Project Title: Crop Safety of Over-the-Top Herbicide Application in Ornamental Crops
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Product tested: Fiesta (Fe HEDTA)
Test System/Crops:
Container nursery, outdoor at UC South Coast Research and Extension Center, Irvine, CA
All crops grown in #12 containers ("gallon") in Sunshine #4 media and overhead irrigation

Crops:

Agapanthus 'Blue Yonder'	72 size tray ~3/4"	transplanted	4/12/16
Liriope spicata 'Silver Dragon'	72 size tray ~3/4"	transplanted	5/4/16
Sedum 'Touchdown Flame'	72 size tray ~3/4"	transplanted	4/29/16
Sedum spathulifolium 'Cape Blanco'	72 size tray ~3/4"	transplanted	4/29/16
Lavendula stoechas 'Otto quast' Spanish Lavender	72 size tray ~3/4"	transplanted	5/4/16
Festuca glauca 'Elijah Blue'	48 plant flat	transplanted	7/30/2016

All plants actively growing

Application:
40 PSI 8004E TeeJet nozzle CO2 backpack sprayer
Unless indicated differently all applications were applied at 50gpa
All tests except for F. glauca and the interval tests were organized in a completely randomized design (CRD) with 4 replications and 3 subsamples per treatment per rep. F. glauca tests were conducted in a CRD with 8 or 10 replications. Interval tests were conducted in a CRD with 4 replications without subsamples.
1/2"overhead irrigation applied approximately 18 hours after each application followed by 1/8" daily

Three studies were conducted for all but F. glauca. These were:

- Timing (1, 2, or 3 applications; 2 or 3 weeks apart) applied at 25.2 oz/1000ft2 in 50 gpa spray volume

1app	5/27/2016		
2app2weeks	5/27/2016	6/12/2016	
2app3weeks	5/27/2016	6/18/2026	
3app2weeks	5/27/2016	6/12/2016	6/26/2016
3app3weeks	5/27/2016	6/18/2026	7/8/2016

- Product rate (12.6, 25.2, 50, 100 oz/1000ft2, applied 3 times, ~2 weeks apart)
- Spray volume (25.2 oz/1000ft2 in 25, 50, 100, 200 gallons per acre (gpa) applied 3 times, ~2 weeks apart)
    - Appropriate spray volume was achieved by changing Fiesta concentration and speed

F. glauca was tested in two studies at:

- 3 product rates (12.6, 25.2, 50 oz/1000ft2 in 50 gpa, applied 2 times, 36 days apart (8/5/16 and 9/10/16)
- applied up to 3 times at ~2 week intervals (25.2 oz/1000ft2 in 50 gpa) (8/5/16, 8/30/16, 9/16/16)

Evaluation

Plant injury per the rating scale provided in PR B00102 was used. Injury was considered unacceptable when it approached 3 or above. Overall weed control was also estimated at some evaluation dates. Plant injury and weed control was evaluated in relation to untreated controls. Weed counts by species were also done at the later evaluation dates. Only weed control for annual sowthistle was evaluated for F. glauca as no other weed species were growing in those pots. Plant heights and widths are reported in cm.
Data were evaluated using ARM 9 and transformed as needed to conduct the analysis of variance. Means were separated using Fisher's Protected LSD at P=0.05.

Results

F. glauca

Rate: F. glauca appears to be very tolerant of Fe HEDTA. While there was slight increase in injury with increasing rates, there were generally no significant differences among rates and any injury observed was acceptable. Heights and widths do not appear to be affected by the treatments. Annual sowthistle control was good to excellent at all rates.

Timing: F. glauca appears to be very tolerant of multiple applications of Fe HEDTA with little injury even after 3 applications. However, there was little to no annual sowthistle control at 24 days after the second application. Then applied 3 times, annual sowthistle control was excellent for at least 15 days (last evaluation date).

