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New Data on *Urostylis trullata* Kerzhner, 1966 (Heteroptera, Urostylididae) from the South of the Russian Far East

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The paper presents observations on the developmental dynamics of the genus *Urostylis* Westwood, 1837 in the natural conditions of the southern Primorsky Krai, Russia. The aim of the study is to show the developmental features of *Urostylis trullata* Kerzhner, 1966 and provide a comparative analysis of the duration of ontogenesis of three species: *U. trullata*, *U. annulicornis* Scott, 1874 and *U. lateralis* Walker, 1867. Nymphs of *U. trullata* from eggs that had overwintered in *Quercus mongolica* Fisch. ex Ledeb. under rhytidome were reared in cages. Instar I–II nymphs hatch before the onset of oak's growing season and develop under rhytidome, feeding on the jelly-like coat of the egg clutch and molting. As Mongolian oak leaves unfold, instars III nymphs their shelters and begin feeding on leaf sap. The postembryonic phase in all three species lasts, on average, 65–68 days. However, observations on *U. annulicornis* and *U. trullata* have shown their ability to complete postembryonic development for minimal periods of 54 and 58 days, respectively.

Key words: true bugs, Heteroptera, Urostylididae, *Urostylis trullata*, ootheca, overwintering, nymphs, seasonal development, phenology, Primorsky Krai, *Quercus mongolica*

The present study is the third one in the series of papers that report observations on the development dynamics in bugs of the genus *Urostylis* Westwood, 1837 under natural conditions in the south of Primorsky Krai. The previously published studies covered the periods of postembryonic ontogeny of *U. annulicornis* Scott, 1874 and *U. lateralis* Walker, 1867 to winged adults (Kanyukova *et al*. 2023a, 2023b). In this study, we show the features of development of *Urostylis trullata* Kerzhner, 1966 and provide a comparative analysis of the postembryonic period in the species under consideration. All three species are associated with their forage plant, the Mongolian oak *Quercus mongolica* Fisch. ex Ledeb. Although bugs of the genus *Urostylis* can also be found on other tree species, marked damage to Mongolian oak leaves is observed during the mass breeding of these three bugs (Kuznetsov 2000).

Urostylis trullata Kerzhner, 1966 was described from Primorsky Krai in a study with the revision of species of the family Urostylididae in the USSR fauna. The author provided a table with keys to two genera and five species known by then, and also described the subgenus *Chlorochela* with an overview of the species from southern China (Kerzhner 1966). Subsequently, *U. trullata* was found on Sakhalin Island, Russia (Kerzhner & Petrova 1975; Kerzhner 1978), in the south of Khabarovsk Krai (Kanyukova 1988, 2010), and recorded from northern China and the Korean Peninsula (Rider, 2006). It differs from other species of the genus in the structural features of the male and female genital segments, as well as in the light punctation of the pronotum and scutellum.

Our studies were carried out in forest biotopes of the south of Primorsky Krai (Far East of Russia) from April to October 2022–2023. Mongolian oak trees were examined in order to assess their occupancy by bugs of the family Urostilididae. Egg clutches of hemipterans were described and collected for rearing adults. The development and molting of nymphs were continuously monitored, with measurements and photographs taken. The methodology of the study was described in detail in previous publications (Markova *et al*. 2018; Kanyukova *et al*. 2023a, 2023b).

In the text below, *n* is the number of specimens and *m* is the mean value.

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Material. Russia. Primorsky Krai, Ussuriysky Urban Okrug, vicinities of the Village of Kaymanovka (43°37′49″ N; 132°13′49″ E), terrace near floodland, oak/Korean pine forest with Manchurian fir (*Abies holophylla* Maxim.), heartleaf hornbeam (*Carpinus cordata* Blume), Manchurian ash (*Fraxinus mandshurica* Rupr.), and mono maple (*Acer mono* Maxim.), clutch was collected on April 15, 2023; vicinities of the Village of Kamenushka, watershed of the Komarovka River and Semenovsky Spring (43°37′23″ N; 132°13′50″ E), Korean pine forest with Mongolian oak and Manchurian fir, maple/hazel forest, clutches were collected on April 17, 2023; protected area of the Land of the Leopard National Park, Ussuriysky Nature Reserve (43°40′00″ N; 132°30′00″ E), Korean pine/broad-leaved forest with Mongolian oak, mono maple, Manchurian maple (*Acer mandshurica* Maxim.), Amur lime (*Tilia amurensis* Rupr.), Manchurian ash, clutches were collected on April 21, 2023; Vladivostok Urban Okrug, Vladivostok, Akademgorodok (43°19′09″ N; 131°92′11″ E), sparse oak forest, clutches with instar II nymphs were collected on April 20, 2023.

