

Introduction

- *Humulus lupulus* (hops) are used to bitter and flavor beer. They are vines that grow up to 7.5 meters tall. The female inflorescence, or cone (Figure 1), is harvested and used in brewing (Kavalier et al. 2011).
- In 2015, of the 45,488 acres of hops grown commercially in the United States mainly in Washington (Figure 2), there was only one acre of commercially grown hops in the entire state of Montana (HGA 2018).
- The goal of this research was to analyze the yields of hop varieties in the Helena Valley, MT using vegetative biomass weight and cone yield. Our results can be used by local farmers in order to inform commercial farming in Montana.
- Based off of last years results we hypothesized that Willamette, which had the highest average above-ground biomass per plant in its first season (N.S.), would have the highest biomass yields in its second season.



Figure 1. Mature cones of a Chinook plant before harvest.

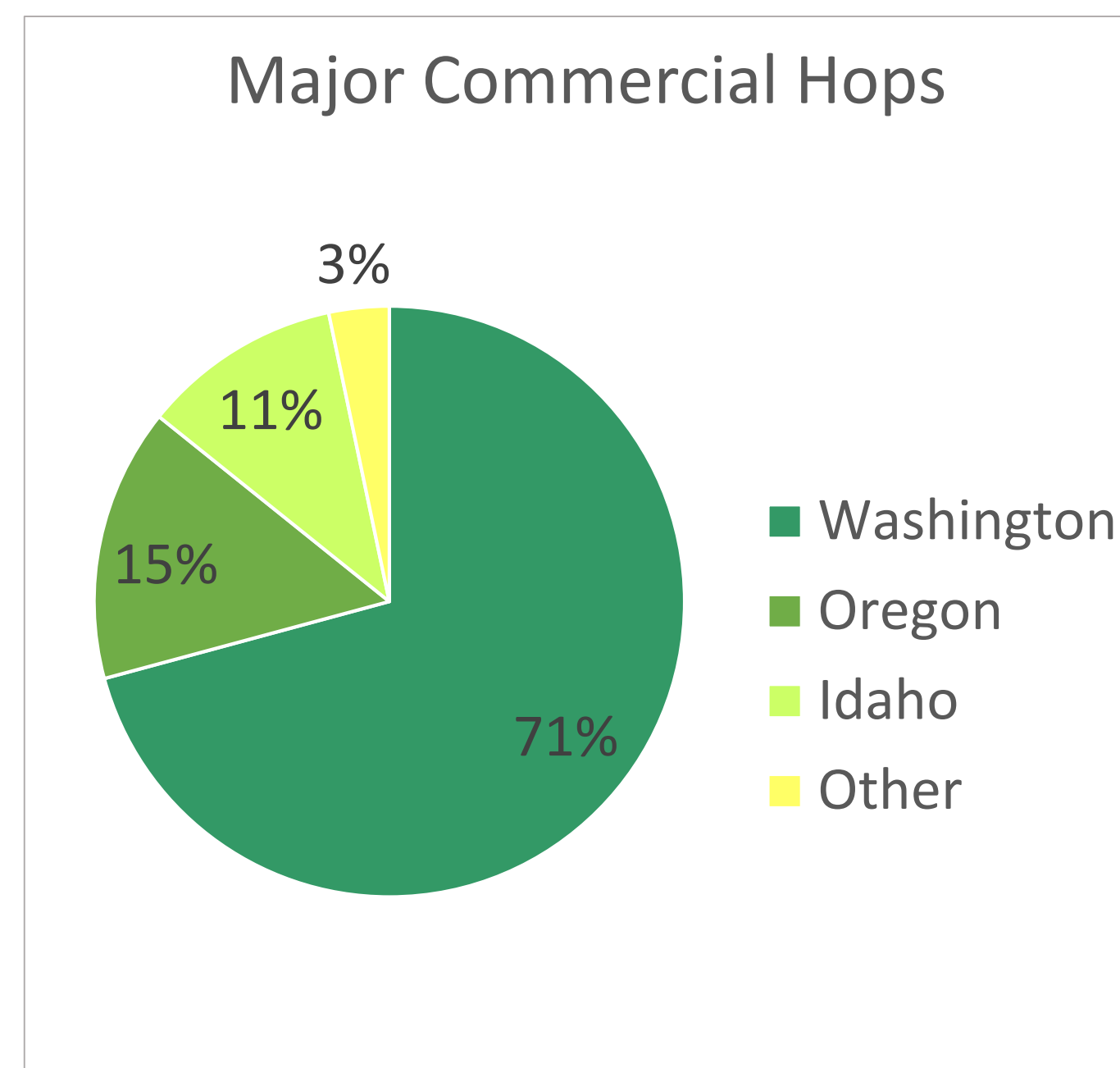


Figure 2. Commercially grown in the United States in 2015 (HGA 2018).