Summary: F. glauca is tolerant of Fe HEDTA at rates up to at least 50 oz/1000ft2. Multiple applications of Fe HEDTA at 25.2 oz/1000ft2 are also well tolerated and should be applied at 2 week intervals to suppress annual sowthistle.

Other crops:

A. Timing (1, 2, or 3 applications; 2 or 3 weeks apart) applied at 25.2 oz/1000ft2 in 50 gpa spray volume

1app	5/27/2016		
2app2weeks	5/27/2016	6/12/2016	
2app3weeks	5/27/2016	6/18/2026	
3app2weeks	5/27/2016	6/12/2016	6/26/2016
3app3weeks	5/27/2016	6/18/2026	7/8/2016

Crop	Injury	Weeds
Agapanthus	Although there were statistically no significant difference among treatments, injury appeared to be higher, exceeding the acceptable range, when applied 3 times 2 weeks apart. Applying 3 weeks apart seems to give the plant more time to recover although injury was still apparent.	Insufficient natural weed population to draw a conclusion
Lavendula	Although there were statistically no significant difference among treatments, injury appeared to be higher, exceeding the acceptable range, when applied 2 weeks apart. Applying 3 weeks apart seems to give the plant more time to recover although injury was	Insufficient natural weed population to draw a conclusion

	still apparent. Note: plants in the 3app/2weeks group exhibited more injury than others at first 2 evaluation dates even though all plants were only treated once.	
Liriope	Although there were statistically no significant difference among treatments, injury appeared to be consistently higher, exceeding the acceptable range, when applied 3 time 3 weeks apart. This treatment also had the least growth by the end of the study.	Insufficient natural weed population to draw a conclusion
Sedum 'Cape Blanco'	Although there were statistically no significant difference among treatments, injury appeared to increase slightly over time and there was a trend for the applications applied 2 weeks apart to injure the plant slightly more. 3 applications applied 2 weeks apart had the most injury.	All treatments reduced the number of sowthistle plants. There was insufficient natural weed population of other species to draw a conclusion
Sedum 'Touchdown Flame'	This species was highly injured by all treatments. Plants that were treated 2 weeks apart were the most injured. Although plants showed some recovery over time, the initial injury was so great that Fe HEDTA should not be used.	All treatments reduced the number of sowthistle plants. There was insufficient natural weed population of other species to draw a conclusion

B. Product rate (12.6, 25.2, 50, 100 oz/1000ft2, applied 3 times, ~2 weeks apart, 5/27/2016, 6/13/2016, and 6/25/2016)

Crop	Injury	Weeds
Agapanthus	Although there were statistically no significant difference among treatments, Agapanthus did exhibit low to moderate injury. Plants treated with the lowest rate showed the most injury and it is unclear why that occurred. There was not a strong trend of increasing injury with rate.	Initial weed control was moderate to good, with a trend towards improved control with increasing rates. Annual sowthistle and cudweed were controlled at the 25.2 oz and higher rates. There was insufficient natural weed population to draw a conclusion about other weed species.
Lavendula	The highest rate (100 oz) caused unacceptable injury within 3 days of application and this continued through the trial with each subsequent application causing higher injury. The 50 oz rate also caused unacceptable injury within 2 weeks of the 2nd and 3rd treatments and in final size. The plants tolerated the	All treatments reduced the number of sowthistle plants. There was insufficient natural weed population to draw a conclusion about other

