

Project Number: 13K-3419-3298

Title: Herbicide Combinations for Weed Control in Ornamental Bulbs

Personnel: Timothy W. Miller, WSU Mount Vernon NWREC
Carl R. Libbey, WSU Mount Vernon NWREC

Reporting Period: 2010-11

Accomplishments: Two projects were conducted from fall 2009 through summer 2010: the full herbicide combination trial at WSU Mount Vernon NWREC and the partial trial at WSU Puyallup. The focus of the trial is to test the effects of several herbicide combinations in ornamental bulb crops.

Mount Vernon. Bulbs were planted at WSU Mount Vernon NWREC September 15, 2009. Herbicides were applied December 3, 2009; some iris were emerged at the time of application. Roundup at 2 pt/a was applied to all plots (including those plots not otherwise treated) to control emerged weeds. Percent weed control was evaluated January 22, March 6, April 13, and May 19, 2010. Flowers were counted and stem length of five random blooms were measured (daffodil, March 17; tulip, April 5; and iris, May 7, 2010). Bulbs were dug June 28, July 7, and July 6, 2010 for tulip, iris, and daffodil, respectively, and then were cleaned, sized, counted, and weighed. The trial was a split-plot randomized complete block with four replicates.

Weed control through early March (weed control evaluations 1 and 2) was excellent, with control in all plots ranging from 91 to 100 (Table 1). By April (weed control evaluation 3), weed control had fallen off in Roundup check plots to 79%, although nearly every herbicide treatment with the exception of Pendulum Aquacap at 4 pt/a providing >90% control. By May (weed control evaluation 4), only Surflan at 3 pt/a and combination treatments and were still providing >90% weed control. Four of the five combination treatments providing the best weed control also included Surflan at 1.5 pt/a (Surflan mixed with Callisto, Devrinol, Pennant Magnum, or with a combination of Devrinol and Pennant Magnum); the fifth combination with >90% weed control was Callisto + Devrinol.

No treatments caused visible foliar injury to any bulb species. There were also no significant differences in bloom (Table 2) or bulb yield (Tables 3, 4, and 5) parameters caused by herbicide treatment.

Puyallup. Bulbs were planted at WSU Puyallup September 24, 2009. Herbicides were applied December 3, 2009; prior to the emergence of any bulb foliage. Roundup at 2 pt/a was applied to all plots (including those plots not otherwise treated) to control emerged weeds. Percent weed control was evaluated January 21, March 3, March 25, and May 5, 2010. Flowers were counted and stem length of five random blooms were measured (daffodil, March 25; tulip and iris, May 5, 2010). All bulbs were dug June 30, 2010 and then were cleaned, sized, counted, and weighed. The trial was a split-plot randomized complete block with four replicates.

Weed control was excellent and did not differ statistically through early March (weed control evaluations 1 and 2), ranging from 89 to 99% compared to Roundup check plots at 83% control by March (Table 1). By late March (weed control evaluation 3), weed control with Devrinol at 4 lb/a was 81%, significantly less than with Devrinol at 8 lb/a or Surflan at 3 pt/a (89 and 88%, respectively). By May (weed control evaluation 4), only the high rate of Surflan was still providing adequate weed control (88%), statistically equivalent to Devrinol at 8 lb/a (83%), compared to the Roundup-treated plots of 63% weed control.

No treatments caused visible foliar injury to any bulb species. There were also no significant differences in bloom (Table 2) or bulb yield (Tables 3, 4, and 5) parameters caused by herbicide treatment.

Product comparisons between Puyallup and Mount Vernon: Weed control in January was excellent at both locations. Weed control began to separate between the two sites by early March, however, with weed controls at Puyallup averaging 91% compared to 96% at Mount Vernon. These differences continued until the May evaluation, which were 82 and 87% in Puyallup and Mount Vernon, respectively. This difference is what one would expect, based on sandier soil at Puyallup compared to Mount Vernon (sandier soils normally have less herbicide adsorption, increasing the potential for leaching out of the weed zone). These differences could also be explained because the weed species differed between the two sites. Statistical comparisons between these two sites will be made later to determine the differential effects (if any) of the herbicides at the two sites.

Table 1. Weed control in ornamental bulbs (tulip, daffodil, and iris) after treatment with various herbicides (2009-10).

