Melon and weed response to herbicides.

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Successful weed management is vital for the production of cantaloupe and honeydew melons. Weed control in melons is difficult due to the vining nature of the crop (which can prohibit mechanical cultivation) and the limited availability of safe and selective herbicides (particularly for the control of broadleaf species). In 2013, 2014, and 2015, research trials were initiated to compare pre-emergence (PRE) applications of ethalfluralin, clomazone, ethalfluralin plus clomazone, halosulfuron, *S*-metolachlor, and sulfentrazone with respect to crop safety and weed control. Weed cover and weed number were greatest in the untreated check and clomazone plots each year; the intensity of competitive interactions were reflected in yields, which were also the lowest. Despite their effectiveness at controlling small-seeded broadleaf weed species, *S*-metolachlor and sulfentrazone (which are not labeled for use in California) were significantly more injurious to cantaloupes and honeydews than ethalfluralin and halosulfuron. There were no yield differences among the ethalfluralin, halosulfuron, *S*-metolachlor, and sulfentrazone treatments. Although crop yields were more affected by weed cover and density than crop injury in our trial, the use of *S*-metolachlor and sulfentrazone may require that growers assume unnecessary risk for a limited benefit. The potential to use safeners to reduce *S*-metolachlor, and sulfentrazone mobility in the soil (and, therefore injury) was investigated; safener efficacy varied across years/production conditions and may not provide sufficient protection against herbicide injury. Further studies are needed to investigate how soil type, herbicide and safener rate, and the type of timing of irrigation events interact before *S*-metolachlor, and sulfentrazone could become viable components of a melon production system in California.

Introduction

According to some of the most recently available statistics, the United States (US) was the world's sixth largest producer of melons in 2012, the majority of which were grown in California, who leads the nation in both volume and value (FAO 2015, NASS 2015). In 2014, California produced 12 million hundred-weight of cantaloupe and honeydew; in comparison, Arizona, Georgia, and Texas, the second-, third-, and fourth-ranked states for melon production, respectively, each produced less than half of California's total yield (NASS 2015). The 2014 crop of cantaloupes and honeydew melons in California was worth an estimated $197 million, and accounted for >50% of the US's total production value (NASS 2015).

Early-season weed control is crucial in order to prevent competitive interference between cucurbit crop species and weeds, which can directly reduce crop yields (Adkins et al. 2010; Friesen 1978; Gilbert et al. 2008; Johnson and Mullinix 1999; Monks and Shultheis 1998;

Nerson 1989; Terry et al. 1997; William and Warren 1975). For example, Monks and Shultheis (1998) found that marketable yield of triploid watermelon (*Citrullus lanatus* (Thunb.) Matsum. & Nakai.) was reduced 5,600 kg for each week of competition with crabgrass (*Digitaria sanguinalis* (L.) Scop.). Gilbert et al. (2008) reported that season-long interference of American black nightshade (*Solanum americanum* Mill.) with diploid watermelon, when grown in a mulched system, reduced melon yields between 54% and 80% at weed densities of 2 plants/m^2; in bare ground production, yield loss ranged from 68% to 100%. In addition to directly impacting yields, weeds may also serve as an alternate host for pests of cucurbits, particularly viruses, which can significantly affect crop growth and subsequent fruit development (Ali et al. 2012a; Ali et al. 2012b; Tantiwanich et al. 2014; Webster et al. 2015).

Because of their vining nature, the use of mechanical cultivation is limited in cucurbits (Gilreath and Everett 1983); while effective at eliminating unwanted plants, hand-weeding is completely dependent on both the availability and affordability of a large labor pool (Martin 2007). The use of some alternative practices for weed control, such as cover crops (Kosterna 2014; Monday et al. 2015; Wang et al. 2007; Wang et al. 2008a; Wang et al. 2008b) and soil solarization (Ozores-Hampton et al. 2012; Reddy 2013), may not provide many growers with sufficient economic return to justify their inclusion in a production system (Wang et al. 2009). Herbicide use in cucurbits can be limited by the narrow spectrum of weed control the available products provide as well as the potential for crop injury (Brandenberger et al. 2005; Figueroa and Kogan 2005; Grey et al. 2000a; Grey et al. 2000b; Haar et al.2002; Harrison and Keinath 2003; Johnson and Mullinix 2005, Norsworthy and Meister 2007; Webster and Culpepper 2005; Webster et al. 2003).

