SAFEGUARDING POTATO ONION AND GARLIC DIVERSITY IN NORTH EUROPE AND THE BALTIC REGION

The experience of the SafeAlliDiv project

European Cooperative Programme for Plant Genetic Resources

ECP//GR

# Genetic analyses

Dainis Ruņģis, Genetic Resource Centre, LSFRI Silava, LATVIA

SILAVA

Genet Resour Crop Evol
https://doi.org/10.1007/s10722-020-01014-2

RESEARCH ARTICLE

# Genetic characterization of European potato onion (*Allium cepa* var Aggregatum G. Don) collections

**Dainis Ruņģis · Matti W. Leino · Līga Lepse · Smiljana Goreta Ban · Erik de Vahl · Külli Annamaa · Priit Põldma · Terhi Suojala-Ahlfors · Danguolė Juškevičienė · Chris Kik · Ingunn M. Vågen · Helena Stavělíková**

Currently, in Northern Europe, potato onions are not widely cultivated on a commercial scale but are mainly maintained in home gardens (Leino et al. 2018). They are also stored in ex situ field gene bank collections, as potato onions are predominantly vegetatively propagated.

The Slow Food movement has encouraged the popularisation of regional and national cultural and gastronomic heritage, and potato onions are often used in restaurants focusing on regional and national cuisine, emphasising the use of locally-sourced and traditional ingredients (Westling et al. 2019).

Photo: Līga Lepse, Institute of Horticulture, Latvia

Leino MW, Solberg S, Tunset HM et al (2018) Patterns of exchange of multiplying onion (Allium cepa L. Aggregatum-Group) in Fennoscandian home gardens. Econ Bot 72:346–356. https://doi.org/10.1007/s12231-018-9426-2

Westling M, Leino MW, Nilsen A et al (2019) Crop and livestock diversity cultivating gastronomic potential, illustrated by sensory profiles of landraces. J Food Sci 84:1162–1169. https://doi.org/10.1111/1750-3841.14582

In general, potato onions are vegetatively propagated, however, one interesting example of potato onion cultivation is in Estonia, in villages near Lake Peipsi, where this species has been propagated by seed since the seventeenth century, when Old Believers settled on the shores of Lake Peipsi.

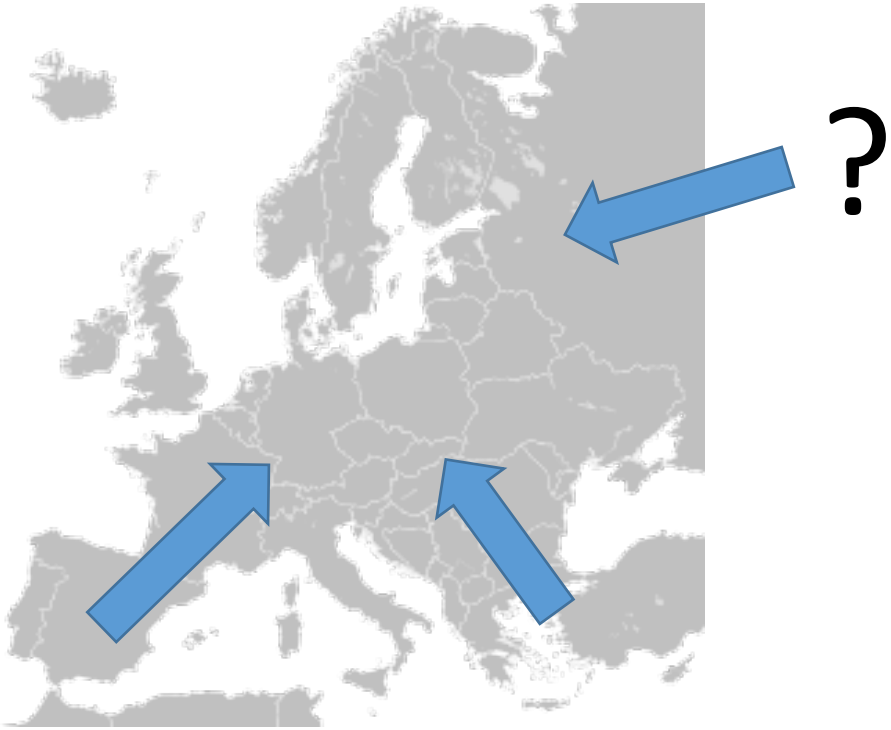
A widely known Estonian potato onion variety ‘Jõgeva 3’ was bred from selections of Lake Peipsi onions at the Estonian Crop Research Institute in the 1960s, providing an example of the direct utilisation of landraces for the breeding of modern cultivars. This cultivar is still popular due to its good storability, pungent taste and high mildew resistance (Bender et al. 2019).

