



## Traits of the pollination process in *Gladiolus imbricatus* and *Iris sibirica* (Iridaceae)

Krystyna SKRYPEC\* , Lydia TASENKEVICH 

Ivan Franko National University of Lviv, 4 Hrushevsky Str., Lviv 79005, Ukraine

**Abstract.** Results of a study of self-pollination in two of Ukrainian flora's threatened species, *Gladiolus imbricatus* and *Iris sibirica* (Iridaceae), are presented. To confirm or refute the occurrence of self-pollination in *G. imbricatus* and *I. sibirica*, an experiment was conducted on pollen germination on their stigmas. It has been found that in *G. imbricatus* pollination with autogenous pollen grains on the last day of flowering leads to the growth of pollen tubes in the cases of both hand and natural pollination. However, pollen grains on the stigma of an isolated *I. sibirica* flower were not detected on the first or last day of flowering, which means the absence of a mechanism of autonomous pollen transfer within the meranthium. Ungerminated pollen grains were also found on the stigma after autogenous hand pollination. It has been experimentally confirmed that in the absence of pollinators at the end of the flowering phase in *G. imbricatus*, as well as in some other members of the genus, self-pollination and self-fertilization are possible, which contribute to the well-being of populations and species. With regard to *I. sibirica*, it has been found that the autogamous self-incompatibility inherent in this species prevents inbreeding, maintaining heterozygosity in plant populations, allowing plants' better adaptation to different environmental conditions.

**Keywords:** *Gladiolus imbricatus*, *Iris sibirica*, pollen grains, pollen tubes, pollination, self-incompatibility, self-pollination, threatened species

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\*Corresponding author e-mail: [krustysja-skrypec@ukr.net](mailto:krustysja-skrypec@ukr.net)

### Introduction

The pollination process is the subject of a number of disciplines, such as botany, ecology, zoology, horticulture and agriculture. The study of pollination processes, in particular the ability to self-pollinate in the family Iridaceae Juss., is of great interest to researchers and these processes are best studied in members of the family from South Africa, which is the center of diversity of genera and species of Iridaceae (Tzvelev, 1979; Goldblatt, Manning, 2021). Wragg and Johnson (2009) confirmed the presence of self-pollination in one of the members of the genus *Gladiolus* from South Africa, *Gladiolus inandensis* Baker. Besides, the authors draw attention to the fact that much shorter pollen tubes and a small number of fruits are formed in this species after self-pollination.

It is also known that some North American *Iris* species have the ability to self-pollinate: *Iris douglasiana* Herb. (Uno, 1979), *I. lacustris* Nutt. (Planisek, 1983), *I. versicolor* L. (Kron et al., 1993; Zink, Wheelwright, 1997), and *I. cristata* Aiton (Hannan, Orick, 2000). Most Mediterranean species of the genus *Iris* are characterized by self-incompatibility (Tucić et al., 1989; Arafeh et al., 2002; Sapir et al., 2006; Imbert et al., 2014; Pellegrino, 2015). Among them, *Iris pumila* L., a Mediterranean species present in the Ukrainian flora, is also known to be self-incompatible (Tucić et al., 1989). However, for most of the irises present in the flora of Ukraine, the ability and mechanisms of self-pollination remain unknown.

The flora of Ukraine contains ca. 35 species and subspecies of the family Iridaceae (Mosyakin, Fedoronchuk, 1999), among them there are five species of *Gladiolus* and 14 species and two subspecies of

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*Iris*. To study the pollination processes, one member from each of these two genera was selected: vulnerable species, according to the *Red Data Book of Ukraine* (Red..., 2009), *Gladiolus imbricatus* L. and *Iris sibirica* L.

The range of *Gladiolus imbricatus* is quite wide; it covers Central and Eastern Europe, the Balkans, the Mediterranean region, Turkey, the Caucasus, and Western Siberia (POWO, 2022; Meusel et al., 1965). Its typical habitats are wet well-drained meadows on rich soils. The species is protected and listed, mostly as Vulnerable, in Red books and Red lists in several European countries: Belarus (Semerenko, Morozova, 2005), the Czech Republic (Pladias..., 2021), Estonia and Latvia (Kose et al., 2019; Red..., 1995), Moldova (Postolache, 2015), France, Hungary, and Switzerland (Kostrakiewicz-Gierałt et al., 2018).

