Hopsource Project Update

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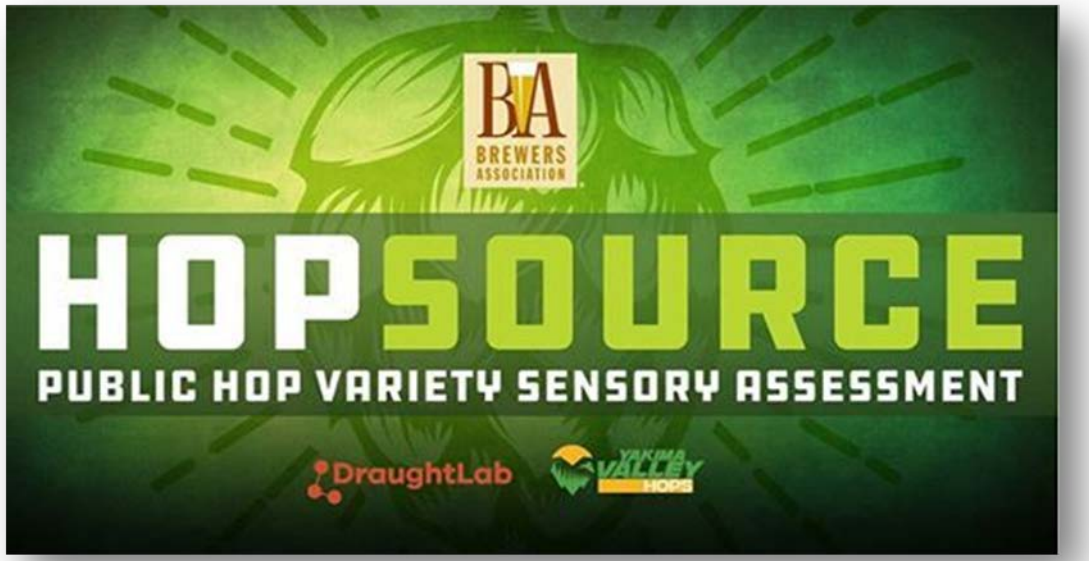
Hopsource Objectives

<u>The Mission</u>

- Identify public varieties, early in the breeding process, that show commercial promise for their sensory characteristics.

<u>The Requirements</u>

- Fast: No more than 1 min/sample
- Flexible: Can be performed nearly anywhere.
- Robust: Produces reliable and actionable data



