Kansas Agricultural Experiment Station Research Reports

Volume 3
Issue 3 *Kansas Fertilizer Research*

Article 10

6-2017

# Palmer Amaranth (Amaranthus palmeri) Suppression with Half Rates of Dicamba and Atrazine with Increasing Sorghum (Sorghum bicolor) Density and Nitrogen Rate

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## Recommended Citation

Cuvaca, I. B.; Currie, R.; and Foster, A. J. (2017) "Palmer Amaranth (Amaranthus palmeri) Suppression with Half Rates of Dicamba and Atrazine with Increasing Sorghum (Sorghum bicolor) Density and Nitrogen Rate," *Kansas Agricultural Experiment Station Research Reports*: Vol. 3: Iss. 3. https://doi.org/10.4148/2378-5977.1401

# Palmer Amaranth (Amaranthus palmeri) Suppression with Half Rates of Dicamba and Atrazine with Increasing Sorghum (Sorghum bicolor) Density and Nitrogen Rate


## Abstract

Palmer amaranth (PA) competition can result in severe yield loss in grain sorghum. Increasing sorghum density and nutrient supply could promote early/rapid canopy closure and therefore reduce the amount of light that could otherwise penetrate the canopy and promote PA growth in sorghum. A study was conducted at the Southwest Research-Extension Center near Garden City, KS, to determine if PA could be suppressed with dicamba and atrazine applied as PRE at half rates combined with increasing sorghum density (60,000, 90,000, and 120,000 seeds/a), and nitrogen rate (0, 100, 200 lb/a). Preliminary results indicate that increasing plant density and nitrogen rate did not suppress PA growth. The increase in plant density and nitrogen (N) rate had no affect on reducing PA height, number, and biomass in plots without in-season control (hoeing). In-season control of Palmer amaranth significantly ($P < 0.01$) increased grain yield, sorghum height and number of heads, and was required to maximize yield. These results suggest that increasing plant density within the row does not reduce light penetration into sorghum canopy to suppress PA growth. Therefore, narrow-row planting will be added to the treatment structure to further determine the effect of plant density on suppressing PA in irrigated sorghum production.



## Keywords

sorghum, Palmer amaranth, Palmer amaranth suppression, dicamba, half rates, nitrogen rate

# Palmer Amaranth (*Amaranthus palmeri*) Suppression with Half Rates of Dicamba and Atrazine with Increasing Sorghum (*Sorghum bicolor*) Density and Nitrogen Rate

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## Summary

Palmer amaranth (PA) competition can result in severe yield loss in grain sorghum. Increasing sorghum density and nutrient supply could promote early/rapid canopy closure and therefore reduce the amount of light that could otherwise penetrate the canopy and promote PA growth in sorghum. A study was conducted at the Southwest Research-Extension Center near Garden City, KS, to determine if PA could be suppressed with dicamba and atrazine applied as PRE at half rates combined with increasing sorghum density (60,000, 90,000, and 120,000 seeds/a), and nitrogen rate (0, 100, 200 lb/a). Preliminary results indicate that increasing plant density and nitrogen rate did not suppress PA growth. The increase in plant density and nitrogen (N) rate had no affect on reducing PA height, number, and biomass in plots without in-season control (hoeing). In-season control of Palmer amaranth significantly ($P < 0.01$) increased grain yield, sorghum height and number of heads, and was required to maximize yield. These results suggest that increasing plant density within the row does not reduce light penetration into sorghum canopy to suppress PA growth. Therefore, narrow-row planting will be added to the treatment structure to further determine the effect of plant density on suppressing PA in irrigated sorghum production.


## Introduction

Sorghum is an important crop in Kansas. Similar to corn, sorghum is very sensitive to biological stress, especially weeds. Several studies have shown that sorghum cropping systems can suffer substantial yield loss when infested with Palmer amaranth.

This 2- to 3-year study aims to investigate the ability of integrated weed management approaches that combine cultural and chemical measures to control Palmer amaranth while maintaining or improving grain yield of sorghum. Particular research emphasis is aimed to understand the effect(s) of increasing planting density by increasing seeding rate and fertilizer rate with ultra-low herbicide applications on Palmer amaranth control and grain yield in irrigated sorghum cropping systems.

