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EFFECTS OF GLYPHOSATE EXPOSURE ON YOUNG PECAN TREES

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ABSTRACT

Growth and yields were determined for 1st leaf and 4th leaf 'Sumner' pecan trees grown for three seasons under nine various treatments. Bark treatments did not effect the 4th leaf trees in regards to reduced growth or yields. Increased foliage exposure decreased both growth and yields. Bark exposure for the 1st leaf trees decreased growth in some instances. Growth declined with increases in foliage exposure, generally.

INTRODUCTION

Weed competition can reduce growth (Patterson et al., 1990), yield (Patterson and Goff, 1994), and nut quality (Daniell, 1974) in pecans. Several studies have shown that reducing all weed competition dramatically increase early growth and yields from young pecan trees (Foshee et al., 1997). The benefits from improved weed control are apparent. Glyphosate is a commonly used herbicide in many pecan orchards (Patterson, 1997). The purpose of this study was to determine the effects of various levels of glyphosate exposure to young pecan trees.

MATERIALS AND METHODS

Existing 4th leaf and newly planted 'Sumner' pecan trees were utilized in this study initiated in 1995 at the E.V. Smith Research Center located in central Alabama. The trees were planted on a 20 x 20-foot spacing. All trees were fertilized based on composite leaf and soil samples taken in July of each year (O'Barr et al., 1989). The experimental design was a randomized complete-block with nine treatments and six replications of each age tree (1st leaf and 4th leaf).

The orchard floor was maintained with recommended herbicides with the exclusion of glyphosate (Patterson, 1997). All data were analyzed with the GLM procedure (SAS Institute, Cary, N.C.) as a RCBD along with a least significant difference (LSD) mean separation and selected single-degree-of-freedom contrasts. Statistical significance was determined with a p value of 0.05.

Treatments were as follows: 1) mechanical weed free by disking (monthly), 2) standard glyphosate treatment - 2-3" on bark, 3) 1/3 bark level, 4) 2/3 bark level, 5) full bark level, 6) foliage 25%, 7) foliage 50%, 8) foliage 75%, and 9) foliage 100%. All treated trees received 1.0 lb. of active ingredient per acre applied to each side of tree three times during each growing season over a three year period. Data collected included: trunk cross-sectional area (TCSA), yields, grades, and photographs to document damage.

RESULTS

Older 4th Leaf Trees. All three-bark levels and the standard were significantly larger in TCSA than the foliage 50%, 75%, and 100% treatments (Table 1). As foliage contact increased TCSA dramatically decreased (Table 1). Contrasts showed that the collective bark treatments were larger in TCSA (78.0 than the foliage group (39.0) (Table 1). This same trend was observed for the yield data in 1997 (Table 2). The lowest yields came from the foliage 75% and 100% and these were significantly lower than all other treatments except the foliage 50% and full bark treatments. Contrasts showed the bark group with higher yield (1.42) as compared to the foliage group (0.58) (Table 2). Grade data was calculated and no differences were observed for percent kernel or total rejects (data not shown).

Young 1st Leaf Trees. The greatest effect on younger trees was from the foliage 100% treatment. It had the lowest mean TCSA as compared to all other treatments except the bark 2/3, foliage 50%, foliage 75% treatments (Table 3). Survival rates for the foliage treatments (25%, 50%, 75%, 100%) were 100%, 50%, 60%, and 0%, respectively. It appears that increased bark contact did affect the growth of

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the trees, however the data is inconsistent. Trees receiving the bark 2/3 treatment were significantly smaller than the bark 1/3 or the standard glyphosate treatment (Table 3). A pre-selected F-test comparison showed that as a group the bark treatments (14.0) were larger in TCSA than the foliage treatments (9.0) (Table 3).

CONCLUSIONS

This study demonstrated that older, hardened off pecan trees (4th leaf and older) showed no adverse affect to bark exposure at any level over a 3-year period. Growth and yields were not adversely affected by these treatments. Even 25% foliage contact did not result in reduced yields or growth. However, increased foliage contact did reduce growth and yields.