	lower 2 rates better both in having an acceptable level of injury and final plant heights and widths.	weed species.
Liriope	While there was initially low injury, by 15 days after the 1st application, injury was unacceptable at all rates. There was slight recovery between treatments. The 100oz rate consistently had the most injury and smallest plant size but even the lower rates showed low to moderate injury at most evaluation dates.	The number of prostrate spurge was reduced by all treatments but there were insufficient natural weed populations of other species to draw a conclusion.
Sedum 'Cape Blanco'	Plants were slightly injured by 100oz rate at 3 and 7 days after the 1st treatment but injury increased to unacceptable by 15 days and injury at all rates reached unacceptable levels after the 2nd application, recovering only slightly by 15 days after the 3rd application. Plant size was unaffected 21 days after the 3rd application.	All treatments reduced the number of sowthistle plants with a trend for lower numbers with increasing rate. There was insufficient natural weed population of other species to draw a conclusion
Sedum 'Touchdown Flame'	This species was highly injured by all treatments within 3 days after the 1st application. There was some recovery by 15 days, it was still in the unacceptable range. The 2nd application caused more injury but plants treated at the lowest (12.6 oz) rate seemed to tolerate the 2nd application better. Although plants may recover over time, the injury is so great that Fe HEDTA should not be used.	Insufficient natural weed population to draw a conclusion although there was a trend for the number of sowthistle plants to be reduced with increasing rate.

Summary: Cape blanco sedum can tolerate low rates of Fe HEDTA but higher rates and reapplication caused unacceptable injury. Touchdown Flame sedum was not tolerant to any rate of Fe HEDTA but did recover slightly between applications. Lirope, Agapanthus, and Lavendula showed some tolerance to Fe HEDTA at lowest rate but multiple applications within 2 weeks of each other and higher rates were likely to cause unacceptable levels of crop injury.

C. Spray volume (25.2 oz/1000ft2 in 25, 50, 100, 200 gallons per acre (gpa) applied 3 times, ~2 weeks apart, 5/27/2016, 6/13/2016, and 6/25/2016)

Appropriate spray volume was achieved by changing Fiesta concentration and speed

Crop	Injury	Weeds
Agapanthus	Although there were statistically no significant difference among treatments, Agapanthus did exhibit moderate injury by 15 days after the 1st application at all volumes. Over time, injury appeared to be higher with lower volumes.	Initial weed control was greater with increasing volume. All treatments reduced the number of sowthistle plants. There was insufficient natural weed population to draw a conclusion about other weed species.

Lavendula	There was unacceptable injury at 25gpa at all evaluation dates. The 50gpa rate appeared to be the safest after one application but injury increased to unacceptable levels, as did all the other volumes after the second application. Plant size was influenced by volume with the both height and width decreasing with lower application volumes.	There was insufficient natural weed population to draw a conclusion.
Liriope	Injury was low to moderate at all volumes by 7 days after application but was unacceptable by 15 days. A similar trend was observed after the 2nd application. All treatments caused similar moderate levels of injury after the 3rd application. Plant heights and widths were not affected by any volume.	The number of prostrate spurge, northern willowherb, and annual sowthistle was reduced by all treatments and there lower volumes had less number of plants. There were Insufficient natural weed populations of other species to draw a conclusion.
Sedum 'Cape Blanco'	Injury was low to moderate at all volumes by 7 days after application but was unacceptable by 15 days at 25 and 100gpa rate and moderate at the 200gpa rate. By 12 days after the 2nd application and all subsequent evaluation dates, injury was unacceptable at all volumes although plant size was not affected.	The number of prostrate spurge and annual sowthistle plants was reduced by all treatments but there was not clear trend related to volume.. There were Insufficient natural weed populations of other species to draw a conclusion.
Sedum 'Touchdown Flame'	This species was highly injured by all treatments within 3 days after the 1st application. The 50gpa rate was the least injurious overall but there was still moderate to unacceptable injury at most evaluation dates. There was some recovery between applications but it was still generally in the unacceptable range. Plant height and width was smaller than the untreated control at all volumes except 50gpa.	Insufficient natural weed population to draw a conclusion.

Summary: 50gpa spray volume appears to be safest volume for crops tested and in some cases lower volumes caused more injury. Alternatively, higher volumes may provide better weed control. Multiple applications ~2 weeks apart increased injury. Should consider increasing time between applications when possible to give crop chance to recover.

