Enhancing Authority MTZ Safety for Processing Tomatoes

Final Report for 2018

Submitted to

Pennsylvania Vegetable Marketing and Research Program
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Overall summary:

- Significant early-season injury was observed with most treatments except:
  - Authority MTZ at 6 oz/A PPI at UD-REC
  - Authority MTZ at 6 and 8 oz/A applied PPI at PSU-RS.
- At 6 WAP, tomato biomass reduction at UD-REC was observed with Authority MTZ, 12 and 16 oz/A PPI, Authority MTZ, 12 oz/A PRE, and both PRE rates of metribuzin plus Spartan Charge, and Authority Elite.
- At 6 WAP, tomato biomass reduction at PSU-RS was at least 25% with Authority MTZ at 16 oz/A PPI, Authority MTZ, 12 oz/A PRE, and both treatments including Authority Elite.
- Mid-season at UD-REC, tomatoes recovered with no treatment resulting in more than 15% biomass reduction; at PSU-RS the levels of biomass reduction observed at 3 WAP remained throughout the growing season.
- Total yield at UD-REC did not differ between treatments.
  - Authority MTZ at 16 oz/A PPI, and metribuzin at 4.3 oz/A plus Spartan Charge at 5.5 fl oz/A resulted in delayed fruit maturity.
- Weed control was acceptable in all treatments, except Authority MTZ at 6 oz/A applied PPI.

Introduction:

Authority MTZ is a pre-packaged herbicide of sulfentrazone and metribuzin, labeled for transplanted tomatoes. The Authority MTZ label mentions control of eastern black

nightshade, ivyleaf morningglory, common lambsquarters, and pigweed species; all weeds that are difficult to control with current herbicide programs. The sulfentrazone portion of the product can also help manage herbicide-resistant weed biotypes. There has been little research with this product in the Mid-Atlantic States to help provide guidance to tomato farmers and crop advisors about the appropriate rates. Furthermore, the Authority MTZ label requires a pre-plant incorporated application. Results from the 2017 Pennsylvania Vegetable Marketing and Research Program showed at least 17% stunting with the 6 oz rate, however the tomatoes did recover from that injury. Additional research is needed to determine if application method (i.e., soil surface application vs. mechanical incorporation) can improve tomato safety. Spartan (a product from FMC with only sulfentrazone) is labeled for surface applications before transplanting, without incorporation. Applying sulfentrazone to the soil surface, rather than incorporating it into the root zone, may improve crop safety.

Improved crop safety of metribuzin and sulfentrazone may allow for higher applications rates and improve weed control. Research is needed to determine optimum rate range for Mid-Atlantic growing conditions as well as our weed spectrum. In addition, it is important to evaluate this approach as part of a weed control program, with a postemergence treatment.

Objectives:

1. Evaluate metribuzin and sulfentrazone for safety with processing tomatoes under different application strategies; and

2. Determine level of early-season weed control from metribuzin and sulfentrazone.

Procedures:

The experiments were conducted in 2018 at the University of Delaware's Research and Education Center (UD-REC) and Penn State's Russell E. Larson Agricultural Research Farm (PSU-RS). UD-REC plots were established in sandy loam soil (79:13:8 sand:silt:clay), 1.1% o.m. and 6.7 pH and PSU-RS site was a silt loam (20:60:20 sand:silt:clay), 1.8% o.m. and 6.7 pH. The field at UD-REC was conventionally tilled with chisel plow and disk. Plots consisted of 2 twin rows of plants on 5 feet centers, each 24 feet long. On May 29, preplant incorporated (PPI) treatments were applied, field-cultivated, and immediately followed by applications of preemergence (PRE) treatments. Processing tomatoes ('Heinz 3402') were hand-transplanted at UD-REC on May 31 with twin rows of plants staggered 9 inches across row and 18 inches apart in the row. At PSU-RS, the field was conventionally tilled and PPI treatments were incorporated with heavy rakes. PPI and PRE applications and transplanting all occurred on June 12. Tomatoes at PSU-RS ('Heinz 3406') were hand transplanted in single row 20 feet long, with plants spaced 15 inches apart. Herbicide rates and timings for UD-REC are listed in Table 1 and for PSU-RS are listed in Table 2. A weed-free and an untreated check were also included. The experiment was conducted as a randomized complete block design;

