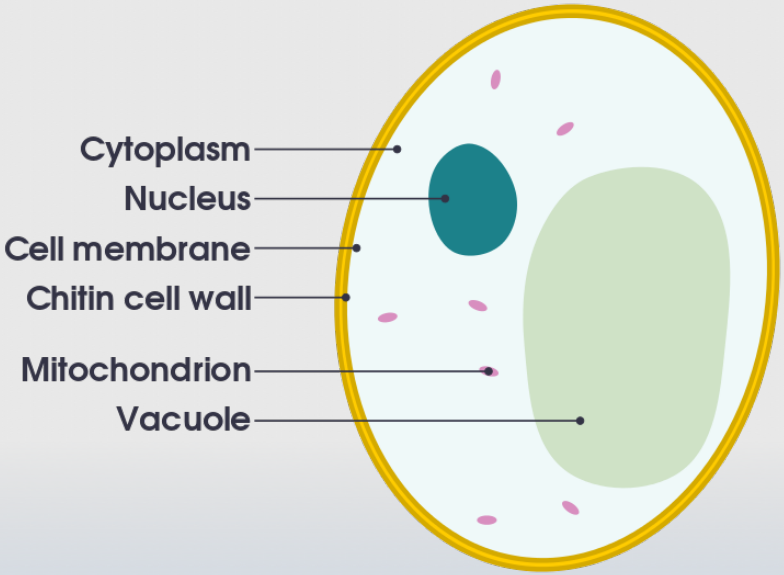
HOW ARE YEASTS DOMESTICATED?

Gizem Karabiyik

Yeasts

- Eukaryotic
- Single-celled mos
- Fungus kingdom
- 100 mya
- 1,500 species (1% of fungal species.)



