CALIFORNIA MELON RESEARCH BOARD
2016 Research Final Report
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A. **Evaluating the effect of adjuvants with Sandea (halosulfuron) and clethodim on pre – and post herbicide applications to cantaloupes and honeydews.**

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Summary
Field trials were established in honeydews (cv Summer Dew) and cantaloupes (cv Durango) in commercial fields to evaluate pre and post emergence combinations of halosulfuron (Sandea) and clethodim (Select Max) herbicides used with various adjuvants for effects on melon injury and weed control. The herbicides used were Sandea (75% halosulfuron) at 0.5 and 1.0 oz/A, and Clethodim 2E (26.4% ai) at 8 oz per acre. Surfactants evaluated were Agri-Dex crop oil concentrate, Induce NIS, and Dyne-Amic MSO. Both PRE (before crop and weed emergence) and POST (about 1 month after planting) treatment timings were used. Treatment design was a randomized complete block with 4 replications; plot size was one bed (6.67 ft) by 30 feet long. Pre-emergent applications of halosulfuron had no discernable effect on crop growth or weed control. At both locations, significantly more crop phytotoxicity occurred in the treatments with POST halosulfuron and clethodim as compared to the other treatments. There was no significant difference between the type of adjuvant, and crop phytotoxicity symptoms faded by the end of the season. At the cantaloupe trial, no significant differences were observed for either grassy or broadleaf weeds control between any of the treatments, and no significant yield differences were observed. At the honeydew trial, broadleaf weeds were significantly reduced in the treatments containing halosulfuron applied POST. The numbers of fruit produced were very similar in all treatments, and though yield was not directly measured, there appeared to be no significant impact on yield.

Introduction
Clethodim is a post emergence, broad spectrum grass herbicide that is sold under names such as Select, SelectMax, and Arrow. It is labeled for most broadleaf annual crops, including all those in the cucurbit crop grouping. Weed control is improved with the addition of adjuvants, and crop oil concentrate at 1% v/v is recommended on the label. In practice, a non-ionic surfactant is also recommended by PCAs on melons to limit crop phytotoxicity, at 0.25% v/v, or no surfactant at all.

While used mainly for nutsedge control, halosulfuron (Sandea) is currently registered on melons for both pre and post emergence broadleaf weed control, including pigweed and purslane. Research has shown halosulfuron causes less injury to pumpkins when applied pre, however post herbicide applications are often necessary as a result of insufficient pre-emergent weed control and/or late-season weed emergence. Unfortunately, halosulfuron does not control grasses, and therefore tank mixtures with clethodim herbicides may improve weed control in melons. Crop oil concentrates are not recommended with halosulfuron because they increase the chance for phytotoxicity.

The objectives of this trial were to evaluate pre and post emergence combinations of halosulfuron (Sandea) and clethodim (Select Max) herbicides used with various adjuvants for effects on melon injury and weed control.

Mehods

Two trial locations were established: a late season honeydew field with Jim Vincent near Dos Palos, and a second cantaloupe location with Dan Burns between Dos Palos and Firebaugh. The treatments were the same at both locations. In all, 10 different herbicide and surfactant combinations were evaluated (Table 1).

Table 1. Trial background and treatment information.

	Cantaloupes	*Honeydews*
Location	Field N8, of Hudson Rd. between Merill and Oxalis Rds. GPS 36° 56'32.45" N 120°32'35.30" W. Gepford clay soil	Off Aubrey Rd, south of Eucalyptus. GPS 37°00'15.48" N 120°39'30.18" W. Dos Palos clay soil
Cooperator	Dan Burns	Jimmy Vincent
Variety and plant date	Durango, July 13	Summer Dew, July 10
Irrigation	Sprinkler, then furrow	Furrow
Sandea PRE treatments	July 18	July 14
POST directed treatments	Aug 12 and 19	Aug 12 and 31
Weed evaluation	Sept 13 and 28	Sept 6 and 28
Harvest	Oct 3 and 7	Did not harvest
Treatments	1. UTC 2. 0.5 oz/A Sandea PRE 3. 1.0 oz/A Sandea PRE 4. Clethodim 2E 8 oz/A + COC 1% v/v POST 5. Sandea 1 oz/A + 0.25 % v/v NIS post directed 6. Clethodim 8 oz/A + Sandea 1.0 oz/A + COC 1% v/v post directed 7. Clethodim 8 oz/A + Sandea 1.0 oz/A + MSO 1% v/v post directed 8. Clethodim 8 oz/A + Sandea 1.0 oz/A + NIS 0.25% v/v post directed 9. Sandea 1 oz/A + 0.25 % v/v NIS post directed, before 1st irrigation 10. Clethodim 8 oz/A + Sandea 1.0 oz/A, post directed no adjuvant	

