

Options for weed control in hazelnut plantings

cias research brief 98

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American Hazelnuts (*Corylus Americana*) are native to the Upper Midwest. Hybrids between *C. americana* and European hazelnuts (*Corylus avellana*) show promise as a commercial crop and, as woody perennials, may offer environmental benefits by providing continuous cover on the land. However, competition from weeds can negatively impact the establishment and growth of hazelnuts. Although vigorous hazelnut growth without weeds can be achieved through tillage, this leaves the soil vulnerable to erosion. If the goal is to prevent soil erosion, protect water resources and promote an ecologically diverse wildlife-friendly agro-ecosystem, alternative methods of weed control for hazelnuts are needed.

Research context

Research support and sites

This project was part of the Forever Green Initiative at the University of Minnesota, which seeks to develop cropping systems with continuous living cover. The hybrid hazelnut research is a joint effort of Forever Green and CIAS. This research was funded by a USDA-NIFA Specialty Crop Research Initiative (SCRI) grant and an Initiative for Renewable Energy and the Environment (IREE) matching grant through the Institute on the Environment (IonE) at the University of Minnesota.

From 2013 to 2015, University of Minnesota researcher Lois Braun and her team compared plant growth under four methods of weed control in hazelnut plantings. They planted hazelnuts on two different types of sites at each of two locations, Rosemount and Waseca, Minnesota: 1) former cropland, following corn and soybeans, where the ground had been tilled and where annual weeds would typically be the challenge; and 2) former hay fields, where the ground was in sod and perennial weeds would be more likely to present a challenge. The latter scenario is similar to what growers planting hazelnuts in former Conservation Reserve Program (CRP) ground may face. Setting up the trial in this way allowed the researchers to control for soil type; soils within each site were similar, whether formerly cropped or not.

Researchers tested four common methods of weed control in hazelnut plantings to see which was the most effective.



Rosemount tilled trial about a month after planting, before the cover crops in the alleyways between rows were up, but after all weed control treatments had been implemented. Weeds were already showing.

At the Rosemount tilled site, the hazelnuts followed soybeans and at the Waseca tilled site, they followed Roundup Ready corn. For both tilled sites, the researchers planted fescue and clover in the alleyways and kept them mowed. The Rosemount sod site was a brome grassland; the hazelnuts were no-till planted directly into the sod, which had been killed with a glyphosate burn-down only.

Unfortunately, the sod field originally selected next to the tilled field at Waseca proved to be too wet during the rainy spring of 2013. Because of the time required to make arrangements at a new site at a former hayfield, researchers transplanted the hazelnuts in the fall rather than in the spring as they had done at the other sites. However, this gave them an opportunity to compare two methods of pre-plant ground preparation when starting with sod. For this “paired” trial, the team prepared alternating rows of glyphosate burn-down (untilled) and glyphosate burn-down plus rototilling (tilled).

Methods

Clonal hazelnuts produced by mound layering were used for all trials, except for the Waseca paired trial, which used rooted stem cuttings. The layers were dug in the fall of 2012 and planted in the spring of 2013. The stem cuttings for the Waseca paired trial were rooted over the winter of 2013, and transplanted in fall 2013. All plants were placed 7 feet apart within rows that were spaced 12 feet apart. Each row was planted to a single genotype, which counted as a replication. There were six replications for the Rosemount tilled trial, seven for the Rosemount sod trial, and five for each of the Waseca trials. The researchers tested four common methods of weed control: cultivation (hoeing), landscape fabric, wood chip mulch, and the pre-emergent herbicide oryzalin (Surflan™). The wood chip mulch and the pre-emergent herbicide were tested with and without the herbicide glyphosate (RoundUp™), which was spot sprayed on whatever live weeds were visible.

- Hoeing was done only at the tilled trials to simulate cultivation, but hoeing was not a treatment in the sod trials because the thick sod residues made it impractical.
- Hoeing and glyphosate spraying occurred approximately once a month from late spring through summer, as long as weeds were still emerging. This resulted in between four and five applications per year.
- Dewitt Sunbelt woven landscape fabric was used. In this treatment weeds came up through the planting hole. The researchers did not hand pull or clip these weeds, assuming that most growers would not have done so.
- Wood chip mulch was applied at a thickness of three to four inches.



