Entomology

Karla Addesso

Section Editor

Managing Flatheaded Appletree Borer with Cover Crops

Karla Addesso, Sujan Dawadi, Jason Oliver, Donna Fare and Anthony Witcher

Tennessee State University, Otis L. Floyd Nursery Research Center
McMinnville, TN 37110

kaddesso@tnstate.edu

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Significance to the Industry The flatheaded appletree borer (FHAB) is a serious pest throughout the United States and reported as injurious to fruit, shade and nut trees. The FHAB is in the order Coleoptera and family Buprestidae. A single flatheaded borer larva is capable of girdling a tree within one season. Although trees attacked by FHAB do not always die, the trunk damage caused by larval tunneling ruins the economic quality of the nursery tree. In general, newly transplanted maples have slightly higher rates of attack, but maples may continue to be attacked well after transplanting (Oliver et al. 2010). The most effective treatment available for FHAB are soil drenches of imidacloprid, although chlorpyrifos, bifenthrin, and permethrin trunk sprays also are commonly used (Oliver et al. 2014). From previous studies on weed management in nursery fields, one possible management alternative identified for FHAB management is the use of cover crops sown within the tree rows in order to make it more difficult for female beetles to access preferred oviposition sites in late spring. The following study was undertaken to evaluate the potential for a winter cover crop to act as a barrier for FHAB egg laying in the late spring/early summer. This method, if effective, can offer an alternative management method to soil drenches, which can be costly as well as labor intensive.

Nature of Work A field site of 97.54 m (320 ft) × 24.38 m (80 ft) was tilled and disked in early September and 5-20-20 NPK (Plant food, Tennessee Farmers' Cooperative, Lavergne, TN) was added at a rate of 116.1 kg/plot ((256 lb/plot). Lime was added at 1,020.6 kg/plot (1.125 tons/plot) to bring the pH to 6 as recommended by soil tests. A cover crop was sown with crimson clover (*Trifolium incarnatum* L.) and winter wheat (*Triticum aestivum* L.) (Adams-Briscoe Seed Company, Jackson, GA) on 15 October 2015 at the rate of 16.8 kg/ha (15 lb/acre) and 84.2 kg/ha (75 lb/acre), respectively, before liner transplant. Red maple 'Franksred' liners were propagated by cutting in June 2014 and transplanted into size #3 containers with slow release fertilizers (15-15-15 NPK) (Plant food, Tennessee Farmers' Cooperative, Lavergne, TN) in spring 2015 at the Otis L. Floyd Nursery Research Center, McMinnville, TN.

On 13 November 2015, four hundred #3 containers were transplanted into the cover cropped field in 10 rows of 40 trees. Rows were spaced 2.1 m (7 ft) apart with 1.8 m (6 ft) within- row spacing between trees. Four treatments were replicated in a 2 × 2 factorial design. Each treatment block was 11 × 11 m (36 × 36 ft) and contained 25 trees randomly assigned to one of the four field treatments. The four treatments included: 1) herbicide +

no insecticide (Herb), 2) herbicide + insecticide (HerbIns), 3) cover crop + insecticide (CoverIns) and 4) cover crop only (Cover). Trees were fertilized on March 8 and June 20, 2016 at the base of the tree (11 g) using 15-15-15 NPK (Plant food, Tennessee Farmers' Cooperative, Lavergne, TN). The pre-emergent herbicide SureGuard (Flumioxazin 51%, Valent U.S.A. Corp., Walnut Creek, CA) was applied at a rate of 10 oz./acre in November 2015, March 2016, August 2016 and April 2017. Finale (Glufosinate-ammonium 11.33%, Bayer Environmental Science., Research Triangle Park, NC) or Glystar Original (Glyphosate 41%, Albaugh, LLC, Ankeny, Iowa) with 80-20 (0.5%) surfactant (Ragan and Massey, Inc, Ponchatoula, LA) were also applied as spot treatments to control weeds that broke through the pre-emergent barrier. Applications of post-emergent herbicides were made in March 2016, June, July and August 2016 and April 2017. The cover crop in all middles was mowed several times through the spring and summer and the cover crop in tree rows was permitted to senesce naturally.

