Rove beetles (Coleoptera: Staphylinidae) on agrolandscape herbaceous vegetation in the Leningrad Region

Страфилиниды (Coleoptera: Staphylinidae) на травянистой растительности агроландшафтов Ленинградской области

O.G. Guseva1, A.M. Shpanev1,2
O.G. Гусева1, А.М. Шпанев1,2

1 All-Russian Institute of Plant Protection, Podbelskogo 3, St. Petersburg, Russia. E-mail: olgaguseva-2011@yandex.ru
2 Agrophysical Research Institute, Grazhdanskiy Pr. 14, St. Petersburg, Russia.

KEY WORDS: biodiversity, rove beetles, sweep netting, herbaceous vegetation, agrolandscape.

ABSTRACT. During the period from 2005 to 2019, 38 rove beetles species were collected by sweeping herbaceous vegetation in agricultural fields and at field margins of the Leningrad Region, Northwestern Russia. The highest species diversity is recorded on the grain crops and at field margins. Eleven of the collected species (29% of the total number of species collected by sweep sampling) were never collected by pitfall traps. Among them Stenus similis (Hbst.), frequently collected in herbaceous layer, mainly on perennial grasses and winter grain crops.

Introduction

Many species of rove beetles (Coleoptera, Staphylinidae) occur in boreal agrolandscapes, mainly on soil surface. In total, 157 species of rove beetles have been found on soil surface in the in the agrolandscapes in Northwestern Russia [Guseva, 2014a]. Their role as predators of agricultural pests that live on plants depends on their ability to climb different plants. Nevertheless, this ability of many species has not yet been clarified in the existing literature. Sweeping on vegetation is rarely used to collect rove beetles [Niedobova, Fric, 2014]. This study determines the species composition of rove beetles on the plants by sweeping vegetation on different agricultural fields and at their margins in the Leningrad Region.

Data and methods

Data were collected during the period from 2005 to 2019 in the framework of a joint project with the Agrophysical Research Institute (ARI, St. Petersburg). Rove beetles were collected with a standard insect net (300 mm diameter) in the different biotopes. The research was carried out on grain crops (spring and winter wheat, rye and spring barley), perennial grasses (clover, timothy grass and rye grass), potato, beet, vetch-oat mixture, rape, lupine and at field margins (about 5–10 m around the cultivated land, the biotope combine herbaceous vegetation and shrubs) mainly at Menkovo Research Station (MRS) of ARI (Menkovo Village, Gatchina District, Leningrad Region). Samples were taken with weekly or bi-weekly intervals from May to August. Whenever possible, sampling was done on warm, dry days. At each sampling site, 50–100 sweeps were made with a sweep net. During the whole sampling period we collected with insect net a total of 347 rove beetles specimens with 40300 sweeps.

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How to cite this article: Guseva O.G., Shpanev A.M. 2019. Rove beetles (Coleoptera: Staphylinidae) on agrolandscape herbaceous vegetation in the Leningrad Region // Russian Entomol. J. Vol.28. No.4. P.373–376. doi: 10.15298/rusentj.28.4.05
Most specimens we identified by us. Some specimens were identified by V.I. Gusarov (Natural History Museum, University of Oslo, Norway) or A.V. Kovalev (All-Russian Institute of Plant Protection, St. Petersburg, Russian Federation). The first also checked and confirmed some of our identifications.

The species richness was estimated by the popular Margalef index \( DM_g = (S - 1)/\ln N \), where \( S \) is the number of species recorded and \( N \) is the total number of individuals of all the species [Pesenko, 1982].

To compare results obtained by sweeping on vegetation and pitfall trapping, this study uses the data collected during our previous investigations in the agrolandscapes of the Leningrad Region [Guseva, 2014a, b; 2017; 2019; Guseva, Koval, 2015, 2017].

Results and discussion

In total, 38 species of rove beetles from 8 subfamilies and 23 genera, were collected on herbaceous vegetation using sweep net sampling. The species richness is distributed in various fields as follows: grain crops 26 species, grasses 15, potato and beet five species (Table).

Among the collected rove beetles, ten species belong to the subfamily Tachyporinae (Tachyporus, Tachinus, Bolitobius, Mycetopus), nine species belong to Aleocharinae (Oxyoda, Nehemiptria, Amischa, Aloconota, Atheta, Mocya, Aleochara), five to Steninae (Stenus), five to Omalinae (Eusphalerum, Omalium, Anthophagus), four to Staphylininae (Gyrohypnus, Gabrius, Philonthus) and three to Oxytelinae (Carpelinus, Anotylus) (Table).

