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Timing of winter annual weed removal in no-till soybean based on growing degree days

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Introduction

- Winter annual weeds are more prevalent in Michigan soybean fields due to an increase in conservation tillage and a decrease in the use of herbicides with residual activity
- Growing degree days (GDD) have been used to time postemergence herbicide applications in other crops like sugarbeets (Dale and Renner 2005)
- The use of GDD may help growers appropriately time burndown herbicide applications for effective weed management in no-till soybean

Objectives

- Determine if GDD can be used to time burndown herbicide applications in no-till soybean
- Determine if there is a difference in GDD timings between applications of herbicides with or without residual activity

Materials and Methods

- Field studies were conducted in 2008 and 2009 at East Lansing and St. Joseph County, MI (5 locations)
- Split-plot design (Table 1), three to four replications
 - Two herbicide treatments:
 - Residual: chlorimuron 26 g/ha + tribenuron 13 g/ha + 2,4-D ester 1.1 kg/ha + glyphosate 0.84 kg ae/ha + ammonium sulfate (AMS) 2% v/v
 - No-residual: 2,4-D ester 1.1 kg/ha + glyphosate 0.84 kg ae/ha + AMS 2% v/v
 - Herbicide application timings were based on GDD
 - GDD calculations were based on a temperature of 34 F starting Jan. 1 of each year

$$\text{GDD} = \sum_{\text{Jan. 1} - \text{application}} [(\text{max. temp.} + \text{min. temp.})/2] - \text{base temp. (34 F)}$$

Table 1. Timing of burndown herbicide applications and herbicide treatments with or without residual activity

Application Timings (days prior to planting)	Dates	Herbicide Treatments
200 GDD (40-68 d)	March 17-April 8	Residual
350 GDD (30-45 d)	April 9-16	No-residual
450 GDD (23-37 d)	April 17-24	
750 GDD (11-23 d)	May 1-6	
1025 GDD (0-6 d) ^a	May 13-19	

^a 2,4-D ester and tribenuron were not applied at this timing

- Soybean planting:
 - East Lansing: soybeans were drilled in 19-cm rows, May 12, 2008 and May 20, 2009 (3 locations)
 - St. Joseph County: soybeans were planted in 76-cm rows, May 25, 2009 (2 locations)
- Postemergence (POST) herbicide applications were made when weeds were 10-cm in height
 - Glyphosate 0.84 kg ae/ha + AMS at 17 lb/100 gal
- Data collected
 - Weed control at planting, 30 and 60 days after planting (DAP)
 - Winter annual weed growth stages were monitored
 - Weed biomass was collected at POST glyphosate applications (plants/m²)
 - Soybean yield at 13% moisture
- Data analysis
 - PROC MIXED in SAS
 - Means separated using Fisher's Protected LSD at $\alpha = 0.05$

Literature Cited

Dale T.M., K.A. Renner. 2005. Timing of postemergence micro-rate applications based on growing degree days in sugarbeet. J of Sugarbeet Res 42:87-102.

Results and Discussion

Weed control

- At planting, all residual herbicide treatments applied prior to 750 GDD provided excellent control of winter and early summer annual weeds (Table 2)
- The no-residual herbicide treatments needed to be applied 350 GDD or later for similar results
- Later in the season (30 DAP) the residual herbicide treatments continued to provide excellent control of weeds (Figure 1)
- However, the no-residual treatments needed to be applied after 450 GDD to provide similar results (Figure 2)



Figure 1. Residual herbicide treatment applied at 200 GDD
 Figure 2. No-residual herbicide treatment applied at 200 GDD

Weed flowering

- Common chickweed, field pennycress, henbit, and purple deadnettle began flowering between 350 and 450 GDD

Weed biomass

- Residual herbicides reduced weed biomass at all application timings (except 750 GDD) when compared with treatments without a residual herbicide (Figure 3)
- For both residual and no-residual herbicide applications, treatments applied earlier in the spring resulted in increased weed biomass when compared with treatments applied closer to planting

Soybean yield

- Soybean yields were similar across all application timings and burndown herbicide treatments, whether a residual herbicide was included or not (except for the non-treated control, data not shown)

