

How yeast strain selection can influence wine characteristics and flavors in Marquette, Frontenac, Frontenac gris, and La Crescent

Katie Cook, Enologist, University of Minnesota



**Viticulture, enology and marketing
for cold-hardy grapes**

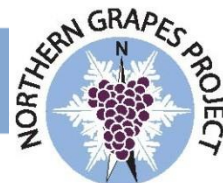
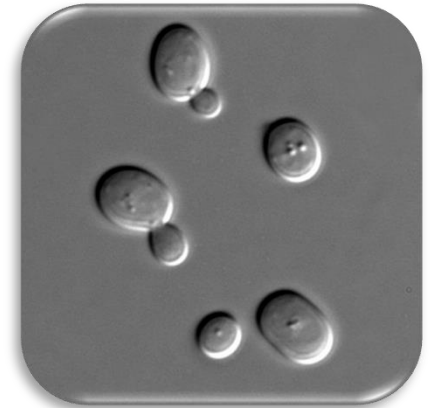


UNIVERSITY OF MINNESOTA



Fermentation Yeast

- *Saccharomyces* – “sugar fungus”
 - In absence of oxygen, they transform sugar to ethanol and CO₂
- Evolved at the same time as fruits with competitive advantages:
 - produce large amounts of ethanol and tolerates it
 - Able to grow in both aerobic and anaerobic conditions



Saccharomyces sensu stricto species

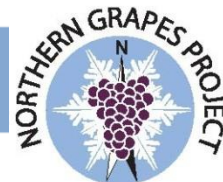
- *S. cariocanus*, *S. mikatae*, *S. paradoxus*, *S. kudriavzevii*
 - Mostly found in natural environments; not associated with human activity
- *Saccharomyces uvarum*
 - Has been isolated from wine and cider fermentations
- *Saccharomyces bayanus*
 - Used in lager beer fermentation
- *Saccharomyces cerevisiae*
 - Most commonly used species by humans
 - Wine, ale beer, sake, palm fermentation
 - Leavened bread



Saccharomyces cerevisiae

- Numerous strains of this species have been isolated from beverages and food, but only few have been found in nature
 - *S. cerevisiae* originated in natural environments, and was followed by human domestication
 - For wine yeasts, 95% of strains isolated around the world belong to the same genetic cluster

Suggests a unique origin of wine yeasts, followed by expansion of populations through human activities



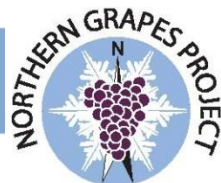
Yeast as a tool

- While selecting proper yeast can help you achieve a desired wine style, it is just a small part of the winemaking process
- Quality primary material (grapes/fruit) will have biggest impact on final wine



Advantages of cultivated yeast

- Faster start to fermentation
 - Exclusion of defects due to delayed start
- Greater yield of ethanol
- Lower production of volatile acidity and other off-aromas
- Full exhaustion of fermentiscible sugars
 - Limits bacterial growth; Better control of wine flavor
 - Increases wine stability



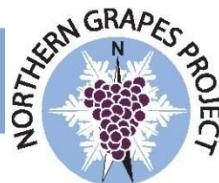
Advantages of cultivated Yeast

- Better control of fixed acidity through malic acid consumption or production
- Optimal production of secondary metabolites
 - Higher alcohols, esters, glycerol...
- Optimizing interaction with Malolactic bacteria