The Waseca paired trial in October 2013. The hazelnuts aren't visible because they were small and starting to go dormant, but the weed control treatments are evident. The strip to the left was tilled, whereas the strip to the right was burned down with herbicide.

The treatments at each location were compared to a control treatment that was mowed approximately once a month, with no additional weed control. In addition, the researchers implemented these treatments at two scales. Divot-scale treatments were limited to an area around each plant approximately two feet in diameter. Divot treatments would be typical for growers doing the work by hand. Full plot treatments covered a bed three feet wide and seven feet long along the length of a row of hazelnut bushes, halfway to the next plant and represent a typical situation for growers who are managing their plots mechanically. Due to a shortage of hazelnut plants at the Rosemount sod site, the pre-emergent herbicide treatments (with and without glyphosate) were only carried out at the full plot scale, and not the divot scale. See Table 1 for a summary of sites and treatments.

Data collection

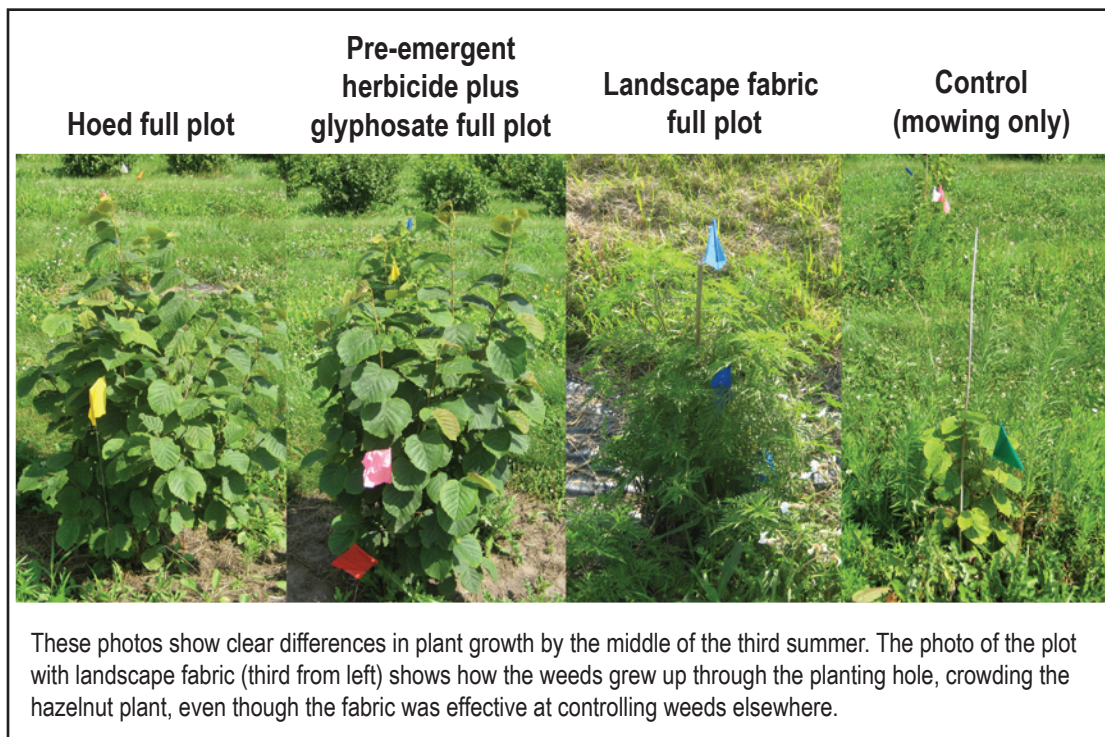
Researchers assessed hazelnut growth by measuring plant width rather than height since plants often grow taller in response to competition with weeds, and because their previous research had showed a stronger relationship between bush width and yield than between bush height and yield. In addition, researchers estimated the percentage of the ground that was covered by weeds within the two-foot diameter “divot” and also in the rest of the plot outside of the divot. They also rated the level of weed pressure on a subjective scale from 0 = none, to 3 = hazelnut plant barely visible due to crowding by weeds.