In April 2016, trees within the insecticide-treated plots were treated with Discus N/G (imidacloprid 2.94% + 0.70% cyfluthrin, OHP, Inc. Mainland, PA) at half the labeled rate (11 ml product/2.5 cm of trunk diameter) based on previous research. All trees from each treatment were evaluated for damage by FHAB in Oct 2016. Trunk temperatures were recorded bi-weekly from 30-Mar to 23-Jun 2016. Temperatures were recorded using a IR crop temperature meter (Spectrum Technologies, Inc., East Plainfield, IL) at 20 cm above the soil surface on the southwest side of each tree. Mean values for each evaluation period are reported. Height and diameter growth measurements were calculated by subtracting Oct 2016 data from Oct 2015 data. Flatheaded appletree borer attack counts were compared among treatments by a generalized linear model procedure (PROC GENMOD) with a negative binomial distribution and treatment means were separated by LS means Tukey's multiple comparison test (SAS 9.3, SAS Institute, Inc., Cary, NC). Temperature values were analyzed by a generalized linear model procedure (PROC GENMOD) with a normal distribution with treatment means separated by LS means Tukey's multiple comparison test Growth values were analyzed with a generalized linear model under a normal distribution. LSmeans were separated by Tukey's multiple comparison test.

Results and Discussion Flatheaded appletree borer attacks in the first year post-transplant were highest in the Herb treatment where no cover crop or insecticide was applied (Fig. 1). The Cover treatment had one tree attack and the CoverIns and HerbIns had no attacks. There was a strong effect of cover crop treatment (cover: $F = 22.53$, $df = 1,396$, $P < 0.0001$) and insecticide (insecticide: $F = 27.26$, $df = 1,396$, $P < 0.0001$), but only in the herbicide treatment (cover*insecticide: $F = 22.53$, $df = 1,396$, $P < 0.0001$). The trunk temperatures at the preferred oviposition site of FHAB was consistently warmer in the herbicided plots (Fig. 2; cover: $F = 165.44$, $df = 1,2789$, $P < 0.0001$) with temperatures as much as 4C warmer in April. The major negative impact of the cover crop treatment was loss of growth due to competition (Table 1). Trees grown with the winter cover crop within the tree rows were shorter and had a smaller diameter than trees grown in rows with pre-emergent herbicide applied (cover: $F = 493.05$, $df = 1,396$, $P < 0.0001$). A positive effect of growth was also observed in the imidacloprid treated trees, but only in the herbicided

treatments (Table 1; insecticide: F = 47.49, df = 1,396, P < 0.0001, cover*insecticide: F = 32.52, df = 1,396, P < 0.0001). Trunk diameter was also affected by cover (cover: F = 278.75, df = 1, 396, P < 0.0001), and by insecticide, but only in the herbicide treatments (insecticide: F = 2.28, df = 1,396, P = 0.1322, cover*insecticide: F = 10.64, df = 1,396, P = 0.0012). These results, if consistent in year 2, suggest that winter cover cropping is a viable alternative to insecticide applications. However, the cover crop will need to be managed to minimize loss of growth through competition. Future work in this area will focus on optimizing winter cover crop selection and management in order to maximize FHAB protection while minimizing the negative impacts of cover crop competition.