Crowdsourcing Data Using Two Methods

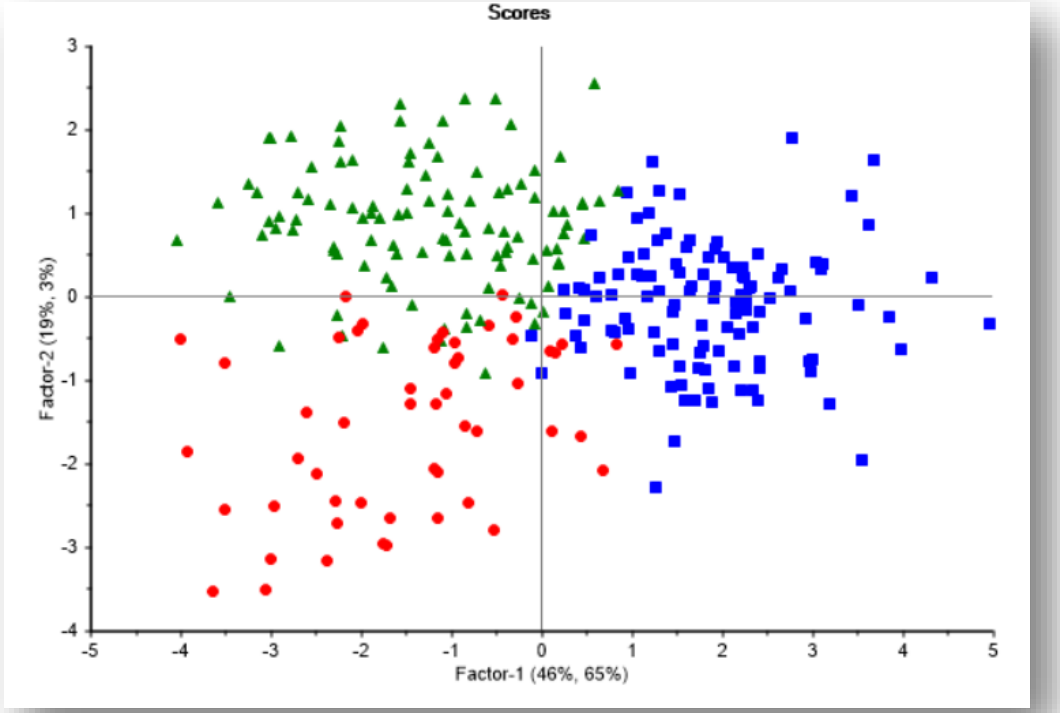
Objectives

- Involve the final consumer (brewers) throughout the entire breeding process
- Identify promising varieties
- Guide future breeding according to consumer preferences
- Build a database to identify trends and track progress year-over-year

Check-All-That-Apply (CATA)	Hedonics
"Check all attributes that are detected in the sample." • Tropical • Stone Fruit • Floral • Citrus • Herbal/Grassy • Pine • Woody/Earthy • Onion/Garlic	"Select the phrase that best describes your overall opinion about this sample." • Like Extremely • Like Very Much • Like Moderately • Like Slightly • Neither Like Nor Dislike • Dislike Slightly • Dislike Moderately • Dislike Very Much • Dislike Extremely

Hopsource Impact on Public Breeding

- 4th year of running Hopsource
  - ~6,000 individual evaluations
  - Over 500 unique participants
  - Over 200 Varieties
- We've identified…
  - …varieties that consistently perform well
    - Repeated results for half of the top varieties
  - …aromas that drive and predict liking in hops
    - Stone Fruit, Citrus, Tropical & Floral
    - Onion/Garlic
    - Woody/Earthy & Herbal/Grassy



