TENNESSEE STATE UNIVERSITY

College of Agriculture, Human
And Natural Science
Cooperative Extension

Controlling the Flatheaded Appletree Borer in Nurseries with Soil Applied Systemic Insecticides

Adam Blalock and Dr. Jason Oliver

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The flatheaded appletree borer (FHAB) can cause major damage to young trees. Soil drenches of selected systemic insecticides can significantly reduce the number of FHAB attacks. To protect trees during the growing season, systemic insecticides need to be applied early in the spring or the previous fall to allow chemical uptake into the tree tissues and prevent larval damage.

The adult FHAB becomes active in middle Tennessee in May and will seek out stressed trees on which to lay its eggs throughout summer. The eggs hatch approximately one week after being laid, and the larvae will bore directly into the tree just beneath the bark and begin to feed. The larva (Image 1) is off-white in color with a prominent enlarged thoracic region just behind its head giving it a flat-headed appearance and hence the name. Adults are "bullet-shaped", between 0.3 – 0.6 inches and generally dark in color with irregular spots (Image 2). However, despite its name, the FHAB is considered a "generalist" and will feed on many species of trees including apples, oaks, maples, dogwoods and many others.

Damage from feeding is usually not evident until fall or the next spring. Early damage symptoms are typically sunken and discolored bark and bark splitting (Image 3). As time passes the bark may begin to slough off revealing a large wound filled with frass (Image 4). Many times the wound is a serpentine-like shape. Small tree transplants are especially at risk from the FHAB because they are often stressed from the digging and transplanting process, and due to their small size, can be completely girdled by the feeding larva (Image 5). After the larva has fully developed it will bore further into the tree where it will mature into an adult. As the adult emerges from the tree, it will leave behind a "D-shaped" exit hole (Image 6).

Image 1. The FHAB larva gets its name from the enlarged thoracic region just behind its head.

Soil applied systemic insecticides containing imidacloprid, dinotefuran and others in this chemical family (the neonicotinoids), may take several weeks to move from the soil

into the roots and then translocate throughout the rest of the plant. These systemic insecticides can provide protection against the FHAB by killing the larva that attempt to feed on the tree. However, during the time period between the root drench and the uptake of the chemical by the plant, the tree is still susceptible to FHAB attacks. Due to this delay in control, it is important to apply these products as soon as the plants begin to leaf out during the spring to prevent FHAB attacks for the current year. Early to mid-April is often the ideal time to apply these systemic insecticides for controlling the FHAB for the upcoming growing season. Fall applications will also prevent FHAB attacks for the following season.

Image 3. Early damage signs from the FHAB larva include sunken and cracking bark.

Many systemic insecticides are labeled for FHAB control. Application rates for soil drench applied systemic insecticides are based on the trees diameter (caliper) (Tables 1 – 5). Some imidacloprid products can provide up to 3 years protection. Imidacloprid tablets (e.g., Discus ® Tablets) are generally slower and must be given at least one year in advance to prevent FHAB attacks. Other systemic products like dinotefuran (Safari®) have provided one year of protection in research tests. Remember to always read a current label because approved uses and rates can change.

Image 4. The result of FHAB feeding are frass filled galleries or wounds left by the larva.

One problem with applying these systemic root drenches to trees grown in the field is that the maximum allowable product per acre limits the total number of trees that can be treated. One possible method to avoid acerage restrictions is to treat container-grown trees before planting. After the plants are treated, preliminary research has shown that container-grown trees treated in the fall or spring prior to field planting have been protected for three years from FHAB hits. During transplanting into the field, it is

important to keep the container substrate intact with the root system. The substrate can act as a chemical reservoir.

