

Weed control in ornamental bulbs (2000).

Tim Miller and Carl Libbey, WSU Mount Vernon.

Four studies were conducted in ornamental bulbs during 1999-2000: (1) bulb herbicide plant-back study, (2) nonselective, postemergence herbicide timing trial, (3) pea herbicide plant-back study, and (4) paraquat rate and timing study on 1st-year daffodils. Plant materials for all these studies were kindly donated by Washington Bulb Co., LeFeber Bulb Co., Skagit Valley Bulb Farm, and Hulbert Farms.

Materials and Methods.

Bulb herbicide plant-back study. Plots were established in the fall of 1999 (1999-2000 study) at WSU Mount Vernon. Visor, Prowl, Devrinol, diuron, Surflan, and Gallery herbicides (each mixed with 3 pints Roundup/acre) plus a Roundup-only check were applied preemergence to 'Negrita' tulip, 'Dutch Master' narcissus, and 'Blue Ribbon' iris. This was the second iteration of this study.

In the 1999-2000 study, weed control was evaluated March 30 and May 26, 2000. When the three bulb types were in bloom, the total number of blooms and 10 random flower heights were recorded. Narcissus, tulip, and iris bulbs were harvested in July and August and yield determined.

In the fall of 1999, tulips (cv. 'Blenda'), winter wheat, and cabbage seed plants were planted into the 1998-99 herbicide trial for the rotational crop phase of this study. In the spring, potato, green pea, cucumber and spinach seed were also planted. Weed control in these rotational crops were conventional herbicide programs typical for each crop. These rotational crops were monitored for injury from carryover of the herbicides used in ornamental bulbs applied in fall of 1998. Injury assessment was based on crop density, height, biomass, and/or yield.

Nonselective, postemergence herbicide timing study. Plots were established in the fall of 1999 at WSU Mount Vernon. Iris varieties were 'Blue Ribbon,' 'Polar Ice,' 'Blue Diamond,' and 'Telstar;' narcissus varieties were 'Standard Value,' 'Dutch Master,' and 'Ice Follies;' and tulip varieties were 'Negrita,' 'Merry Widow,' 'Ile de France,' and 'Apeldoorn.' Roundup, Touchdown, Finale, Aim, and Gramoxone was applied postemergence to bulbs at one of two timings (early and late), and an untreated check was also established. Iris and narcissus were sprayed February 11 and February 24, 2000; tulips were sprayed February 24 and March 6. Foliage injury was evaluated March 30, and the total number of blooms and height of six flowers were recorded when the three bulb types were in bloom. Narcissus, tulip, and iris bulbs were harvested in July and August and yield determined.

Pea herbicide plant-back study. Plots were established in the spring of 1999 in 'Charo' green peas at WSU Mount Vernon. Raptor, Prowl, Treflan, Command, and Spartan herbicides were applied either preplant incorporated or preemergence. Following pea harvest, plots were planted to 'Negrita' tulip and treated with preemergence Surflan + Devrinol + Roundup in the fall of 1999. The total number of blooms and heights of ten flowers were recorded in April, 2000. Bulbs were harvested in July and yield determined.

The statistical design for all field studies was a randomized complete block designs with four replicates.

Results.

Bulb herbicide plant-back study (Tables 1-3). Weed control through March 30 was excellent for all treatments, but most products failed to maintain that level of control through the spring. Visor and diuron continued to show excellent weed control through May 26, however (91 and 92%, respectively). Flower number and flower height was not reduced by any treatment. Most products did not significantly affect bulb yield except for Visor in tulip resulting in less total yield than in the Roundup-only treatment. Surflan in narcissus resulted in total bulb weights similar to those from the Roundup-only treatment, which were less than from any of the other products. These total bulb weights did not result in smaller bulbs, however, as none of the average bulb weights were significantly different.

There was only limited effects of these herbicides on rotational crops in the 1999-2000 growing season. The only significant response was in cucumber weights, and all were at least statistically equal to the Roundup-only treatment. It did appear, however, that Devrinol and diuron might have caused some reduction of cucumber weight when compared to the top yielding treatment (Gallery). The rotational iteration is being repeated during 2000-01.