Hopsource 2019 and beyond

<u>Goals for 2019 and 2020</u>

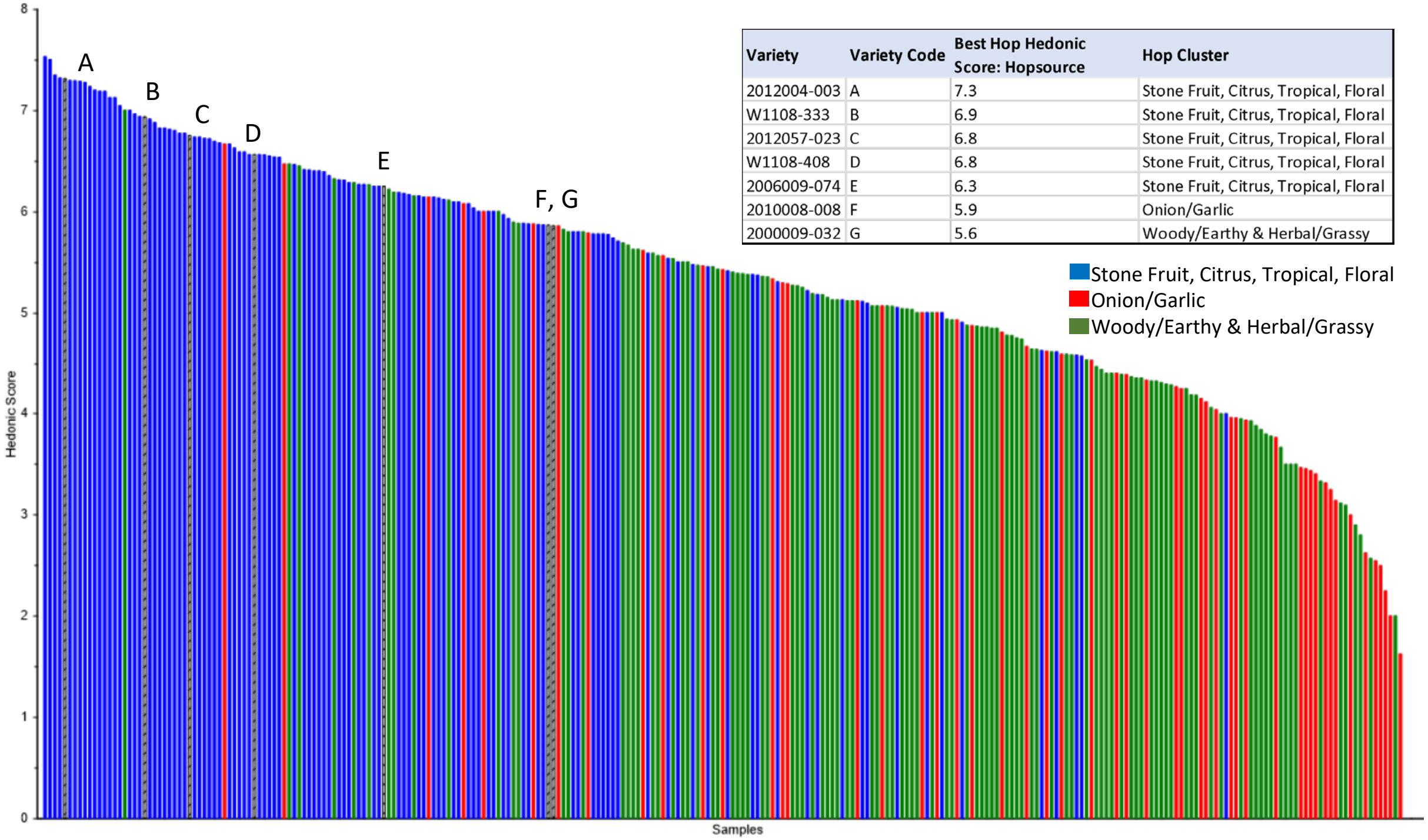
- Validate previous year's results
- Continue evaluating more experimental varieties
- Correlate liking between hops and beer
- Assess aroma similarities/differences between hops and beer

Stone Fruit, Citrus, Tropical, Floral
Onion/Garlic
Woody/Earthy & Herbal/Grassy

Brewing Trials

- Objective
  - Analyze experimental varieties for their brewing potential
- Hypothesis
  - Hop liking translates to beer liking
  - Raw hop aromas translate into beer aromas
- Method
  - Consistent CATA and Hedonic sensory evaluation method
  - 7 Breweries
  - 7 Varieties
  - 15 Beers
    - 7 Lagers
    - 8 IPAs
  - ~65 Panelists during the HRC meeting 1/21/20

Check-All-That-Apply (CATA)	Hedonics
"Check all attributes that are detected in the sample." • Tropical • Stone Fruit • Floral • Citrus • Herbal/Grassy • Pine • Woody/Earthy • Onion/Garlic • Cereal/Bready • Nutty • Stale • Cheesy • Dried Fruit • Bitter • Sweet	"Select the phrase that best describes your overall opinion about this sample." • Like Extremely • Like Very Much • Like Moderately • Like Slightly • Neither Like Nor Dislike • Dislike Slightly • Dislike Moderately • Dislike Very Much • Dislike Extremely 