*Iris sibirica* is native to Europe and parts of Asia; it occurs on wet meadows in France, in the north of Italy, in Switzerland, Austria, the Czech Republic, Slovakia, Germany, Hungary, Poland, Romania, Bulgaria, the countries of former Yugoslavia, in the north of Turkey, in Belarus, Estonia, Latvia, Lithuania, Moldova, Ukraine, the European part of the Russian Federation, Armenia, Azerbaijan, northwestern Kazakhstan, and the southwest of Western Siberia (Doronkin, 1987; Tzvelev, 1979; Webb, 1980).

The conservation status of *I. sibirica* differs in various parts of its range. In Switzerland and Croatia, the species is considered in the IUCN category Vulnerable (VU) (Moser et al., 2002; Nikoli, Topi, 2005). In countries neighboring Ukraine, in particular, in Poland and Slovakia, the species is also considered to be Vulnerable (VU) (Mitka et al., 2008; Turis et al., 2014), in Belarus – Potentially Vulnerable (category IV) (Morozova, 2005), in Hungary – Endangered (EN) (Takács et al., 2015), in Lithuania and Latvia – Vulnerable (VU) (Red..., 1995; Patalauskaitė, 2021). *Iris sibirica* is also listed in the *IUCN Red List* with the category Near Threatened (NT) within its whole geographic range (Khela, 2013).

For species of the genus *Gladiolus*, the possibility of self-pollination on the last day of flowering is known. However, there is no such data for taxa of the genus *Iris* (Tzvelev, 1979). According to other published data (Goldblatt et al., 2001; Goldblatt, Manning, 2006), the species of both genera (*Gladiolus* and *Iris*), are characterized by physiological incompatibility; therefore, the effectiveness of indigenously pollination (autogamy and geitonogamy) requires a special study to determine its significance in the reproductive processes.

From previously obtained data it is known that the main pollinator in both species is the honey bee *Apis mellifera* Linnaeus (Odintsova, Skrypec, 2014; Skrypec, 2020).

It also turned out that both species have certain morphological adaptations to self-pollination: the stamens and receptacles became closer to each other on the last day of flowering in *Gladiolus imbricatus* (Skrypec, Odintsova, 2014), and stigmas curl down and sometimes contact the anthers with the beginning of flower wilting in *I. sibirica* (Odintsova, Skrypec, 2014), just as it was observed by Kron with co-authors in *I. versicolor* (Kron et al., 1993).

The objective of further research was to determine experimentally the ability of autogenous and xenogenous pollen of these species to germinate in the receptive stigma at different times during the flowering period. This will help to clarify the question of the occurrence and effectiveness of different types of pollination in the species under study.

## Material and Methods

The study of the germination of pollen grains on stigma was carried out according to the method proposed for *Amborella trichopoda* Baill. (Williams, 2009), modified for *G. imbricatus* and *I. sibirica* at the Botanical Garden of Ivan Franko National University of Lviv. The experiment was performed based on previously obtained data, which revealed the period and mechanisms of flowering. In particular, it was revealed that the flowering of *G. imbricatus* lasts four days, and that of *I. sibirica*, only two days (Odintsova, Skrypec, 2014, Skrypec, Odintsova, 2014). The research was conducted on 20 flowers from 20 individuals in sunny weather. The flowers were marked at the budding stage for both species in model populations: *G. imbricatus* – from village Kostryno, Zakarpattia (Transcarpathian) Region, Uzhansky National Nature Park, *I. sibirica* – from village Naditychi, Lviv Region, Botanical Reservation of National Importance "Valley of Irises". Before opening, the flowers were isolated with a plastic mesh cover. Anthers in each experimental flower were excised. When the flower opened, it was hand pollinated with autogenous (own pollen) and xenogenous (cross pollen) on the first and last day of flowering. Transfer of pollen to the receptive stigma (in the evening of the first day of flowering) was carried out with a needle from the anthers of the studied flower in autogamy, and from

the flowers of another individual – in xenogeny. After pollination of the flowers, the stigmas were cut off at different time intervals determined experimentally: after 5, 15, and 30 minutes, 1 hour, 3, 6, 12, and 24 hours, and fixed for 24 hours in acetic alcohol (3 : 1), then stored in 70% ethanol. The prepared stigmas were stained with 0.1% methylene blue and examined under a light microscope.

