

Post-mortem seed development: Does termination timing or method make a difference?

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Introduction

- Despite farmer's best efforts, monetary losses due to weeds in 2010 were estimated to be over 2.6 billion dollars in the U.S. (Davis 2013).
- Escaped weeds produce hundreds to thousands of seeds that will germinate over several growing seasons.
- Late season weed control measures are targeted at stopping viable seed from being produced and improving crop harvest.
- Plants terminated within three weeks of flowering may produce viable seed.
- Weed termination method may influence the timing of viable seed formation due to differences in desiccation.

Objectives

- Determine if weed termination method affects viable seed production
- Determine if plants terminated at flowering or with immature seeds present develop viable seeds

Materials & Methods

- Locations (Study years):
 - Agronomy Farm, Michigan State University, East Lansing, MI (2011 & 2012)
 - Carvel Research & Education Center, University of Delaware, Georgetown, DE (2012 & 2013)
- Three-way factorial with 6 (MI) or 12 (DE) replications:
 1. Weed species:
 - a. Common lambsquarters (MI only)
 - b. Giant foxtail
 - c. Jimsonweed
 - d. Velvetleaf
 2. Termination methods (Figure 1):
 - a. Cut at base of plant (simulate hoeing)
 - b. Chopped into 10 cm (MI) or 15-20 cm (DE) segments (simulate mowing)
 - c. Applied glyphosate 2% v/v solution (MI) or 1.12 kg ae/ha (DE)
 3. Termination timings:
 - a. Flowering (except for c. lambsquarters)
 - b. Immature seed present
 - c. Mature seed present (MI only)
 - d. No termination; physiologically mature (DE only)
- Upon termination plants were placed in mesh bags and stored lying between soybean rows (cut and chopped) or left standing (glyphosate application)
- Plant retrieval timing; seed viability testing methods
 - MI- early November; germination + tetrazolium chloride test
 - DE- mid-October; germination + pressure test

Results- Termination Method

- Termination method did not influence viable seed production.

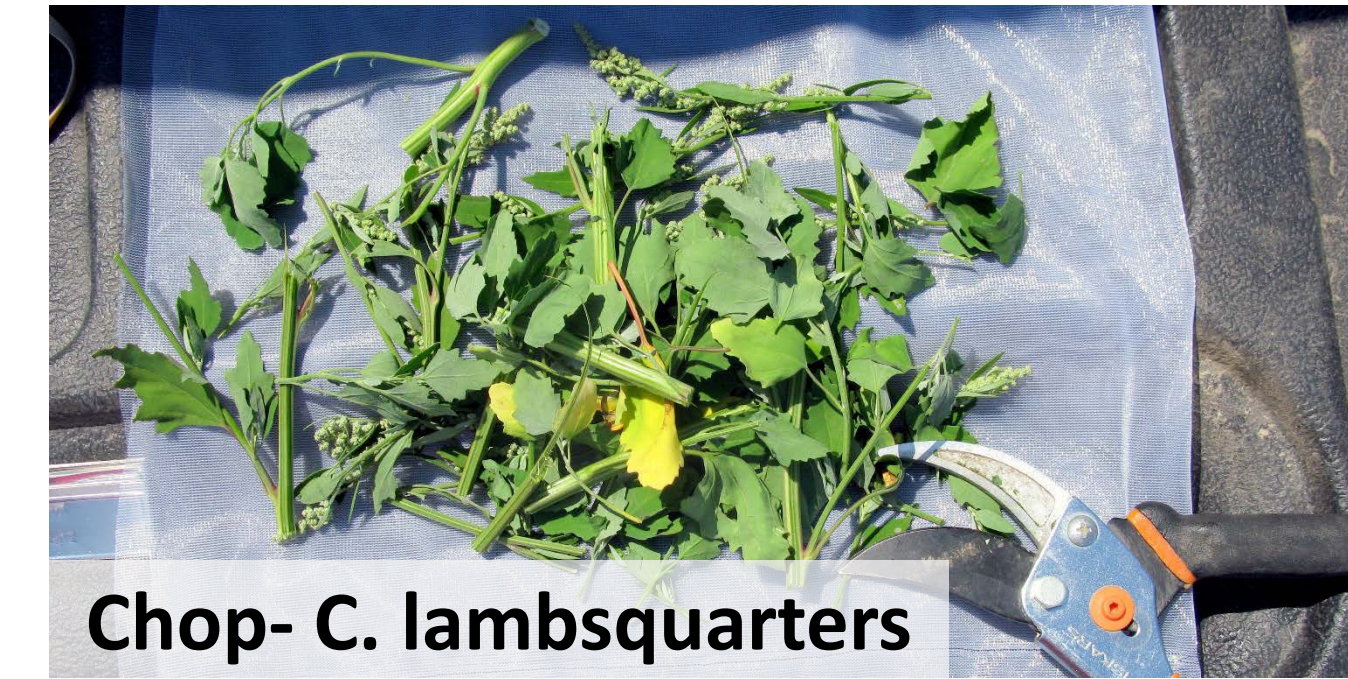


Figure 1. Termination methods: cut at base of plant (left), chopped into segments (center), sprayed with glyphosate and bagged in field (right).