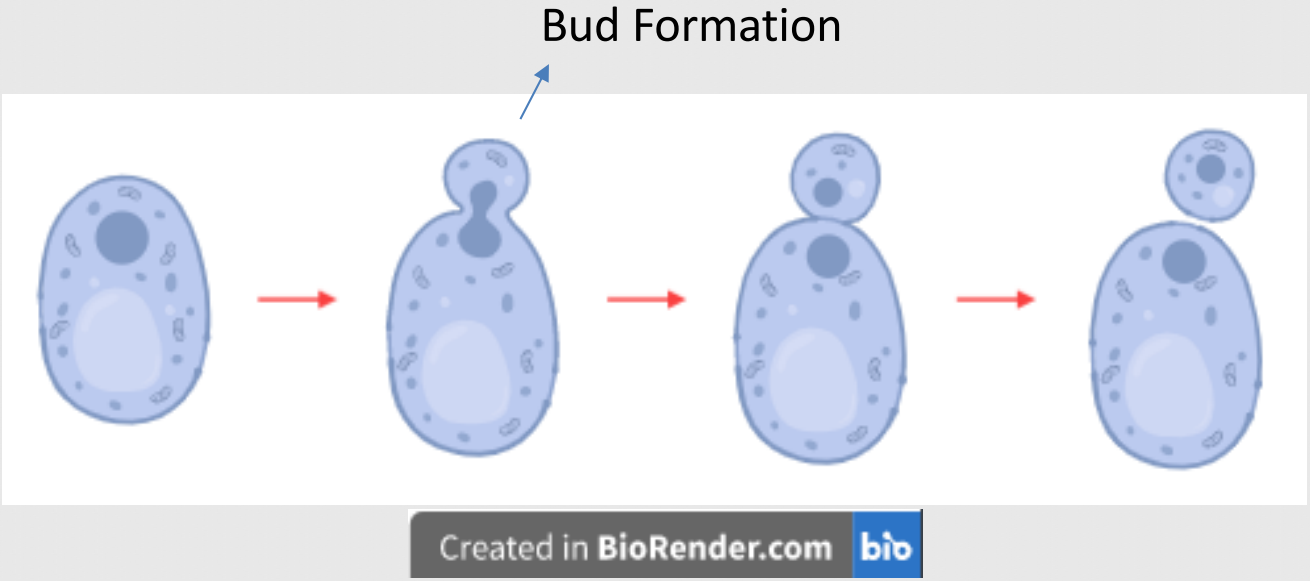
semanticscholar.org



phys.org

Mitosis

- Diploid
- Haploid



Domestication: human selection and breeding of wild species

Ploidy: # of complete sets of chromosomes

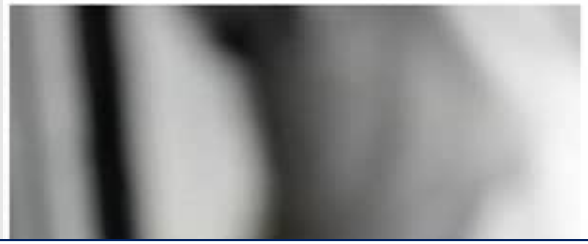
Use in Biotechnology

Baker's yeast in bread production

Brewer's yeast in beer fermentation

Yeast in wine fermentation







Article

Cell

Domestication and Divergence of *Saccharomyces cerevisiae* Beer Yeasts







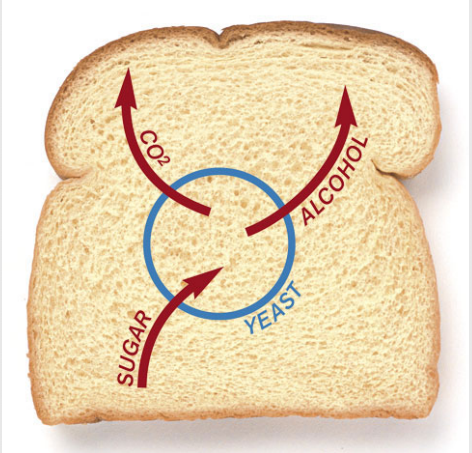
157 *S. cerevisiae* in their natural ploidy