Administering these soil drenches quickly and easily while minimizing chemical exposure can be challenging. One of the simplest methods for applying the correct dose rate is a measuring cup with a hole punched at the desired application volume level (Image 7). This method may be quick and easy but it may increase your risk of chemical exposure. For a few trees this method may be sufficient. For treating large numbers of trees, an automatic refilling syringe may reduce chemical exposure and improve the efficiency and accuracy of the soil drench applications. A third way to apply the correct volume of solution to each tree would be to time how long it takes to apply a known volume when using a hand held spray wand. A large number of trees can be effectively treated with this method, as long as each tree receives the same amount of solution. To avoid application error, use a stopwatch or other timing device.

Neonicotinoid insecticides, including imidacloprid, are potentially harmful to bees and have been the subject of recent concern. Be especially careful not to apply to plants in flower and follow the label's recommendations for minimizing bee exposure. Because of this high risk, at least one product (Mallet® 75WSP) specifically says do not apply to *Tilia* tree species.

Image 5. Small trees are especially at risk from the FHAB since a single larva can complete girdle a tree as seen here.

Image 6 (bottom right). A "D-shaped exit hole left by the adult beetle.

Image 2 (top right). The adult FHAB beetle is bullet-shaped with large eyes and irregular spots. (pictured is not to scale)

Image 7 (top left). A measuring cup with holes punched at the desired volume.

Table 1. Insecticide product amounts to apply by soil drench for different tree trunk diameters measured in inches for imidacloprid 2F products targeting FHAB.

Trunk Diameter (in Inches)[2]	Imidacloprid 2F Amounts per Tree per Trunk Diameter[1]						Maximum Number of Trees Treated per Acre per Year		
	Milliliters			Fluid Ounces					
	Half Low Rate[3]	Lowest Labeled Rate	Highest Labeled Rate	Half Low Rate	Lowest Labeled Rate	Highest Labeled Rate	Half Low Rate	Lowest Labeled Rate	Highest Labeled Rate
0.25	0.375	0.75	1.5	0.012	0.025	0.05	2,019	1,009	505
0.5	0.75	1.5	3	0.025	0.05	0.1	1,009	505	252
0.75	1.125	2.25	4.5	0.037	0.075	0.15	673	336	168
1.0	1.5	3	6	0.05	0.1	0.2	505	252	126
1.5	2.25	4.5	9	0.075	0.15	0.3	336	168	84
2.0	3	6	12	0.1	0.2	0.4	252	126	63
2.5	3.75	7.5	15	0.125	0.25	0.5	202	101	50
3.0	4.5	9	18	0.15	0.3	0.6	168	84	42
3.5	5.25	10.5	21	0.175	0.35	0.7	144	72	36
4.0	6	12	24	0.2	0.4	0.8	126	63	32
4.5	6.75	13.5	27	0.225	0.45	0.9	112	56	28
5.0	7.5	15	30	0.25	0.5	1	101	50	25
5.5	8.25	16.5	33	0.275	0.55	1.1	92	46	23
6.0	9	18	36	0.3	0.6	1.2	84	42	21
6.5	9.75	19.5	39	0.325	0.65	1.3	78	39	19
7.0	10.5	21	42	0.35	0.7	1.4	72	36	18
7.5	11.25	22.5	45	0.375	0.75	1.5	67	34	17
8.0	12	24	48	0.4	0.8	1.6	63	32	16
8.5	12.75	25.5	51	0.425	0.85	1.7	59	30	15
9.0	13.5	27	54	0.45	0.9	1.8	56	28	14
9.5	14.25	28.5	57	0.475	0.95	1.9	53	27	13
10.0	15	30	60	0.5	1	2	50	25	13
10.5	15.75	31.5	63	0.525	1.05	2.1	48	24	12
11.0	16.5	33	66	0.55	1.1	2.2	46	23	11
11.5	17.25	34.5	69	0.575	1.15	2.3	44	22	11
12.0	18	36	72	0.6	1.2	2.4	42	21	11
12.5	18.75	37.5	75	0.625	1.25	2.5	40	20	10
13.0	19.5	39	78	0.65	1.3	2.6	39	19	10
13.5	20.25	40.5	81	0.675	1.35	2.7	37	19	9
14.0	21	42	84	0.7	1.4	2.8	36	18	9
14.5	21.75	43.5	87	0.725	1.45	2.9	35	17	9
15.0	22.5	45	90	0.75	1.5	3	34	17	8