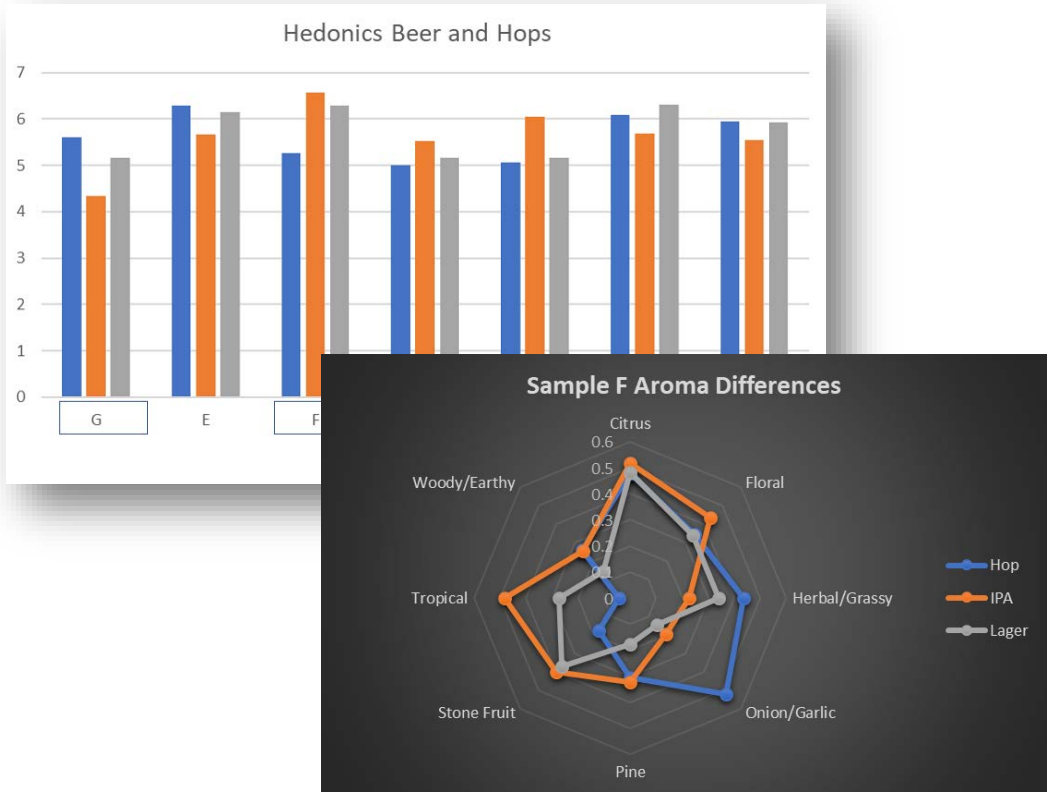
Variety	Variety Code	Best Hop Hedonic Score: Hopsource	Hop Cluster
2012004-003	A	7.3	Stone Fruit, Citrus, Tropical, Floral
W1108-333	B	6.9	Stone Fruit, Citrus, Tropical, Floral
2012057-023	C	6.8	Stone Fruit, Citrus, Tropical, Floral
W1108-408	D	6.8	Stone Fruit, Citrus, Tropical, Floral
2006009-074	E	6.3	Stone Fruit, Citrus, Tropical, Floral
2010008-008	F	5.9	Onion/Garlic
2000009-032	G	5.6	Woody/Earthy & Herbal/Grassy

Brewing Trial Results

American Hop Convention 2020: Results

- All data captured at the American Hop Convention 2020
- Number of panelists
  - ~20 panelists for hops
  - ~64 panelists for beer

