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Chromosome numbers of invasive and potentially invasive species in the flora of the Republic of Altai. III

E. Yu. Zykova*, T. V. An'kova, M. N. Lomonosova

*Federal State Institution of Science Central Siberian Botanical Garden of Siberian Branch of RAS, Zolotodolinskaya str., 101, Novosibirsk, 630090, Russian Federation. *E-mail: elena.yu.zykova@gmail.com*

** Corresponding author*

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Summary. Chromosome numbers (2*n*) in 10 invasive plant species from the families Apiaceae, Asteraceae, Brassicaceae, Caryophyllaceae, Fabaceae, Lamiaceae, Poaceae and Urticaceae are reported on the samples collected in the Republic of Altai. Among them, chromosome complements were first examined in Asian part of Russia for *Lapsana communis* (*2n* = 14). *Saponaria officinalis* (2*n* = 28) and *Lotus corniculatus* (2*n* = 24) were studied first from Siberia. Six species: *Conium maculatum* (*2n* = 22), *Bunias orientalis* (2*n* = 14), *Vicia hirsuta* (2*n* = 14), *Leonurus quinquelobatus* (2*n* = 18), *Digitaria ischaemum* (2*n* = 36) and *Setaria pumila* (2*n* = 36), were studied first from the Republic of Altai. The most studied species are diploids. General distribution and the history of floristic findings of these species in the Republic of Altai are given. Previously published data on chromosome numbers based on the material from Russia are cited.

Числа хромосом инвазивных и потенциально инвазивных видов во флоре Республики Алтай: сообщение 3

Е. Ю. Зыкова, Т. В. Анькова, М. Н. Ломоносова

Федеральное государственное бюджетное учреждение науки «Центральный сибирский ботанический сад» Сибирского отделения РАН, ул. Золотодолинская, 101, г. Новосибирск, 630090, Россия. E-mail: elena.yu.zykova@gmail.com

Ключевые слова: кариологическое изучение, расселение видов, Apiaceae, Asteraceae, Brassicaceae, Caryophyllaceae, Fabaceae, Lamiaceae, Poaceae, Urticaceae.

Аннотация. Приводятся данные о числах хромосом (2*n*) для 10 инвазивных видов из семейств Apiaceae, Asteraceae, Brassicaceae, Caryophyllaceae, Fabaceae, Lamiaceae, Poaceae, Urticaceae, полученные на материале из Республики Алтай. Впервые для Азиатской части России определено число хромосом у *Lapsana communis* (*2n* = 14), впервые для Сибири – у *Saponaria officinalis* (2*n* = 28) и *Lotus corniculatus* (2*n* = 24), впервые для Республики Алтай – у *Conium maculatum* (*2n* = 22), *Bunias orientalis* (2*n* = 14), *Vicia hirsuta* (2*n* = 14), *Leonurus quinquelobatus* (2*n* = 18), *Digitaria ischaemum* (2*n* = 36), *Setaria pumila* (2*n* = 36). Большинство изученных видов являются диплоидами. Для всех исследованных видов приводятся сведения по общему распространению, истории флористических находок и расселению на территории Республики Алтай, а также литературные данные по числам хромосом, опубликованные на материале с территории России.

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We continue the karyological study of invasive and potentially invasive species in the flora of Southern Siberia on the example of the Republic of Altai (Lomonosova et al., 2018; Zykova et al., 2018), one of the most visited regions of Siberia. The growth of tourist flow followed by the increase of disturbed natural habitats contribute to introduction of a significant number of diasporas of alien plants. It is important to trace whether invasive species form new cytological races under new conditions. This paper provides an information about 10 species that are most active in the republic, seven of which are included in the list of invasive or potentially invasive species of Siberia (Ebel et al., 2014).

The information on the history of floristic studies of examined species in the territory of the Republic of Altai is provided here. For all species, the references on chromosome numbers revealed from the samples collected in Russia are given as well, while relevant information in the international databases "The Chromosome Counts Database" (Rice et al., 2015) and "Index to Plant Chromosome Numbers" (Goldblatt, Johnson, 1979+) is reflected incompletely.

