Effect of Degree of Water Stress on the Growth and Fecundity of Palmer amaranth

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Introduction

- Palmer amaranth is the most problematic weed in agronomic crop production fields in the United States (WSSA 2016).
- Water is one of the most limiting factors for optimum crop production created by climatic change.
- C4 plants, including Palmer amaranth, usually have high tolerance to water stress allowing them to grow in a wide range of water stress conditions (Long 1998).
- Limited information is available in the scientific literature regarding the growth response of Palmer amaranth to different water stress levels.

Hypothesis

- Palmer amaranth plants maintained at lowest water stress will have the highest growth, seed production, and germination than the plants maintained at highest water stress levels.

Objective

- To determine the effect of degree of water stress levels on the growth and fecundity of Palmer amaranth biotypes.

Materials & Methods

Location – Greenhouse, Lincoln, Nebraska-2016.

Treatment Information –
- Palmer amaranth plants from two different biotypes (collected from Shickley and Kearney, NE) were grown in the soil maintained at 100%, 75%, 50%, 25%, and 12.5% of the field capacity using moisture sensors in 20 cm wide and 40 cm deep plastic pots.

Treatment Application –
- 10 kg of loam soil (sand 37%, silt 44%, clay 19%) was filled in each pot. Palmer amaranth seeds were germinated and 6-8 cm tall plants were transplanted in the plastic pots.
- Gravimetric field capacity of soil (by weight) = 33.46% or 28% by volume as calculated from following soil water retention equation of watermark sensor for given soil.
- % Volumetric water content = 5.818 * ln(soil matric potential) + 51.228
- Two types of sensors, watermark (for 100% and 75%) and Decagon 5TE (for 50%, 25%, and 12.5%), were buried in the pots to measure the moisture level to maintain the desired soil water content.

Data Collection and Statistical Analysis –
- Daily Observations – Water content per pot from data loggers (B & D) and Decagon data loggers (C) in each pot and required water was added.

Results and Discussion

- No difference was observed in the growth, development, and seed production between Palmer amaranth biotypes, except root biomass weight, and between two experimental runs; therefore, data were combined over biotypes.
- Plants maintained at ≥75% FC produced the highest number of leaves (≥664 plant⁻¹) (Fig 2A) and plants at ≥50% FC capacity produced highest dry root biomass (≥2.3 g plant⁻¹) (Fig 2D).
- The highest plant height (211 cm), seed production (41,696 plant⁻¹), and growth index (120,272 cm⁻¹) was observed among plants maintained at 100% FC and reduced with increasing water stress (Fig 2A & C and Fig 3B).
- Plants maintained at ≥50% FC had the highest total leaf area plants⁻¹ (≥570 cm²) (Fig 3E).
- A cumulative seed germination (%) was similar (18 to 26%) when plants were exposed to ≥50% FC.
- Palmer amaranth plants maintained at ≤25% FC did not survive more than 5 weeks after transplanting and were not able to produce seeds.
- Similarly, Sarangi et al. (2015) reported highest common waterhem plant height, seed production plant⁻¹, total aboveground biomass, and growth index at 100% field capacity.
- The model efficacy coefficient for curves fitted to leaf number, plant height, and growth index was >0.90.

Conclusions

- Palmer amaranth growth and seed production was affected by degree of water stress and it has capacity to survive and reproduce under low to moderate water stress.

Future Research

- To evaluate the effect of different durations of water stress on growth and fecundity of Palmer amaranth.

Literature Cited