Methodology

- Four hops varieties (Chinook, Liberty, Sterling, and Willamette) were planted summer 2017. Five additional varieties (Cascade, Centennial, Columbus, Galena, and Tettnanger) were planted early at the start of the 2018 growing season. Replacement plants were also planted for the plants that died last year.
- The plant vines grew up rope trellises (Figure 3) and were harvested in late August. All plants were watered three times a week using a drip irrigation system during the entire growing season through the harvest.
- The plants were then harvested and separated by vegetative biomass and cone yield, then dried and weighed.
- ANOVA and z-tests were then conducted on the collected weights to find the p-values.



Figure 3. Hops planted in 2017 growing up the trellises (left) and the temporary trellises built for the 2018 hops (right).

Results

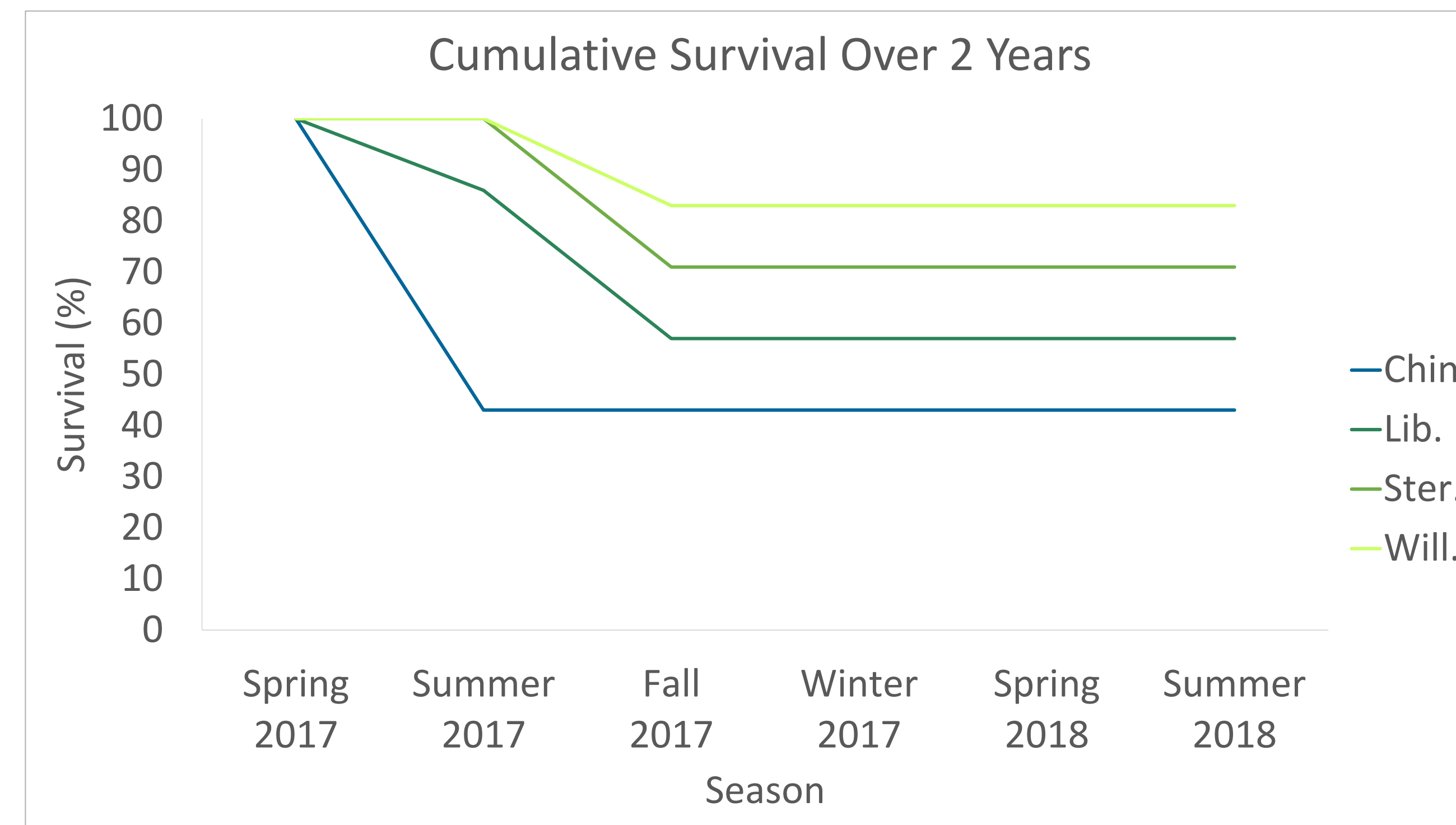


Figure 3. Percentage of plants that survived through the 2017 and 2018 seasons.