Herbicide applications were made by hand using a backpack sprayer with 60 gpa of water equivalent. Plots were one bed by 30 feet long, with 4 replications. Herbicides used were Sandea (75% halosulfuron) at 0.5 and 1.0 oz/A, and Clethodim 2E (26.4% ai) at 8 oz per acre. Surfactants evaluated were Agri-Dex crop oil concentrate (COC), Induce non-ionic surfactant (NIS), and Dyne-Amic methylated seed oil (MSO). PRE treatments (Sandea only) were made after planting but before crop emergence to the seed row, about a 2 ft wide band on the top of the bed. POST treatments were made when the crop was about 1 ft across and just starting to run with the cantaloupes and about 1 week after the first irrigation with the honeydews. POST treatments were applied as a directed spray to the outside and shoulder of the beds to minimize contact with foliage.

Weed and crop phytotoxicity ratings were done using a subjective scale, where 0 = no weeds/no phyto, 1 = <10%, 2 = <25%, 3 = < 50%, 4 = <75%, and 5 = >90% weeds or phyto. Cantaloupes and honeydew fruit counts were also made at harvest by counting all fruit in each plot. Both locations had a commercial picking crew go through the plots before a complete yield determination could be made. Cantaloupe yields were estimated by sizing ripe fruit (slipped off the vine) on two harvests. The honeydew site was

commercially picked before any yields were measured. I attempted to estimate yield based on the number of fruit remaining in the plots as compared to the total fruit count I had made before harvest.

Results

Weed pressure was much higher at the cantaloupe trial. Main weeds at this location were field bindweed, redroot pigweed, nightshade, and volunteer wheat and tomatoes. Crop emergence in some parts of this field, including some of the test plots, was erratic and poor, and therefore sprinklers were used after transplanting to improve germination. Some of the Sandea PRE treatments (#2 and #3) at this location had insufficient plants to estimate yield, which increased variability and reduced the power of the statistical analysis. Marketable yield (fruit size of 12, 9, and 6) ranged from 340 boxes/A for treatment 8 to 603 boxes/A in the untreated control (UTC), but this difference was not significant. No significant differences were found for any size class in the cantaloupe trial (Table 2).

Weed and crop phytotoxicity ratings for the cantaloupe trial are shown in Table 3. None of the treatments significantly reduced the number of broadleaf or grassy weeds on either evaluation date as compared to the untreated control, though the weed ratings were slightly less in the POST treatment combinations. Symptoms of crop phytotoxicity were significantly greater in the treatments that received POST applications of herbicides, especially on the second evaluation date on September 13 (Figure 1). Symptoms included spotting and chlorosis, but there was no discernable difference between the type of adjuvant used. Clethodim, which was applied over-the-top, had the most phyto after application, but by September 28, most symptoms were no longer visible, and no affect on fruit shape was observed.

There were almost no weeds at the honeydew location until after the first irrigation. Main weeds were redroot pigweed, Venice Mallow, Malva, stinging nettle, nightshade, and volunteer wheat. Broadleaf weeds at the honeydew location were significantly decreased with the POST Sandea + clethodim treatments; grassy weeds were reduced but not to the extent of the broadleaf weeds (Table 4). As at the cantaloupe trial, pre emergence applications of Sandea did not significant effect weed control, probably because the material was not water incorporated immediately after application.

Some crop phytotoxicity was noted following the POST applications as a result of spray drift. Symptoms included spotting, chlorosis, and marginal necrosis, and were significantly greater in treatments 4 (clethodim applied over-the-top), 5, 6, 7, and 8 (Figures 2 and 3). Unlike the cantaloupe trial, by September 28, symptoms were still visible, especially where MSO and NIS adjuvants were used (Figure 4), and some honeydew plants appeared stunted.

