Julius Kühn-Institut
Bundesforschungsinstitut für Kulturpflanzen
Federal Research Centre for Cultivated Plants

# Caraway (*Carum carvi*) with increased essential oil content as a example for impact of breeding in medicinal and aromatic plants (MAP)


GREEN RIO
GREEN LATIN AMERICA

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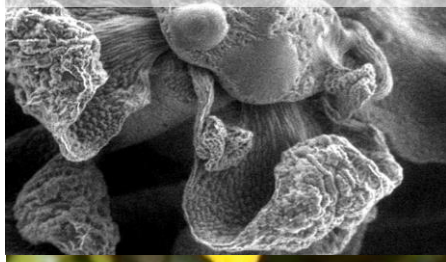
Marina da Glória - Rio de Janeiro

Daniel von Maydell, Frank Marthe, Wolfram Junghanns

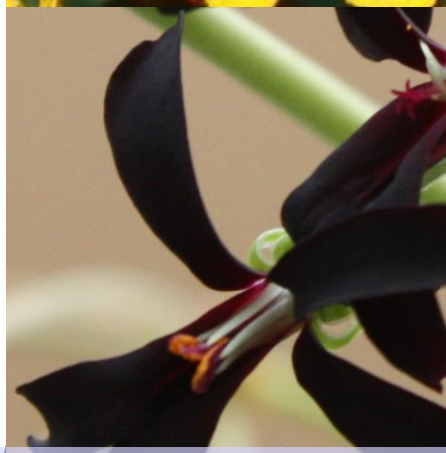
# **Overall goals** of the Institute for Breeding Research on Horticultural Crops of Julius Kuehn Institute

**Policy advice**

**Qualification of young scientists**

- Adaptation to changing weather and climate, **abiotic stress** and **increasing the yield** of different crop species as a contribution to strengthening **new cultivation systems** in Germany through **breeding optimization**
- **Quality improvement** (sec. plant metabolites, shelf-life, morphology)
- **Evaluation of plant genetic resources** and protection of this resources as contribution to limiting the ongoing genetic erosion
- Study of host pathogen interaction to improve **resistance** of different crop species
- Research on issues of **organic cultivation**



**Vegetables**

**Medicinal and aromatic plants**

**Ornamental plants**

Julius Kühn-Institut
Federal Research Centre for Cultivated Plants

Institute for Ecological Chemistry, Plant Analysis and Stored Product Protection (ÖPV) of JKI

BBG Kilian-Horsch GbR

Horrmann GbR

Landwirtschaftsbetrieb Kittler

Dr. Junghanns GmbH
Ascavital® Kräuterprodukte

# Improvement of annual caraway (*Carum carvi*) as a raw material for bioactive products

Gefördert durch:

Bundesministerium für Ernährung und Landwirtschaft

aufgrund eines Beschlusses des Deutschen Bundestages

FNR
Fachagentur Nachwachsende Rohstoffe e.V.

Connected projects 06/2017 to 03/2021
and 4/2021 to 3/2024

# Objectives

The **Ph. Eur.** requires for schizocarps of caraway (Carvi fructus)