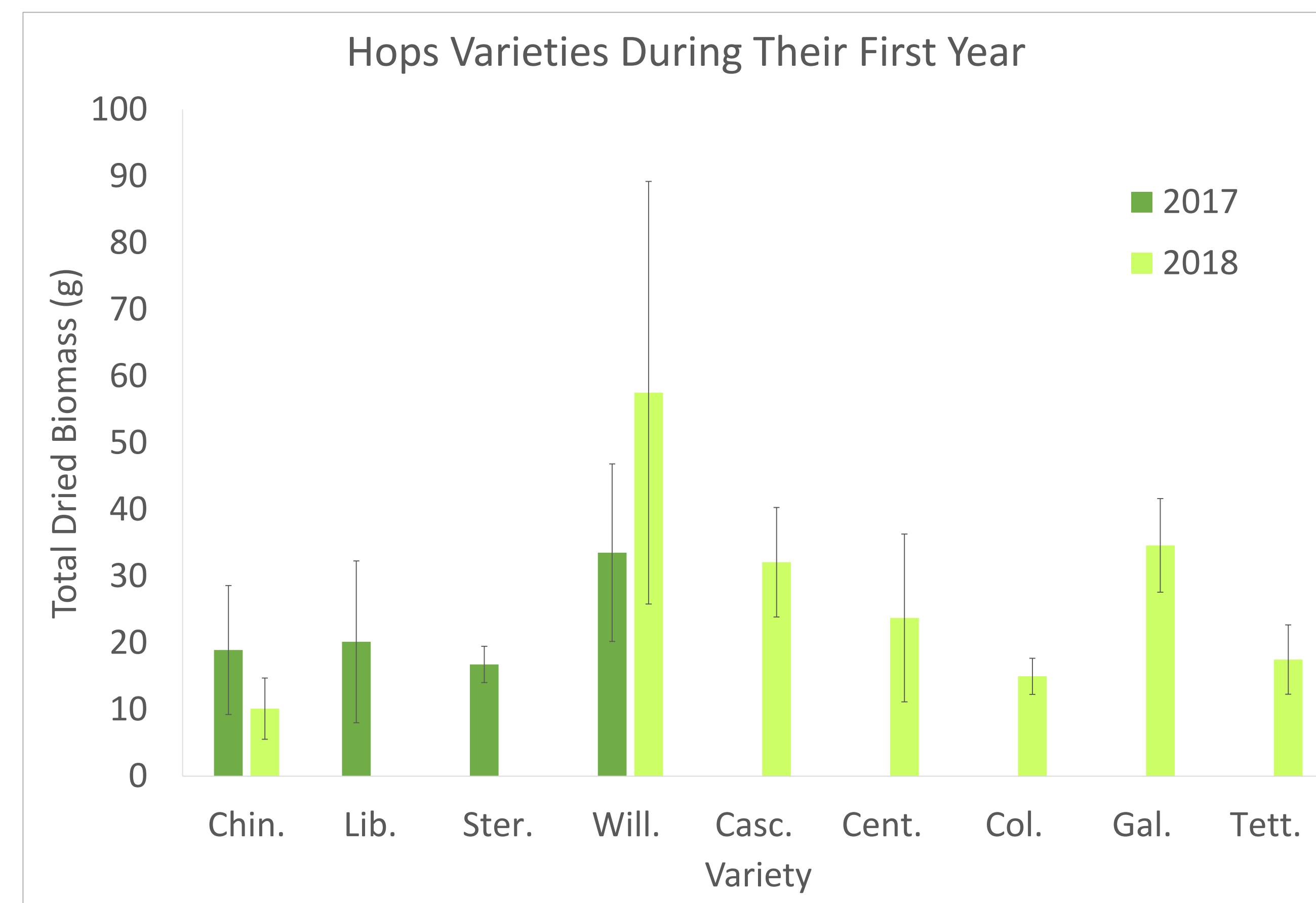


Figure 4. Average dried weights for each of the varieties during their first year. The weight is the combined biomass and cone yield.