Of the relatively few herbicides registered for use in cantaloupes and honeydews (*Cucumis melo* L.) in California, only bensulide (fatty acid biosynthesis inhibitor), ethalfluralin (mitosis inhibitor), and halosulfuron (acetolactate synthase-inhibitor) can be applied at planting to provide residual weed control. *S*-metolachlor, a mitosis inhibitor, and sulfentrazone, a protox inhibitor, have also been explored for pre-emergence (PRE) use in melons through the Interregional Research #4 Project (IR-4), which is charged through the United States Department of Agriculture (USDA) with developing research data to support the registration of new crop protection tools for minor use crops. The purpose of our first study was to evaluate the tolerances of melons to *S*-metolachlor and sulfentrazone, as well as the efficacy of the prospective and registered herbicides for early-season weed control. In a second study, we evaluated the efficacy of safeners for reducing melon crop injury from select PRE-applied herbicides.

Materials and Methods

<u>Study 1:</u> Field trials were established between 6 and 15 of June in 2013, 2014 and 2015 at the University of California - Davis, Plant Sciences Field Station (38 32'N, 121 47'W) to evaluate the safety and efficacy of PRE herbicides in seeded melon production. This region has a Mediterranean climate, characterized by hot, dry summers and relatively wet winters. Soil at the site is a fine, silty loam (Yolo series, 37% sand, 41% silt, 22% clay; 1.5-3% OM; pH 6.7-7.2) (Haar et al. 2002). The study sites were planted to wheat (*Triticum aestivum* L.) during the preceding growing seasons. After wheat harvest, the entire area was sub-soiled, disked, and planed in order to eliminate residue and create a uniform surface prior to the establishment of

melon beds.

The experimental design was a split-plot with three whole plots (crop cultivars) and seven subplots (six herbicides and an untreated check). Two cantaloupe ('Oro Rico' and either 'Mercedes' [2013] or 'Yosemite' [2014, 2015]) and one honeydew ('Saturno') melon cultivars were included in the study, each year. Melons were direct-seeded (1.5 inches deep) into raised beds (rows) that had been pre-irrigated two to five days prior to planting. Row centers were spaced 60 inches apart; every other row was planted, thus allowing for 120 inches between seed lines. Following seedling emergence, which began at seven days after planting, melons were thinned to a density of one melon plant per 14 to 16 inches of row.

Pre-emergence herbicides were broadcast-applied directly to the bed surfaces post-plant, but prior to crop emergence, using a CO_2-pressurized backpack sprayer equipped with three 8002VS flat-fan nozzles (TeeJet Technologies, Wheaton, IL) spaced 20 inches apart and calibrated to deliver 30 gal A^{-1}. Herbicide treatments included: ethalfluralin (as Curbit at 4 pt A^{-1}, Loveland Products Inc.), clomazone (as Command at 0.5 pt A^{-1}, FMC Corporation Agricultural Products Group), ethalfluralin plus clomazone (as Strategy at 4 pt A^{-1}, Loveland Products Inc.), halosulfuron (as Sandea at 1 oz A^{-1}, Gowan Company), *S*-metolachlor (1.3 pt A^{-1}, Dual Magnum®, Syngenta Crop Protection LLC), and sulfentrazone (3.2 oz A^{-1}, Zeus Herbicide, FMC Corporation Agricultural Products Group). Each individual herbicide treated plot was 30 feet in length and each cultivar by herbicide combination was replicated three times, each year. Plots were irrigated with 20 mm water immediately after planting, using solid set sprinklers, to ensure crop stand and incorporate the herbicides; furrow irrigation was used, thereafter. Bed shoulders were cultivated at approximately four and eight weeks after crop emergence (WAE) to maintain weed-free furrows and ensure the even flow of irrigation water. Irrigation, fertilization and pest management, excluding weed control, decisions were made based on guidelines developed by University of California Cooperative Extension.

