

Hops: A potential niche crop for Ontario

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Introduction

Hops, the female inflorescence of the hop plant (*Humulus lupulus* L.), are used in the brewing process and provide unique flavour and aroma to beer (Figure 1). Hops were grown in Ontario until the 1930's when acreage decreased due to disease problems and market pressures. Recently there has been a renewed interest in hop production predominantly for micro breweries. There are over 20 hop growers in Ontario but as a new industry, they require information to develop markets and identify well adapted cultivars. A research project was initiated in 2012 to address these priorities.



Figure 1. a) hop burrs; b) cones; c) cross section of an immature cone.

Objectives

1. Identify hop production and market opportunities in Ontario including:
 - a) current production practices; b) market demand: current and desired from brewers.
2. Evaluate commercial hop cultivars for: a) plant establishment and vigour, b) susceptibility to insect pests and diseases, c) yield and visual quality of cones.

Materials and Methods

Market research

- Two surveys conducted of producers and brewers contacted through the Ontario Hop Growers Association and the Alcohol and Gaming Commission of Ontario, approximately 20 questions per survey
- Sample size:
 - Hop producers: targeted sample; N = 28; this study, N = 12
 - Brewers: targeted sample; N = 65; this study, N = 23

Cultivar evaluation

- A hop yard was established at the Simcoe Research Station in May 2013 (Figure 2)
- 10 cultivars: Cascade, Hallertauer, Sterling, Northern Brewer, Zeus, Crystal, Chinook, Galena, Centennial, Bertwell (naturalized selection)
- Spacing: between row 4.5 m, in-row 1 m
- One 5.5 m tall string per plant, 2-3 bines trained per string
- Plots harvested in late August-mid September when cones reached 20-25% dry matter, harvested cones then dried down to 8% moisture

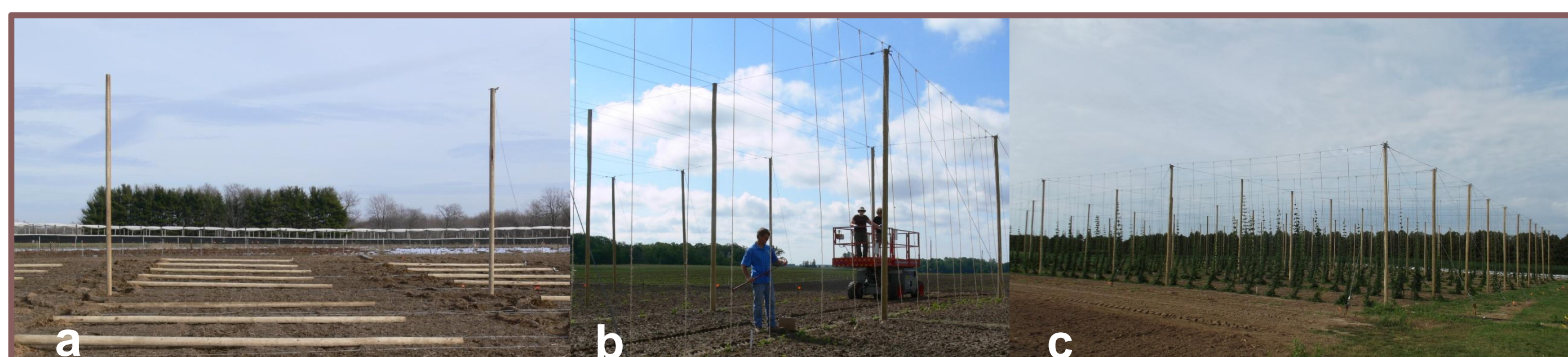


Figure 2. a) hop yard construction, Oct. 2012; b) 'stringing', June 2013; c) hop yard in Aug. 2013.

