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New Cultivars of Blight-Resistant Hazelnuts

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Introduction

Hazelnuts have been grown commercially in British Columbia's Fraser Valley and Okanagan since the 1930's but the introduction of eastern filbert blight (EFB) around 2005 decimated the industry. Fortunately EFB-resistant cultivars are available from Oregon State University's (OSU) hazelnut breeding program, established in 1969 and which, combined with the USDA Germplasm Repository (also in Corvallis, Oregon) holds the largest collection of hazelnut germplasm in the world (1). In collaboration with the Nut Growers Society of Oregon, Washington & British Columbia, the OSU program uses classic plant breeding to develop cultivars with high resistance to EFB and other desirable traits, including high yields and improved nut quality. Some of these cultivars were evaluated in a recent trial (2) but several were either not included or weren't yet available in BC.

This paper summarizes published information regarding disease resistance, nut quality, nut yield and tree characteristics of 13 cultivars of EFB resistant hazelnut cultivars known to be available in BC. Cultivars and information sources are listed in **Table 1**. My goal is not to recommend any cultivar over another but to inform growers of available options and summarize data to help them inform their decisions.

The OSU breeding program has been selecting for pest and disease resistance, yield and nut quality. Forty years of classic breeding has resulted in substantial improvements in hazelnut cultivars. For example, a grower recently reported harvesting over 4800 lbs per acre of nuts from 'Yamhill' (N. Bierkemier, pers. comm.), while typical yields for the old standard 'Barcelona' were 2000–3000 lbs per acre.

Pest & Disease Resistance

OSU evaluates resistance to EFB and big bud mite during their preliminary trials. Big bud mite is not very prevalent in BC and is not included in this paper. Cultivars released in the past twenty years have one of two sources of genetic resistance to EFB, quantitative and 'Gasaway'. Cultivars with quantitative resistance to EFB are considered resistant to highly resistant, maintaining vigor once infected and, in the case of 'Sacajawea', becoming infected only under very high disease pressure (3) (4) (5). 'Gasaway' refers to the cultivar where the resistance gene was first identified; most cultivars with 'Gasaway' resistance do not exhibit symptoms of EFB when grown in western North America. Exceptions are 'Jefferson' and 'McDonald' which can have some symptoms under high disease pressure (5) (6).

It is important to note that these descriptions of EFB resistance are only for Oregon, Washington and British Columbia and only for the disease as it exists today. Available evidence suggests that EFB was introduced to this region a single time. Genetic diversity within the disease is lower here than in its native habitat (7). If additional introductions of the disease occur, it's possible that more virulence will result since 'Gasaway' resistant cultivars can develop full-blown EFB in New Jersey (7).

Each cultivar's EFB resistance is presented in **Table 1**, and color-coded the same way in each of the following tables for ease of comparison in combination with other traits.

Table 1. EFB-resistant hazelnut production and pollinizer cultivars currently available in BC.

Cultivar ¹	Release Year	EFB Resistance ¹	Data sources
Clark	1999	++	(7) (5) (8) (9) (3) (10)
Doris	2012	—	(5) (10)
Eta ²	2009	—	(5) (11)
Felix ²	2012	—	(5) (6)
Gamma ²	2002	—	(5) (12)
Jefferson	2009	—*	(5) (8) (6)
Lewis	1997	++	(7), (5) (8) (9) (3) (10) (13)
McDonald ³	2015	—*	(5) (6)
Sacajawea	2006	+	(5) (10) (3)
Theta ²	2009	—	(5) (11)
Wepster ³	2013	—	(5) (6) (14)
Yamhill	2008	—	(5) (10) (9) (14)
York ²	2012	—	(5)

1. EFB Resistance: ++ = Resistant, shorter cankers and with good vigor
 + = Highly resistant, shortest cankers, can become infected but only under very high disease pressure. (Both are considered quantitative resistance).
 — = Also highly resistant but have a single dominant resistant gene ('Gasaway' resistance). Cankers may develop but are smaller and heal over.
 —* = 'Gasaway' resistance with some EFB symptoms under high disease pressure in Oregon and BC. Sources: (2) (4) (5) (6) (8).

2. Released as a pollinizer.

3. 'McDonald' (CDN PBRAF# 18-9479) and 'Wepster' (CDN PBRAF# 18-9480) are licensed varieties of Oregon State University and protected both by patents in the US and Plant Breeders Rights in Canada.

