

# Evaluation of Hop Cultivars for Commercial Production in North Carolina

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## Introduction

Many farmers in North Carolina have started growing hops (*Humulus lupulus*) to supply the burgeoning craft brew industry in the Southeastern US. In the US, hop cultivars and the information for growing hops have been generated almost entirely from the major hop production regions in the Pacific Northwest. There long day lengths, sufficient winter chilling, sunshine, and adequate moisture support high yields of quality cones. Identifying cultivars that perform well in humid southern environments with shorter day lengths is essential for success in this new growing region.

## Materials and Methods

In 2011, based on their range of alpha acid content, yield potential, disease and pest resistance, and demand by local craft breweries, ten hop cultivars, Cascade, Centennial, Chinook, Galena, Magnum, Mt. Hood, Newport, Nugget, Willamette, and Zeus (Columbus) were selected for a three year field trial in Mills River, NC. The cultivars were planted in four replications (five plant plots) on a high-trellis system (6 m tall) in a 0.10 ha hop yard (Fig. 1). Modified standard cultural practices were followed and diseases and insects were managed using products recommended in Vermont and New York.



Fig. 1. High trellis with a moveable top wire that can be lowered by hooking it to a trailer hitch (A) or by way of a winch (B).

## Results

**Plant growth.** Significant variation in plant growth and development was observed among cultivars.

We used plant height as an indicator of plant vigor and adaptability and found Zeus grew significantly taller than the other cultivars (Fig. 2; year 3 data). Galena, Chinook, Cascade, Nugget, Mt. Hood, and Centennial performed similarly. Although Centennial reached a similar height to the others in that group, the plants appeared very weak. Mt. Hood exhibited vigorous vegetative growth, but failed to produce a good crop of cones (Fig. 3). Magnum and Willamette were shorter than the other cultivars, never growing taller than 3 meters.

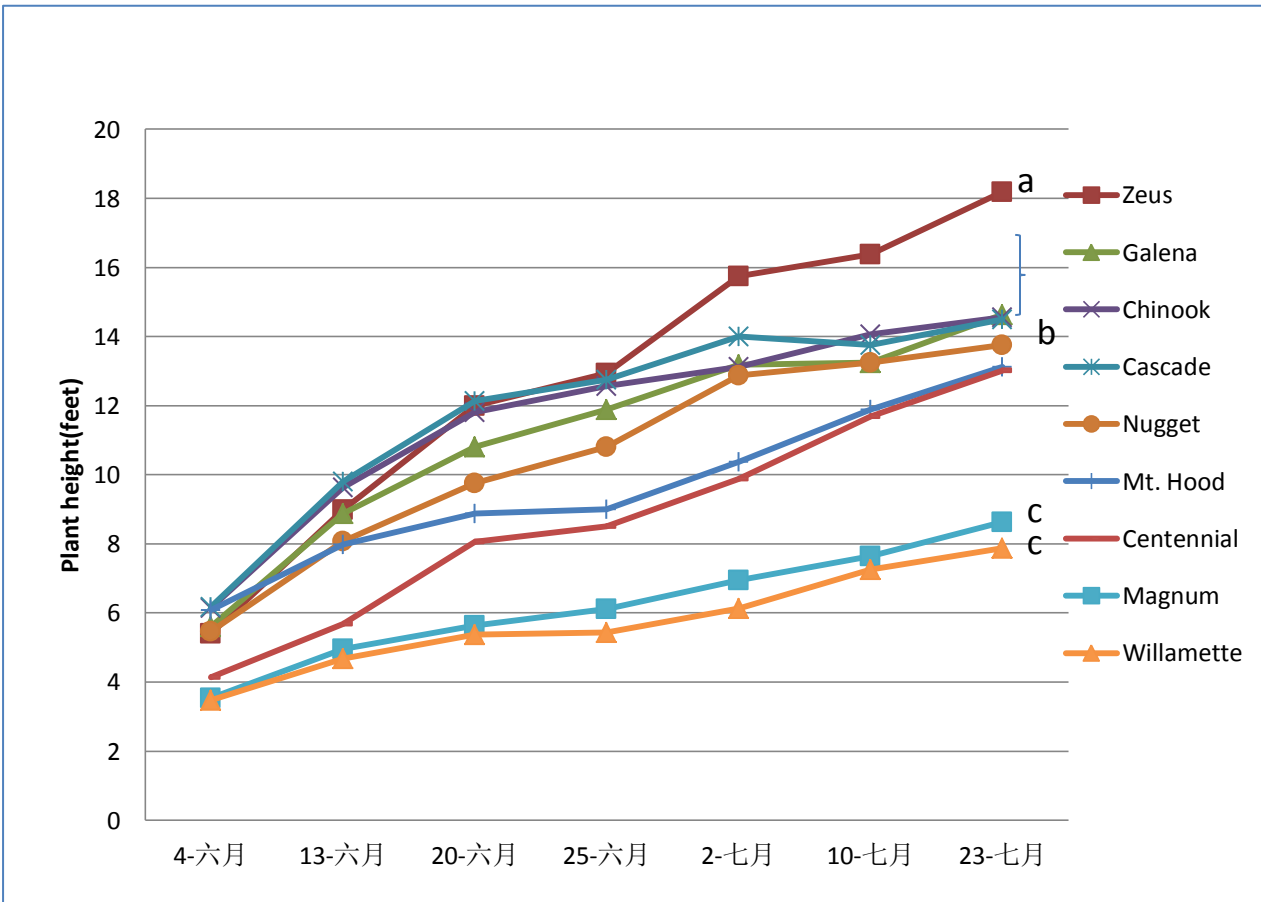


Fig. 2. Hop plant height in 2013.

