HAZELNUT (*Corylus avellana* 'Ennis', 'Jefferson', 'McDonald')
Eastern Filbert Blight; *Anisogramma anomala*

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Response of resistant cultivars to various doses of *Anisogramma anomala*, 2014 - 2015.

Jefferson hazelnut trees planted next to orchards heavily infected with eastern filbert blight have developed cankers at low rates. The cultivars 'Ennis', 'Jefferson' and 'McDonald' were inoculated with various doses of *A. anomala* ascospores to see if high doses resulted in more cankers than lower doses. The cultivar 'Ennis' was propagated by tie-off layering at the Botany and Plant Pathology Field Laboratory, Corvallis, OR. Rooted suckers of Ennis were cut in Dec 2013 and healed into sawdust prior to potting. The cultivar 'Jefferson' was obtained from a grower nursery in Jan 2014, also propagated by tie-off layering and healed into sawdust prior to potting. The cultivar 'McDonald' was micropropagated, also obtained from a grower but already potted in 1 gal pots. All 'Ennis' and 'Jefferson' trees were potted into 1 gal pots and all cultivars were placed in a warm (60 to 70^{o} F) greenhouse (for 2 to 4 weeks) to force bud growth.

Inoculum was prepared from frozen cankers that were warmed under a stream of tap water, then stroma were excised, crushed and ooze containing ascospores was pipetted into a small watch glass. The concentration of ascospores was determined with a hemocytometer and adjusted accordingly through dilution with sterile distilled water. Viability was also checked using a vital staining technique (Heckert et al. 2013). Doses at or above 10^7 ascospores per ml were extremely viscous.

Trees at bud break and/or early shoot growth were selected periodically from Mar to May 2014 for inoculation (Table 1). All cultivars were inoculated at concentrations of 0, 10^4, 10^5, 10^6, and 10^7 ascospores per ml. Ennis was also inoculated at 10^2 ascospores per ml and both Jefferson and McDonald were also inoculated at 10^8 ascospores per ml. A total of 5 Ennis trees were inoculated at each concentration on each of 6 inoculation dates for a total of 30 inoculated trees at each concentration. A total of 8 Jefferson or McDonald trees were inoculated at each concentration on each of 6 inoculation dates for a total of 48 inoculated trees per cultivar at each concentration. Ascospores were sprayed onto 4 to 5 open buds and/or shoots using a hand held pump-style sprayer. Inoculation at a dose of 10^8 ascospores per ml was done with an eyedropper due to the viscous and granular nature of the preparation. Individual trees were then enclosed in plastic bags for 72 hours then held in a greenhouse at 50^{o}F for several weeks. Trees were then held in greenhouse facilities at outside ambient air temperatures for 1.5 years. Trees were watered and fertilized as needed during this time. The number of trees with EFB cankers on the main tree trunk and total length of these cankers/tree was determined during Oct 2015.

Potted 'McDonald' trees were first to break bud in Mar 2014 and continued vigorous rapid growth. 'Jefferson' trees were slower to break bud and grow resulting in vigor differences between inoculation dates (more vigorous earlier). 'Ennis' trees were also slower to break bud but had even vigor throughout each of the inoculation dates. 'Ennis' trees became infected when the concentration was at least 10^4 ascospores per ml and the percentage of trees infected increased as the concentration increased to 10^6 but declined at 10^7 ascospores per ml (Figure 1). Both 'Jefferson' and 'McDonald' trees became infected when the concentration was at least 10^6 ascospores per ml. The percentage of 'McDonald' trees infected at 10^6 ascospores per ml (21%) was significantly higher than the percentage of 'Jefferson' trees infected (2%). Both 'Jefferson' and 'McDonald' trees had a similar percentage of trees infected when the concentration was at least 10^7 ascospores per ml.