Table 1. Summary of treatments and sites

Treatments		Hoeing	Landscape fabric	Woodchip mulch		Pre-emergent herbicide		Mowing (Control)
				+glyphosate?		+glyphosate?		
Trials and sites	Pre-Plant Preparation			Yes	No	Yes	No	
Tilled trials (Rosemount and Waseca)	Tillage	X	X	X	X	X	X	X
Sod trial Rosemount	Glyphosate burn-down	0	X	X	X	X*	X*	X
Paired trial Waseca	Tillage	X	X	X	X	X	X	X
	Glyphosate burn-down	0	X	X	X	X	X	X

X = treatment implemented, 0 = treatment not implemented

*Full plot only; a plant shortage precluded the divot treatments here.



Results

Rosemount tilled

Figure 1 shows the effects of the different treatments on hazelnut plant width at the Rosemount tilled trial at the end of the third year. Treatments that resulted in significantly better plant growth than simply mowing (the control treatment) included all treatments that included spot spraying with glyphosate (red bars); the full plot wood chip mulch without glyphosate (orange); and the full plot hoed treatment (yellow).

Full plot treatments resulted in better hazelnut growth than divot treatments. The researchers suggest that this may have been because tall weeds on the periphery of the divot treatment areas leaned over and shaded the hazelnuts by mid-summer. All treatments that included glyphosate resulted in equal or better growth than the same treatment without it.

Although the landscape fabric provided nearly complete weed control where it was intact, hazelnut growth was not as good with it as some of the other treatments. The researchers believe this is probably because of the intense competition from weeds growing through the planting holes.

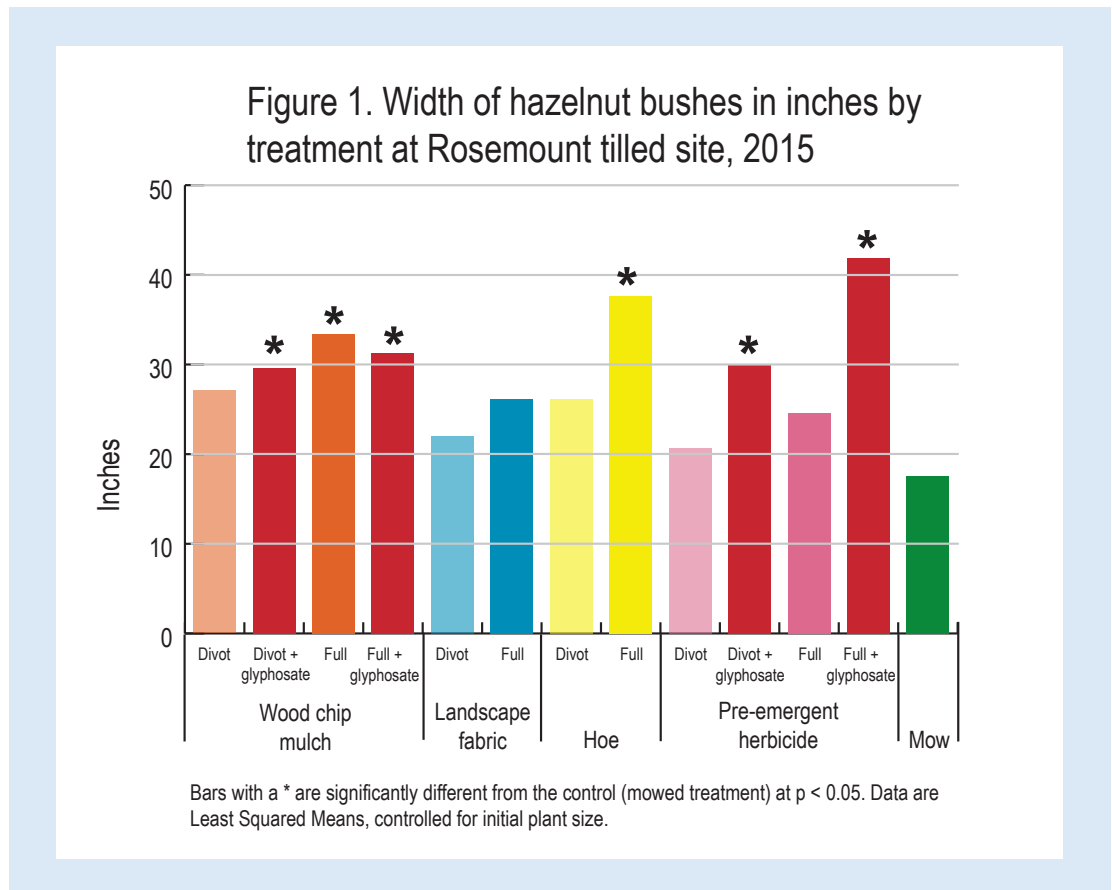
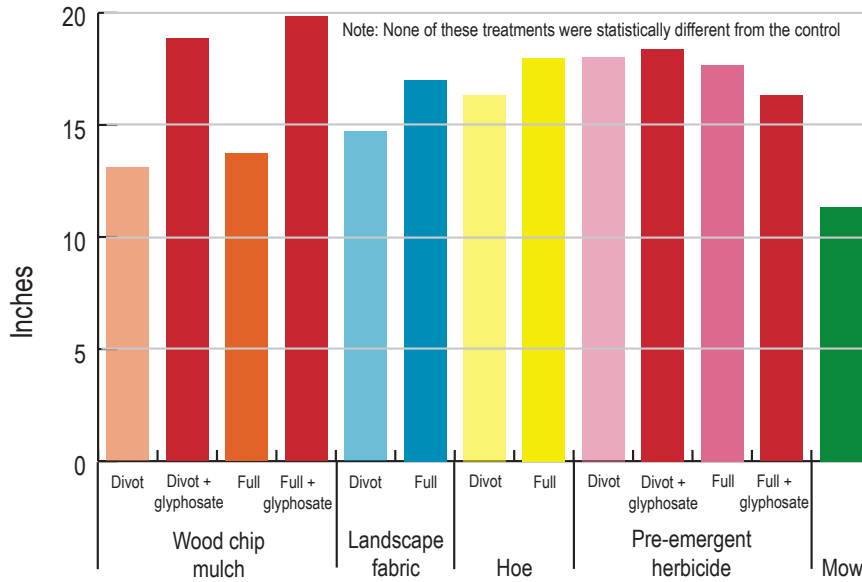