Photo: Līga Lepse, Institute of Horticulture, Latvia

Bender I, Annamaa K, Michelson A, Po ˜ldma P, Rungis D (2019) Cultivation of potato onion (Allium cepa var. aggregatum) in Estonia. In: Programme and abstract book of the NJF conference on horticulture 2019, Tartu, 10–12 June 2019, p 22

Recent research suggests that early European potato onion or shallot varieties were distributed both as seeds and sets when introduced to Sweden from Russia, Denmark and Spain in the mid 1800's (De Vahl 2020).

The range of old varieties and landraces historically traded in Europe has not been fully examined, but vegetative propagation has been the most common practice in most countries. Therefore, it could be expected that the spread of individual potato onion clones throughout Europe might be an important and widespread phenomenon.




De Vahl E (2020) Potato onion, Johannes onion or Nordic shallot?—historical growing systems, denomination and introduction for Allium cepa Aggregatum-Group. Master's dissertation, Swedish University of Agricultural Sciences. https://doi.org/10.13140/RG.2.2.31869.31203

A total of 264 Allium cepa L. Aggregatum group accessions were received for DNA analysis from the genetic resource collections of eight countries: Croatia (HRV), the Czech Republic (CZE), Estonia (EST), Finland (FIN), Latvia (LVA), Lithuania (LTU), Norway (NOR), Sweden (SWE). Most collections consisted of accessions collected within their respective countries, however, the Czech collection contains accessions from Austria, China, Germany, France, UK, Hungary, Indonesia, the Netherlands, Poland, Romania, Slovakia, USA, and Russia.

Photo: Līga Lepse, Institute of Horticulture, Latvia

DNA was extracted from bulked tissue samples from two individuals for vegetatively propagated accessions (262 accessions), and from nine separate individuals for the two seed-propagated Estonian accessions (Jõgeva 3, Kolkja KA14004).

Samples were genotyped with 11 SSR markers. Nine of these markers were also utilised in a previous genetic analysis of potato onion in Sweden (Leino et al. 2018), and seven for analysis of Finnish potato onion accessions (Antonius and Tanhuanpää unpublished).

Leino MW, Solberg S, Tunset HM et al (2018) Patterns of exchange of multiplying onion (Allium cepa L. Aggregatum-Group) in Fennoscandian home gardens. Econ Bot 72:346–356. https://doi.org/10.1007/s12231-018-9426-2

# RESULTS – ‘housekeeping’

Eighty accessions that were not known to be safety duplications had identical genotypes with one or more other accessions. In most cases, the accessions with identical multilocus genotypes were from one country/collection (12 groups).

Seventeen accession—safety duplicate pairs (a total of 34 samples) were known to be present in the collections analysed, and of these, nine pairs had identical multilocus genotypes. The majority of accession – safety duplicate pairs that did not have identical multilocus genotypes, had unique genotypes, but two safety duplicate accessions had genotypes identical to other accessions.

**In some cases, these accessions may in fact be genetically identical, as they are annotated as landraces with the same name, or collected from the same region. They also may represent cases of historical movement of germplasm, which have subsequently been collected and maintained in different countries.**

## OR

**SSR markers did not have sufficient resolution to differentiate accessions, and the use of additional markers may enable discrimination of these.**