- at least 3 % essential oil
- with a carvone like smell

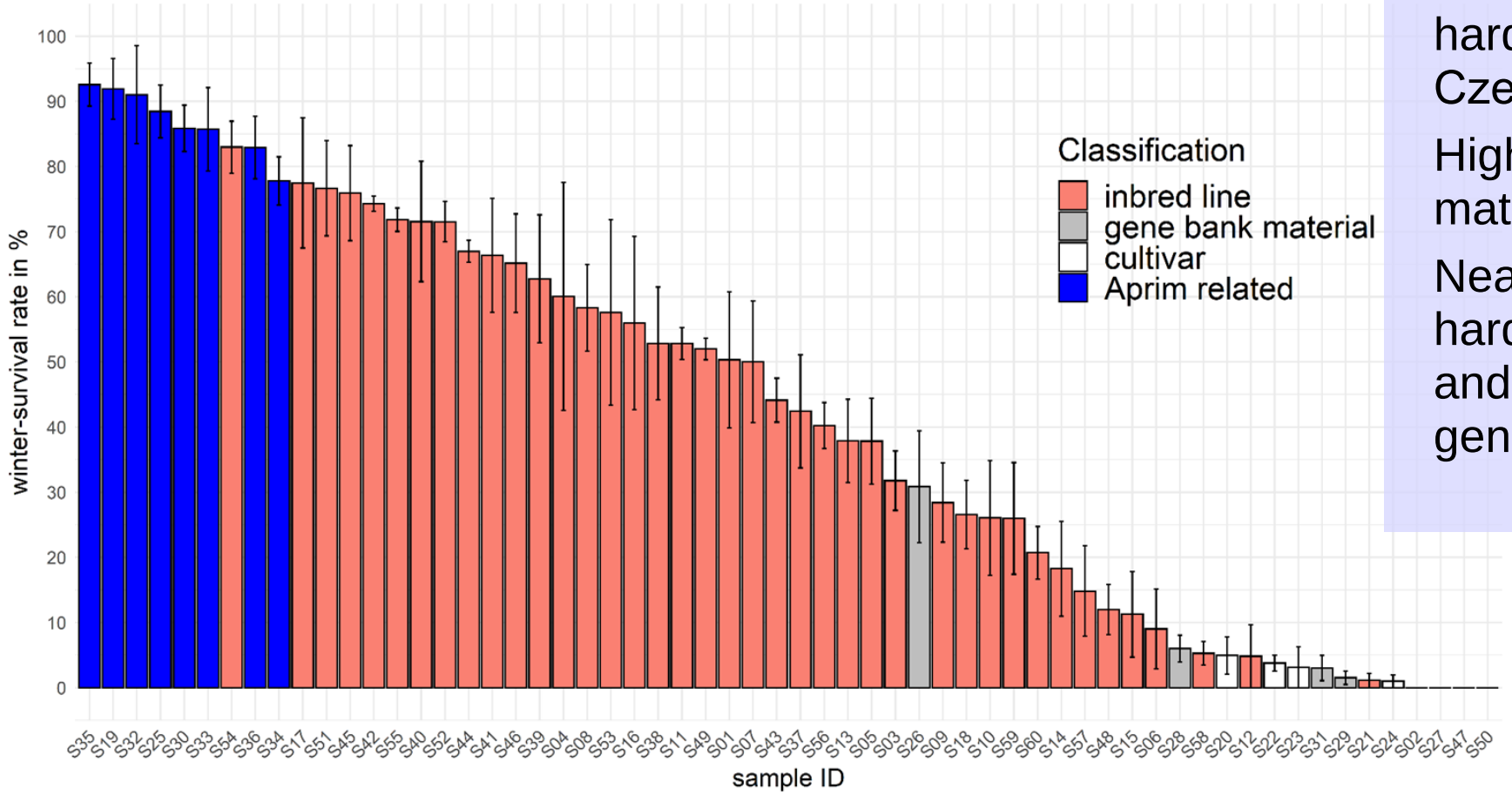
Essential oil of caraway contains 50.0 – 65.0 % carvone, 30.0 – 45.0 % limonene, 0.1 – 1.0 %, ß-myrcene, maximal 2.5 % trans-dihydrocarvone, and maximum 2.5 % trans-carveol

schizocarps of caraway for use in food industry has to have only 1.5 – 2.5 % essential oil (ISO 5561)