both sites had three replications. A postemergence (POST) herbicide application of Matrix (rimsulfuron) at 2 oz wt/A, metribuzin at 3 oz wt/A plus a nonionic surfactant was made to all plots 3 and 4 weeks after planting at PSU-RS and UD-REC, respectively.

Applications were made with a 6-nozzle boom delivering 20 gal/A at UD-REC and 15 gal/A at PSU-RS. Visual crop response and weed control ratings were made based on appropriate check plot on a scale of 0 to 100. Crop response was evaluated seven times at UD-REC and three times at PSU-RS. A single destructive yield was taken at UD-REC on August 28 when fruit maturity (red/orange tomatoes) was greater than 60%. Eight plants were pulled (4 consecutive plants in two rows) and all fruit was picked and sorted. Weight of the three groups was taken separately; (red/orange), ripening (yellow) and unripened (green) fruit.

Results:

UD-REC. Tomato response was observed with all treatments. At 4 weeks after planting (WAP) >40% biomass reduction was observed with Authority Elite, Spartan Charge at 5.5 fl oz, and Authority MTZ at 12 and 16 oz/A (see Table 1). Spartan Charge at 3.7 fl oz/A and Authority MTZ, 12 oz/A PPI resulted in 33 and 32% biomass reduction, respectively. Authority MTZ at 6 oz/A PPI was the only treatment that did not differ from either the untreated or weed-free check. At 6 WAP plant biomass was significantly reduced in all treatments except the 6 oz/A PPI and the 8 oz/A PRE of Authority MTZ as compared to the untreated check. At 8 WAP Authority MTZ at 12 and 16 oz/A PPI and Authority Elite resulted in 10, 15, and 12% biomass reduction, respectively. At harvest tomato injury was observed with Authority MTZ at 12 and 16 oz/A PPI, Spartan Charge at 5.5 PRE, and Authority Elite treatments (data not presented). Application method, PPI versus PRE, was not significant, although there was a trend for less injury with PPI applications compared to PRE.

Carpetweed was the only species present where differences in control existed (data not presented). The weed-free treatment of Devrinol showed 75% control, and the lower rates (6, 8 oz) of Authority MTZ PPI treatments provided 82-90% control of carpetweed. All other treatments had greater than 90% control of carpetweed. No significant differences were observed with Palmer amaranth control throughout the entire season. At 4 WAP Palmer amaranth control ranged from 85 to 99% and after the POST application control was ≥96% for all treatments. Annual grasses were rated late in the season with all treatments having greater than 93% control. [Weed densities were low in the early season and the broadcast POST application controlled most weeds through mid-season. Late season Palmer amaranth was hand-weeded from plots to prevent seed dispersal.]

Table 1. Tomato injury at 4, 6, 8 weeks after planting (WAP) at UD-REC.