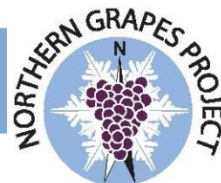
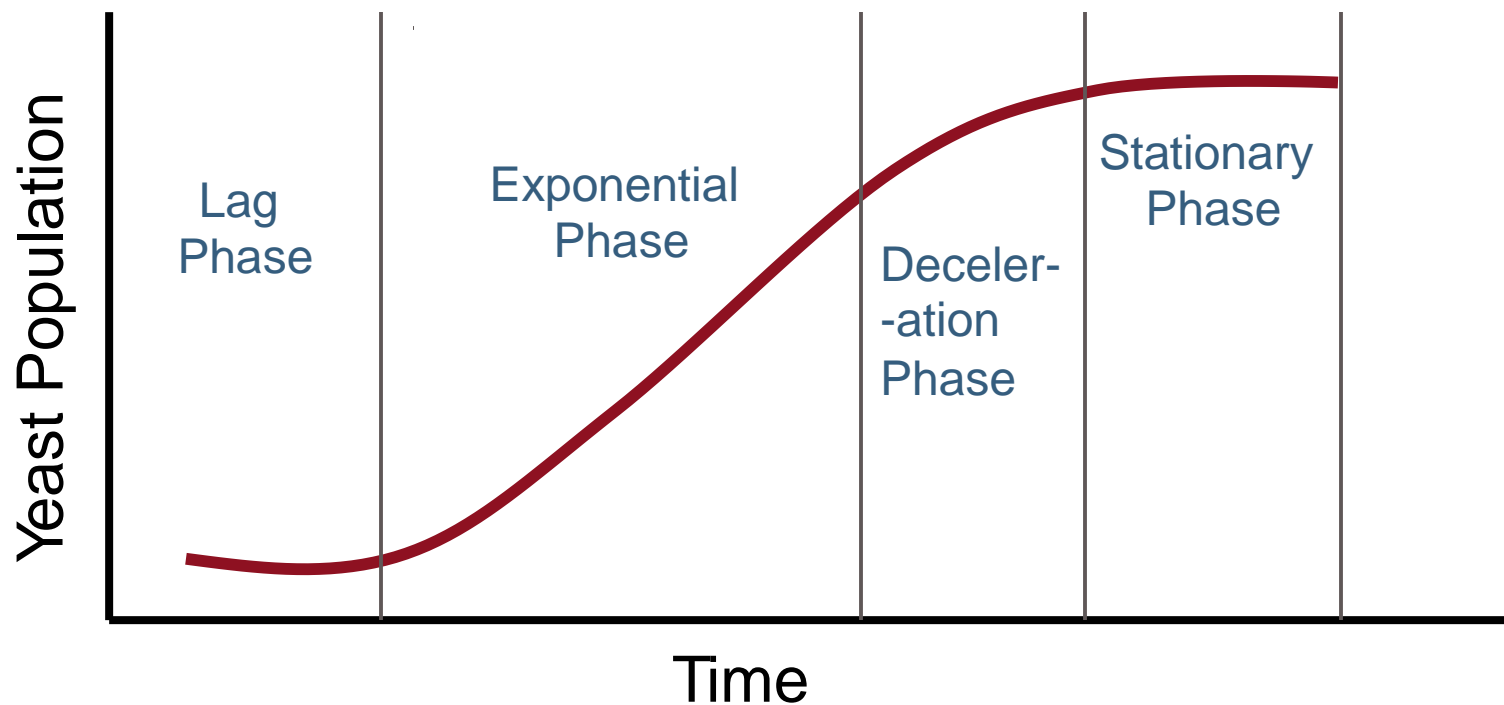
Advantages of cultivated Yeast

- Selection of yeast strains has made wine safer:
 - Able to ferment and stabilize wine with lower levels of SO₂
 - Detoxification of wines from Heavy metals originating from vineyard treatments
 - Low production of ethyl carbamate and biogenic amines



Fermentation Kinetics

- Four phases of yeast growth:



What do yeast contribute to wine?

- Ethanol
- Glycerol
- Higher Alcohols
- Esters
- Acetic Acid
- Lactic Acid



Indirect Aroma Contributions

- Enhance varietal aroma freeing bound aromas
 - Monoterpenes
 - Floral aromas, muscat
 - Thiols
 - Lemongrass, grapefruit, passionfruit, guava, boxtree

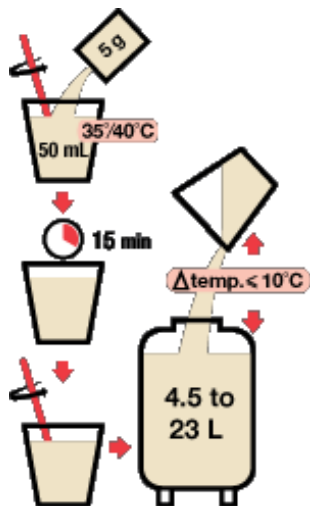


Alfi
cy



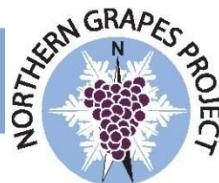
Choosing a Yeast

- All of these direct and indirect contributions by yeast need to be considered when choosing a yeast strain – or when choosing to NOT inoculate your wines!



