

HAZELNUT (*Corylus avellana* ‘Ennis’ and ‘Butler’)
Eastern Filbert Blight; *Anisogramma anomala*

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Whole orchard evaluation of pruning strategies for management of eastern filbert blight, 2020-2022.

The goal of this trial is to evaluate pruning strategies for management of EFB on heavily infected, mature, commercial sized hazelnut trees. This is a redesign of a 12-year randomized complete block fungicide trial within a 1-acre orchard of Ennis hazelnuts with Butler pollenizers (every 3rd tree in every 3rd row) planted on a final 20 x 20 foot spacing in 1986 at the Botany and Plant Pathology Field Laboratory, Corvallis, OR. Growers wanted to know if cutting heavily infected trees to the ground and re-growing from sucker shoots would be an effective management strategy. There were also questions about the value of pruning heavily diseased trees. We hypothesize that the detailed pruned blocks will continue to decline in yield while non-pruned blocks could have a slight increase in yield for a period before declining rapidly. We also predict that severely cut and regenerated trees will take several years to bring back into production.

Treatments were arranged in a randomized complete block design. Each treatment consisted of 4 blocks (replicates) containing a group of 9 trees, (8 Ennis and 1 Butler). Each set of 9 trees was composed of 3 consecutive trees in a row and in 3 consecutive rows. The former non-treated trees were cut one foot above the ground on 15 Feb 2016. The former Bravo (chlorothalonil) only blocks were left non-pruned to let the disease take its natural course. The former Best Management Program (BMP) blocks were detailed pruned from 10 to 12 Jan cutting most EFB cankers 1 to 3 feet below symptomatic tissue. The number and length of cankers removed was not determined. The entire 1 acre block of trees was treated with an application of Echo 90 DF (3.25 lb/A) on 16 Mar (bud break), then Tilt EC (8 fl oz/A) plus Equus DF (28 oz/A) on 31 Mar, then Cabrio EG (5 oz/A) plus Equus DF (28 oz/A) on 14 Apr, then Equus DF (28 oz/A) plus Tilt EC (8 fl oz/A) on 28 Apr. Fungicides were applied using a Rear’s air blast sprayer at a rate of 100 gal water/A. Suckers were mechanically removed on 13 Apr, 15 Jun, 14 Jul, 5 Aug and 31 Aug. For the management of weeds, the following herbicides were applied as a general and/or spot treatment; Makaze (3%) was tank mixed with Weedar 64 (1 pt/acre) and applied on 11 Mar, Forfeit (1.7 oz/gal) was applied alone on 13 May, and Roundup Pro (3%) was applied alone on 16 May, and Forfeit (1.7 oz/gal) was applied alone on 26 Aug. Intrepid 2F (16 fl oz/A) was applied on 20 Jul for filbert worm management. There was no supplemental irrigation applied this year. The orchard was fertilized with 46-0-0 at 30 lb/A on 24 Apr. The orchard floor was “floated” on 10 Aug and 15 Aug to remove dead weeds, blanks and twigs. Plots were harvested on 13 Oct by raking nuts into windrows, then placed in wooden tote boxes using a Flory Hazelnut Harvester. The harvester was designed to allow soil and dirt to fall between conveyor belt chains and to blow or suck away leaves, husks and some blank nuts. Nuts were then conveyed into large wooden bins and weighed using a Vishay Celtron model Digital Summit 3000 scale.

Rainfall for the dormant season (Oct 2021 to Mar 2022) was 5.4 inches below normal but spring weather conditions were very wet with the second wettest spring on record. Rainfall, however, was below normal all summer (July through October) such that trees once again appeared water stressed with rolled leaves.

The severely cut trees produced many sucker shoots in 2016 where 4 to 6 were selected during the 2016-2017 dormant season for continued growth. Although a handful of nuts were produced in 2017 on these shoots they were not harvested. Catkins were observed to form on shoot re-growth in the fall of 2017. Fruiting bodies of wood decay fungi in all but one stump indicated colonization by *Trametes versicolor* and a *Paxillus* sp. EFB cankers were observed in these blocks in 2018 and 2019 and removed. In 2018, two of the severely pruned blocks did not have EFB cankers while the other two blocks had 4 and 7 one year old cankers, respectively. In 2019, each severely pruned block had EFB cankers with an average of 8 one year old cankers among 2 to 5 trees. In 2021, one of the blocks did not have cankers but the other blocks had an average of 3 cankers on 2 trees.