Weather Data (Agapanthus, Lavendula, Lirope, sedums)

Date	Precip (mm)	Max Air Temp (C)	Min Air Temp (C)	Avg Air Temp (C)	Max Rel Hum (%)	Min Rel Hum (%)	Avg Rel Hum (%)
5/27/2016	0	23.1	13.6	17.7	97	56	73
5/28/2016	0	22.7	15.1	17.4	84	60	75
5/29/2016	0	22.2	14	17.4	99	59	74
5/30/2016	0	23.3	13	17.8	94	56	73
5/31/2016	0	22.7	13.1	17.4	92	64	80
6/1/2016	0	23.7	14.9	18.3	100	62	80
6/2/2016	0	28.5	14.5	21.2	95	49	68
6/3/2016	0	32.2	14.7	21.3	100	37	70
6/4/2016	0	27.1	13.4	19.8	100	52	75
6/5/2016	0	22.7	13.5	17.7	100	60	80
6/6/2016	0	24.1	14.2	17.9	98	56	77
6/7/2016	0	24.3	16.3	18.8	82	57	73
6/8/2016	0	25.8	15.3	19.3	98	59	77
6/9/2016	0	23.7	16.5	18.9	88	64	79
6/10/2016	0	25.3	15.3	19.1	100	57	77
6/11/2016	0	19.6	16.1	17.6	95	70	79
6/12/2016	0	21	14.7	17.2	100	60	75
6/13/2016	0	22.8	13.7	17.7	100	58	73
6/14/2016	0	21.7	15.1	17.4	87	67	79
6/15/2016	0	23.1	14.1	18.2	91	54	70
6/16/2016	0	25.3	11.7	18.8	89	40	61
6/17/2016	0	29.8	12.8	21.3	89	25	48
6/18/2016	0	33.2	13.3	23.9	83	25	44
6/19/2016	0		15.3		83	21	
6/20/2016	0		18.5		75	23	
6/21/2016	0	30.2	17	23.9	80	35	54
6/22/2016	0	29.9	15.3	21.8	93	40	67
6/23/2016	0	27	18	21.5	87	54	70
6/24/2016	0	26	16.7	20.4	98	56	75
6/25/2016	0	26.4	16.4	20.5	99	57	75
6/26/2016	0	29.2	15.1	21.5	99	54	74
6/27/2016	0	32.5	17.1	23.2	98	43	71
6/28/2016	0	30.3	17.2	23.1	95	48	71
6/29/2016	0	29.7	18.4	22.8	100	50	73
6/30/2016	0	27.6	19	22.2	86	57	73
7/1/2016	0	26.4	17.4	20.8	100	57	75
7/2/2016	0	26.2	15.3	19.8	100	55	72
7/3/2016	0	24.7	15.2	19.5	100	57	73

7/4/2016	0	25.8	15.4	20	100	53	72
7/5/2016	0	26.2	15.9	20.7	100	51	69
7/6/2016	0	25.5	16.3	20.7	100	56	72

Weather Data (Festuca)