To study natural pollination, we took two types of flowers: the first – not isolated emasculated flowers, and the second – isolated flowers with anthers. After 6 hours their stigmas were fixed, stained and examined under a light microscope just as in the case with hand pollination. The length of the pollen tubes was measured using a Bresser PC-eyepiece VGA 640x480. Statistical data processing was performed using Microsoft Excel 2010.

## Results

When pollinating flowers with autogenous pollen on the first day of flowering, we did not find germinated pollen grains on the stigmas during the entire study period (from five minutes to 24 hours) in both species (Figure 1A, D, Table 1).

In pollinated with xenogenous pollen on the first day of flowering we observed the initial germination of pollen and the appearance of single short pollen tubes 30 minutes after pollination in *G. imbricatus* (Table 2, Figure 1B). In *I. sibirica*, the germination of xenogenous pollen was observed only three hours after pollination (Table 2, Figure 1E).

A similar study was conducted on the last day of both species' flowering. *G. imbricatus* flowers were pollinated with autogenous pollen on the third day of flowering (in the afternoon) and a large number of germinated pollen grains with long pollen tubes were observed after 6 hours (Fig. 1C).

*Iris sibirica* flowers were pollinated by autogenous pollen (before the noon) on the second day (the last day) of flowering, and ungerminated pollen grains without germinated pollen tubes were observed 6 hours after the pollination (Fig. 1F).

In the second part of the experiment, the study of pollen germination after natural pollination in emasculated and intact flowers, in which geitonogamy was prevented in various ways, was carried out. On the first day of flowering in non-isolated emasculated flowers, pollen grains were observed on the stigmas in both species, indicating the receptive state of the stigmas.

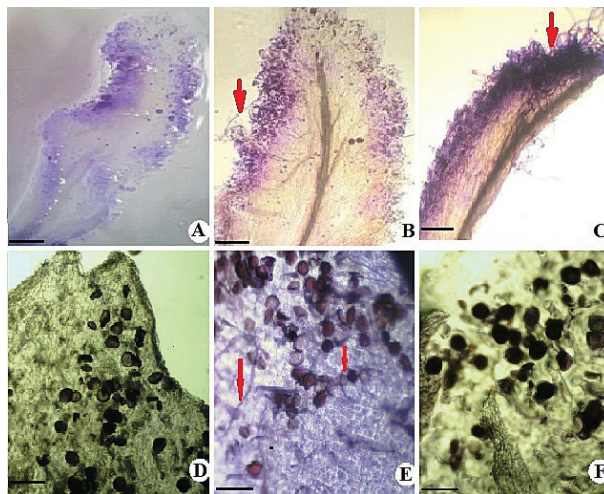


Fig. 1. Germination of pollen grains on the *Gladiolus imbricatus* (A, B, C) and *Iris sibirica* (D, E, F) stigma: autogenous pollen on the first day (A: *G. imbricatus*; D: *I. sibirica*), xenogenous pollen on the first day (B: *G. imbricatus*; E: *I. sibirica*), autogenous pollen on the last day of flowering (C: *G. imbricatus*; F: *I. sibirica*) (pollen tubes are marked with red arrows). Ruler of 100 microns

On the last day of flowering, a large amount of pollen with long pollen tubes was found on the stigmas. Therefore, it can be recognized that during the flowering period the flowers of the studied species are intensively visited by insects, which provide natural xenogenic pollination by entomophily.

