *B. difformis* (in Kyiv and Volyn Regions), *Lycoriella ingenua* (in Kyiv and Volyn Regions) and *Pnyxia scabiei* (Western regions excluding the Carpathians). *B. brunnipes*, also known as "cucumber gnat", is one of the widespread cucumber pests in greenhouses, damaging roots and above-ground shoots of cucumbers. In Ukraine, mass development of this species and significant loses of the harvest caused by it have not been reported. *B. difformis* is a widespread pest sciarid, but in Ukraine it has been recorded for the first time. The mass development of this species was recorded in hothouses with cacti and other succulent plants at the O. V. Fomin Botanical Garden, where the larvae of *B. difformis* cause significant damage to these plants, especially to their sprouts. *L. ingenua* is the most common sciarid pest which damages mushrooms in hothouses. In Ukraine it was massively recorded in cellars and on vegetables in storages. *P. scabiei* was recorded in Western Ukraine, except the Carpathians, as a potato pest species that damages sprouts in the fields and tubers in storages. Considering the absence of records of *P. scabiei* in natural biotopes of Ukraine, it is likely that this species was introduced to our country from America together with potatoes and should be recognized as an alien species to the natural entomofauna of Ukraine.

Keywords: Mycetophiloidea; black fungus gnats; species richness; chorology; trophic links.

Introduction

Sciarids (Diptera, Sciaridae) or black fungus gnats are small (length of imago up to 8 mm), mainly dark coloured insects whose larvae usually develop in rotting plant remains permeated by fungal hyphae. Typical habitats for sciarids are shaded forests and wet meadows, but some species can migrate from natural biotopes to anthropogenic ecosystems and live as synanthropes. Synanthropic sciarid species in the case of their larvae mass development, may cause significant damage to agricultural plants and mushrooms. Such species are considered as pests. The objective of our research was identifying the active pest species from the Sciaridae family and determine among them the most dangerous and potentially dangerous pests. Also we aimed to find data on the spread of the harmful sciarids in Ukraine analyzing literature sources and specimens from the Andriy Babytskiy's private collection, Kyiv (PABK).

Pest active sciarid species

The information on pest activities of sciarids in the literature is provided for 34 species: *Bradysia affinis* (Zetterstedt, 1838), *B. amoena* (Winnertz, 1867), *B. bellstedti* Menzel & Mohrig, 1998, *B. brevispina* Tuomikoski, 1960, *B. brunnipes* (Meigen, 1804), *B. cellarum* Frey, 1948, *B. difformis* Frey, 1948, *B. fenestralis* (Zetterstedt, 1838), *B. fungicola* (Winnertz, 1867), *B. lutaria* (Winnertz, 1869), *B. nomica* Mohrig & Röschmann, 1996, *B. ocellaris* (Comstock, 1882), *B. peraffinis* Tuomikoski, 1960, *B. pilistriata* Frey, 1948, *B. praecox* (Meigen, 1818), *B. rufescens* (Zetterstedt, 1852), *B. spatitergum* (Hardy, 1956), *B. strenua* (Winnertz, 1867), *B. trivittata* (Staeger, 1840), *Chaetosciara estlandica* (Lengersdorf, 1929), *Corynoptera concinna* (Winnertz, 1867), *C. per-*

pusilla Winnertz, 1867, *Cratyna* (*Peyerimhoffia*) *perniciosa* (Edwards, 1922), *Cratyna* (*Spathobdella*) *perplexa* (Winnertz, 1867), *Hyperlasion aliens* Mohrig, 2004, *Lycoriella* (*Hemineurina*) *modesta* (Staeger, 1840), *Lycoriella* (*Lycoriella*) *auripila* (Winnertz, 1967), *L.* (*Lycoriella*) *castanescens* (Lengersdorf, 1940), *L.* (*Lycoriella*) *ingenua* (Dufour, 1839), *L.* (*Lycoriella*) *cellaris* (Lengersdorf, 1934), *L.* (*Lycoriella*) *subterranea* (Märkel, 1844), *Pnyxia scabiei* (Hopkins, 1895), *Scaptosciara* (*Scaptosciara*) *atomaria* (Zetterstedt, 1851) and *S.* (*Scaptosciara*) *vitripennis* (Meigen, 1818).

The level of harmful influence for agriculture of the abovementioned species is not the same and for some of the sciarids considered as pests damage to crops or mushrooms has not been confirmed. Basically, *Bradysia brevispina*, *B. peraffinis*, *B. rufescens*, *Chaetosciara estlandica*, *Corynoptera concinna*, *C. perpusilla* and *Lycoriella subterranea* have been discovered in greenhouses or vegetable stores or found on flower pots, but direct damage caused by these species to horticultural crops has not been confirmed (Komarova, 2003; Sataeva, 2006; Broadley et al., 2018). These sciarids may enter agricultural buildings from the nearest natural habitats and develop there as synanthropic organisms because new conditions, especially high moisture level and the presence of rooting organic substance, turn out to be convenient for their development. These species can be considered only as potential pests because in the case of their larvae mass development, they may damage cultivated plants in the same way as the confirmed pest sciarids. Also *Bradysia spatitergum* is a doubtful pest. It has been recorded in rotting sugar cane, rotting sweet potatoes, coffee grounds, in a banana plantation and on flowers, but as stated by Broadley et al. (2018) this sciarid has not been detected in greenhouses or mushroom farms and its mass developments has not been reported. However, *B. spatitergum* shows facultative synanthropic peculiarities and is a potential pest species. One more sciarid, *Hyperlasion aliens* has been detected in pot plants and is considered as a potential pest species, but together with *B. spatitergum* it has not been registered in Europe and is not a dangerous pest, especially for Ukrainian agriculture (Broadley et al., 2018).

For the other sciarid pest species, insignificant direct harmful influence to specific horticultural crops has been recorded. *Bradysia affinis* was recorded in a greenhouse with decorative house plants and a mushroom hothouse in the Altay (Komarova, 2003). Despite no reports on direct damage to plants or mushrooms by this species, it is very likely to be a harmful insect pest because it has not been found in the nearest habitats and may has been brought to the hothouses with substrate contaminated by *B. affinis* larvae (Komarova, 2003). *B. fungicola* was recorded in a mushroom hothouse with cultivated *Agaricus bisporus* (J. E. Lange) Imbach, 1946 in the Altay (Komarova, 2003) and in greenhouses with decorative plants in Belarus (Pryshchepa & Kindratenko, 2009). *B. nomica* is considered as a crop pest in Spain (Rodríguez-Rodríguez et al., 2005). *B. praecox* is known as a cucumber pest (Gerbachevskaja, 1963). *B. trivittata* is a widespread species and recorded in greenhouses with decorative house plants and mushroom hothouses with cultivated *Agaricus bisporus* in the Altay (Komarova, 2003). *Cratyna* (*Spathobdella*) *perplexa* harms cucumbers in Leningrad Oblast of the Russian Federation (Gerbachevskaja, 1969). *Scaptosciara atomaria* was recorded as a mushroom pest and as a common species in areas with anthropogenic influence, also *S. vitripennis* is noted as a pest that damages potato tubers during storage (Gerbachevskaja, 1963; Broadley et al., 2018).

The most harmful pests are sciarid species that develop in large numbers and turnfrom saprophagy to predation. Pest sciarids cause the greatest damage to greenhouse plants and mushrooms. They gnaw holes in the stems and roots, and are less likely to damage seedlings where larvae form rather deep caverns on cotyledons and pupate there. When larvae develop in large numbers, they fiberise the damaged organs and the plants lose their turgor and wither (Akhatov & Izhevskii, 2004). Larval feeding on mushrooms destroys the mycelium and the ability of the substrate to support growth (Shamshad et al., 2008). The adult sciarid flies do not actively feed and may only take some water, but imagoes can be mechanical vectors of fungal diseases in cultivated mushrooms. This property depends on the structure of the tibial organ and is common for *Bradysia* species (Shamshad et al., 2009).

Most often, sciarids damage cucumbers, champignons, more rarely potatoes, tomatoes, peppers, eggplants, beans, wheat, tobaccos and some other plants. In vegetable stores they damage potatoes, onions, carrots, bees, apples. Potted crops are harmed mainly in the seedling period (Akhatov & Izhevskii, 2004). Apart from direct feeding, sciarid larvae can serve as vectors of fungal and plant pathogens (Cloyd, 2015).

Bradysia amoena damages cucumber, onion and tomato plants in greenhouses and champignons in hothouses (Komarov, 2011; Cloyd, 2015). Also root damage of red clover (*Trifolium pretense* L.) by larvae of this species was detected in Chile, which caused 9% plant loss (Agullera & Fernando, 1996). *B. amoena* was detected in flower pots, was reared from fungi, tulip and lily bulbs, decaying onions, and young ling seedlings (Menzel et al., 2006; Broadley et al., 2018). According to Broadley et al. (2018), this species is common in houses with plant pots but rare in greenhouses and mushroom cultures and has been introduced by humans to the Tristan da Cunha archipelago. This demonstrates the high synanthropic activity of *B. amoena* and makes this species one of the non-dangerous sciarid pests that does not cause economic loss to agriculture.

Bradysia bellstedti is reported as a ginseng pest in South Korea (Shin et al., 2008). The authors note that larvae of the gnat can penetrate the stem of ginseng and then they make a shaft in the shoot and root and that it damaged 29.7% of plants in a ginseng field. Moreover, *B. bellstedti* was also infected by a bacterial disease caused by *Pectobacterium carotovorum* (Jones, 1901), which decreased the effect of damage by over 85% (Shin et al., 2008, 2015).