Both melons and weeds began to emerge at seven days after planting. Weed cover (%), weed density (numbers m^{-2}), and crop injury (%) were evaluated bi-weekly for up to six weeks after crop emergence (WAE). Visual estimates of crop injury were based on a scale from 0% (no crop injury) to 100% (plant death); chlorosis, necrosis, crop stunting, leaf deformations, and stand loss were considered when estimating injury. Cantaloupes were harvested when they reached the ¾- to full-slip stage; honeydew were harvested when the blossom ends began to soften and yellow. Weed cover, weed number, crop injury, and fruit number data were transformed prior to analysis to meet the assumptions of normality and homogeneity of variance. Data were analyzed using mixed-models ANOVA where cultivar and herbicide and the interaction between cultivar and herbicide were considered to be main effects; year and replication were considered as random. Due to a planter malfunction, melons were not planted evenly in the 2014 research trials, resulting in extremely uneven stands; melon plants were subsequently rogued out of the study so that weed cover and density were evaluated in the absence of a crop. As a consequence, the 2014 weed data was analyzed separately. Because of the number of multiple comparisons, means were separated using Tukey's protocol. If no significant cultivar by herbicide interactions were detected ($P \leq 0.05$), the data were pooled for presentation.

Study 2: In 2014, an additional study was undertaken to evaluate the effects of three proprietary soil adjuvants (hereafter referred to as 'safeners') designed to improve herbicide retention within the treatment zone, thereby preventing leaching and minimizing the potential for crop injury. Herbicides (ethalfluralin as Curbit at 4 pt A^{-1}; *S*-metolachlor as Dual Magnum at 1.3 A^{-1}; sulfentrazone as Zeus at 3.2 oz A^{-1}) were applied to the soil surface after seeding of 'Yosemite' cantaloupes. The three exploratory, and proprietary, safeners (Umb at 5 oz A^{-1}, 6415 at 1 pt A^{-1}, 6363 at 0.5% v/v) were applied in mixture with *S*-metolachlor and sulfentrazone. The trial was sprinkler irrigated, weekly, with 0.5-1" of water for up to eight weeks; overhead irrigation was utilized to facilitate movement of the herbicides into the seedline/seedling root zone and maximize crop injury. Estimates of weed cover and crop injury were made between 2 and 6 WAE. Visual estimates of crop injury were based on a scale from 0% (no crop injury) to 100% (plant death); chlorosis, necrosis, crop stunting, leaf deformations, and stand loss were considered when estimating injury. In 2015, the trial was repeated using two rates (5 and 10 oz A^{-1}) of Umb; crop injury was estimated as described previously.

Results and Discussion

Study 1: The 2013, 2014, and 2015 field sites were dominated by a mixture of small seeded broadleaf species: common purslane (*Portulaca oleracea*), common lambsquarters (*Chenopodium album*), and pigweeds (a mixture of *Amaranthus blitoides* – prostrate pigweed and *A. retroflexus* – redroot pigweed). Results from statistical analyses indicated that the 2013/2015 weed cover and density data were influenced ($P \leq 0.05$) solely by herbicide treatment (Table 1); cultivar and the interaction between cultivar and herbicide did not affect early season weed control. Mean weed cover was greatest in the untreated check; percent cover at 2, 3, 4, and 6 WAE was 31, 53, 49, and 41%, respectively. Percent cover was next highest in the clomazone treated plots, which ranged from 7 to 22%. Mean weed cover in the ethalfluralin, ethalfluralin plus clomazone, *S*-metolachlor, sulfentrazone, and halosulfuron treatments did not exceed 7% at any time point. At each observation period, both the untreated check and clomazone differed, significantly ($P \leq 0.05$), from all other herbicide treatments with respect to weed cover. With the exception of the sulfentrazone (< 1 to 2%) vs. ethalfluralin (6 to 7%) and ethalfluralin plus clomazone (4 to 5%) comparisons at 3 and 4 WAE, there were no differences ($P \geq 0.05$) in weed cover among the remaining herbicide treatments at any time point.

The mean number of weeds m^{-2} encountered in the 2013/2015 plots was greatest in the untreated control (16 to 31 m^{-2}) followed by the clomazone treatment (5 to 14 m^{-2}) from 2 to 6 WAE (Table 2). In general, the untreated check and clomazone differed, significantly ($P \leq 0.05$), from ethalfluralin, ethalfluralin plus clomazone, *S*-metolachlor, sulfentrazone, and halosulfuron with respect to weed number (<1 to 9 m^{-2}). With the exception of the sulfentrazone treatment, which contained one or fewer weeds m^{-2} than all other herbicides at 3, 4, and 6 WAE, there were few differences ($P \geq 0.05$) in weed density among the remaining herbicides.