The younger trees were adversely affected by exposure to the foliage. Increased bark exposure appears to have an adverse affect on growth of trees at this age. Foliage exposure did have statistical decreases in growth. No apparent damage was observed from minimal exposure to the bark on younger trees but that treatment is currently not a registered use.

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Table 1. Trunk cross-sectional area (TCSA) of young pecan trees (4th leaf) exposed to glyphosate following three-years of treatment (preliminary data) (November 1997).

Treatment	TCSA (cm^2)
Bark 1	76a[z]
Bark 2	76a
Bark 3	81a
Standard	71a
Disking	64ab
Foliage 25%	73a
Foliage 50%	49b
Foliage 75%	20c
Foliage 100%	11c
SIGNIFICANCE *(P>F)*	
Treatment	.0001
F-TEST Comparisons *(P>F)*	
glyphosate (58)[y] vs. none (64)	.2552
bark (78) vs. foliage (39)	.0001
bark-foliage (56) vs. none (64)	.1477
bark-foliage (56) vs. standard (71)	.0114

[z]Mean separation within each column by LSD at $P \leq 0.05$. Values followed by different letters are statistically different.
[y]Contrast group mean.

Note: F-TEST comparisons

1. glyphosate vs. none: included all trees treated with glyphosate vs. the disking tree
2. bark vs. foliage: 1/3, 2/3, and 3/3 bark level vs. all 4 foliage levels.
3. bark-foliage vs. none: all of bark and foliage vs. disking treatment.
4. bark-foliage vs. standard: all of bark and foliage vs. standard (2-3" on bark).

Table 2. Yield of young pecan trees (4th leaf) exposed to glyphosate following three-years of treatment (preliminary data) (November, 1997).

Treatment	Yield (lbs./tree)
Bark 1	1.93a[z]
Bark 2	1.43ab
Bark 3	0.97bcd
Standard	1.19abc
Disking	1.13abc
Foliage 25%	1.55ab
Foliage 50%	0.35cde
Foliage 75%	0.04de
Foliage 100%	0.00e
SIGNIFICANCE *(P>F)*	
Treatment	.0018
F-TEST Comparisons *(P>F)*	
glyphosate (0.98)[y] vs. none (1.13)	.5206
bark (1.42) vs. foliage (0.58)	.0007
bark-foliage (0.95) vs. none (1.13)	.4508
bark-foliage (0.95 vs. standard (1.19)	.3447

[z]Mean separation within each column by LSD at $P \leq 0.05$. Values followed by different letters are statistically different.
[y]Contrast group mean.

Note: F-TEST comparisons

1. glyphosate vs. none: included all trees treated with glyphosate vs. the disking tree
2. bark vs. foliage: 1/3, 2/3, and 3/3 bark level vs. all 4 foliage levels.
3. bark-foliage vs. none: all of bark and foliage vs. disking treatment.

bark-foliage vs. standard: all of bark and foliage vs. standard (2-3" on bark

Table 3. Trunk cross-sectional area (TCSA) of young pecan trees (1st leaf) exposed to glyphosate following three-years of treatment (preliminary data) (November, 1997).

Treatment	TCSA (cm^2)
Bark 1	21a[z]
Bark 2	9cde
Bark 3	12abcd
Standard	18ab
Disking	17abc
Foliage 25%	16abc
Foliage 50%	9bcde
Foliage 75%	7de
Foliage 100%	2e
SIGNIFICANCE *(P>F)*	
Treatment	.0037
F-TEST Comparisons *(P>F)*	
glyphosate (12)[y] vs. none (17)	.1199
bark (14) vs. foliage (9)	.0273
bark-foliage (12) vs. none (17)	.0763
bark-foliage (12) vs. standard (18)	.0506

[z]Mean separation within each column by LSD at $P \leq 0.05$. Values followed by different letters are statistically different.
[y]Contrast group mean.

Note: F-TEST comparisons

1. glyphosate vs. none: included all trees treated with glyphosate vs. the disking tree
2. bark vs. foliage: 1/3, 2/3, and 3/3 bark level vs. all 4 foliage levels.
3. bark-foliage vs. none: all of bark and foliage vs. disking treatment.
4. bark-foliage vs. standard: all of bark and foliage vs. standard (2-3" on bark).