Long-term Weed Control for Landscape Pecan (*Carya illinoinensis*) Trees[1]

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Abstract

Studies were conducted at the E.V. Smith Research Center in Shorter, AL (32°43′N, -85°89′W) in 2013 and 2014 to evaluate herbicides suitable for providing season-long weed control in pecan orchards. Herbicide treatments included: (1) glyphosate applied at 1.12 kg ae·ha^{-1} (1.0 lb ae·A^{-1}), (2) glyphosate at 1.12 kg ae·ha^{-1} + indaziflam at 73.1 g ai·ha^{-1} (1.04 oz ai·A^{-1}), (3) glyphosate at 1.12 kg ae·ha^{-1} + flumioxazin at 422 g ai·ha^{-1} (6.02 oz ai·A^{-1}) + pendimethalin at 4.25 kg ai·ha^{-1} (3.79 lb ai·A^{-1}), and (4) a nontreated control. Glyphosate + indaziflam provided the highest weed-free area at all rating dates, but at 150 DAT (69%) it wasn't acceptable. Glyphosate + flumioxazin + pendimethalin provided a similar weed-free area to glyphosate + indaziflam 30 DAT (88%).

Index words: landscape weed control, shade trees, pecan, edible landscape.

Species used in this study: *Carya illinoinensis* (Wang.) K. Koch 'Desirable'.

Chemicals used in this study: indaziflam (Alion®), glyphosate (Cornerstone Plus), flumioxazin (Chateau ®), pendimethalin (Prowl H_20®).

Significance to the Horticulture Industry

Landscape professionals often have to meet demands for weed-free areas around flowers, shrubs, and trees. In most landscapes, the area underneath ornamental and shade trees provide a less than ideal environment to sustain turf and also limits use of many groundcover plants. Areas underneath landscape tree canopies are generally dry, shady, and filled with surface or shallow roots. Rather than the continuous struggle to maintain solid vegetation, landscapers use bark mulch or other aggregates to provide consistently aesthetically pleasing, weed-free areas. However, many escape weeds can be problematic in this setting. In addition, increased demand for edible landscapes from homeowners has made pecan trees a suitable landscape tree in many areas of the southeast. Long-term weed control is needed to enhance the landscape while providing the best growing conditions to produce pecans. Indaziflam is an herbicide used extensively in pecan production that can assist in weed control in landscape systems. When used on mature pecan trees, indaziflam can provide an acceptable weed free-area for up to 120 days, which could potentially lead to less labor spent on hand weeding for landscaping crews.

Introduction

Pecan trees are well suited for the southeastern U.S. and are often planted in landscapes with the dual goals of aesthetic appeal and nut production (Goff et. al. 1991). Areas underneath landscape tree canopies are generally dry, shady, and filled with surface or shallow roots. Rather than the continuous struggle to maintain solid vegetation, landscapers use bark mulch, ric-rac or other aggregates to provide consistently aesthetically pleasing, weed-free areas. The increased demand for edible landscapes from homeowners has made pecan trees a suitable landscape tree in many areas of the southeast (Serzen 2015). Many nurseries market pecan trees as edible landscape options; however, many landscapes have mature pecan trees. Pecan trees can be fast-growing shade trees with a broad canopy that produce nutritious nuts with high anti-oxidant properties (Robbins et al. 2015, Serzen 2015).

Maintaining landscapes in a proper order increases the value of the landscape and many times is done by a landscape professional. Weed control in the landscape is a major component in maintaining properties. Chemical weed control underneath shade trees along with the aesthetic appeal of mulching is a commonly used landscape practice (Marble 2015).

Young pecan trees have been shown to grow faster and produce marketable nuts much sooner if grown in a weed-free environment (Foshee et al. 1997). Because physiologically mature wood is grafted to seedling understocks, young pecan orchards routinely produce measurable nut yields by the 4th growing season (Goff et al. 1991).

Pecan trees have the potential for increased use in southeastern U.S. landscapes due to shade production and the long-term potential of nut production. Therefore, providing extended weed control underneath the trees can be valuable to landscape professionals when suggesting pecans as a landscape option or enhancing existing pecan trees in the landscape. Therefore, the goal of our research was to evaluate new herbicides that will allow long-term weed control in pecan trees.

Materials and Methods

Studies were conducted at the E.V. Smith Research Center in Shorter, AL (32°43′N, -85°89′W) in 2013 and 2014 to evaluate herbicides suitable for use in providing season-long weed control in pecan orchards. The study was conducted in a mature orchard with trees spaced 6 m by 12 m (20 ft. by 40 ft.) on center in a marvyn sandy loam soil

[1]Received for publication November 26, 2017; in revised form February 14, 2018.

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Table 1. Weed control in a mature pecan orchard following application[z] of selected herbicide treatment. Data from 2013 and 2014 are pooled.

Herbicide treatment		Weed control (%)[y]				
Postemergence	Preemergence	30 DAT[x]	60 DAT	90 DAT	120 DAT	150 DAT
Glyphosate	NA	82 b[w]	74 b	58 c	43 c	23 c
Glyphosate	Indaziflam	91 a	83 a	81 a	77 a	69 a
Glyphosate	Pendimethalin + Flumioxazin	88 a	73 b	65 b	58 b	46 b
Nontreated	–	28 c	11 c	8 d	7 d	4 d

[z]Herbicides were applied on April 13th (2013 study) and April 24th (2014 study).

[y]Weed control was rated on a scale of 0 to 100 [0 = no control, 100 = complete control].

[x]DAT = days after treatment.