Nonselective, postemergence herbicide timing study.

Tulip (Tables 6 and 7). Application of Roundup, Touchdown or Finale to tulips emerged to less than 1" was generally safe to foliage and did not significantly reduce total bulb number, total bulb weight, or average bulb weight. Flower number and flower height, however, were reduced at this timing with Roundup or Touchdown. Weed control was excellent with all treatments except for Aim.

Narcissuss (Tables 8 and 9). Application with Roundup or Touchdown applied to narcissus up to 6 inches tall or Finale up to 3" tall did not cause significant injury to foliage, flowers, or bulb yield parameters. As with tulips, weed control was excellent with all treatments except for Aim.

Iris (Tables 10 and 11). Application with Roundup or Touchdown applied to iris up to 6 inches tall did not cause significant injury to foliage, but application of Finale, Aim, and Gramoxone caused moderate to severe foliage burn to all iris 4 inches tall or more. Flower number was reduced by treatment with Roundup after irises were 4 inches tall; no other product resulted in reduction of flower number. Flower height was slightly reduced by most treatments applied to iris taller than 4 inches. None of these treatments, however, significantly reduced any bulb yield parameters. As with tulips, weed control was excellent with all treatments except for Aim.

Pea herbicide plant-back study (Table 12). None of the pea herbicides applied in 1999 significantly reduced flower number, flower height, total bulb number, total bulb weight, or average bulb weight of tulips grown during 1999-2000.

Table 1. Effect of herbicides on ornamental bulbs (1999-2000).

Treatments ^a	Rate	Weed control		Flower number			Flower height		
		3/30	5/26	Tulip	Narcissus	Iris	Tulip	Narcissus	Iris
	product/A	----- % -----		----- per plot -----			----- cm -----		
Visor	3 pt	93	91	52	102	9	35	35	37
Prowl	7.2 pt	98	75	63	106	11	36	36	45
Devrinol 2 lb		90	50	61	97	10	36	36	41
Diuron	4 lb	100	92	61	104	9	35	35	37
Surflan	3 pt	95	81	68	99	9	36	36	42
Gallery	10.7 oz	100	76	57	102	9	36	36	43
Untreated	—	55	0	66	98	7	38	35	42
LSD _{0.05}	—	11	15	ns	ns	ns	ns	ns	ns

^aAll treatments, including the check, were mixed with 3 pt/A Roundup Ultra.

Table 2. Effect of herbicides on ornamental bulbs (1999-2000).

Treatments ^a	Rate	Total bulb number			Total bulb weight			Average bulb weight		
		Tulip	Narcissus	Iris	Tulip	Narcissus	Iris	Tulip	Narcissus	Iris
	product/A	----- per plot -----			----- kg per plot -----			----- g -----		
Visor	3 pt	432	108	571	3.9	11.9	3.4	9.3	111.7	5.9
Prowl	7.2 pt	472	120	657	4.8	11.9	4.2	10.3	99.7	6.4
Devrinol 2 lb		500	107	634	4.9	11.3	3.9	9.9	105.7	6.1
Diuron	4 lb	509	97	700	4.6	11.1	4.4	9.0	113.9	6.3
Surflan	3 pt	516	99	673	5.2	9.5	4.3	10.1	96.6	6.4
Gallery	10.7 oz	494	102	626	4.5	11.6	4.0	9.1	115.5	6.3
Untreated	—	493	87	594	4.6	9.0	3.1	9.3	104.2	5.1
LSD _{0.05}	—	ns	ns	ns	0.3	1.3	ns	ns	ns	ns

^aAll treatments, including the check, were mixed with 3 pt/A Roundup Ultra.

Table 3. Effect of herbicides used in ornamental bulbs (1998) on rotational crops (1999-2000).