The material is deposited in the Zoological Museum, Far Eastern Federal University (Vladivostok; FEFU).

Distribution. China (NO), Korea, Russia (FE) (Kerzhner 1966; Kerzhner & Petrova 1975; Kerzhner 1978; Kanyukova 1988, 2010; Rider 2006).

Life cycle. Clutches (oothecae) were found in the period from April 15 to 21, 2023 on the inner side of Mongolian oak rhytidome. The trunk diameter of the examined trees ranged from 0.3 to 0.6 m ($m = 0.4$; $n = 4$); the thickness of the rhytidome above the clutch was from 0.3 to 0.7 cm ($m = 0.6$). The clutches were found at a height of 0.7 to 1.7 m ($m = 1.2$) above the soil surface. They were located in the sector of the trunk facing south.

Ootheca of *U. trullata* was elongated in shape, from 8 to 12 mm in length ($m = 10.2$), from 2.5 to 3 mm in width ($m = 2.8$), formed by 3–4 rows of eggs (Fig. 1A). Eggs in the ootheca could be arranged into 2–4 layers, evenly covered by a thickened jelly-like mass. The number of eggs in clutches was from 10 to 62 ($m = 27.4$). If a female laid several clutches under the same site of rhytidome, the maximum number of eggs in them reached 135.

