

HAZELNUT (*Corylus avellana* 'Royal')
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 30 Jan 01 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 in each of 4 replications (total of 20 trees per treatment). Treatments were applied on two sides of the tree to run-off with a backpack sprayer equipped with a hand wand. Approximately 2 gal of a spray suspension were applied per 20 trees. Bravo Weather Stik was applied at 32 fl oz/100 gal water on 22 Mar 01 (budbreak) and again on 4 Apr 01 and 18 Apr 01 depending on the treatment. Applications of Orbit EC at 2.5 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 11 Apr 01. An additional protocol for using just Orbit after detecting 21 hours wetness anytime after budbreak but before the 1st week in May resulted in applications on 27 Mar 01 and 24 Apr 01. 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 was not considered. Roundup at 2 gal/100 gal water was used between trees to control weeds on 24 Apr 01 and 23 Jul 01. Sawdust mulch was placed around the base of each tree on 8 May 01. Trees were also painted with at 50% solution of white latex paint on 24 Apr 01 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 8 Jul 02.

Similar trials were conducted adjacent to and north of a heavily diseased 'Ennis' orchard located north of Keiser, OR. Healthy 2-year-old 'Royal' trees were planted on 31 Jan 01 and 1 Feb 01. Treatments were arranged in a randomized complete block design with 5 trees in each of 4 replications (total of 20 trees per treatment). Bravo applications occurred on 22 Mar 01, 4 Apr 01 and 18 Apr 01. Orbit and Elite applications occurred between 10 am and Noon on 9 Apr 01. An additional protocol for using just Orbit after detecting 21 hours wetness anytime after budbreak but before the 1st week in May resulted in applications on 28 Mar 01. Roundup at 2 gal/100 gal water was used between trees to control weeds on 13 Apr 01 and 24 Jul 01. Sawdust mulch was placed around the base of each tree on 9 May 01. Trees were painted with at 50% solution of white latex paint on the southwest side of the trunk on 25 Apr 01 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 11 Jul 02.

Two PVC trough spore traps were placed at the North Plains site on 6 Mar 01. (Each spore trap consisted of a 2.3 meter long 1/2 inch PVC pipe split in half lengthwise, 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 22 and 27 Mar 01, 4, 11, 18 and 24 Apr 01 and 8 May 01 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: 0.71 in from 6 Mar 01 to 22 Mar 01, 0.68 in from 22 Mar 01 to 27 Mar 01, 0.77 in from 27 Mar 01 to 4 Apr 01, 0.48 in from 4 Apr 01 to 11 Apr 01, 0.32 in from 11 Apr 01 to 18 Apr 01, 0.57 in from 18 Apr 01 to 24 Apr 01, and 0.61 in from 24 Apr 01 to 8 May 01. Two spore traps were also located at Mission Bottom starting 7 Mar 01 with rainwater collected on 22 and 28 Mar 01, 4, 9 and 18 Apr 01 and 9 May 01. Rainfall during those periods was 0.93, 1.26, 0.15, 0.65, 0.71 and 0.89 in, respectively.

North Plains – Dormant and spring weather conditions in Western Oregon were considered dry with below normal rainfall all season. During early shoot growth there were 4 wet periods, initiated by rain, that were longer than 21 hours (Figure 2). These wet periods occurred on 24 and 27 Mar 01 and 9 and 22 Apr 01. Some DMIs were applied within 2-3 days of these events depending on the treatment protocol. Spore counts were quite high throughout this early period (Figure 3). There were no significant differences in canker number or length comparing fungicide treated trees with nontreated trees (Table 1). None of the trees showed any phytotoxicity during the growing season, however, trees treated with Orbit showed typical growth regulation activity in the form of smaller, darker green leaves. Overall, the number of cankers per tree was uncharacteristically low for this trial and for this location. Given the high spore counts, favorable weather and susceptible trees (trees from the same lot were heavily infected when planted in a different location) it is highly likely that this plot was accidentally oversprayed from the adjacent commercial orchard.

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.