On the first day of flowering no pollen grains were found on the stigmas of *G. imbricatus* isolated flowers with intact anthers, which mean the absence of self-pollination. However, on the last day of flowering, germinated pollen grains with long pollen tubes were detected at the *G. imbricatus* stigmas, confirming the species' ability to self-pollinate within the flower (autogamy) by anthers' and stigmas' contacts at the end of flowering. It occurs when the column elongates and leans toward the anthers, causing the style to be placed between the anthers. The anther sacs open completely and the pollen grains fall on the receiving surface of the stigma.

Pollens on the stigma of an isolated flower of *I. sibirica* were not detected on the first or last day of flowering, which means the absence of a mechanism of natural self-pollination (Table 1). After 24 h in artificial pollination the pollen tubes on the receiver of *G. imbricatus* are on average 480  $\mu\text{m}$  long, i.e. slightly less than the length of the pollen tubes of *I. sibirica*, which reaches 568  $\mu\text{m}$ .

Table 1. Germination of pollen grains on the stigmas of *Gladiolus imbricatus* and *Iris sibirica*

Pollination conditions	<i>G. imbricatus</i>	<i>I. sibirica</i>
<b>Hand pollination</b>		
Pollination by autogenous pollen on the first day of flowering	–	–
Pollination by xenogenous pollen on the first day of flowering	+	+
Pollination by autogenous pollen on the last day of flowering	+	–
<b>Natural pollination</b>		
Autogenous pollen (isolated flowers with anthers), the first day of flowering	–	–
Xenogenous pollen (not isolated emasculated flowers), the first day / last day of flowering	+/+	+/+
Autogenous pollen (isolated flowers with anthers), the last day of flowering	+	–

(+) – the presence of germinated pollen grains on the stigma; (–) – no germinated pollen grains on the stigma.

Table 2. The length of pollen tubes on the stigma after hand pollination of *Gladiolus imbricatus* and *Iris sibirica*

Interval from the beginning of pollination	Length of pollen tubes, $\mu$	
	<i>G. imbricatus</i>	<i>I. sibirica</i>
	Average value	Average value
30 minutes	18 $\pm$ 0,01	–
1 hour	44 $\pm$ 0,02	–
3 hours	88 $\pm$ 0,1	14 $\pm$ 0,01
6 hours	176 $\pm$ 0,01	100 $\pm$ 0,04
12 hours	360 $\pm$ 0,01	352 $\pm$ 0,2
24 hours	480 $\pm$ 0,01	568 $\pm$ 0,05

## Discussion

The mechanism of *G. imbricatus* flowering was described in detail in an earlier publication (Skrypec, Odintsova, 2014). It was noted that at the beginning of *G. imbricatus* flowering the herkogamy (spatial separation of stamens and stigma) is observed, but at the end of flowering it disappears and there is a convergence of anthers and stigmas (Skrypec, Odintsova, 2014; Scrypec et al., 2020). This indicates that self-pollination is inherent in *G. imbricatus* at the end of the flowering period. As a result of an experiment on pollen germination at the stigma, we found that pollination with autogenous pollen on the last day of flowering leads to the growth of pollen tubes in hand and natural pollination, which confirms the ability of *G. imbricatus* to self-pollinate within the flower (with autogenous pollen).

The flower of *I. sibirica* consists of three separate zygomorphic two-lipped units, meranthia (singular: meranthium). According to Burova (1970), *I. sibirica* in bad weather is capable of self-pollination within a meranthium, but in our studies, contact self-pollination did not occur even in rainy weather, because the anthers and the stigma have never been in contact. Troitsky (1948) also argued that *I. sibirica* flowers still have an adaptation to self-pollination. To confirm or deny the existence of this phenomenon, we performed an experiment and observed that autogenous pollens on the

stigma of an isolated *I. sibirica* flower were not detected on the first or last day of flowering, which means that there is no mechanism of autonomous pollen transfer within a meranthium. Ungerminated pollen were also found on the stigma after hand autogenous pollination, which indicates sporophytic self-incompatibility. In addition, *I. sibirica* has a clonal population structure, and this leads to an increase in the frequency of inbreeding, which may be one of the reasons for the decrease in the adaptability of this species. Our data on the self-incompatibility of *I. sibirica* are consistent with those of Szöllösi et al. (2011).