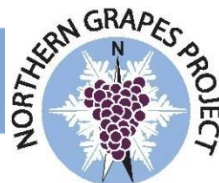
Choosing a Yeast

- The following questions need to be answered for each fermentation lot before selecting a yeast:
 - What style of wine would I like to produce?
 - What does my harvest chemistry look like?
 - Phenolic and technologic
 - What are my cellar limitations?
 - What post-fermentation treatments will I employ?



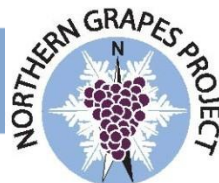
Technological Maturity

- Most cold-hardy grapes are harvested according to their technological maturity
 - Limitations in climate
 - Early frost, short growing season
 - Genetic constraints of cold-hardy cultivars
 - High brix/high TA/high pH; foxy characteristics
 - Poor understanding of phenolic development and its contribution to cold-climate wines



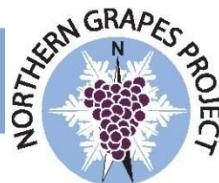
Choosing a Yeast

- Grape variety and ripeness should also be considered when thinking about wine style
 - Aromatic vs. neutral variety
 - Full-ripeness vs. underripe
 - Age of vineyard, soil type, climate...
- Overcropped vines or shaded fruit with poor phenolic and/or technologic ripeness will rarely make a high-end wine



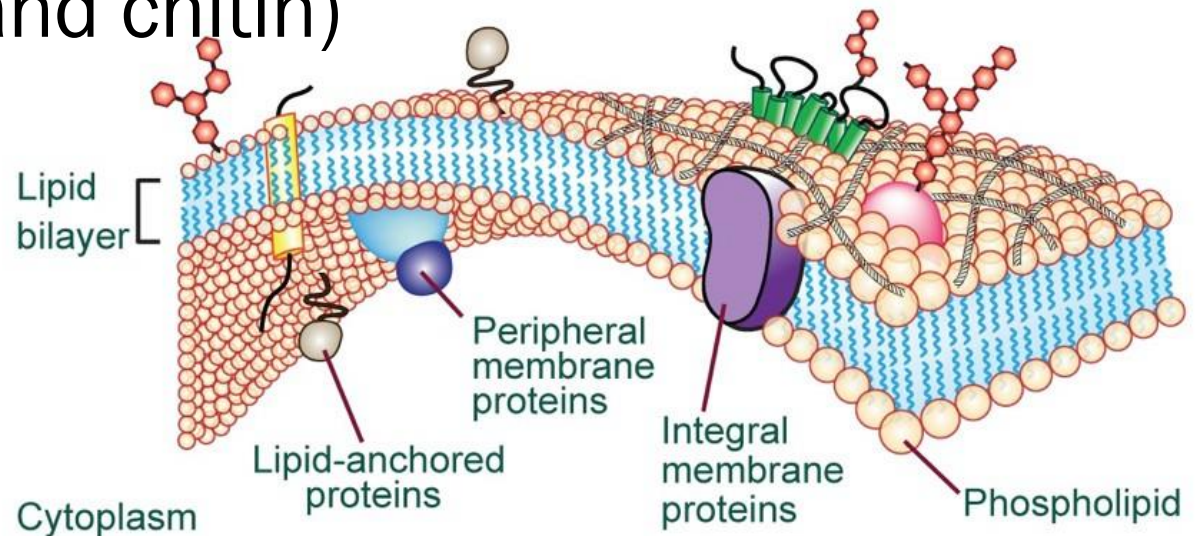
Wine Style

- Often wine style is determined more by the quality of the fruit rather than the desire of the winemaker
- Poor quality fruit needs to be treated differently than high quality fruit
 - Short maceration time, cooler fermentation temperatures, less extractive techniques
 - Underdeveloped fruit aromas in the grape mean that aromatic yeasts should be used



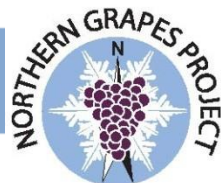
Limitations on yeast

- Yeast cell membrane - lipid bilayer
 - The fluidity of the Lipid bilayer is weakened by alcohol, temperature, sugar concentration...
- Polysaccharides provide strength to the cell wall (glucan and chitin)



