RUSSET BURBANK VINE DESICCATION WITH DIQUAT*

Steven R. James
Central Oregon Agricultural Experiment Station
Madras, Oregon

Abstract

An experiment to examine the efficacy of Diquat on stem and leaf desiccation, tuber maturity, yield, grade, specific gravity, and stem end discoloration of Russet Burbank potatoes was established during 1989 at the Powell Butte site of Central Oregon Agricultural Research Center. Although the initial two pint Diquat rate was quicker acting than the one pint rate, after seven to 10 days both initial Diquat rates were equal in leaf and stem desiccation. The second application of Diquat produced no statistically significant increase in stem or leaf desiccation under the conditions prevalent in this trial. The application of Diquat hastened tuber maturity as compared with untreated plots, but tuber skinning remained unacceptably high 14 days after treatment. Tuber bulking in Diquat treated plots continued for approximately one week after application. Specific gravity of the untreated plots was significantly higher than the specific gravity of Diquat-treated plots seven, 14, and 27 days after the initial Diquat treatment. Tubers that had a higher percentage of skinning suffered a higher percentage of weight loss in storage than tubers that had less skinning. There were no significant differences in stem end discoloration among treatments.

Introduction

Killing potato vines prior to harvest is a common practice in most of the major potato producing areas in Oregon. Various top-kill methods are employed, but all serve to mature tuber skins, control tuber size, reduce potential bruise susceptibility, and reduce disease and dehydration in storage.

Diquat has been widely used by potato growers in Oregon since the U.S. Environmental Protection Agency (EPA) ban on dinoseb imposed in 1987. In fact, Diquat is the most commonly used chemical desiccant on potatoes in Oregon. Although Diquat has been available for many years, growers did not utilize it until dinoseb was banned because it was more expensive than dinoseb and growers were largely unfamiliar with it.

A number of field trials have been conducted in major potato growing areas with Diquat. Application rates, leaf and stem kill efficacy, the time of day it is applied, and the effect on

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tuber stem end discoloration have all been thoroughly researched. However, little information is available for Diquat's effect on yield, grade, specific gravity, and tuber maturity. This study was initiated to provide information in those areas.

Materials and Methods

An experiment to examine the efficacy of Diquat on stem and leaf desiccation, tuber maturity, yield, grade, specific gravity, and stem end discoloration of 'Russet Burbank' (Solanum tuberosum L.) potatoes was established during 1989 at the Powell Butte site of Central Oregon Agricultural Research Center. Five treatments were arranged in a randomized block experimental design with four replications. Individual plots were 10 rows wide (30 ft) by 50 feet in length. Rows were planted 36 inches apart and plants were spaced at 9 inches apart in the rows. The trial area was sprinkler irrigated throughout the growing season and a final irrigation was applied two days prior to the first application of Diquat. The field in which the trial was located was fertilized and managed by practices common in central Oregon.

The experimental treatments, application rates, and application dates are shown in Table 1. Treatment application rates were chosen to provide data for EPA registration and labelling. The plots were green with no natural vine senescence on September 1, 1989, when the first Diquat treatments were applied. The following summarizes the weather data and application procedures for each spray date:

	September 1, 1989	September 6, 1989
Air Temperature:	72°F	66°F
Soil Temperature-4":	51°F	49°F
Soil Moisture:	Moist	Moist
Wind:	West 3-5 mph	West 5-8 mph
Sky:	Partly cloudy	Clear
Time of Day:	10:30 am	10:45 am
Sprayer:	Tractor Mount	Tractor Mount
Nozzles:	Flat fan	Flat fan
Spray Pressure:	, 32 PSI	32 PSI
Spray Gallonage:	33 gal/acre	33 gal/acre

Stem and leaf desiccation were visually rated prior to the initial spray treatment and twice weekly thereafter for three weeks.

On August 31, 1989, two rows were harvested from each plot. The vines from each harvest row were eliminated with a flail mower and the tubers were lifted with a level bed digger and hand- bagged to minimize harvest injury. A similar procedure was followed for each of the four subsequent harvest dates (September 5, September 8, September 15, September 28).