## Conclusions

The experiment confirmed that the herkogamy in *G. imbricatus* disappears at the last phase of flowering, and self-pollination (contact autogamy) happens.

Sporophytic self-incompatibility, which prevents fertilization after successful pollen transfer within the flower, individual and clone, has been experimentally confirmed for *I. sibirica*.

When hand pollinated with xenogenous pollen on the first day of flowering, pollen tubes germinate in 30 minutes in *G. imbricatus*, and after three hours in *I. sibirica*.

Since the members of the genera *Gladiolus* and *Iris*, including *G. imbricatus* and *I. sibirica*, are highly ornamental and are widely used in floriculture (Goldblatt, Manning, 1998; Komarnicki, 2016), the data presented on the specifics of pollination in both species can be important for using in selecting new breeds or improvement of known cultivated varieties, and for development of measures for protection of these useful very ornamental and endangered species of the Ukrainian flora.

## ORCID

K. Skrypec:  <https://orcid.org/0000-0003-4833-1653>

L. Tassenkevich:  <https://orcid.org/0000-0001-9348-1218>

## References

- Arafeh R.M.H., Sapir Y., Shmida A., Iraki N., Fragman O., Comes H.P. 2002. Patterns of genetic and phenotypic variation in *Iris haynei* and *I. atrofusca* (*Iris* sect. *Onocyclus* = the royal Irises) along an ecogeographical gradient in Israel and the West Bank. *Molecular Ecology*, 11: 39–53.
- Burova E.A. 1970. Autogamy in Irises. *Botanicheskiy Zhurnal*, 55(9): 1344–1348. [Бурова Э.А. 1970. Автогамия у ирисов. *Ботанический журнал*, 55(9): 1344–1348].
- Doronkin V.M. 1987. Family *Iridaceae*. In: *Flora of Siberia*. Vol. 4. *Araceae–Orchidaceae*. Novosibirsk: Nauka, pp. 114–124. [Доронкин В.М. 1987. Семейство *Iridaceae* – Касагииковые. *Флора Сибири*. Т. 4. *Araceae–Orchidaceae*. Новосибирск: Наука, с. 114–124].
- Goldblatt P., Manning J. 1998. *Gladiolus in Southern Africa*. Cape Town: Fernwood Press, 320 pp.
- Goldblatt P., Manning J. 2006. Radiation of pollination systems in the *Iridaceae* of sub-Saharan Africa. *Annals of Botany*, 97(3): 317–344. <https://doi.org/10.1093/aob/mcj040>
- Goldblatt P., Manning J. 2021. *Iridaceae of Southern Africa* [*Strelitzia*, vol. 42]. Pretoria: South African National Biodiversity Institute (SANBI Publishing), 1159 pp. Available at: [http://opus.sanbi.org/bitstream/20.500.12143/7671/1/2020\\_Strelitzia42\\_SANBI.pdf](http://opus.sanbi.org/bitstream/20.500.12143/7671/1/2020_Strelitzia42_SANBI.pdf)
- Goldblatt P., Manning J.C., Bernhardt P. 2001. Radiation of pollination systems in *Gladiolus* (*Iridaceae: Crocoideae*) in southern Africa. *Annals of the Missouri Botanical Garden*, 88: 713–734. <https://doi.org/10.2307/3298641>
- Hannan G.L., Orick M.W. 2000. Isozyme diversity in *Iris cristata* and the threatened glacial endemic *I. lacustris* (*Iridaceae*). *American Journal of Botany*, 87: 293–301.
