Competitiveness and management of volunteer corn in sugarbeet

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Introduction

- Glyphosate-resistant (GR) volunteer corn is a common weed problem in GR sugarbeet grown in Michigan.
- 100% of Michigan sugarbeet are GR, and 34% follows corn (G. Clark, MI Sugar Company).
- Volunteer corn is capable of causing sugarbeet yield and quality reductions if appropriate management is not implemented.

Objectives

- Quantify the effects of volunteer GR corn on GR sugarbeet yield and quality.
- Determine the effects of sugarbeet row-width on volunteer corn interference in sugarbeet.
- Develop effective volunteer corn management strategies in GR sugarbeet.

Materials and Methods

- Two field trials were conducted at two locations in 2012 and 2013 (E. Lansing & Richville, MI)
- Planting dates:
  - E. Lansing: April 12, 2012 and May 3, 2013
  - Richville: April 4, 2012 and May 2, 2013
- 'Hilleshog 173 RR' planted at 124,000 seeds ha^{-1}
- GR corn ('F_2') planted 13-cm off the sugarbeet row immediately after sugarbeet planting
- Randomized complete block design with four replications
- Plots kept weed-free with glyphosate (0.84 kg ae ha^{-1})

Study 1: Sugarbeet row width & volunteer corn density

- Sugarbeet row widths: 38- and 76-cm
- V. corn densities: 0, 0.2, 0.4, 0.9, 1.7, 3.4 plants m^{-2}
- Measurements:
  - Canopy closure, v. corn biomass, sugarbeet yield, % sugar and recoverable white sucrose ha^{-1} (RWSH)

Study 2: Herbicide & volunteer corn removal time

- Sugarbeet row width: 76-cm
- V. corn density: 1.7 plants m^{-2}
- Herbicide treatments & two controls:

Removal timing	clethodim[a]	quizalofop[ab]
V2 corn	105 g ha^{-1}	28 g ha^{-1}
V4 corn	105 g ha^{-1}	28 g ha^{-1}
V6 corn	158 g ha^{-1}	35 g ha^{-1}
V8 corn	158 g ha^{-1}	35 g ha^{-1}
V10 corn	210 g ha^{-1}	56 g ha^{-1}

[a] Glyphosate 0.84 kg ha^{-1} + AMS 2% w/w
[b] Non-ionic surfactant 0.125% v/v

- Measurements:
  - Volunteer corn control and biomass, sugarbeet yield, % sugar and recoverable white sucrose ha^{-1} (RWSH)
- Analyzed with PROC MIXED in SAS
- Interactions tested
- Means separated with Fisher's Protected LSD at $p \leq 0.05$

Results and Discussion

- Variable growing conditions resulted in differences between years and locations. As a result, data are presented separately by year and location for both studies.
- Even though volunteer corn was planted with sugarbeet it only emerged simultaneously with sugarbeet at Richville in 2013. At the three remaining locations volunteer corn emerged by 2-leaf sugarbeet.

Study 1: Effects of sugarbeet row width and volunteer corn density

Figure 1. GR sugarbeet growing in 38- (left) and 76-cm (right) row widths 75 d after planting.

- Sugarbeet canopy closer was quicker in narrow rows than in wide rows in 3 of 4 site-years (Figure 1). The one exception was East Lansing 2012 where canopy closure only reached 55% for both row widths due to drought conditions (data not shown).
- At locations where canopy closure was quicker in narrow rows, end of season volunteer corn biomass was also suppressed (data not shown).

Table 1. Main effects of sugarbeet row width and v. corn density on recoverable white sucrose per ha (RWSH).