Bradysia brunnipesis is also known as "cucumber gnat" because it is one of the widespread cucumber pests under conditions of planting cucumbers in greenhouses (Gerbachevskaja, 1963, 1969; Pryshchepa & Kindratenko, 2009). The larvae of this species feed inside the large roots and on the above-ground shoots of cucumbers. This insects cause noticeable damage in greenhouses to peppers and eggplants grown both on the ground and on mineral wool or pure peat in the case of using low-technology *B. brunnipes* larvae do significant damage seedlings of faba beens by gnawing a hole in the caulicles (Akhatov & Izhevskii, 2004). Also there are a few reports about damage to champignons by this sciarid (Gerbachevskaja, 1963, 1969; Akhatov & Izhevskii, 2004; Broadley et al., 2018).

Bradysia cellarum is considered as dangerous pest in China, which damages the Chinese vegetable crop garlic chives, green onions, garlic, cucumbers, lettuces, and Chinese cabbages. Larvae of this insect feed on bulbs, roots and young stems and can decrease crop yields by 30–80%; garlic chive plants damaged by this species can wither and sometimes die (Zhang et al., 2014; Gao et al., 2016; Ye et al., 2017).

Bradysia difformis is one of widespread and dangerous sciarid pests, which damages numerous plants and mushrooms in greenhouses and hothouses. Moreover, this gnat is common in private houses and flats and develops in flower pots, not rarely in large numbers. Cloyd (2015) described the damage caused by this species as following: "The larvae feed mainly on decaying plant material and fungi. However, they will also feed on healthy plant roots and tunnel into stems of young cuttings and seedlings, and the crowns of mature plants. Therefore, the larvae are primarily responsible for causing direct plant damage by feeding on the roots, thus interfering with the ability of plants to uptake water and nutrients, which results in wilting and stunted growth. Fungus gnat adults are mainly a nuisance causing minimal direct plant damage". According to Broadley et al. (2018) larvae of this gnat feed as phytophages, phytosaprophages and perhaps mycetophages on roots of different crops, living in rotting plant material in the soil, in compost and in mouse holes. The authors, based on results of their own research and analysis of the literature, indicate the following host plants and mushrooms for *B. difformis* larvae: *Acacia* Mill., *Adiantum* L., African violets, *Agapanthus* L'Hér., *Agaricus bisporus*, *A. blazei* Murrill, 1945, alfalfa, *Anthurium* Schott, *Antirrhinum* L., avocado, *Azalea* L., banana, *Banksia* L., barley, basil, beans, *Begonia* L., *Bougainvillea* Comm. ex Juss., bromeliads, *Buddleja* L., cabbage, cacti, *Callistemon* R. Br., carnations, carrot, Christmas cactus, *Chrysanthemum* L., citrus, *Clivia* Lindl., cotton, cucumbers, *Curcuma* L., *Cyclamen* L., daisy, *Dracaena* Vand., edible fungi in China, *Eucalyptus* L'Her., *Euphorbia* L., *Eustoma* Salisb., *Eustrephus* R. Br., *Ficus* L., *Ficus carica* L., *Fittonia* Coem., flax, freesias, *Fuchsia* L., *Gahnia* J. R. Forst. & G. Forst., *Gardenia* J. Ellis, geraniums, *Gerbera* L., *Grevillea* R. Br. ex Knight, *Hardenbergia* Benth., *Harpullia* Roxb., *Hebe* Comm. ex Juss., *Hemerocallis* L., hoop pine, *Hoya* R. Br., *Hydrangea* Gronov., *Hymenocallis* Salisb., *Impatiens* L., *Iris* L., *Ixora* L., jackfruit, lavender, lettuce, *Leucanthemum* Burm., *Liriope* Herb., *Lomandra* Labill., *Lophostemon* Schott, *Medicago sativa* L. seedlings, *Lupinus* L., maize, *Mandevilla* Lindl., marigolds, melons, *Mentha* L., *Orthrosanthus* Sweet, parsley, passion fruit, peas, *Pelargonium* L'Hér., peony roses, peperomia, *Phalaenopsis* Blume, orchid seedlings in greenhouses, pines, *Plumeria* L., poinsettia, potatoes, potted lilies, sage, *Saintpaulia* H. Wendl., *Salvia hispanica* L., *Sansevieria* Thunb., *Schlumbergera* Lem., *Schoenoplectus* (Rchb.) Palla, *Selaginella* P. Beauv., *Stachys* L., stone fruit, strawberries, succulents, sugar beet, sunflowers, *Sutera* Roth, *Tillandsia* L., tomatoes, various herbs and vegetables, *Westringia* Sm. (Harris et al., 1996; Menzel et al., 2003; Han et al., 2015; Broadley et al., 2018). Wilkinson & Daugherty (1970) reported on damage to soybeans by *B. difformis* larvae. Also imagoes of this species were reared from onion bulbs (Komarov, 2011). Among 28 mushroom farms in Britain visited by White et al. (2000), sciarid pests were found in 21 but only in one of them *B. difformis* was present.

Bradysia fenestralis is recorded as a champignon, tomato and cucumber pest (Gerbachevskaja, 1963, 1969). Also it was found in a greenhouse with decorative plants in the Altay and in a vegetable store in Kazakhstan (Komarova, 2003; Sataeva, 2006).

Bradysia lutaria was found infesting mushroom crops in Great Britain in 1997 and may be considered as a *Agaricus bisporus* pest (White & Smith, 2000).

Bradysia ocellaris is also known as "moss fly" and is a very common pest in greenhouses, palm houses, winter gardens and in pot plants (Broadley et al., 2018). The species is considered as a major mushroom pest in Australia, which causes losses in yield through larval damage of the compost, mycelium and sporophores, and affects the structural features of the compost itself (Shamshad, 2010; Broadley et al., 2018). There are also a few observations of leaf mining and root damage of wheat by *B. ocellaris* (Coquillett, 1895; Gerbachevskaja, 1963). Broadley et al. (2018), according to their own research and literature analysis, indicate the following host plants and mushrooms for larvae of this species: *Acacia*, African violets, *Agaricus bitorquis* (Quél.) Sacc., 1887, *Agaricus blazei*, *Agaricus brunnescens* Peck, 1900, *Aglaonema* Schott, *Anthurium*, *Auricularia* Bull. ex Juss., (1789), avocado, *Azalea*, *Bambusa* Schreb., banana, *Banksia*, barley, *Begonia*, *Billardiera* Sm., *Bougainvillea*, bromeliads, *Calathea* G. Mey., *Campanula*, carnations, *Citrus*, *Clivia*, *Codiaeum* A. Juss., corn, *Correa* Andrews, *Costus* L., cotton, *Curcuma*, cucumbers, *Cyclamen*, deciduous woods, *Dianella* Lam. ex Juss., *Dracaena*, *Eucalyptus*, *Euphorbia*, *Ficus*, *Ficus carica*, *Gahnia*, *Gardenia*, geraniums, *Grevillea*, hoop pine, *Hoya*, *Ixora*, jackfruit, lettuce, *Lilium* L., *Lomandra* Labill., *Mandevilla* Lindl., *Maranta* L., mosses, nasturtiums, *Ophiopogon* Ker Gawl., ornamental plants, *Orthrosanthros*, palms, passion fruit, peas, *Phalaenopsis*, pineapple, *Pleurotus cystidiosus* O. K. Mill., 1969, *Pleurotus ostreatus* (Jacq.) P. Kumm., 1871, poinsettia, potato tubers, potato plants, primula seedlings, reeds on stream banks, rice, sage, *Sansevieria*, soil around cactus plants, stone fruit, strawberry, sugar cane, sunflowers, *Tabernae montana* L., tomatoes, *Tradescantia* L., tulips, wheat, young orchids, *Yucca* L. (Menzel et al., 2003; Shamshad, 2010; Broadley et al., 2018). Also this species vectors pathogens across mushroom beds, e.g. *Verticillium fungicola* (Preuss) Hassebr., 1936, which causes "dry bubble" disease of *Agaricus bisporus* because of *V. fungicola* spores attached to the inner side of a comb-like row of bristles on the fore tibia of *B. ocellaris* (Shamshad et al., 2009).

Recently in the literature several references to pest activity of *Bradysia pilistriata* have appeared, especially in relation to mushrooms in hothouses – *Agaricus bisporus* and *Pleurotus ostreatus* (Ivanytsia et al., 2010; Nepomyashcha & Uzhevska, 2010; Reshetova & Fedorenko, 2013). Moreover, in some sources *B. pilistriata* is indicated as a pest of vegetables and decorative plants (Reshetova & Fedorenko, 2013). But identification of sciarid specimens collected in hothouses has not been checked and affiliation of the abovementioned pest to *B. pilistriata* need confirmation.

Bradysia strenua is unlikely to be a pest in Europe. Its larvae are probably herbivorous and perhaps mining in leaves, also imagoes of this species have been reared from decaying narcissus bulbs, potatoes, a mole nest, angelica root, and old ragwort stems (Menzel et al., 2006; Broadley et al., 2018). But mass breeding of *B. strenua* larvae has not been reported. Thus this sciarid may be considered only as a low-dangerous pest species.

Cratyna (*Peyerimhoffia*) *perniciosa* is considered as an aggressive cucumber pest in Europe and Azerbaijan (Gerbachevskaja, 1963, 1969). Also there is report on mass developments of this species in Australia and England (Speyer, 1922; Broadley et al., 2018). In cucumber houses in England there was a very serious outbreak of this sciarid and the damage caused by its larvae is described by Speyer (1922) as following: "The attack has been confined to fruiting plants in the border, the hundreds of larvae having reduced the tap-root to a pulp, and caused much further damage by removing the cortex of the stem just below, and sometimes even above, the soil surface". Thus, *C. perniciosa* larvae damage cucumbers in hothouses and glasshouses – they bite into the root and make holes through it or completely thrash it. Larvae develop during spring and summer seasons and make 4–5 generations (Akhatov & Izhevskii, 2004).

