Известия Харьковского энтомологического общества **2017, том XXV, выпуск 2** **ISSN 1726–8028**
Вісті Харківського ентомологічного товариства **2017, том XXV, випуск 2**
The Kharkov Entomological Society Gazette **2017, volume XXV, issue 2**

UDC [595.768.11:591.5:630*453:582.475.4]([477.61+477.54]:212.6)

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SEASONAL DEVELOPMENT OF THE TIMBERMAN BEETLE *ACANTHOCINUS AEDILIS* (LINNAEUS, 1758) (COLEOPTERA: CERAMBYCIDAE) IN THE NORTH-EASTERN STEPPE OF UKRAINE

Мєшкова, В. Л., Кочетова, А. І., Скрильник, Ю. Є., Зінченко, О. В. Сезонний розвиток сірого довговусого вусача *Acanthocinus aedilis* (Linnaeus, 1758) (Coleoptera: Cerambycidae) в Північно-Східному Степу України. *Вісті Харків. ентомол. т-ва*. 2017. Т. XXV, вип. 2. С. 40–44.
Визначено найбільш ранні дати розвитку сірого довговусого вусача, тривалість різних стадій та відповідні суми додатних температур у Північно-Східному Степу України. Виявлено, що сірий довговусий вусач найчастіше зимує на стадії імаго, але частина популяції зимує на стадії личинки та продовжує розвиток наступної весни. Жуки, що зимували, заселяють дерева чи колоди наприкінці квітня. Перші личинки вилуплюються в кінці квітня – на початку травня. Перші лялечки з'являються на початку серпня, перші імаго нового покоління – в кінці серпня. Імаго, які розвиваються із личинок, що зимували, заселяють дерева чи колоди влітку.
2 рис., 3 табл., 9 назв.
Ключові слова: сірий довговусий вусач, *Acanthocinus aedilis*, сезонний розвиток, сума додатних температур.

Мешкова, В. Л., Кочетова, А. И., Скрыльник, Ю. Е., Зинченко, О. В. Сезонное развитие серого длинноусого усача *Acanthocinus aedilis* (Linnaeus, 1758) (Coleoptera: Cerambycidae) в Северо-Восточной Степи Украины. *Изв. Харьк. энтомол. о-ва*. 2017. Т. XXV, вып. 2. С. 40–44.
Определены наиболее ранние даты развития серого длинноусого усача, длительность разных стадий и соответствующие суммы положительных температур в Северо-Восточной Степи Украины. Установлено, что серый длинноусый усач наиболее часто зимует на стадии имаго, однако часть популяции зимует на стадии личинки и продолжает развитие следующей весной. Перезимовавшие жуки заселяют деревья или бревна в конце апреля. Первые личинки отрождаются в конце апреля – в начале мая. Первые куколки появляются в начале августа, первые имаго нового поколения – в конце августа. Имаго, развившиеся из перезимовавших личинок, заселяют деревья или бревна летом.
2 рис., 3 табл., 9 назв.
Ключевые слова: серый длинноусый усач, *Acanthocinus aedilis*, сезонное развитие, сумма положительных температур.

Meshkova, V. L., Kochetova, A. I., Skrylnik, Yu. Ye., Zinchenko, O. V. Seasonal development of the timberman beetle *Acanthocinus aedilis* (Linnaeus, 1758) (Coleoptera: Cerambycidae) in the North-Eastern Steppe of Ukraine. *The Kharkov Entomol. Soc. Gaz*. 2017. Vol. XXV, iss. 2. P. 40–44.
The earliest dates of timberman beetle development, duration of different stages and respective sums of positive temperatures have been calculated in the North-Eastern Steppe of the Ukraine. It was found, that timberman beetle more often hibernates as adult, but the part of population hibernates as larvae and continues to develop the next spring. The beetles, which hibernated, colonize trees or logs at the end of April. The first larvae hatch at the end of April – at the beginning of May. The first pupae appear at the beginning of August, the first adults of the new generation emerge at the end of August. Adults, which developed from hibernated larvae, colonize trees or logs in summer.
2 figs, 3 tabs, 9 refs.
Keywords: timberman beetle, *Acanthocinus aedilis*, seasonal development, sum of positive temperatures.