- Imbert E., Wang H., Anderson B., Hervouet B., Talavera M., Schatz B. 2014. Reproductive biology and colour polymorphism in the food-deceptive *Iris lutescens* (*Iridaceae*). *Acta Botanica Gallica: Botany Letters*, 161(2): 117–127. <https://doi.org/10.1080/12538078.2014.895419>
- Khela S. 2013. *Iris sibirica*. In: *The IUCN Red List of Threatened Species 2013*. Available at: <https://www.iucnredlist.org/species/203236/2762502> (Accessed 15 November 2021).
- Komarnicki L. 2016. *Piękno irysów (Beauty of irises)*. Rzeszów: Bolestraszyce, 256 pp.
- Kose M., Liira J., Tali K. 2019. Long-term effect of different management regimes on the survival and population structure of *Gladiolus imbricatus* in Estonian coastal meadows. *Global Ecology and Conservation*, 20: e00761. <https://doi.org/10.1016/j.gecco.2019.e00761>
- Kostrakiewicz-Gierałt K., Palici C.C., Stachurska-Swakoń A., Nedeff V., Sandu I. 2018. The causes of disappearance of sword lily *Gladiolus imbricatus* L. from natural stands – synthesis of current state of knowledge. *International Journal of Conservation Science*, 9(4): 821–834.
- Kron P., Stewart S.C., Back A. 1993. Self-compatibility, autonomous self-pollination, and insect-mediated pollination in the clonal species *Iris versicolor*. *Canadian Journal of Botany*, 71: 1503–1509. <https://doi.org/10.1139/b93-182>
- Meusel H., Jäger E., Weinert E. 1965. *Vergleichende Chorologie der Zentraleuropäischen Flora*. Vol. 1. Jena: Gustav Fischer Verlag, 583 pp.
- Mitka J., Oklejewicz K., Szewczyk M., Pawelec J. 2008. Kosaciec syberyjski *Iris sibirica*. In: *Czerwona Księga Karpat Polskich (The Red Book of the Polish Carpathians)*. Ed. Z. Mirek, H. Piękoś-Mirkowa. Kraków: Rośliny naczyniowe. Instytut Botaniki im. W. Szafera PAN, pp. 436–438.
- Morozova T.K. 2005. *Iris sibirica*. In: *Red Book of the Republic of Belarus: Rare and endangered species of wild plants*. Ed. G.P. Pashkov. Minsk: BelEn, pp. 222–224. [Морозова Т.К. *Iris sibirica*. В кн.: *Красная книга Республики Беларусь: Редкие и находящиеся под угрозой исчезновения виды дикорастущих растений*. Ред. Г.П. Пашков, Минск: БелЭн, 2005, с. 222–224].
- Moser D., Gyğax A., Bäumler B., Wyler N., Palese R. 2002. Liste rouge des fougères et plantes à fleurs menacées de Suisse. Berne: Office fédéral de l'environnement, des forêts et du paysage, Chambésy: Centre du réseau suisse de floristique, and the Conservatoire et Jardin botaniques de la Ville de Genève, pp. 118.
- Mosyakin S.L., Fedoronchuk M.M. 1999. *Vascular plants of Ukraine. A nomenclatural checklist*. Kiev, xxiii + 345 pp. <https://doi.org/10.13140/2.1.2985.0409>
- Nikolic T., Topic J. 2005. *Iris sibirica*. In: *Crvena knjiga vaskularne flore Hrvatske (Red Book of Vascular Flora of Croatia)*. Eds. T. Nikolic, J. Topic. Republika Hrvatska: Ministarstvo kulture, Drzavni zavod za zastitu prirode, pp. 458–459.
- Odintsova A., Skrypec Ch. 2014. New data on pollination of *Iris sibirica* L. (*Iridaceae*). *Studia Biologica*, 8(3–4): 197–208. [Одінцова А., Скрипець Х. 2014. Нові дані щодо