Results and Discussion

Survey results: Hop producers

- Organic and conventional hops grown
- Various aroma and bittering cultivars produced (Figure 3)
- Current land for production: 0.1 - 2 ha per farm
- Desired increase in acreage: 0.4 - 4 ha annually
- Sale price: CAD \$24 - \$29 per kg, and above CAD \$33 per kg
- Cost of establishing a hop yard: approx. \$14000 - \$19000 per ha
- Annual quantity of sales: up to 2270 - 2720 kg (1120 - 1230 kg per ha)

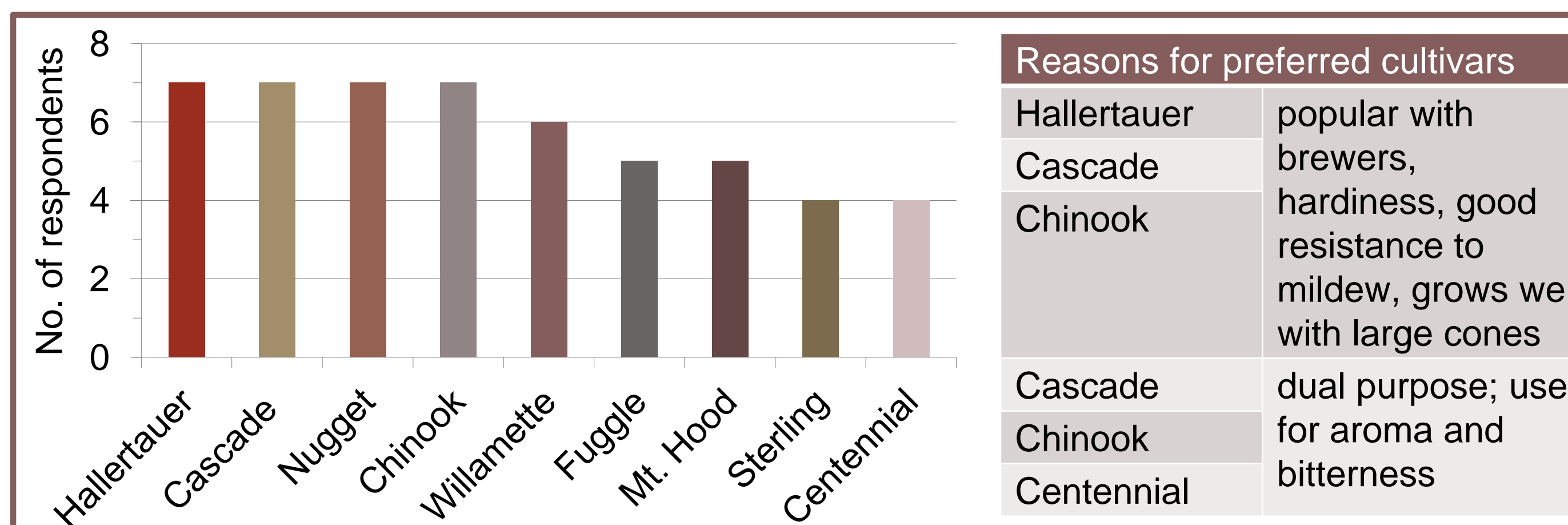


Figure 3. Most commonly grown cultivars in Ontario and reasons for cultivar preference.

Survey results: brewers

- Market players: 61% Ontario Craft brewers, 26% micro-brewers
- Various cultivars purchased (Figure 4); conventional hops purchased by 87% of the brewers
- Desired cultivars not grown currently in Ontario:
 - Amarillo, Nelson, Citra, Sorachi, Ace, Magnum, Galaxy
- Pelletized was the most popular form of hops purchased (70%)
- Packaging desired: Nitrogen purged bags
- Labeling content desired:
 - Alpha acids, beta acids, Hop Storage Index, oils, date of harvest
- Market demand: between 34 to 3630 kg
- Hops currently purchased from: British Columbia, England, Germany, Czech Republic, New Zealand, U.S. Willamette Valley
- Price range: \$15 - \$20, \$24 - \$29, and above \$33 per kg