Fewer differences in weed cover and number were observed among the treatments in 2014 (Tables 3 and 4). In the 2014 trial, melon beds were pre-irrigated five days prior to crop seedling and PRE herbicide applications; this delay allowed many small-seeded weeds to germinate and emerge before soil-applied herbicides could be activated post-planting. Mean weed cover in the control plots ranged from 36 to 48% between 2 and 6 WAE; weed cover in the clomazone treatment (23 to 44%) did not differ ($P \geq 0.05$) from the untreated check at any time point (Table 3). The ethalfluralin, ethalfluralin plus clomazone, *S*-metolachlor, sulfentrazone, and halosulfuron treatments all differed ($P \leq 0.05$) from the untreated control, with respect to weed cover (6 to 20%), at 2 and 3 WAE; at 4 and 6 WAE, only the sulfentrazone treatment (5 to 13%) differed ($P \leq 0.05$) from the check. With respect to weed density in 2014, mixed models ANOVA indicated a significant treatment effect for the 3 WAE observations, only (Table 4); all of the herbicides, except clomazone, differed ($P \leq 0.05$) from the untreated control. Not unlike the 2013/2015 data, weed density was numerically lowest in the sulfentrazone treated plots.

Melon seedlings began to emerge at approximately one week after planting; melons were thinned to a density of one plant per 14 to 16 inches of row at 2 WAE. Although not accounted for in the formal injury estimates, *S*-metolachlor and sulfentrazone reduced stand establishment (Sosnoskie, personal observation). *S*-metolachlor (5 to 20% injury) and sulfentrazone (35 to 65% injury) caused the most severe injury to melons across all observation dates (Table 5). Injury resulting from application of ethalfluralin, ethalfluralin plus clomazone, and halosulfuron did not exceed 12% at 3 WAE and had declined to 1% or less by 6 WAE.

Total cantaloupe yields per plot were significantly affected by herbicide treatment (Table 6). Mean fruit numbers were lowest in the untreated check (25 fruit $plot^{-1}$) and clomazone plots (30 fruit $plot^{-1}$) where weed cover and density were greatest up to 6 WAE. Cantaloupe fruit yield in the ethalfluralin, ethalfluralin plus clomazone, *S*-metolachlor, sulfentrazone, and halosulfuron treatments ranged from 45 to 55 fruit $plot^{-1}$. With respect to honeydew yields, mean fruit numbers were lowest in the untreated check (6 fruit $plot^{-1}$) and the ethalfluralin plus clomazone treatments (17 fruit $plot^{-1}$) (Table 7). Honeydew fruit yield in the ethalfluralin, clomazone, *S*-metolachlor, sulfentrazone, and halosulfuron treatments ranged from 20 to 28 fruit $plot^{-1}$. Despite significant early season crop injury, cantaloupe and honeydew yields in the *S*-metolachlor and sulfentrazone treatments were greater than those in the untreated check and statistically equal to ethalfluralin and halosulfuron.

Study 2: In 2014, an additional study was undertaken to evaluate the effects of three proprietary soil adjuvants (hereafter referred to as 'safeners') designed to improve herbicide retention within the treatment zone, thereby preventing leaching and minimizing the potential for crop injury. Trials were sprinkler irrigated, weekly, to increase herbicide mobility into the seedline and root zone. Observed melon injury was lower, over all evaluation dates, when the Umb, 6415, and 6363 safeners were included in tankmixes of *S*-metolachlor and sulfentrazone, as compared to the herbicides applied singly (Table 8). By 6 WAE, injury in the *S*-metolachlor + Umb and *S*-metolachlor + 6415 treatments were reduced to levels observed for the Curbit standard (5%). Although the inclusion of the safeners Umb, 6363, and 6415 did reduce crop injury caused by sulfentrazone (up to 93% when sulfentrazone was applied alone), injury estimates still exceeded 70%.

In 2015, the study plots were sprinkler irrigated twice following seeding to initiate seed germination and activate herbicides; to better approximate what might occur in a commercial field, the plots were furrow irrigated afterwards. As a consequence, the crop injury observed in 2015 was not as severe as 2014 (Table 9). The use of the safener, Umb, in a tank mixture with *S*-metolachlor did not reduce crop injury relative to *S*-metolachlor applied alone; the 10 oz A^{-1} rate actually increased the visual injury rates relative to the herbicide applied singly. Although the 5 oz A^{-1} rate of Umb helped to reduce sulfentrazone injury, the 10 oz A^{-1} rate was equivalent to sulfentrazone applied singly. All of the *S*-metolachlor and sulfentrazone treatments exhibited greater injury than the untreated check and the ethalfluralin standard.