[w]Least squares means within columns followed by the same letter do not differ according to the Shaffer Simulated Method at $\alpha = 0.05$.

comprised of 76.8% sand, 5.63% silt and 17.5% clay with an organic matter of 2.8% and a pH of 6.2. The orchard received no supplemental irrigation. The experimental design was a completely randomized design with four single-tree replications of each herbicide treatment. Different trees were treated in each year, however they were in the same orchard. Herbicide treatments included: (1) glyphosate (Cornerstone Plus, AgriSolutions Inc., Brighton, IL) applied at 1.12 kg ae·ha^{-1} (1.0 lb ae·A^{-1}), (2) glyphosate at 1.12 kg ae·ha^{-1} + indaziflam (Alion, Bayer CropScience, Research Triangle Park, NC) at 73.1 g ai·ha^{-1} (1.04 oz ai·A^{-1}), (3) glyphosate at 1.12 kg ae·ha^{-1} + flumioxazin (Chateau, Valent U.S.A. Corporation, Walnut Creek CA) at 422 g ai·ha^{-1} (6.02 oz ai·A^{-1}) + pendimethalin (Prowl H_2O, BASF, Research Triangle Park, NC) at 4.25 kg ai·ha^{-1} (3.79 lb ai·A^{-1}), and (4) a nontreated control. Treatments were applied on April 13th and April 24th in 2013 and 2014, respectively, with a CO_2 powered sprayer equipped with one 11004 flat-fan nozzle (Spraying Systems Co., Wheaton, IL) set to deliver 280 L·ha^{-1} (30 GPA). The treated area under single-tree replication was approximately 27.8 m^2 (300 ft^2). Weed control was evaluated at 30, 60, 90, 120, and 150 days after herbicide treatment (DAT). Weed control was determined by estimating the percentage of weed-free area within the treated area on a scale of 0 to 100 where 0 equals no weed control and 100 equals complete control (no weeds present). Predominant weed species within the orchard included: yellow foxtail (*Setaria pumila* (Poir.) Roem. & Schult.), crabgrass species (*Digitaria* spp.), yellow nutsedge (*Cyperus esculentus* L.), smartweed species (*Polygonum* spp.), morningglory species (*Ipomoea* spp.), Virginia pepperweed (*Lepidium virginicum* L.), and poison ivy (*Toxicodendron radicans* (L.) Kuntze).

Data were analyzed with generalized linear models with the use of the GLMMIX procedure (version 9.4; SAS Institute, Cary, N.C.). Year was included in the model as a random variable. The normality assumption for analysis of variance was checked using Studentized residuals and the tests for normality statistics in PROC UNIVARIATE. Data were considered non-normal when the Shapiro-Wilk, Kolmogorov-Smirnov, Anderson-Darling, and Cramér-von Mises tests were significant at $\alpha = 0.05$. Weed control ratings at all dates were found to be non-normal. Therefore, data were analyzed using the Shaffer-Simulated method at $\alpha = 0.05$. Data for each rating date were analyzed separately.

Results and Discussion

The amount of weed-free area was influenced by herbicide treatment at all dates (Table 1). At 30 DAT, the amount of weed-free area was highest in plots receiving glyphosate + indaziflam or glyphosate + pendimethalin + flumioxazin (91.2 and 87.5 % weed-free area, respectively). Acceptable weed-free area (≥ 70% weed-free area) was achieved with all treatments excluding the nontreated control (27.5 % weed-free area). At 60 DAT, the amount of weed-free area was highest in plots receiving glyphosate + indaziflam (82.5 % weed-free area). Acceptable weed-free area (≥ 70% weed-free area) was maintained by all treatments excluding the nontreated control (11.2 % weed-free area). At 60 and 90 DAT, the weed-free area continued to be highest in plots receiving glyphosate + indaziflam (80.6 % at 90 DAT and 76.8 % at 120 DAT). All other treatments failed to provide acceptable weed-free area. At 150 DAT, the weed-free area was highest in plots receiving glyphosate + indaziflam (69.3 % weed-free area); however, all treatments failed to provide an acceptable weed-free area (80% or higher). No pecan injury was observed from any treatment.

The results from this study show that glyphosate + indaziflam and glyphosate + pendimethalin+ flumioxazin are effective choices for weed control around pecan trees in the landscape. These herbicide treatments provided 120 and 90 days of acceptable weed-free area, respectively. Indaziflam is labeled in landscape applications under the tradename Spect(i)cle FLO. The label rates for this product are 437-729 mL·ha^{-1} (6 -10 fl oz·A^{-1}). Spect(i)cle FLO is not currently labeled for applications on landscape pecans, however it would be beneficial for a label to be written for this use. Alion (indaziflam) can be applied in an orchard setting to pecans established at least three years. Flumioxazin is labeled in landscape applications as SureGuard SC among others, and pendimethalin is labeled as Pendulum 3.3 EC among others. Both of these herbicides are labeled for established non-bearing pecans. The label rates for SureGuard SC are 585 to 877 mL·ha^{-1} (8-12 fl oz·A^{-1}). Applications are restricted to 1.8 L·ha^{-1} (24 fl oz·A^{-1}) in one year with at least 30 days between applications. The label rates for Pendulum 3.3 EC are 5.6 to 11.2 L·ha^{-1} (2.4-4.8 qts·A^{-1}). Single applications should not exceed 11.2 L·ha^{-1} (4.8 qts·A^{-1}). The combination of these two herbicides should provide acceptable weed-free area up to 90 DAT in pecan trees that do not meet establishment

requirements for indaziflam or are non-bearing. However, weed control may vary depending on soil characteristics.

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