It is known, that those representatives of Tachyporinae and Aleocharinae subfamilies that do not have a narrow specialization, are able to climb plant stems, but among rove beetles from Tachyporinae subfamily, 11 species: Tachyporus chrysomelinus and T. hypnorum are most abundant on the herbaceous vegetation (Table).

Among rove beetles from Aleocharinae subfamily, Tachyporus chrysomelinus and T. hypnorum are most abundant on the herbaceous vegetation (Table).

The Steninae subfamily (Stenus spp.) plays a distinct role among the rove beetles that are able to climb plants. The species of this genus which are encountered on the ground surface and on the plants in wet biotopes, share distinctive features that enable them to move freely across the plants and to resist dehydration [Tikhomirova, 1973]. S. similis in herbaceous layer in the agrolandscapes of the Leningrad Region were especially abundant (Table).

Representatives from Omalinae subfamily climb plants in order to search for food. It is known that species of the genus Eusphalerum (Omalinae) feed on pollen [Freude et al., 2012]. E. minutum occurs on flowers of Caltha and Ranunculus [Freude et al., 2012]. The other representative of this genus, E. luteum, was highly abundant in the agrolandscape of MRS at the field margin covered mostly with Filipendula vulgaris (Moench, 1794) and Epilobium angustifolium (Linnæus, 1753), during their flowering period.

However, most rove beetles are predators. Stenus preys on larvae of Cicadellidae, Diptera and others small arthropods [Freude et al., 2012]. S. similis has been recorded as a predator of aphids Sitobion avenae Fabricius, 1775 [Sunderland et al., 1987]. A. gregaria preys on aphids Rhopalosiphum padi (Linnæus, 1758) [Guseva, 2011]. Tachyporus spp. are significant predators of aphids and others arthropods. T. hypnorum preys on aphids R. padi, Sitobion avenae [Sopp, Wratten, 1986; Kyneb, Toft, 2004] and Acyrthosiphon pisum Harris, 1776 [Balog et al., 2013]. According to field observations in different parts of Turkey, adult beetles of T. nitidulus and T. hypnorum prey upon cereal aphids and eggs of cabbage root flies (Delia sp.) [Özgen, Anlas, 2011]. Tachyporus obtusus feeds on aphids S. avenae [Dennis et al., 1991]. Tachyporus chrysomelinus preys on aphids S. avenae [Sopp, Wratten, 1986] and R. padi [Guseva, 2011]. The level of consumption of aphid R. padi by adult T. chrysomelina is 4.2 ± 3.40 individuals per day under laboratory conditions [Guseva, 2011]. The study carried out in winter grain fields in the Leningrad Region demonstrated that Tachyporus spp. are present in the crops from the third decade of May, while S. similis are present from the second decade of May, before the appearance of aphids on the fields. Abundance of the rove beetles (calculated as the number of specimens per 100 sweeps) on plants of winter grain fields is higher than on the other fields, the highest species diversity is recorded on the grain crops (Table). Probably, grain aphids along with other phytophagous insects attract various species of predatory rove beetles, who climb plants in order to feed. Therefore, they might play an important role as useful predators at the beginning of the appearance of aphids on the winter grain fields.

Among those rove beetles that occurred on the herbaceous vegetation, many species were also known to be abundant on the soil surface. For instance, our previous investigations carried out by pitfall trapping method have shown T. chrysomelina, T. hypnorum, A. analis, M. fungi and A. gregaria to be among the most numerous species in agrolandscapes of the Leningrad Region [Guseva, 2014b, 2017, 2019; Guseva, Koval, 2015, 2017].

Eleven species: E. luteum, E. minutum, C. elongatus, A. omalinus, O. rufus, S. similis, P. pseudovarians, T. formosus, T. obtusus, A. debilis and N. lividipennis were captured by sweeping herbaceous vegetation, but they have never been found in pitfall traps during the whole period of our research (Table). They constitute a 29 % share of the overall number of species collected on the plants by sweeping. The species that are able to climb plants and to move freely along vertical surfaces presumably do not get caught in pitfall traps or they are able to leave them. This implies that
Table. Rove beetles collected on herbaceous vegetation in different kinds of agricultural fields and field margins.