Lycoriella auripila was recorded in a greenhouse with decorative house plants in the Altay and as an agaric pest (Gerbachevskaja, 1969; Wright & Chambers, 1994; Komarova, 2003). Observations provided by Hussey & Gurney (1968) have shown that *L. auripila* is primarily saprophagous, but can attack healthy mushrooms, thus is considered as one of the pest species. Also Shamshad (2010) reported that "*L. auripila* flies first infest mushroom compost as it is cooling down after phase II pasteurisation, and they can sometimes be seen congregating around the doors of pasteurisation rooms at this time. A heavy infestation may inhibit the spawn run, as the larvae, feeding within the compost, will produce large quantities of faecal material. Subsequently, the mushroom mycelium will be unable to colonise the contaminated compost, and thus poor yield will result. The most obvious larval damage is tunnelling in the stipes. The most serious injury is attack on the developing pinheads".

Lycoriella castanescens is a common pest in greenhouses and mushroom cultures, where it breeds in large numbers and is of considerable economic importance (Jess & Schweizer, 2009; Broadley et al., 2018). It harms champignons in Leningrad Oblast of Russian Federation and cucumbers (Gerbachevskaja, 1963, 1969). Their larvae feed on mycelia in the casing layer and tunnel into the sporophores and cause about 15% crop loss (Loudon, 1978). Among 28 mushroom farms in Britain, visited by White et al. (2000), sciarid pests were found in 21, including 7 with *L. castanescens* (White et al., 2000). The presence of this species in such a large number of studied farms was explained by the authors in the following way: "This is, perhaps, not surprising as, until 1994, the centre for mushroom research in Britain was based on the south coast of England, well within the *L. castanescens* 'territory'. The apparent dominance of this species, therefore, may well have been an artefact" (White et al., 2000). It is also reported that *L. castanescens* can be a minor pest in greenhouses but this statement is neither reasoned nor confirmed (Freeman, 1983).

Lycoriella cellaris has been collected from rotting straw, mushroom beds, mushroom compost, poultry manure and has been reported as a damaging pest of mushrooms in a cellar (Felt, 1898; Loudon, 1978; Broadley et al., 2018). It was also found in a greenhouse with decorative plants in the Altay (Komarova, 2003). *L. cellaris* is one of the first discovered sciarid pests and has great synanthropic changeability, which is why may be considered as an active pest species.

Lycoriella ingenua is also known as "mushroom gnat" or "mushroom fly" because it is one of the most economically important sciarid pests and considered to be the most damaging arthropod pest for *Agaricus bisporus* cultivation (Cantelo et al., 1982; Brewer & Keil, 1989; Al-Amidi et al., 1991). Among 28 mushroom farms in Britain, visited by White et al. (2000), sciarid pests were found in 21, including 13 with *L. ingenua*, thus it was regarded as the dominant species infesting commercial mushroom farms in Britain (White et al., 2000). *L. ingenua* larvae can damage the mushroom crop by feeding on the mycelium, destroying the fruiting body and breaking down the structure of the compost, thus causing various levels of reduction in mushroom yield, but they prefer to feed on the compost itself, nibble on developing mycelium, damage primordia, and tunnel into the stipes of mature sporophores (Ali et al., 1999; Demir et al., 2011). It is common not only in mushroom farms, but in greenhouses and flower pots too. *L. ingenua* has been recorded in a hothouse with decorative plants in the Altay, reared from rotting potatoes, root-crop of table beets and carrots in vegetable stores, rotting apples crusted by moth, turnip onion bulbs. This species also damages cucumbers in glasshouses (Gerbachevskaja, 1963, 1969; Komarova, 2003; Broadley et al., 2018). Larvae of *L. ingenua* are phytosaprophagous and mycetophagous, normally feed on rotting plant tissues and are frequently found in damaged bulbs, slug-eaten celery roots, potato tubers, and on tomato roots affected by brown root rot, also recorded feeding on plasmodia of slime moulds and damaging the roots of azalea and *Mesembryanthemum* L. (Broadley et al., 2018). Freeman (1983) stated that "it is common around houses, breeding in decaying potatoes, bulbs, household refuse etc. and can be a damaging pest in mushroom houses". Also it is reported that *L. ingenua* larvae can utilize a wide spectrum of soil microscopic fungi, moreover female imagoes prefer to oviposit on mycelium of micromycetes to sporocarps of macromycetes (Frouz & Nováková, 2001). Adult flies act as vectors for the introduction of mushroom disease agents, nematodes, mites, and other contaminants, and are reported as a constant nuisance to picking staff (Demir et al., 2011).

Lycoriella (*Hemineurina*) *modesta* larvae damage champignons, seedlings of tomatoes and tobaccos, eating the root hairs and climbing into the stem, and vegetables during winter storage (Gerbachevskaja, 1963; Freeman, 1983).

Pnyxia scabiei is also known as "potato gnat" or "potato scab-gnat"and is one of the best studied sciarid species. It has been definitely recognized as a dangerous potato pest since 1895 and as a cucumber pest in 1922 (Hopkins, 1895; Speyer, 1922). Imagoes of the species have been reared from potato tubers, potato seed tubers, ordinary potting soil, stable and barnyard manure, decaying organic matter in the soil, rotting narcissus, peony and other bulbs (Broadley et al., 2018). *P. scabiei* has been collected from leaf mold, in a mushroom bed, in a greenhouse and both larvae and adults on an old bone buried in a potato field. It has also been recorded damaging potatoes, potted glasshouse cucumber plants, peony roots, tomato and cucumber seedlings feeding upon and within the stems of young potato plants, on damaged onion bulbs in the field, and upon an injured parsnip root (Speyer, 1922; Gui, 1933b). There is a report that larvae of *P. scabiei* can mine wheat and it is noted that they may be the vectors of root and tuber rot in vegetable storage cellars (Gerbachevskaja, 1963; Komarov, 2011). Thus, the potato scab-gnat may be considered as a general feeder, but the potato is usually its preferred food (Gui, 1933b).

Fertilized females prefer to oviposit to soft spots on tubers, cracks and crevices in the soil, under loose soil particles, on the underside of the young stems or in potato "eye" pits. Also eggs may be deposited on firm objects, such as the skin of a potato or the surface of the soil (Gui, 1933; Osmola, 1970). Under natural conditions, larvae that have emerged from eggs laid in the soil near the plants or in the cracks of the stem they were injected into it, or into the roots, where they start feeding (Gerbachevskaja, 1963).

The larval stages of *P. scabiei* feed on tissues of potato sprouts, or on potato tubers, often hide under plant parts which do not eat or decaying parts of the infested tuber, the surrounding soil, or a web which the insect spins. Imagoes do not feed and are aphagous. However, all stages of the insect have been found upon a freshly dug tuber, which confirms the possibility of larvae feeding on fresh, living tissues, which are not rotting and damaged by fungal hyphae. But the most often larvae concentrate in wounded areas of infested potatoes (Gui, 1933b). The wounds with larvae normally are more or less filled with refuse beneath which the insects feed on the some parts of the tuber. The most voracious are larvae in III and IV ages. Due to their strong upper jaws with jagged inner edges, they freely gnaw through the rind of the tuber and make shallow holes in it. Dry and wet rot of potatoes or potato scab appear on the damaged areas of tubers (Osmola, 1970). *P. scabiei* may damage potatoes in the spring, when the insects attack the seed piece and occasionally the tender stem of the young plant, or later during the growing season, when its presence is manifested by the wounds found on the new-crop tubers at harvest time. Further, when potato tubers are placed in vegetable storages the larvae may still gnaw them, but this type of injury is less usual and is not likely to occur when the storage is kept dry and cool. When the damage is done to the seed piece in spring, the stand may be reduced due to the damage caused by the pest by depriving the sprouts of the source of nutrients. This type of injury may weaken the vitality of the sprouts or destroy up to 60% of the stand in the field (Gui, 1933b). The injury to the tuber crop may vary greatly, ranging from small scab-like abrasions on the rind to the formation of large, deep cavities in the tuber. Formation of small wounds varies from one wound per tuber to a number sufficient to involve the entire surface. Large and deep wounds frequently penetrate to the depth of 2.5 cm into the flesh of the tuber. When preparing for pupation, the larva leaves the place of feeding and hides either in debris or under a spun web, where it constructs a delicate cocoon (Gui, 1933b).

P. scabiei overwinters in the larval stage in the field at a depth of 15 cm under the surface or on stored potatoes (Gui, 1933b; Osmola, 1970). According to Gui (1933), "In storage, it tolerates any temperature suitable for potatoes but is the most active if both temperature and humidity are relatively high. Potato scab-gnat injury is more severe when potatoes are grown more than 1 year in succession in the same field. Potatoes grown in soils in which the organic content is high or when straw mulch is used in the cultural practice are less susceptible to damage than when smaller amounts of organic matter are present. The activities of the potato scab-gnat are favored by soil reactions above pH 5.0 and are inhibited by lower reactions. The insect has never been found upon potatoes stored in dry buildings". Imagoes under the field conditions of Ukraine appear in May (Osmola, 1970).

Concerning cucumber sprouts, Speyer (1922) reported that 600 pot plants were destroyed by larvae of *P. scabiei* during 4 days in January. The author described damage as following: "The tap-root of the infected plants had been eaten into by the larvae, and hollowed out from below upwards to within quarter-inch to half-inch below the soil surface. Some root stems contained as many as 60 larvae. On no part of the plant were any eggs found. When full-fed the larvae ate their way out of the stem below the ground and pupated in the soil" (Speyer, 1922). *P. scabiei* is also indicated as cucumber pest in the former USSR, where it damages mainly roots of plants in hothouses (Gerbachevskaja, 1963; Akhatov & Izhevskii, 2004).

Thus, among 34 sciarid species indicated as active pests, only 7 can be considered as dangerous pests, namely *Bradysia brunnipes* ("cucumber gnat"), *B. difformis*, *B. ocellaris* ("moss fly"), *Cratyna perniciosa*, *Lycoriella cellaris*, *L. ingenua* ("mushroom gnat") and *Pnyxia scabiei* ("potato scab-gnat"). The largest number of sciarid species attracted to cultivated objects is characteristic of different plants growing in greenhouses – all 7 sciarid pests are dangerous and 15 species may slightly damage pot cultures. Four sciarid pests are confirmed to feed on mushrooms and additionally 12 potential pest species may feed on mushrooms. Larvae of 5 sciarid species may feed on rotting or fresh vegetables in storages or cellars.