[1] Imidacloprid 2F products labeled for FHAB in nursery crops include **AmTide Imidacloprid 2F T&O, Lada 2F Insecticide, Mallet 2F T&O Insecticide, Marathon II Greenhouse & Nursery Insecticide Quali-Pro Imidacloprid 2F Nursery & Greenhouse Insecticide, and Quali-Pro Imidacloprid 2F Turf & Ornamental Insecticide**. Always read a current label because approved uses can change. Other new products may exist that we have not named.

[2] Measure the trunk diameter for several trees in your nursery block at 6 inches above the soil line, average the diameter measurements and then use the average size to determine the correct rate to apply from the table above. Apply the insecticide in minimum solution volume of 60 mL (2 fl. oz.) or a water volume recommended by the label. Apply all the way around the tree at the base.

[3] The half-lowest-labeled rate is under experimental evaluation but has provided reasonably consistent control of FHAB. This rate will provide protection, but until all the research is completed, use it at your own discretion and risk.

Table 2. Insecticide product amounts to apply by soil drench for different tree trunk diameters measured in inches for Discus® N/G targeting FHAB.

Trunk Diameter (in Inches)[2]	Discus® N/G Amount per Tree per Trunk Diameter[1]						Maximum Number of Trees Treated per Acre per Year		
	Milliliters			Fluid Ounces					
	Half Low Rate[3]	Lowest Labeled Rate	Highest Labeled Rate	Half Low Rate	Lowest Labeled Rate	Highest Labeled Rate	Half Low Rate	Lowest Labeled Rate	Highest Labeled Rate
0.25	2.75	5.5	11	0.093	0.187	0.375	2626	1313	657
0.5	5.5	11	22	0.187	0.375	0.75	1314	657	328
0.75	8.25	16.5	33	0.281	0.562	1.125	876	438	219
1.0	11	22	44	0.375	0.75	1.5	656	328	164
1.5	16.5	33	66	0.562	1.125	2.25	438	219	109
2.0	22	44	88	0.75	1.5	3	328	164	82
2.5	27.5	55	110	0.937	1.875	3.75	262	131	66
3.0	33	66	132	1.125	2.25	4.5	218	109	55
3.5	38.5	77	154	1.312	2.625	5.25	188	94	47
4.0	44	88	176	1.5	3	6	164	82	41
4.5	49.5	99	198	1.687	3.375	6.75	146	73	36
5.0	55	110	220	1.875	3.75	7.5	132	66	33
5.5	60.5	121	242	2.062	4.125	8.25	120	60	30
6.0	66	132	264	2.25	4.5	9	110	55	27
6.5	71.5	143	286	2.437	4.875	9.75	102	51	25
7.0	77	154	308	2.625	5.25	10.5	94	47	23
7.5	82.5	165	330	2.812	5.625	11.25	88	44	22
8.0	88	176	352	3	6	12	82	41	21
8.5	93.5	187	374	3.187	6.375	12.75	78	39	19
9.0	99	198	396	3.375	6.75	13.5	72	36	18
9.5	104.5	209	418	3.562	7.125	14.25	70	35	17
10.0	110	220	440	3.75	7.5	15	66	33	16
10.5	115.5	231	462	3.937	7.875	15.75	62	31	16
11.0	121	242	484	4.125	8.25	16.5	60	30	15
11.5	126.5	253	506	4.312	8.625	17.25	58	29	14
12.0	132	264	528	4.5	9	18	54	27	14
12.5	137.5	275	550	9.687	9.375	18.75	52	26	13
13.0	143	286	572	4.875	9.75	19.5	50	25	13
13.5	148.5	297	594	5.062	10.125	20.25	48	24	12
14.0	154	308	616	5.25	10.5	21	46	23	12
14.5	159.5	319	638	5.437	10.875	21.75	45	23	11
15.0	165	330	660	5.625	11.25	22.5	44	22	11

[1] **Discus® N/G** is labeled for FHAB in nursery crops. Always read a current label because approved uses can change.