Treatment	Rate product/a	Weed control ^a			
		1 %	2 %	3 %	4 %
Puyallup					
Devrinol	4 lb	97 a	89 a	81 c	74 c
Devrinol	8 lb	99 a	93 a	89 a	83 ab
Surflan	1.5 pt	96 ab	90 a	84 bc	81 b
Surflan	3 pt	96 ab	93 a	88 ab	88 a
Roundup (check)	2 pt	93 b	83 b	73 d	63 d
Mount Vernon					
Callisto	5 floz	99 a-d	100 ab	93 def	69 fg
Callisto	8 floz	99 abc	99 abc	96 a-d	80 de
Devrinol	4 lb	95 f	94 def	91 ef	80 de
Devrinol	8 lb	96 ef	97 a-d	97 abc	86 bcd
Surflan	1.5 pt	97 c-f	96 b-e	95 b-e	85 bcd
Surflan	3 pt	96 ef	96 a-e	96 a-d	98 a
Pennant Magnum	2 pt	96 ef	91 f	90 f	66 fg
Pennant Magnum	2.5 pt	96 def	95 c-f	93 def	71 ef
Pendulum Aquacap	4 pt	97 b-f	96 a-e	84 g	49 h
Pendulum Aquacap	6 pt	95 f	96 a-e	91 ef	60 g
Callisto + Devrinol	5 floz + 4 lb	100 ab	100 a	99 a	93 abc
Callisto + Surflan	5 floz + 1.5 pt	100 a	100 a	98 ab	95 ab
Callisto + Pennant Magnum	5 floz + 2 pt	100 ab	100 a	97 abc	86 bcd
Callisto + Pendulum Aquacap	5 floz + 4 pt	100 a	100 a	96 a-d	84 cd
Devrinol + Surflan	4 lb + 1.5 pt	97 c-f	96 a-e	97 abc	93 abc
Devrinol + Pennant Magnum	4 lb + 2 pt	97 c-f	95 c-f	94 c-f	86 bcd
Devrinol + Pendulum Aquacap	4 lb + 4 pt	95 f	93 ef	91 ef	80 de
Surflan + Pennant Magnum	1.5 pt + 2 pt	96 ef	96 a-e	96 a-d	94 abc
Devrinol + Surflan + Pennant Magnum	4 lb + 1.5 pt + 2 pt	96 ef	96 a-e	95 a-e	93 abc
Roundup (check)	2 pt	98 a-e	91 f	79 h	34 i

Means in the same column followed by the same letter are not significantly different ($P < 0.05$).

^aWeed Control 1 = January 21 (P) and January 22 (MV); Weed Control 2 = March 3 (P) and March 6 (MV); Weed Control 3 = March 25 (P) and April 13 (MV); Weed Control 4 = May 5 (P) and May 19 (MV).

Table 2. Flower number and flower stem length after treatment with various herbicides (2009-10).

Treatment	Rate product/a	Flower number ^a			Stem length ^b		
		Daffodil no./plot	Tulip no./plot	Iris no./plot	Daffodil inches	Tulip inches	Iris inches
Puyallup							
Devrinol	4 lb	24.3	27.5	18.3	15.7	13.9	12.7
Devrinol	8 lb	24.5	29.3	15.8	16.1	13.6	13.3
Surflan	1.5 pt	23.8	25.8	19.5	15.8	13.5	14.5
Surflan	3 pt	25.5	26.8	16.0	15.8	14.0	13.7
Roundup (check)	2 pt	25.8	26.0	17.0	16.3	13.7	12.3
Mount Vernon							
Callisto	5 floz	25.0	35.2	21.3	18.2	18.6	20.0
Callisto	8 floz	24.3	34.8	20.3	18.7	18.4	20.2
Devrinol	4 lb	24.3	35.8	18.5	18.1	18.7	19.8
Devrinol	8 lb	28.0	35.5	13.0	18.4	19.0	19.9
Surflan	1.5 pt	24.3	35.8	16.3	18.8	18.7	20.0
Surflan	3 pt	24.3	35.3	24.0	18.0	18.3	20.6
Pennant Magnum	2 pt	26.3	34.8	19.0	19.1	18.3	20.0
Pennant Magnum	2.5 pt	24.8	34.8	14.3	18.7	18.6	18.7
Pendulum Aquacap	4 pt	26.5	35.8	20.5	18.4	18.5	21.3
Pendulum Aquacap	6 pt	25.3	35.0	20.3	18.3	18.6	20.3
Callisto + Devrinol	5 floz + 4 lb	26.8	35.0	17.0	18.7	18.9	19.8
Callisto + Surflan	5 floz + 1.5 pt	27.5	34.5	17.3	18.5	18.6	19.0
Callisto + Pennant Magnum	5 floz + 2 pt	24.8	35.0	15.5	18.2	18.0	19.1
Callisto + Pendulum Aquacap	5 floz + 4 pt	26.3	34.8	21.5	17.5	18.7	19.5
Devrinol + Surflan	4 lb + 1.5 pt	24.3	35.5	15.0	18.7	18.7	19.1
Devrinol + Pennant Magnum	4 lb + 2 pt	24.8	35.5	16.8	18.3	17.9	19.7
Devrinol + Pendulum Aquacap	4 lb + 4 pt	24.8	35.8	22.8	18.8	18.9	19.6
Surflan + Pennant Magnum	1.5 pt + 2 pt	26.8	35.3	16.5	18.6	18.7	19.4
Devrinol + Surflan + Pennant Magnum	4 lb + 1.5 pt + 2 pt	26.8	34.3	19.3	18.3	18.1	21.2
Roundup (check)	2 pt	23.5	36.5	18.0	18.7	18.7	19.7

