Response of Common Waterhemp (*Amaranthus rudis*) to Water Stress

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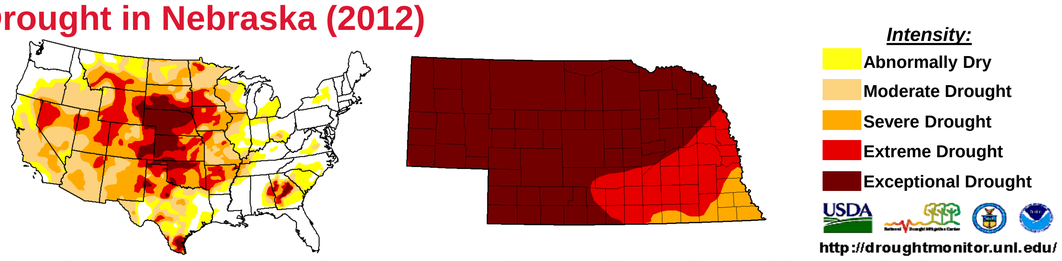
Introduction

- Common waterhemp (*Amaranthus rudis* Sauer), a C_4 broadleaf summer annual weed, is the most encountered and troublesome weed in row-crop production systems in the Midwestern United States (Sarangi et al. 2015).
- Favorable biological attributes (rapid growth habit, extended period of emergence, and prolific seed production) and the rapid evolution of herbicide resistance make common waterhemp very competitive.
- Water is the most limiting factor for crop production in the Great Plains and Midwest.

Fig 1. Drought in Nebraska (2012)



- The objective of this study was to determine the effect of degree and duration of water stress on the growth and fecundity of common waterhemp.

Materials and Methods

- Two separate experiments: degree and duration of water stress
- Two biotypes: from Lancaster and Clay County
- Greenhouse experiments (in 2013 and 2014) were laid out in a randomized complete block design with six replications.
- **Field (pot) capacity determination:**
  - Pots were filled with 10 kg of finely ground dry soil.
  - Weight of the pots was measured.
  - Pots were watered to saturation and covered.
  - They were allowed to drain for 36 hrs., and reweighed.
- Field capacity, $FC = [(W_w - W_d) / d]$

  W_w = wet weight; W_d = dry weight; d = density of water

Soil information:
Silt-loam
Sand- 22%
Silt- 54%
Clay- 24%
OM- 2.8%
BD- 1.4 g cm^{-3}

- Treatment details:

Degree of water stress	Duration of water stress
1. 100% Field capacity	2 days interval
2. 75% Field capacity	4 days interval
3. 50% Field capacity	6 days interval
4. 25% Field Capacity	8 days interval
5. 12.5% Field Capacity	10 days interval
- Water was applied at 2 days interval	- 100% Field capacity water was applied

- **Observations:** Plant height, leaves plant^{-1}, growth index, biomass, seeds plant^{-1}
- Data were subjected to ANOVA; and a four-parameter log-logistic sigmoid growth function was regressed on growth parameters in R stat.

$$Y = c + \{d - c / 1 + exp[b(\log x - \log e)]\}$$

where, Y = growth parameters, c = lower limit, d = maximum value, e = time to reach 50% of the maximum value, b = relative slope around e

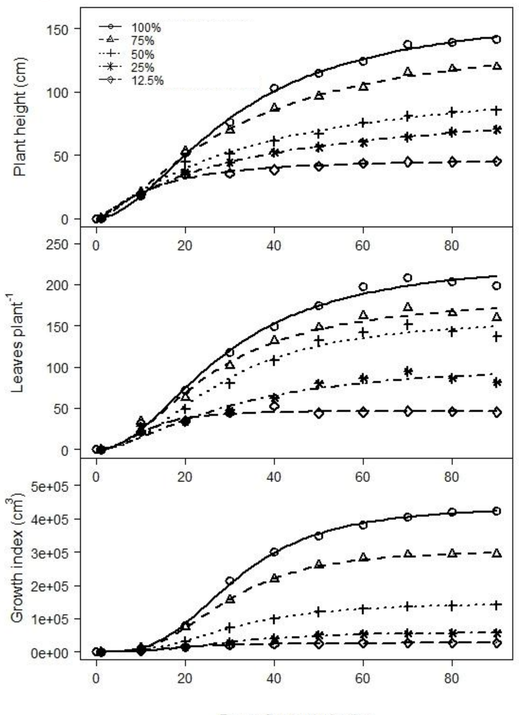
- **Model goodness of fit:**

$$RMSE = \left[\frac{1}{n}\sum_{i=1}^{n}(P_i - O_i)^2\right]^{1/2} \quad EF = 1 - \left[\frac{\sum_{i=1}^{n}(O_i - P_i)^2}{\sum_{i=1}^{n}(O_i - \bar{O}_i)^2}\right]$$

where,
O_i = observed
P_i = predicted
n = total #obs.