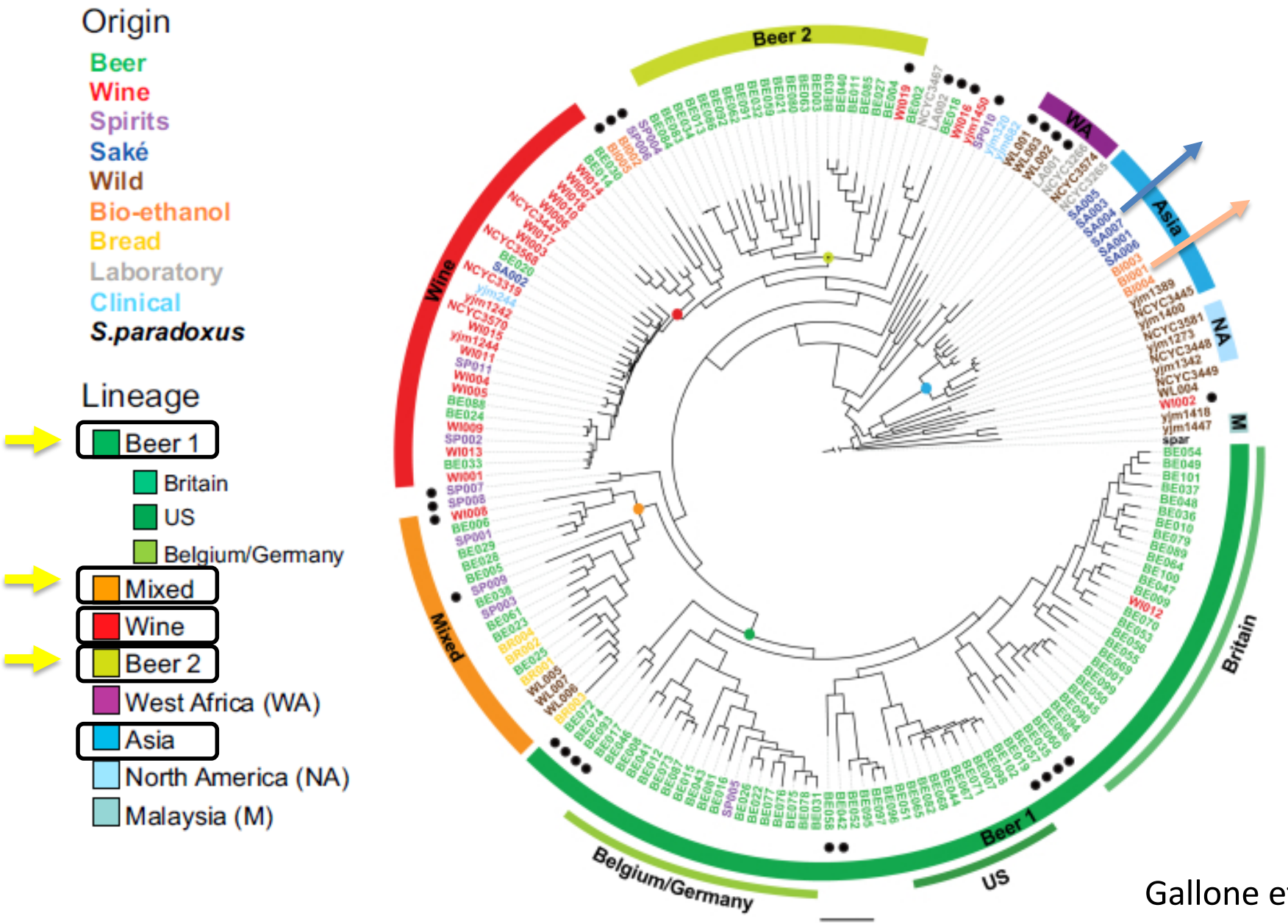




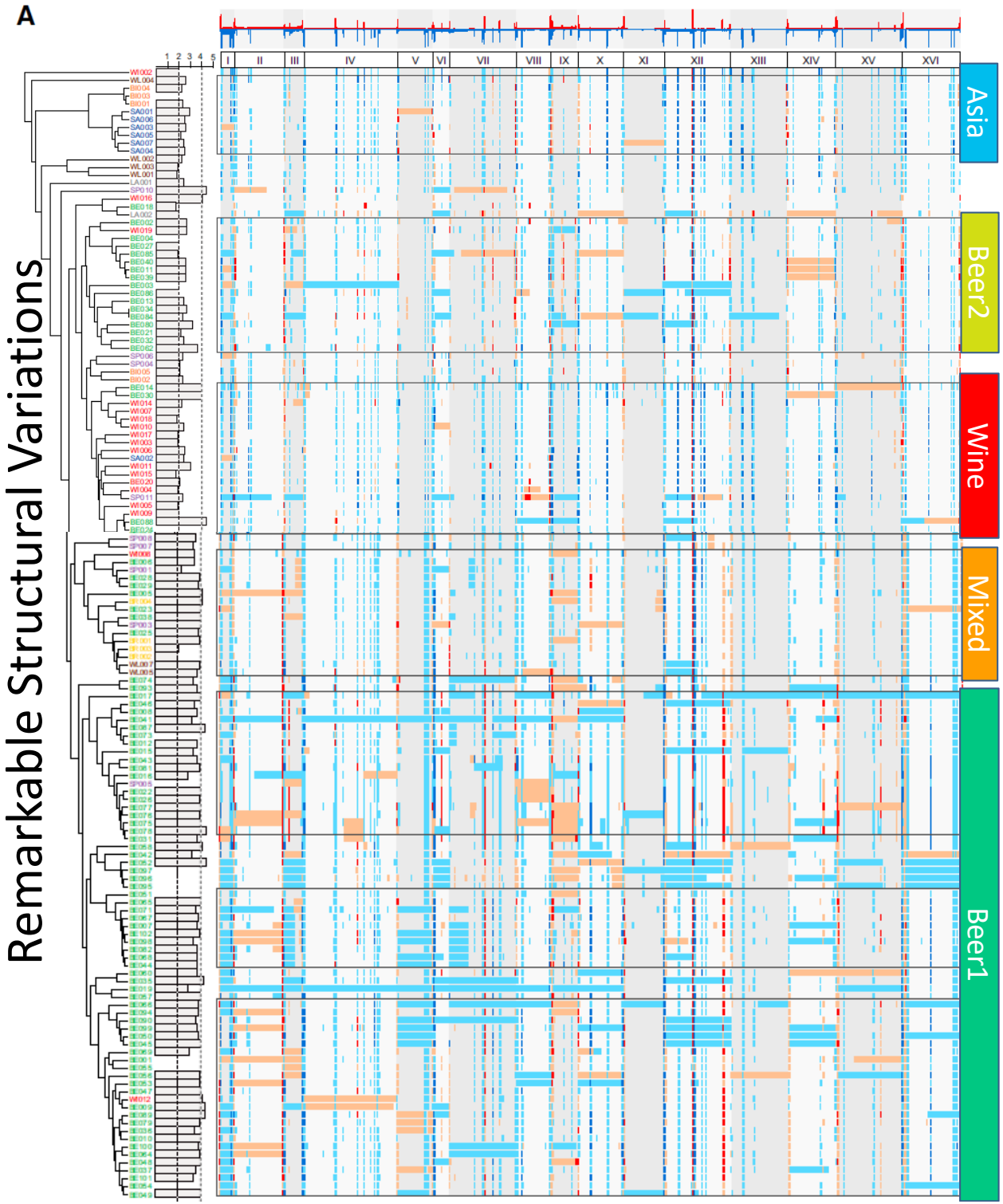
157 *S. cerevisiae* strains

- 102 industrial beer strains
- 19 wine strains
- 11 spirit strains
- 7 sake´ strains
- 7 strains isolated from spontaneous fermentations
- 5 bioethanol strains
- 4 bread strains
- 2 laboratory strains

Phylogeny of Industrial *S. cerevisiae*



Gallone et al., 2016



Origin

- Beer
- Wine
- Spirits
- Saké
- Wild
- Bio-ethanol
- Bread
- Laboratory
- Clinical
- ***S.paradoxus***