Herbicide[1]	Rate/A	Applic. method[2]	% Stunting (4 WAP)[x]	% Biomass Reduction (6 WAP)	% Biomass Reduction (8 WAP)	Cumulative Injury[3]
Untreated check			0	0	0	0
Authority MTZ	6 oz wt	PPI	12 de	6 c	0 a	276 d
Authority MTZ	8 oz wt	PPI	21 cde	16 bc	6 a	679 bcd
Authority MTZ	10 oz wt	PPI	25 cd	16 bc	0 a	705 bcd
Authority MTZ	12 oz wt	PPI	32 bc	25 ab	10 a	1236 abc
Authority MTZ	16 oz wt	PPI	43 ab	36 a	15 a	1720 a
Authority MTZ	8 oz wt	PRE	22 cd	15 bc	2 a	593 cd
Authority MTZ	12 oz wt	PRE	45 ab	32 a	6 a	1366 ab
Metribuzin fb Spartan Charge	2.9 oz wt 3.7 fl oz	PPI fb PRE	33 abc	26 ab	7 a	1151 abc
Metribuzin fb Spartan Charge	4.3 oz wt 5.5 fl oz	PPI fb PRE	45 ab	30 ab	3 a	1413 a
Authority Elite	24 fl oz	PRE	47 a	34 a	12 a	1738 a
Weed-free[4]			6 e	3 c	3 a	220 d
$P^x>F^y$			0.0001	0.0023	0.0624	0.0008

[1]Authority MTZ = sulfentrazone + metribuzin; Authority Elite = sulfentrazone + s-metolachlor; Spartan Charge = sulfentrazone + carfentrazone; Devrinol = napropamide. All plots received a POST treatment of Matrix (rimsulfuron) at 2 oz wt plus metribuzin at 3 oz wt/A plus nonionic surfactant

[2]PPI (preplant incorporated) and PRE (preemergence) applications were made the same day.

[3]Cumulative injury is total injury over the season (total of average injury per day).

[4]PPI treatment of Devrinol at 2 qts/A + metribuzin at 3.5 oz wt/A. This treatment was also hand-weeded

[x]Means within a column followed by the same letter are not significantly different (p=0.05) according to Fisher's protected LSD test.

[y]P values ≤0.05 indicate significant differences exist among treatments.

PSU-RS. Tomato injury at 2 weeks after planting was most severe with metribuzin applied PPI followed by Authority Elite PRE. Injury was significantly higher than Authority MTZ at 10 oz/A applied PPI. This was the same rates as Authority Elite, but Authority Elite also contains s-metolachlor (Dual Magnum) which confounds the interpretation of the results. As a trend, PPI applications of Authority MTZ resulted in less injury than PRE applications. Injury continued throughout the season, with similar injury ratings at 6 weeks after planting and at end of season.

Large crabgrass control was excellent (≥96%) for most treatments except Authority MTZ at 6 and 8 oz/A applied PPI. Redroot pigweed and common lambsquarters control was at last 95% for all treatments at 3 WAP and remained consistent throughout the season due to the POST application of Matrix plus metribuzin. Eastern black nightshade is a late emerging species and was not rated at 3 WAP, but at 6 WAP all treatments except the lowest rate of Authority MTZ provided ≥92% control.

Table 2. Tomato injury and weed control at PSU-RS.

Herbicide[1]	Rate/A	Applic. method[2]	% Biomass Reduction (3 WAP)[x]	% Biomass Reduction (6 WAP)	Lg. crabgrass (3 WAP)	Redroot pigweed (3 WAP)	Eastern black nightshade (6 WAP)
Untreated check			0	0	0	0	0
Authority MTZ	6 oz wt	PPI	4 e	5 e	65 c	95 b	71 b
Authority MTZ	8 oz wt	PPI	9 de	8 de	89 b	99 a	92 a
Authority MTZ	10 oz wt	PPI	13 cde	17 cde	96 ab	99 a	94 a
Authority MTZ	12 oz wt	PPI	20 bcd	19 b-e	98 a	99 a	97 a
Authority MTZ	16 oz wt	PPI	33 ab	35 ab	97 ab	99 a	99 a
Authority MTZ	8 oz wt	PRE	23 abc	22 b-e	97 ab	99 a	99 a
Authority MTZ	12 oz wt	PRE	27 abc	28 abc	96 ab	99 a	99 a
Metribuzin fb Authority Elite	4.3 oz wt fb 25 fl oz	PPI fb PRE	37 a	42 a	99 a	99 a	99 a
Authority Elite	25 fl oz	PRE	23 abc	25 a-d	99 a	99 a	99 a
$P^x>F^y$			0.0018	0.0068	0.0016	1.000	0.0001

[1]Authority MTZ = sulfentrazone + metribuzin; Authority Elite = sulfentrazone + s-metolachlor; Devrinol = napropamide. All plots received a POST treatment of Matrix (rimsulfuron) at 2 oz wt plus metribuzin at 3 oz wt/A plus nonionic surfactant

[2]PPI (preplant incorporated) and PRE (preemergence) applications were made the same day.