**Breeding goal** for summer annual caraway

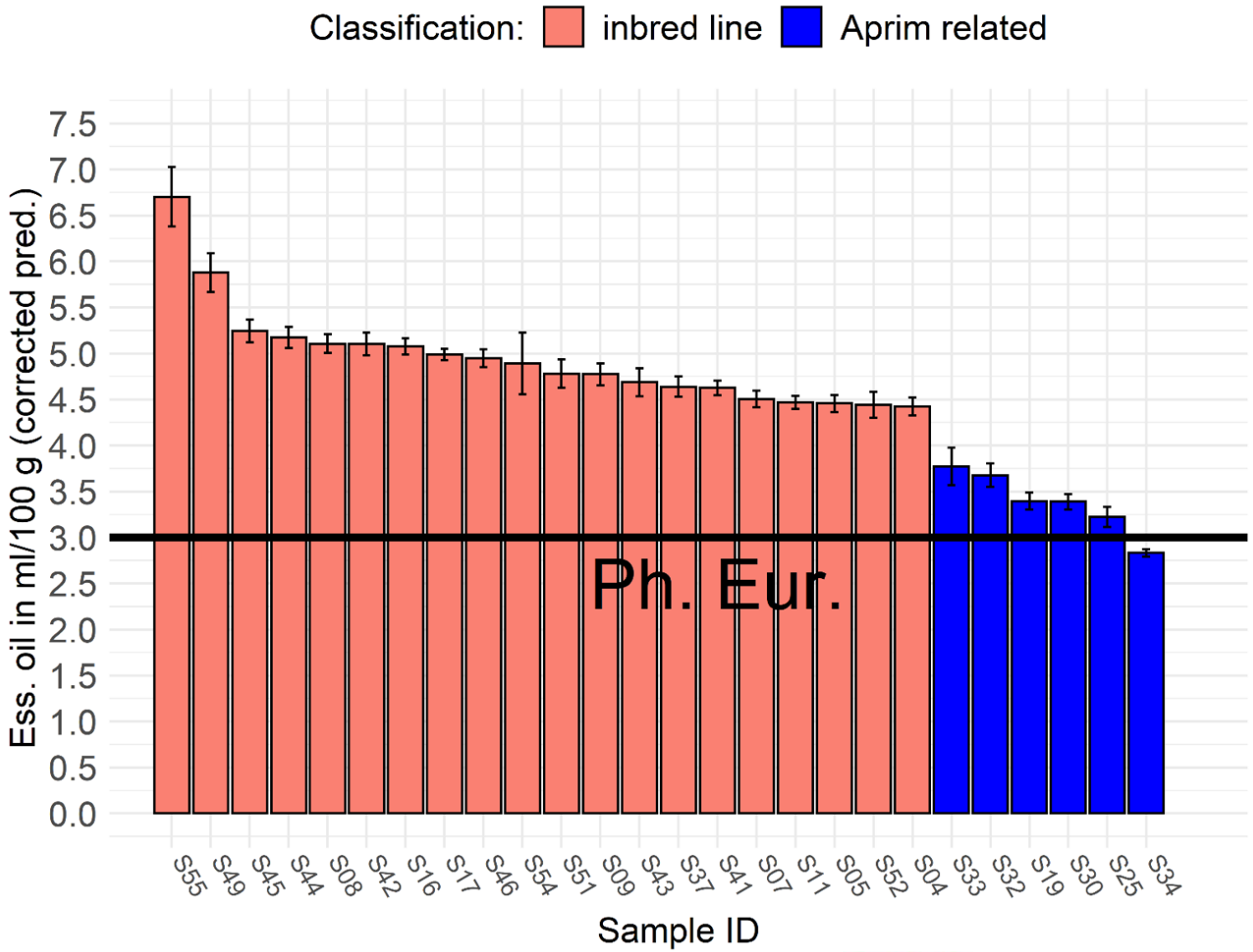
- 5 % essential oil
- Yield of 1.5 t/ha
- Looking for material with suitability for winter annual growing

# Winter annual caraway: Evaluation of material in 2019/2020




- Acceptable winter hardiness from Czech variety 'Aprim‘
- High variability in JKI material
- Nearly no winter hardiness in varieties and accessions from gene bank

# Winter annual caraway: Evaluation of material in 2019/2020




- Low content of essential oil in Czech variety 'Aprim‘
- Acceptable content in JKI lines
- The material pools has to combine by crossings and selection