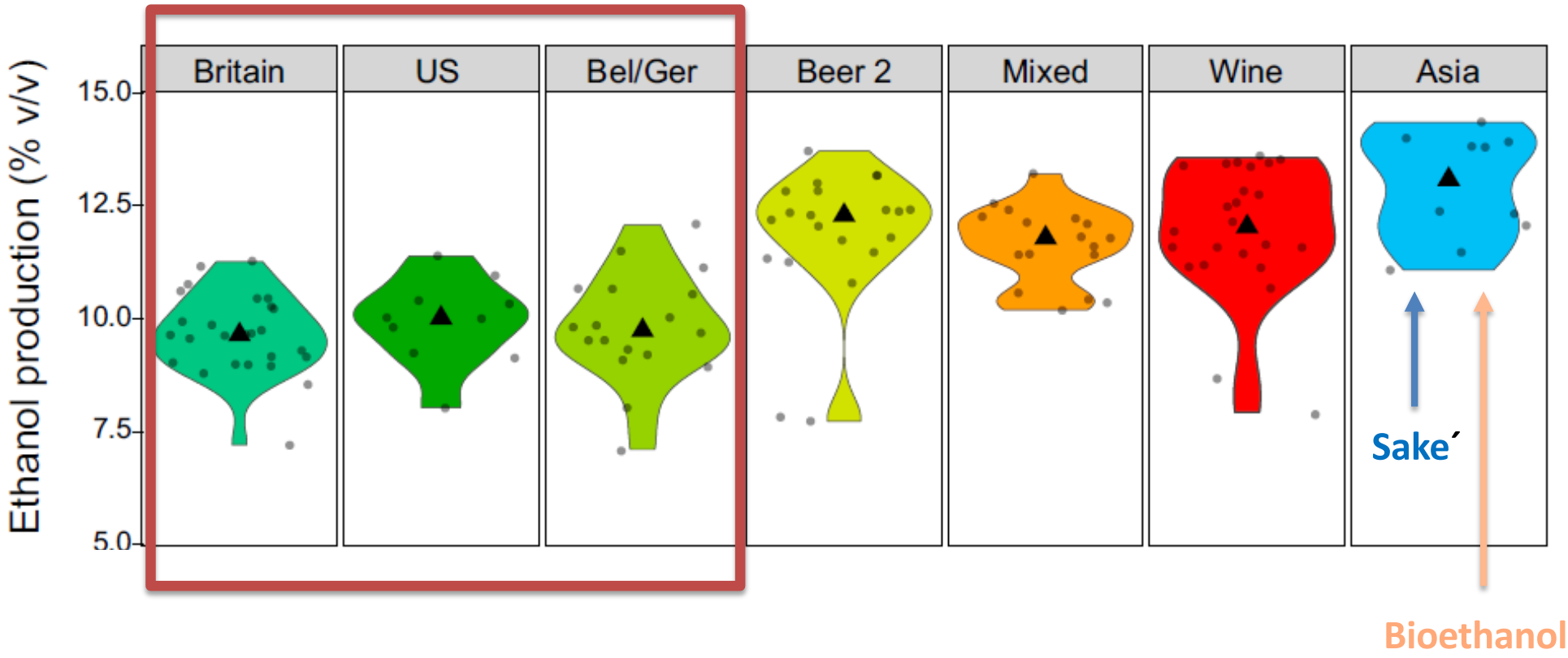
Amplification

Deletion

> 15,000 events

Gallone et al., 2016, Cell 166

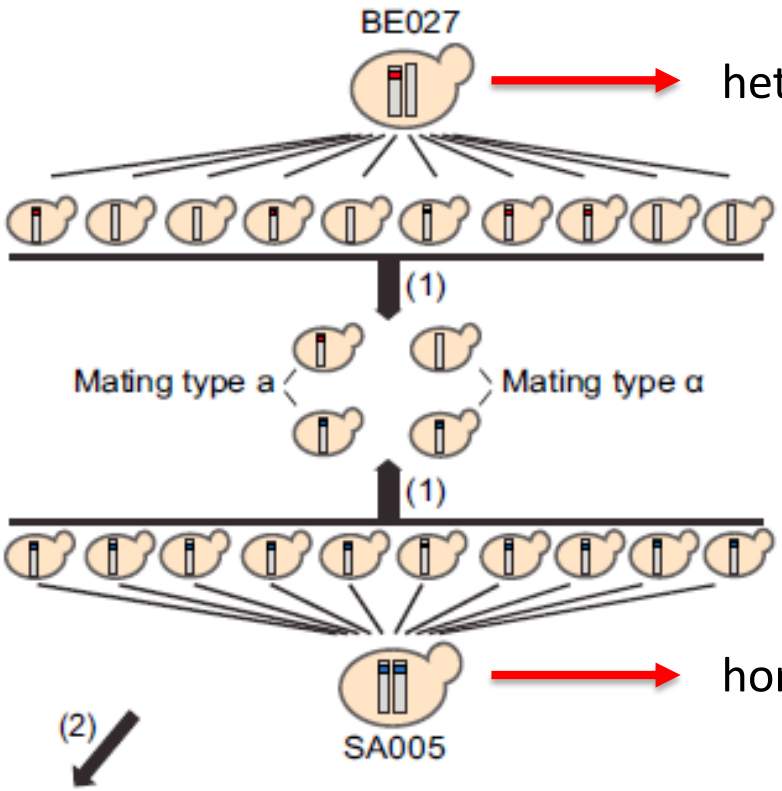
Ethanol production of different *S. cerevisiae*

