Sweet Corn Hybrid Responses to Thifensulfuron-methyl

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Abstract. Limited information exists on sweet corn (Zea mays) tolerance to postemergence (POST) applications of thifensulfuron-methyl under Ontario growing conditions. Eight sweet corn hybrids were evaluated for tolerance to thifensulfuron-methyl in four field experiments conducted in 2003 and 2004. Thifensulfuron-methyl was applied POST at 6 and 12 g·ha⁻¹ a.i., the registered and twice the registered rate for use in soybean in Ontario. Sweet corn hybrid responses to thifensulfuron-methyl varied. Delmonte 2038 was the most sensitive to thifensulfuron-methyl and had as much as 92% visual injury, 76% height reduction, and 98% yield reduction compared to the nontreated control. Empire, GH1861, GH2298, and GH2684 hybrids showed visual injury of 53%, 55%, 53%, and 61%, height reduction of 34%, 31%, 32%, and 26% and yield reduction of 77%, 68%, 68%, and 51%, respectively. GG214, GH2547, and GSS9299 sweet corn hybrids were not as sensitive to thifensulfuron-methyl. The initial sensitivity observed in these hybrids was minimal and transient with no effect on yield. Although thifensulfuron-methyl is safe for use on some sweet corn hybrids, it has the potential to cause severe crop injury and yield reduction in other hybrids and therefore it should not be recommended for weed management in sweet corn production in Ontario.

Materials and Methods

Field studies were conducted at the Huron Research Station, Exeter, Ont., and Ridgetown College, Ridgetown, Ont., in 2003 and 2004. The soil at Exeter was a Brookston clay loam with 23% sand, 47% silt, 30% clay, 4.0% organic matter and pH of 7.7 in 2003, and 34% sand, 33% silt, 33% clay, 3.8% organic matter, and pH of 8.0 in 2004. The soil at Ridgetown was a Watford/Brady loam with 50% sand, 29% silt, 21% clay, 8.2% organic matter and pH of 6.8 in 2003, and 51% sand, 32% silt, 17% clay, 5.5% organic matter, and pH of 7.2 in 2004. Seedbed preparation at both locations consisted of fall moldboard plowing followed by two passes with a field cultivator in the spring.

The experiments were arranged in a split-plot design with four replications. The main plots were herbicide rates and subplots were eight sweet corn hybrids. Selection of herbicide rates and spray additives was based on the current maximum use rate in soybean in Ontario. The treatments consisted of a nontreated check and two rates of thifensulfuron-methyl (6 and 12 g·ha⁻¹), the maximum registered use rate and twice the maximum registered use rate in soybean. Thifensulfuron-methyl treatments included 0.1% and 0.2% v/v nonionic surfactant at 6 and 12 g ·ha⁻¹, respectively (OMAF, 2004). The main plots were 6 m wide (eight rows) by 10 m long at Exeter and 6 × 8 m at Ridgetown. Each of the eight rows in a plot was planted with a different hybrid.

Sweet corn was planted on 3 June 2003 and 5 June 2004 at Exeter, and 5 June 2003 and 28 May 2004 at Ridgetown. The row spacing was 75 cm and plants were thinned to a final plant population of 50,000 plants/ha. Eight of the most commonly grown processing sweet corn hybrids in southwestern Ontario were selected. Hybrids included Delmonte 2038, Empire, GG214, GH1861, GH2298, GH2547, GH2684, and GSS9299. Hybrids chosen encompassed a range of endosperm genotypes. A preemergence application of a preformulated mixture of S-metolachlor plus atrazine (1.08) was applied immediately after planting at 2.16 kg·ha⁻¹ a.i. in all trials, and plots were maintained weed-free by inter-row cultivation and hand hoeing as required.

Thifensulfuron-methyl was applied four to five-leaf stage, 21 d after planting (DAP) in 2003 and 23 DAP in 2004 at Exeter, and 19 DAP in 2003 and 18 DAP in 2004 at Ridgetown. Treatments were applied with a CO₂-pressurized backpack sprayer, calibrated to deliver 200 L·ha⁻¹ with XR8002VS (Teetjet XR8002VS Tip, Spraying Systems Co., Wheaton, Ill.) flat-fan nozzles at 241 and 207 kPa pressure at Exeter and Ridgeway, respectively.