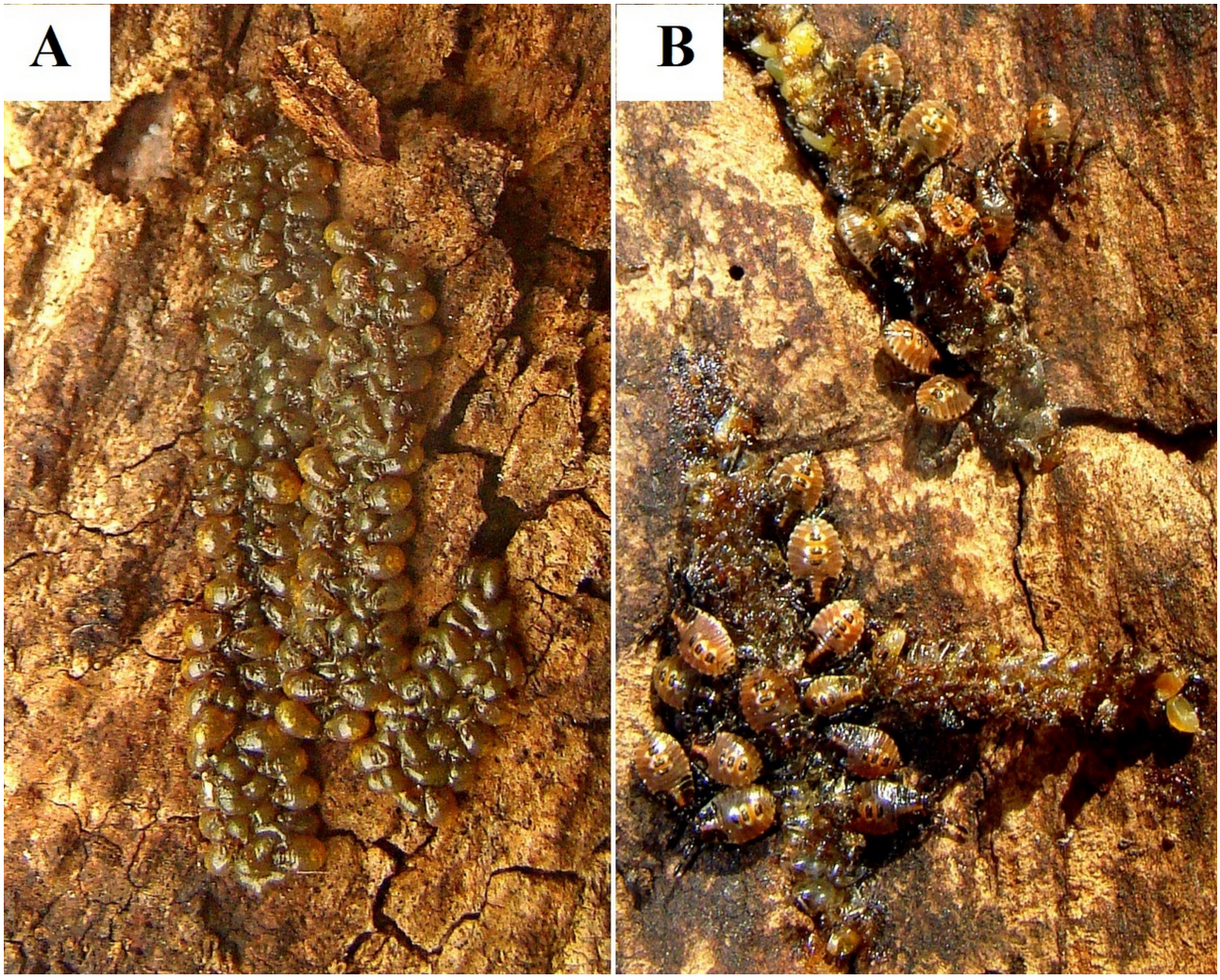

Figure 1. *Urostylis trullata* Kerzhner, 1966. **A,** Ootheca on the inner side of rhytidome from *Quercus mongolica* Fisch. ex Ledeb. and hatching of instar I nymphs, April 15, 2023; **B,** instar II nymphs on the inner side of rhytidome, April 22, 2023.

Phenology. Hatching of instar I nymphs of *U. trullata* from eggs was observed from April 15 (Fig. 1A). The duration of their development was 8–11 days (*m* = 9.3). Instar II nymphs appeared from April 22 (Fig. 1B); the duration of their development was 11–13 days (*m* = 11.6). Instar III nymphs were recorded since May 2 (Fig. 2A) (mass molting of instar II was observed on May 6); the duration of their development was 7–8 days (*m* = 7.6). Instar IV nymphs were recorded since May 9 (Fig. 2B) (mass molting of instar II was observed on May 9–10); the duration of their development was 14–15 days (m = 14.5). Instar V nymphs emerged since May 24 (Fig. 3A); their development lasted for 18–21 days (*m* = 19.3). The complete formation of winged adults occurred on June 11–28 (Fig. 3B) (28 ♂ 25 ♀); the mass emergence of winged adults was observed on June 14. The postembryonic phase in *U. trullata* lasted from April 15 to June 11–28, with a total of 58–72 days (*m* = 65) at an average daily air temperature from –1.7 to +28.4°C. The individuals kept in laboratory conditions became winged adults on June 11 and 12.