Purchasers of these varieties are not allowed to propagate for either further sale or expansion of orchards. Illegal propagation will be prosecuted.

Nut quality

The two main markets for hazelnuts, in-shell and kernel, have some differences in the nut qualities deemed desirable. Large, attractive nuts are sought for the in-shell market; smaller and very uniform sized nuts are preferred for extracting kernels for processing. Nut fill is the percentage of total dry weight that is kernel. Cultivars with a greater percentage of kernel typically bring higher prices from the wholesale purchaser.

Yield

Yield is the weight of nuts produced. It is presented here as the sum of five consecutive harvests from trials described in the publication sources of **Table 1**. Nut quality and yield are summarized in **Table 2**.

Table 2. Nut quality and yield.

Cultivar	Nut Size Grade	Nut Weight In Shell (g)	Nut fill (%)	Pellicle removal ²	Yield (cumulative kg/tree, 3 rd -7 th leaf)
Clark	Small	2.6	51	2.6-3.5	17.6
Dorris	Medium	3.4	42	2.4-2.9	19.4
Jefferson ¹	Medium	3.7	44	4-5	21.0
Lewis	Small	2.8	47	4-5	21.6
McDonald	Small	2.5	52	3.3-3.8	19.3
Sacajawea	Small	2.8	51	2.5-3.5	16.5
Wepster	Small	2.4	45	3.0	22.8
Yamhill	Small	2.3	46	4.4-5	20.8

1. EFB Resistance: **Yellow** = quantitative resistance, **Green** = 'Gasaway' resistance, **Blue** = 'Gasaway' resistance with some EFB symptoms under high disease pressure.

2. Scale is 1-7, with 1 = 100% removal of the pellicle and 7 = no pellicle removal after roasting at 266°F-302°F (130°C-150°C) for 15 minutes.

Tree growth characteristics

Hazelnut "trees" are really multi-stemmed shrubs by nature; it takes active management, especially pruning of suckers at the base of the tree, to keep it a tree form. In addition, when suitably pruned, some varieties have a more spreading crown while others are more upright. Most new cultivars are also smaller than the old standard 'Barcelona' of comparable age. Stature and vigor of cultivars are summarized in **Table 3**.



Figure 1. 'Yamhill', 4th leaf.



Figure 2. 'Jefferson', 4th leaf.

Table 3. Tree stature & vigor of Hazelnut Production Cultivars.

Upright	Upright-spreading to moderate-spreading
Wepster (95) ^{1,2}	Sacajawea (85)
Lewis (75)	Clark (73)
Jefferson (70*)	Yamhill (65)
	McDonald (63)
	Dorris (60)

1. EFB Resistance: **Yellow**= quantitative resistance, **Green** = 'Gasaway' resistance, **Blue** = 'Gasaway' resistance with some EFB symptoms under high disease pressure.
2. Trunk Cross-sectional Area, % of 'Barcelona' at 7th leaf.

Legal Status

Cultivars may be licensed in some countries or jurisdictions. Newly released cultivars are not licensed outside of Oregon and Washington for three years following release. After that, some become public while others are licensed in various countries including Canada. Current status of available cultivars, including pollinizers, is given in **Table 4**.

Table 7. Patents/Plant Breeders Rights of Hazelnut Production Cultivars in the U.S. and Canada.

Public in OR and Canada	Licensed in OR	Licensed in Canada
Eta ²	Dorris	McDonald
Gamma ²	Felix ²	Wepster
Jefferson ¹	McDonald	
Lewis	Wepster	
Sacajawea	York ²	
Theta ²		
Yamhill		

1. EFB Resistance: **Yellow**= quantitative resistance, **Green** = 'Gasaway' resistance, **Blue** = 'Gasaway' resistance with some EFB symptoms under high disease pressure.
2. Released as pollinizer.

Which Cultivar is Best?

The first question in this regard is: what are your goals for growing hazelnuts? Do you want small nuts for processing, or large ones for selling in-shell? Are you more interested in the highest yields or ease of canopy management? Are you willing to be more diligent in scouting and treating EFB in order to get the advantages of higher kernel percentages? How much risk are you willing to accept? Several production cultivars, 'Clark', 'Dorris', 'McDonald' and 'Wepster', have yet to be planted in orchard quantities in BC, so they are unproven in the province.

These are some of the questions that must be addressed in choosing production cultivars. Even for a particular end use, from the above data it is clear that no one cultivar is best by every measure. There is no one right answer and the answers differ depending on your goals for your orchard and your management approaches.

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