Poisonous invasive plant exhibits twice as many genes as expected

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Sosnowsky's hogweed (Moscow region, near the Sukhanovo estate). Credit: Anton Gladin

For the first time ever, scientists have studied the genome of Sosnowsky's hogweed, a poisonous invasive plant whose juice causes skin burns. They found that its genome has nearly twice as many genes as most other plants. The study is published in *The Plant Journal*.

The research findings open the door to practical applications in medicine and pharmacology, thanks to hogweed's unique bioactive molecules, which can be used to create new drugs.

Sosnowsky's hogweed (Heracleum sosnowskyi) is an invasive plant that has spread far beyond its natural habitat in the North Caucasus, posing a major threat to ecosystems and human health. After World War II, the plant was regarded as a promising fodder crop and was widely cultivated in the northwest of European Russia.

From there, it started to spread, quickly invading larger areas and reducing biodiversity by forcing out other plant species. Moreover, its juice contains natural toxins that make the human body, mostly the skin and mucous membranes, highly sensitive to ultraviolet radiation and can cause skin burns and irritation through physical contact.

Researchers from Skoltech and their colleagues from A. A. Kharkevich Institute for Information Transmission Problems of RAS investigated the complete genome of Sosnowsky's hogweed and assembled it up to the chromosome level.

Using a DNA sequencer, the team obtained data on the plant's genome and marked individual genes, which, unexpectedly, turned out to be too many: 55,000 as opposed to 25,000–35,000 in most other plants. Having proposed and verified several possible hypotheses, the researchers discovered that numerous gene duplications (copies) are responsible for this phenomenon.

"This is rather unusual, since plants typically have duplications all over their genome and not just in its individual parts. Many gene families with a sharp increase in the number of genes in Sosnowsky's hogweed appear as a result of the synthesis of secondary metabolites, including linear furanocoumarins (psoralen and its derivatives), which make hogweed highly dangerous," Maria Logacheva, an assistant professor from the Bio Center and a project team member, explains.

The researchers thoroughly analyzed the genes that may be involved in the synthesis of toxins that cause skin burns in daylight and experimentally determined the function of one of the genes that converts marmesin into psoralen.

The research findings could be useful for medicine and pharmacology. Understanding the specific features of Sosnowsky's hogweed's genome will help identify and study its unique bioactive molecules, which could be used to create new drugs and treatment approaches to skin problems. They can also help researchers to develop biological control and monitoring methods for this noxious plant.

"We plan to continue our research into the hogweed genome and study the genetic diversity of this species in its original habitat and 'invaded' areas. We are collecting and analyzing samples from all over Russia—from Kaliningrad to the Far East—in order to figure out the hogweed's spread patterns and strategies, as well as to learn more about the relationships between Sosnowsky's hogweed and related species, such as Mantegazzi's hogweed, which is spreading like wildfire in Western Europe," Logacheva concludes.

More information: Mikhail I. Schelkunov et al, The genome of the toxic invasive species Heracleum sosnowskyi carries an increased number of genes despite absence of recent whole-genome duplications, *The Plant Journal* (2023). DOI: 10.1111/tpj.16500

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