I n t r o d u c t i o n . Timberman beetle (*Acanthocinus aedilis* (Linnaeus, 1758), Coleoptera: Cerambycidae) is one of the most spread longhorn beetles in the pine forests of Europe (Schroeder, 1997; Lieutier et al., 2004; Wermelinger et al., 2008), particularly in the Left-bank Ukraine (Aristova, 2014; Martynov and Pisarenko, 2003(2004); Bartenev, 2009; Meshkova et al., 2015; Skrylnyk, 2011).

Timberman beetle colonizes mainly severely weakened and drying trees (3rd and 4th categories of health condition), logs, stumps and coarse wood debris (Schroeder, 1997; Skrylnik, 2013a). Development of timberman beetle in stumps and wood debris accelerates their destruction, which is beneficial for forest ecosystem. Certain useful role of this beetle consists in eliminating bark beetles larvae in colonized trees, if their galleries intersect, though it does not help the tree to survive (Schroeder, 1997; Skrylnik, 2013a). At the same time, timberman beetle development in living trees and vectoring the pathogenic fungi (Jankowiak and Rossa, 2007) is the manifestation of physiological injuriousness that is bad for forest. Its development in logs accompanied by vectoring the blue-stain and wood-destroying fungi is the manifestation of technical injuriousness, which is

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Received 05.10.2017 **Accepted 17.11.2017 by Dr. O. G. Shatrovskiy** **Published 21.12.2017**

unwholesome for forest production (Skrylnyk, 2013b). To make decision about the optimal dates for harvesting and timber removal it is necessary to clarify the peculiarities of timberman beetle seasonal development. However, the most of publications describe the spread of timberman beetle (Martynov and Pisarenko, 2003(2004); Lieutier et al., 2004; Bartenev, 2009), only a few r of publications is devoted to its injuriousness (Skrylnyk, 2013b) while its seasonal development has not yet been fully studied, especially in the North-Eastern Steppe of Ukraine.

The aim of research was to estimate the dates of timberman beetle development, duration of different stages and respective temperature conditions in the North-Eastern Steppe of the Ukraine.

Materials and methods. Research was carried out in 2012–2016 in the stands of Scots pine (*Pinus sylvestris* L.) in the State Enterprises (SE) 'Kremenske Forest & Hunting Economy' (FHE), SE 'Stanychno-Luhanske FHE', SE 'Novoaidarske FHE', and SE 'Severodonetske FHE' of Luhansk region, in 2012–2015 in pine stands of SE 'Kupyanske Forest Enterprise (FE)' and SE 'Izyumske FE' of Kharkiv region.

Characteristics of timberman beetle seasonal development were studied both by direct registration the beetles during leaving colonized trees, pairing and colonizing of new trees or their segments, and by inspection colonized stems by dissection in different dates.

The date of the first appearance of certain insect stage was considered as the earliest date from all findings in the region. Data on daily air temperature were taken from Luhansk meteorological station (48° 35' N, 39° 20' E, Luhansk region) in 2012–2013 and Izyum meteorological station (49° 11' N, 37° 18' E, Kharkiv region) in 2014–2016. It was shown (Meshkova et al., 2015), that summer temperature for these meteorological stations has no significant differences.

The dates of phenological events for analysis were transformed to number of days from January, 1 (Meshkova, 2009).

The sums of positive temperatures have been calculated for different periods of timnberman beetle seasonal development using MS Excel application (Meshkova, 2009).

Results and discussion. The first beetles which abandoned the places of hibernation were revealed the most early on April, 7, 2016 and the most lately on April, 20, 2015, on the average on April, 13 (Table 1).

