The Connecticut Agricultural Experiment Station, New Haven

Pumpkin Trials 1992-1993

BY DAVID E. HILL

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SUMMARY

In 1992-93, a total of 14 cultivars of large to small pumpkins were grown at Windsor in a sandy terrace soil and at Mt. Carmel in a loamy upland soil. In 1992, average yield at Mt. Carmel was 12.4 T/A compared to 7.0 T/A at Windsor. The low yield, especially at Windsor, was due to an infection of Phytophthora which rotted 24-97% of fruit in each cultivar at both sites. In 1993, the average yield at Windsor was 26.1 T/A compared to 13.6 T/A at Mt. Carmel. The lower yield at Mt. Carmel was due to persistent drought from June to August which caused the fruit to mature early while they were still small. Despite poor yield of most cultivars in 1992, yield of Connecticut Field exceeded 20.0 T/A at both sites. The yield of Howden exceeded 19.0 T/A at Mt. Carmel. In 1993, the heavy yield of Big Autumn (58.0 T/A) was attributed to large average weight (16.0 lb) and prolific fruit production (7,200/A). Yield of Pro Gold 500 and Connecticut Field also exceeded 30 T/A at Windsor. Yield of miniature pumpkins, Baby Bear and Oz, exceeded 12.0 T/A at Windsor. At Mt. Carmel, yield of Big Autumn, JSS 9032, and Pro Gold 500 exceeded 18.0 T/A.

In 1992, post-harvest loss of unprotected fruit, due to frost damage in October, was least for Connecticut Field and Howden. In 1993, Big Autumn and Pro Gold 500 had the least frost damage of all cultivars.

Among all cultivars, Big Autumn, Howden, JSS 9032, and Pro Gold 500 provided excellent yield and quality of fruit. High yield and quality were dependent upon weather and adequate control of Phytophthora, black rot, powdery mildew, cucumber beetles, and vine borers.

The Connecticut Agricultural Experiment Station, founded in 1875, is the first experiment station in America. It is chartered by the General Assembly to make scientific inquiries and experiments regarding plants and their pests, insects, soil and water, and to perform analyses for State agencies. The laboratories of the Station are in New Haven and Windsor; its Lockwood Farm is in Hamden. Single copies of bulletins are available free upon request to Publications; Box 1106; New Haven, Connecticut 06504. ISSN 0097-0905

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BY DAVID E. HILL

Pumpkins are members of the genus *Cucurbita* whose orange fruit is highly prized for fall decoration and as pie and bread ingredients. Most pumpkins belong to the species *C. pepo*, *C. moschata*, and *C. maxima*. *C. pepo* was cultivated by pre-Columbian natives from the Mexico City area northward to the southwestern United States (Yamaguchi 1983). This species is most tolerant to cold weather, hence its northward spread into the Midwest and East. It was reported that pumpkins were originally grown for their edible seeds (Splittstoesser 1979). The fruit is also edible and contains high amounts of Beta-carotene.

Present outlook

The marketing of pumpkins for Halloween decoration and pie filling has increased substantially in the last decade. Many growers of fruit and vegetables who tailor their production for pick-your-own clientele now include a pumpkin patch in their plans. In 1989, the Connecticut Agricultural Marketing Directory listed 29 farmers who grew pick-your-own pumpkins. Another 32 growers listed pumpkins as a major item in their fall sales. Virtually all roadside stands that remain open through October have pumpkins to sell. There are also several growers who supply retail outlets. Although the precise area devoted to pumpkins is unknown, the Connecticut Department of Agriculture estimated that 800-1000 acres were grown in Connecticut in 1993.

To maximize production of pumpkins and to increase sales, growers must choose cultivars that are uniform in color and shape. Many open pollinated cultivars are inconsistent in these qualities. Because decorative pumpkins are mostly selected by eye appeal, a substantial number of pumpkins with defects are left in the field. Breeders have developed many new hybrid cultivars that are more uniform in color and shape and also resist mildew and rot. A new breeding objective is to develop cultivars whose seeds are hulless and readily edible.