Conclusions

Weed control in melons is difficult due, in part, to the limited availability of registered herbicides. Early-season weed control is crucial in order to prevent competitive interference between melons and weeds, which can reduce crop yields; late-season weed management is also important as weeds can harbor pests and pathogens which can adversely affect fruit quality. Weeds can also reduce harvest efficiency, which can result in increased labor costs. The lowest levels of weed control in 2013/2015 occurred in the clomazone and the untreated check. All other herbicide programs provided good to excellent control of weeds for up to 6 weeks after crop emergence. The greatest amount of crop injury was observed in the *S*-metolachlor and sulfentrazone plots, which also provided the best weed control; herbicide injury was still evident in these treatments at six weeks after crop emergence. Total fruit numbers were lowest in the check and clomazone treatments plots, where weed cover was the greatest. Despite significant early season injury, the *S*-metolachlor and sulfentrazone treatments yielded better than the control, and as well as ethalfluralin and halosulfuron. In 2014, when the research plots were pre-irrigated 5 days in advance of the herbicide applications, weed control was significantly reduced; only sulfentrazone significantly reduced weed cover. Results from 2014 and 2015 research trials show that irrigation can significantly affect crop injury potential *S*-metolachlor and sulfentrazone can be very effective at suppressing troublesome weeds in melon production systems, although soil-irrigation interactions can significantly affect crop injury potential. The use of safeners reduced the injury potential from *S*-metolachlor and sulfentrazone in certain instances, but not others. Despite their utility for controlling small-seeded broadleaf weed species, there use of *S*-metolachlor and sulfentrazone broadcast PRE may not be warranted in cantaloupes and honeydews because of injury concerns.

Table 1. Weed cover (%) in cantaloupe and honeydew melons (2013/2015) from two to six weeks after crop emergence in response to herbicides. Data are averaged over melon cultivars.

	2 WAE	3 WAE	4 WAE	6 WAE
	Percent (%) weed cover			
untreated	30.6	52.8	49.0	41.2
clomazone	6.6	13.6	18.9	21.6
ethalfluralin	2.5	6.9	6.1	6.0
ethalfluralin plus clomazone	1.4	4.1	5.4	5.9
S-metolachlor	< 1	3.6	3.2	4.0
sulfentrazone	< 1	< 1	2.4	2.0
halosulfuron	< 1	2.4	3.4	5.5

Table 2. Weed density (number m^{-2}) in cantaloupe and honeydew melons (2013/2015) from two to six weeks after crop emergence in response to herbicides. Data are averaged over melon cultivars.

	2 WAE	3 WAE	4 WAE	6 WAE
	Number weeds m^{-2}			
untreated	15.5	31.4	20.9	19.4
clomazone	5.4	13.6	11.4	11.4
ethalfluralin	2.8	8.5	3.7	3.6
ethalfluralin plus clomazone	1.6	4.9	3.7	3.8
S-metolachlor	< 1	4.0	2.5	3.2
sulfentrazone	< 1	1.2	< 1	1.2
halosulfuron	< 1	4.3	2.8	3.1

Table 3. Weed cover (%) in cantaloupe and honeydew melons (2014) from two to six weeks after crop emergence in response to herbicides. Data are averaged over melon cultivars.

	2 WAE	3 WAE	4 WAE	6 WAE
	Percent (%) weed cover			
untreated	39.7	45.1	35.8	47.8
clomazone	32.8	31.7	22.8	41.1
ethalfluralin	16.1	17.2	13.3	26.1
ethalfluralin plus clomazone	18.3	17.6	16.9	28.3
S-metolachlor	19.6	19.2	18.7	27.2
sulfentrazone	5.7	6.2	5.4	12.9
halosulfuron	22.2	21.7	23.3	31.7

Table 4. Weed density (number m^{-2}) in cantaloupe and honeydew melons (2014) from two to six weeks after crop emergence in response to herbicides. Data are averaged over melon cultivars.