Dangerous pest sciarid species registered in Ukraine

In order to study sciarid biodiversity of Ukraine, we collected material during expeditions and excursions in different biotopes of the country from 2012 to 2018. Male imagoes we caught using the Malaise trap, by the method of non-count sweeping with entomological net and with exhauster directly from substrate. Collected imagoes were placed into 5 mL vials with 70% ethanol. In the laboratory fixed material was dehydrated in absolute ethanol, and mounted on slides in Euparal.

The morphology was studied using MBS-9 and Biolam D11 microscopes equipped with Nikon D90 camera; images were processed using NKRemote Ver. 2.2.1, AxioVision Rel. 4.7 and Photoshop CC 2018 programs; pictures were stacked by Helicon Focus 6.7.1 open source software. All of the studied material is kept in Andriy Babytskiy's Private Collection, Kyiv (PABK) and mostly made avialable to the public on the Ukrainian Biodiversity Information Network. Individual catalogue numbers of the vouchers are given (e.g., UkrBIN-795774). The genera arrangement and species names follows Frank Menzel and Werner Mohrig's Palearctic Sciaridae revision (Menzel & Mohrig, 2000). Diagnoses of the species are generally based on the keys and protologs (Johannsen, 1912; Speyer, 1922; Gui, 1933b; Tuomikoski, 1960; Osmola, 1970; Steffan, 1972, 1974; Menzel & Mohrig, 2000; Broadley et al., 2018). Life cycle description is given according to previous research (Gui, 1933b, 1933a; Osmola, 1970; Berg, 2000; Lewandowski et al., 2004). The names of plant species are given according to The Plant List (www.theplantlist.org) and The International Plant Names Index (www.ipni.org), the names of fungi following Index Fungorum (www.indexfungorum.org).

Among the 7 harmful sciarid pests, 4 species from 3 genera are registered in Ukraine – *Bradysia brunnipes* (Meigen, 1804), *B. difformis* Frey, 1948, *Lycoriella* (*Lycoriella*) *ingenua* (Dufour, 1839) and *Pnyxia scabiei* (Hopkins, 1895).

Bradysia brunnipes

= *Bradysia picipes* (Zetterstedt, 1838)

World distribution. Europe: Albania, Austria, Azores Is., Belgium, Bosnia and Herzegovina, Britain I., Canary Is., the Czech Republic, Finland, Germany, Greek mainland, Hungary, Ireland, Kaliningrad Region, Norwegian mainland, Poland, Romania, Sweden, Switzerland, the Netherlands (Gerbachevskaja-Pavluchenko, 1986; Menzel & Heller, 2013); Asia: East Siberia, China, Kazakhstan (Gerbachevskaja-Pavluchenko, 1986; Sataeva, 2006). Ukraine (Gerbachevskaja, 1969; Gerbachevskaja-Pavluchenko, 1986).

Localities in Ukraine. Crimea.

B. brunnipes was first mentioned for the territory of Ukraine in an identification guide by Gerbachevskaja to sciarids of the European part of the USSR with the comment "North, west, south (Crimea); Siberia (Irkutsk Region). – Western and Middle zone of Western Europe" (Gerbachevskaja, 1969). In our research we have collected one specimen of *B. brunnipes* in Kyiv, but it has not been checked by this time and the identification of the specimen hasnnot been confirmed. That's why we do not add this material to the article.

Bradysia difformis

= *Bradysia paupera* Tuomikoski, 1960

World distribution. Europe: Britain I., Canary Is., Finland, Germany, Ireland, Island, Italian mainland, Latvia, Spanish mainland, Sweden, the Netherlands (Gerbachevskaja-Pavluchenko, 1986; Menzel & Heller, 2013); Asia: Western Siberia (Altay), Japan, Kazakhstan (Komarova, 2003; Sataeva, 2006; Broadley et al., 2018); USA: California, Hawaii (Broadley et al., 2018); Australia: Australian Capital Territory, Norfolk Island, Northern Territory, South Australia, Tasmania, Victoria, Western Australia (Broadley et al., 2018). Ukraine (first record).

Localities in Ukraine. Kyiv and Volyn Regions.

Material examined. Ukraine, Kyiv City (former Pyrohiv vil.), Kvitucha St., 14/2: 50.342004 N, 30.525016 E, altitude ca. 125 m, in a room, from the soil of flowerpots, with exhauster, 06.07.2013, 3 ♂, leg. A. Babytskiy (No 13-5); Ukraine, Kyiv City (former Pyrohiv vil.), Kvitucha st., 14/2: 50.342004 N, 30.525016 E, altitude ca. 125 m, in a room, on flowerpots, mass development, with exhauster, 04.08.2013, 5 ♂, leg. A. Babytskiy (No 6-9; 16); Ukraine, Kyiv City (former Pyrohiv vil.), Kvitucha st., 14/2: 50.342004 N, 30.525016 E, altitude ca. 125 m, in a room, with exhauster, 07–09.2013, 3 ♂, leg. A. Babytskiy (No 2; 4-5); Ukraine, Volyn Reg., Turiisk settlement, B. Hmelnytskiy St., 8: 51.080061 N, 24.530237 E, altitude ca. 185 m, in the kitchen, on the windowsill with flowerpots, with brush dipped in alcohol, 25–26.10.2015, 3 ♂, 2 ♀, leg. A. Babytskiy (No 309-11); Ukraine, Kyiv City, Vasylkivska st., 94, 604 room (dormitory of Taras Shevchenko National University of Kyiv): 50.385438 N, 30.478396 E, altitude ca. 180 m, on the windowsill with flowerpots (sprouted onions and cucumbers, *Phalaenopsis* Blume), mass development, with exhauster, 11.03.2017, 14 ♂, 5 ♀, leg. A. Babytskiy (No 140-1; 142, UkrBIN-795845; 143, UkrBIN-795846); Ukraine, Kyiv City, S. Petliury St., 1, O. V. Fomin Botanical Garden: 50.4445472 N, 30.5007278 E, altitude ca. 155 m, 2 succulent plant greenhouses, above seedlings of cacti and other xerophytic plants, with exhauster, 14.11.2018, 7 ♂, leg. A. Babytskiy (No 824-30); Ukraine, Kyiv City, S. Petliury st., 1, O. V. Fomin Botanical Garden: 50.4445472 N, 30.5007278 E, altitude ca. 155 m, succulent plant greenhouses, ex larvae from rotten cactus collected 14.11.2018, 23.11.2018, 4 ♂, leg. A. Babytskiy (No 831-34).

Bradysia difformis (Fig. 1–10) is a widespread pest sciarid, but in Ukraine it had not been recorded until the time of our research. Obviously, the absence of the data about the presence of this species in our country is connected with poor study of sciarid biodiversity in Ukraine. The mass development of this species is recorded in hothouses with cactuses and other succulent plants of O. V. Fomin Botanical Garden, where the larvae cause significant damage to these plants, especially their sprouts.

Diagnosis. Eyes clearly hairy. Eye bridge with 3 rows of ommatidia (Fig. 7). Face and clypeus with quite strong bristles. Maxillary palpus consists of 3 segments (palpomeres), the third one is the longest; basal palpomere with sharply bordered deep sensory pit and 3 bristles – a longer subapical and 2 shorter ones (Fig. 6). Flagellum is 0.93 mm in length, flagellomeres are yellow, with light seta; flagellomere neck is bright, definitely separated from its body; length/width of 4th flagellomere is 1.4 (vary between l/w indexes of 1.0–1.5), setae on it reach ½ of flagellomere width (Fig. 8). Wings are slightly brownish with dark posterior veins (but stM is weak distinct), reach 1.55 mm in length and 0.60 mm in width; c = 3/5w; subcostal vein is very short; $r/r_1 = 3/2$; r_1 with 6–7 macrotrichia, fall into C a little earlier than Cu_{1b} reaches the lower edge of the wing and well before M-fork; r_5 is ventrally bare; x = y, both are bare; M-fork is small, much shorter than stM; stM is indistinct; stCu = ½ x; 6 bristles are in the wing angle (Fig. 10). Helter is dark with a light stalk (Fig. 3). Legs are yellowish, but tibia and tarsus are slightly darker. Tibial organ t_1 forms true comb with 6 bristles (Fig. 9). The length of $femur_3$ is 0.55 mm, $tibia_3$ – 0.71 mm, $metatarsus_3$ – 0.31 mm and $tarsus_3$ – 0.68 mm. Thorax and abdomen are black, with the black bristles (Fig. 3). Notum with the distinct black bristles. Acrotrichal hairs are distinct, dorsocentral – pretty long, some lateral and 4 scutellar hairs are long and strong. Antepronotum and episternite are quite strong and long-bristled. Abdomen with long black bristles. Hypopigium without basal differentiations (Fig. 4). Gonostylus is rather compact, sometimes slender, with a short claw-like apical tooth amongst 6–8 dense subapical spines (Fig. 5) (Tuomikoski, 1960; Steffan, 1974; Menzel & Mohrig, 2000; Broadley et al., 2018).

Note: male imagoes reach 2.5 mm and female – 3.0 mm in length. In the studied specimens of *B. difformis* from Ukraine x and y is bare (on the specimen No 142 in y of one of the wings 1 distal macrotrichia is present); r and r_1 are setosed, on r_1 6–9 macrotrichia are present (on the specimen No 16 1 r_1 with 5 macrotrichia, but 1 seta migrates to the rs). Also on the studied specimens we have found 5 bristles on the first palpomere, but not three, as in previous morphological descriptions (Fig. 6). Biometric indexes of studied specimens: wing length – 1.41–1.59 mm, wing width – 0.65–0.74 mm; width/length of wing = 0.43–0.49; stM/M-fork = 1.01–1.19; r_1/r = 0.60–0.79; x/y = 0.98–1.41; stCu/x = 0.62–0.94; c/w = 0.59–0.68. Length of spur/width of tibia: leg 1 = 1.35–1.63, leg 2 = 1.45–1.88; leg 3 = 0.86–1.72. Length of metatarsus/length of tibia: leg 1 = 0.54–0.62, leg 2 = 0.48–0.52, leg 3 = 0.38–0.51. Length of tibia 3/length of thorax 0.84–1.28.