Means in the same column not followed by a letter are not significantly different ($P < 0.05$).

^aFlower number for daffodil = March 25 (P) and March 17 (MV), for tulip = May 5 (P) and April 5 (MV), and for iris = May 5 (P) and May 7 (MV).

^bFlower height for daffodil = March 25 (P) and March 17 (MV), for tulip = May 5 (P) and April 5 (MV), and for iris = May 5 (P) and May 7 (MV).

Table 3. Daffodil bulb number and weights after treatment with various herbicides (2009-10).

Treatment	Rate product/a	Total bulb number no./plot	Total bulb weight g/plot	Average bulb weight g/bulb
Puyallup				
Devrinol	4 lb	23.8	2398	101.8
Devrinol	8 lb	20.5	2322	115.1
Surflan	1.5 pt	19.8	2358	119.7
Surflan	3 pt	22.3	2538	114.5
Roundup (check)	2 pt	23.0	2487	108.6
Mount Vernon				
Callisto	5 floz	21.0	3094	147.5
Callisto	8 floz	18.3	2706	148.9
Devrinol	4 lb	19.0	2748	145.2
Devrinol	8 lb	21.0	3126	149.3
Surflan	1.5 pt	17.8	2989	168.8
Surflan	3 pt	19.3	2938	153.4
Pennant Magnum	2 pt	19.5	2943	151.3
Pennant Magnum	2.5 pt	19.3	2971	154.3
Pendulum Aquacap	4 pt	20.3	2858	141.3
Pendulum Aquacap	6 pt	19.0	2847	149.9
Callisto + Devrinol	5 floz + 4 lb	19.0	2701	143.1
Callisto + Surflan	5 floz + 1.5 pt	20.0	3048	152.8
Callisto + Pennant Magnum	5 floz + 2 pt	19.5	2912	149.0
Callisto + Pendulum Aquacap	5 floz + 4 pt	18.5	3014	164.0
Devrinol + Surflan	4 lb + 1.5 pt	21.0	2995	144.2
Devrinol + Pennant Magnum	4 lb + 2 pt	20.0	2919	146.1
Devrinol + Pendulum Aquacap	4 lb + 4 pt	18.75	2879	155.4
Surflan + Pennant Magnum	1.5 pt + 2 pt	20.8	3113	150.6
Devrinol + Surflan + Pennant Magnum	4 lb + 1.5 pt + 2 pt	19.0	2907	154.3
Roundup (check)	2 pt	20.8	3043	147.9

Means in the same column not followed by a letter are not significantly different ($P < 0.05$).

^aFlower number for daffodil = March 25 (P) and March 17 (MV), for tulip = May 5 (P) and April 5 (MV), and for iris = May 5 (P) and May 7 (MV).

^bFlower height for daffodil = March 25 (P) and March 17 (MV), for tulip = May 5 (P) and April 5 (MV), and for iris = May 5 (P) and May 7 (MV).

Table 4. Tulip bulb number and weights after treatment with various herbicides (2009-10).