	2 WAE	3 WAE	4 WAE	6 WAE
	Number weeds m^{-2}			
untreated	33.8	61.1	17.1	19.8
clomazone	30.4	43.8	13.8	16.4
ethalfluralin	20.7	31.1	8.9	13.1
ethalfluralin plus clomazone	24.0	27.6	11.6	14.9
S-metolachlor	15.3	24.9	10.9	14.0
sulfentrazone	6.9	14.0	5.3	3.8
halosulfuron	24.0	28.7	9.3	14.2

Table5. Crop injury (%) in cantaloupe and honeydew melons (2013/2015) from three to six weeks after crop emergence in response to herbicides. Data are averaged over melon cultivars.

	3 WAE	4 WAE	6 WAE
	Percent (%) injury		
untreated	0.0	0.0	0.0
clomazone	6.7	5.3	1.8
ethalfluralin	8.8	3.5	< 1
ethalfluralin plus clomazone	12.2	6.9	1.0
S-metolachlor	20.2	14.9	5.0
sulfentrazone	64.5	55.3	34.9
halosulfuron	10.2	6.7	< 1

Table 6. Mean fruit yield from cantaloupe plots in 2013/2015. Fruit were harvested over the course of 10 days when melons reached the ¾ slip stage.

	Number of fruit plot^{-1}
untreated	24.8
clomazone	29.8
ethalfluralin	54.0
ethalfluralin plus clomazone	45.4
S-metolachlor	49.2
sulfentrazone	50.0
halosulfuron	54.8

Table 7. Mean fruit yield from honeydew plots in 2013/2015. Fruit were harvested over the course of 10 days when the blossom ends began to soften and yellow.

	Number of fruit plot^{-1}
untreated	6.3
clomazone	20.3
ethalfluralin	27.8
ethalfluralin plus clomazone	16.8
S-metolachlor	27.8
sulfentrazone	23.3
halosulfuron	26.0

Table 8. Effects of three potential herbicide safeners on *S*-metolachlor and sulfentrazone injury in melons in 2014.

	2 WAE	3 WAE	4 WAE	5 WAE	6 WAE
1-UTC	0.0	0.0	0.0	0.0	0.0
2-Curbit	2.0	10.0	11.8	15.0	5.0
3-Dual Mag	8.3	43.8	43.8	28.3	18.3
4-Zeus	36.3	83.8	92.5	90.0	91.7
7-Dual Mag + Umb	2.5	33.8	37.5	18.3	3.3
5-Dual Mag + 6415	7.5	40.0	41.3	31.7	8.3
6-Dual Mag + 6363	7.0	28.8	35.0	23.3	1.7
10-Zeus + Umb	40.0	77.5	88.8	83.3	73.3
8-Zeus + 6415	20.0	68.8	77.5	75.0	71.7
9-Zeus + 6363	32.5	80.0	86.3	86.7	73.3

	2 WAE	3 WAE	4 WAE	5 WAE	6 WAE
3-Dual Mag	8.3	43.8	43.8	28.3	18.3
7-Dual Mag + Umb	2.5	33.8	37.5	18.3	3.3
5-Dual Mag + 6415	7.5	40.0	41.3	31.7	8.3
6-Dual Mag + 6363	7.0	28.8	35.0	23.3	1.7
4-Zeus	36.3	83.8	92.5	90.0	91.7
10-Zeus + Umb	40.0	77.5	88.8	83.3	73.3
8-Zeus + 6415	20.0	68.8	77.5	75.0	71.7
9-Zeus + 6363	32.5	80.0	86.3	86.7	73.3

Table 9. Effects of a potential herbicide safener on *S*-metolachlor and sulfentrazone injury in melons in 2015.

	2 WAE	4 WAE	5 WAE	6 WAE
	% Crop Injury			
untreated	0.0	0.0	0.0	0.0
ethalfluralin	8.3	0.0	0.0	0.0
S-metolachlor	23.3	6.0	8.3	6.7
S-metolachlor + Umb 5 oz/A	25.0	10.0	6.7	6.7
S-metolachlor + Umb 10 oz/A	30.0	25.0	18.3	15.0
sulfentrazone	81.7	58.3	63.3	58.3
sulfentrazone + Umb 5 oz/A	48.3	26.7	36.7	30.0
sulfentrazone + Umb 10 oz/A	66.7	60.0	56.7	51.7