2019 Hop Germplasm Study

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THE UNIVERSITY OF VERMONT EXTENSION

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Until now, commercial hop (*Humulus lupulus* L.) production has not occurred in the northeast (NE) region of the United States for 150 years. Vermont production peaked in 1860 when the state produced 638,767

Figure 1. Map of original wild hop rhizome collection sites.

In 2019, germplasm varieties were fertilized

Although these data were not analyzed for statistical differences, it is worth noting the observed differences in pest pressure, yield, cone quality, and brewing quality.

The germplasm lines appeared to differ in their susceptibility to pests (Table 3). With the wet spring and above average precipitation in April and May, conditions were conducive for heavy downy mildew pressure within the hop yard. Aerial spike and basal spike data is presented as an average number of spikes per plot with basal spikes more prevalent early in the growing season before training, and aerial spikes present later in the growing season after training. Wolcott 001 showed the highest yearly occurrences for downy mildew aerial and basal spikes at 10.0 and 8.0 spikes plot^{-1} whereas Peacham 002 showed the lowest average number of aerial spikes at 0.5 spikes plot^{-1} and Argyle 001 had the lowest average number of basal spikes at 0.4 spikes plot^{-1}.

Table 3. Insect and disease scouting incidence for Germplasm varieties, Alburgh, VT 2019.

Variety	Aerial spike	Basal spike	HA	PLH	TSSM	SMD
	plot^{-1}	plot^{-1}	leaf			

Figure 2. Average number of

Figure 3. Hop germplasm cone yields at 8% moisture, 2019.

Kingdom 002 had the highest 100 cone weight at 39.6 g, whereas Wolcott 001 had the lowest 100 cone weight at 12.0 g. Cone size and shape varied greatly across germplasm varieties. In 2019, cones became noticeably browner in the week leading up to harvest and major cone affecting diseases such as downy mildew and alternaria were found throughout the hops, perhaps impacting the brewing quality and aromatic profiles of the hops in addition to yields. All varieties as a result showed high incidence of cone disease and severity throughout the study.

Hop varieties varied dramatically in alpha and beta acids (Table 5). In addition to varietal differences, hops also have potential to be influenced by various growing conditions such as fertility, temperatures, precipitation, disease pressure and many others, impacting their profiles. Kingdom 002 and 001 had the highest overall alpha acid percentage within the study (9.8% and 6.1% respectively),

Humulene	0.769	1.79	1.83	1.47	1.47	2.55	4.26	4.31
Geranyl Acetate	0.015	0.154	0.134	0.115	0.121	0.558	0.294	0.289
Beta-citronellol	0.002	0.005	0.00	0.007	0.008	0.017	0.026	0.024
Nerol	0.067	0.023	0.086	0.062	0.058	0.104	0.140	0.156
Geraniol	0.008	0.00	0.027	0.011	0.018	0.023	0.00	0.00