The chromosome numbers were determined by direct count in metaphase on squash preparations of root meristem. Seeds were germinated at 25 °C (day) and 16 °C (night) on sterile sand. The root tips were pretreated for two hours with 0.2 % colchicine water solution, fixed in 3 : 1 absolute ethanol-glacial acetic acid and stained with 1 % acetic hematoxylin. Metaphase plates were observed under 100× magnification by the Axioscope 40 (Karl Zeiss, Axio Lab) and photographed by the AxiCam MRc 5 digital camera. The herbarium specimens (vouchers) are deposited in the Herbarium of the Central Siberian Botanical Garden SB RAS (NS). For species marked with an asterisk (*), the chromosome number was determined in Siberia for the first time.

APIACEAE

Conium maculatum L., **2*n* = 22**

"Russian Federation, the Republic of Altai, Mayma district, vicinity of Rybalka village, wasteland at a construction site, 51°55′N, 85°51′E. 2 VIII 2015. E. Zykova", Z429–3315 (Fig. 1A); "Russian Federation, the Republic of Altai, Choya district, vicinity of Sugul village, gravel roadside, 52°03′N, 86°15′E. 07 VIII 2015. E. Zykova", Z427–3615.

Biennial. Eurasian species growing in most regions of Siberia (Ebel et al., 2014). The first records in the republic date back to 1980s (Rostovtseva, 1976; Nikiforov, 1989). At present, it is common in northern regions though registers in the central parts of the republic (Zykova, 2015). Main habitats are courtyards, along the banks of water bodies, vegetable gardens, landfills and deposits.

The same chromosome number has been previously reported for the Republic of Crimea (Rostovtseva, 1982) and Novosibirsk Region (Krasnikov, Lomonosova, 1990; Krivenko et al., 2013). Ploidy set n = 11 was determined from the Turochak District of the Republic of Altai (Rostovtseva, 1976).

Diploid (2x), x = 11.

ASTERACEAE

****Lapsana communis*** L., **2*n* = 14**

"Russian Federation, the Republic of Altai, Gorno-Altaysk city, Shosseynaya street, wasteland, 51°58′N, 85°55′E. 22 VIII 2017. E. Zykova", Z611–6717 (Fig. 1B).

Annual. Euro-Mediterranean species with a Holarctic secondary range. Known in most regions of Southern Siberia (Ebel et al., 2014). Until recently, only three localities were known in the territory of the republic: Ust-Kan village (Krylov, 1904), the vicinity of Manzherok village and the city of Gorno-Altaysk (Zykova, 2012). In recent years, it has been very actively settling in the city of Gorno-Altaysk, abundant along the banks of the Mayma River (Zykova et al., 2019).

The number of chromosomes was first determined for the Asian part of Russia. The same chromosome complement has been published earlier from the Republic of Karelia and the Leningrad Region (Probatova et al., 2009), the Republic of North Ossetia-Alania (Probatova, Seledets, 2008), and Krasnodar Territory (Probatova et al., 2013a).

Diploid (2x), x = 7.

BRASSICACEAE

Bunias orientalis L., **2*n* = 14**

"Russian Federation, the Republic of Altai, Gorno-Altaysk city, surroundings of the stadium Spartak, pebble banks of the Mayma river, 51°954939′N, 85°952793′E. 29 VIII 2018. E. Zykova", Z694–3018 (Fig. 1C).

Biennial or perennial herb. Eurasian species, widely distributed over Siberian regions (Ebel et al., 2014). Since the mid-20th century, it has been observed in the territory of the republic as weedy in cultivated fields of Northern Altai (Kuminova, 1960). It is possible that the species could penetrate the territory of the republic at a much earlier period. Thus, the fruits of *Bunias orientalis* were identified during the study of paleocarpological material of a

burial mound of the Chinet II burial ground (Altai Territory) dating from the 4th century to the 3rd century BC (Dashkovskiy et al., 2014). However, despite the proximity of the territories, we cannot reliably confirm the species invasion in the same period into this territory. In the Republic of Altai, it is currently one of the most widespread species, common in the northern regions and penetrating to the central ones (Zykova, 2015). It was also found in the southeast (Ebel, 1997).