| Species                              | SF   | Biotope                |
|--------------------------------------|------|------------------------|
|                                      |      | spring grain crops     | winter grain crops | potato and beet fields | annual grasses | perennial grasses | field margins |
| Eusphalerum luteum (Marsham, 1802)*  | Om   |                        | 65                 |
| Eusphalerum minutum (Fabricius, 1792)* | Om   | 1                      | 52                 |
| Omalius caesus Gravenhorst, 1806     | Om   | 1                      |                    |
| Anthophagus caraboides (Linnaeus, 1758) | Om   | 1                      |                    |
| Anthophagus omalinus Zetterstedt, 1828* | Om   | 1                      |                    |
| Carpelinus elongatus (Erichson, 1839)* | Ox   | 1                      |                    |
| Anotylus nitidulus (Gravenhorst, 1802) | Ox   | 1                      |                    |
| Anotylus rugosus (Fabricius, 1775)   | Ox   | 1                      | 3                  |
| Oxyopus rufulus (Linnaeus, 1758)*    | Sn   | 1                      | 1                  |
| Stenus cinceloides (Schaller, 1783)  | Sn   | 1                      |                    |
| Stenus flavipes Stephens, 1833      | Sn   | 2                      |                    |
| Stenus fulvicornis Stephens, 1833   | Sn   | 1                      | 1                  |
| Stenus namus Stephens, 1833         | Sn   | 2                      |                    |
| Stenus similis (Hebst, 1784)*       | Sn   | 1                      | 9                  |
| Rugitus erichsoni (Fauvel, 1876)    | Pd   | 1                      |                    |
| Gyrohymus angustatius Stephens, 1833| St   | 1                      |                    |
| Gabrius breviventer Sperr, 1835     | St   | 1                      | 2                  |
| Philonthus concinns Gravenhorst, 1802| St   | 1                      |                    |
| Philonthus pseudovarius A. Strand, 1941* |      |                        |                    |
| Mycetoporus bimaculatus Lacordaire, 1835 | Tp   | 1                      | 1                  |
| Bolitobius formosus (Gravenhorst, 1806) | Tp   | 1                      |                    |
| Tachinus marginellus (Fabricius, 1781) | Tp   | 1                      |                    |
| Tachinus rufulus (Linnaeus, 1758)    | Tp   | 2                      | 1                  |
| Tachyusporus chrysolomus (Linnaeus, 1758) | Tp   | 2                      | 10                 |
| Tachyusporus ?formosus Matthews, 1838* | Tp   | 1                      |                    |
| Tachyusporus hypnorum (Fabricius, 1775) | Tp   | 3                      | 7                  |
| Tachyusporus nitidulus (Fabricius, 1781) | Tp   | 1                      | 1                  |
| Tachyusporus obtusus (Linnaeus, 1767)* | Tp   | 1                      |                    |
| Tachyusporus pusillus Gravenhorst, 1806 | Tp   | 1                      | 1                  |
| Oxyopsida brevicornis (Stephens, 1832) | Al   | 1                      |                    |
| Nemophilota lividipennis (Mannerheim, 1831)* | Al   | 1                      |                    |
| Amischa analis (Gravenhorst, 1802)   | Al   | 10                     | 28                 |
| Aloconota gregaria (Erichson, 1839)  | Al   | 1                      | 1                  |
| Athela debilis (Erichson, 1837)*     | Al   | 1                      |                    |
| Athela latifolius (Stephens, 1832)   | Al   | 2                      |                    |
| Mecyna jingi (Gravenhorst, 1806)     | Al   | 9                      | 9                  |
| Aleochara bilineata (Gyllenhaal, 1810) | Al   | 1                      | 1                  |
| Aleochara bipustulata (Linnaeus, 1761) | Al   | 1                      |                    |

No of species: 16 17 5 8 11 18

No of specimens: 27 59 5 15 81 160

Dmg: 4.54 3.92 2.48 2.58 2.28 3.35

No of sweeps: 8000 5100 4500 8300 6900 7500

Total catchability (specimens per 100 sweeps): 0.34 1.16 0.11 0.18 1.17 2.13

SF — subfamily: Om — Omaliinae, Ox — Oxytelinae, Op — Oxyporinae, Sn — Steninae, Pd — Paederinae, St — Staphylininae,
Tp — Tachyporinae, Al — Aleocharinae; * — species was not collected by pitfall trapping.

SF — подсемейства: Om — Omaliinae, Ox — Oxytelinae, Op — Oxyporinae, Sn — Steninae, Pd — Paederinae, St — Staphylininae,
Tp — Tachyporinae, Al — Aleocharinae; * — виды, не собранные в почвенные ловушки.
sweep netting method has a huge potential to enrich data collection, nowadays focused on the widespread use of pitfall traps.

Acknowledgments. We are sincerely grateful to V.I. Gusarov (Natural History Museum, University of Oslo, Norway) and A.V. Kovalev (All-Russian Institute of Plant Protection, St. Petersburg, Russian Federation) for their advice and help with material identification. We would like to thank V.I. Gusarov whose expertise was invaluable in the preparation of this paper. The study was performed within the frames of the Russian State Research Project no. 0665-2018-0008.

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