Yield impacts and fruit size evaluations were planned but could not be done as the field crew accidentally harvested the plots before the trial was completed. No significant difference in the number of fruit per plot occurred. Based on the number of fruit left unpicked, estimated yield for this trial was 440 boxes/A.

At both locations, the severity of crop phytotoxicity was reduced when Sandea and clethodim were applied with no adjuvants. In the honeydew trial, weed pressure was significantly reduced as compared to the untreated control or the pre emergent applications of Sandea. Additional research is needed to refine this tankmix combination for melon production in central California.

Acknowledements.

Many thanks to Mr. Dan Burns and Mr. Jim Vincent for their help and cooperation in these trials. This research was made possible through the generous support of the California Melon Research Board.

Table 2. Cantaloupe yield as affected by herbicide treatment, Firebaugh location 2016.

	40 lb boxes per acre						size 6-9-12		
Treatments:	23	18	15	12	9	6	Total yld	TMY	small %
1 UTC	40.2	133.1	250.5	340.3	199.7	63.5	1027.3	603.5	39.4%
2 0.5 oz/A Sandea PRE	14.2	42.4	217.8	281.3	217.8	36.3	809.8	535.4	25.9%
3 1.0 oz/A Sandea PRE	28.4	217.8	508.2	272.3	96.8	0.0	1123.5	369.1	67.2%
4 Clethodim 2E 8 oz/A + COC 1% v/v POST	78.1	181.5	268.6	195.1	157.3	9.1	889.7	361.5	57.9%
5 Sandea 1 oz/A + 0.25 % v/v NIS post directed	33.1	115.0	228.7	258.6	217.8	81.7	934.9	558.1	36.9%
6 Clethodim 8 oz/A + Sandea 1.0 oz/A + COC 1% v/v post directed	40.2	166.4	326.7	276.8	121.0	9.1	940.2	406.9	57.3%
7 Clethodim 8 oz/A + Sandea 1.0 oz/A + MSO 1% v/v post directed	66.3	175.5	246.8	213.3	236.0	9.1	946.9	458.3	52.7%
8 Clethodim 8 oz/A + Sandea 1.0 oz/A + NIS 0.25% v/v post directed	73.4	181.5	388.4	213.3	127.1	0.0	983.6	340.3	66.4%
9 Sandea 1 oz/A + 0.25 % v/v NIS post directed, before 1st irrigation	61.6	242.0	442.9	213.3	151.3	0.0	1110.9	364.5	68.1%
10 Clethodim 8 oz/A + Sandea 1.0 oz/A, post directed no adjuvant	41.0	367.0	493.7	260.2	177.5	24.2	1363.6	461.8	67.8%
Average	51.5	182.2	337.2	252.4	170.2	23.3	1013.0	445.9	54.0%
LSD 0.05	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV %	81.7	57.5	40.8	50.0	80.0	169	26.2	49.0	35.6

TMY = total marketable yield of 6, 9, and 12 sized fruit.

%small = percentage of fruit smaller than 12

LSD 0.05 = Least significant difference at the 95% confidence level. NS = not significant.

CV = coefficient of variation

Table 3. Scores for crop phytotoxicity, broadleaf (BL) weeds, grass weeds, and fruit counts as affected by herbicide treatment at the Firebaugh location, 2016.