Visual crop injury was rated on a scale of 0% to 100% at 7, 14, and 28 d after treatment (DAT). A rating of 0% was defined as no visible effect of the herbicide and 100% was defined as plant death. Visual injury included leaf color changes from green to yellow with a copper tint, leaf distortion and crinkling, growth reduction, and in some sweet corn hybrids total plant necrosis. Height of five randomly selected plants was determined 21 DAT by measuring from the soil surface to the highest point of the corn plant with the leaves extended. The entire
Table 1. Mean visual injury (%) of eight sweet corn hybrids 7, 14, and 28 d after treatment (DAT) with thifensulfuron-methyl postemergence at 6 and 12 g ha⁻¹ a.i. at Exeter and Ridgetown, Ont., in 2003 and 2004.

| Sweet corn hybrid | Thifensulfuron-methyl rate (g·ha⁻¹ a.i.) | 6 | 12 | 6 | 12 | 6 | 12 | 6 | 12 |
|-------------------|------------------------------------------|---|----|---|----|---|----|---|----|
| Delmonte 2038     |                                          | 33 a² | 43 a | 69 a | 81 a | 83 a | 92 a |
| Empire            |                                          | 24 a | 29 b | 25 bc | 53 b | 16 b | 36 bc |
| GG214             |                                          | 4 b | 14 c | 7 d | 7 c | 2 c | 3 d |
| GH1861            |                                          | 28 a | 39 ab | 23 c | 55 b | 10 b | 37 bc |
| GH2298            |                                          | 26 a | 26 b | 35 b | 53 b | 16 b | 34 c |
| GH2547            |                                          | 2 b | 9 c | 5 c | 5 c | 2 b | 1 d |
| GH2684            |                                          | 27 a | 33 ab | 35 b | 61 b | 21 b | 49 b |
| GSS9299           |                                          | 5 b | 15 c | 3 d | 8 c | 1 c | 4 d |
| SE                |                                          | 5 | 5 | 7 | 6 | 3 | 3 |

²Thifensulfuron-methyl treatments included 0.1% and 0.2% v/v nonionic surfactant at 6 and 12 g·ha⁻¹, respectively.

Results and Discussion

Visual injury. At 7, 14, and 28 DAT, thifensulfuron-methyl applied POST at 6 and 12 g·ha⁻¹ caused more injury in Delmonte 2038, Empire, GH1861, GH2298 and GH2684 than in GG214, GH2547, and GSS9299 sweet corn hybrids (Table 1). Visual injury increased with increasing rates of thifensulfuron-methyl.

Visual injury in GG214, GH2547, and GSS9299 was most severe at 7 DAT. However, the injury was transient as indicated by the rating completed 14 and 28 DAT. Visual injury was most severe at 14 DAT in Exeter, Empire, GH1861, GH2298, and GH2648 hybrids, while Delmonte 2038 showed the highest injury at 28 DAT. Thifensulfuron-methyl POST injuries observed in this study with Delmonte 2038 are consistent with other findings that have shown it to be one of the most sensitive hybrids in Ontario exhibiting as much as 94% injury when treated with sulfonylurea herbicides (Diebold et al., 2003; O’Sullivan et al., 1998, 2000; O’Sullivan and Sikkema, 2001, 2002). Visual injury generally increased as thifensulfuron-methyl rate was increased from 6 to 12 g·ha⁻¹. Grey et al. (2000) and O’Sullivan and Sikkema (2001) found similar differential hybrid injury and rate responses with other sulfonylurea herbicides in sweet corn.

Plant height. Sweet corn height data are reported for each hybrid and rate individually, and contrasts were performed comparing cob size or yield between rates within hybrids (Table 4). Thifensulfuron-methyl applied POST reduced yield 21% to 98% at the 6 g·ha⁻¹ rate and 51% to 98% at 12 g·ha⁻¹ in Delmonte 2038, Empire, GH1861, GH2298, and GH2684 sweet corn hybrids (Table 4). There was no significant effect on yield of the other sweet corn hybrids. O’Sullivan et al. (2000) observed significant variability in yield loss among a range of sweet corn hybrids treated with nicosulfuron, another sulfonylurea herbicide. Grey et al. (2000) found that only one of eleven sweet corn hybrids had a decreased yield with nicosulfuron. Robinson et al. (1994) observed that POST applications of nicosulfuron resulted in complete crop loss in one hybrid (Merit), a 50% reduction in yield in another, but no reduction in yield in Zenith. Stall and Bewick (1992) determined that 4 of 12 hybrids demonstrated a response to nicosulfuron rate and marketable yield was significantly lower at higher rates. Similar sweet corn yield responses were also reported with other sulfonylurea herbicides such as AE F130360, CGA 152005, primisulfuron, and rimsulfuron (Diebold et al., 2003; O’Sullivan et al., 1998; O’Sullivan and Sikkema, 2001, 2002; Van Wychen et al., 1997).

Table 2. Height (cm) of eight sweet corn hybrids 21 d after treatment with thifensulfuron-methyl postemergence at 0, 6, and 12 g·ha⁻¹ a.i. at Exeter and Ridgetown, Ont., in 2003 and 2004.

| Sweet corn hybrid | Thifensulfuron-methyl rate (g·ha⁻¹ a.i.) |
|-------------------|------------------------------------------|
|                   | 0 | 6 | 12 | SE |
| Delmonte 2038     | 100 a² | 28 b | 24 b | 5 |
| Empire            | 92 a | 74 b | 58 c | 3 |
| GG214             | 93 a | 90 ab | 85 b | 2 |
| GH1861            | 93 a | 79 b | 64 c | 3 |
| GH2298            | 92 a | 72 b | 63 c | 3 |
| GH2547            | 93 a | 89 ab | 86 b | 2 |
| GH2684            | 98 a | 82 b | 73 c | 2 |
| GSS9299           | 87 a | 82 ab | 77 b | 2 |

²Thifensulfuron-methyl treatments included 0.1% and 0.2% v/v nonionic surfactant at 6 and 12 g·ha⁻¹, respectively.