Successful completion of this project will provide a basis for a more comprehensive understanding and management of Palmer amaranth using integrated approaches as alternatives to chemical measures in irrigated sorghum cropping systems.

## Procedures

### *Experimental Site*

In 2016, field experiments were conducted at the Southwest Research-Extension Center, near Garden City, KS. The soil at the site was predominantly Richfield silt loam (fine, montmorillonitic, mesic Aridic Argiustoll).

### *Experimental Design*

Three planting densities (60,000, 90,000, and 120,000 seeds per acre), three fertilizer rates (0, 100, and 200 pounds per acre N), and two in-season weed control levels (hoeing; weed vs. weed free) were evaluated for their ability to suppress Palmer amaranth while maintaining grain yield of sorghum using a completely randomized block design with split-split plot arrangement and four replicates. Planting density, fertilizer rate, and in-season weed control were treated as main plot, sub-plot, and sub-sub plot factors, respectively.

### *Plot Establishment and Management*

Experimental plots were established using a John Deere max emerge planter in a field with natural infestation of Palmer amaranth. Due to limited space each sub-sub plot was planted to four 22.5-ft-long rows of sorghum. The field was disked and field cultivated to assure a weed-free seedbed at planting while at the same time creating an optimum environment for both sorghum and Palmer amaranth emergence and establishment. Sorghum, "DK 3707," was planted on June 20, 2016, in rows 30 in. apart and with 8 oz of dicamba tank mixed with 1 pint atrazine + .25% v/v Induce (surfactant) was sprayed across all plots at the spike stage or after sorghum has sprouted but prior to sorghum emergence to avoid potential injury from the herbicide. No other weed species but Palmer amaranth was allowed to grow within the plots to avoid unwanted sources of variation. Further, hand-pulling and hoeing was done as necessary in plots assigned for in-season weed control. Irrigation was supplied to meet 120% of crop evapotranspiration. Sorghum was harvested at physiological maturity and yields were adjusted to 13% grain moisture.

### *Data Collection*

Yield and other parameters, including sorghum height and headcount, Palmer amaranth number, height, and biomass were estimated from the two central rows. Other data that were measured include the normalized difference vegetation index (NDVI), which is indicative of the abundance of photosynthetically active vegetation. NDVI was measured using a hand-held Green Seeker model 505 (Trimble Navigation, Sunnyvale, CA) which is an active sensor (i.e. unaffected by time of day or night, nor cloud cover as it emits its own light), equipped with a COMPAQ iPAQ pocket PC and specific software that collects and stores NDVI data. Leaf area index (LAI) was measured using AccuPAR model LP-80 Ceptomenter (Decagon Devices, Inc., Pullman, WA) which is a portable linear array of photosynthetically active radiation sensors that together with an external sensor accurately measures LAI at any location within a plant canopy in real time without destroying the crop regardless of the ambient light conditions.

### *Data Analysis*

Data were analyzed using SAS 9.3 (SAS Institute, Inc., Cary, NC) and Sigmaplot 12.0 software.

## Results

Preliminary results indicate that increasing planting density and nitrogen rate did not suppress Palmer amaranth growth, number, and biomass (Table 1 and Figure 1), but in-season weed control (hoeing) of Palmer amaranth did increase sorghum height, number of heads, and grain yield (Table 1 and Figure 2). Increasing planting density within the row did not reduce light penetration (data not shown) into sorghum canopy enough to suppress Palmer amaranth growth. In regards to these results, narrow-row planting will be added to the treatment structure in 2017 to further determine the effect of planting density on suppressing Palmer amaranth in irrigated sorghum.

**Table 1. Summary statistics; *P*-values and least significant difference (LSD) at α = .001**

| | Source of variation | | |
|---|---|---|---|
| | *P*-values (LSD) | | |
| Parameter | Planting density | Nitrogen rate | In-season weed control |
| Sorghum headcount | <0.001(12.306)* | 0.382(12.306) | <0.001(10.048)* |
| Sorghum height | 0.098(5.019) | 0.412(5.019) | <0.001(4.098)* |
| Sorghum grain yield | 0.886(17.088) | 0.868(17.088) | <0.001(13.953)* |
| Palmer amaranth fresh biomass | 0.217(1215.4) | 0.932(1215.4) | --- |
| Palmer amaranth dry biomass | 0.232(513.29) | 0.816(513.29) | --- |
| Palmer amaranth fresh-dry biomass | 0.225(726.07) | 0.983(726.07) | --- |
| Palmer amaranth height | 0.569(51.065) | 0.263(51.065) | --- |
| Palmer amaranth per yd row | 0.185(10.463) | 0.981(10.463) | --- |

*Significant at .1% probability level.

