WINTER LOSSES IN CARROT SEED FIELDS IN CENTRAL OREGON IN 1987-88

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ABSTRACT

An experiment with eight treatments (control, mulches of straw, mint slug material, wood shavings, a six-inch deep soil cut on one and both sides of the carrot row, soil on carrot crown, and a foliar nutrient spray of high potassium) was established in 1987-88 at each of eight locations from Agency Plains to Powell Butte. Carrots were counted in the fall and again in the spring from which loss values were calculated. Both male and female parents of hybrids and open pollinated varieties were studied. Winter plant loss averaged over all locations ranged from 29 to 41 percent for straw, mint, and wood mulch compared to 57 percent for control plants. Soil slicing increased plant loss (64 and 63 percent) but the loss of plants with soil on the crown of plants (55 percent) was similar to control plants.

INTRODUCTION

Carrot seed is produced by the seed-to-seed method in Central Oregon. Fields are planted in August so carrot seedlings can grow sufficiently and become hardened for winter survival. However, with all the many contributing factors, winter losses have still reached or exceeded 30 percent or more in some years. During the 1985-86 winter in two tests at Madras the percent winterkill ranged from 14.2 to 21.7 with plants spaced six-12 inches apart compared to 2.8 percent or less winterkill with about one inch between plants (1). There can be less winter losses with high plant stand densities. Stands are thinned in the spring to a carrot each four to eight inches, depending on plant vigor and seed company preference (2). Therefore, if winter losses are not too severe, erratic normal field practices can be followed. However, on occasion, transplanting is necessary to obtain the correct plant stand density for some varieties

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to maximize yield. Techniques to reduce winter losses could result in large savings to growers.

MATERIALS AND METHODS

Seven treatments were compared with a control or untreated check in a randomized complete block design. The amounts of each mulch applied were adjusted to minimize leaf coverage and still get some root crown coverage. Each treatment was replicated four times. Identification and description of each treatment is shown in Table 1. An individual plot was a row either 30 or 36 inches wide by 20 feet long. Treatments were applied to the whole plot but data were collected only from the center 10 feet. Plant counts were made November 16 and 17, 1987, prior to any treatment application. Plants that survived the winter were counted March 15-18, 1988. The percent of plants lost during the winter were calculated and analyzed statistically. The significance among treatment means was tested with least significant differences statistic at the 5 percent level of probability. In cooperation with seed company personnel, eight (grower fields) were selected for study representing different varieties (both hybrids and open-pollinated), size of carrots, and various other factors or conditions. Fields were distributed throughout central Oregon (Table 2).

Observations on carrot height, diameter of carrot root, the amount of soil cracking, and carrot heaving were made on all fields. One inch air and two inch soil temperatures were recorded January 28 to February 18, 1988 for the control and straw mulch treatment in field I. One soil sample from the zero to eight inch depth was taken from each field on March 15,1988 and analyzed by the Oregon State University Soil Testing Laboratory for pH, P, K, total N, and organic matter.

RESULTS AND DISCUSSION

Percentage plant loss on control plots ranged from 23 in field III to 90 percent on field V (Table 2). Mulching was beneficial to winter survival except for wood on field III and mint on field VII. Based on winter survival, straw appeared to be the best mulch on five fields. The physical nature and mat characteristics of the straw mulch on the carrot roots seemed to be more ideal for protection. Straw was longer, less dense, and provided more air spaces for insulating value than mint or wood. However more of the straw had blown off the plots than either mint or wood pieces. Nevertheless, all products remained sufficiently in place to serve their purpose as a mulch. No mulch inhibited the spring regrowth of carrots although this might be a problem if too much mulch was applied. Sizeable reductions in plant

loss were obtained at relatively low mulch rates per acre (Table 1). During the mild winter of 1986-87, some carrots which had been covered with two to three inch deep straw and mint mulch were retarded and etiolated in regrowth . However, thick layers of mulch would probably give greater protection than the light rates and still not interfere with early spring regrowth if proper timing of mulch removal occurred. In practice, a grower may be able to move the mulch from top of the carrots with a side delivery rake or similar piece of equipment.

Variety Effects. The degree of winter hardiness of male and female parents of a carrot hybrid may be expected to differ. This was observed in three fields tested on the Agency Plains. Percentage of plant loss averaged 53 among males in field II, compared to only 5 in field III (Table 3). However, beside genetic effects, the condition of the carrots along with environmental influences confound the results observed. The size and vigor of male and female plants varied among fields. In field II the mulch treatments were applied to the male parent because it was small and weak. The percentage of plant loss during the winter ranged from 30 to 78 for this parent compared to 3 to 15 loss for the larger and more vigorous female parent. Consequently there may be some advantage to applying mulch differentially in a hybrid field to the weakest parent. It was interesting to observe that in field III the weakest parent was the male but differences between parents was not as marked as in field II. It has be assumed that different male and female parents were used in each field but this has not been confirmed.

Influence of soil characteristics. No clear pattern averaged to indicate whether soil characteristics affected winter survival (Table 4).

Effect of straw mulch on air and soil temperature. Data are not shown here, but straw acted as insulator. Temperature was either warmer or cooler under the straw than ambient air temperature. Carrot plants received some protection from the straw, both in terms of injury from heaving as well as from the cold temperature.