Results are averaged for both locations and years; letters represent the statistical comparison using contrasts of the means among thifensulfuron-methyl rates within a variety; means within a row followed by the same letter indicate no significant difference according to a Fisher’s Protected LSD test (P ≤ 0.05).
Table 3. Cob size (g) of eight sweet corn hybrids treated with thifensulfuron-methyl postemergence at 0, 6 and 12 g ha⁻¹ a.i. at Exeter and Ridgetown, Ont., in 2003 and 2004.

| Sweet corn hybrid | Thifensulfuron-methyl rate (g ha⁻¹ a.i.) | Cob size (g) | 0 | 6 | 12 | SE |
|------------------|------------------------------------------|--------------|---|---|----|----|
| Delmonte 2038    | 243 a                                     | 111 b        | 80 c | 14 |
| Empire           | 209 a                                     | 172 b        | 124 c | 7  |
| GG214            | 236 a                                     | 225 a        | 217 a | 4  |
| GH1861           | 213 a                                     | 164 b        | 131 c | 8  |
| GH2298           | 214 a                                     | 168 b        | 146 c | 6  |
| GH2547           | 232 a                                     | 245 a        | 238 a | 5  |
| GH2684           | 229 a                                     | 208 b        | 171 c | 7  |
| GSS9299          | 206 a                                     | 206 a        | 199 a | 3  |

*Thifensulfuron-methyl treatments included 0.1% and 0.2% v/v nonionic surfactant at 6 and 12 g ha⁻¹, respectively.

Results are averaged for both locations and years; means have been back transformed to the original scale; letters represent the statistical comparison using contrasts of the means among thifensulfuron-methyl rates within a variety; Means within a row followed by the same letter indicate no significant difference according to a Fisher’s protected LSD test (P ≤ 0.05).

Table 4. Yield (t ha⁻¹) of eight sweet corn hybrids treated with thifensulfuron-methyl postemergence at 0, 6 and 12 g ha⁻¹ a.i. at Exeter and Ridgetown, Ont., in 2003 and 2004.

| Sweet corn hybrid | Thifensulfuron-methyl rate (g ha⁻¹ a.i.) | Yield (t ha⁻¹) | 0 | 6 | 12 | SE |
|------------------|------------------------------------------|----------------|---|---|----|----|
| Delmonte 2038    | 17.0 a                                     | 14.9 a         | 14.9 a | 17.4 a | 14.9 a | 1.3 |
| Empire           | 14.9 a                                     | 16.5 a         | 16.1 a | 16.1 a | 16.1 a | 0.3 |
| GG214            | 16.5 a                                     | 16.5 a         | 16.5 a | 16.5 a | 16.5 a | 0.9 |
| GG2547           | 20.4 a                                     | 20.4 a         | 20.4 a | 20.4 a | 20.4 a | 1.1 |
| GG2684           | 17.0 a                                     | 17.0 a         | 17.0 a | 17.0 a | 17.0 a | 0.9 |
| GSS9299          | 12.6 a                                     | 12.6 a         | 12.6 a | 12.6 a | 12.6 a | 0.4 |

*Thifensulfuron-methyl treatments included 0.1% and 0.2% v/v nonionic surfactant at 6 and 12 g ha⁻¹, respectively.

Results are averaged for both locations and years; letters represent the statistical comparison using contrasts of the means among thifensulfuron-methyl rates within a variety; means within a row followed by the same letter indicate no significant difference according to a Fisher’s protected LSD test (P ≤ 0.05).

Conclusions

Differential sensitivity of sweet corn hybrids to other sulfonylurea herbicides has been reported in other studies conducted in Ontario (Diebold et al., 2003, 2004; O’Sullivan and Sikkema, 2001, 2002; O’Sullivan et al., 1999, 2000, 2002). In this study, differential sensitivity to postemergence application of thifensulfuron-methyl was observed in sweet corn hybrids. Delmonte 2038 was most sensitive to thifensulfuron-methyl, followed by Empire, GH1861, GH2298, and GH2684. Injury to these hybrids was persistent and resulted in significant yield losses. Generally, crop injury increased as thifensulfuron-methyl rate increased from 6 to 12 g ha⁻¹. GG214, GH2547, and GSS9299 were not as sensitive to thifensulfuron-methyl at either rate of application. The initial injury observed in these hybrids was minimal and transient with no detrimental effect on cob size or yield. This research concludes that thifensulfuron-methyl, although safe for use on some sweet corn hybrids, has the potential to cause severe crop injury and yield reduction in other hybrids. Therefore, thifensulfuron-methyl should not be recommended for weed management in sweet corn in Ontario.

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