

## **Evaluation of Ground Covers to Prevent Frost-Heaving to Carrot**

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### **Introduction**

A trial was conducted in 2009 to evaluate the potential of several mulch products to prevent seed-to-seed carrot from frost heaving (Affeldt et al. 2009). In that trial we learned about effective ways to apply different mulches and that manure caused problems with the carrots rotting. However, the variability in the carrot stand was not accounted for in the experimental design therefore it was difficult to determine if there was any reduction in frost-heaving from the mulch treatments. In an effort to better evaluate mulch products to prevent frost-heaving a redesigned trial was put out at two locations.

Described below is some background information, which was also explained in last year's report. Hybrid carrot seed production is the single most highly valued crop in central Oregon, having a gross value in 2010 of \$14.7 million. Carrot seed acreage has consistently been from 3,000-4,000 acres in recent years. Approximately 75% of carrot seed acres are planted from seed in August the year before harvest (seed-to-seed); the other 25% are spring transplanted from roots (root-to-seed). Frost-heaving is a major risk factor for seed-to-seed carrot production in the region. Frost-heaving tends to occur from January through March when the soil is moist and frequently freezes and thaws in response to daily temperature fluctuation. The freezing and thawing soil can result in seedling carrots being pushed up out of the soil, or heaved, which results in plant mortality. In severe cases, frost-heaving can result in complete stand failure.

To avoid catastrophic crop loss, growers have attempted various methods to insulate seedling carrots and prevent them from heaving. Previously, mint hay, wood mulch and hydro seeding have been tried but availability of product and applications have been difficult.

Another method of protecting carrots that is commonly used covers several rows at once with a material called Agri-Bond<sup>®</sup> paper. This method does a very good job of protecting carrots but has some drawbacks. First, the paper is expensive with labor intensive installation and removal. Second, the paper is susceptible to being blown off the carrots by high winds. Third, the paper allows pests such as aphids, rodents, and weeds to proliferate over the winter months. Fourth, the timing for paper removal in the spring can be risky because a hard frost after the paper is removed can be fatal to the carrots. Our objective of the trial was to evaluate potential mulches to protect against frost heaving which could save money and time, as well as use readily available on-farm sources.

## **Materials and Methods**

Two trials were conducted in separate fields of commercial hybrid carrot grown for seed, one north of Madras and one near Culver. The treatments in each trial consisted of two types of mulch (listed in Tables 1 and 2), Agri-Bond paper as a standard, and an untreated check. Mulch treatments included chopped wheat straw and pelletized seed cleanings of Kentucky bluegrass. Each treatment was replicated four times in randomized complete blocks the plots for each treatment were placed in two rows of female carrots; each row was 10 ft long in the Culver site and two rows of male carrots; each 15 ft long at the Madras site. Each mulch treatment was applied in a 4-in wide band over the row. The trial near Madras was in a field that had previously grown Kentucky bluegrass and then was fallowed. The trial near Culver was in a field that had previously grown wheat and the straw residue was burned prior to seedbed preparation.

The carrots were seeded in August 2010 and the treatments were applied December 31, 2010. Prior to treatment application the numbers of carrots in each row were counted. Then in the first week of May 2011, the numbers of surviving carrots in the same rows were counted again in order to determine winter mortality.

## **Results and Discussion**

It was not possible for us to differentiate carrot mortality caused by frost-heaving from other factors such as poor vigor or freezing. In May, only live carrots that had not heaved were counted. Some carrots that had heaved still had green leaves, but their fitness and survival was doubtful. A carrot was considered to have heaved if at least 0.25 inches of the root was exposed above the soil surface.

At Madras and Culver, Agri-Bond paper cover had significantly less carrot mortality over the winter than the check. The mulches tended to be less effective than the Agri-Bond paper, with chopped straw showing some improvement over the pelletized seed screenings. The pelletized seed screenings appeared to slightly smother the carrot seedlings when moist. Wheat straw provided good covering but issues with the equipment used to spread the straw raise some concerns. The compaction of the straw spreaders during wet months of the year and disruption of the corrugation of the rows is undesirable.

For fields with a high risk of frost heaving and winter injury the Agri-Bond paper is probably the best protection for seedling carrots.

## **References**

Affeldt, R., B. Holliday, D. Oppenlander, and B. Martens. 2009. Protection of seedling carrot from frost heaving. Central Oregon Agricultural Research Center, 2008 Annual Report. Special Report 1093. pp 5-9.

## **Acknowledgements**

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**Table 1.** Winter survival of male seedling carrots with mulch treatments applied in December near Madras, Oregon, 2010-2011.

Treatment	Application rate (in 4 inch band)	Carrot stand count		Stand difference
		November	April	
		----- (plants per 30 ft) -----		
Check	N/A	81.4	33.8	47.6
Agri-Bond paper	N/A	103	89.3	13.8
Chopped Straw	As per farmer application	82.8	43.3	39.5
Pelletized seed screenings	22 tons/acre <sup>1</sup>	90.9	20.1	70.8
Pelletized seed screenings	44 tons/acre <sup>2</sup>	78.9	20.5	58.4
LSD (p=0.05)		---	---	24.1
CV		---	---	2.18

<sup>1</sup> 44,400 lb/acre in a 4 inch band on 30 inch rows=5,920 lb/field acre or 3 ton/field acre

<sup>2</sup> 88,900 lb/acre in a 4 inch band on 30 inch rows=11,840 lb/field acre or 6 ton/field acre

**Table 2.** Winter survival of female seedling carrots with mulch treatments applied in December near Culver, Oregon, 2010-2011.

Treatment	Application rate (in 4 inch band)	Carrot stand count		Stand difference
		November	May	
		----- (plants per 20 ft) -----		
Check	N/A	39.4	23.1	16.3
Agri-Bond paper	N/A	54.6	63.6	-9.0
Chopped Straw	As per farmer application	43.9	39.5	4.4
Pelletized seed screenings	22 tons/acre <sup>1</sup>	44.1	27.6	16.5
Pelletized seed screenings	44 tons/acre <sup>2</sup>	38.8	25.6	16.3
LSD (p=0.05)		---	---	10.5
CV		---	---	2.18

<sup>1</sup> 44,400 lb/acre in a 4 inch band on 30 inch rows=5,920 lb/field acre or 3 ton/field acre

<sup>2</sup> 88,900 lb/acre in a 4 inch band on 30 inch rows=11,840 lb/field acre or 6 ton/field acre