Recommendations. Growers interested in mulching to reduce winter carrot plant loss should experiment on a limited scale. An application technique compatible with grower ability and/or resources needs to be devised. There may be a possibility that a manure spreader or commercial mulch machine could be effective. The results reported here on eight sites from the Agency Plains to Powell Butte were obtained in a wide range of biotic and physical factors. Nevertheless, winter plant survival is a complex process, care must be exercised in launching a program to improve it. Every grower is well aware of seasonal differences in weather effect plant responses significantly. Therefore

caution is urged for growers who may try mulching to reduce winter plant loss.

REFERENCES

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Table 1. Identification and description of treatments in 1987-88 winter survival tests on carrot seed fields in Central Oregon

No.	Name	Description
1.	Control (Ck)	Check plot -- normal field conditions and grower practices.
2.	Straw (St)	Air dry baled wheat straw was passed through a garden/greenhouse soil shredder to obtain a chunk-free mulch. It was spread uniformly by hand directly over the carrot plants. Most of the straw filtered through the carrot canopy and covered the carrot root crown about one inch deep. From four-six inches of soil on each side of the carrot row was also covered. About one ton of 12% moisture straw was applied per acre in the band on November 23, 1987. A five gallon pail of the straw mulch weighed 2.1 lbs. This mulch was the lightest and had the largest particle size of the three types of mulch tested.
3.	Mint (Mt)	Air-dry material (70% dry matter) from a mint slug pile was shredded in a manner similar to the wheat straw. It was applied at 2.5 T/A in a 12 inch wide band over the carrot row on November 23, 1987. A five gallon pail of the mint mulch weighed 6.7 lbs.
4.	Wood (Wd)	Wood shavings (56% dry matter) from a planer were applied in a 12 inch wide band over the carrot row at 1.5 T/A on November 23, 1987. A five gallon pail of this product weighed 4.5 lbs.
5.	1-Cut (1c)	A straight coulter was used to cut six-inches deep four inches to one side of the carrot row. No carrot leaves were pruned nor carrot roots disturbed. Treatment was performed November 18 and 19, 1987.
6.	2-Cut (2c)	Similar to treatment five except soil cut was made on each side of the carrot row. Treatment made November 18 and 19, 1987.
7.	Soil	Soil was pushed by hand to cover the crown of the carrot root but not the leaves on November 20 and 21, 1987.
8.	K	A nutrient foliar spray, High K, (12-8-30+S+micronutrients), distributed by Smith & Ardussi, Inc., was applied on the carrot row at ten lbs/A on November 20 and 21, 1987.

Table 2. Average plant stand in fall 1987 and percent winterloss after seven fall treatments compared to a control on carrots grown for seed in Central Oregon, 1987-88

Field no.	Variety type	Site[3]	Percentage of original stand[1] Treatments[2] Ck	St	Mt	Wd	1c	2c	Soil	K	LSD/ (5%)	CV (%)
			% winterloss									
I	Hy	AP	31	12	14	19	40	41	26	38	16	39
II	Hy	AP	53	17	27	45	73	50	49	52	28	42
III	Hy	AP	23	7	7	31	42	21	26	20	18	54
IV	O.P.	WM	60	34	45	33	73	78	38	69	21	26
V	O.P.	EM	90	57	74	73	93	90	98	87	24	19
VI	O.P.	WC	73	25	17	22	67	83	75	61	23	29
VII	O.P.	SJB	65	39	66	56	62	74	73	66	22	23
VIII	O.P.	PB	61	40	46	45	65	64	--[4]	73	26	26
Treatment over Site Avg.			57	29	37	41	64	63	55	58		

1 Original plant stands (average number of plants in 32-10 feet sections of row) were 81, 35, 40, 60, 59, 33, 76 and 71 plants per 10 foot for fields I through VIII, respectively. These stands were adjusted to 100 percent for establishment of a baseline against which to measure percentages of winter losses.

2 For full explanation of various mulch treatments, see Table 1.

3 Site: AP = Agency Plains; WM = West of Metolius; EM = East of Metolius; WC = West of Culver; SJB = South of Juniper Butte; PB = Powell Butte.

4 This treatment and replication four for all treatments were lost so an analysis of variance was conducted on seven treatments replicated three times.

Table 3. Percent winterloss among female and male parents by replication in three hybrid carrot fields on the Agency Plains, Madras, Oregon, 1987-88

Parent type	Replicate no.	Field Number I	II	III
		--% winterloss[1]--		
Female	1	33	10	12
	2	28	15	24
	3	29	3	26
	4	33	7	30
	Avg.	31	9	23
Male	1	0	30	0
	2	0	67	8
	3	0	78	9
	4	0	37	2
	Avg.	0	53	5

1 Percent winterloss = $\frac{\text{Spring plant number per 10 row-ft.}}{\text{Fall plant number per 10 row-ft.}} \times 100$

Table 4. Soil sample results from 0-8 inch depth on winter survival test fields in Central Oregon, March 15, 1988

Field no.	pH	P	K	Total N	Organic matter
		---ppm---			%
I	5.9	33	316	0.08	1.74
II	6.3	33	304	0.10	2.30
III	6.3	37	569	0.07	1.40
IV	6.4	36	324	0.10	1.91
V	5.6	36	433	0.10	1.97
VI	6.2	74	585	0.09	1.80
VII	6.7	32	312	0.11	2.42
VIII	6.0	16	183	0.16	3.15