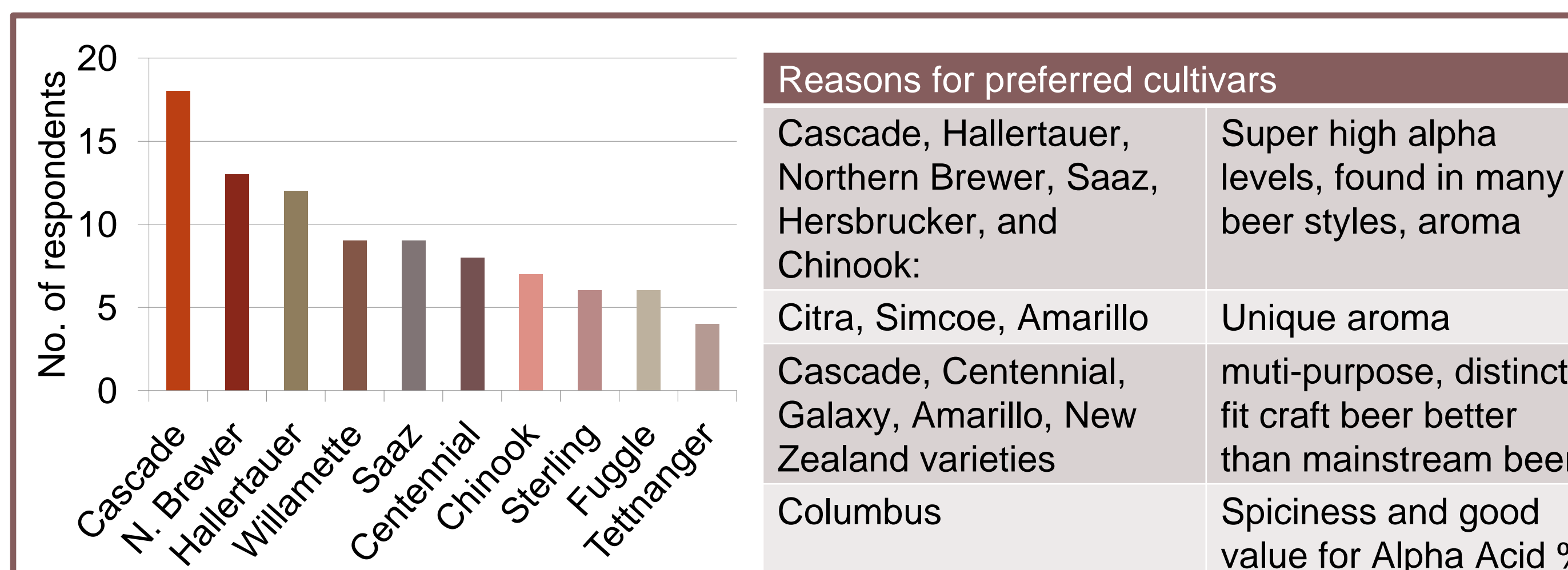


Figure 4. Cultivars purchased by brewers and attributes of preferred cultivars.

Conclusions of Market Research Phase I

- Looks like a viable horticultural crop with an established market
 - In 2010, 937 tonnes of hops were imported with a value of \$12.4 million
- Current acreage minimal but potential acreage still uncertain & to be defined by the market
- Market Research Phase II in 2014: demand and economic feasibility
 - Cost of production and Value/supply chain design

Cultivar trial

Two-spotted spider mite (TSSM) and potato leafhoppers were the most common insect pests (Figure 5). There were no statistically significant differences amongst cultivars but there were some trends. Northern Brewer and Sterling tended to have higher numbers of TSSM eggs, nymphs and adults. Crystal had the highest leafhopper counts and showed the most severe damage at harvest. Downy mildew was first observed in early July. All cultivars showed symptoms, however they were most severe in Centennial, Galena and Zeus. Cone diseases caused by *Alternaria alternata*, *Fusarium* sp. and *Botrytis cinerea* were widespread causing brown discoloration of the cones. At harvest, Zeus had the highest percentage of brown cones.

