

HAZELNUT (*Corylus avellana* 'Royal' and 'Ennis')
Eastern Filbert Blight; *Anisogramma anomala*

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A FORECASTING MODEL FOR FUNGICIDE APPLICATION FOR CONTROL OF EASTERN FILBERT BLIGHT, 2001 - 2002. A model was developed, based on length of branch wetness due to rain, to help decide when to deploy fungicides. Healthy 2-year-old 'Royal' hazelnut trees were planted on 27 Jan 00 adjacent to and north of a commercial block of heavily diseased 'Barcelona' trees planted near North Plains, OR. Treatments were arranged in a randomized complete block design with 5 trees per treatment in each of 4 replications. Treatments were applied on two sides of the tree to run-off with a backpack sprayer equipped with a hand wand. Approximately 0.8 gal of a spray suspension were applied per 20 trees. Bravo Weather Stik was applied at 32 fl oz/100 gal water on 21 Mar 00 at budbreak and again on 3 Apr 00 and 17 Apr 00 depending on the treatment. Applications of Orbit EC at 2.74 fl oz/100 gal water or Elite 45 DF at 2 oz/100 gal water were dependent on detecting greater than 21 hours of branch wetness starting 2 weeks after budbreak until the first week of May. Applications of Orbit and Elite were made on 14 Apr 00. Branch wetness due to rain was monitored using an Adcon A730 weather station equipped with standard leaf wetness sensors and customized hazelnut branch wetness sensors. The customized branch wetness sensors consisted of two wires in parallel coils wound around a 0.5 inch diameter hazelnut branch. The amount of current running from one coil to the other is directly related to the amount of moisture on the branch surface. Branch wetness due to dew periods were not considered. Roundup at 2 gal/100 gal water was used between trees to control weeds on 12 Apr 00 and 14 Jun 00. Sawdust mulch was placed around the base of each tree on 15 May 00. Trees were also painted with at 50% solution of white latex paint on 1 Jun 00 on the southwest side of the trunk to prevent summer sunburn. The number of diseased trees, cankers per tree and total canker length was determined on 12 Jul 01.

Similar trials were conducted adjacent to and north of a heavily diseased 'Ennis' orchard located north of Keiser, OR. Healthy 2-year-old 'Royal' and 'Ennis' hazelnut trees were planted on 25 Jan 00. Treatments were arranged in a randomized complete block design with 5 trees per treatment in each of 4 replications for Royal trees and with 4 trees in each of 3 replications for Ennis trees. For Royal trees, Bravo applications occurred on 14 Mar 00, 28 Mar 00 and 11 Apr 00. For Ennis trees, Bravo applications occurred on 21 Mar 00, 4 Apr 00 and 18 Apr 00. Orbit and Elite applications occurred on 24 Apr 00 for both cultivars. Roundup at 2 gal/100 gal water was used between trees to control weeds on 11 Apr 00 and 2 Jun 00. Sawdust mulch was placed around the base of each tree on 16 May 00 and painted with at 50% solution of white latex paint on the southwest side of the trunk to prevent summer sunburn. Supplemental irrigation water was applied regularly through both growing seasons. The number of diseased trees, cankers per tree and total canker length was determined on 18 Jul 01.

A PVC trough spore trap was placed in each replication of the North Plains site on 3 Mar 00. (Each spore trap consisted of a 2.3 meter long 1/2 inch PVC pipe split in half, supported by 2 metal posts, and angled at 20 degrees to drain into a covered 16 liter collection bucket. Each bucket contained 200 ml of 50% copper sulfate v/v as a spore preservative and germination inhibitor.) Rainwater from the traps was collected on 21 Mar 00, 3, 14 and 17 Apr 00 and 9 May 00 by swirling the contents and pouring into a volumetric cylinder to measure the total volume of rainwater collected. Approximately 500 ml of the rainwater was collected for laboratory analysis and the copper sulfate solution was replenished after each collection. The rainwater was filtered first through a 20 um sieve then through a cellulose nitrate filter with 0.8 um pore size. This filter paper was placed on a microscope slide, stained with 0.05% (v/v) trypan blue in lactoglycerine. The number of ascospores on filters was then determined using a light microscope at 400X and used to calculate the number of ascospores collected per M² of trap surface. Rainfall during the spore trapping periods were as follows: 3.27 in from 3 Mar 00 to 21 Mar 00, 0.15 in from 21 Mar 00 to 3 Apr 00, 0.8 in from 3 Apr 00 to 14 Apr 00, 0.11 in from 14 Apr 00 to 17 Apr 00 and 1.93 in from 17 Apr 00 to 9 May 00. A single spore trap was located at Mission Bottom starting 6 Mar 00 with rainwater collected on 28 Mar 00, 11 Apr 00, 24 Apr 00 and 2 Jun 00. Rainfall during those periods was 1.42, 0.06, 1.09 and 1.64 in, respectively.

North Plains – Spring weather conditions in Western Oregon were considered dry with below normal March and April rainfall. After bud break, wet periods were generally short except for a 28-hour period on 12 Apr 00 (Figure 3). Applications of Orbit or Elite were made 2 days after this event. Spore counts rose significantly during that time relative to previous weeks (Figure 2). Trees treated every 2 weeks with Bravo or according to the forecasting model with Bravo and Orbit or with just Orbit alone after the long wet period did not develop cankers (Table 1). The number of cankers on trees treated according to the forecasting model with Bravo and Elite were not significantly different from zero. There were significantly fewer cankers on trees treated with Bravo only at budbreak or with just Elite alone after the long wet period than on nontreated trees but significantly more than on trees treated according to the forecasting model.