	2012		2013	
Main effects	East Lansing	Richville	East Lansing	Richville
Row width	kg ha^{-1}			
Narrow	7459 A	8054 A	8926 A	5354 A
Wide	6191 B	7483 B	8808 A	4681 B
V. corn density				
0 plants m^{-2}	7280 ab	7849 a	9203 a	5695 a
0.2 plants m^{-2}	7532 a	8450 a	9574 a	5964 a
0.4 plants m^{-2}	6627 ab	8344 a	9738 a	5827 a
0.9 plants m^{-2}	7575 a	8489 a	9066 ab	5179 a
1.7 plants m^{-2}	6375 bc	6445 b	7850 bc	3829 b
3.4 plants m^{-2}	5564 c	7034 b	7771 c	3826 b

- RWSH was greater in narrow row sugarbeet in 3 of 4 site-years (Table 1). RWSH was 7 to 17% higher in narrow row sugarbeet.
- Independent of row width, the minimal number of volunteer corn plants that contributed to significant loss of RWSH was 1.7 plants ha^{-1}. RWSH was 12 to 32% lower when 1.7 volunteer corn plants ha^{-1} were present compared with the no volunteer corn control (Table 1).

Study 2: Effects of herbicide and volunteer corn removal time

- Clethodim and quizalofop provided excellent control of glyphosate-resistant corn in glyphosate-resistant sugarbeet (data not shown).
- Combined over removal times, there was no difference in volunteer corn biomass at harvest between clethodim and quizalofop (Table 2).
- At 3 of 4 site-years, control of volunteer corn was reduced if management strategies were not implemented by the V4 growth stage, though control at the V6 stage was adequate (data not shown).
- Significant v. corn biomass remained at the end of the season in 2 of 4 site-years when v. corn was controlled at the V10 corn stage (Table 2).
- Yield loss was not observed at Richville in 2012 or at East Lansing in 2013 when v. corn emerged at the 2-leaf stage of sugarbeet (Table 3). RWSH losses were variable at East Lansing 2012.
- When volunteer corn emerged with sugarbeet, significant losses in RWSH occurred if volunteer corn was not controlled prior to the V4 corn growth stage (Table 3).

Table 2. Main effects of herbicide treatment and v. corn removal timing on volunteer corn biomass remaining at harvest.

	2012		2013	
Main effects	East Lansing	Richville	East Lansing	Richville
Herbicide	kg ha^{-1}			
Clethodim	99 A	33 A	150 A	368 A
Quizalofop	76 A	59 A	112 A	241 A
V. corn removal time				
No v. corn	0 a	0 a	0 a	0 a
V2 corn	0 a	0 a	0 a	0 a
V4 corn	16 a	3 a	0 a	0 a
V6 corn	10 a	42 a	0 a	0 a
V8 corn	117 a	72 a	114 a	0 a
V10 corn	293 a	78 a	540 b	1523 b
No removal	2132 b	924 b	1295 b	2132 c

Table 3. Main effects of herbicide treatment and v. corn removal timing on recoverable white sucrose per ha (RWSH).

	2012		2013	
Main effects	East Lansing	Richville	East Lansing	Richville
Herbicide	kg ha^{-1}			
Clethodim	6238 A	8323 A	8019 A	6331 A
Quizalofop	6577 A	8775 A	8108 A	6023 A
V. corn removal time				
No v. corn	6306 b	7917 a	9060 a	7542 a
V2 corn	6522 b	8901 a	8656 a	6793 ab
V4 corn	6841 ab	7753 a	8853 a	6738 b
V6 corn	7724 a	8076 a	8862 a	6701 b
V8 corn	6279 b	7635 a	8707 a	6585 b
V10 corn	6428 b	8439 a	8266 a	4927 c
No removal	4104 c	7768 a	7838 a	4599 c

Conclusions

- Volunteer GR corn (1.7 plants ha^{-1}) can be a significant problem if not adequately controlled in GR sugarbeet, particularly if volunteer corn emergence is simultaneous with the sugarbeet crop. If volunteer corn emerges after the sugarbeet crop reductions in yield and quality are not as dramatic.
- Growing sugarbeet in narrow rows and implementing control strategies prior to V4 corn with either clethodim or quizalofop are effective methods to reduce the impact of volunteer corn on sugarbeet.

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