Figure 2. Width of hazelnut bushes in inches by treatment at Waseca tilled site, 2015



Bars with a * are significantly different from the control (mowed treatment) at $p < 0.05$. Data are Least Squared Means, controlled for initial plant size.

Waseca tilled

At the Waseca tilled site, even though growth declined with increasing weed pressure, there were no statistically significant differences in hazelnut growth between any of the weed control methods and mowing (Figure 2). In general, plants grew larger with glyphosate spot treatments and when weed control was applied to whole plots, rather than to a small divot around each plant. This was the only site at which pre-emergent herbicide was effective.

The differences between the tilled sites at Waseca and Rosemount can be attributed to much lower weed competition at Waseca. Whereas weed cover in the controlled plots at Rosemount averaged 93 percent, they only averaged 55 percent at Waseca. The researchers think this may have been due to years of row cropping at this site with Roundup Ready corn and soybeans, which reduced the weed seed bank.

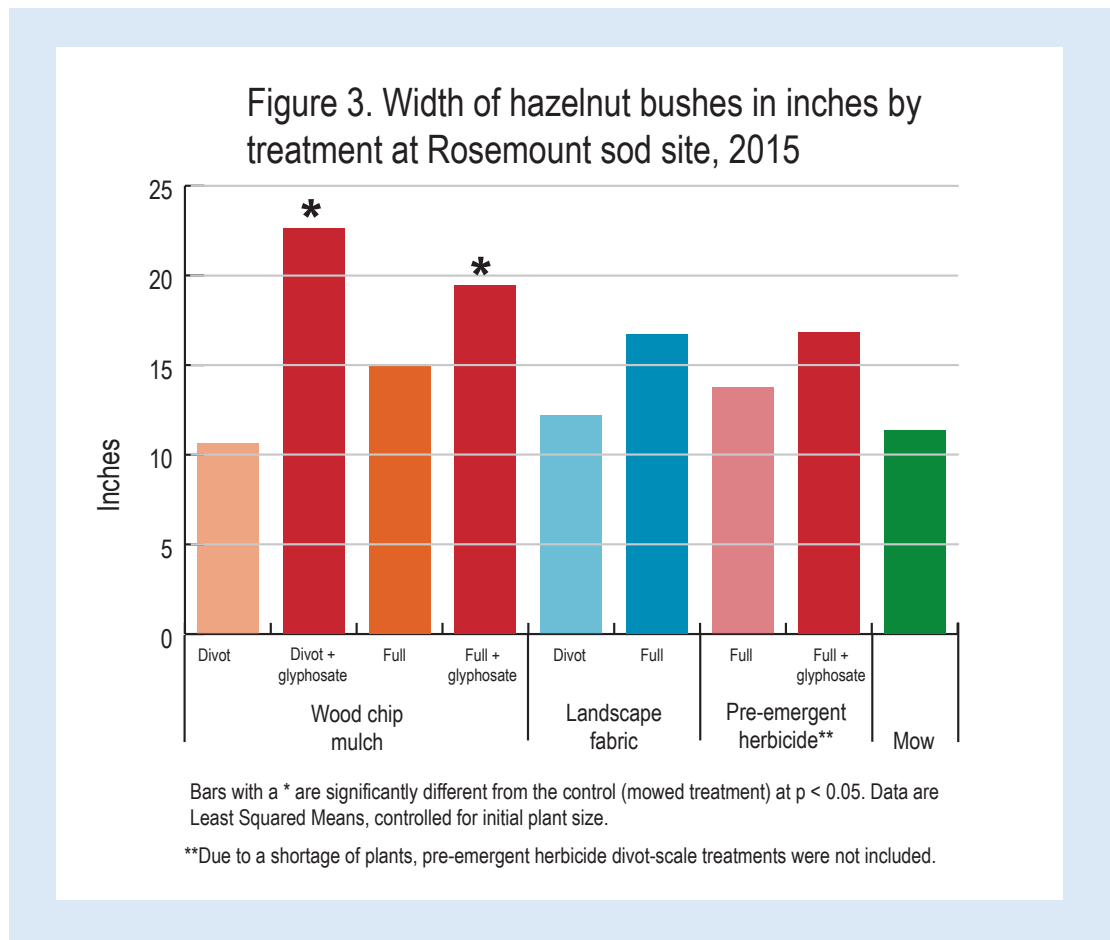
Considerations for planting in tilled fields:

- Most weeds are annuals
- Annual weeds are fairly easy to control with cultivation if started early and repeated.
- Wood chip mulch must be applied in a thick layer—three to four inches thick—to block out sunlight effectively.
- If perennial weeds like thistles and quackgrass are present, they need to be controlled with more intensive methods such as glyphosate or aggressive cultivation. These are easiest to eliminate before the hazelnuts are planted.

Rosemount sod

As expected, perennial weed competition was the main challenge at the Rosemount sod site. As at the tilled sites, landscape fabric provided complete weed control except in the planting holes. Wood chip mulch alone did not result in significantly better growth than mowing, but results improved when it was augmented by spot applications of glyphosate.

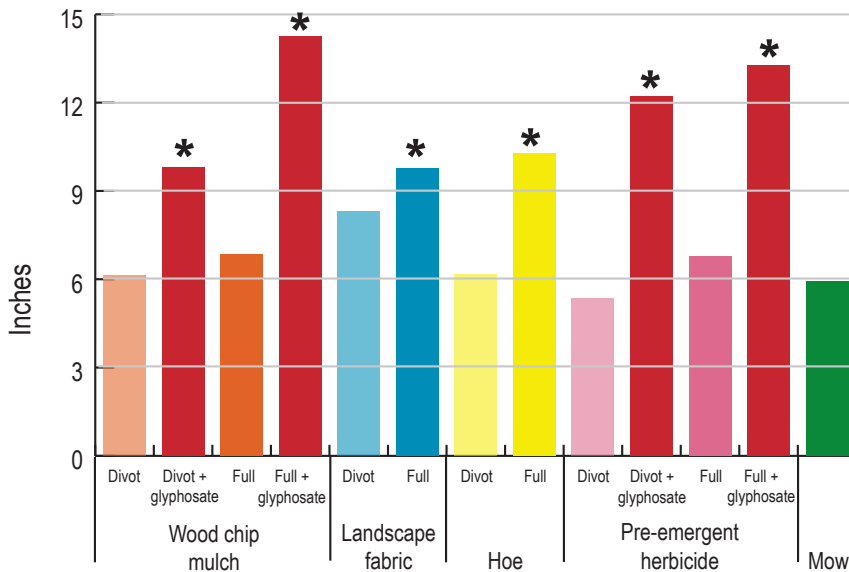
Pre-emergent herbicide oryzalin was completely ineffective against perennial weeds, as expected. The only Rosemount sod treatment that resulted in statistically significant greater hazelnut plant growth than the control was wood chip mulch plus glyphosate, divot and full plot (Figure 3).