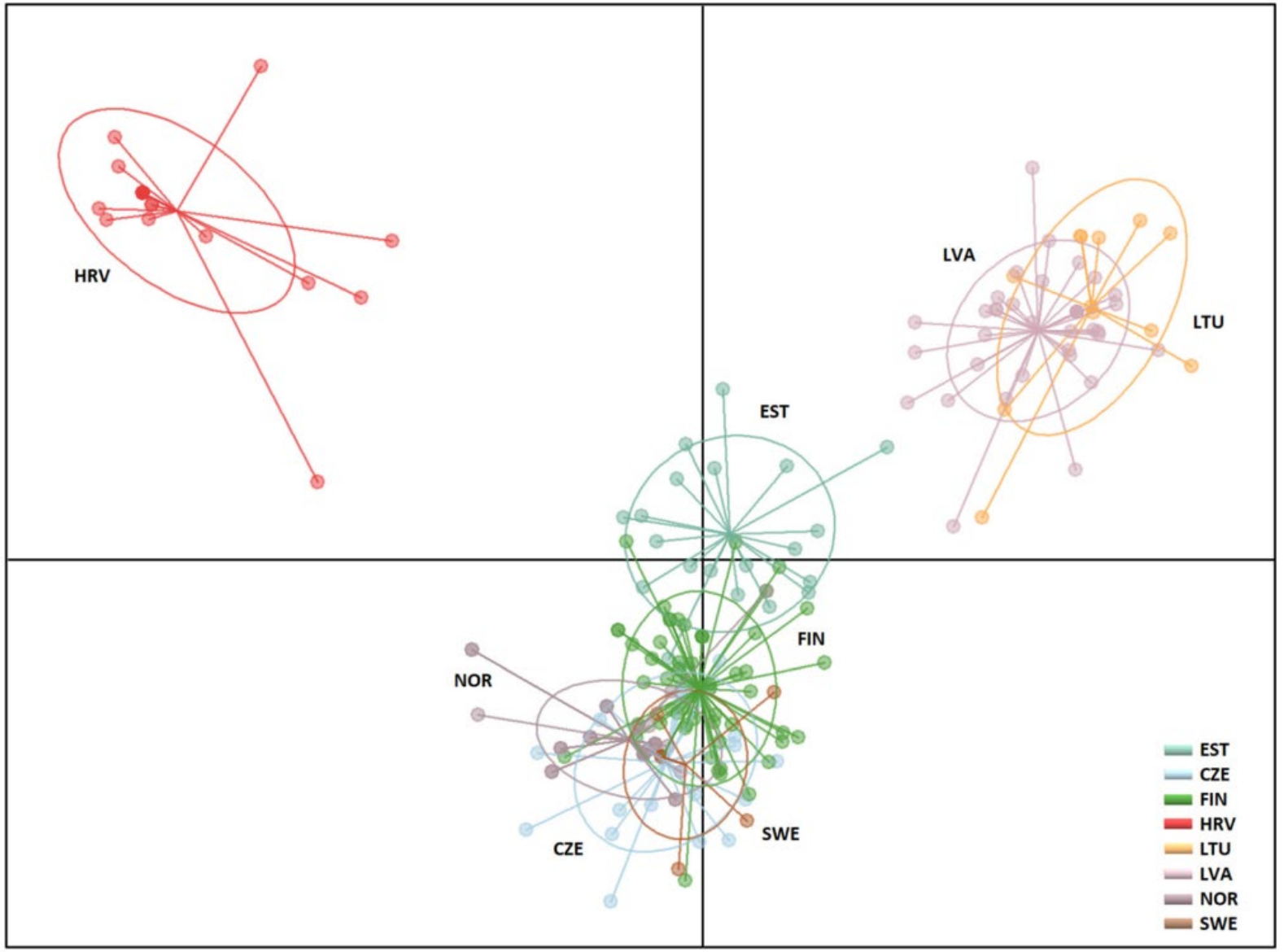
# RESULTS – ‘diversity’

All the individuals from the two sexually propagated Estonian accessions (Jõgeva 3 and Kolkja KA14004) had unique multilocus genotypes.

The allelic diversity found in the two Estonian sexually propagated accessions was comparable to that found in all the vegetatively propagated accessions, despite the large differences in the number of individuals in each group (18 and 258, respectively),

| Diversity measure | Propagation method | |
|---|---|---|
| | Vegetative | Sexual |
| No. of accessions/individuals | 258 | 18 |
| Total no. of alleles (over 11 SSR loci) | 120 | 79 |
| Mean no. of alleles per locus | 10.909 (1.048) | 7.182 (0.796) |
| Total no. of alleles with freq. $\geq$ 5% (11 loci) | 63 | 65 |
| Mean no. of alleles with freq. $\geq$ 5% | 5.727 (0.541) | 5.909 (0.595) |
| Effective number of alleles | 5.362 (0.656) | 5.032 (0.587) |
| Information index | 1.820 (0.122) | 1.685 (0.116) |
| No. of unique alleles | 4.091 (0.495) | 0.364 (0.152) |
| Allelic richness | 4.900 (0.169) | 5.664 (0.314) |
| Gene diversity | 0.780 (0.032) | 0.793 (0.029) |
| Observed heterozygosity | 0.514 (0.052) | 0.614 (0.051) |

# RESULTS – ‘differentiation’



# CONCLUSIONS

The obtained results are consistent with previous molecular analyses of Nordic potato onion germplasm, which also reported the close relationship of Norwegian and Swedish potato onion collections, with the Finnish collection being more differentiated (Leino et al. 2018).

It was suggested that the differentiation of the Finnish potato onion collection may be due to introduction from Eastern Europe, including Russia. This study elaborates on the previous study, confirming the intermediate position of Finnish accessions between the Nordic and Baltic accessions, and suggesting that historic exchange of germplasm between Finland and the Baltic States has occurred.

It has been reported that some Latvian potato onion germplasm originated from Russia, characterised by clones with pungent taste, and intensive hearting. Local clones have been developed by long-term selection from these Russian onion types. Potato onions of the Lake Peipsi region are also of similar origin (Taranovs 1968).

Unfortunately, the hypothesis that these north eastern European potato onion collections have been influenced by the introduction of germplasm from western Russia could not be tested, due to the lack of material from this region.

Leino MW, Solberg S, Tunset HM et al (2018) Patterns of exchange of multiplying onion (Allium cepa L. Aggregatum-Group) in Fennoscandian home gardens. Econ Bot 72:346–356. https://doi.org/10.1007/s12231-018-9426-2

Taranovs V (1968) Dārzeņkopība Latvijā (Vegetable cultivation in Latvia). ‘‘Liesma’’, Riga (in Latvian)

# Thank you for your attention!

Thanks to Helena Stavělíková and the Allium WG and grant activity members!

And of course ECPGR!

Photo: Līga Lepse, Institute of Horticulture, Latvia