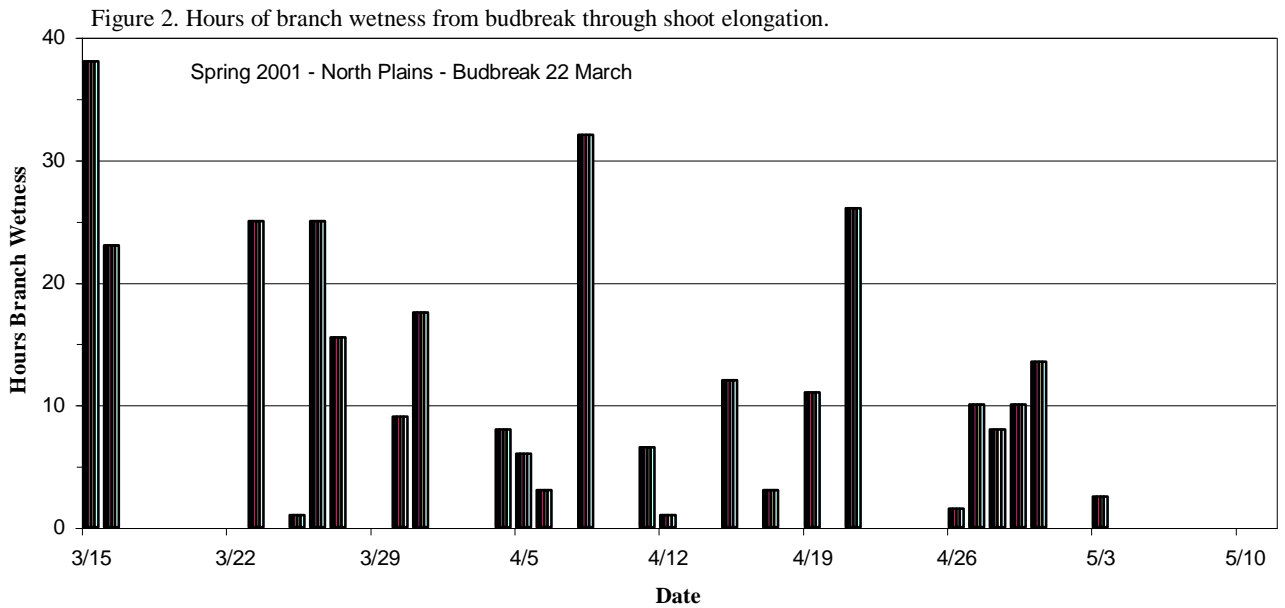


Table 1 – North Plains

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	35 ab	0.4 abc	2.5 abc
Bravo Weather Stik 32 fl oz	22 Mar (BB) only...	1	55 a	0.6 ab	4.0 ab
Bravo Weather Stik 32 fl oz then Orbit EC 2.5 fl oz after a wetness period of >21 hours	22 Mar..... 11 Apr.....	1 1	23 abc	0.4 ab	4.0 ab
Bravo Weather Stik 32 fl oz then Elite 45 DF 2 oz after a wetness period of >21 hours	22 Mar..... 11 Apr.....	1 1	40 ab	0.4 ab	2.8 ab
Orbit EC 2.5 fl oz after a wetness period of >21 hours	11 Apr only	1	20 bc	0.3 bc	1.6 bc
Elite 45 DF 2 oz after a wetness period of >21 hours	11 Apr only	1	45 ab	0.7 a	5.0 a
Bravo Weather Stik 32 fl oz every 2 weeks.....	22 Mar, 4 and 18 Apr.....	3	5 c	0.1 c	0.4 c
Orbit EC 2.5 fl oz after a wetness period of >21 hours	27 Mar and 24 Apr.....	2	55 ab	0.6 ab	4.4 ab

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 very similar with Royal trees at budbreak on 22 Mar 01. Wet periods longer than 21 hours occurred on 6, 9 and 10 Apr 01 (Figure 5). Some DMIs were applied within 2-3 days of these events depending on the treatment protocol. Spore counts were high throughout this period except for a mostly dry period at the end of March, beginning of April (Figure 6). All fungicide treated trees had significantly fewer EFB cankers than nontreated trees (Table 2). Trees treated with 3 applications of Bravo on a protection schedule had significantly fewer cankers than trees treated according to various forecasting programs. None of the trees showed any phytotoxicity during the growing season, however, trees treated with Orbit showed typical growth regulation activity in the form of smaller, darker green leaves. Data suggest that we may not get a full 3 days of kickback activity with Orbit or Elite. It is also recommended that an additional application of a DMI be made if an infection period occurs at the end of a 10 - 14 day protection period.

Table 2 – Mission Bottom

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	100 a	5.1 a	82.1 a
Bravo Weather Stik 32 fl oz	22 Mar (BB) only...	1	100 a	2.6 bcd	27.2 cd
Bravo Weather Stik 32 fl oz then Orbit EC 2.5 fl oz after a wetness period of >21 hours	22 Mar..... 9 Apr.....	1 1	85 a	2.2 d	24.6 d
Bravo Weather Stik 32 fl oz then Elite 45 DF 2 oz after a wetness period of >21 hours	22 Mar..... 9 Apr.....	1 1	90 a	2.5 cd	29.9 cd
Orbit EC 2.5 fl oz after a wetness period of >21 hours	9 Apr.....	1	90 a	2.6 cd	29.8 cd
Elite 45 DF 2 oz after a wetness period of >21 hours	9 Apr.....	1	95 a	3.6 b	59.3 ab
Bravo Weather Stik 32 fl oz every 2 weeks.....	22 Mar, 4 and 18 Apr.....	3	55 b	0.8 e	7.7 e
Orbit EC 2.5 fl oz after a wetness period of >21 hours	28 Mar	1	95 a	3.0 bc	40.5 bc

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.

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