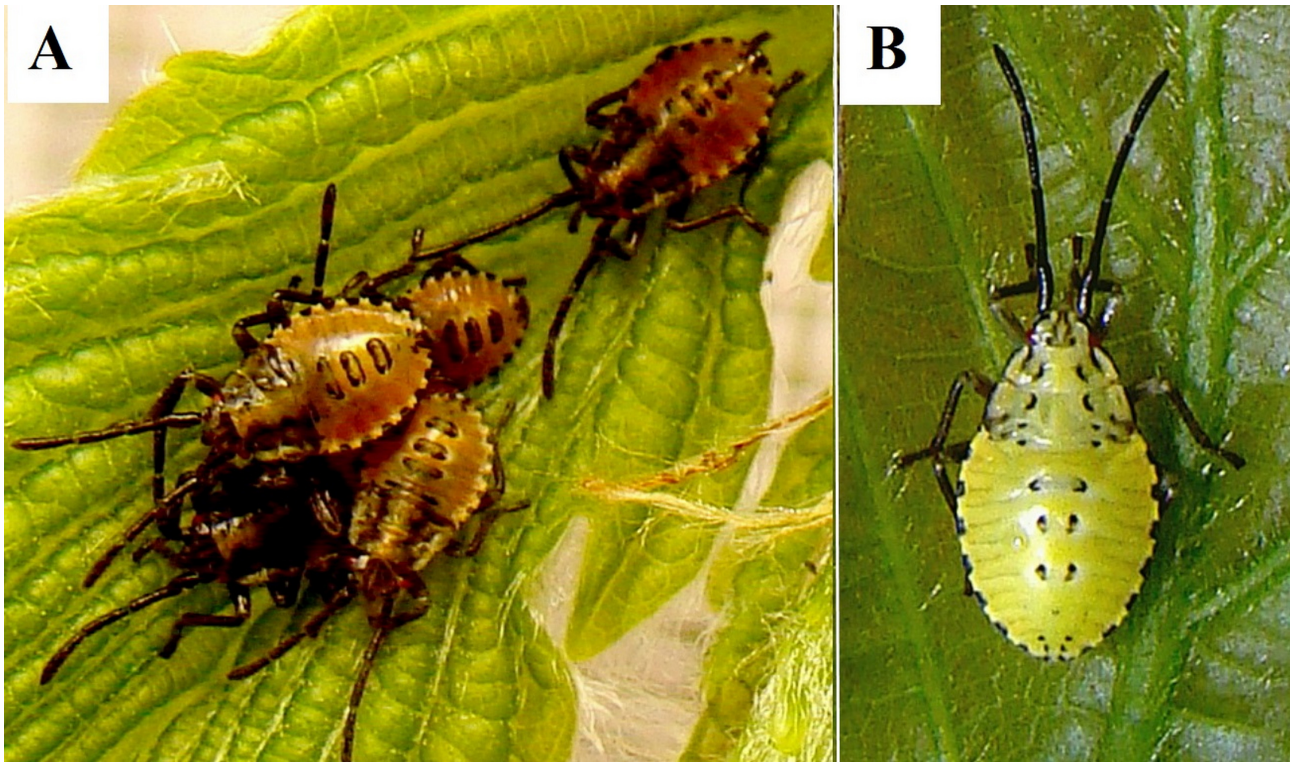

Figure 2. *Urostylis trullata* Kerzhner, 1966. **A,** instar III nymph on a leaf blade from *Q. mongolica*, May 3, 2023; **B,** instar IV nymph on a leaf blade from *Q. mongolica*, May 16, 2023.

Like those in other species of the genus, instar I and II nymphs of *U. trullata* stay aggregated in a group under the rhytidome and feed on the jelly-like coat of the ootheca. Starting from instar III, their activity increase, they leave their shelter, still keeping in the group, and begin to suck the sap of unfolding oak leaves. A comparative analysis of the timing and duration of the ontogeny in three species, *U. trullata, U. annulicornis*, and *U. lateralis*, has shown the following:

1. The postembryonic period in *U. annulicornis*, according to the data of 2022, began from April 8–10 and completed within a total of 54–77 days (*m* = 65.5) at an average daily air temperature from –4.1 to +29.4°C. The complete formation of winged adults occurred from June 16 to 25, 2022. The duration of development of nymphal instars of *U. annulicornis* was as follows (in days): instar I, 12–14 (*m* = 13); instar II, 9–12 (*m* = 10.5); instar III, 10–12 (*m* = 11); instar IV, 10–13 (*m* = 12); and instar V, 22–26 (*m* = 24) (Kanyukova *et al*. 2023a).

According to the data of 2023, the postembryonic period in *U. annulicornis* began on April 17 and completed within a total of 56–79 days (*m* = 67.5) at an average daily air temperature from –1.2 to +28.4°C. The formation of winged adults began on June 12 (with their mass emergence on June 14) and lasted until early July.

2. The postembryonic period in *U. lateralis* began later than in *U. trullata* and *U. annulicornis*: from April 21 and within a total of 63–69 days (*m* = 66) at an average daily air temperature from –1.2 to +28.4°C. The complete formation of winged adults occurred on June 23, 2023. The duration of development of nymphal instars of *U. lateralis* was as follows (in days): instar I, 9–10 (*m* = 9.5); instar II, 8–9 (*m* = 8.5); instar III, 9–11 (*m* = 10); instar IV, 10–12 (*m* = 11); and instar V, 27 (Kanyukova *et al*. 2023b).