Table 1. Timberman beetle phenology (2012–2016)

Phenological events and periods	Years					Mean
	2012	2013	2014	2015	2016	
Calendar dates of certain phenological events, dd.mm						
Abandonment the places of hibernation by the beetles	08.04	11.04	17.04	20.04	07.04	13.04
Mass swarming	20.04	23.04	22.04	28.04	26.04	24.04
Larvae hatching	26.04	28.04	04.05	12.05	10.05	04.05
Pupation	06.08	10.08	15.08	22.08	09.08	12.08
Young adults emergence	22.08	25.08	01.09	09.09	25.08	29.08
Period duration, days						
From abandonment the places of hibernation by the beetles to larvae hatching	18	17	17	22	33	21
Larvae development	102	104	103	102	91	100
Pupae development	16	15	17	18	16	16
From abandonment the places of hibernation by the beetles to young adults emergence	136	136	137	142	140	138

Average daily air temperature of first adults appearance was 5.6–12.7 °C in different years (in average 10 °C) (Table 2), and the sum of positive temperatures was 96.2–292.7 °C (in average 174.8 °C) (Table 3). Due to the heterogeneity of wintering places of beetles and the corresponding microclimate, the dates of first adults' appearance varied even in one year in the same forest stand.

Mass swarming of timberman beetle was revealed in the third decade of April (April, 20–28) in all monitored years (Table 1) at 12.7–18.8 °C (Table 2). At these days the most of the deciduous trees showed foliage expansion. The sum of positive temperatures was 231.8–366.3 °C in different years (on the average 308.4 °C) (Table 3).

Adults of timberman beetle carry out both maturation and, later, renewal feeding after abandonment the places of hibernation and during all their further life. They feed not only on bark of branches of living trees but also recently cut branches. In May, mating of timberman beetles is rather active; about 4–5 pairs can be seen mating simultaneously on the felled trees in the clear-cut.

Table 2. Mean air temperature (°C) in different periods of timberman beetle development (2012–2016)

Phenological events and periods	Years					Mean
	2012	2013	2014	2015	2016	
Abandonment the places of hibernation by the beetles	11.9	5.6	8.1	12.7	11.7	10.0
Mass swarming	12.7	18.2	18.8	18.3	13.7	16.3
Larvae hatching	14.6	13.6	15.4	13.5	17.2	14.9
Pupation	30.9	26.7	31.7	17.1	24.2	26.1
Young adults emergence	23.2	25.5	16.8	25.5	19.4	22.1

Table 3. Sum of positive temperatures (°C) on the date of certain phenological events beginning in timberman beetle development or for different periods of its development (2012–2016)

Phenological events and periods	Years					Mean
	2012	2013	2014	2015	2016	
Sum of positive temperatures on the date of certain phenological event beginning, °C						
Abandonment the places of hibernation by the beetles	96.2	115.0	292.7	267.3	102.6	174.8
Mass swarming	231.8	258.5	366.3	335.1	350.2	308.4
Larvae hatching	321.1	318.3	536.7	545.7	395.3	423.4
Pupation	2,500.1	2,642.1	2,822.6	2,732.6	2,532.4	2,646.0
Young adults emergence	2,909.1	2,931.4	3,110.9	3,136.6	2,956.2	3,008.8
Sum of positive temperatures for periods, °C						
From abandonment the places of hibernation by the beetles to larvae hatching	224.9	203.3	244.0	278.4	292.7	248.7
Larvae development	2,179.0	2,323.8	2,285.9	2,186.9	2,137.1	2,222.5
Pupae development	409.0	289.3	288.3	404.0	423.8	362.9
From abandonment the places of hibernation by the beetles to young adults emergence	2812.9	2,816.4	2,818.2	2,869.3	2,853.6	2,834.1

The females oviposited into cracks and crevices of living trees in the parts of stem with rough bark. But sometimes they oviposited on the stem part with thin bark of felled trees where typical nodes are visible.