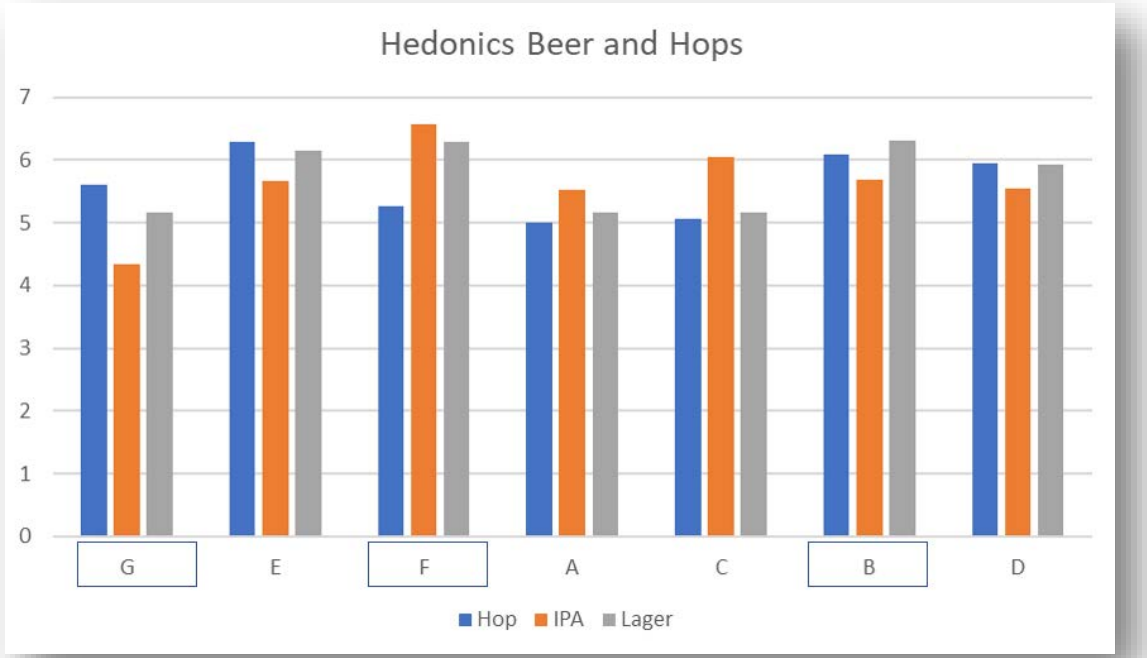
These data are presented as preliminary results for directional evidence to be explored further with larger samples.*



Overall hedonic scores for hops & beer styles

We chose one example from each cluster to dive into preliminary understanding of the relationship between liking and aroma across hop and beer:

- G: Woody / Earthy & Herbal / Grassy
- F: Onion / Garlic
- B: Stone fruit, Citrus, Tropical, Floral

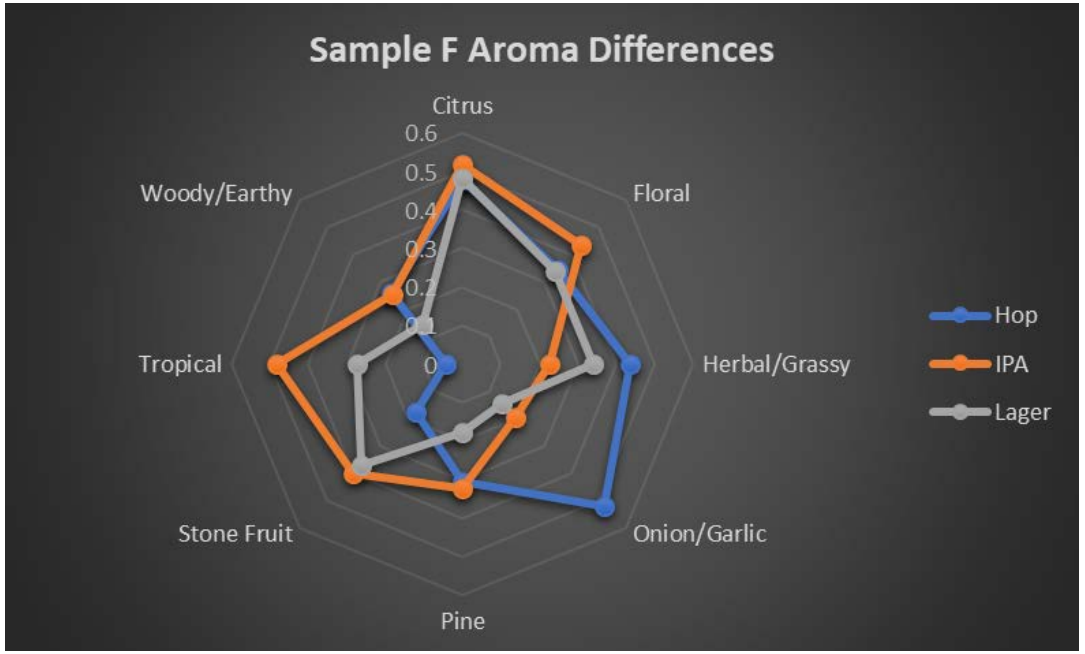


Initial analyses indicate that **variety** moderates the stability of both **liking** and **aroma** between hops and beers