The frequency of occurrence of *U. annulicornis* and *U. trullata* clutches in 2022–2023 in nature was higher than those of *U. lateralis*. Observations on the former two species have shown their ability to complete postembryonic development for minimal periods of 54 and 58 days, respectively. However, the postembryonic phase in all three species lasts, on average, 65–68 days.

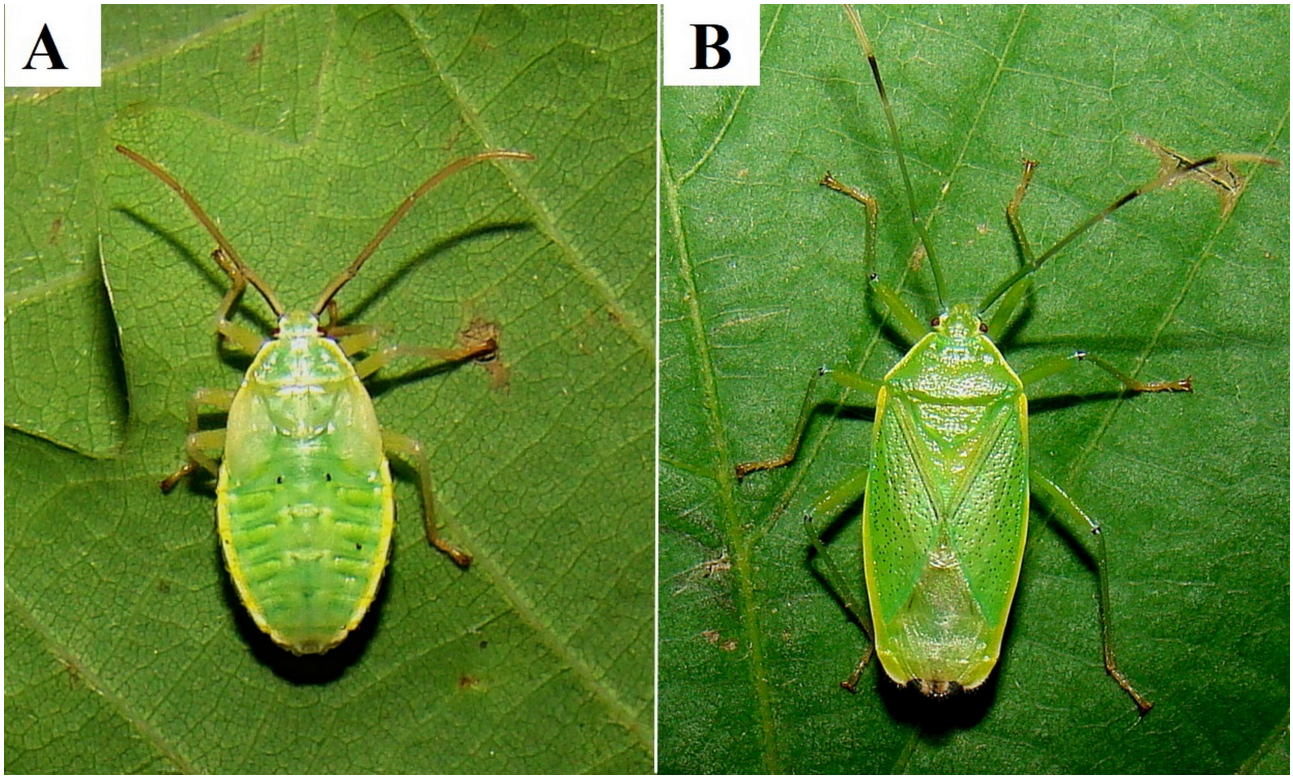

Figure 3. *Urostylis trullata* Kerzhner, 1966. **A,** instar V nymph on a leaf blade from *Q. mongolica*, June 13, 2023; **B,** an adult ♀ on a leaf blade from *Q. mongolica*, winged on June 21, 2023.

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