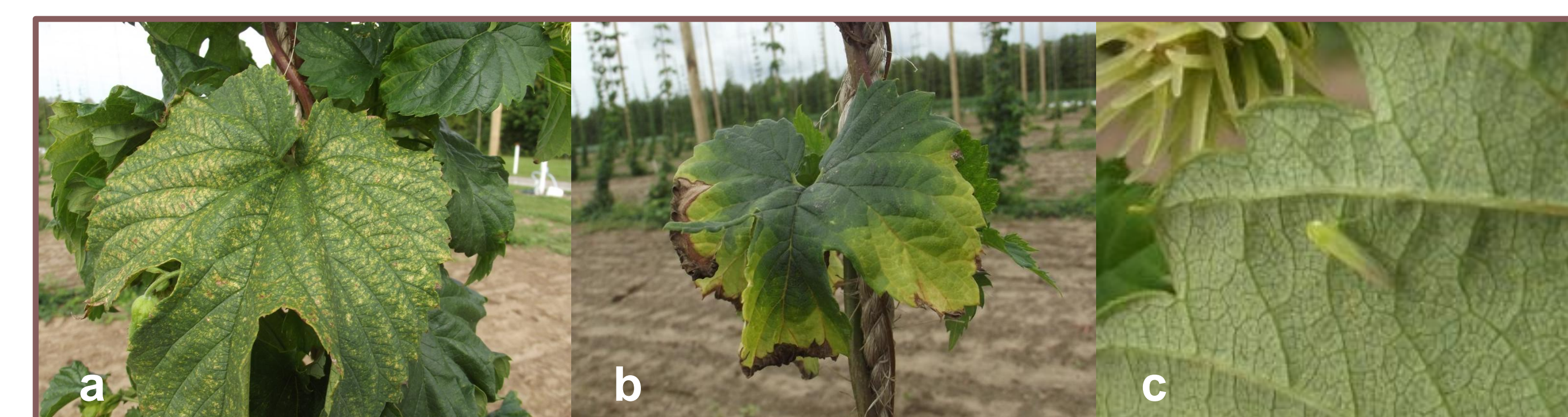


Figure 5. a) damage caused by two-spotted spider mite, b) 'hopper burn' caused by potato leafhoppers, c) potato leafhopper adult.

Bertwell was the most vigorous cultivar, producing the tallest bines (Table 1). Cultivars Hallertauer, Sterling and Northern Brewer were slow to establish, remaining stunted and chlorotic. Zeus produced the highest yield in the first year of the trial followed by Galena, Bertwell and Chinook. Cascade, Centennial and Crystal were less vigorous but produced a small yield.

Table 1. Bine length and yield of 10 hop cultivars grown at Simcoe, ON.

Cultivar	Bine length (m)	Yield at harvest moisture		Yield at 8% moisture		
		g/plant	kg/ha	100 cone weight (g)	g/plant	kg/ha
Bertwell	4.3 a ¹	248.4 ab	552.0 ab	21.2 b	66.2 ab	147.2 ab
Zeus	3.7 ab	325.5 a	723.2 a	30.5 a	82.6 a	183.5 a
Galena	3.5 b	283.0 ab	628.8 ab	24.6 ab	73.3 ab	162.9 ab
Chinook	3.3 b	228.6 b	507.9 b	24.6 ab	56.7 b	125.9 b
Cascade	2.2 c	81.8 c	181.7 c	13.6 c	16.8 c	37.5 c
Crystal	2.0 cd	11.9 c	26.5 c	10.7 cd	2.6 c	5.7 c
Centennial	1.5 de	7.4 c	16.5 c	9.9 cd	2.6 c	5.9 c
Hallertauer	1.5 de	0.8 c	1.8 c	7.0 cd	0.1c	0.4 c
Sterling	1.0 e	0.1 c	0.3 c	5.6 d	0.1 c	0.1 c
Northern Brewer	1.3 e	0.1 c	0.2 c	-	0.1 c	0.1 c

¹ Numbers in a column followed by a different letter were significantly different at P = 0.05, Fisher's Protected LSD.

Conclusions of cultivar trial Year 1

- Two-spotted spider mites, potato leafhoppers, downy mildew and cone diseases were the most significant production challenges in 2013
- No statistically significant differences in susceptibility to insects and diseases amongst cultivars but some visual differences were observed
- Bertwell was the most vigorous cultivar but Zeus produced the highest yield

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