Results: Sample F

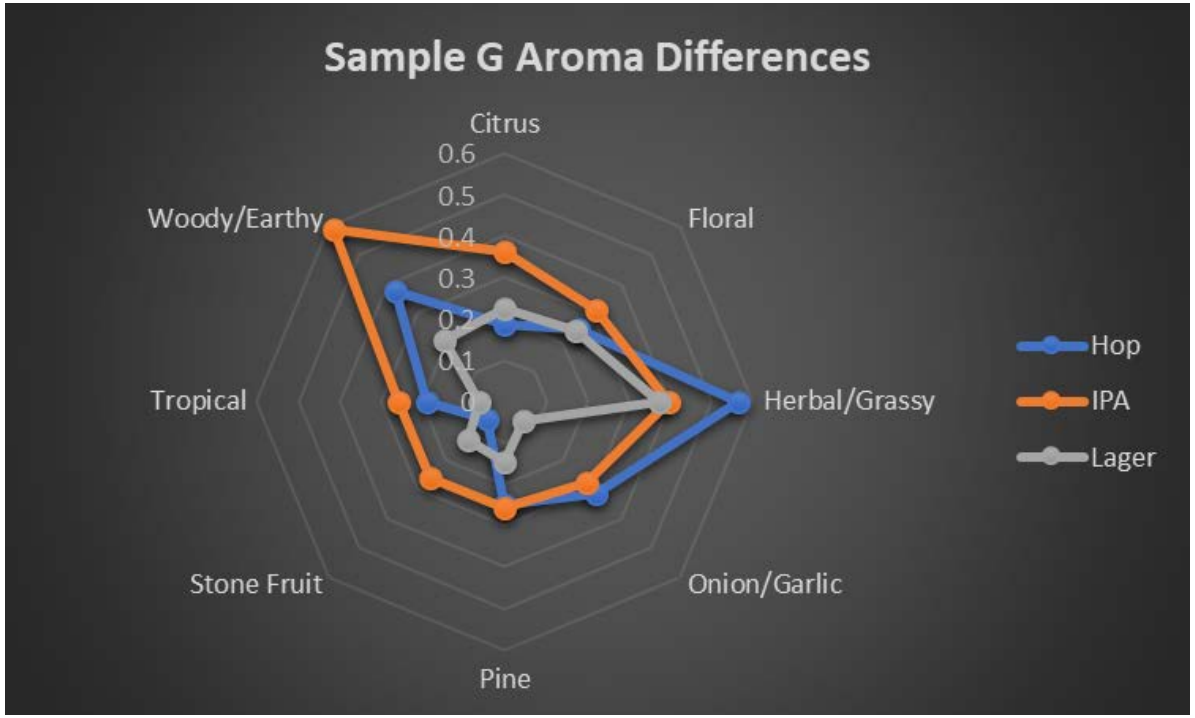
- Sample F (Onion/Garlic Cluster) *Liked more in beer than in hop*
  - High in hop/Low in beer: Onion/Garlic
  - Low in hop/High in beer: Tropical and Stone Fruit
  - Unchanged: Citrus and Floral

- Directional evidence: *Compared to hops in other clusters, aroma attributes are less stable for hops in the onion/garlic cluster*