In this bulletin, I shall report yield and quality of 14 cultivars, ranging in size from large to miniature. I shall also report on post-harvest losses of pumpkins during 4 weeks of unprotected storage. Strategies to maximize yield will also be discussed.

METHODS AND MATERIALS

Soils

Pumpkin trials were conducted at the Valley Laboratory, Windsor on Merrimac sandy loam, a well drained, sandy terrace soil with somewhat limited moisture holding capacity and at Lockwood Farm, Mt. Carmel on Watchaug loam (1992), a moderately well drained loamy upland soil, and on Cheshire fine sandy loam (1993), both with moderate moisture holding capacity.

Cultivars

Seeds were obtained from several domestic suppliers. A total of 14 cultivars of pumpkins were grown during the 2-year trial (Table 1).

Table 1. Pumpkin cultivars grown at Windsor and Mt. Carmel during 1992-1993.

Cultivar	Characteristics*	1992	1993
Aspen			X
Autumn Gold	PYG	X	
Baby Bear	SH		X
Big Autumn	SB, PYG		X
Connecticut Field		X	X
Ghost Rider		X	X
Howden		X	
JSS 9032			X
Lumina	WHITE		X
New England Pie			X
Oz	SB, PYG	X	X
Pro Gold			
500			X
Spirit			X
Wizard	SB	X	X

*SB = Semi-bush; PYG = Precocious yellow gene; SH = Semi-hulless seed

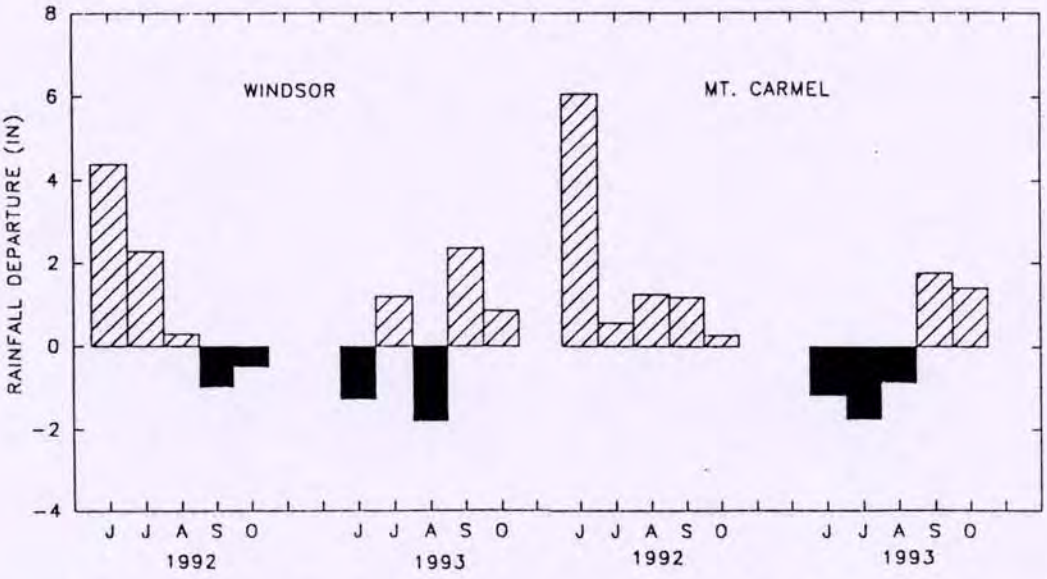

Figure 1. Departure from normal rainfall (0) during the growing seasons 1992-1993 at Mt. Carmel and Windsor.

Semi-bush (SB) cultivars have shorter vines and require less planting space. Cultivars with precocious yellow genes (PYG) are yellow to orange throughout their growth instead of green changing to yellow or orange as they mature. Cultivars with semi-hulless seed (SH) can be readily used for toasted snacks.

