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Discovery of *Heliothela wulfeniana* (Scopoli, 1763) (Lepidoptera: Crambidae: Heliothelinae) in northwestern Russia by use of pheromone trapping

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Abstract. The grass moth *Heliothela wulfeniana* (Scopoli, 1763) is found in northwestern Russia (Leningrad Region) for the first time, thus filling the geographical gap between Finland and Estonia, on one hand, and central European Russia, on the other hand. The moths were caught by traps baited with synthetic sex attractants for the diamondback moth, *Plutella xylostella* (Linnaeus, 1787), operating in the period from August 2 to September 6 on fields of cultivated Brassica crops. It seems highly possible that the main component of the *H. wulfeniana* sex attractant is Z-11-hexadecenal.

Key words: Lepidoptera, Heliothelinae, Leningrad Region, new record, synthetic sex attractant, Z-11-hexadecenal.

Обнаружение *Heliothela wulfeniana* (Scopoli, 1763) (Lepidoptera: Crambidae: Heliothelinae) на северо-западе России с помощью феромонных ловушек

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Резюме. Огневка-травянка *Heliothela wulfeniana* (Scopoli, 1763) впервые обнаружена на северо-западе России (Ленинградская область). Эта находка заполнила пробел в ареале между Финляндией и Эстонией, с одной стороны, и центральной частью Европейской России, с другой. Бабочек отлавливали ловушками с синтетическими половыми аттрактантами для капустной моли *Plutella xylostella* (Linnaeus, 1787) со 2 августа по 6 сентября на полях с культурными растениями рода Brassica. Весьма вероятно, что основным компонентом полового аттрактанта *H. wulfeniana* является Z-11-гексадеценаль.

Ключевые слова: Lepidoptera, Heliothelinae, Ленинградская область, новое указание, синтетический половой аттрактант, Z-11-гексадеценаль.

Introduction

Heliothela wulfeniana (Scopoli, 1763) is the only European species of the genus *Heliothela* Guenée, 1854 and the tribe Heliothelinae. Another species, *H. ophideresana* (Walker, 1863), has been recorded from the southern Palaearctic, the Afrotropical and Oriental regions, while the remaining two genera and 26 species of this tribe are distributed in Australia and New Zealand [Nuss, 1999]. The range of *H. wulfeniana* extends from France and Spain in the West across Central Europe (northernmost to Denmark and southern Fennoscandia), the Mediterranean, the Caucasus, Minor and Central Asia to the Far East. According to Aarvik et al. [2017], the species is known from Denmark, southern Sweden, Finland, Estonia, Latvia and Lithuania. In Russia, this species was reported from the Kaliningrad Region, European southern taiga and central regions, Crimea, the West Caucasus, Middle Volga and South Ural, Altai Republic, Transbaikalia, Amur Region, Jewish Autonomous Region, south of Khabarovsk Region, Primorye and southern Kuriles [Sinev, Streltzov, 2019]. It was also mentioned for the 'NW of the European part of the USSR' [Martin, 1986: 422, as *H. atralis* Hübner, 1788, nec Fabricius, 1775] but without any precise locality.

The sex pheromone of *H. wulfeniana*, as well as any other species of the subfamily Heliothelinae, is yet unknown [El-Sayed, 2022]. However, Ostrauskas et al. [2002] trapped this species with the synthetic sex attractant of the noctuid cotton bollworm moth, *Heliothis armigera* (Hübner, 1808) (Noctuidae), in Lithuania. The authors found 21 specimens of this species in three pheromone traps baited with the commercial attractant of the cotton bollworm moth, which contains usually two aldehydes, Z-11-hexadecenal and Z-9-hexadecenal (9 : 1) [Grichanov, Ovsyannikova, 2005]. It is worth noting that the hexadecenals were often reported as sex attractants for species of the subfamily Crambinae related to the subfamily Heliothelinae of the family Crambidae [El-Sayed, 2022].