- запилення *Iris sibirica* L. (*Iridaceae*). *Біологічні Студії*, 8(3–4): 197–208].
- Patalauskaitė D. 2021. Sibirinis vilkdalgis. *Iris sibirica*. In: *Lietuvos raudonoji knyga. Gyvūnai. Augalai. Grybai (Red Data Book of Lithuania. Animals. Plants. Fungi)*. Ed. V. Rasomavicius. Vilnius: Leidykla "Lututė", p. 419.
- Pellegrino G. 2015. Pollinator limitation on reproductive success in *Iris tuberosa*.  *AoB Plants*, 7: plu089. <https://doi.org/10.1093/aobpla/plu089>
- Pladias – *Database of the Czech Flora and Vegetation*. 2014–onward. Available at: <https://www.pladias.cz/en/taxon/overview/Gladiolus%20imbricatus> (Accessed 15 July 2021).
- Planisek S.L. 1983. The breeding system, fecundity, and dispersal of *Iris lacustris*. *The Michigan Botanist*, 22: 93–101.
- POWO. 2022–onward. *Plants Of the World Online*. Facilitated by the Royal Botanic Gardens, Kew. Available at: <https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:437527-1> (Accessed 10 July 2022).
- Postolache Gh. 2015. Sabiuta. *Gladiolus imbricatus*. In: *Cartea roșie a Republicii Moldova (The Red book of the Republic of Moldova)*. Ed. M. Belencius. Republic Moldova: Stiinta, pp. 142.
- Red Data Book of the Baltic region. Part 1. Lists of threatened vascular plants and vertebrates*. 1995. Ed. T. Ingelög, R. Andersson, M. Tjernberg. Riga: Swedish Threatened Species Unit, Uppsala in cooperation with Institute of Biology, 95 pp.
- Red Data Book of Ukraine. Plant Kingdom*. 2009. Ed. Ya.P. Didukh. Kyiv: Globalkonsalting, 912 pp. [Червона книга України. Рослинний світ. 2009. Ред. Я.П. Дідух. Київ: Глобалконсалтинг, 912 с.].
- Sapir Y., Shmida A., Ne'eman G. 2006. Morning floral heat as a reward to the pollinators of the *Oncocyclis* irises. *Oecologia*, 147(1): 53–59. <https://doi.org/10.1007/s00442-005-0246-6>
- Scrypec K., Tasenkevich L., Seniv M. 2020. *Iris sibirica* L. (*Iridaceae*) on the territory of Western Ukraine. *Biosystems Diversity*, 28(3): 211–215. <https://doi.org/10.15421/012027>
- Semerenco L.V., Morozova T.K. 2005. *Gladiolus imbricatus*. In: *Red Book of the Republic of Belarus: Rare and endangered species of wild plants*. Ed. G.P. Pashkov. Minsk: BelEn, pp. 222–224. [Семеренко Л.В., Морозова Т.К. 2005. *Gladiolus imbricatus*. Красная книга Республики Беларусь: Редкие и находящиеся под угрозой исчезновения виды дикорастущих растений. Ред. Г.П. Пашкова. Минск: БелЭн, с. 222–224].
- Skrypec Ch., Odintsova A. 2014. Flowering and pollination traits in *Gladiolus imbricatus* L. *Proceedings of Ternopil Volodymyr Hnatiuk National Pedagogical University. Series Biology*, 4(61): 37–43. [Скрипеч Х., Одінцева А. 2014. Особливості цвітіння і запилення *Gladiolus imbricatus* L. Наукові записки Тернопільського національного педагогічного університету імені Володимира Гнатюка. Серія Біологічна, 4(61): 37–43].
- Skrypec K. 2020. *Reproductive biology of Gladiolus imbricatus L. and Iris sibirica L. (Iridaceae Juss.)*. Cand. Sci. Diss. Kyiv, M.G. Kholodny Institute of Botany NAS of Ukraine, 227 pp. (manuscript). [Скрипеч Х.І. *Репродуктивна біологія Gladiolus imbricatus L. та Iris sibirica L. (Iridaceae Juss.)*. Дис. ... канд. біол. наук: спец. 03.00.05 "Ботаніка". Київ, Інститут ботаніки ім. М.Г. Холодного НАН України, 227 с. (рукопис)].
- Szöllösi R., Medvegy A., Benyes E., Nemeth A., Mihalik E. 2011. Flowering phenology, floral display and reproductive success of *Iris sibirica* L. *Acta Botanica Hungarica*, 53(3–4): 409–422. <https://doi.org/10.1556/ABot.53.2011.3-4.20>
- Takács A., Nagy T., Salamon-Albert É., Molnár V. A. 2015. The wildflower of the year 2014 in Hungary: Siberian flag (*Iris sibirica* L.). *Kitaibelia*, 20(2): 268–285.
- Troitsky N.A. 1948. Some data on the biology of the flower *Iris sibirica* L. *Botanical Journal*, 33(3): 375–376. [Троицкий Н.А. 1948. Некоторые данные к биологии цветка *Iris sibirica* L. *Ботанический журнал*. 33(3): 375–376].
- Tucić B., Milojković S., Tarasjev A., Vujčić S. 1989. The influence of climatic factors on clonal diversity in a population of *Iris pumila*. *Oikos*, 56: 115–120.
- Turis P., Kliment J., Feráková V., Dítě D., Eliáš P., Hrivnák R., Košťál J., Šuvada R., Mráz P., Bernátová D. 2014. Red List of vascular plants of the Carpathian part of Slovakia. *Thaiszia – Journal of Botany*, 24(1): 35–87.
- Tzvelev N.N. 1979. *Iridaceae*. In: *Flora Partis Europaeae URSS*. Vol. Ed. An.A. Fedorov. Leningrad: Nauka, pp. 292–311. [Цвелев Н.Н. 1979. Сем. *Iridaceae*. В кн.: *Флора европейской части СССР*. Т. 4. Ред. Ан.А. Федоров. Ленинград: Наука, с. 292–311].
- Uno G.E. 1979. The influence of pollinators on the breeding system of *Iris douglasiana*. *The American Midland Naturalist*, 108: 149–158.
- Webb D.A. 1980. *Iris*. In: *Flora Europaea*. Vol. 5. Eds T.G. Tutin, V.H. Heywood, N.A. Burges, D.M. Moore, D.H. Valentine, S.M. Walters. Cambridge: Cambridge Univ. Press, pp. 87–92.
- Williams J.H. 2009. *Amborella trichopoda (Amborellaceae)* and the evolutionary developmental origins of the angiosperm progamic phase. *American Journal of Botany*, 96(1): 144–165. <https://doi.org/10.3732/ajb.0800070>
- Wragg P.D., Johnson S.D. 2009. Breeding system and pollination of the narrowly endemic South African wildflower *Gladiolus inandensis*. In: *The 94<sup>th</sup> ESA Annual Meeting*, pp. 37–159:
- Zink R.A., Wheelwright N.T. 1997. Facultative self-pollination in Island Irises. *The American Midland Naturalist*, 137(1): 72–78. <https://doi.org/10.2307/2426756>