# Jaborandi (bras. local name) (*Pilocarpus microphyllus* Stapf ex Wardleworth Pharm. J. Trans. ser. 3, 24:506. 1893)

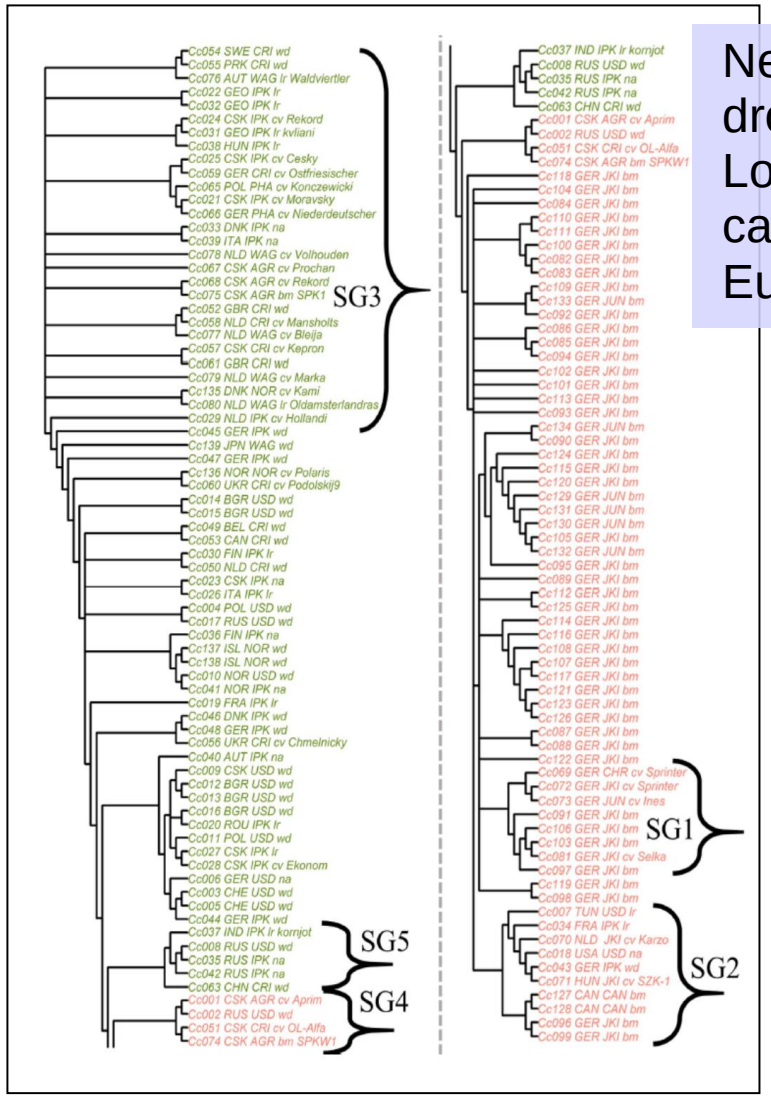
Commercial production of the alkaloid muscarinic receptor agonist **pilocarpine** is derived entirely from the leaves of the shrub. The plant being gathered from the wild for this purpose.

Leaves contain a number of medically active constituents, including alkaloids, an essential oil, terpenes and tannic acid.

The alkaloid pilocarpine has been shown to be responsible for much of the biological activity of the plant- especially its ability to induce sweating and salivation, as well as to lower intraocular pressure in the eyes (making it an effective treatment in certain types of glaucoma).

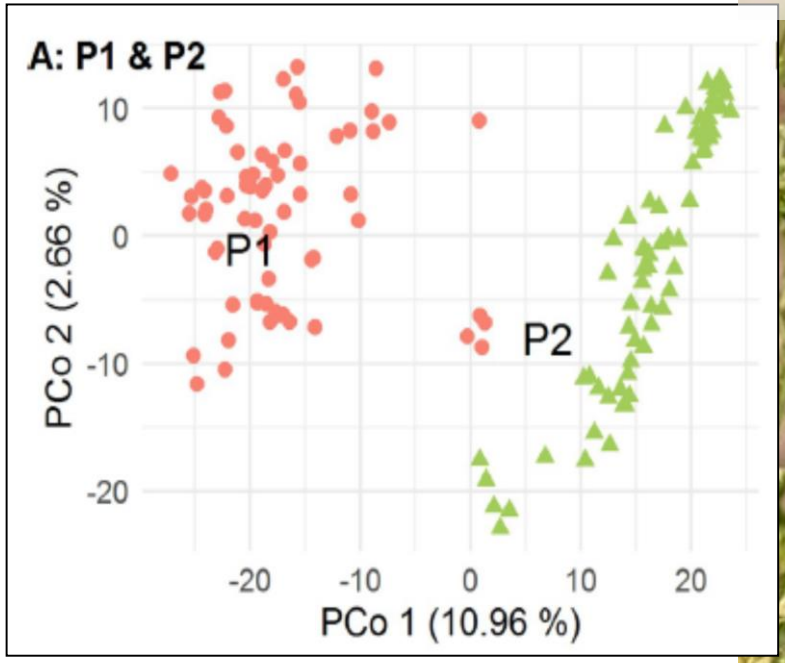
Obrigado pela sua atenção!