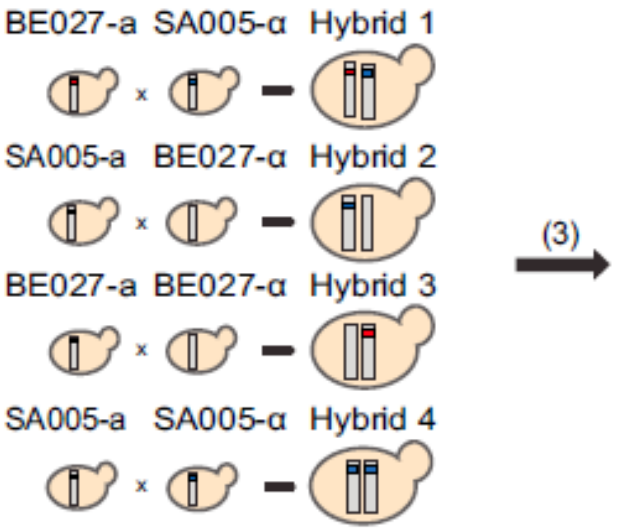


Gallone et al., 2016, Cell 166

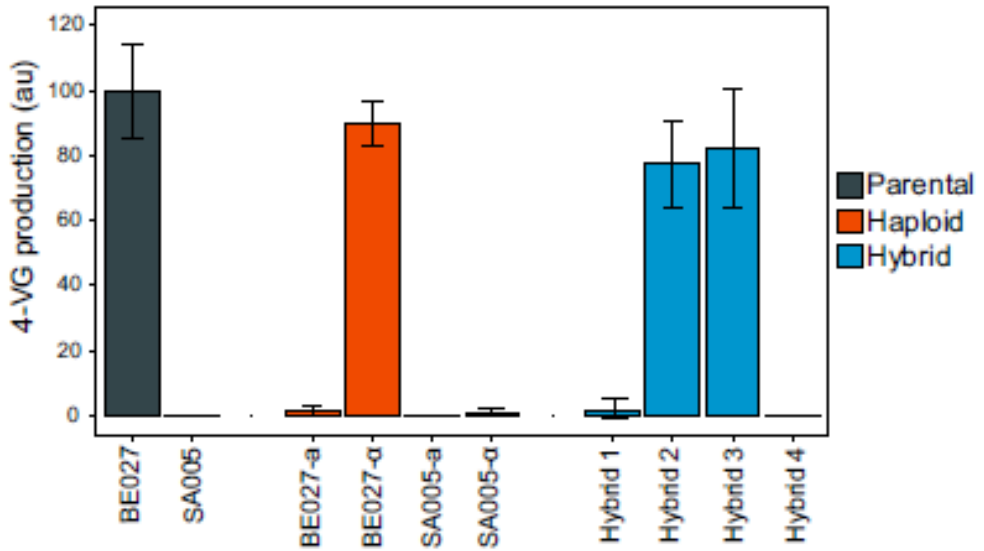
Creating Superior Hybrid

4-VG
(4-vinyl guaiacol)





(3)



Gallone et al., 2016

RESULTS

- ✓ New industrial strains with altered aromatic properties -> by targeted selection and breeding

- ✓ Today's industrial yeasts -> few domesticated ancestors and distinct from wild strains

Industrial yeasts with superior aroma production by large-scale selection and breeding

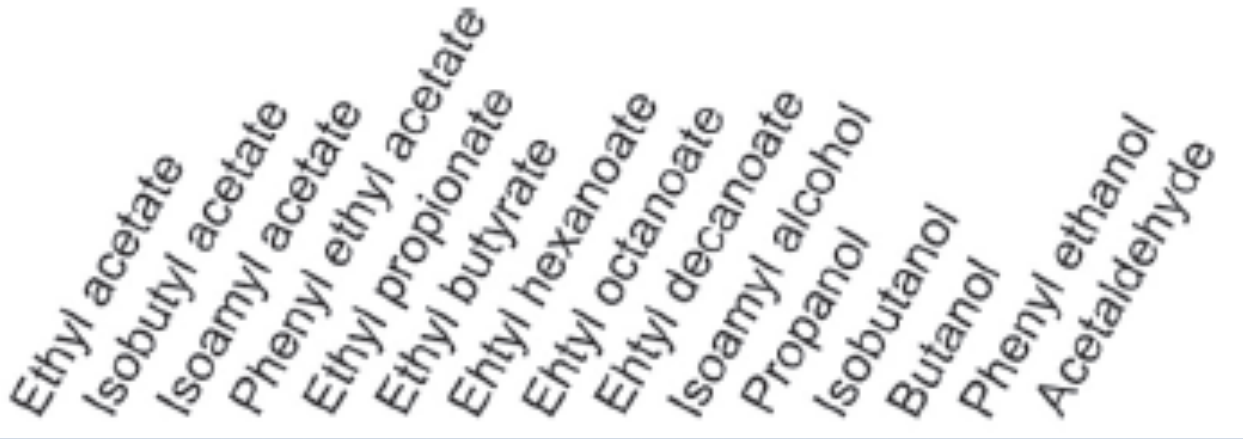
TABLE 1 Overview of the yeast collection used in this study

Yeast source(s)	No. of strains[a]
Ale beer	104
Lager beer	29 (*S. pastorianus*)
Wine	63
Sake	13
Spirit	11
Bakery	10
Bioethanol	7
Wild (nondomesticated) isolates	36 (*S. paradoxus*), 28 (*S. cerevisiae*)

[a] All strains belong to *S. cerevisiae* unless otherwise noted.

301 *Saccharomyces* strains.