The data on *B. difformis* life cycle is not very detailed. There is only a little research indirectly linked with development of this sciarid. Alberts et al. (1981) found that *B. difformis* females emit a sex pheromone that elicits upwind flight in the male, evidently via a mechanism of optomotor-modulated anemotaxis. Mated and unmated females appeared to have similar quantities of extractable pheromone. The mating sequence appears relatively stereotyped. Wilkinson & Daugherty (1970b) showed that the preoviposition period of *B. difformis* females was less than 24 h when males were present. Fecundity ranged from 12 to 156 eggs, and averaged about 75 eggs per female at 23.9 ºC. The mean periods of incubation, development, and longevity were: egg, 4.0; larva I, 3.3; larva II, 3.1; larva III, 1.8 larva IV, 5.9; pupa, 3.5; and adult, 5.9 days (Wilkinson & Daugherty, 1970b). Also, these authors ascertained that the lower and upper temperature limits for *B. difformis* development at constant temperatures were 10 °C and 32.2–35.0 °C, respectively. The mean developmental period for the immature stages decreased with increasing constant temperatures until a peak temperature was reached, and then increased. Longevity increased with decreasing constant temperatures. Optimum constant temperature for the mean development of the egg, larva, pupa, and longevity of the adult at constant temperatures was 29.4, 23.9, 29.4, 12.8 °C, respectively. The optimum temperature required to complete development from egg to adult was the variable temperature 18.9–30.0 °C. At this temperature regime the mean developmental period was 19.2 days. At constant temperatures, the mean development period ranged from 48.8 days at 12.8 °C to 19.9 days at 29.4 °C. Fecundity was about the same from 12.8 to 29.4 °C; however, fecundity was reduced at 32.2 °C. The 32.2 °C temperature caused injurious effect on eclosion fromeggs, development of larvae, emergence of pupae, and longevity of the adults (Wilkinson & Daugherty, 1970a).

The brief life cycle of *B. difformisis* is given in Berg (2000) article. The author indicated that the longevity of newly emerged females, cultivated on peat/bean mixture and the non-nutritive bacto-agar covered with a thin layer of ground grass powder at 20 °C temperature, varied from 4 to 7 days. The males emerged 2 to 4 d before the females and their longevity was 1 to 2 d shorter than that of the females. Mating usually took place during the first 24 h after emergence of the female and oviposition occurred 1 or 2 d later. On average, 94 eggs (range: 42–154 eggs) were laid, deposited in one to six clusters. The larvae hatched approximately on 6.5 d (range: 4–9 d) after oviposition. The length of the larval period ranged 11 to 17 d, on average 14 d, and ended with the transformation of the 4th instar larvae into pupae. The duration of the pupal stage was about 4.5 d (range: 4–15 d). In total, new adults emerged 27 d after the first eggs were laid (range: 22–32) (Berg, 2000).

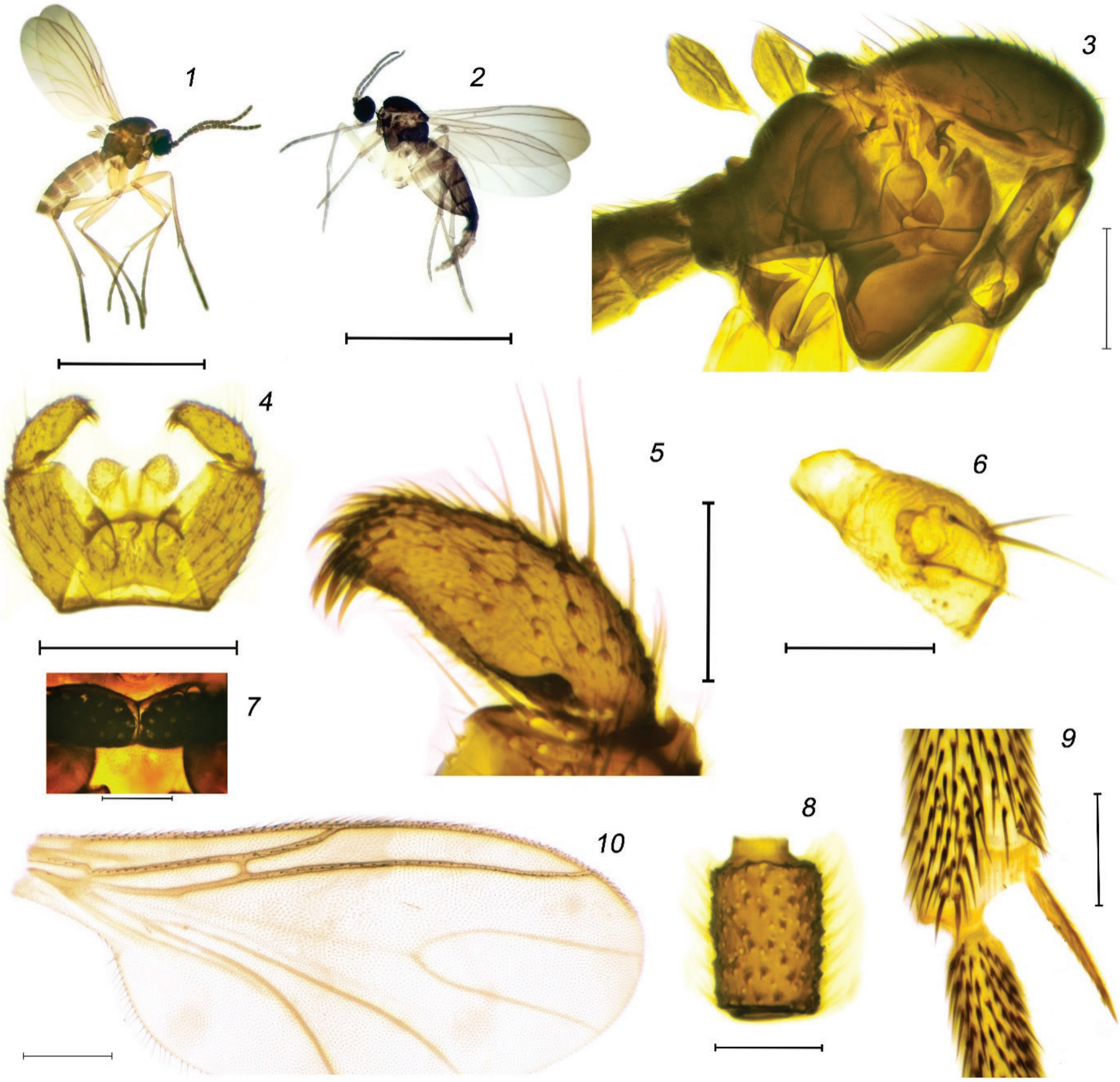

Fig. 1–10. *Bradysia difformis*, imagoes: *1* – male; *2* – female; *3* – thorax; *4* – general view of hypopygium ventral; *5* – ventral view of gonostylus; *6* – basal palpomere of maxillary palpus; *7* – eye bridge; *8* – the fourth flagellomere; *9* – front tibial (t_1) organ; *10* – wing; scale bar: *1*, *2* – 2.0 mm; *3*, *4*, *10* – 0.20 mm; *5*, *6*, *7*, *8*, *9* – 0.05 mm

Lycoriella ingenua

= *Lycoriella* (*Lycoriella*) *solani* (Winnertz, 1871)

World distribution. Europe: Austria, Belgium, Britain I., Bulgaria, the Czech Republic, Finland, French mainland, Germany, Greek mainland, Ireland, Italian mainland, France, Kaliningrad Region, Norwegian mainland, Poland, Romania, Slovakia, Spanish mainland, Sweden, Switzerland, the Netherlands (Gerbachevskaja-Pavluchenko, 1986; Menzel & Heller, 2013; Roskov et al., 2017); Asia: Mongolia, Uzbekistan, West Siberia (West Altay) (Gerbachevskaja-Pavluchenko, 1986; Komarova, 2003); USA: Hawaii (Broadley et al., 2018); Australia: New South Wales, New Zealand, Tasmania, Victoria (Broadley et al., 2018); Crozet Islands, Tristan da Cunha (Gerbachevskaja-Pavluchenko, 1986); Africa (Sataeva, 2006). Ukraine (Gerbachevskaja-Pavluchenko, 1986).

Localities in Ukraine. Kyiv and Volyn Regions.