[2] Measure the trunk diameter for several trees in your nursery block at 6 inches above the soil line, average the diameter measurements and then use the average size to determine the correct rate to apply from the table above. Apply the insecticide in minimum solution volume of 60 mL (2 fl. oz.) or a water volume recommended by the label. Apply all the way around the tree at the base.

[3] The half-lowest-labeled rate is under experimental evaluation but has provided reasonably consistent control of FHAB. This rate will provide protection, but until all the research is completed, use it at your own discretion and risk.

Table 3. Insecticide product amounts to apply by soil drench for different tree trunk diameters measured in inches for Marathon® 60WP targeting FHAB.

Trunk Diameter (in Inches)[2]	Marathon® 60WP Amount per Tree per Trunk Diameter (in.)[1]						Maximum Number of Trees Treated per Acre per Year		
	Grams			Ounces					
	Half Low Rate[3]	Lowest Labeled Rate	Highest Labeled Rate	Half Low Rate	Lowest Labeled Rate	Highest Labeled Rate	Half Low Rate	Lowest Labeled Rate	Highest Labeled Rate
0.25	0.161	0.312	0.625	0.005	0.011	0.022	1936	968	484
0.5	0.312	0.625	1.25	0.011	0.022	0.044	968	484	242
0.75	0.468	0.937	1.875	0.016	0.033	0.066	646	323	161
1.0	0.625	1.25	2.5	0.022	0.044	0.088	484	242	121
1.5	0.937	1.875	3.75	0.033	0.066	0.132	322	161	81
2.0	1.25	2.5	5	0.044	0.088	0.176	242	121	60
2.5	1.562	3.125	6.25	0.055	0.110	0.220	194	97	48
3.0	1.875	3.75	7.5	0.066	0.132	0.264	162	81	40
3.5	2.187	4.375	8.75	0.077	0.154	0.308	138	69	35
4.0	2.5	5	10	0.088	0.176	0.352	120	60	30
4.5	2.812	5.625	11.25	0.099	0.198	0.396	108	54	27
5.0	3.125	6.25	12.5	0.11	0.220	0.440	96	48	24
5.5	3.437	6.875	13.75	0.121	0.242	0.484	88	44	22
6.0	3.75	7.5	15	0.132	0.264	0.529	80	40	20
6.5	4.062	8.125	16.25	0.143	0.286	0.573	74	37	19
7.0	4.375	8.75	17.5	0.154	0.308	0.617	70	35	17
7.5	4.687	9.375	18.75	0.165	0.330	0.661	64	32	16
8.0	5	10	20	0.176	0.352	0.705	60	30	15
8.5	5.312	10.625	21.25	0.187	0.374	0.749	56	28	14
9.0	5.625	11.25	22.5	0.198	0.396	0.793	54	27	13
9.5	5.937	11.875	23.75	0.209	0.418	0.837	50	25	13
10.0	6.25	12.5	25	0.220	0.440	0.881	48	24	12
10.5	6.562	13.125	26.25	0.231	0.462	0.925	46	23	12
11.0	6.875	13.75	27.5	0.242	0.484	0.969	44	22	11
11.5	7.187	14.375	28.75	0.253	0.507	1.014	42	21	11
12.0	7.5	15	30	0.264	0.529	1.058	40	20	10
12.5	7.812	15.625	31.25	0.275	0.551	1.102	38	19	10
13.0	8.125	16.25	32.5	0.286	0.573	1.146	38	19	9
13.5	8.437	16.875	33.75	0.297	0.595	1.190	36	18	9
14.0	8.75	17.5	35	0.308	0.617	1.234	34	17	9
14.5	9.062	18.125	36.25	0.319	0.639	1.278	34	17	8
15.0	9.375	18.75	37.5	0.330	0.661	1.322	32	16	8

[1] **Marathon® 60WP Insecticide** is labeled for FHAB in nursery crops. Always read a current label because approved uses can change.