	12-Aug 0 - 5 scale				9/13/16 0 - 5 scale			9/28/16 0 - 5 scale			
Treatments:	Crop Phyto	BL Weeds	Grass weeds	plant #	Crop Phyto	BL Weeds	Grass weeds	Crop Phyto	BL Weeds	Grass weeds	Fruit #
1 UTC	0.0	2.5	0.3	17.0	0.5	2.3	0.8	0.0	3.3	1.3	73.5
2 0.5 oz/A Sandea PRE	0.0	1.8	0.0	15.3	0.0	2.0	1.0	0.0	2.8	1.5	70.0
3 1.0 oz/A Sandea PRE	0.0	1.3	0.5	11.5	0.5	1.5	1.5	0.0	2.0	2.0	88.0
4 Clethodim 2E 8 oz/A + COC 1% v/v POST					2.5	1.5	1.5	0.3	2.3	1.5	65.3
5 Sandea 1 oz/A + 0.25 % v/v NIS post directed					1.5	1.8	1.3	0.8	3.0	1.0	61.0
6 Clethodim 8 oz/A + Sandea 1.0 oz/A + COC 1% v/v post directed					2.3	2.3	1.5	1.0	3.0	1.3	62.5
7 Clethodim 8 oz/A + Sandea 1.0 oz/A + MSO 1% v/v post directed					1.5	1.8	1.3	1.0	2.5	1.0	66.5
8 Clethodim 8 oz/A + Sandea 1.0 oz/A + NIS 0.25% v/v post directed					2.3	2.3	1.3	1.0	2.8	1.3	74.0
9 Sandea 1 oz/A + 0.25 % v/v NIS post directed, before 1st irrigation					0.5	1.5	0.8	0.3	2.3	1.0	80.8
10 Clethodim 8 oz/A + Sandea 1.0 oz/A, post directed no adjuvant					1.5	1.5	1.3	0.0	3.0	1.0	---
Average	0	1.8	0.3	14.6	1.3	1.8	1.2	0.4	2.7	1.3	71.3
LSD 0.05	---	ns	ns	ns	1.2	ns	ns	0.7	ns	ns	---
CV %	---	55.3	159	44.8	62.3	48.9	59.4	112.5	37.6	46.2	---

On Aug 12, POST application treatments had not been applied.

Ratings scale: 0 = no weeds/no phyto, 1 = <10%, 2 = <25%, 3 = < 50%, 4 = <75%, and 5 = >90% weeds or phyto

LSD 0.05 = Least significant difference at the 95% confidence level. NS = not significant.

CV = coefficient of variation

Table 4. Crop phyto, weed control, and honeydew fruit production and estimated yield, Dos Palos 2016.

		9/6/16	0 - 5 scale		9/28/16	0 - 5 scale		estimated yield per plot 46% uncut				80% pack
	Treatment	Crop Phyto	BL Weeds	Grass weeds	Crop Phyto	BL Weeds	Grass weeds	Fruit #	@ 3.42 lbs	@ 5 lbs	total lbs	cartons/A
1	UTC	0.0	0.5	0.8	0.0	2.3	1.8	30.3	47.6	81.7	129.3	474.1
2	0.5 oz/A Sandea PRE	0.0	0.5	1.3	0.3	1.5	2.8	30.8	48.4	83.0	131.4	482.0
3	1.0 oz/A Sandea PRE	0.0	0.5	1.0	0.0	2.3	2.0	29.3	46.0	79.0	125.0	458.5
4	Clethodim 2E 8 oz/A + COC 1% v/v POST	1.8	0.3	0.8	0.8	2.0	1.3	27.0	42.5	72.9	115.4	423.2
5	Sandea 1 oz/A + 0.25 % v/v NIS post directed	0.5	0.0	1.0	1.3	1.0	1.8	26.3	41.3	70.9	112.2	411.4
6	Clethodim 8 oz/A + Sandea 1.0 oz/A + COC 1% v/v post directed	0.3	0.3	1.3	0.3	0.8	1.5	29.0	45.6	78.3	123.9	454.5
7	Clethodim 8 oz/A + Sandea 1.0 oz/A + MSO 1% v/v post directed	0.5	0.0	0.8	1.5	1.0	1.0	26.5	41.7	71.6	113.2	415.4
8	Clethodim 8 oz/A + Sandea 1.0 oz/A + NIS 0.25% v/v post directed	0.8	0.0	1.3	1.3	0.3	1.3	24.5	38.5	66.2	104.7	384.0
9	Sandea 1 oz/A + 0.25 % v/v NIS post directed, before 1st irrigation	0.0	0.5	0.8	0.0	1.5	2.3	29.3	46.0	79.0	125.0	458.5
10	Clethodim 8 oz/A + Sandea 1.0 oz/A, post directed no adjuvant	0.3	0.0	0.5	0.5	0.8	0.5	---	---	---	---	---
	Average	0.4	0.3	0.9	0.6	1.3	1.6	28.1	44.2	75.8	120.0	440.2
	LSD 0.05	0.61	ns	ns	0.8	1.1	ns	ns	---	---	---	---
	CV %	105	182	58.6	96.8	57.1	57.1	11.5	---	---	---	---

Ratings scale: 0 = no weeds/no phyto, 1 = <10%, 2 = <25%, 3 = < 50%, 4 = <75%, and 5 = >90% weeds or phyto

LSD 0.05 = Least significant difference at the 95% confidence level. NS = not significant.