Plots were graded into six size and grade categories immediately after harvest for each of the five harvest dates. A sample of 20, 6-12 ounce tubers was taken from each plot to determine specific gravity and skin set. Specific gravity was calculated using the air-water method. The 20 tubers were then air-dried and subjected to skinning in the Valent potato skinning apparatus, which simulated harvest on harvesters with a coated digger chain. Each of the 20 tubers were rated for percent skinning based on the Banat and Horsfall surface defect rating scale. After skinning measurements were taken, the tubers were placed in poly-mesh bags and placed in storage until January 10, 1990, when all samples were removed and weighed to determine tuber weight loss (shrinkage). The storage temperature was gradually lowered from 55°F to 38°F over a period of several weeks and relative humidity was maintained at 92 percent. The tuber samples from the September 28, 1989 harvest date were also evaluated for stem end discoloration. The tubers were sliced longitudinally and scored for depth of discoloration.

Results

The effects of Diquat on the leaf and stem desiccation of Russet Burbank potatoes are shown in Tables 2 and 3. Three days after the initial Diquat application, the two treatments that initially received two pints of Diquat had significantly greater stem and leaf desiccation than the two treatments that initially received one pint of Diquat. However, after seven days and the second Diquat application, there were no differences in leaf desiccation among the Diquat treatments. Ten days after the initial Diquat treatment there were no significant differences in stem desiccation among the Diquat treatments. The stem and leaf desiccation that occurred in the untreated control was caused by light frosts on September 3 and 10, 1989 and a severe killing frost on September 18, 1989. The data suggests that there is little benefit in applying more than one pint of Diquat on the initial application. Although the initial two pint rate was quicker acting than the one pint rate, after seven to ten days both initial Diquat rates were equal in leaf and stem desiccation. The second application of Diquat produced no statistically significant increase in stem or leaf desiccation under the conditions prevalent in this trial.

Tuber maturity results are tabulated in Table 4. The application of Diquat decreased tuber skinning at seven and 14 days after the initial Diquat application as compared with the untreated control treatment. Although the application of Diquat hastened tuber maturity, tuber skinning remained unacceptably high 14 days after treatment. A similar study (Central Oregon Crop Research 1987-1988, Special Report 847, pages 119-126) conducted in 1988 at Powell Butte, OR also suggested that harvest of Russet Burbank potatoes should be delayed for 18-21 days after the initial Diquat treatment.

The effect of Diquat on the yield of Russet Burbank potatoes is summarized in Table 5. No statistically significant differences in yield were noted until the last two harvest dates. Total yields from the untreated treatment were significantly greater than the Diquat treatments when harvested 14 days after the initial Diquat treatment. A similar trend was noted for the

last harvest date. U.S. number one yields observed for the untreated plots also trended higher than number one yields of Diquat treated plots at the last two harvest dates. Tuber bulking in Diquat-treated plots continued for approximately one week after application.

Specific gravity of the untreated plots was significantly higher than Diquat-treated plots seven, 14, and 27 days after the initial Diquat treatment (Table 5). When vines are killed rapidly, either by chemical desiccants, severe frosts, or mechanical means, there is less opportunity for the transfer of carbohydrates from plant tops to the tubers. As a result, the tubers are lower in dry matter.

There were no differences in tuber weight shrinkage among all treatments within each harvest date (Table 4). However, tuber shrinkage and skinning were directly related. Tubers that had a higher percentage of skinning suffered a higher percentage of weight loss in storage than tubers that had less skinning. Maturing tubers after desiccation served to minimize tuber skin defects and reduce weight loss in storage.

There were no significant differences in stem end discoloration among treatments.

Table 1. Diquat application rates and dates, Powell Butte, OR, 1989.

Treatment	Application Rate and Date		Total Application Rate
	September 1	September 6	
Diquat	1 ptl	1 pt	2 pt
Diquat	1 pt	2 pt	3 pt
Diquat	2 pt		2 pt
Diquat	2 pt	1 pt	3 pt
Untreated			0 pt

1 - 1 pt =0.25 lbs a.i. of Diquat H/A

Table 2. Effect of Diquat on leaf desiccation of Russet Burbank potatoes, Powell Butte, OR, 1989.

Treatment	Rate	Leaf Desiccation--Days After First Application						
		0	3	7	10	14	17	21
Diquat	1 pt + 1 pt	0	48	91	96	100	100	100
Diquat	1 pt + 2 pt	0	53	94	100	100	100	100
Diquat	2 pt	0	73	95	99	100	100	100
Diquat	2 pt + 1 pt	0	69	96	100	100	100	100
Untreated		0	5	25	58	83	100	100
LSD 5%		NS	10	6	9	3	NS	NS

Table 3. Effect of Diquat on stem desiccation of Russet Burbank potatoes, Powell Butte, OR, 1989.