[2] Measure the trunk diameter for several trees in your nursery block at 6 inches above the soil line, average the diameter measurements and then use the average size to determine the correct rate to apply from the table above. Apply the insecticide in minimum solution volume of 60 mL (2 fl. oz.) or a water volume recommended by the label. Apply all the way around the tree at the base.

[3] The half-lowest-labeled rate is under experimental evaluation but has provided reasonably consistent control of FHAB. This rate will provide protection, but until all the research is completed, use it at your own discretion and risk.

Table 4. Insecticide product amounts to apply by soil drench for different tree trunk diameters measured in inches for Mallet® 75WSP targeting FHAB.

Trunk Diameter (in Inches)[2]	Mallet® Amount per Tree per Trunk Diameter (in.)[1,4]						Maximum Number of Trees Treated per Acre per Year		
	Grams			Ounces					
	Half Low Rate[3]	Lowest Labeled Rate	Highest Labeled Rate	Half Low Rate	Lowest Labeled Rate	Highest Labeled Rate	Half Low Rate	Lowest Labeled Rate	Highest Labeled Rate
0.25	0.118	0.236	None	0.004	0.008	None	2048	1024	None
0.5	0.236	0.472	None	0.008	0.016	None	1024	512	None
0.75	0.354	0.708	None	0.012	0.025	None	682	341	None
1.0	0.472	0.944	None	0.016	0.033	None	512	256	None
1.5	0.708	1.417	None	0.024	0.049	None	342	171	None
2.0	0.944	1.889	None	0.033	0.066	None	256	128	None
2.5	1.181	2.362	None	0.041	0.083	None	204	102	None
3.0	1.417	2.834	None	0.049	0.099	None	170	85	None
3.5	1.653	3.307	None	0.058	0.116	None	146	73	None
4.0	1.889	3.779	None	0.066	0.133	None	128	64	None
4.5	2.126	4.252	None	0.074	0.149	None	114	57	None
5.0	2.362	4.724	None	0.083	0.166	None	102	51	None
5.5	2.598	5.197	None	0.091	0.183	None	94	47	None
6.0	2.834	5.669	None	0.099	0.199	None	86	43	None
6.5	3.071	6.142	None	0.108	0.216	None	78	39	None
7.0	3.307	6.614	None	0.116	0.233	None	74	37	None
7.5	3.543	7.087	None	0.124	0.249	None	68	34	None
8.0	3.779	7.559	None	0.133	0.266	None	64	32	None
8.5	4.016	8.032	None	0.141	0.283	None	60	30	None
9.0	4.252	8.504	None	0.149	0.299	None	56	28	None
9.5	4.488	8.977	None	0.158	0.316	None	54	27	None
10.0	4.724	9.449	None	0.166	0.333	None	52	26	None
10.5	4.961	9.922	None	0.174	0.349	None	48	24	None
11.0	5.197	10.394	None	0.183	0.366	None	46	23	None
11.5	5.433	10.867	None	0.191	0.383	None	44	22	None
12.0	5.669	11.339	None	0.199	0.399	None	42	21	None
12.5	5.906	11.812	None	0.208	0.416	None	40	20	None
13.0	6.142	12.284	None	0.216	0.433	None	40	20	None
13.5	6.378	12.757	None	0.224	0.449	None	38	19	None
14.0	6.614	13.229	None	0.233	0.466	None	36	18	None
14.5	6.851	13.702	None	0.241	0.483	None	36	18	None
15.0	7.087	14.174	None	0.249	0.499	None	34	17	None

[1] **Mallet® 75WSP** is labeled for FHAB in nursery crops. Always read a current label because approved uses can change.

[2] Measure the trunk diameter for several trees in your nursery block at 6 inches above the soil line, average the diameter measurements and then use the average size to determine the correct rate to apply from the table above. Apply the insecticide in minimum solution volume of 60 mL (2 fl. oz.) or a water volume recommended by the label. Apply all the way around the tree at the base.