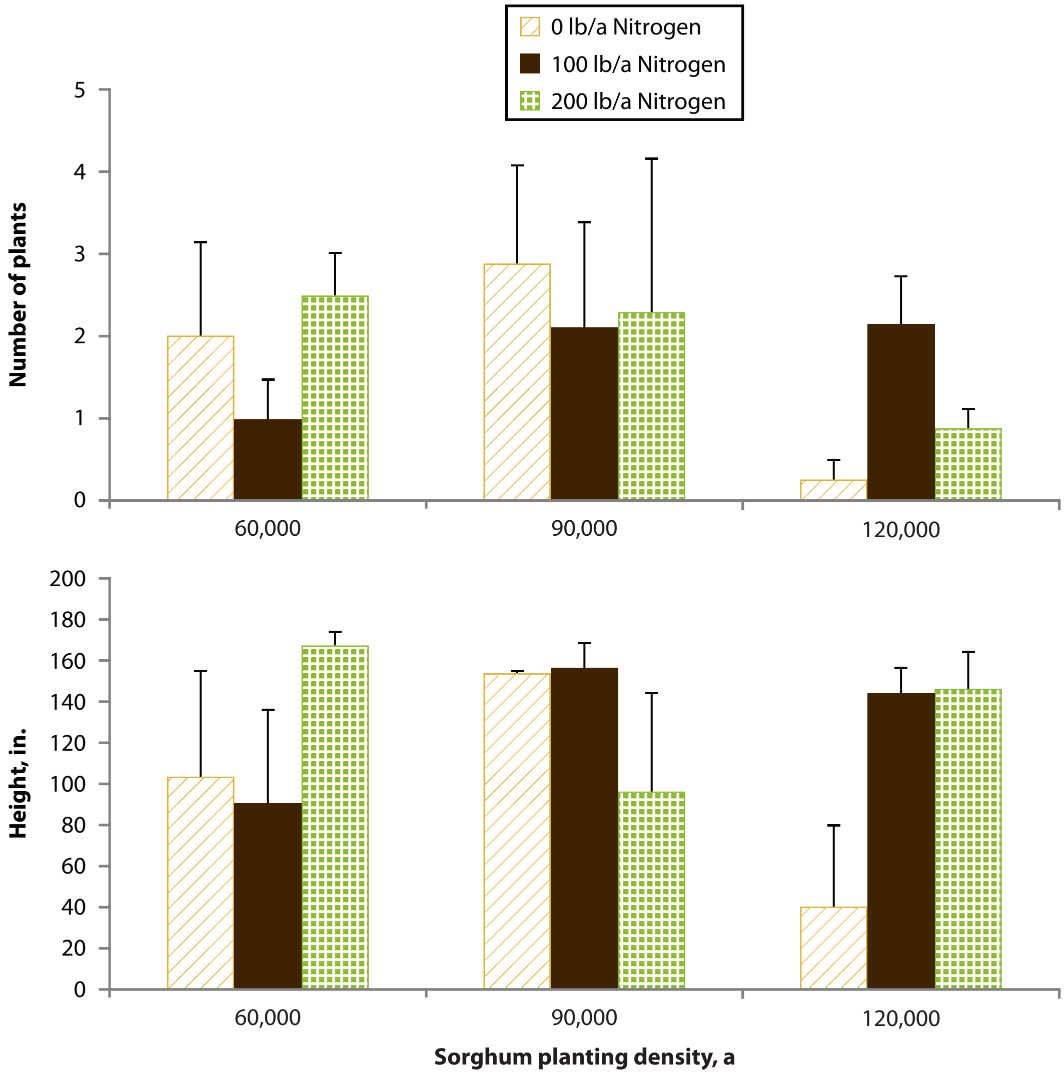


**Figure 1. Palmer amaranth number (A) and height (B) by sorghum planting density and nitrogen rate.**

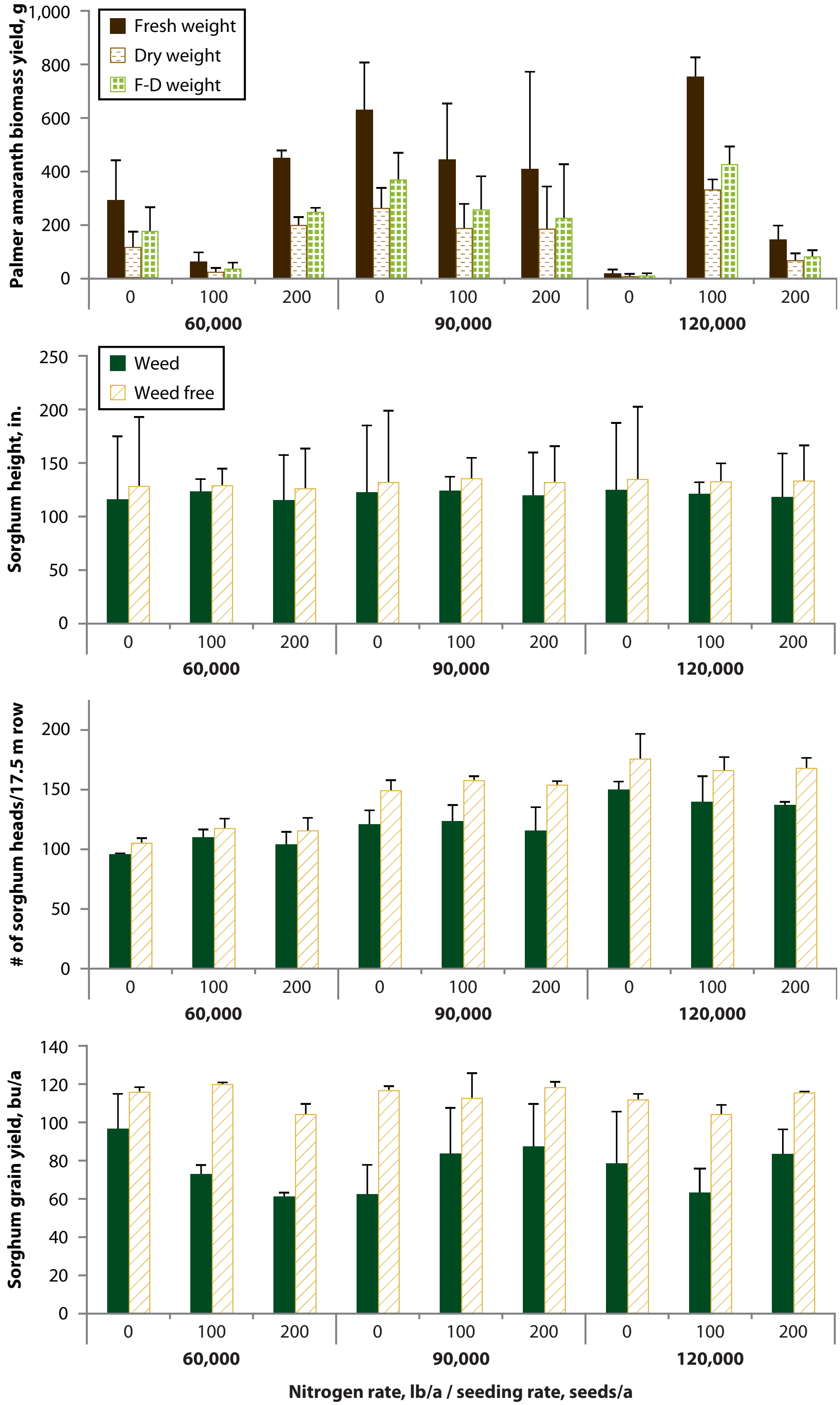


**Figure 2. (A) Palmer amaranth biomass, (B) sorghum height, (C) headcount, and (D) grain yield by sorghum planting density and nitrogen rate.**