Material examined. Ukraine, Kyiv City, Timiriazevska st., 1, M. M. Gryshko National Botanical Garden of NAS of Ukraine, Laboratory No 29: 50.416973 N, 30.562372 E, altitude ca. 180 m, in the washroom, on the window glass, with exhauster, 08.12.2012, 2 ♂, leg. A. Babytskiy (No 10-1, UkrBIN-795774-5); Ukraine, Kyiv City (former Kytaevo vil.): 50.367694 N, 30.542864 E, altitude ca. 120 m, hornbeam forest, ex larvae from young fruit body of *Fomes fomentarius* (L.) Fr. 1849 collected 13.04.2013, 23.04.2013, 1 ♂, leg. A. Babytskiy (No 12); Ukraine, Kyiv City (former Pyrohiv vil.), Kvitucha st., 14/2: 50.342004 N, 30.525016 E, altitude ca. 125 m, ex larvae from the rotting potato tubers, collected in the cellar, 04.08.2013, 1 ♂, leg. A. Babytskiy (No 3); Ukraine, Kyiv City (former Pyrohiv vil.), Kvitucha st., 14/2: 50.342004 N, 30.525016 E, altitude ca. 125 m, ex larvae from rotting potato tubers, collected in the cellar 17.08.2013, 03.09.2013, 2 ♂, leg. A. Babytskiy (No 437-8); Ukraine, Cherkasy Reg., outskirts of Kaniv town, Kaniv Nature Reserve: 49.873611 N, 31.737778 E, altitude ca. 110 m, broadleaved hornbeam forest, on the wall of summer shower, with exhauster, 09.06.2014, 1 ♂, leg. A. Babytskiy (No 35); Ukraine, Kyiv Reg., Vyshneve town, Sviatoshynska St., 27-a, 103 ap.: 50.389362 N, 30.366616 E, altitude ca. 200 m, in the flat, on the windowsill, near the flower pots, with exhauster, 26.12.2014, 1 ♂, leg. A. Babytskiy (No 34);Ukraine, Volyn Reg., Turiisk settlement, B. Hmelnytskiy st., 8: 51.080061 N, 24.530237 E, altitude ca. 185 m, in the kitchen, on the windowsill with flowerpots, by brush dipped in ethanol, 10.04.2015, 1 ♂, leg. A. Babytskiy (No 313); Ukraine, Volyn Reg., Turiisk settlement, B. Hmelnytskiy st., 8: 51.080076 N, 24.530083 E, altitude ca. 185 m, summer kitchen, on the windowsill, by brush dipped in ethanol, 10.04.2015, 1 ♂, leg. A. Babytskiy (No 315); Ukraine, Kyiv Reg., Vyshneve town, Sviatoshynska St., 27-a, 103 ap.: 50.389362 N, 30.366616 E, altitude ca. 200 m, in the flat, with exhauster, 10.05.2015, 1 ♂, leg. A. Babytskiy (No 418);Ukraine, Kyiv Reg., Vyshneve town, Sviatoshynska st., 27-a, 103 ap.: 50.389362 N, 30.366616 E, altitude ca. 200 m, on the balcony, near the packet with rotting beet roots, with exhauster, 12.06.2015, 2 ♂, leg. A. Babytskiy (No 419-20); Ukraine, Kyiv Reg., Vyshneve town, Sviatoshynska st., 27-a, 103 ap.: 50.389362 N, 30.366616 E, altitude ca. 200 m, on the balcony, from rotting beet roots, with exhauster and trap, 13.06.2015, 8 ♂, 13 ♀, leg. A. Babytskiy (No 441-8); Ukraine, Kyiv Reg., Vyshneve town, Sviatoshynska st., 27-a, 103 ap.: 50.389362 N, 30.366616 E, altitude ca. 200 m, on the balcony, from rotting beet roots and near a packet where the roots were kept, with exhauster, 15.06.2015, 84 ♂, 55 ♀, leg. A. Babytskiy (No 439); Ukraine, Kyiv Reg., Vyshneve town, Sviatoshynska st., 27-a, 103 ap.: 50.389362 N, 30.366616 E, altitude ca. 200 m, in the kitchen, in a pan with water, females – with exhauster, male – found dead, 27.06.2015, 1 ♂, 5 ♀, leg. A. Babytskiy (No 440); Ukraine, Kyiv Reg., Vyshneve town, Sviatoshynska st., 27-a, 103 ap.: 50.389362 N, 30.366616 E, altitude ca. 200 m, in the kitchen, with exhauster, 27.06.2015, 1 ♂, 4 ♀, leg. A. Babytskiy (No 449); Ukraine, Kyiv Reg., Vyshneve town, Sviatoshynska st., 27-a, 103 ap.: 50.389362 N, 30.366616 E, altitude ca. 200 m, in a pot with wet substrate for orchids, 23.12.2015, 2 ♂, leg. A. Babytskiy (No 136-7, UkrBIN-795842-3); Ukraine, Kyiv Reg., Vyshneve town, Sviatoshynska st., 27-a, 103 ap.: 50.389362 N, 30.366616 E, altitude ca. 200 m, in the flat, with exhauster, 11.03.2016, 1 ♂, leg. A. Babytskiy (No 52); Ukraine, Volyn Reg., Turiisk settlement, B. Hmelnytskiy st., 8: 51.079953 N, 24.530273 E, altitude ca. 185 m, country yard, on potato tubers brought from the cellar, among rotten fragments of tubers, with exhauster, 08.10.2016, 4 ♂, 3 ♀, leg. A. Babytskiy (No 84-6, UkrBIN-795801-3); Ukraine, Kyiv Reg., Vyshneve town, Sviatoshynska st., 27-a, 103 ap.: 50.389362 N, 30.366616 E, altitude ca. 200 m, on the balcony, on a cartoon with rotten vegetables (cabbages and onions), with exhauster, 09.04.2017, 1 ♂, leg. A. Babytskiy (No 166, UkrBIN-795864); Ukraine, Kyiv Reg., Vyshneve town, Sviatoshynska st., 27-a, 103 ap.: 50.389362 N, 30.366616 E, altitude ca. 200 m, on sprouted onions, by hand, 31.03.2018, 1 ♂, leg. A. Babytskiy (No 400).

Lycoriella ingenua (Figs 11–22) was first indicated for Ukraine in the "Catalogue of Palearctic Diptera" as *Lycoriella solani* (Winnertz, 1871) without specified location (Gerbachevskaja-Pavluchenko, 1986). It is a widespread pest insect, especially dangerous for fungi in hothouses. Apart from direct damage, this species is considered as an infectious carrier. Shamshad et al. (2009) studied the anatomical structure of *L. ingenua* imagoes connected with their ability to transfer the metaspores of pathogenic organisms. They concluded that *Bradysia ocellaris* has a comb-like row of bristles in t_1 tibial organ and spores of studied *Verticillium fungicola* attach to the inner side of the bristles, which is why this species actively spread the "dry bubble" disease caused by this fungus (Shamshad et al., 2009). But this morphological peculiarity is inherent for the species from *Bradysia* genus and is not shared by *L. ingenua*, which spreads this disease much less often.

Diagnosis. Male imagoes reach 2.2–3.0 mm (Fig. 11). Face fine and lightly bristled. Prefrons with 28–30 long setae. Clypeus with 2 median setae. Eye bridge consists with 3 rows of ommatidias. Flagellum is long and monochrome brown; flagellomeres are dark; length/width of 4th flagellomere is 1.8–2.8, with fine-sticking and light vestiture; bristles are slightly longer than the flagelomere width; necks are short and distinctly separated (Fig. 17). On the flagellomere two types of bristles are present – long hyaline and shorter, thicker than hyaline ones and with cut apex bristles (see on Fig. 17 in black circle). Maxillary palpus is short, bright and consists with three palpomeres; basal palpomere with several (up to 8) bristles (one of them is much longer than others) and deepened sensory pit (Fig. 18). The second palpomere is about 1/2 as long as the first one. The third palpomere is narrow and about 1.5 times as long as the second one (Fig. 18). Thorax and abdomen are bright to dark brown (Fig. 11–13). Body hair is fine, sparse and bright. Acrostichal setae are short, biserial; dorsocentral setae are mixture – long and short. Scutum is dark. Posterior pronotum is bare, anterior pronotum with 3–4 short setae. Mesonotum is sparsely light haired and with some stronger lateral and scutellar bristles. Proepisternum with 10 scattered setae. Gonocoxites and legs are slim, white-yellow to yellow-brown. The length of coxa1 is 0.37, $femur_1$ is 0.53 mm, $tibia_1$ – 0.60 mm and $metatarsus_1$ – 0.33 mm. Front tibial organ t_1 is densely bristled (approximately consists 14 bristles) and sharply curved bordered (Fig. 14). Spur on t_1 is only slightly longer than width of tibial apex. Tibial ends of the t_2 and t_3 with 2 equal, slender spurs. Tarsal claws without teeth. Wings are bright, 2.27 mm in length (female – 3.07 mm), 0.84 mm in width; posterior veins are distinct and as the wing membrane, without macrotrichia; stM is wide open, about as long as the M-fork; x = 1.0–1.3 y, both bare; r_1 = 4/5 r, r_1 falls into C well before the M-fork; c = 2/3–4/5 w (Fig. 20). Helter with short stalk, from light yellow to dirty-grey (Fig. 13). Hypopygium is higher than wide, sparingly light-haired and with great basalobus; gonocoxites is short hairy inside (Fig. 15). Basalobus with approximately 10 long bristles (Fig. 19). Gonostylus (Fig. 16) is very slender, apically narrowed and with a powerful apical tooth, inside with 6 to 7 hyaline setae (2 or 3 under the apical tooth and 3 or 4 in the middle of the gonostylus); on the base of gonostylus 1 or 2 whiplash setae are present (see on Fig. 16 is pointed by black pointer). The ventral side of the gonostylus is bare, only the top third is densely haired. Genital plate (tegmen) is lightly sclerotized, slightly wider than high, apically is evenly rounded. Field of tooth is about as high as wide, with a fine single-pointed tooth. Aedeagus is short, with U-shaped fork (Menzel & Mohrig, 2000; Steffan, 1972).

Note: in the studied specimens of *L. ingenua* from Ukraine x and y are bare (on the specimens No 35, 84 and 166 in y of one of the wings or both 1 distal macrotrichia is present (indicated by black pointer in Fig. 22)); r and r_1 are setosed, on r_1 6–15 macrotrichia are present; r_5 is completely setosed or sometimes is proximally bare, as in specimens No 136–137 (indicated by black circle in Fig. 21). Biometric indexes of studied specimens: wing length – 1.75–2.54 mm, wing width – 0.77–1.09 mm; width/length of wing = 0.39–0.47; stM/M-fork = 0.85–1.12; r_1/r = 0.59–0.88; x/y = 0.71–2.52 (anomaly short y is indicated in specimen No 137 (indicated by black brace in Fig. 21)); stCu/x = 0.17–0.63; c/w = 0.59–0.70. Length of spur/width of tibia: leg_1 = 0.88–1.09, leg_2 = 0.71–1.41; leg_3 = 0.81–1.25. Length of metatarsus/length of tibia: leg_1 = 0.49–0.55, leg_2 = 0.43–0.50, leg_3 = 0.41–0.48. Length of $tibia_3$/length of thorax 1.14–1.28.