CV = coefficient of variation

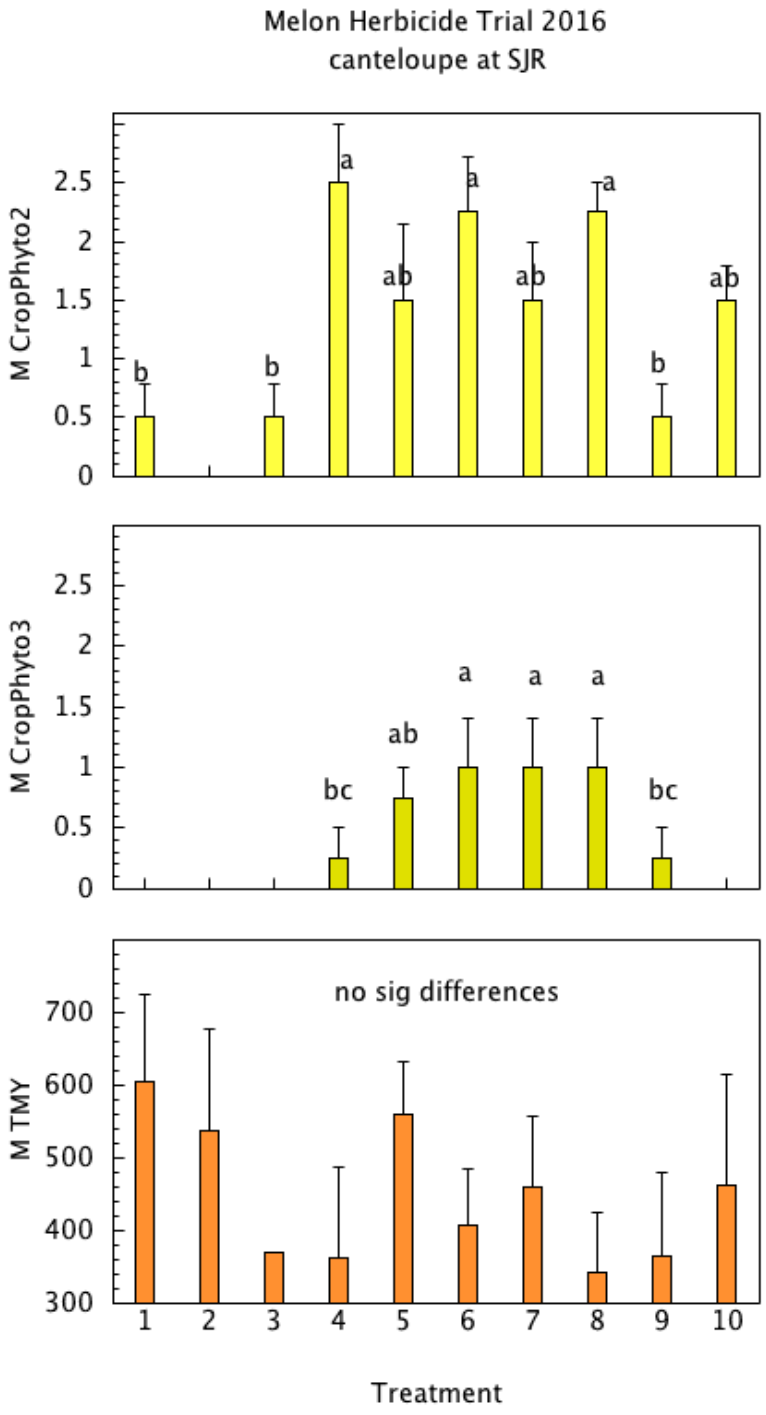

Figure 1. Cantaloupe phytotoxicity ratings (0-5 scale) on Sept 13 and 28 (top, center), and total marketable yield (TMY), in boxes per acre (bottom).

Figure 2. Treatment 4. Clethodim + COC.