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Львівський національний університет імені Івана Франка, вул. Грушевського, 4, Львів 79005, Україна.

**Реферат.** У роботі наведено результати дослідження самозапилення двох видів флори України – *Gladiolus imbricatus* та *Iris sibirica* (Iridaceae). Щоб підтвердити або спростувати наявність самозапилення у *G. imbricatus* та *I. sibirica*, було проведено експеримент із пророщування пилку на приймочці. Встановлено, що у *G. imbricatus* запилення автогенним пилком в останній день цвітіння призводить до проростання пилкових трубочок як при ручному, так і природному запиленні. Проте пилку на приймочці ізольованої квітки *I. sibirica* не виявлено ні в перший, ні в останній день цвітіння, що означає відсутність механізму автономного перенесення пилку в межах мерантию. Непророслий пилкок також був виявлений на приймочці після ручного автогенного запилення. Експериментально підтверджено, що за відсутності запилювачів наприкінці фази цвітіння у *G. imbricatus*, як і у деяких інших представників роду, можливе самозапилення та самозапліднення, що сприяє підтриманню життєвості популяції та виду. Стосовно *I. sibirica* було виявлено, що притаманна для цього виду автогамна самонесумісність перешкоджає інбридингу, підтримуючи гетерозиготність у популяціях рослин, що дозволяє рослинам краще адаптуватися до різних умов середовища.

**Ключові слова:** вразливі види, самозапилення, самонесумісність, пилкові зерна, пилкові трубки