Life cycle and biometry of different *L. ingenua* life stages are described in an article by Lewandowski et al. (2004). According to the authors, the time needed to complete the development of the first generation at 24 °C ranged 18 to 21 days. The development of *L. ingenua* eggs lasted

4 days. The first, second, third and fourth instars of larvae developed during 12–13 days and on the 15th day after oviposition the first pupas appear. The pupal period lasted 3 to 5 days, which subsequently resulted in the emergence of the first adult individuals after 18 days. Males appeared one day earlier than females (Lewandowski et al., 2004).

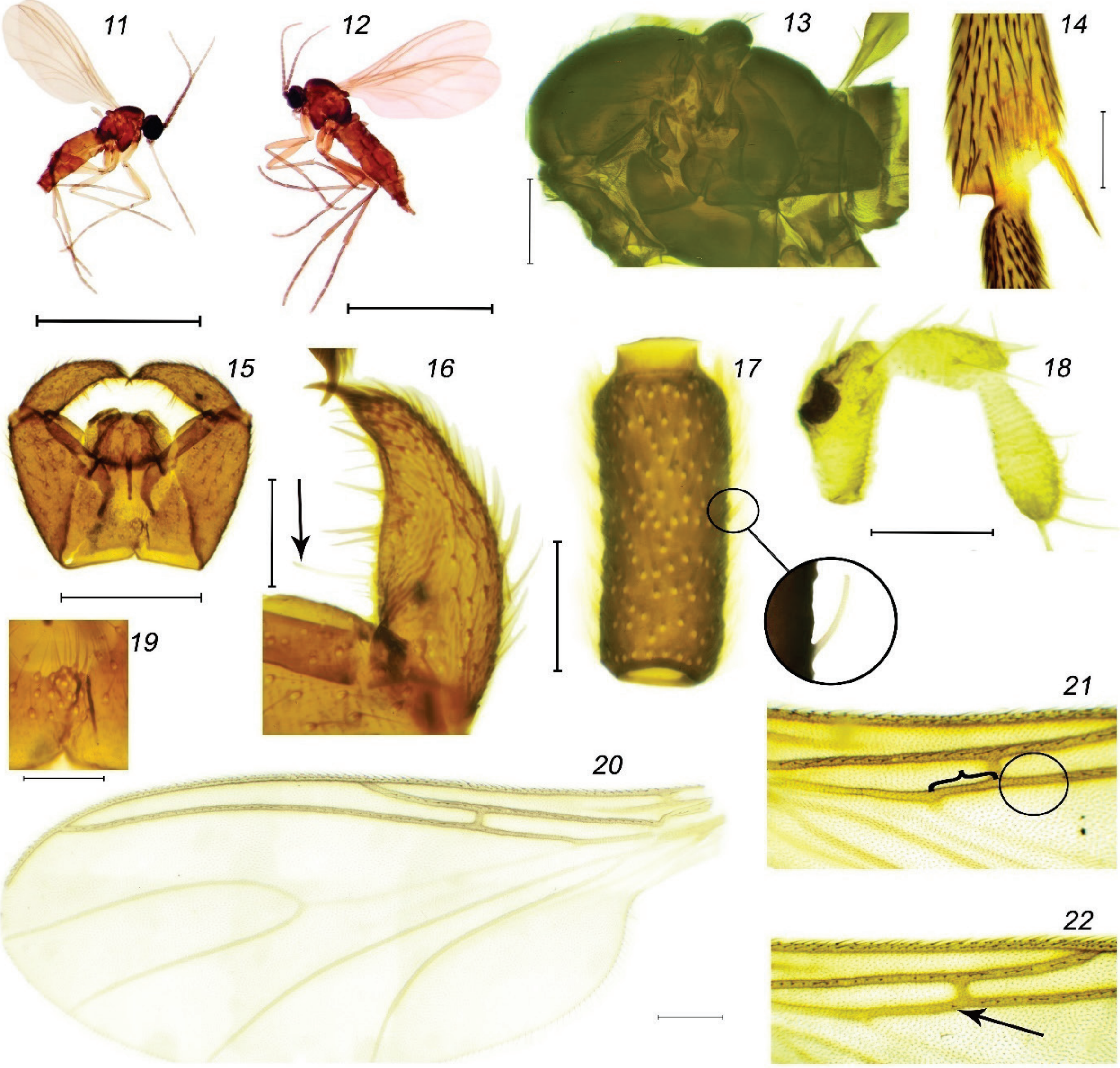

Fig. 11–22. *Lycoriella ingenua*, imagoes: *11* – male; *12* – female; *13* – thorax; *14* – front tibial (t_1) organ; *15* – general view of hypopygium ventral; *16* – ventral view of gonostylus; *17* – the fourth flagellomere; *18* – maxillary palpus; *19* – basalobus; *20* – wing; *21* – proximally bare r_1 (indicated by black circle) and anomaly short y (indicated by black brace) of specimen No 137; *22* – 1 distal macrotrichia on y of specimen No 35 (indicated by black pointer); scale bar: *11*, *12* – 2.0 mm; *13*, *15*, *20* – 0.20 mm; *14*, *16*, *17*, *18*, *19* – 0.05 mm

Pnyxia scabiei

World distribution. Europe: Britain I., Finland, France, Germany, Italian mainland, Switzerland, Russian Federation (Saint-Petersburg Reg.), the Netherlands (Gerbachevskaja, 1963; Gerbachevskaja-Pavluchenko, 1986; Menzel & Heller, 2013); Asia: Kazakhstan, Siberia (Altay) (Komarova, 2003; Sataeva, 2006); USA: West Virginia, Philadelphia (Hopkins, 1895); South America: Argentina (Sataeva, 2006); Africa: Egypt (Gerbachevskaja-Pavluchenko, 1986). Ukraine (Osmola, 1970).

Localities in Ukraine. Western regions excluding the Carpathians, Ternopil Reg.

Material examined. Ukraine, Ternopil Reg., Mykulyntsi settlement, Ternopilska st., 20: 49.401260 N, 25.601400 E, altitude ca. 295 m, vegetable garden in a yard with potatoes and onions, near the house, Malaise trap, 19–21.06.2016, 1 ♂, leg. A. Babytskiy (No 122, UkrBIN-795831); Ukraine, Ternopil Reg., Mykulyntsi settlement, Ternopilska st., 20: 49.401240 N, 25.601460 E, altitude ca. 295 m, vegetable garden in a yard with carrots, parsleys and admixture of zucchinis and raspberries, near the house, Malaise trap, 02–06.08.2017, 2 ♂, leg. A. Babytskiy (No 284; 286).

Pnyxia scabiei (Fig. 23–31) was first registered in Ukraine in 1957 when in Kyiv A. Zrazhevskyi caught an imago of a gnat which was unknown for the territory of the former USSR. This material was given for identification to B. Rodendorf and A. Shtakelberg which recognized it as *P. scabiei* or "potato scab-gnat" – pest sciarid species. During 1963–1964 N. Osmola studied morphological peculiarities and development of *P. scabiei* imaginal and preimaginal phases on the territory of Western Ukraine. Osmola (1970) published the results of his research and stated that the potato scab-gnat was spread all over the western regions of Ukraine excluding the Carpathians. We have found only two specimens of *P. scabiei* in one place, but in different periods. Namely, imagoes have been collected in the vegetable garden of a country yard in Mykulyntsi settlement of Ternopil Region in June 2016 and August 2017. Not a single *P. scabiei* specimen is known from natural biotopes of Ukraine. Thus, this species could have been introduced to our country from America together with potatoes and obviously does not belong to the natural entomofauna of Ukraine.

Diagnosis. Male. The length of the male imagoes reaches 1–2 mm (most often males are 1.3–1.4 mm in length). Both sexes are dusky brown in colour, but the male is much darker (Fig. 23). The entire insect is sparsely covered with very short and brown hairs. Head capsule is roundish, dark-brown, covered with forward-orientated bristles. Compound eyes are egg-shaped, black in colour, convergent near the mouth, but widely separated on the top, eye bridge is reduced to 2 line-like edges. Ommatidia are prominent, few in number (50 to 75 in each eye; 40 in females), with gibbous and rounded basad keratosis, separated by the black bristles. Ocelli 3 in number, in a triangle on the vertex. Antennae has 16 segments, is divided on "handle" (scapus), which consists of irregular cup-like scape and globular pedicel, and flagellum that consists of 14 flagellomeres, covered with obtuse and apical directed bristles (Fig. 30). Antennae are brown to yellow in colour, reach ¾ of the combined length of head, thorax, and abdomen. Basal flagellomeres are dark, pedicellus is slightly extended; the 4th flagellomere is rough, spiky and long setosed, its length/width is 2.9 (Fig. 29). The length of the bristles is approximately in 1.5 times exceeds the width of flagellomere. Neck is 1/3 times as long as the flagellomere basal part and sharply separated (Fig. 29). Maxillary palpus with a single segment and a large, recessed apical sensory pit. Sensilla are long. Palpomere is club-shaped, thickened with 3 to 4 bristles, one of them is longer than the others (Fig. 24). Thorax is dark brown, abdomen slightly lighter (Fig. 25). Legs are short and brownish. Femurs (especially f_1) and gonocoxites are strong and thickened. Postpronotum is bristled or rarely bare. Mesonotum is dark brown and sparsely dark haired, without stronger bristles. Tibias 2 and 3 with 2 short spurs, one of them is longer than the other. Tibial organ t_1 with unarranged sparse light bristles (Fig. 26). Tarsal claws are untoothed, very narrow and sickle-shaped. Wings are greatly reduced; venation is regressed and deviates from the normal type; posterior veins are weak and like the membrane without macrotrichia (Fig. 31). stM is about as long as the M-fork and ends about opposite rs; M-fork is short and wide-triangular opened; x and y are extremely short, both bare; stCu is absent; Cu_{1a} and Cu_{1b} are basal widely separated; Cu_2, A_1 and A_2 are reduced; r_1 is very short and distinctly shorter than r_s; r_5 is almost linear and very early falls into C; c = 3/5w. Wing length is great variable and varies from 0.53 to 1.16 mm and in some specimens does not reach the 4th abdominal segment, but in the others the wings extend beyond the tip of the abdomen. Helter is brown, with stalk (Fig. 25). Hypopigium is wider than high, without ventral basalobus or group of bristles. The inner side of gonocoxa with thin and sparse bristles; gonocoxites are densely covered by light bristles (Fig. 28). Gonostylus is about 2.5 times as long as broad, slightly narrowed apically (Fig. 27). Gonostylus tip is rounded, apically/subapically coarsely bristled and in the upper half with a fine spine. In the upper third of the gonostylus dorsal is a very short, inconspicuous and heavily sclerotized tooth (located between the stylus tip and the hyaline spine). Genital plate is rather large, high arched and apically rounded. Aedeagus is short and slender. Field of teeth is small, with very fine, one-pointed teeth (Johannsen, 1912; Speyer, 1922; Gui, 1933b; Osmola, 1970; Menzel & Mohrig, 2000).