Testing new synthetic sex attractants for the diamondback moth, *Plutella xylostella* (Linnaeus, 1787) (Plutellidae) in Leningrad Region of Russia, we have identified a significant number of males of *H. wulfeniana* in some pheromone traps, thus firstly recording this species for the northwestern part of Russia.

Material and methods

The synthetic sex attractants (SSA) were tested in 2021 in Leningrad Region on the fields of spring rapeseed

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Table 1. Component ratios of SSA compositions.
Таблица 1. Соотношение компонентов полового аттрактанта.

Composition No Вариант состава	Z-11-hexadecenal, μg	Z-11-hexadecenyl acetate, μg	Z-11-hexadecenol, μg
1	10	90	1
2	50	50	1
3	70	30	1

Brassica napus L. planted in the agroecological station of the Menkovo Branch of the Agrophysical Research Institute in Gatchina District (59°25′N / 30°01′E) and on the experimental white cabbage Brassica oleracea var. oleracea L. fields at the Tosno laboratory of the All-Russian Institute of Plant Protection in Tosno District (59°30′N / 30°54′E).

The Menkovo Station is located in the central part of Gatchina District on the right bank of the Suida River. The traps were set up on two experimental rapeseed plots, 0.6 and 1.3 hectares. The Tosno laboratory is located at the Ushaki village in the northern part of Tosno District. The experiments were carried out on five fields with white cabbage of mid-ripening and late ripening varieties, each about 1 hectare. The weed flora was abundant and species-rich along the field borders [Shpanev, 2019].

Pheromone materials produced by the company "Shchelkovo Agrokhim" (Moscow, Russia) were used in delta traps made of laminated cardboard with an adhesive surface of 18 × 10 cm. Standard pink rubber capsules were used as dispensers [Bobreshova et al., 2020]. Traps for the diamondback moth were placed on fields since mid-June, at a distance of 20–25 meters from each other, and were checked once a week. Three variants of three-component SSA compositions with different ratios of the two main components were tested in order to identify the optimal blend for attracting adults of the diamondback moth in the Leningrad Region (Table 1). Seven replications on rapeseed fields and five replications on cabbage fields were used for each of the three variants.

The *Heliothela wulfeniana* male genitalia were removed from the abdomen, macerated with KOH, and kept in a microvial with glycerine on the same pin as the specimens. Martin's key [1986] was used for the species identification. The voucher specimens are housed at the Zoological Institute of the Russian Academy of Sciences (St Petersburg, Russia).

Data from the nearest weather station (Pulkovo observatory) [http://www.pogodaiklimat.ru/weather.php?id=26065] were used to analyze the temperature and precipitation dynamics during the vegetation season.

Results

Precipitation exceeded the long-term average by 3 times in May and by 1.5 times in August, and hot weather was observed against the background of drought during June – July, that possibly prevented the flight of *H. wulfeniana* moths (Table 2).

The beginning of *H. wulfeniana* moth flight was recorded during August 2–9 in traps baited with SSA variants 2 and 3 in Gatchina District on rape crops during its flowering (Fig. 1) and during August 11–19 on variant 3 in Tosno District on cabbage fields. By these dates, the sum of degree days 921.3–946.3° was reached. The moth flight to attractants lasted for a month and ended on September 6, when the sum of degree days reached 1072.8°.

In total, ten *H. wulfeniana* specimens were caught by traps baited with SSA variant 2 and 15 specimens were trapped by SSA variant 3 on seed rape in Gatchina District. In Tosno District, single adult specimen was found in all traps over the entire observation period, caught by SSA variant 3. The moth flight was observed at the end of the rapeseed flowering.

Discussion

As a result of the present research, *Heliothela wulfeniana* is found in the northwestern Russia for the first time, thus filling the geographical gap between Finland and Estonia, on one hand, and central European Russia, on the other hand. Adults were trapped on fields with cultivated Brassica L. (Brassicaceae) crops together with

Table 2. Meteorological data for the 2021 growing season.
Таблица 2. Метеоданные за вегетационный сезон 2021 года.