# Variability of caraway calculated by single nucleotid polymorphisms (SNP) from genotyping by sequencing (GBS)




Neighbor joining-dendrogram, 13,155 SNP Loci, 137 acessions of caraway, BIONJ und Euklidian distances

Flowering type:
- annual
- biennial




Multidimensionale Skalierung (MDS, Multiple Principle coordinate analysis (PCoA), Darwin-Software) 13.155 SNP Loci, Blühtyp,


PLOS ONE

RESEARCH ARTICLE

On genetic diversity in caraway: Genotyping of a large germplasm collection

Daniel von Maydell[1]*, Heike Lehnert[2], Thomas Berner[2], Evelyn Klocke[1], Wolfram Junghanns[3], Jens Keilwagen[2], Frank Marthe[1]

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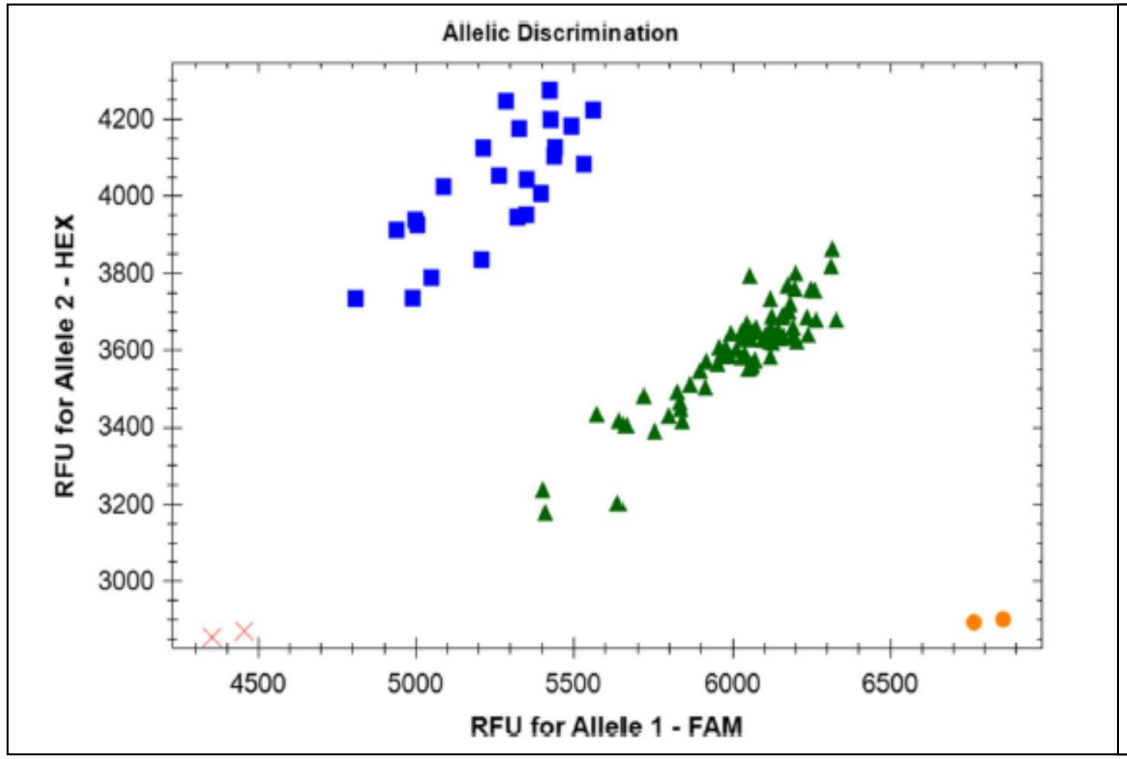
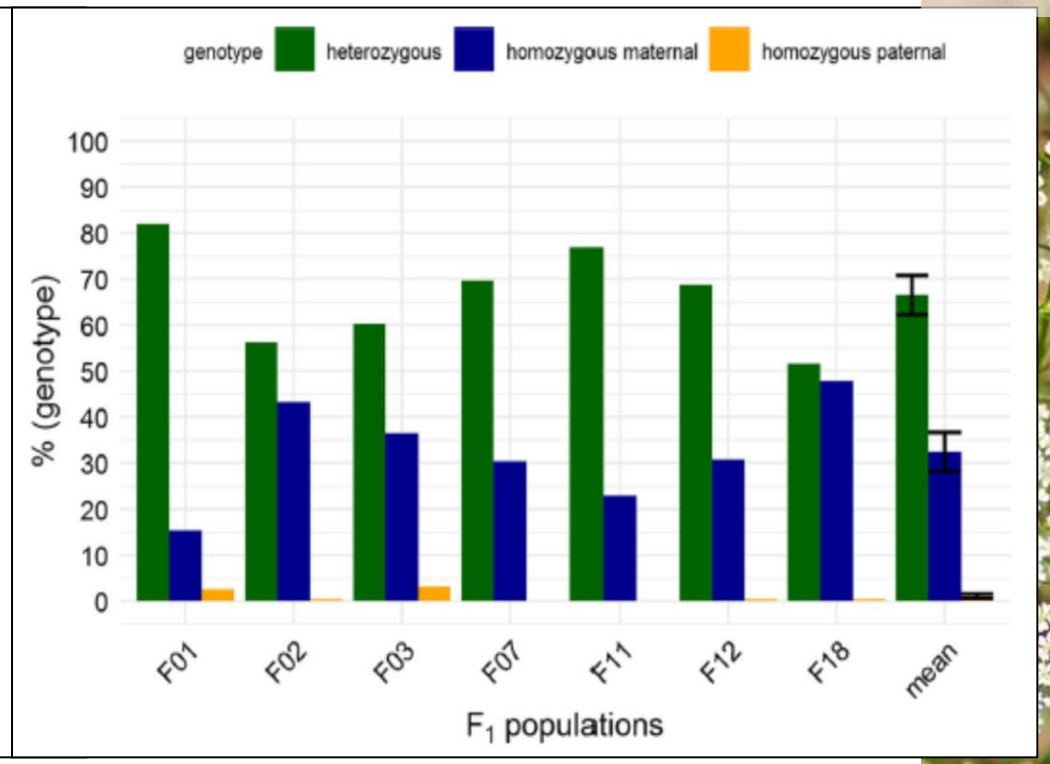
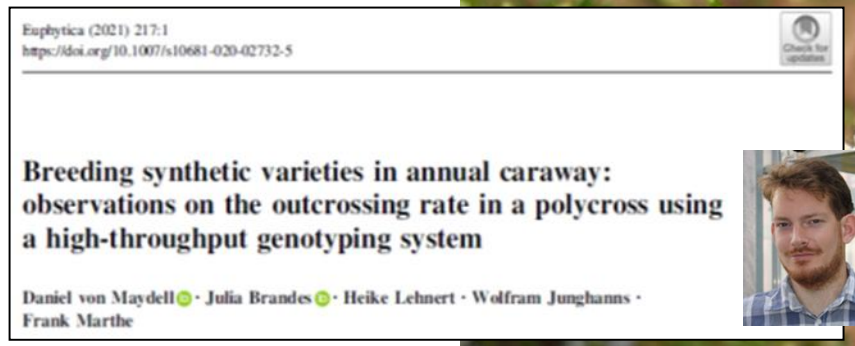
# Marker based measuring of the natural cross-pollination rates