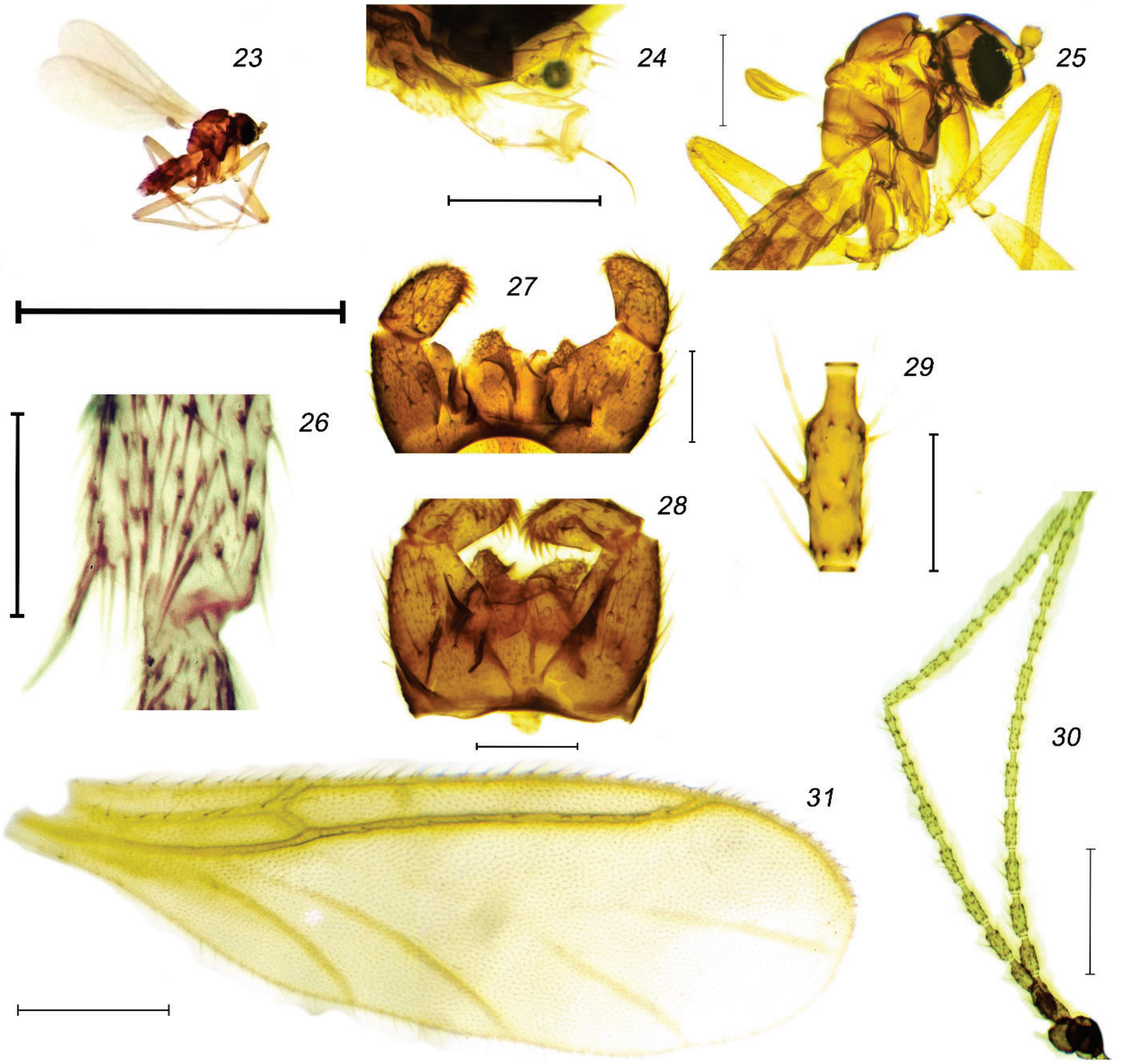

Fig. 23–31. *Pnyxia scabiei*, males: *23* – general view of imago; *24* – maxillary palpus; *25* – thorax, head and helter; *26* – front tibial (t_1) organ; *27* – ventral view of gonostylus; *28* – general view of gonocoxa ventral; *29* – the fourth flagellomere; *30* – antennas; *31* – wing; scale bar: *23* – 2.0 mm; *25*, *30*, *31* – 0.20 mm; *24*, *26*, *27*, *28*, *29* – 0.05 mm

Note: biometric indexes of studied specimens: wing length – 1.07–1.08 mm, wing width – 0.37 mm; width/length of wing = 0.34–0.35. Length of spur/width of tibia: leg 1 = 0.81–0.86, leg 2 = 0.69–0.78; leg 3 = 0.72–0.77. Length of metatarsus/length of tibia: leg 1 = 0.34–0.38, leg 2 = 0.33–0.37, leg 3 = 0.40–0.45. Length of tibia 3/length of thorax 1.09–1.30.

Female. The length of the female imagoes reaches 1.7–2.2 mm. Dusky brown in colour, lighter when newly emerged but darkening with age. Head capsule is flattened, elongated oval shape. Eye bridge is reduced to 2 line-like edges and without ommatidia. Ocelli are present, weakly deposited and not separated. Antenna is short; pedicellus is cylindrically elongated; the length/width of 4th flagellomere is 2.2. Palpomere is thick-lobed, with a larger apical sensory pit than in male, with 3 to 5 bristles. Mesonotum is flattened. Thoracal sclerite is fused. Scutellum is reduced. Wings and helters are completely missing (apterygial imago). All other features are the same as in male (Gui, 1933b; Menzel & Mohrig, 2000).

Life cycle of *P. scabiei* is described in H. Gui's publications and in N. Osmola's article (Gui, 1933a, 1933b; Osmola, 1970). The incubation period of *P. scabiei* eggs under the room temperature conditions varied from 3 to 8 days, with 62 per cent hatching on the fourth day and 29 per cent on the fifth. The average length of time was 4.4 days. The larval development last 11.4 days for males and 14.1 days for females. The duration of the pupal period varies from 2 to 7 days without differences in duration of this period connected with sex. In the laboratory male imago lived during 7 days, female – 3 days. The life cycle may be completed in as 15 days, although the average length of time is 22.6 days (Gui, 1933b).

In Western Ukraine, the largest concentrations of *P. scabiei* are in potato stores and potato fields. The appearance of potato scab-gnat in Lviv Region was detected in different seasons – spring, summer, autumn and even in winter (Osmola, 1970). Under condition of Ukraine *P. scabiei* developeds in 9 generations – 3 generations develop during spring and summer in the fields and 6 generations develop in stores from the harvesting in autumn to the planting in spring. The development period of one generation depends on the meteorological conditions and last 21–38 days.

The potato gnat winters in the larvae stage in fields in the soil at a depth of up to 15 cm. Larvae that winter in the soil of fields awaken when the air temperature reaches 16–18 °C and the soil warms up to 14 °C. The emergence of imagoes is noticed in May (Osmola, 1970).

Conclusions

Among the large Sciaridae family there are 34 species with pest activity, but only 7 species can be considered as harmful pests. In Ukraine 4 species from 3 genera of harmful sciarid pests are recorded, namely *Bradysia brunnipes* (in Crimea), *B. difformis* (in Kyiv and Volyn Regions), *Lycoriella ingenua* (in Kyiv and Volyn Regions) and *Pnyxia scabiei* (Western regions excluding the Carpathians). *B. brunnipes* also known as "cucumber gnat" is one of the widespread cucumber pests in greenhouses that damage roots and above-ground shoots of cucumbers. In Ukraine mass development of this species and significant loses of the harvest caused by it is unreported. *B. difformis* is a widespread pest sciarid, but in Ukraine it has been recorded for the first time. The mass development of this species is recorded in hothouses with cacti and other succulent plants at O. V. Fomin Botanical Garden, where the larvae of *B. difformis* cause significant damage to these plants, especially to their sprouts. *L. ingenua* is the most common sciarid pest that damages mushrooms in hothouses. In Ukraine, it is recorded in massive amounts in cellars and on vegetables in storage. *P. scabiei* is recorded in the Western Ukraine excluding the Carpathians as a potato pest species that damage sprouts in the fields and tubers in the storages. Considering the absence of records of *P. scabiei* in natural biotopes of Ukraine, this species could well have been introduced to our country from America together with potatoes and should be recognized as an alien to the natural entomofauna of Ukraine.

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