Treatments ^a	Rate	Potato weight	Pea yield	Wheat weight	Spinach seed wt.	Cabbage biomass	Tulip number	Tulip height	Cuke number	Cuke weight
	product/A	kg/plot	tons/a	kg/plot	g/5 pl.	g/2 pl.	per plot	cm	per plot	kg/plot
Visor	3 pt	3.2	1.9	2.0	144	532	43	30	76	4.0
Prowl	7.2 pt	3.0	2.3	2.3	186	514	46	26	68	3.2
Devrinol 2 lb		3.4	2.0	2.4	153	507	41	27	60	2.4
Diuron	4 lb	3.5	2.2	2.2	154	485	43	28	62	2.8
Surflan	3 pt	3.1	2.1	2.2	129	421	40	27	81	3.8
Gallery	10.7 oz	2.6	2.4	1.8	120	495	47	29	74	4.3
Untreated	—	3.2	2.1	2.4	85	401	47	28	60	3.3
LSD _{0.05}	—	ns	ns	ns	ns	ns	ns	ns	ns	1.2

^aAll treatments, including the check, were mixed with 3 pt/A Roundup Ultra.

Table 4. Height of tulip, narcissus, and iris at the time of application of nonselective, postemergence herbicides (2000)

Cultivar	Tulip height		Cultivar	Narcissus height		Cultivar	Iris height	
	2/24	3/6		2/11	2/24		2/11	2/24
	in	in		in	in		in	in
Apeldoorn	1	2	Dutch Master	3	6	Blue Diamond	5	5
Ile de France	2	4	Ice Follies	2	3	Blue Ribbon	4	6
Merry Widow	2	3	Standard Value	1	3	Polar Ice	5	6
Negrita	2	4				Telstar	4	5

Table 5. Application data for nonselective, postemergence herbicides (2000)

Treatment ^a	Active ingredient	Rate	Rate	Herbicide type
Roundup	glyphosate	product/a	ai/a	Translocating
Touchdown	sulfosate	1.5 pt	0.75 lb	Translocating
Finale	glufosinate	1.2 pt	0.75 lb	Contact
Aim	carfentrazone	6 pt	0.75 lb	Contact
Gramoxone	paraquat	2 oz	0.05 lb	Contact
		2.4 pt	0.75 lb	Contact

^aAll treatments made at 12.5 gallons per acre.

Table 6. Effect of several nonselective herbicides applied at two timings on tulip.

Variety	<u>Roundup</u>		<u>Touchdown</u>		<u>Finale</u>		<u>Aim</u>		<u>Gramoxone</u>		Untreated	LSD _{0.05}
	2/24	3/6	2/24	3/6	2/24	3/6	2/24	3/6	2/24	3/6		
<u>Foliage Injury (%)</u>												
Apeldoorn	1	18	5	14	4	30	11	40	9	29	0	8
Ile de France	5	15	9	8	16	25	68	90	25	45	0	10
Merry Widow	11	19	18	13	15	43	39	75	20	68	0	15
Negrita	13	25	13	15	19	33	28	93	19	50	0	11
<u>Weed Control (%)</u>												
Apeldoorn	100	100	100	100	98	100	0	0	73	98	0	20
Ile de France	99	100	100	100	95	96	0	18	100	100	0	24
Merry Widow	100	100	100	100	95	100	0	0	100	100	0	2
Negrita	100	100	100	100	95	99	0	3	98	99	0	4
<u>Flower Number</u>												
Apeldoorn	53	40	56	42	59	56	58	57	60	53	60	7
Ile de France	34	35	39	29	47	41	38	28	43	43	45	6
Merry Widow	28	31	32	35	42	39	42	22	46	39	44	6
Negrita	40	46	46	42	46	51	38	21	48	42	52	9
<u>Flower Height (cm)</u>												
Apeldoorn	38	18	39	21	42	33	41	38	41	34	42	4
Ile de France	28	15	29	18	26	17	22	9	29	19	38	5
Merry Widow	9	8	18	8	23	14	18	7	21	12	27	3
Negrita	22	13	23	12	28	19	25	10	31	19	36	5

Table 7. Effect of several nonselective herbicides applied at two timings on tulip.