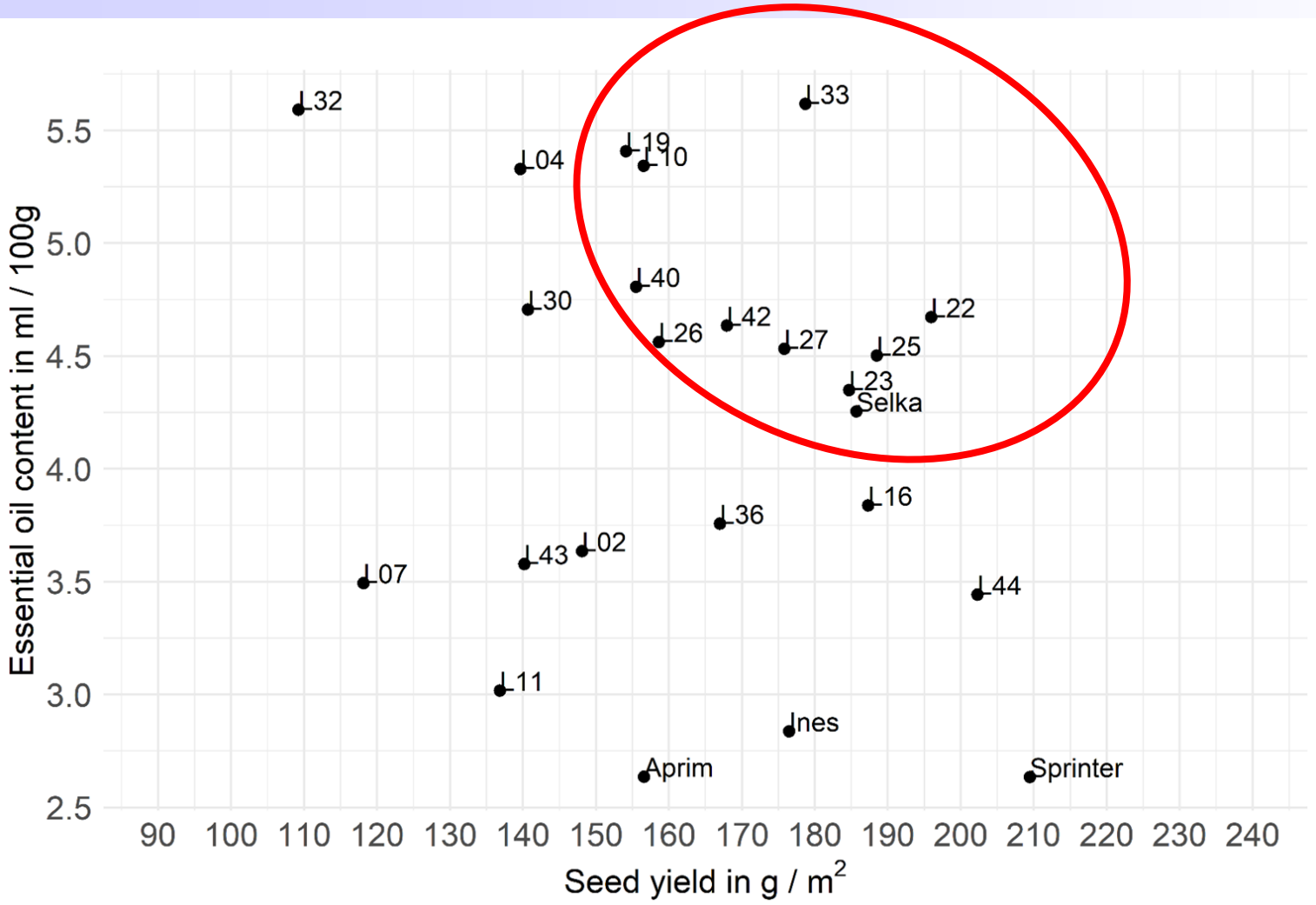

Differentiation of 96 caraway genotypes (CFX Maestro); read: negative control; blue: homozygote – maternal; green: heterozygote; orange: homozygote – paternal;
PACE-Marker (PCR Allele competitive extension) / KASP-technique (Competitive allele specific PCR)


Euphytica (2021) 217:1
https://doi.org/10.1007/s10681-020-02732-5

**Breeding synthetic varieties in annual caraway: observations on the outcrossing rate in a polycross using a high-throughput genotyping system**

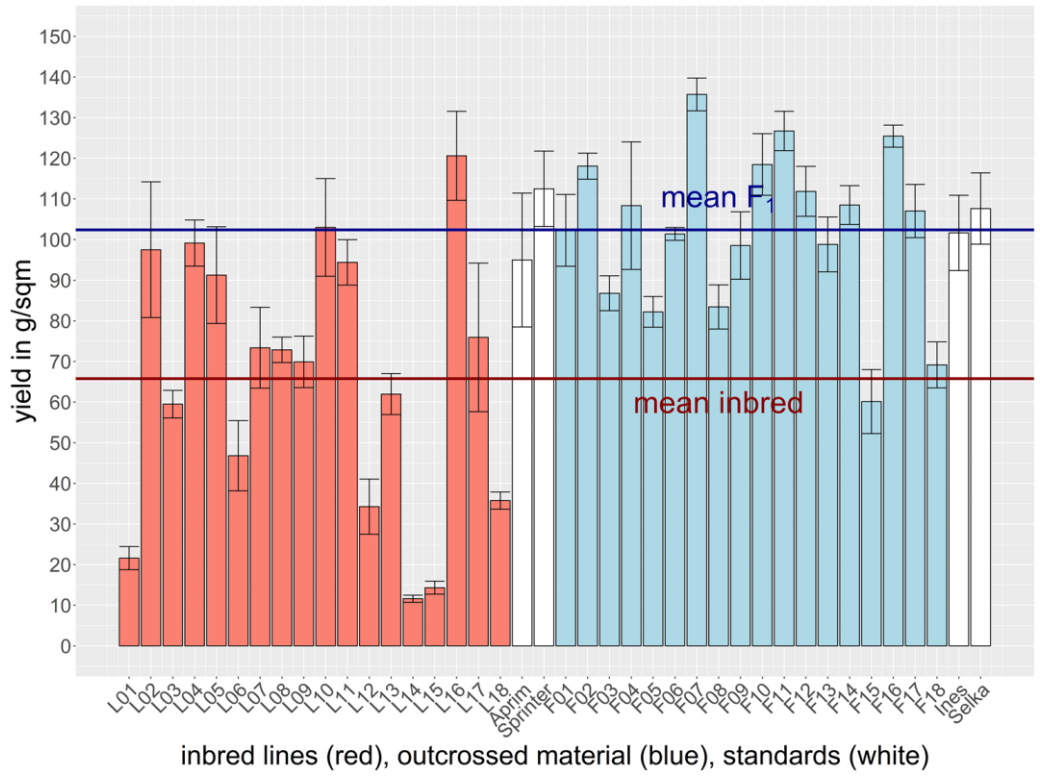
Daniel von Maydell · Julia Brandes · Heike Lehnert · Wolfram Junghanns · Frank Marthe