Culture

Seeds were sown June 2-5 in groups of 5-7 seeds. The groups were spaced 5 feet apart within rows that were 8 feet apart (1090 planting groups/A). After germination, the plants were thinned to 3 plants/group (1992) and 5 plants/group (1993). At the denser population in 1993, the plants, after thinning, were at least 10 inches apart within each group. In 1992, the plants, after thinning, were 6 inches apart. At each location, there was one row for each cultivar. In 1992, irrigation was not necessary at either site because rainfall was sufficient from June through September. In 1993, a dry year, two irrigations were required at both sites.

Fertilization

Before planting, 3-foot wide planting swaths of soil were fertilized at a rate of 900 lb/A 10-10-10 (90 lb N/A). After 4 weeks, when the plants began to form vines, the unfertilized 5-foot swaths between the rows were fertilized at a rate of 500 lb/A 10-10-10 (50 lb N/A) and rototilled into the soil. Soil pH was about 6.5 at each site; lime was not added.

Disease control

A pre-plant application of Ridomil 2E (2 qt/A) was disked into the soil to a depth of 2 inches to control Phytophthora crown and fruit rot. Black rot and powdery mildew were controlled with alternate weekly applications of Bravo 500 (3 pt/A) and Ridomil-Bravo 81W (2 lb/A) from mid-June to mid-August. Benlate DF (0.5 lb/A and Karathane (0.5 lb/A) were also applied alternately each week from late-June through August to control powdery mildew.

Insect control

Asana XL (9.6 oz/A) was applied weekly from mid-June through mid-July to control vine borers and cucumber beetles.

Weed control

Weeds were controlled by cultivation. Weeds germinating in the 4-week period following planting were rototilled under as the late fertilizer application was incorporated into the soil. Within 3 weeks, the vines completely covered the spaces between the rows and suppressed further weed growth.

Harvest

All pumpkins were harvested from September 20 to October 10. The pumpkins were weighed individually and graded for color, shape, thickness of handle, and presence of surface blemishes. All pumpkins remained unprotected at the edge of the field and were re-graded October 29-30 to determine post-harvest loss from rotting or frost damage.

Rainfall and temperature

Rainfall distribution throughout the pumpkin growing season, June through October (1992-1993), is shown in Figure 1. Each bar represents the departure from the mean monthly rainfall for Hartford and Mt. Carmel reported by the

National Weather Service. In 1992, total rainfall from June through October was 21.1 inches at Windsor and 25.4 inches at Mt. Carmel compared to means of 15.7 inches and 16.2 inches respectively at each site. In 1992, the above-average rainfall from June to August at Windsor and June to September at Mt. Carmel, provided adequate moisture for the growing crop, but caused an extensive infection of Phytophthora at both sites. Pre-harvest and post-harvest loss of fruit were extensive despite attempts to control the disease. Additional post-harvest loss of fruit by frost damage occurred on nights when the temperature fell as low as 28F.

In 1993, total rainfall during the growing season for pumpkins was 17.0 inches at Windsor and 15.5 inches at Mt. Carmel, compared to means of 15.7 inches and 16.2 inches respectively at each site (Figure 1). At Mt. Carmel, below-average rainfall from June to August severely stunted the crop and caused the pumpkins to mature earlier than normal. At Windsor, several local thunderstorms in July replenished moisture deficiency incurred in June and provided enough stored water to balance the deficit in August. Post-harvest loss of fruit was caused by frost damage. At both locations, the unprotected fruit was exposed to freezing temperatures on six nights in October, some as low as 26F.