Results- Termination Timing

Table 1. Viable seeds produced by summer annual weeds terminated at three different growth stages, pooled across termination methods[§].

Species Location/Year	Termination timing		
	Flowering	Immature seed	Mature seed [†]
—————average viable seeds plant ⁻¹ —————			
C. lambsquarters			
MI 2011	.	35 a	6,817 b
MI 2012	.	6 a	12,279 b
Giant foxtail			
MI 2011 [‡]	5	69	191
MI 2012	0 a	10 a	925 b
DE 2012	232	.	4,229 *
DE 2013	1,198 a	7,611 b	16,003 *
Jimsonweed			
MI 2011	0	264	2,486
MI 2012	0	111	6,093
DE 2012 [‡]	0	1,291	1,100 *
DE 2013 [‡]	0	3,344	2,780 *
Velvetleaf			
MI 2011	0 a	0 a	123 b
MI 2012	0 a	49 b	607 c
DE 2013	0	#	#

[§] Different letters indicate significant differences among the means in that site year ($p \leq 0.05$).

[†] In MI, mature plants were terminated when some mature seed was present using the three methods. In DE, mature plants (*) were allowed to reach physiological maturity in the absence of termination.

[‡] An interaction between termination timing and method was observed.

Viable seed produced, total seed number not available.

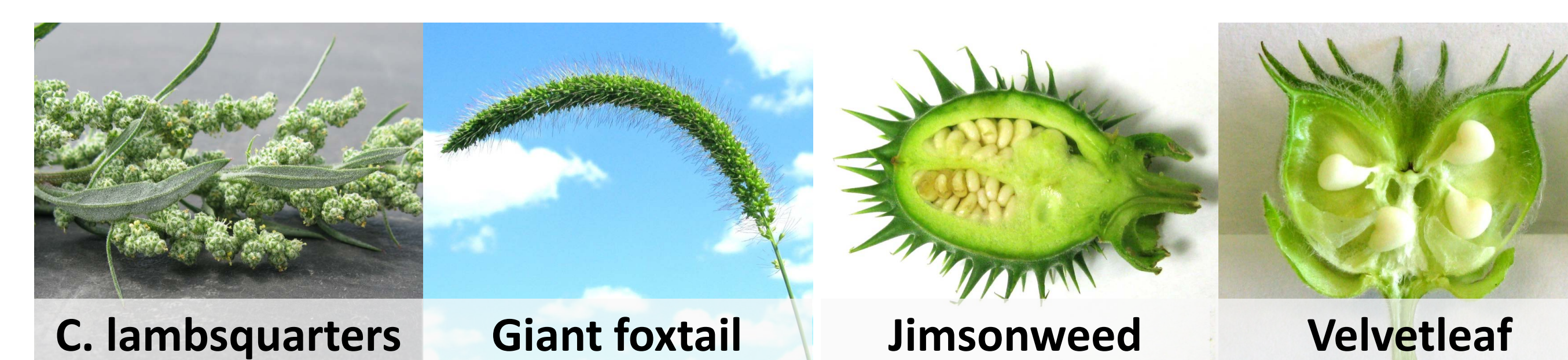


Figure 3. Summer annual immature stages in Michigan.

- Jimsonweed and velvetleaf did not produce viable seed when terminated at the time of flowering (Table 1).
- Giant foxtail seed production varied based on the definition of "flowering". Plants terminated with flower heads still emerging from the whorl (MI Figure 2) resulted in <10 viable seeds per plant. Fully emerged flower heads with anthers present (DE Figure 2) resulted in an average of 230 and 1,200 viable seeds per plant for 2012 and 2013, respectively.



Figure 2. G. foxtail flowering stages in MI (left) & DE (right).

- All species produced viable seeds when terminated at the immature stage (Table 1, Figure 3).
- Days from flowering to viable seed production ranged from 13 to 49, depending on the species and/or site-year (Table 2).
- Termination at the immature stage reduced the total number of viable seeds produced compared with waiting until the onset of mature seed (MI only, Table 1).
 - C. lambsquarters= 99% reduction
 - Giant foxtail= 82% reduction
 - Jimsonweed= 94% reduction
 - Velvetleaf= 96% reduction

Table 2. Days from flowering to viable seed production.

Species	Michigan		Delaware	
	2011	2012	2012	2013
days from flowering to viable seed/immature stage [§]				
Giant foxtail	18	14	.	13
Jimsonweed	21	.	49	57
Velvetleaf	13	13	.	13

[§] MI- Days to white seed, DE- days to brown seed (50% plants).

Conclusions

- Hoeing, mowing, and applying glyphosate resulted in similar viable seed production.
- To avoid seed bank additions, common lambsquarters and giant foxtail must be terminated *prior* to flowering, whereas jimsonweed and velvetleaf must be terminated less than two weeks *after* flowering.
- Terminating weeds with immature seeds will drastically reduce seed bank inputs compared with allowing plants to fully mature.

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