CONTROL OF STORAGE DISEASES OF CARROTS BY WASHING, GRADING, AND POSTHARVEST FUNGICIDE TREATMENTS'

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Abstract

Carrots washed and graded before being stored for 15–16 weeks at 32 F (0 C) and 95–100% relative humidity had significantly less decay than carrots stored directly from the field. Treating washed carrots with sodium orthophenyl phenate, by spraying in 1970 and by flooding in 1971, gave a further significant decrease in decay. A postharvest spray rinse of dichloran was effective in one year but not in the other. In 1971–72, thiabendazole gave significantly better control than sodium orthophenyl phenate. Chlorine did not control storage decay. Botrytis cinerea was the predominant rotting organism.

Introduction

In Nova Scotia the storage life of carrots in commercial jacketed cold storage is limited by rots caused mainly by Botrytis cinerea Pers. Losses of carrots after 4-5 months in jacketed cold storage have ranged from 5% to 80%, with the average loss being about 30% (2,3). Losses varied considerably in carrots from different fields, and carrots harvested late in the season usually had more storage decay than those dug early. Van den Berg and Lentz (3) tested several storage environments and found that 32-34 F and 98-100% relative humidity (R.H.) was optimum for control of decay and quality in carrots. They later reported that Sclerotinia sclerotiorum de Bary did not survive or grow in this environment but that some strains of B. cinerea were not inhibited (4).

Hoadley (1) found that dipping unwashed carrots in Dowicide A prior to storage reduced the incidence of decay. In preliminary work we found that washing carrots in water before storage was as effective as some fungicide dip treatments in controlling decay in carrots held at 32 F for 3 months. The effects of washing, grading, and postharvest fungicide treatments on the decay of carrots in a commercial jacketed cold storage are presented in this paper.

Materials and methods

In September 1970, carrots (Daucus carota L. var. sativa DC, cultivar Nantes) machine harvested from field no. 1, Sawler Gardens Limited, Berwick, Nova Scotia, were washed, spray rinsed, and graded in a commerical operation. The prestorage treatments were as follows:

1. Field run control - carrots as received from the field.
2. Washed control - carrots from conveyor following grading.
3. Botran (50% dichloran, Upjohn Company, Kalamazoo, Michigan, USA), 2 lb/100 gal water, sprayed at 200 p.s.i. onto carrots on conveyor belt following rinse.
4. Dowicide A (97% sodium orthophenyl phenate, Dow Chemicals of Canada Limited, Sarnia, Ontario), 0.5 lb/100 gal, applied as in No. 3.
5. Chlorine (Javex) 25 ppm in rinse water.
6. Chlorine (Javex) 50 ppm in rinse water.
7. Chlorine (Javex) 100 ppm in rinse water.

Each treatment was applied to three 18-bushel bulk bins of carrots. The carrots were held for 16 weeks in a jacketed cold storage at 32 F (0 C) and 95–100% R.H., and then sorted into No. 1's, culls, and rots and weighed. Isolstions were made onto potato dextrose agar from the rots in a 10 lb sample of carrots from each treatment.

In September 1971 carrot cultivars Touchon and Long Type Nantes from fields no. 1 and no. 18, respectively, were used in a test for control of storage rots. Both fields had received a field spray of maleic hydrazide for sprout control. The prestorage operation was the same as in 1970

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Table 1. Percentage of carrots in different grades following storage at 32°F and 95-100%relative humidity for 15–16 weeks

Prestorage treatment	1970–71			1971–72					
	Field no. 1			Field no. 1			Field no. 18		
	#1	Culls	Rots	#1	Culls	Rots	#1	Culls	Rots
Field run, unwashed	48	22	30	30	16	54	43	22	35
Washed and graded	92	2	6	89	1	10	88	2	10

The 1970–71 and 1971–72 samples are based on 54 and 72 bushels of carrots, respectively.

except that the grower replaced the spray rinse with a flood rinse containing Dowicide A. The treatments. were as follows:

1. Field run control - carrots as received from the field.
2. Washed control - carrots washed and graded.
3. Botran (50% dichloran), 2 lb/100 gal of water, sprayed at 200 p.s.i. onto carrots on conveyor belt following washing.
4. Mertect 460 (60% thiabendazole, Merck and Company Inc., Rahway, New Jersey, U.S.A.), 1.12 lb/100 gal, applied as in No. 3.
5. Dowicide A (97% sodium orthophenyl phenate), 0.5 lb/100 gal, applied as a flood rise.

Each treatment was applied to four 18-bushel bulk bins of carrots'from each field. The carrots were held in the jacketed cold storage for 15 weeks at 32 F and 95–100% R.H. and then sorted into No. l's, culls, and rots, and weighed. The rot types were identified visually.

Results and discussion

There was significantly less storage decay in carrots that had been washed, graded, and culled before storage than in those stored directly from the field (Table 1). Less than 1%of the carrots were culled out during grading because of field rots, except in field no. 1 in 1971 when 10%of the carrots had field rots. Removing this source of infection, the cracked and broken carrots and adhering soil, obviously accounts for the decrease in storage decay. The high incidence of storage rots in field run control carrots from field no. 1 in 1971–72, compared with those of 1970–71, was due to heavy rains that occurred in mid–August and flooded some parts of the field for 10 days.

Field rots were mainly due to B. cinerea except in those from the flooded field where bacterial rots predominated, followed by rots caused by B. cinerea and Fusarium spp.

Prestorage fungicide treatments of washed and graded carrots significantly decreased storage decay (Table 2). Botran was not effective in 1970–71 but it significantly decreased rots the following year. Sodium orthophenyl phenate and thiabendazole significantly decreased decay in the years they were used. The chlorine treatments were not effective and there was an indication that the higher concentrations may have increased the amount of decay. The causal organisms of the storage rots with their percent occurrence were as follows: B.

Table 2. Percentage rots in carrots stored at 32°F and 95–100% relative humidity for 15–16 weeks

Prestorage treatment	Field no. 1		Field no. 18
	1970–71	1971–72	1971–72
Field run, unwashed	28.9a*	54.5a	35.4a
Washed and graded	6.1 b	9.9 b	10.3 b
Chlorine 25 ppm	7.8 b	**	
Chlorine 50 ppm	11.6 b		
Chlorine 100 ppm	15.8 b		
Botran	6.3 b	1.4 d	1.1 d
Dowicide A	2.6 c	3.6 c	3.5 c
Thiabendazole		1.4 d	1.2 d

* Letters indicate treatments which do not differ significantly in Duncan's Multiple Range groupings at the 5%level.

** Blank spaces indicate no evaluation.

cinerea 51%, bacteria 20%, Alternaria sp. 9%, S. sclerotiorum 7%, Penicillium, Rhizopus, and Fusarium spp. 13%.

Prestorage washing and grading of carrots followed by fungicide treatments markedly reduced losses from storage decay in a jacketed cold storage. The heavy losses in field run carrots reported here were also encountered by van den Berg and Lentz (3). The rot control with sodium orthophenyl phenate agrees with that obtained by Hoadley (1). The grower who cooperated in these tests obtained excellent control of storage decay in carrots with a prestorage flood of sodium orthophenyl phenate in the washing and grading operation. Removal of soil and unmarketable carrots before storage also allowed more efficient use of cold storage facilities. It should be noted that when carrots are to be washed and graded before storage, a field spray of maleic hydrazide is required for sprout control. Normally sprouts developing during storage are removed by the post-storage washing operations.

Literature cited

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