Variety	<u>Roundup</u>		<u>Touchdown</u>		<u>Finale</u>		<u>Aim</u>		<u>Gramoxone</u>		Untreated	LSD _{0.05}
	2/24	3/6	2/24	3/6	2/24	3/6	2/24	3/6	2/24	3/6		
<u>Total Bulb Number (no./plot)</u>												
Apeldoorn	139	107	142	135	133	105	124	99	125	98	127	20
Ile de France	88	89	96	79	69	63	66	65	67	71	77	14
Merry Widow	201	129	188	132	190	125	156	138	160	111	155	33
Negrita	121	58	102	66	78	65	75	72	83	66	89	15
<u>Total Bulb Weight (g/plot)</u>												
Apeldoorn	1493	611	1610	797	1509	887	1233	826	1472	723	1445	182
Ile de France	753	450	875	471	537	285	338	280	537	246	833	99
Merry Widow	858	370	835	422	881	517	828	544	1003	286	1071	198
Negrita	627	188	684	222	544	248	363	256	608	228	811	129
<u>Average Bulb Weight (g)</u>												
Apeldoorn	10.8	5.7	11.4	6.0	11.3	8.4	10.0	8.4	11.8	7.5	11.4	1.3
Ile de France	8.6	5.8	9.4	6.0	7.7	4.5	5.2	4.3	8.0	3.5	10.9	1.2
Merry Widow	4.4	2.9	4.5	3.1	4.6	4.3	5.7	4.3	6.8	2.6	7.3	2.1
Negrita	5.2	3.2	6.7	3.4	6.9	3.9	4.8	3.6	7.4	3.5	9.2	1.4

Table 8. Effect of several nonselective herbicides applied at two timings on narcissus.

Variety	<u>Roundup</u>		<u>Touchdown</u>		<u>Finale</u>		<u>Aim</u>		<u>Gramoxone</u>		Untreated	LSD _{0.05}
	2/11	2/24	2/11	2/24	2/11	2/24	2/11	2/24	2/11	2/24		
<u>Foliage Injury (%)</u>												
Dutch Master	0	0	1	3	5	8	23	53	10	11	0	8
Ice Follies	0	3	3	3	3	10	11	38	6	13	0	6
Standard Value	0	0	–	–	0	5	8	–	–	–	0	4
<u>Weed Control (%)</u>												
Dutch Master	91	100	95	100	91	97	30	15	100	99	0	16
Ice Follies	89	100	95	100	97	95	10	24	100	99	0	20
Standard Value	90	100	–	–	93	94	0	–	–	–	0	6
<u>Flower Number</u>												
Dutch Master	23	24	22	23	22	20	16	18	23	22	19	4
Ice Follies	25	24	22	26	25	25	23	21	23	22	22	ns
Standard Value	14	16	–	–	15	14	14	–	–	–	17	ns
<u>Flower Height (cm)</u>												
Dutch Master	34	34	35	33	36	35	25	20	33	33	34	3
Ice Follies	33	34	33	32	33	32	32	19	34	33	31	3
Standard Value	43	43	–	–	44	44	44	–	–	–	44	ns

Table 9. Effect of several nonselective herbicides applied at two timings on narcissus.

Variety	<u>Roundup</u>		<u>Touchdown</u>		<u>Finale</u>		<u>Aim</u>		<u>Gramoxone</u>		Untreated	LSD _{0.05}
	2/11	2/24	2/11	2/24	2/11	2/24	2/11	2/24	2/11	2/24		
<u>Total Bulb Number (no./plot)</u>												
Dutch Master	23	24	23	22	24	22	22	22	23	21	20	ns
Ice Follies	26	21	20	26	27	26	21	21	22	27	25	ns
Standard Value	15	15	–	–	18	18	15	–	–	–	17	ns
<u>Total Bulb Weight (g/plot)</u>												
Dutch Master	2308	2450	2207	2333	2379	2108	1843	1608	2216	2236	2105	ns
Ice Follies	2178	2089	1956	2049	2168	1907	1863	1517	2409	1811	1923	ns
Standard Value	2012	2227	–	–	2367	1995	1742	–	–	–	2160	298
<u>Average Bulb Weight (g)</u>												
Dutch Master	110	105	98	109	103	98	85	80	98	116	106	ns
Ice Follies	87	104	100	80	82	75	88	73	112	69	80	22
Standard Value	136	149	–	–	133	113	116	–	–	–	131	ns

Table 10. Effect of several nonselective herbicides applied at two timings on iris.