Date	Precip (mm)	Max Air Temp (C)	Min Air Temp (C)	Avg Air Temp (C)	Max Rel Hum (%)	Min Rel Hum (%)	Avg Rel Hum (%)
8/5/2016	0	26.5	19.3	22	92	58	76
8/6/2016	0	27.8	18.2	21.8	100	58	77
8/7/2016	0	27.6	18.1	22.1	100	56	75
8/8/2016	0	26.7	17.9	21.3	100	62	80
8/9/2016	0	26.6	16.1	21.2	100	52	72
8/10/2016	0	27.8	15	21	100	45	71
8/11/2016	0	26.6	16.3	21.3	85	52	68
8/12/2016	0	28.4	16.9	22	100	53	73
8/13/2016	0	31.1	16.6	23.4	100	43	68
8/14/2016	0	32.7	17	24.3	100	38	67
8/15/2016	0	35.4	16.3	24.9	100	23	59
8/16/2016	0	33.5	13.1	22.4	100	32	63
8/17/2016	0	31.7	12.6	21.9	100	29	60
8/18/2016	0	29.8	14.3	21.3	100	42	68
8/19/2016	0	29.7	14.3	21	100	43	71
8/20/2016	0	27.6	14.6	20.6	100	50	74
8/21/2016	0	29.7	15	21.5	100	43	70
8/22/2016	0	28.4	15.1	21	100	46	74
8/23/2016	0	28.9	15.1	21.2	100	49	73
8/24/2016	0	28.7	16.2	21.3	100	49	73
8/25/2016	0	26.6	16.5	20.7	96	55	74
8/26/2016	0	24.8	15.4	19.5	100	53	73
8/27/2016	0	25.4	15.5	20	99	54	72
8/28/2016	0	29.1	14.7	21.1	100	51	72
8/29/2016	0	30	15.3	22.2	100	48	70
8/30/2016	0	32.1	17.4	23.2	100	44	73
8/31/2016	0	30.9	17	22.8	100	50	75
9/1/2016	0	28.5	16.8	21.2	100	57	79
9/2/2016	0	26.5	16.4	20.7	100	55	74
9/3/2016	0	24.4	15.5	19.5	99	53	71
9/4/2016	0	24.7	14.7	19.7	92	46	66
9/5/2016	0	23.9	14.9	19.7	94	52	68
9/6/2016	0	26.9	15.7	20.6	100	51	71
9/7/2016	0	26.4	14.1	19.8	100	59	79

9/8/2016	0	25.6	15.9	20.9	89	55	69
9/9/2016	0	27.5	14.7	20.3	93	52	73
9/10/2016	0	28.3	13.4	20.2	100	48	76
9/11/2016	0	27.1	15.1	20	100	52	77
9/12/2016	0	23.6	15.3	19	100	60	71
9/13/2016	0	21.3	14.1	18	96	62	73
9/14/2016	0	24.7	12.3	18	95	46	68
9/15/2016	0	26	11.9	18.6	88	41	63
9/16/2016	0	26.4	11.6	18.2	100	45	72
9/17/2016	0	28.5	12.5	19.7	100	46	70
9/18/2016	0	31.6	11.6	20.6	100	41	74
9/19/2016	0	32.7	15.1	22.2	99	37	67
9/20/2016	0	27.9	17.1	23.1	99	46	70
9/21/2016	0	28.9	18.6	23	97	58	75
9/22/2016	0	24.5	15.4	19.8	93	38	68
9/23/2016	0	25.2	11.9	18.6	100	35	57
9/24/2016	0	30.3	11	21.3	89	23	41
9/25/2016	0	37.8	11.6	26.2	86	6	
9/26/2016	0	39.7	14.2	28.9	75	10	
9/27/2016	0	34.7	14.9	27	77	19	31
9/28/2016	0	32.5	14.9	24.4	91	27	43
9/29/2016	0	32.3	17.4	24	79	33	51
9/30/2016	0	31.2	15.6	22.6	100	34	59
10/1/2016	0	30.7	14.9	20.9	100	29	64
10/2/2016	0	24.6	13.9	19.1	96	47	72
10/3/2016	0	23.6	12.3	17.6	95	42	66
10/4/2016	0	24.2	13.5	18.4	97	53	72
10/5/2016	0	23.7	13.1	17.6	99	50	74
10/6/2016	0	28	10.9	18.9	96	40	67
10/7/2016	0	31.9	11.7	20.7	100	14	45
10/8/2016	0	31.2	9	20.8	82	17	34
10/9/2016	0	32.3	9.6	21.6	81	16	34
10/10/2016	0	30	11.2	20	95	34	58
10/11/2016	0	22	12.3	16.9	100	61	83
10/12/2016	0	21.7	11.8	15.8	100	61	82
10/13/2016	0	24.6	10	16.4	99	53	78
10/14/2016	0	24.2	11.7	16.2	100	56	86