Month Месяц	Temperature, °C Температура, °C			Precipitation Осадки		
	1991–2020 average monthly / среднемесячная в 1991–2020	factual фактическая	deviation from the average monthly / отклонение от среднемесячной нормы	1991–2020 average, mm / норма за 1991–2020, мм	factual, mm фактическая, мм	% of the norm % от нормы
May Май	11.5	12.1	+0.6	47	139	296
June Июнь	16.1	21.3	+5.4	69	22	32
July Июль	19.1	23.1	+4.0	84	50	60
August Август	17.4	16.9	–0.5	87	135	156
September Сентябрь	12.4	10.2	–2.2	57	43	75

moths of *Plutella xylostella*. It is remarkable, because the *H. wulfeniana* larvae are known to feed on mints Mentha L. (Lamiaceae) and Viola L. species, including Viola arvensis Murr. (Violaceae) [Schütze, 1931; Jensen, 1968]. The plant Viola arvensis is among the most dominant weeds in the agroecosystem of the Menkovo Station [Shpanev, 2019], but Mentha arvensis L. also occurs there [Shpanev, 2018].

This xerophilous moth species inhabits sandy places with sparse vegetation and is rarely recorded but locally common in sunny and dry years [Goater et al., 2005]. In middle Europe, *H. wulfeniana* moths fly in May – June, then again in mid-July until August or even September. The imagoes are diurnal and fly close to the ground, where they visit Achillea L. (Asteraceae), Convolvulus L. (Convolvulaceae) and Thymus L. (Lamiaceae) flowers [Courtois, 1985]. In the north of its range (the Netherlands, southern Sweden, Denmark, southern Finland) the species is very rare, occurring usually in July – August, and some researchers suggest that the moths are occasional migrants there, originated from the middle Europe [Mutanen, Kaila, https://laji.fi/en/taxon/MX.61187].

It is known that *Heliothela wulfeniana* specimens were collected by pheromone traps baited with sex attractant of *Heliothis armigera* in Lithuania, Z-11-hexadecenal and Z-9-hexadecenal (9 : 1) blend [Ostrauskas et al., 2002]. In Leningrad Region, we have collected males of *Heliothela wulfeniana* in traps baited with Z-11-hexadecenal and Z-11-hexadecenyl acetate (5 : 5 and 7 : 3) with addition of 1% of minor component, Z-11-hexadecenol. According to Mõttus et al. [1997], an initial ratio 1 : 1 of the main components in dispensers for the diamondback moth provides their ratio 83 : 17 in SSA vapours. That is, the aldehyde evaporates much faster than the acetate. Based on this rule, we can conclude that the main component of the *H. wulfeniana* sex attractant is Z-11-hexadecenal. The addition of other semiochemicals (Z-9-hexadecenal, Z-11-hexadecenol and Z-11-hexadecenyl acetate) to improve dispenser attractiveness and their role in the pheromone system of the species require further study.

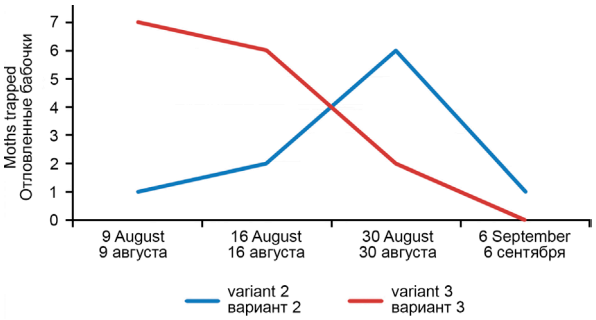

Fig. 1. *Heliothela wulfeniana* males in traps baited with SSA variants 2 and 3, spring rapeseed, Gatchina District of Leningrad Region, 2021.

Рис. 1. Лёт самцов *Heliothela wulfeniana* в ловушки с вариантами аттрактанта 2 и 3, рапс яровой, Гатчинский район Ленинградской области, 2021 год.

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