Figure 4. Total oil and essential oil compo

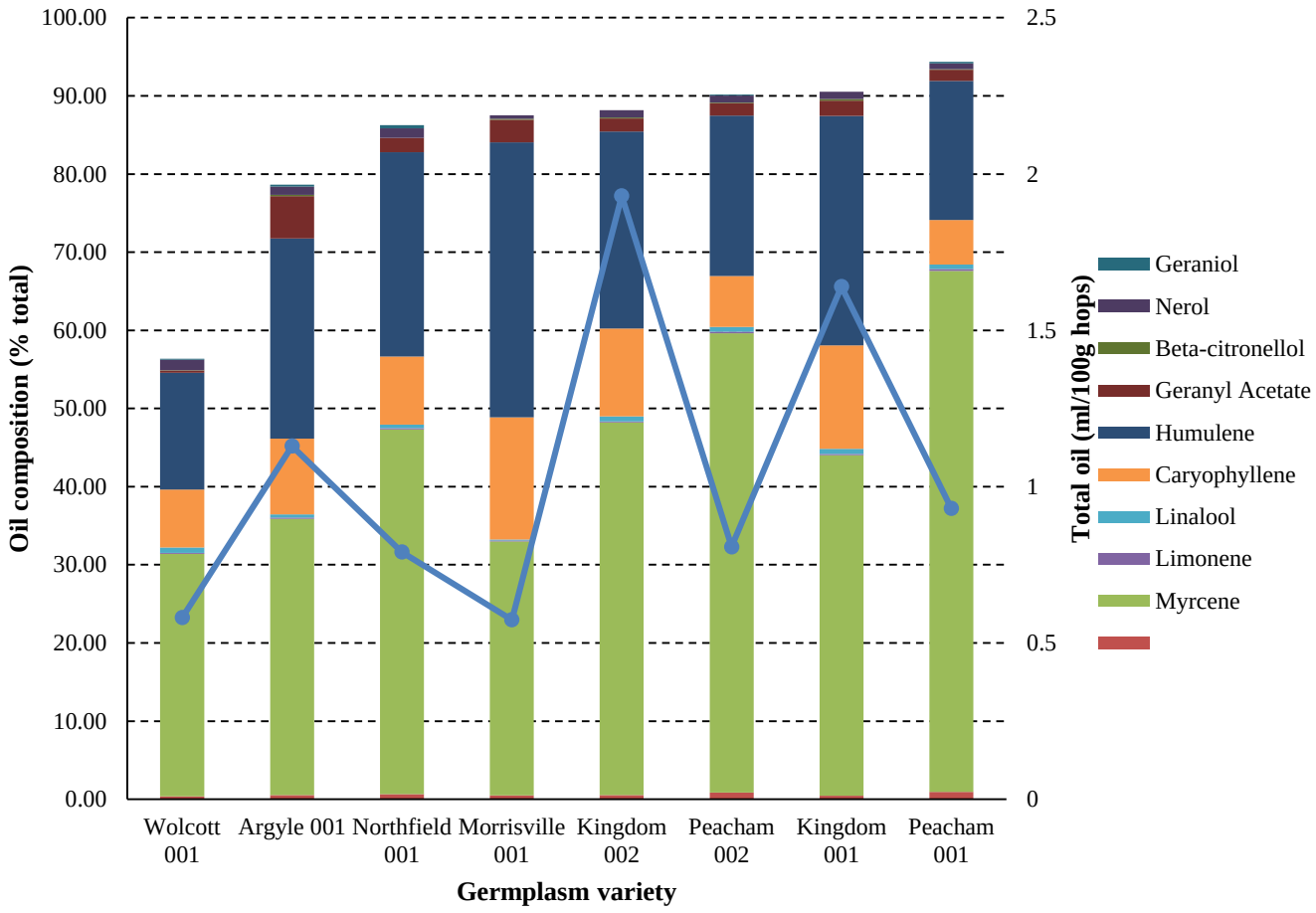

Figure 5. Total oil and essential oil proportions for germplasm varieties, 2019.

DISCUSSION

In 2019, cones became noticeably browner in the week prior to germplasm harvest and major cone affecting diseases such as downy mildew and alternaria were found throughout the hops, perhaps impacting the brewing quality and aromatic profiles of the hops. Disease and pest pressure also impacted overall yields on top of inadequate water supply, limited by both weather conditions during critical cone forming periods and limited well capacity for irrigation. Many of these varieties may have also benefited from earlier harvest date. Despite poor cone quality as a result of delayed harvest, these varieties showed some distinct differences in alpha and beta acids in addition to essential oil profiles. Unique characteristics from these germplasm varieties could provide unique branding opportunities for growers or brewers. As the project continues to develop, we hope to obtain additional wild hop samples from across the Northeast to build a database of genetically distinct cultivars of our wild hop species (*Humulus lupulus* var. *lupulus* and *Humulus lupulus* var. *lupuloides).* This year, three new varieties were collected from Ferrisburgh, VT, Franklin, VT, and Plattsburgh, NY, however yield data and other metrics were not collected as the plants were in their establishment year. Wild hop varieties could provide new and distinct flavor profiles through variable acid and oil profile combinations for use by brewers. With the aim to build this database, new

varieties could become available to regional hop producers that are more suitably adapted to our growing region through greater resistance to downy mildew and other prevalent and damaging pests and diseases. Furthermore, this could offer the potential to open up regionally adapted breeding experiments, which could allow us to select hop traits that would be beneficial for our growing region. Ideally, this would lead to improvements in the quality and consistency of hops for our growers and brewers in our ever-expanding craft brewing industry in Vermont and the rest of the Northeast.

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