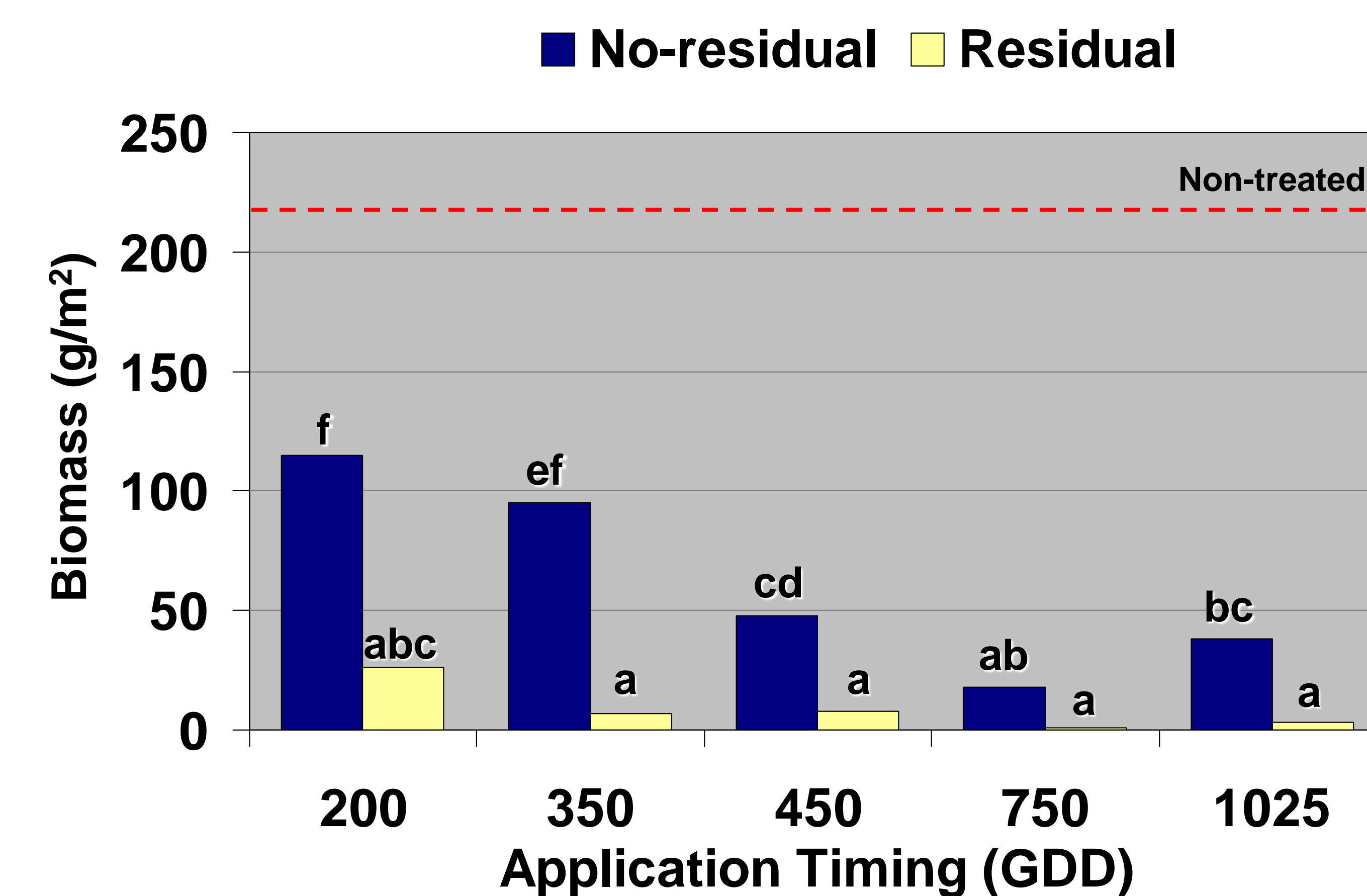


Figure 3. Mid-season biomass (late June) comparing treatments with and without residual activity applied by GDD₃₄ (combined across 3 studies at East Lansing)

Table 2. Common chickweed, field pennycress, common lambsquarters, and purple deadnettle control at planting

Application Timings	Herbicide Treatments	East Lansing	St. Joseph	East Lansing	East Lansing	St. Joseph
		Common chickweed	Field pennycress	C. lambsquarters	P. deadnettle	
200 GDD ^a	No-residual ^b	98a	75b	99a	92ab	87c
	Residual ^c	99a	99a	99a	99a	99a
350 GDD	No-residual	98a	99a	99a	99a	96ab
	Residual	99a	98a	99a	98a	98a
450 GDD	No-residual	99a	93a	99a	99a	90bc
	Residual	99a	99a	99a	99a	99a
750 GDD	No-residual	38b	99a	80b	70c	92abc
	Residual	30b	99a	70c	63c	94abc

^a Growing degree days (GDD) were calculated starting at January 1st of each year and using a base temp. of 34 F

^b 2,4-D ester 1.1 kg/ha + glyphosate 0.84 kg ae/ha + AMS 2% v/v

^c Chlorimuron 36 g /ha + tribenuron 13 g/ha + 2,4-D ester 1.1 kg/ha + glyphosate 0.84 kg ae/ha + AMS 2% v/v

Acknowledgements

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Conclusions

- Residual herbicides extended early-season weed control and reduced in-season weed biomass, especially at earlier application timings
- Although differences in yield were not detected, GDD can be used to time burndown herbicide applications to control winter annual weeds before seed production occurs, and may reduce the presence of these weeds in the future