Northwest Florida Shade Tunnel Low Trellis Hops Variety Demonstration

West Florida Research and Education Center – Jay, FL

Table 1. Experimental Conditions

Experimental Design	Demonstration (2 reps)
Irrigation	Drip tubing w/ button emitters
Fumigation	None
Pruning	None in Year 1
Row Direction	North - South
Planting Date	4/20/2016
Plot Size	27 ft. long
Plant Spacing	36 in. between plants 6 ft. between varieties
Bed Spacing	6 ft.
Bed Width	3 ft.
Plant population per Acre	1,936
Plants Harvested per Plot	10
1st Harvest Date	Neo1: 7/5/2016 Centennial: 7/25/2016
Planting to Final Harvest	26 weeks (10/17/2016)

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Materials and Methods:

Two varieties of hops (*Humulus lupus*), Neo1 and Centennial, were grown with two replications each, in a shade tunnel system on mulched raised beds with fertigation. The goal was to examine preliminary economic feasibility of Northwest Florida hops production to meet the needs of the rising Southeast US microbrewery sector. Pre-plant fertilizer of controlled release, Arborite-coated urea was broadcast in an amount estimated to provide 25% of crop need (75 lb/A nitrogen for first-year plants). Pre-plant application of potash was broadcast estimating 50% of crop need (180 lb/A potassium for first-year plants). A secondary broadcast application in the same amounts was carried out three weeks after planting as plants began to show increased growth rates. Five weeks post-plant, fertilization method switched to weekly applications through the fertigation system until plants switched from vegetative growth stage to reproductive, cone-producing stage following the summer solstice.

Four 6”x6”x12’ ground-treated wood posts were installed at a 65 degree angle at the ends of the rows. Four 4”x4”x12’ ground-treated wood posts were installed at the center of the four rows. Posts were set in the ground so that trellis height would measure 8.5 ft. Auger-style earth anchors were installed ten feet from each exterior post. High-strength aircraft cable was used as the top wire and guy wire. Turnbuckles connected the earth anchors to the guy wires to allow the cables to be tightened as plant weight increased over the life of the hop yard. Lower strength aircraft cable was suspended 1 ft. above bed height. Coir rope was tied from the low wire above the plant to the high wire at a slight angle to allow for two strings per plant. The low wire also allows for the option of suspending the irrigation lines.

Transplants were planted on April 20, 2016 following continuous heavy rains that prevented the desired planting date of March 15-April 1. A 47% shade cloth was installed for the first two weeks to promote a healthy establishment and then removed. Once the plants were established, the bines were trained clockwise up one of the two coir ropes. To maximize root development, all first-year bines were trained with no pruning of bines until they reached the top of the trellis, at which point the tops of the plant were removed to promote lateral sidearm growth. The plants grew in direct sun until June 1st, when temperatures began to regularly climb into the 90’s. A 30% shade cloth was used from this point through the end of the year to prevent heat stress and shutdown of the shallow feeder roots. The shade cloth is to remain until the spring to promote cooler soil temperatures and increase the plant’s ability to hibernate.

The first Neo1 harvest was on July 5, 2016, 11 weeks after transplant. The first Centennial harvest was on July 25, 2016, 14 weeks after transplant. Only mature cones with a papery feel, deep yellow lupulin, and an average 75% moisture content were harvested. Harvested cones were weighed and immediately dried to 8% moisture content, allowed to rest at room temperature until cool, and stored in a freezer in vacuum-sealed bags containing oxygen

absorbers. Fresh, undried, “wet” cones were weighed and immediately delivered to a local brewery for immediate use.

Beginning in mid-June there began a recurring infestation of glossy-winged sharpshooters (*Cuerna costalis*). Damage from sharpshooter feeding resulted in curled leaves that eventually died. Spray applications of pyrethrin insecticide were carried out when sharpshooter populations reached a threshold of three per plant. *Lepidoptera* damage began in mid-July, with periodic recurrence throughout the trial. *Bacillus thuringiensis* was sprayed to prevent further damage to leaves and cones. On August 25, a fungal infection later identified as Anthracnose (*Colletotrichum spp.*) was discovered, which reduced yields. The fungus swept through the hopyard and the infection symptoms mimicked the appearance of natural post-harvest bine dieback which occurs at the end of the growing season. Consequently, it is unclear how widespread the infection was. A full cleanup of the hopyard was required for the winter season to reduce the chance of a recurring infection in Year 2.