Figure 3. Treatment 8. Clethodim + Sandea + NIS.

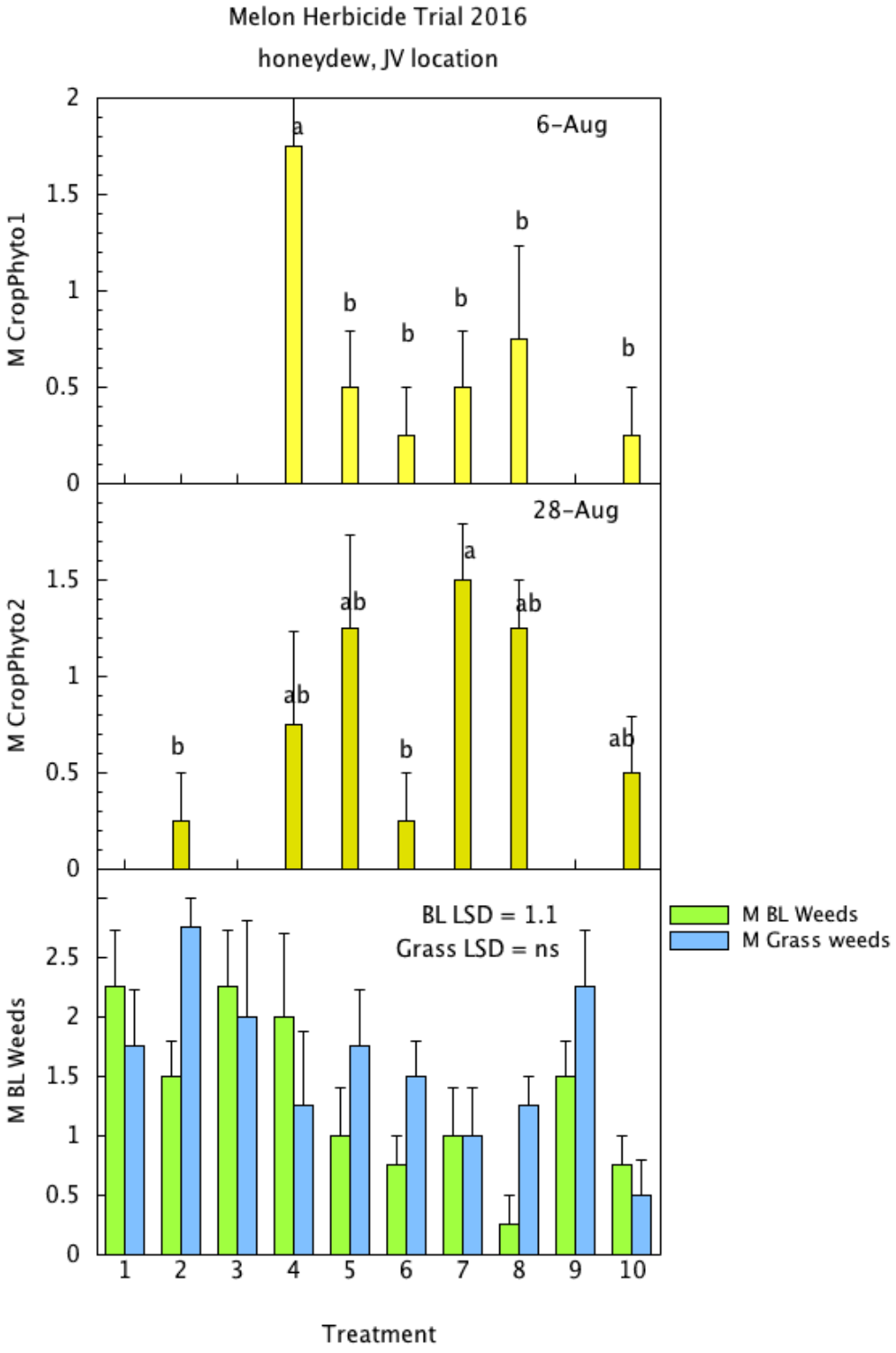

Figure 4. Honeydew crop phytotoxicity ratings (0-5 scale) on September 6 and 28 (top, middle), and broadleaf (BL) and grass weed control ratings on Sept 28, 2016 (bottom).