Treatment	Rate	Stem Desiccation--Days After First Application						
		0	3	7	10	14	17	21
Diquat	1 pt + 1 pt	0	13	66	91	99	100	100
Diquat	1 pt + 2 pt	0	14	70	93	100	100	100
Diquat	2 pt	0	18	79	94	100	100	100
Diquat	2 pt + 1 pt	0	19	76	95	100	100	100
Untreated		0	0	6	36	60	81	100
LSD 5%		NS	4	9	6	6	6	NS

Table 4. Tuber skinning and shrinkage of Russet Burbank potatoes at five harvest dates after vine desiccation with Diquat, Powell Butte, OR, 1989.

Harvest Date	Treatment	Rate	Tuber Skinning	Tuber Shrinkage'
DAT[2]				
0	Diquat	1 pt + 1 pt	41	12
0	Diquat	1 pt + 2 pt	45	12
0	Diquat	2 pt	52	13
0	Diquat	2 pt + 1 pt	49	12
0	Untreated		44	12
	LSD 5%		NS	NS
4	Diquat	1 pt + 1 pt	51	11
4	Diquat	1 pt + 2 pt	42	11
4	Diquat	2 pt	49	11
4	Diquat	2 pt + 1 pt	42	11
A	Untreated		45	10
	LSD 5%		NS	NS
7	Diquat	1 pt + 1 pt	33	9
7	Diquat	1 pt + 2 pt	37	10
7	Diquat	2 pt	36	11
7	Diquat	2 pt + 1 pt	39	12
7	Untreated		42	10
	LSD 5%		NS	NS
14	Diquat	1 pt + 1 pt	16	7
14	Diquat	1 pt + 2 pt	15	7
14	Diquat	2 pt	15	7
14	Diquat	2 pt + 1 pt	14	7
14	Untreated		25	7
	LSD 5%		7	NS
27	Diquat	1 pt + 1 pt	1	4
27	Diquat	1 pt + 2 pt	1	3
27	Diquat	2 pt	1	3
27	Diquat	2 pt + 1 pt	1	3
27	Untreated		1	3
	LSD 5%		NS	NS

1 - Tuber shrinkage=(harvest weight-weight on Jan. 10, 1990)/harvest weight x 100
2 - Days after the initial Diquat treatment.

Table 5. Yield and specific gravity of Russet Burbank potatoes at five harvest dates after vine desiccation with Diquat, Powell Butte, OR, 1989.

Harvest Date	Treatment	Rate	Yield < 4 oz	Yield No. 1	Yield Total	Specific Gravity
DAT[1]			cwt/A	cwt/A	cwt/A	
0	Diquat	1 pt + 1 pt	73	325	445	1.083
0	Diquat	1 pt + 2 pt	72	321	477	1.082
0	Diquat	2 pt	69	324	435	1.083
0	Diquat	2 pt + 1 pt	71	318	445	1.083
0	Untreated		75	300	435	1.083
	LSD5%		NS	NS	NS	NS
4	Diquat	1 pt + 1 pt	100	350	509	1.085
4	Diquat	1 pt + 2 pt	81	335	475	1.085
4	Diquat	2 pt	86	341	480	1.084
4	Diquat	2 pt + 1 pt	88	365	499	1.086
4	Untreated		87	343	492	1.087
	LSD5%		NS	NS	NS	NS
7	Diquat	1 pt + 1 pt	94	326	475	1.084
7	Diquat	1 pt + 2 pt	73	341	480	1.083
7	Diquat	2 pt	86	306	461	1.083
7	Diquat	2 pt + 1 pt	81	326	466	1.083
7	Untreated		68	329	457	1.088
	LSD 5%		NS	NS	NS	0.003
14	Diquat	1 pt + 1 pt	92	351	503	1.082
14	Diquat	1 pt + 2 pt	77	326	484	1.083
14	Diquat	2 pt	74	312	454	1.082
14	Diquat	2 pt + 1 pt	91	322	472	1.083
14	Untreated		82	355	491	1.088
	LSD 5%		NS	NS	31	0.002
27	Diquat	1 pt + 1 pt	120	308	478	1.084
27	Diquat	1 pt + 2 pt	85	324	471	1.085
27	Diquat	2 pt	88	307	474	1.085
27	Diquat	2 pt + 1 pt	94	333	499	1.085
27	Untreated		106	347	513	1.090
	LSD 5%		18	NS	NS	0.002

1 - Days after the initial Diquat treatment.