15 different aroma compounds



Steensels et al., 2014

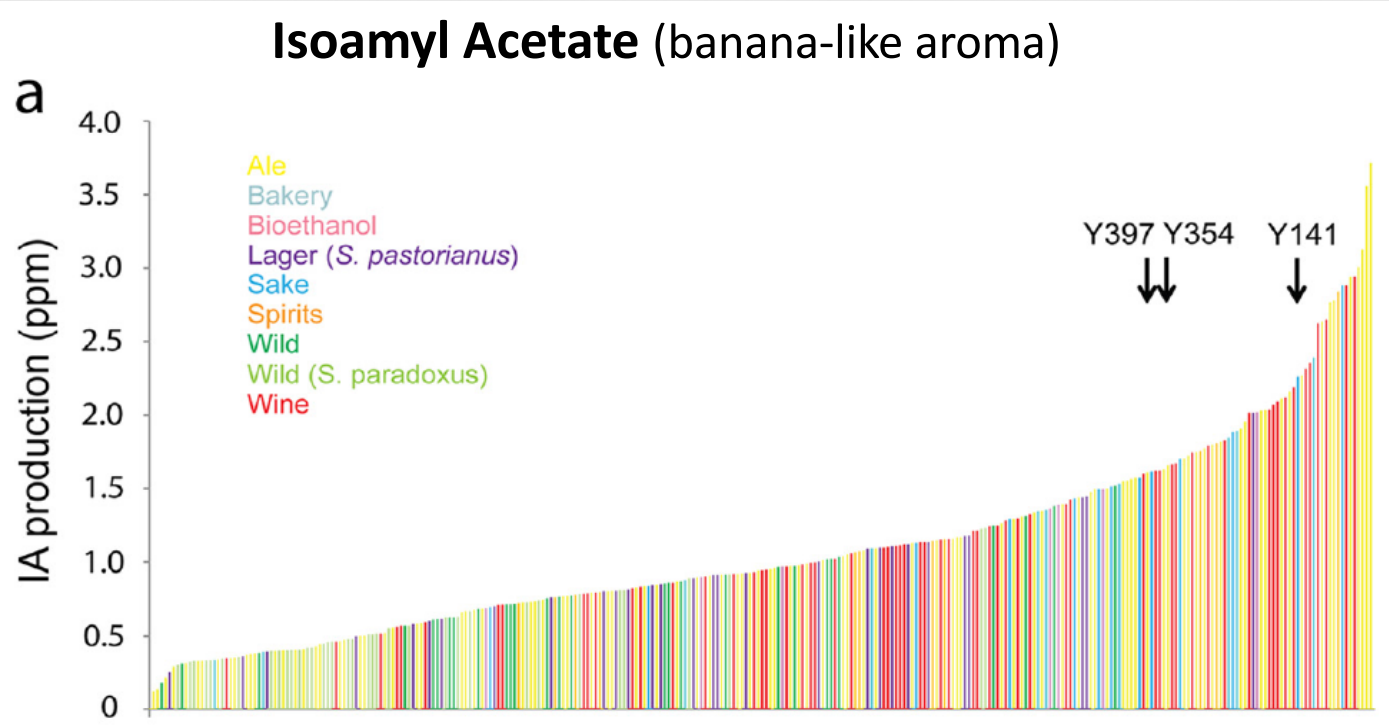
Comparison of Isoamyl Acetate production