The highly susceptible 'Ennis' cultivar had more trees infected and longer cankers (Table 2) than the resistant 'Jefferson' or 'McDonald' cultivars. 'McDonald' trees had more infected trees at 10^6 ascospores per ml and twice the average canker length than 'Jefferson trees' (Table 2). This supports field observations in Canby OR, where both cultivars have been planted in the same orchard where 'McDonald' trees have more cankers than 'Jefferson' trees.

In general, the higher the dose of ascospores the more ' trees become infected. Highest doses may not have diluted an anti-germination factor, found in perithecia (Stone), enough to allow all spores to germinate. Any orchard planted next to or downwind of a heavily diseased orchard should be protected with fungicide during bud break and early shoot growth.

Table 1. Date of cultivar inoculation.

Inoculation Replication	Ennis*	Jefferson**	McDonald**
1	Mar 28	Mar 28	Mar 19
2	Apr 4	Apr 4	Mar 20
3	Apr 11	Apr 11	Mar 21
4	Apr 18	Apr 18	Mar 25
5	Apr 24	Apr 24	Mar 26
6	May 7	May 7	Mar 28

*5 trees were inoculated each date at each of 6 concentrations.
**8 trees were inoculated each date at each of 6 concentrations.

Figure 1. Dose response curve for 'Ennis', 'Jefferson' and 'McDonald' inoculated with various concentrations of *A. anomala* ascospores.

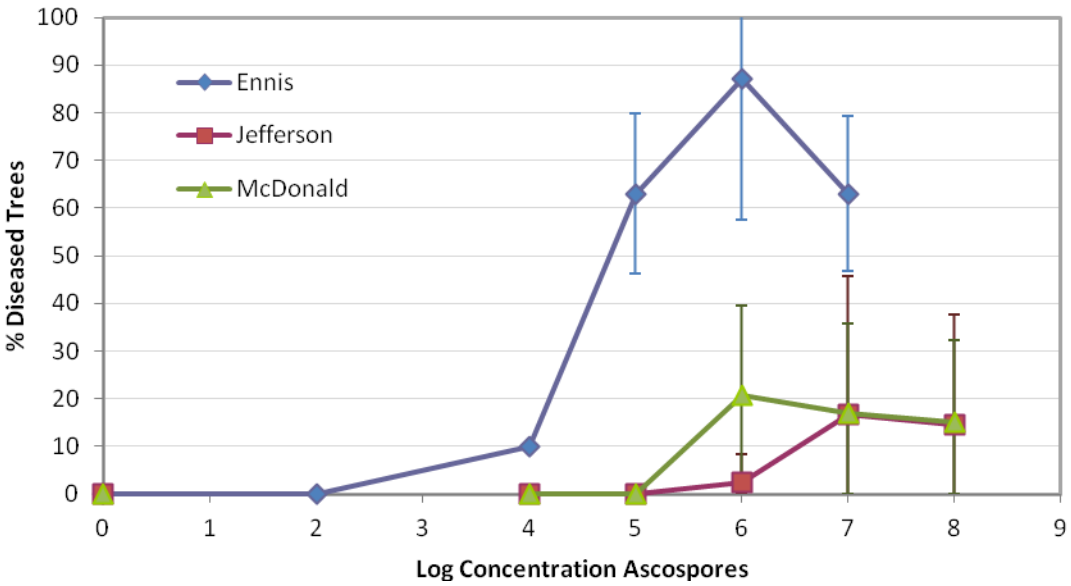

Table 2. Average canker length (cm) for trees with cankers*.

Cultivar	Concentration of Ascospores							Ave canker length (cm)*
	10^0	10^2	10^4	10^5	10^6	10^7	10^8	
Ennis	0	0	22.8 n=3	17.9 n=19	24.0 n=26	26.2 n=18	--	22.7
Jefferson	0	--	0	0	3.0 n=1	5.1 n=7	5.4 n=7	4.5
McDonald	0	--	0	0	10.8 n=10	8.8 n=8	7.4 n=7	9.0

*Too few cankers developed for a statistical analysis of the data.