Treatment	Rate product/a	Total bulb number no./plot	Total bulb weight g/plot	Average bulb weight g/bulb
Puyallup				
Devrinol	4 lb	93.0	923	9.9
Devrinol	8 lb	84.3	914	10.9
Surflan	1.5 pt	80.8	870	10.9
Surflan	3 pt	83.3	947	11.4
Roundup (check)	2 pt	81.3	842	10.3
Mount Vernon				
Callisto	5 floz	156.8	862	5.5
Callisto	8 floz	167.0	806	4.8
Devrinol	4 lb	154.5	700	4.5
Devrinol	8 lb	140.3	602	4.3
Surflan	1.5 pt	151.3	725	4.8
Surflan	3 pt	162.0	895	5.5
Pennant Magnum	2 pt	155.3	781	5.0
Pennant Magnum	2.5 pt	139.8	641	4.5
Pendulum Aquacap	4 pt	152.8	822	5.3
Pendulum Aquacap	6 pt	170.0	825	4.9
Callisto + Devrinol	5 floz + 4 lb	163.0	767	4.7
Callisto + Surflan	5 floz + 1.5 pt	153.5	659	4.3
Callisto + Pennant Magnum	5 floz + 2 pt	146.0	674	4.6
Callisto + Pendulum Aquacap	5 floz + 4 pt	162.5	822	4.9
Devrinol + Surflan	4 lb + 1.5 pt	159.0	654	4.2
Devrinol + Pennant Magnum	4 lb + 2 pt	141.5	599	4.2
Devrinol + Pendulum Aquacap	4 lb + 4 pt	156.8	795	5.1
Surflan + Pennant Magnum	1.5 pt + 2 pt	160.3	716	4.5
Devrinol + Surflan + Pennant Magnum	4 lb + 1.5 pt + 2 pt	158.3	823	5.0
Roundup (check)	2 pt	158.0	792	5.0

Means in the same column not followed by a letter are not significantly different ($P < 0.05$).

^aFlower number for daffodil = March 25 (P) and March 17 (MV), for tulip = May 5 (P) and April 5 (MV), and for iris = May 5 (P) and May 7 (MV).

^bFlower height for daffodil = March 25 (P) and March 17 (MV), for tulip = May 5 (P) and April 5 (MV), and for iris = May 5 (P) and May 7 (MV).

Table 5. Iris bulb number and weights after treatment with various herbicides (2009-10).

Treatment	Rate product/a	Total bulb number no./plot	Total bulb weight g/plot	Average bulb weight g/bulb
Puyallup				
Devrinol	4 lb	121.3	377	3.0
Devrinol	8 lb	119.8	377	3.1
Surflan	1.5 pt	132.3	419	3.2
Surflan	3 pt	115.5	344	3.0
Roundup (check)	2 pt	122.5	407	3.3
Mount Vernon				
Callisto	5 floz	129.0	1714	13.3
Callisto	8 floz	136.3	1720	12.6
Devrinol	4 lb	121.5	1591	13.1
Devrinol	8 lb	126.8	1663	13.1
Surflan	1.5 pt	127.8	1766	13.8
Surflan	3 pt	124.0	1715	13.8
Pennant Magnum	2 pt	117.5	1592	13.6
Pennant Magnum	2.5 pt	119.5	1676	14.0
Pendulum Aquacap	4 pt	130.0	1653	12.8
Pendulum Aquacap	6 pt	130.5	1711	13.1
Callisto + Devrinol	5 floz + 4 lb	121.8	1647	13.6
Callisto + Surflan	5 floz + 1.5 pt	123.3	1687	13.8
Callisto + Pennant Magnum	5 floz + 2 pt	126.3	1671	13.3
Callisto + Pendulum Aquacap	5 floz + 4 pt	119.5	1647	13.8
Devrinol + Surflan	4 lb + 1.5 pt	128.5	1743	13.6
Devrinol + Pennant Magnum	4 lb + 2 pt	124.3	1665	13.5
Devrinol + Pendulum Aquacap	4 lb + 4 pt	130.5	1736	13.3
Surflan + Pennant Magnum	1.5 pt + 2 pt	137.3	1662	12.1
Devrinol + Surflan + Pennant Magnum	4 lb + 1.5 pt + 2 pt	135.3	1672	12.4
Roundup (check)	2 pt	120.8	1677	13.9

Means in the same column not followed by a letter are not significantly different ($P < 0.05$).

^aFlower number for daffodil = March 25 (P) and March 17 (MV), for tulip = May 5 (P) and April 5 (MV), and for iris = May 5 (P) and May 7 (MV).

^bFlower height for daffodil = March 25 (P) and March 17 (MV), for tulip = May 5 (P) and April 5 (MV), and for iris = May 5 (P) and May 7 (MV).