This chromosome number confirms earlier counts from Irkutsk Region (Chepinoga, 2014, and references therein) and Primorye Territory (Probatova, 2014, and references therein). The same number is typical for most definitions (Goldblatt, Johnson, 1979+; Rice et al., 2015). Indications of $2n = 28$ (Lövkvist, Hultgård, 1999) and $2n = 42$ (Jaretzky, 1928) were later questioned (Greilhuber, Obermayer, 1999).

Diploid ($2x$), $x = 7$.

CARYOPHYLLACEAE

Saponaria officinalis L. **$2n = 28$**

"Russian Federation, the Republic of Altai, Gorno-Altaysk city, Sportivnyy lane, wasteland, 51°58′N, 85°55′E. 18 VIII 2017. E. Zykova", Z325–6217 (Fig. 1D).

Perennial herb. Species is native in Europe and West Asia, spreads over the Holarctic including Siberia (Ebel et al., 2014). In the Republic of Altai, this species withdrawal from culture was recorded in the 2010s. (Shaulo et al., 2010). Presently, it is common in landfills, wastelands, often forming thickets in Gorno-Altaysk and the Mayma District. Later, it was found in the Turochak and Ulagan Districts (Zolotukhin, 2012; Zykova, 2015).

The chromosome number is determined first on Siberian material. The same data were obtained from Primorye Territory (Probatova, 2014 and references therein).

Diploid ($2x$), $x = 14$.

FABACEAE

Lotus corniculatus L. s. l., **$2n = 24$**

"Russian Federation, the Republic of Altai, Mayma District, vicinity of Kysyl-Ozek village, quarry at a closed landfill, 51°58′N, 85°55′E. 15 VIII 2018. E. Zykova", Z677–2418a; "Russian Federation, the Republic of Altai, Gorno-Altaysk city, surroundings of the stadium Spartak, pebble banks of the Mayma river, 51°954939′N, 85°952793′E. 29 VIII 2018. E. Zykova", Z679–3018 (Fig. 1E).

Perennial herb. European-Caucasian-Central Asian species. Over the past two decades, it has penetrated into Western Siberia often acting as a dominant (Ebel et al., 2014). Outside of culture, it was first recorded in Mayma District in 1997 (Zykova, 2014). At present, it is active in this district and in Gorno-Altaysk, forms extended thickets along the banks, on wastelands, along roads. Recently discovered in Choya District (Zykova et al., 2019).

This is the first chromosome count in Siberian population, which agrees with the data reported for Primorye Territory (Probatova, 2014 and references therein), the Republic of North Ossetia – Alania (Efimov, 1998), European part of Russia (Kramina, 1999).

Tetraploid ($4x$), $x = 6$.

Vicia hirsuta (L.) Gray, **$2n = 14$**

"Russian Federation, the Republic of Altai, Mayma District, vicinity of Mayma village, along country roads, 52°02′N, 85°54′E. 12 VIII 2017. E. Zykova", Z385–5017 (Fig. 1F).

Annual. The European-Mediterranean species, which has spread throughout the globe including Siberia (Ebel et al., 2014). First record in the Republic of Altai was made in 2010 (Zykova, 2012). Now it is common in Mayma District and in the city of Gorno-Altaysk, penetrating Chemal District (Zykova, 2015). The plants grow along the roads and embankments, in cultivated fields and deposits, invading meadows as well.

This chromosome number confirms earlier counts from Irkutsk Region (Chepinoga, 2014, and references therein), Primorye Territory (Probatova, 2014, and references therein), Khabarovsk Territory (Probatova et al., 2011), and the Republic of Ingushetia (Efimov, 1987).

Diploid ($2x$), $x = 7$.