Fig 1. EFB Fungicide Timing Model.

Step 1) Apply protectant fungicide (such as Bravo) at Budbreak.

Step 2) Wait two weeks.

Step 3) Apply systemic fungicide with after infection activity (such as Orbit or Elite) within 3 days of a rain event that wets branches for longer than XX (21) hours. If a long wet period is not detected until after the first week in May then no more fungicide is needed.

Step 4) Wait 14 days then repeat step 3.

Stop after the first week of May.

Note: Model is based on research, high costs of fungicide and grower reluctance to make more than three applications per season. If more applications of fungicide are possible then continue forecasting through mid-May.

Table 1 – North Plains - Royal

Treatment and Rate /100 gal water	Application Timing	Number of Applications	Disease Incidence ^{1,2} (%)	Ave Number of Cankers/Tree ^{1,3}	Total Canker Length ^{1,3} (cm)
Nontreated.....	None.....	0			
Bravo Weather Stik 32 fl oz	21 Mar (BB) only...	1			
Bravo Weather Stik 32 fl oz then Orbit EC 2.74 fl oz after a wetness period of >21 hours	21 Mar..... 14 Apr.....	1 1			
Bravo Weather Stik 32 fl oz then Elite 45 DF 2 oz after a wetness period of >21 hours	21 Mar..... 14 Apr.....	1 1			
Orbit EC 2.74 fl oz after a wetness period of >21 hours	14 Apr.....	1			
Elite 45 DF 2 oz after a wetness period of >21 hours	14 Apr.....	1			
Bravo Weather Stik 32 fl oz every 2 weeks.....	21 Mar, 3 and 17 Apr.....	3			

¹ Means followed by the same letter do not differ significantly based on Fisher’s protected LSD (P=0.05). Means without any letters did not differ significantly.

² Analysis of variance is based on arcsin (square root (x)) transformation. Values presented are detransformed means.

³ Analysis of variance is based on log10 (x+1) transformation. Values presented are detransformed means.

Mission Bottom – Conditions at this location were similar, however, Royal trees were at budbreak on 14 Mar 00, which was a week earlier than at North Plains, while Ennis trees were at budbreak on 21 Mar 00. Wet periods longer than 21 hours occurred on 18 Mar 00 and 22 Apr 00, however a 20.5 hour wet period occurred on 12 Apr 00 (Figure 5). All fungicide treated Royal trees had significantly fewer EFB cankers than nontreated trees (Table 2). However, there were no significant differences in the number of cankers observed on Royal trees among fungicide treatments.

Ennis trees treated with Bravo and Orbit according to the forecasting model did not develop cankers (Table 3). Trees treated with Orbit only once after the long wet period of 22 Apr 00 had as few cankers statistically as trees treated with Bravo and Orbit according to the forecasting model. Trees treated once with Bravo at budbreak had as many cankers statistically as nontreated trees.

Table 2 – Mission Bottom - Royal

Treatment and Rate /100 gal water	Application Timing	Number of Applications	Disease Incidence ^{1,2} (%)	Ave Number of Cankers/Tree ^{1,3}	Total Canker Length ^{1,3} (cm)
Nontreated.....	None.....	0			
Bravo Weather Stik 32 fl oz	14 Mar (BB) only...	1			
Bravo Weather Stik 32 fl oz then Orbit EC 2.74 fl oz after a wetness period of >21 hours	14 Mar..... 24 Apr.....	1 1			
Bravo Weather Stik 32 fl oz then Elite 45 DF 2 oz after a wetness period of >21 hours	14 Mar..... 24 Apr.....	1 1			
Orbit EC 2.74 fl oz after a wetness period of >21 hours	24 Apr.....	1			
Elite 45 DF 2 oz after a wetness period of >21 hours	24 Apr.....	1			
Bravo Weather Stik 32 fl oz every 2 weeks.....	14 and 28 Mar and 11 Apr.....	3			

¹ Means followed by the same letter do not differ significantly based on Fisher's protected LSD (P=0.05). Means without any letters did not differ significantly.

² Analysis of variance is based on arcsin (square root (x)) transformation. Values presented are detransformed means.

³ Analysis of variance is based on log₁₀ (x+1) transformation. Values presented are detransformed means.

In general, forecasting programs using 2 applications of fungicide were as good as or better than the standard program using 3 applications of Bravo. Over the last three years, the standard program would have used 9 applications of Bravo for a cost of chemical of approximately \$277.02 while the forecasting program would have used 3 applications of Bravo plus one application of Rubigan plus one application of Elite for a total cost of \$130.34 for chemical. The strategy of only making a single application of Bravo at budbreak over the last 3 years would have resulted in significantly fewer cankers each year than doing nothing for a cost of \$92.34. Using the forecasting program would have resulted in significantly fewer cankers than the single budbreak Bravo spray in 1 out of the last 3 years. Further program refinements could reduce fungicide applications even more.

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