Results

Fig 2. Effect of degree of water stress:



FC (%)	d	e	b	RMSE	EF
	Plant height (cm)				
100	163	31	-1.8	16.5	0.90
75	146	31	-1.5	18.4	0.82
50	115	35	-1.2	13.8	0.79
25	93	33	-1.1	7.8	0.89
12.5	47	12	-1.4	7.2	0.78
	Leaves plant^{-1}				
100	231	29	-2.0	31.5	0.84
75	185	26	-2.0	27.8	0.81
50	161	28	-2.2	18.7	0.88
25	105	30	-1.7	17.2	0.75
12.5	47	11	-2.4	21.4	0.32
	Growth index (cm^3)				
100	4.4×10^5	31	-3.1	0.6	0.87
75	3.1×10^5	29	-3.1	0.9	0.57
50	1.5×10^5	31	-2.8	0.3	0.69
25	0.6×10^5	31	-2.9	0.2	0.51
12.5	0.3×10^5	19	-2.6	0.1	0.43

Growth index = $\pi \times (w/2)^2 \times h$

w = width of the plant; *h* = height of the plant

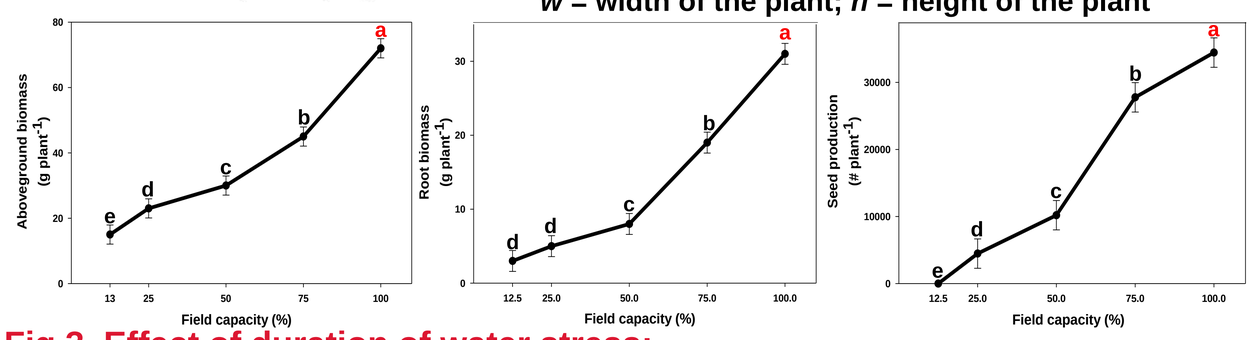
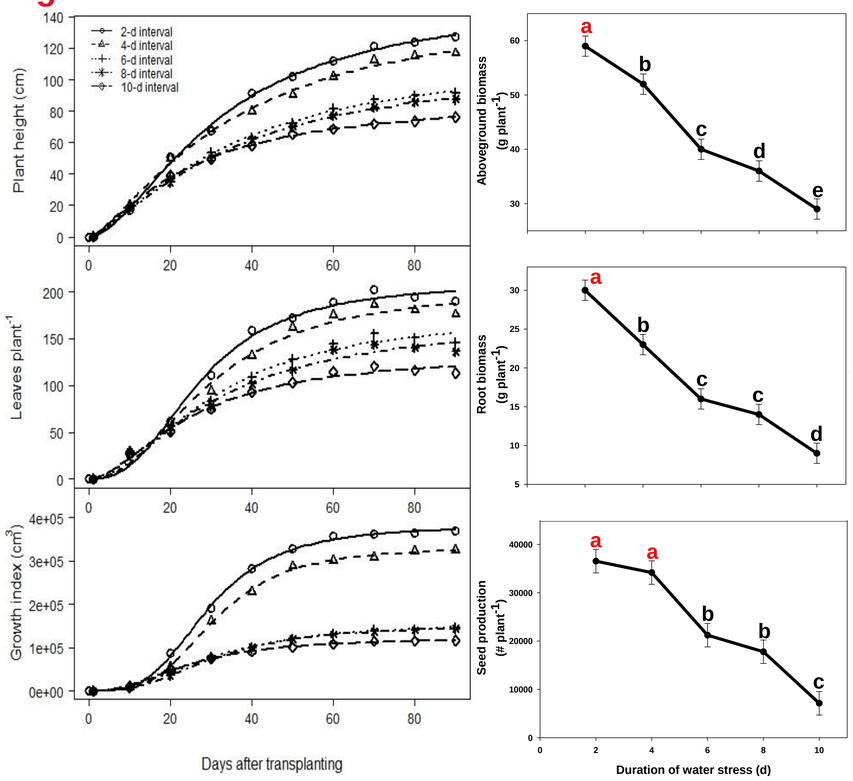
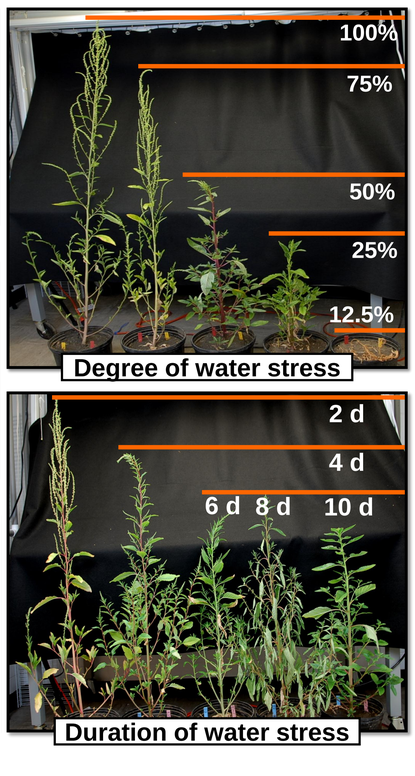


Fig 3. Effect of duration of water stress:





Conclusions

- Water stress can affect the growth and seed production of waterhemp.
- Under higher level of water stress (25% FC or 10-d interval) waterhemp plants not only survived, but also produced significant amount of seeds.

Literature cited:

Sarangi D, Sandell LD, Knezevic SZ, Aulakh JS, Lindquist JL, Irmak S, Jhala AJ (2015) *Weed Technology* 29:82–92

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