Waseca paired

Overall, the pattern of response to the various methods of weed control in the Waseca paired trial was similar to the other trials: glyphosate spot spraying and full plot treatments resulted in larger hazelnut plants. The wood chip mulch plus glyphosate (divot and full); landscape fabric (full); hoeing (full);

Figure 4. Width of hazelnut bushes in inches by treatment at Waseca paired site, averages of tilled and untilled, 2015**



Bars with a * are significantly different from the control (mowed treatment) at $p < 0.05$. Data are Least Squared Means, controlled for initial plant size.

**The Waseca paired sites had only two years of treatments (see text) by the fall of 2015 when measurements were taken.

and pre-emergent herbicide plus glyphosate (divot and full) treatments all resulted in greater hazelnut growth than mowing (Figure 4).

Two years after planting, the plants in the untilled plots were significantly larger than the ones in the tilled plots, which was completely contrary to the researchers' expectations. It is still too early to draw any conclusions about this.

Considerations for planting in sod:

- Perennial weeds are a problem, so it is advisable to eliminate them before planting. Methods that are effective include spraying with a burn-down herbicide, which may need to be done more than once, and smothering them out with landscape fabric. Cultivation is not effective against perennial weeds unless done repetitively over several years.
- Wood chip mulch provides moderate control, but only in the first year or two.
- Pre-emergent herbicides are not effective against perennial weeds.

Recommendations and future directions

Weeds do restrict the growth of hazelnut plants, although it may not be apparent until after a year or two. Bush width is inhibited more than height. Even weeds outside the divot can negatively affect plant growth, but these could be controlled simply by mowing.

The researchers note that spot application of glyphosate is an effective supplement to other weed control methods. They caution growers to apply it carefully, following label instructions, including using the proper personal protection equipment. Prevent contact with the green foliage of the hazelnut plants, especially when plants are young. Although established hazelnuts can tolerate some glyphosate drift, young shoots are killed by it. So until the plants have enough root reserves to grow back after their shoots are killed, be very careful with glyphosate around them.

High-quality landscape fabric that blocks out all light is very effective against both annual and perennial weeds. The researchers recommend clipping or hand pulling the weeds that grow through the planting hole. This should only be necessary for the first two or three years, until the hazelnuts are large enough to shade out most new weeds. Over the long term, landscape fabric may restrict the lateral growth of hazelnuts, and more work is needed to determine if this is a problem.

“Although this research has definitively shown a positive growth response to weed control in hybrid hazelnuts, it has not shown that weed control is cost effective, nor what methods might be most cost effective,” notes Braun. The researchers would like to be able to make recommendations about weed control economics but yield data is needed to calculate return on investment for weed control. Since only a few of the plants at the Rosemount tilled site started to produce nuts in 2016, it will take a few more years before this information is available.

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This project was part of the Forever Green Initiative at the University of Minnesota. Forever Green seeks to develop cropping systems with continuous living cover such as with winter annual and perennial crops. Forever Green is a collaborative effort of the College of Food, Agricultural and Natural Resource Sciences (CFANS), Center for Integrated Natural Resources and Agricultural Management (CINRAM), and the Minnesota Institute for Sustainable Agriculture (MISA); with major funding support from the Minnesota Legislature and the Minnesota Department of Agriculture.



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