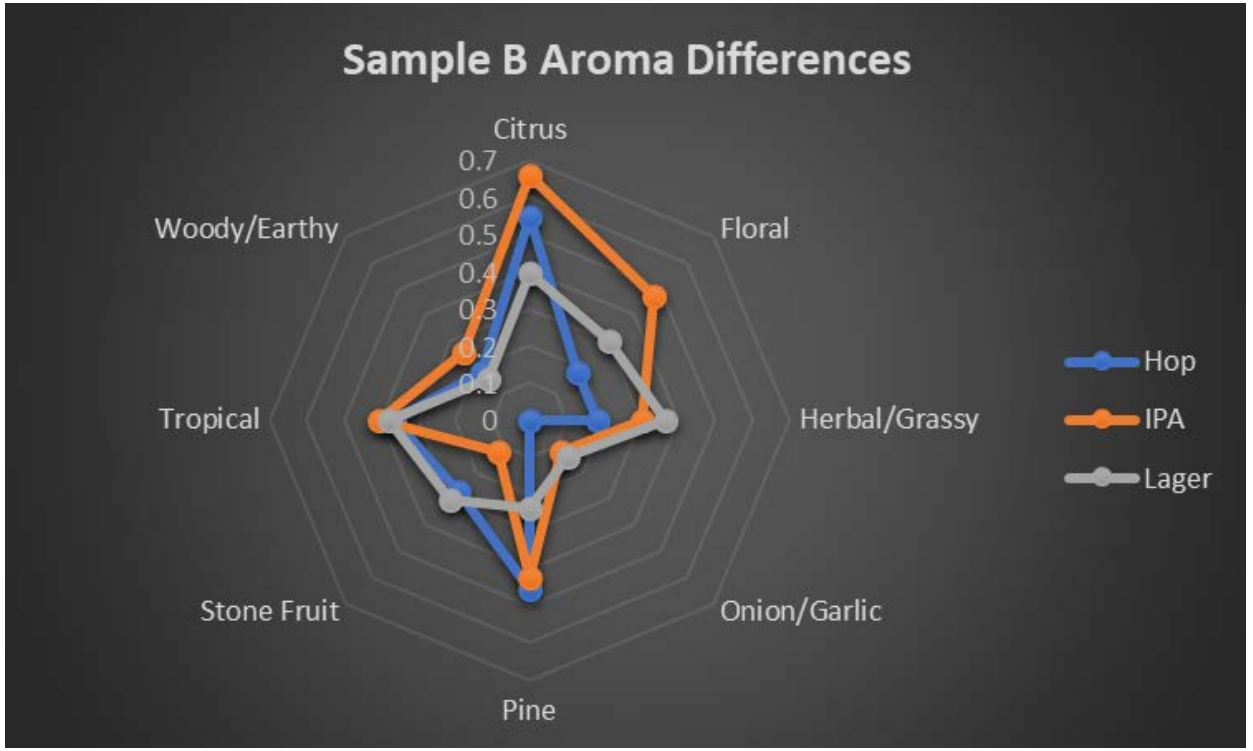
Results: Sample G

- Sample G (Woody/Earthy & Herbal/Grassy Cluster) *Liked more in hop than in beer*
  - High in hop/Low in IPA: Herbal/Grassy
  - Low in hop/High in IPA: Woody/Earthy
- Directional evidence to explore further: *Woody/Earthy and Herbal/Grassy aromas are stable from hops to beer and have a negative impact on beer liking*



Results: Sample B

- Sample B (Stone Fruit, Citrus, Tropical, Floral Cluster) *Consistent liking in hop and beer*
  - High in hop/Low in IPA: N/A
  - Low in hop/High in IPA: Floral
  - Unchanged: All but Floral
- Directional evidence to explore further: *Compared to hops in other clusters, aroma attributes are more stable for hops in the fruity/floral cluster*



Next Steps

- Questions
  - Explore factors that influence hop and beer liking correlations
- 2020 and Beyond
  - Expand into more brewing trials
  - Evaluate more experimental varieties in more locations over multiple weeks in 2020
  - Continue validating results