LAMIACEAE

Leonurus quinquelobatus Gilib., *L. cardiaca* auct. non L.: Krylov, 1937, Flora of Western Siberia, 9: 2357, **$2n = 18$**

"Russian Federation, the Republic of Altai, Gorno-Altaysk city, Kosmonavtov street, by the fences, along the roads, 51°58′N, 85°55′E. 25 VIII 2017. E. Zykova", Z397–7017; "Altai Territory, Sovetskoye District, the village of Shulgin Log, along the streets, along the road, 52°11′N, 85°50′E. 01 VIII 2015. E. Zykova", Z527–3215 (Fig. 1G).

Perennial herb. The European-West Asian species penetrated into Siberia and the Far East (Ebel et al., 2014). The first locality in the republic was mentioned for the village of Anos of Chemal District (Krylov, 1937), by the end of the 20th century it was also known in the village of Rybalka in Mayma

District (Krestovskaya, 1997) and in the village of Uymen of Choya District (Silantieva, 1994). Now it is one of the most widespread species in disturbed habitats in the northern regions of the republic.

This chromosome number confirms earlier counts from Novosibirsk Region (Krasnikov, 1991), Krasnoyarsk Territory (Stepanov, Muratova, 1995), and Sakhalin Region (Probatova et al., 2017).

Diploid (2*x*), *x* = 9.

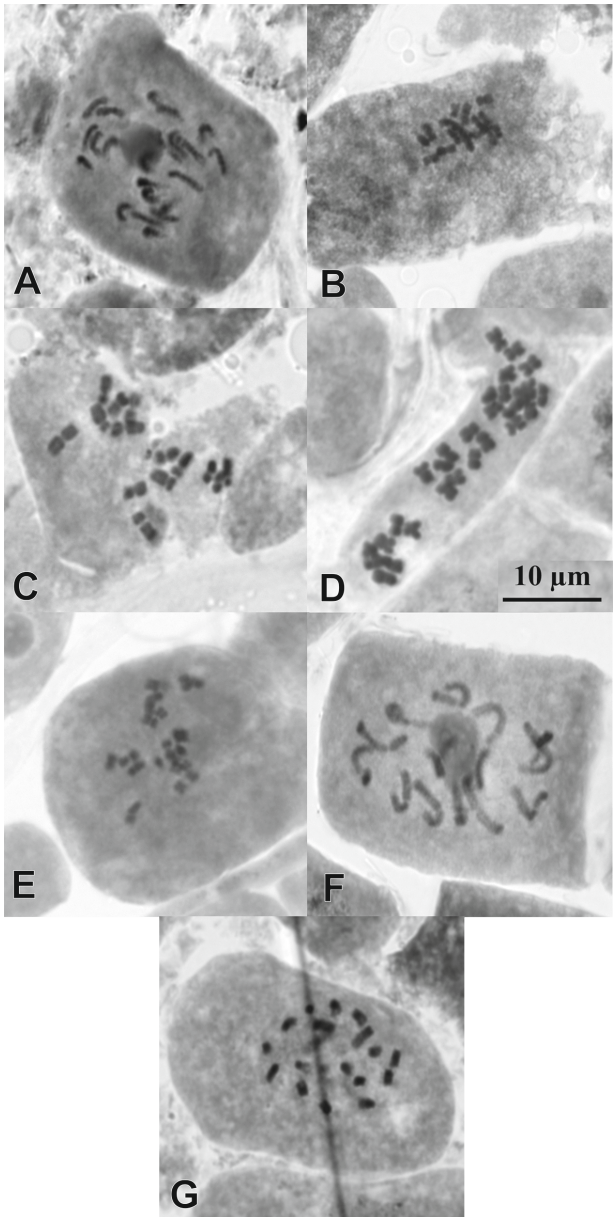

Fig. 1. Mitotic metaphase and late prophase of some invasive species: **A** – *Conium maculatum*, 2*n* = 22; **B** – *Lapsana communis*, 2*n* = 14; **C** – *Bunias orientalis*, 2*n* = 14; **D** – *Saponaria officinalis,* 2*n* = 28; **E** – *Lotus corniculatus*, 2*n* = 24; **F** – *Vicia hirsuta*, 2*n* = 14; **G** – *Leonurus quinquelobatus*, 2*n* = 18. Scale = 10 µm.