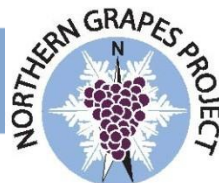
Cultivar Considerations

- Most yeast catalogs give yeast recommendations based on how well they work with certain grape cultivars
- Generally a large sensory study is carried out to determine the organoleptic impact that the yeast has on the wine
- Only a very small % of the world's cultivars are represented on these charts



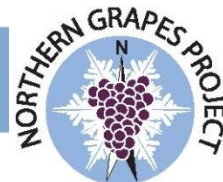
Cultivar Considerations

- When working with a grape cultivar not listed on yeast charts, key words listed in the description can help guide your selection:
 - Monoterpenes
 - Esters
 - Thiols
 - Neutral
 - Spicy
 - Aromatic
 - Extraction
 - Mouthfeel



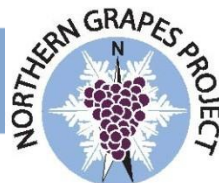
Yeast Selection in Cold-hardy hybrids

ENHANCING VARIETAL AROMAS IN FRONTENAC, FRONTENAC GRIS, MARQUETTE, AND LA CRESCENT



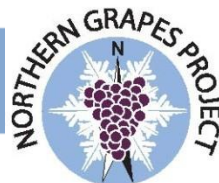
What we know...

- Some aroma work has been done to elucidate varietal aromas and their origins in hybrid grapes



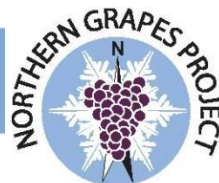
Frontenac Varietal Aromas

- Descriptive Analysis (Mansfield, 2009)
 - Cherry, black currant, blackberry, cooked vegetable, spice, earthy, black pepper, geranium, floral, jammy, fresh green, cedar, tamari
- Aroma Compounds (Pedneault, 2013)
 - β -damascenone, 2-phenylethanol, eugenol
 - C6 compounds decreased over ripening
 - Hydroxycinnimate esters increased during ripening



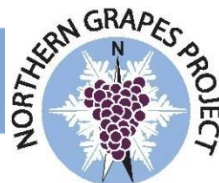
Marquette Varietal Aromas

- Cherry, Raspberry, Black Pepper, vegetal, straw, blackberries, plum, tobacco, leather, spice...



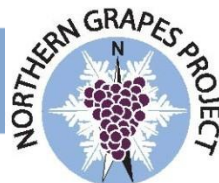
Marquette Varietal Aromas

- Analysis of aroma compounds (Pedneault)
 - High concentrations of monoterpenes
 - Geraniol, linalool, *cis* rose oxide
 - 2-phenylethanol, eugenol
 - Hexanal increased over ripening
 - Hydroxycinnamate esters increased during ripening



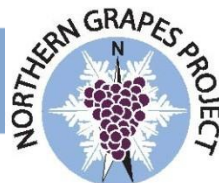
La Crescent

- Floral, spice, citrus, tropical fruit...
- Dharmadhikari observed Sauv. Blanc-like aromas when fermented with a thiol-releasing yeast (Alchemy)
- Aroma Compounds
 - High in Monoterpenes (Dharmadhikari)



Frontenac Gris Aromas

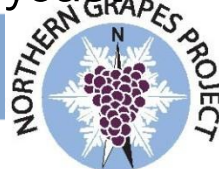
- Peach, Apricot, Citrus, Tropical Fruit, pineapple, Honey, Melon...



Cultivar Consideration - NGP

In 2012, a multi-state trial of wine yeasts with cold-hardy cultivars will help give insight as to how certain yeast might benefit wines made from cold-hardy grapes

- Marquette
 - looking to enhance varietal character (spiciness and dark fruits) as well as mouth-feel and extraction
- Frontenac Gris
 - Looking at the effect of thiol-producing yeast on wine made from FG
- La Crescent
 - Aromatic yeast strains, as well as monoterpene production
- Frontenac
 - Enhancing fruit character with ester-producing yeast



Yeast Trials – First Year NGP

Yeast	Grape cultivar	Goal
Vin 13 NT 116	Frontenac gris	Understand whether thiols play an important role in varietal aroma
Vitilevure Elixir Cross Evolution	La Crescent	Release terpenes to intensify primary aromas
D254 BRG	Marquette	Enhance spicy characters
Rhone 4600 ICV Opale	Frontenac	Enhance fruity character