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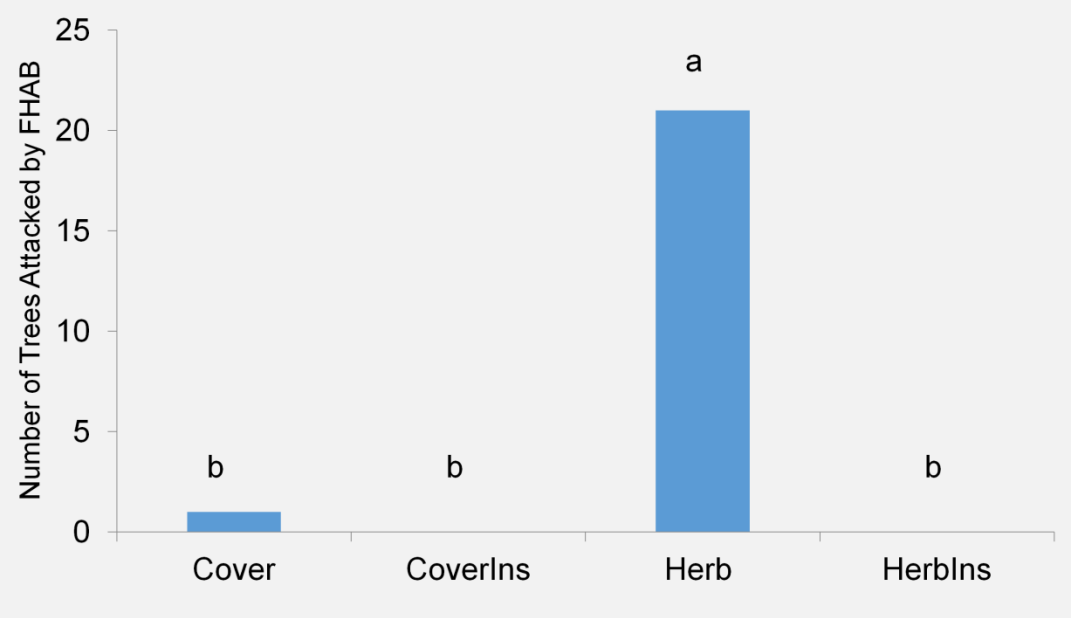

Figure 1. Total number of red maple 'Red Sunset®' trees attacked by FHAB in Year 1 post-transplant. Counts with different letters are significantly different by Tukey's pair-wise comparison (P < 0.05).

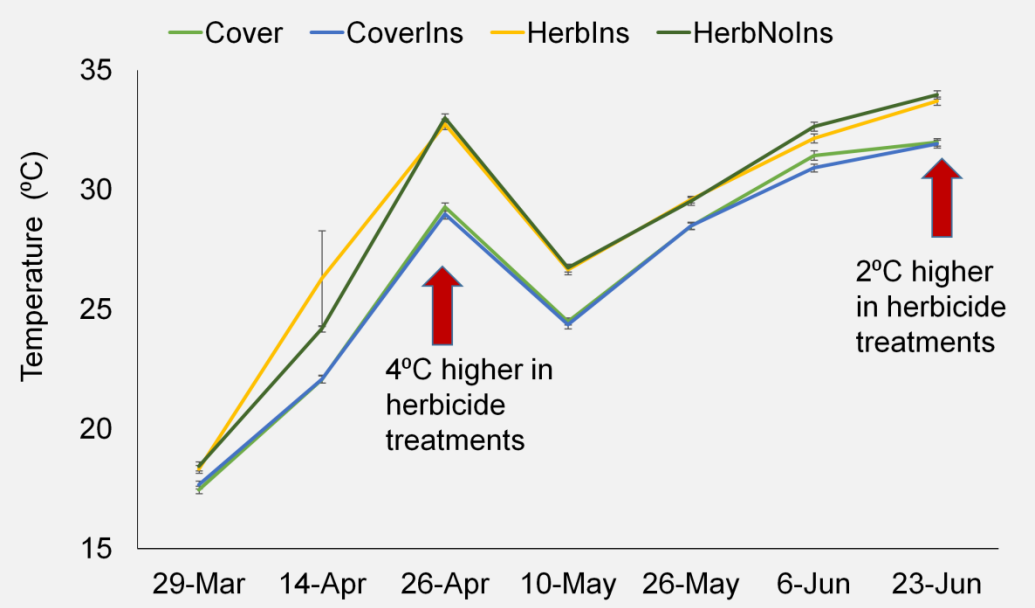

Figure 2. Trunk temperatures on the southwest side of red maple 'Red Sunset®' trees at 20 cm from soil surface.

Table 1. Growth of red maple 'Red Sunset®' in first year (Oct 2015 - Oct 2016) in all treatments (mean ± SEM).

Treatments	Height Growth (cm)*	Trunk Diameter Growth (cm)
Cover	8.26 ± 1.18**c**	0.41 ± 0.10**c**
CoverIns	10.59 ± 1.45**c**	0.31 ± 0.01**c**
HerbIns	65.28 ± 1.84**a**	1.43 ± 0.03**a**
HerbNoIns	40.60 ± 2.92**b**	1.17 ± 0.03**b**

*Values with different letters are significantly different by Tukey's pair-wise comparison ($P < 0.05$).