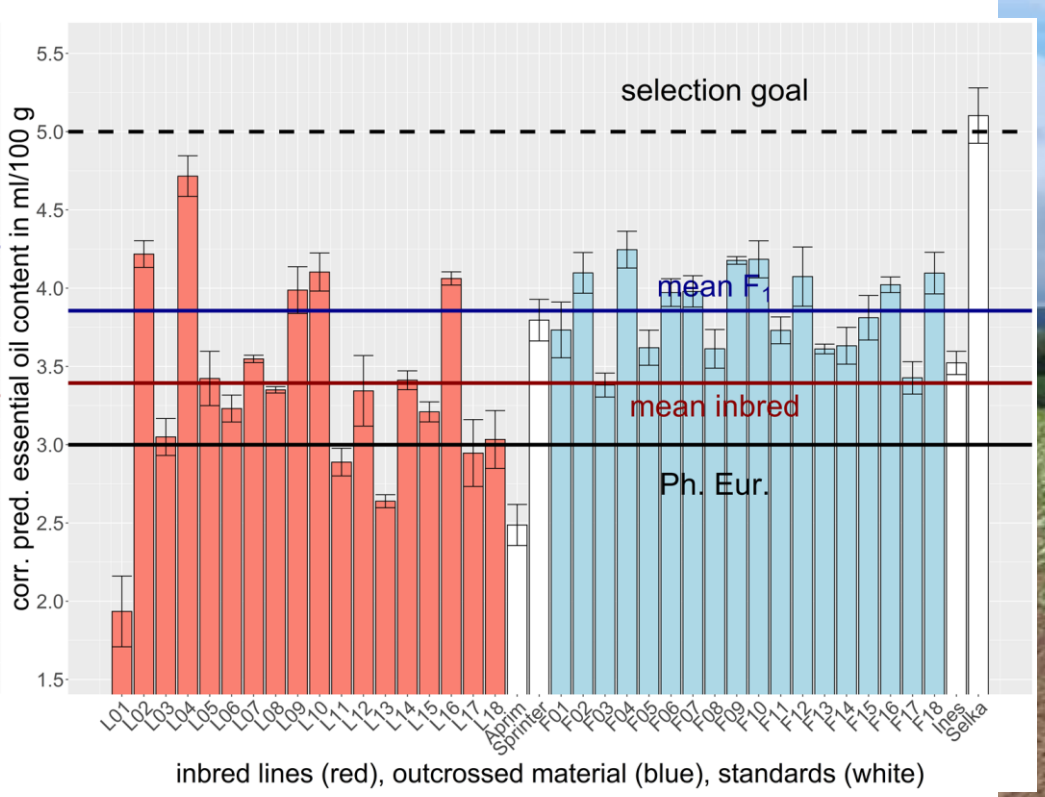
# Results of performance tests of inbreed lines for yield and essential oil content in 2021




Inbreed lines in the read circle connect high essential oil content with good yield performance

# Heterosis effect in caraway for yield and essential oil content in 2019




Outcrossing increases yield in caraway (heterosis-effect)
Outcrossing increases the essential oil content to a smaller degree
Best lines in self-performance, GCA and essential oil content can be combined to a first synthetic (L02, L04, L07, L10 and L16)