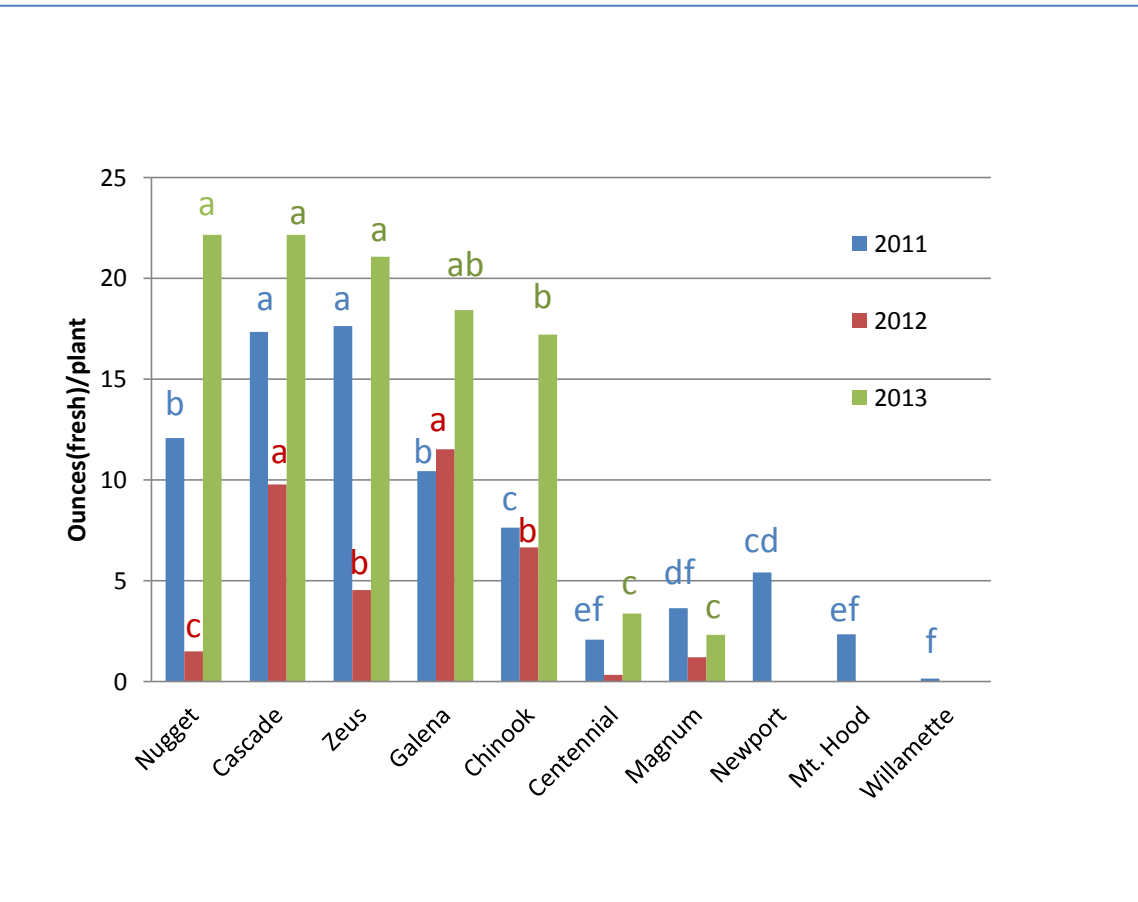


Fig. 3. Hop cone yield.

**Yield.** Significant variation in cone yield was also found among these varieties (Fig. 3). Yields in 2012 were abnormally low because of a severe downy mildew infection. Cascade and Zeus were the top performers in 2011, with Nugget joining that group in 2013. Averaged over those two years, yields were the same for Cascade, Zeus, and Nugget (data not shown). Galena produced similarly to Nugget but less than Cascade and Zeus. There was a significant yield increase from 2011 to 2013 for the top five cultivars (Fig. 3); more than doubling for Chinook and increasing 170% and 184% for Galena and Nugget, respectively (Fig. 3). Yields of the remaining cultivars (Centennial, Magnum, Newport, Mt. Hood, and Willamette) were significantly lower than the other varieties (with the exception of Newport in 2011) in all three years.

**Response to downy mildew (*Pseudoperonospora humuli*).** In 2012, we were not aggressive enough with our fungicide program and downy mildew caused severe damage to the plants (Fig.4). Cascade, Chinook, and Nugget were least affected by the disease followed by Centennial and



Fig. 4. Downy mildew infected hop plants and cones in 2012.

Willamette (Table 1). Galena produced the tallest plants that year, even though it had the most disease symptoms. (data not shown). The height of Zeus, however, was significantly reduced and attributed to the fungus. Nugget was relatively consistent in plant height for all three years (data not shown). Newport was severely infected with downy mildew and none of the crowns survived the winter. Galena exhibited the most severe downy mildew symptoms (Table 1) but was still one of the highest cone producers that year and the following year (Fig. 3).

## Conclusions

There was a big difference among cultivars for plant height, cone yield, and downy mildew infection. These results are already helping farmers in the Southeast choose hop cultivars with most production going into Cascade, Chinook, and Nugget. Galena is being planted where downy mildew is of most concern.

Table 1. Severity of downy mildew symptoms on hop cultivars in 2012.

Cultivar	Mean
Cascade	0.3125 a
Chinook	0.3125 a
Nugget	0.8750 a
Centennial	1.5625 b
Willamette	1.7500 b
Magnum	2.8125 c
Zeus	3.5000 d
Mt. Hood	3.6250 d
Newport	3.6875 d
Galena	4.1250 d

Symptom ratings collected on 5/17, 5/30, 7/14, and 8/15. Rated on a scale of 0-5 with 0=no presence to 5= most severe.