Variety	<u>Roundup</u>		<u>Touchdown</u>		<u>Finale</u>		<u>Aim</u>		<u>Gramoxone</u>		Untreated	LSD _{0.05}
	2/11	2/24	2/11	2/24	2/11	2/24	2/11	2/24	2/11	2/24		
<u>Foliage Injury (%)</u>												
Blue Diamond	0	4	–	–	9	8	21	–	–	–	0	5
Blue Ribbon	1	8	5	1	11	11	20	20	23	26	1	6
Polar Ice	1	5	4	5	8	11	20	23	26	26	0	7
Telstar	0	1	–	–	10	14	16	–	–	–	0	5
<u>Weed Control (%)</u>												
Blue Diamond	97	100	–	–	95	100	8	–	–	–	0	10
Blue Ribbon	92	100	85	100	93	100	14	0	100	100	0	14
Polar Ice	96	100	83	100	89	98	8	13	100	100	0	14
Telstar	97	100	–	–	95	95	14	–	–	–	0	8
<u>Flower Number</u>												
Blue Diamond	14	9	–	–	16	18	18	–	–	–	18	5
Blue Ribbon	8	5	8	10	7	6	7	6	6	7	7	ns
Polar Ice	16	18	26	22	28	27	31	27	30	30	29	8
Telstar	8	6	–	–	7	8	9	–	–	–	8	ns
<u>Flower Height (cm)</u>												
Blue Diamond	41	39	–	–	46	39	41	–	–	–	44	ns
Blue Ribbon	39	28	35	34	34	33	33	39	29	31	41	8
Polar Ice	38	34	39	38	42	41	42	42	39	36	44	4
Telstar	41	37	–	–	40	38	40	–	–	–	48	ns

Table 11. Effect of several nonselective herbicides applied at two timings on iris.

Variety	<u>Roundup</u>		<u>Touchdown</u>		<u>Finale</u>		<u>Aim</u>		<u>Gramoxone</u>		Untreated	LSD _{0.05}
	2/11	2/24	2/11	2/24	2/11	2/24	2/11	2/24	2/11	2/24		
<u>Total Bulb Number (no./plot)</u>												
Blue Diamond	165	157	–	–	160	168	165	–	–	–	139	ns
Blue Ribbon	149	126	154	149	136	118	137	143	129	150	136	ns
Polar Ice	129	150	139	116	136	138	148	130	143	157	134	ns
Telstar	147	148	–	–	142	159	140	–	–	–	139	ns
<u>Total Bulb Weight (g/plot)</u>												
Blue Diamond	748	646	–	–	757	776	695	–	–	–	668	ns
Blue Ribbon	880	640	742	873	717	763	737	743	683	683	691	ns
Polar Ice	513	519	606	469	560	568	552	461	621	550	546	ns
Telstar	544	544	–	–	545	558	443	–	–	–	512	ns
<u>Average Bulb Weight (g)</u>												
Blue Diamond	4.6	4.2	–	–	4.7	4.6	4.2	–	–	–	4.8	ns
Blue Ribbon	5.9	5.1	4.8	5.9	5.3	6.5	5.4	5.2	5.3	4.6	5.1	2.0
Polar Ice	4.0	3.5	4.4	4.2	4.2	4.1	3.7	3.6	4.4	3.5	4.1	ns
Telstar	3.7	3.7	–	–	3.9	3.5	3.2	–	–	–	3.6	ns

Table 12. Effect of pea herbicides (1999) on rotationally-grown tulips (1999-2000).

Pea herbicide	Rate	Flower number	Flower height	Tot. bulb number	Tot. bulb weight	Avg. bulb weight
	product/A	per plot	cm	per plot	g per plot	g
Raptor	4.1 floz	48	35	112	1021	9.1
Raptor	5.1 floz	48	34	104	986	9.5
Prowl	2.4 pt	48	33	106	922	8.7
Raptor + Prowl	4.1 floz + 2.4 pt	52	35	113	1067	9.5
Treflan	1.5 pt	45	32	109	950	8.7
Command	1 pt	47	34	93	941	10.6
Spartan	5.3 oz	45	32	96	830	8.7
Untreated	—	49	34	112	982	8.8
LSD _{0.05}	—	ns	ns	ns	ns	ns