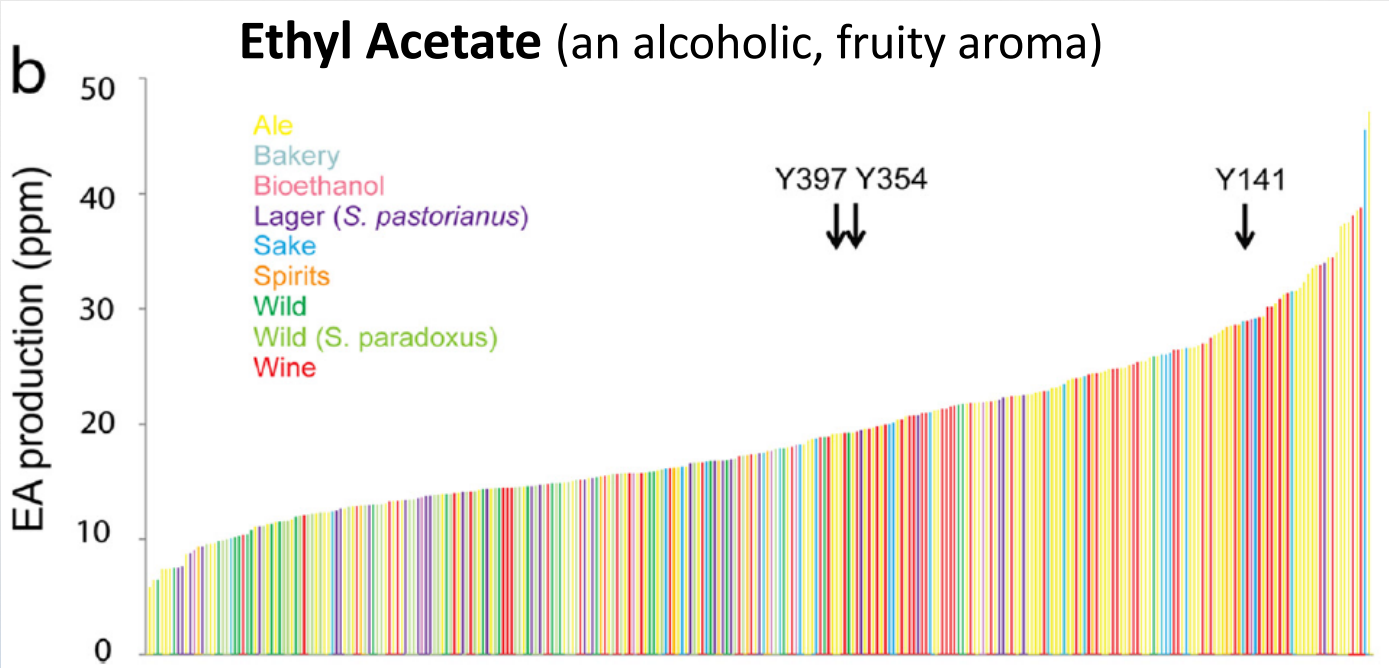


Domesticated strains

Nondomesticated strain

Steensels et al., 2014





The difference in (a) IA and (b) EA between 301 *Saccharomyces* strains.