[x]Means within a column followed by the same letter are not significantly different (p=0.05) according to Fisher's protected LSD test.

[y]P values ≤0.05 indicate significant differences exist among treatments.

Yield. Tomatoes were harvested at UD-REC when approximately 60% ripeness was observed in the weed-free check. Yield of ripe (red/orange) tomatoes and immature (green) tomatoes showed significant differences between treatments (see Table 3). A significant reduction (34%) of ripe tomatoes occurred with the Spartan Charge, 5.5 fl oz/A and Authority MTZ at 16 oz/A applied PPI. Although not significantly different from the untreated check, fewer ripe tomatoes were recorded with Authority MTZ 12 oz/A PRE treatment as compared to the weed-free check. Authority Elite, Spartan Charge at 5.5 fl oz, Authority 8 oz/A PRE and Authority MTZ 16 oz/A PPI resulted in greater than 55% increase in weight of green tomatoes as compared to the untreated. No significant difference was observed with total yield (ripe + yellow + green tomatoes) or with yellow tomatoes (data not presented).

Table 3. Tomato yield and distribution of fruit maturity at UD-REC.

Herbicide[1]	Rate/A	Applic. method[2]	Yield Ripe lbs/plot[x]	% Ripe Fruit	Yield Green lbs/plot	% Green Fruit
Untreated check			28.3 ab	73 a	3.8 e	10 f
Authority MTZ	6 oz wt	PPI	25.8 abc	69 abc	7.0 cde	17 cde
Authority MTZ	8 oz wt	PPI	28.7 a	72 ab	5.8 de	12 ef
Authority MTZ	10 oz wt	PPI	24.1 abc	63 a-d	6.1 de	14 def
Authority MTZ	12 oz wt	PPI	28.1 ab	62 bcd	8.5 a-d	17 cde
Authority MTZ	16 oz wt	PPI	19.3 c	53 de	9.5 abc	24 ab
Authority MTZ	8 oz wt	PRE	24.1 abc	58 cde	10.3 ab	23 abc
Authority MTZ	12 oz wt	PRE	21.3 bc	60 cd	8.5 a-d	23 abc
Metribuzin fb Spartan Charge	2.9 oz wt 3.7 fl oz	PPI fb PRE	22.1 abc	62 bcd	7.1 bcd	20 bcd
Metribuzin fb Spartan Charge	4.3 oz wt 5.5 fl oz	PPI fb PRE	19.3 c	49 e	11.7 a	28 a
Authority Elite	24 fl oz	PRE	22.8 abc	59 cde	9.9 abc	24 ab
Weed-free[3]			29.5 a	65 abc	6.1 de	13 ef
P[x]>*F*[y]			0.0480	0.0036	0.002	0.001

[1]Authority MTZ = sulfentrazone + metribuzin; Authority Elite = sulfentrazone + s-metolachlor; Spartan Charge = sulfentrazone + carfentrazone; Devrinol = napropamide. All plots received a POST treatment of Matrix (rimsulfuron) at 2 oz wt plus metribuzin at 3 oz wt/A plus nonionic surfactant

[2]PPI treatments and PRE applications were made the same day.

[3]PPI treatment of Devrinol at 2 qts/A + metribuzin at 3.5 oz wt/A. This treatment was also hand-weeded.

[x]Means within a column followed by the same letter are not significantly different (p=0.05) according to Fisher's protected LSD test.

[y]P values ≤0.05 indicate significant differences exist among treatments.