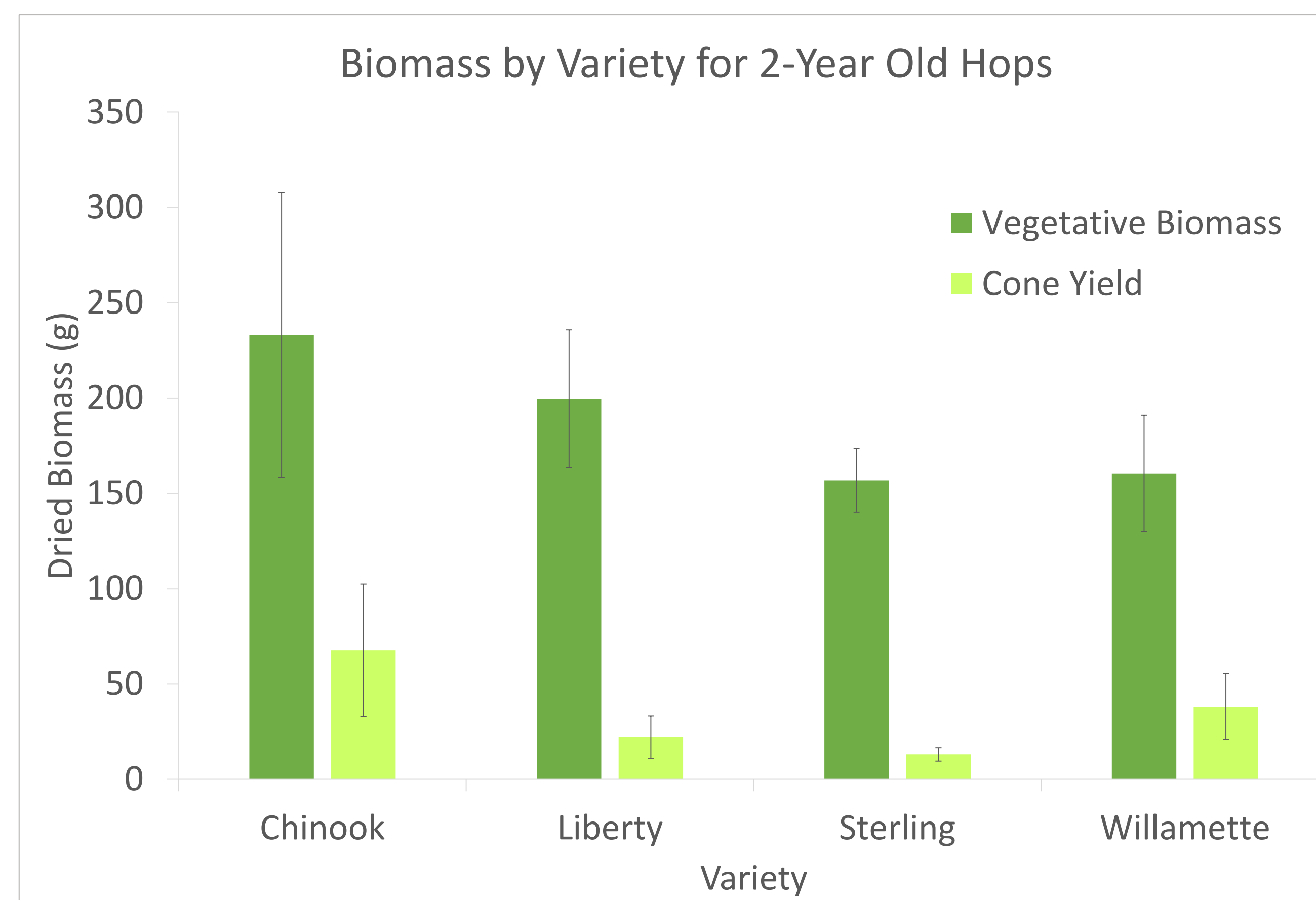


Figure 5. Average dry weights after harvest in August of 2018, for the four varieties of hops planted in 2017. The p-values were 0.588345 and 0.334605 for vegetative biomass and cone yield, respectively.

Discussion

- All of the plants planted in 2017 that survived through their first harvest season survived through the winter and through their second season (Figure 3).
- Despite Willamette's trend for having the highest average biomass in its first season (N.S.) (Figure 4), Chinook had the highest average yield in its second season (N.S.) (Figure 5). However, these results were not surprising since Chinook tends to have highest average yield per acre out of the four varieties (HGA 2018), which our findings supported.
- We found that the p-values for cone yield per plant by variety versus the common values (HGA 2018) were less than 0.000001 for all four varieties of the two year old plants. A likely explanation for p-values less than 0.000001 is that our plants are in their second year, while hop plants do not reach maturity until their third year.
- Further research should be conducted on the hops next growing season looking at plant survival during the winter as well as biomass and cone yield. This will be especially important for the plants entering their third season because hop plants reach their full yield potential in their third year, giving us the best idea of how local hops yields compare to varietal means regionally.



Figure 7. Training two year old hops (left) and harvesting hops, 2018 (right).

References

- Hop Growers of America (HGA). "USA Hops." *usahops.org*. Accessed 10/18/2018.
- Kavalier, Adam R, Nicholi J Pitra, Jared M Koelling, Mark C Coles, Edward J Kennelly, and Paul D Matthews. 2011/ "Increase in Cone Biomass and Terpenophenolics in Hops (*Humulus Lupulus* L.) by Treatment with Prohexadione-calcium." *Journal of Agricultural and Food Chemistry* 59, no. 12: 6720-9.

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