[3] The half-lowest-labeled rate is under experimental evaluation but has provided reasonably consistent control of FHAB. This rate will provide protection, but until all the research is completed, use it at your own discretion and risk.

[4] The use of Mallet® 75WSP on linden (*Tillia* sp.) trees is prohibited.

Table 5. Insecticide product amounts to apply by soil drench for different tree trunk diameters measured in inches for Safari® 20SG targeting FHAB.

Trunk Diameter (in Inches)[2]	Safari® 20SG Amount per Tree per Trunk Diameter[1]				Maximum Number of Trees Treated per Acre per Year	
	Grams		Ounces			
	Lowest Labeled Rate	Highest Labeled Rate	Lowest Labeled Rate	Highest Labeled Rate	Lowest Labeled Rate	Highest Labeled Rate
0.25	0.75	3	0.02	0.10	1633	408
0.5	1.5	6	0.05	0.21	816	204
0.75	2.25	9	0.07	0.31	544	136
1.0	3	12	0.10	0.42	408	102
1.5	4.5	18	0.15	0.63	272	68
2.0	6	24	0.21	0.84	204	51
2.5	7.5	30	0.26	1.05	163	41
3.0	9	36	0.31	1.26	136	34
3.5	10.5	42	0.37	1.48	117	29
4.0	12	48	0.42	1.69	102	26
4.5	13.5	54	0.47	1.90	91	23
5.0	15	60	0.52	2.11	82	20
5.5	16.5	66	0.58	2.32	74	19
6.0	18	72	0.63	2.53	68	17
6.5	19.5	78	0.68	2.75	63	16
7.0	21	84	0.74	2.96	58	15
7.5	22.5	90	0.79	3.17	54	14
8.0	24	96	0.84	3.38	51	13
8.5	25.5	102	0.89	3.59	48	12
9.0	27	108	0.95	3.80	45	11
9.5	28.5	114	1.00	4.02	43	11
10.0	30	120	1.05	4.23	41	10
10.5	31.5	126	1.11	4.44	39	10
11.0	33	132	1.16	4.65	37	9
11.5	34.5	138	1.21	4.86	35	9
12.0	36	144	1.26	5.07	34	9
12.5	37.5	150	1.32	5.29	33	8
13.0	39	156	1.37	5.50	31	8
13.5	40.5	162	1.42	5.71	30	8
14.0	42	168	1.48	5.92	29	7
14.5	43.5	174	1.53	6.13	28	7
15.0	45	180	1.58	6.34	27	7

[1] **Safari® 20SG** is labeled for FHAB in nursery crops. Always read a current label because approved uses can change. Safari 20SG has not provided more than 1 year protection in recent tests. It is recommended to reapply Safari® each year based on these research tests.

[2] Measure the trunk diameter for several trees in your nursery block at 6 inches above the soil line, average the diameter measurements and then use the average size to determine the correct rate to apply from the table above. Apply the insecticide in minimum solution volume of 60 mL (2 fl. oz.) or a water volume recommended by the label. Apply all the way around the tree at the base.

For additional information, contact your local nursery specialist office at:

Tennessee State University
College of Agriculture, Human and Natural Sciences
3500 John A. Merrit Blvd., Box 9635
Nashville, TN 37209-1561
http://www.tnstate.edu/extension

Tennessee State University Otis L. Floyd Nursery Research Center
472 Cadillac Lane
McMinnville, TN 37110
http://www.tnstate.edu/agriculture/nrc/

Precautionary Statement

To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label.

Disclaimer

This publication contains pesticide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all curent label directions for the specific pesticide being used. The label always takes precidence over the recommendations found in this publication. Use of trade, brand, or active ingredient names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others that may be of simmilar and suitable composition, nor does it garuntee or warrant the standard of the product. The author(s) and Tennessee State University assume no liability resulting from the use of these recommendations.

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