POACEAE

Digitaria ischaemum (Schreb.) Muehl., **2*n* = 36**

"Russian Federation, the Republic of Altai, Turochak District, Iogach village, stadium, 51°46′N, 87°15′E. 15 VIII 2017. E. Zykova", Z456–5517.

Annual. As alien, this Palaearctic species is almost cosmopolitan though rare in Siberia. In the Altai Republic, the first locations were recorded at the beginning of the 20th century in Mayma and Chemal Districts (Krylov, 1928). Now it is found in Gorno-Altaysk, Onguday and Turochak Districts (Zykova, 2015) occuring on gravel substrates: roadsides, stadiums, and on sites trampled and overgrazed by cattle. According to our observations, it is a potentially invasive species in the Republic of Altai.

This chromosome number confirms earlier counts from the Primorye Territory (Probatova, 2014, and references therein), Volgograd Region (Probatova et al., 2008), the Republic of Buryatia (Probatova et al., 2016). 2*n* = 18 was determined from Khabarovsk Territory (Probatova et al., 1996).

Tetraploid (4*x*), *x* = 9.

Setaria pumila (Poir.) Roem. et Schult., **2*n* = 36**

"Russian Federation, the Republic of Altai, Gorno-Altaysk city, Naberezhnyy lane, weedy on flowerbeds and by fences, 51°58′N, 85°55′E. 11 VIII 2017. E. Zykova", Z495–4717.

Annual. A species with a wide Eurasian-American range. In the territory of the Republic of Altai, isolated locations were recorded at the beginning of the 20th century in Chemal District (Krylov, 1928). Now it is an ubiquitous anthropophilic species in northern and central districts of the republic.

This chromosome number confirms earlier counts from Irkutsk Region (Chepinoga, 2014, and references therein), the Republic of Buryatia (Probatova et al., 2015), Primorye Territory (Probatova, 2014, and references therein), Krasnodar Territory (Probatova et al., 2009, 2014b, 2015), Volgograd Region (Probatova et al., 2013b), and Amur Region (Probatova et al., 2014a). 2*n* = 18 was determined from Amur Region (Probatova et al., 2013b) as well.

Tetraploid (4*x*), *x* = 9.

URTICACEAE

Urtica urens L., **2*n* = 24**

"Russian Federation, the Republic of Altai, Mayma District, Podgornoye village, wasteland, 52°01′N, 85°53′E. 24 VI 2017. E. Zykova", Z361–1417.

Annual. European species with a cosmopolitan secondary range. The first locations in Altai were recorded at the beginning of the 20th century (Krylov, 1930). Currently distributed in northern, western and central regions of the republic (Zykova, 2015) growing in courtyards, cultivated fields, preferably on loose, moist soils.

We determined earlier the same chromosome number from one of the central regions (An'kova, Zykova, 2018). These are the first data from the northern region of the Republic of Altai. The same chromosome number is indicated for most parts of Europe (Rice et al., 2015). Other data were obtaimed from the material from Russia: $2n = 24–25$ for Primorye Territory and $2n = 26$ for Murmansk Region (Geltman, 1984).

Diploid ($2x$), $x = 12$.

Conclusion

Chromosome numbers of 39 invasive species distributed in the Republic of Altai were examined. The data for 10 species is represented in this study. Among them, chromosome complements were examined on the material from the Asian part of Russia for *Lapsana communis* for the first time. *Saponaria officinalis* and *Lotus corniculatus* were studied first on the material from Siberia. Chromosome numbers for *Conium maculatum*, *Bunias orientalis*, *Vicia hirsuta*, *Leonurus quinquelobatus*, *Digitaria ischaemum* and *Setaria pumila* were first investigated in the Republic of Altai. The most of the studied invasive species are diploids. Polyploids *Lotus corniculatus* and *Digitaria ischaemum* have begun to exhibit invasive properties during the last 5 years. The polyploid *Setaria pumila*, apparently an archaeophyte, has spread very widely and is one of the most common species in human-disturbed habitats.

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