The study began using bare earth raised beds. However, severe irrigation issues resulted, as the high-clay soil was prone to erosion and channeling from the irrigation system that diverted both water and nutrients from the plants during a period of peak need. This problem was corrected by the addition of cypress mulch, which caused an immediate noticeable turnaround in hop health. However, many of the plants had been stunted due to lack of nutrients in the early season and were unable to achieve maximum vegetative growth before the solstice.

Results:

Harvest data shows a substantially lower yield than necessary for commercial viability in Year 1. Total yield for Centennial was 39.65 ounces wet weight and 13.69 ounces dry weight, with a per plant yield of 0.99oz/0.34oz. Total yield for Neo1 was 55.54 ounces wet weight and 15.12 ounces dry weight, with a per plant yield of 1.39oz/0.38oz. Neo1 harvests were characterized by frequent, small harvests, while Centennials displayed less frequent but larger harvests by comparison.

Brewing value tests were conducted twice during the growing season, one from the July 26 harvest and one from the August 30 harvest. The July 26 results were underperforming. Alpha and beta acid concentrations were below commercial brewing standards, at 2.35%α/1.26%β for Neo1 and 4.15%α/1.26β for Centennial. For Neo1, we would expect 7-9%/3-3.3%. For Centennial, 7-12%/3.5-5.5%. Cohumulone percentage values were within normal standards, though on the lower end of the spectrum. The August 30 harvest values were much more favorable. Neo1 values had increased to 4.35%α/2.47β. While still below standard values, Cohumulone levels had dropped sharply from 46.3% to 30.1%, quite low for a *neomexicanus* variety. Centennial values had increased as well, with alpha acids within normal brewing levels at 8.8%. Beta acids remained low at 2.24%. Cohumulone levels increased 0.6% to 23.2%, still in the low range. The August 30 Centennials were also tested for essential oil concentrations, where a marked increase in Myrcene and a decrease in Caryophylene, Humulene, and Farnesene were observed. Total essential oil content was in the midrange of the spectrum at 1.98mL/100g.

Overall, first year yield data does not support recommending commercial low trellis, shade grown hop production in Northwest Florida at this time, though are sufficient for most home uses. Hops require three to four years to fully establish and produce full yields, but current yields were well below what would be expected to meet the threshold of economic viability. Brewing values, however, do meet industry standards and the characteristics of the essential oils may outperform their northern counterparts for use in late aroma additions.

Table 2. Neo1 Results

Neo1 Harvests					
Abbreviations: WW = Wet Weight, DW = Dry Weight at 8% moisture content.					
Date	WWg	WWoz	% Moisture at Harvest	DWg	DWoz
YTD	1574.50	55.54		428.72	15.12
7/5/2016	102.00	3.60	70.00	33.26	1.17
7/13/2016	103.00	3.63	79.90	22.50	0.79
7/25/2016	52.00	1.83	76.50	13.28	0.47
7/28/2016	208.00	7.34	76.80	52.45	1.85
8/16/2016	279.50	9.86	74.00	78.99	2.79
8/29/2016	104.50	3.69	75.40	27.94	0.99
8/31/2016	550.00	19.40	75.40	147.07	5.19
9/23/2016	123.5	4.36	72.1	37.45	1.32
10/17/2016	52	1.83	72.1	15.77	0.56

Table 3. Centennial Results

Centennial Harvests					
Abbreviations: WW = Wet Weight, DW = Dry Weight at 8% moisture content					
Date	WWg	WWoz	% Moisture at Harvest	DWg	DWoz
YTD	1124.00	39.65		388.21	13.69
7/25/2016	60.00	2.12	69.80	19.70	0.69
8/3/2016	592.00	20.88	69.80	194.33	6.85
8/29/2016	246.50	8.70	60.00	107.17	3.78
9/23/2016	200	7.05	73	58.70	2.07
10/17/2016	25.5	0.90	70	8.32	0.29
Essential Oil Test of August 29, 2016 Harvest					
	Lab Value	Average Brewing Values			
Total Essential Oils (mL/100g)	1.98	1-3			
Myrcene (%)	70.38	55-65			
Humulene (%)	5.77	10-20			
Caryophyllene (%)	3.58	5-7			
Farnesene (%)	<0.01	<1			