In 2020, fruiting bodies of wood decay fungi were found in 72% and 64% of the non-pruned and pruned trees, respectively. The number of dead or removed scaffold branches was 25% and 21% which was not significantly different for the non-pruned and pruned trees, respectively. By 2022, wood rot was so extensive in some trees that whole sections of trees would fall unexpectedly.

Also in 2020, 2021 and 2022, overall canopy ratings were assessed using a 0 to 5 canopy rating scale where 0 = healthy canopy, 1 = 1 to 10% canopy dieback, 2 = 10 to 25% dieback, 3 = 25-50%, 4 = > 50% dieback and 5 = dead tree. Non-pruned trees had significant dieback with many dead limbs in the upper part of the canopy. Highest canopy dieback ratings were determined for non-pruned trees which were significantly higher than for pruned trees in 2020 and 2021 (Table 2). Although canopy ratings differed some years, the average tree volume was not significantly different between non-pruned and pruned trees (Table 3). The severely pruned trees were significantly lower in tree volume.

Field run nut weight was 6.5, 19.5 and 24.4 lb/tree for the severely pruned, detailed pruned and non-pruned treatments, respectively. Yield data, however, were normalized for moisture content to make year to year comparisons. Average dry weight yield per tree increased slightly for the severely pruned trees while the detailed pruned trees or non-pruned trees increased more (Table 1 and Figure 1). The treatments, however, were not significantly different from each other due to wide replicate variation. Each treatment had one replicate that was very different from the other three. The change in yield from 2021 to 2022 was also not significantly different between all treatments also due to wide variations. Although there was no significant difference in yield the non-pruned trees were showing a lot more twig and branch dieback. Twigs and small branches were a minor but noticeable problem during harvest of the non-pruned plots and may result in increased cleaning fees.

Table 1. Pruning treatments and clean dry weight yield for 2021 and 2022.

Treatment	Ave yield/tree 2021* (lbs)	Ave yield/tree 2022* (lbs)	Ave. change from 21 to 22* (%)
Severely pruned.....	5.5	6.0	-4.2
Detailed pruned.....	13.5	17.9	18.0
Non-pruned.....	18.2	22.5	18.6

* Means followed by the same letter do not differ significantly based on Fisher's protected LSD ($P=0.05$). Means without letters are not significantly different.

Table 2. Canopy dieback ratings for 2020, 2021 and 2022.

Treatment	Canopy rating/tree 2020*	Canopy rating/tree 2021*	Canopy rating/tree 2022*
Severely pruned.....	ND	2.3 b	2.2 b
Detailed pruned.....	2.3 b	2.6 b	2.4 ab
Non-pruned.....	3.4 a	3.6 a	3.4 a

* Means followed by the same letter do not differ significantly based on Fisher's protected LSD ($P=0.05$). Means without letters are not significantly different.

ND = Not Determined

Table 3. Tree volume in 2021 and 2022.

Treatment	Ave. tree volume (ft3)*			
	2021		2022	
Severely pruned.....	604	b	782	b
Detailed pruned.....	2,215	a	2,492	a
Non-pruned.....	2,144	a	2,149	a

* Means followed by the same letter do not differ significantly based on Fisher's protected LSD ($P=0.05$). Means without letters are not significantly different.

Figure 1. Clean and dry weight yield per tree from 2012 to 2022. All trees were treated with the same fungicide program from 2016 to 2022. The former non-treated trees (square symbols) were severely cut one foot above the ground in Feb 2016. The former Bravo only blocks (diamond symbols before 2016, circle symbols after) were left non-pruned to let the disease take its natural course. The former Best Management Program blocks (diamond symbols before and after 2016) were detailed pruned each year in Jan or Feb from 2016 to 2022 cutting most EFB cankers 1 to 3 feet below symptomatic tissue. Analysis based on Fisher's protected LSD ($p < 0.05$) and standard error bars included.