Dissection of timberman beetle galleries gave the possibility to see the earliest larvae in 2012 (on April, 26 at 14.6 °C), and the latest on May, 12, 2015 (13.5 °C). The highest air temperature at the date of first larvae hatching (17.2 °C) was registered in 2016 (Tables 1 and 2).

Dark sawdust was visible well after logs colonization by timberman beetle, especially in the part of stem with thin bark. The color of sawdust becomes light when larvae penetrate deeper into xylem before pupation (Fig. 1).

From 203.3 °C in 2013 to 292.7 °C in 2016 (on the average 248.7 °C) accumulated from abandonment the places of hibernation by the beetles to larvae hatching (Table 3).

The last larvae of timberman beetle were revealed in the second decade of August. Usually, they were in superficial wood layers. The larvae of the last instar prepared pupal chambers. They located in the bark or under the bark in the parts of stem with rough bark, and in the xylem (on the depth about 5 mm) in the parts of stem with thin bark.

Period of larvae development was on average 100 days (from 91 to 104 days) (Table 1). The first pupae were found at the beginning of August. The pupae of females were located in the depth about 1 cm, and the pupae of males were located under the bark. The air temperature was usually rather high at this period (24.2–31.7 °C) (Table 2). Only in 2015, a certain chill in the second decade of August brought to slowing down insect development.

The first adults of the new generation emerged in the third decade of August–on the beginning of September, on average on August, 29 (Table 1). At that time an air temperature was from 16.8 to 25.5 °C, on average 22.1 °C (Table 2).

Pupae developed 15–18 days in different years, on average 16 days (Table 1). They developed more quickly at higher air temperature: in 2013 developmental time was 15 days at 26.7 °C while in 2015 it was 18 days at 17.1 °C (Tables 1 and 2).

The period from coming out of hibernation to young adults emergence was 138.2 days on average (136–142 days) (Table 1). For this time 2,834.1 °C of positive temperatures have been accumulated (2,812.9–2,869.3 °C) (Table 3).

The beetles of new generation sometimes were observed gnawing thin bark of felled stems and branches (Fig. 2).

Fig. 1. Larvae of timberman beetle in pupal chamber (August, 2015).

Fig. 2. Timberman beetle (June, 2012).

The last beetles were revealed at the end of September.

Some researchers (Martynov and Pisarenko, 2003(2004); Bartenev, 2009) found adults timberman beetle during the whole summer. However in the Left-bank forest-steppe part of Kharkiv region it was shown, that timberman beetles emerge in August, then hibernate in the forest litter or under the bark, and the next spring colonize pine trees or logs. At the same time both older larvae and mother galleries were found in July, and

sometimes larvae were found in October. It's proof that the part of timberman beetle population can overwinter as larvae continuing their development the next spring, and adults of this part of population colonize the trees or logs in summer (Skrylnik, 2013a).

Because the dates of development of certain specimen of the both parts of population vary depending on microclimate in the places of overwintering inside every forest stand, it appears that timberman beetle can colonize trees and timber during the whole summer.

C o n c l u s i o n s . In the North-Eastern Steppe of Ukraine the main part of timberman beetle population hibernates as adults. These beetles come out after hibernation on April, 7–20, and colonize the trees or logs at the end of April. Larvae hatch at the end of April–at the beginning of May and pupae start to appear at the beginning of August. In total, the first adults of the new generation emerge at the end of August. Mean duration of larvae development is 100 days, mean duration of pupae development is 16 days.

This species accumulates 248.7 °C of positive temperatures on the average from way out of overwintering beetles to larvae hatching. Larvae and pupae development requires 2,222.5 °C and 362.9 °C of positive temperatures. Entire life cycle from coming out beetles after winter to emergence of young beetles accumulates 2,834.1 °C of positive temperatures in the average.

The part of timberman beetle population hibernates as larvae and continue their development the next spring. Adults of this part of population colonize the trees or logs in summer.

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