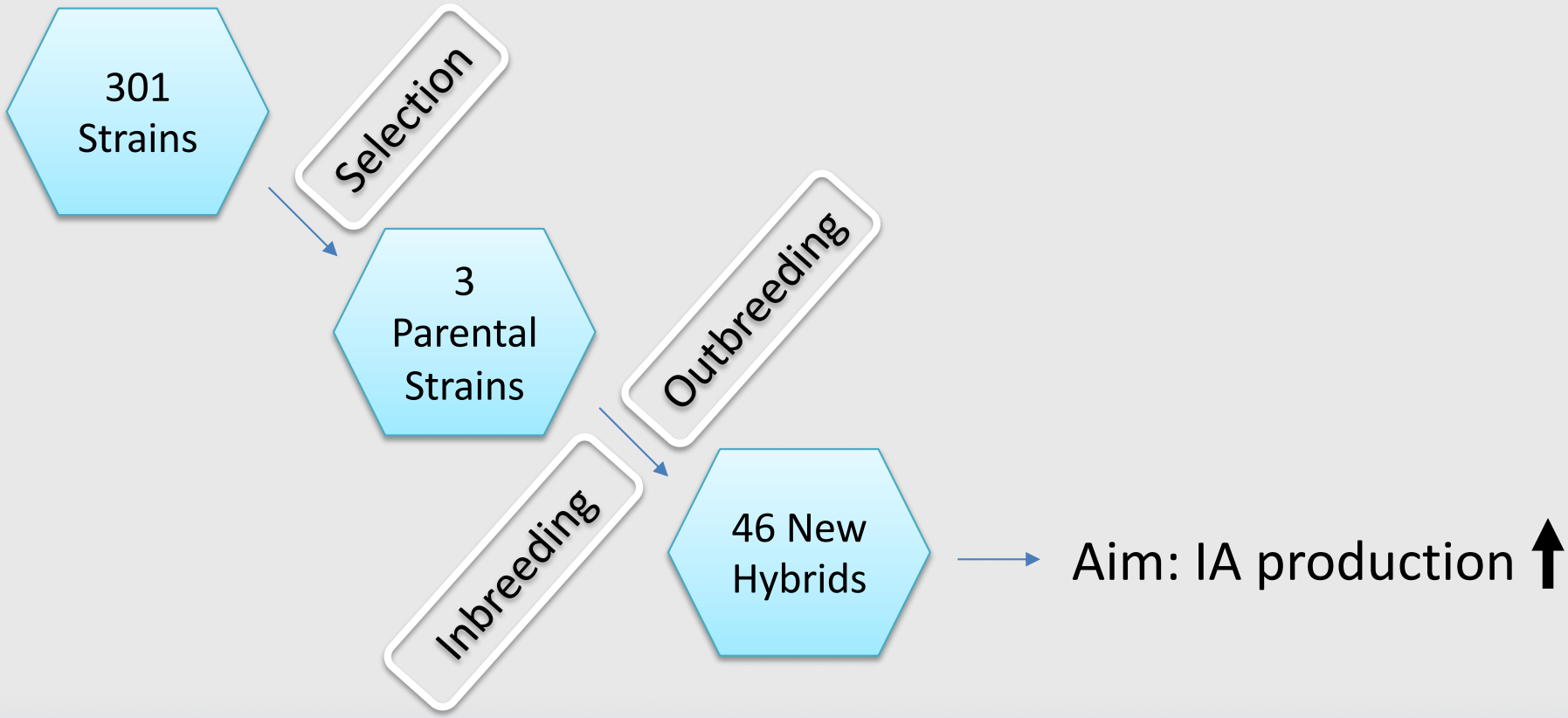
Y141

Y354

Y397

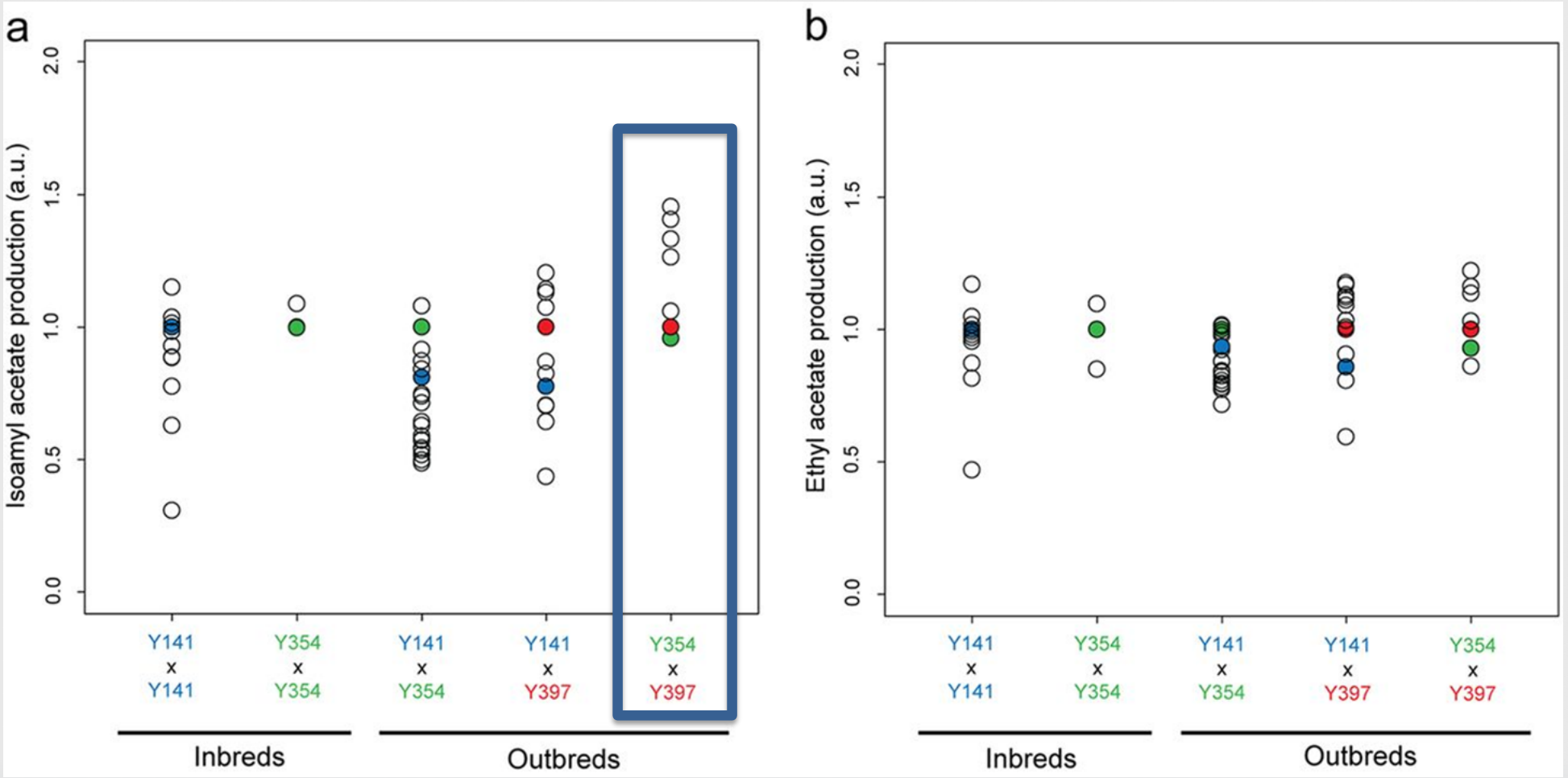
Steensels et al., 2014

Aroma production, genetic relatedness, and sexual life cycle



Created in PowerPoint

Production levels of IA (a) and EA (b) of the 46 different hybrids.



46 developed hybrids (open circles)
3 parental strains (colored circles)

Steensels et al., 2014

In conclusion

- ✓ The production of IA -> domestication phenotype
- ✓ Overview of the diversity in yeast aroma production
- ✓ New hybrids with superior IA production -> readily usable in industrial applications

Take-Home-Message

- ✓ Studies on the origins, evolutionary history, and phenotypic diversity of industrial yeasts provide a resource for further selection of superior strains.
- ✓ Selective breeding is a promising approach to obtain superior industrial yeasts with desired phenotypes.


END
Thank you for your attention
Any Questions ?

Why they did not use GMO strategies?

GMO

GENETICALLY MODIFIED ORGANISMS



more appropriate to improve complex <u>industrially</u> relevant yeast traits

Is there any side effect of hybridization?

During selective breeding for a specific phenotype, undesired traits may appear.

In their case, selection for IA is often accompanied by an increase in EA bec. of sharing metabolic pathway. Although EA often contributes positively to the flavor of fermented products, it can affect negatively when it is present in high concentrations. But in this study, EA production of the hybrids did not reach critically high levels.