YIELD AND POST-HARVEST LOSS OF FRUIT

1992 Yields

The average yield of six cultivars at Mt. Carmel was 77% greater (12.4 T/A) than at Windsor (7.0 T/A), Table 2. The lower yield at Windsor was due to an infection of Phytophthora which rotted 43-97% of the fruit of each cultivar. In comparison, pre-harvest losses due to Phytophthora at Mt. Carmel were 24-46% of the fruit of each cultivar. While the losses at Mt. Carmel were less than at Windsor, yield of each cultivar was still about one-half of those expected. The ravages of Phytophthora were observed in many fields throughout Connecticut in late-summer and early-fall 1992.

Despite severe loss of fruit in many cultivars, yield of Connecticut Field exceeded 20.0 T/A at both sites. Yield of Howden exceeded 19.0 T/A at Mt. Carmel, but disease at Windsor reduced the yield to less than 10.0 T/A. The higher yield of both cultivars at Mt. Carmel and Windsor, compared to others, was attributed to some resistance to Phytophthora.

1993 Yields

At Windsor, the average yield of 12 cultivars was 92% greater (26.1 T/A) than at Mt. Carmel (13.6 T/A), Table 3. The lower average yield at Mt. Carmel was due to persistent drought from June to August. Despite irrigation, the plants were stunted and the fruit matured early, in mid-August. At Windsor, local thunderstorms in July provided adequate moisture for the growing crop and the fruit matured normally, in late-August and early-September.

At Windsor, yield of Big Autumn, Pro Gold 500, and Connecticut Field exceeded 30.0 T/A. Big Autumn not only produced large fruit weighing 16.0 lb, but total fruit produced exceeded 7,200/A. The prolific miniature pumpkins, Baby Bear and Oz, produced the most fruit, and yield exceeded 12.0 T/A. Aspen was harvested after the first frost and about 30% of the fruit lost their handles.

At Mt. Carmel, Aspen had the greatest yield despite 16% pre-harvest loss. The yield of Big Autumn, JSS 9032, and Pro Gold 500 exceeded 18 T/A. The miniature and small pumpkin cultivars, Baby Bear, Oz, and New England Pie had the greatest number of fruit/A. An infection of Phytophthora, 2 weeks before harvest, reduced the percent of fruit harvested for Wizard.

Table 2. Yield of pumpkins at Windsor and Mt. Carmel, 1992

	WINDSOR					MT. CARMEL				
Cultivar	Hvst. %	Avg. Wt. lbs.	Total* Yield T/A	Total Fruit #/A	Field Storage Losses %	Hvst. %	Avg. Wt. lbs.	Total* Yield T/A	Total Fruit #/A	Field Storage Losses %
Autumn Gold	12	12.6	2.3	365	100	68	8.9	9.7	2180	30
Conn. Field	57	23.7	24.1	2035	21	76	20.5	20.8	2030	21
Ghost Rider	22	8.7	3.2	725	90	62	9.2	8.7	1890	46
Howden	24	23.7	9.5	800	27	79	17.7	19.3	2180	20
Oz	18	3.8	2.0	1090	47	68	3.6	7.0	3920	56
Wizard	3	19.0	0.7	75	100	54	3.2	8.6	1305	33

*Total yield = yield of fruit/75 ft. row x 72.6 (# 75-foot segments in 5445 linear feet of row/A)

Table 3. Yield of pumpkins at Windsor and Mt. Carmel, 1993.

	WINDSOR					MT. CARMEL				
	Hvst. %	Avg. Wt. lbs.	Total* Yield T/A	Total Fruit #/A	Field Storage Losses %	Hvst. %	Avg. Wt. lbs.	Total* Yield T/A	Total Fruit #/A	Field Storage Losses %
Cultivar										
Aspen	61	14.8	24.2	3270	64	84	11.9	27.0	4520	72
Baby Bear	95	1.7	12.2	14405	41	95	1.4	4.6	6700	34
Big Autumn	87	16.0	58.5	7285	33	83	10.3	18.9	3685	66
Conn. Field	97	12.8	31.6	4940	78	82	9.5	16.4	3435	78
Ghost Rider	87	8.8	22.5	5110	88	89	9.2	15.8	3435	68
JSS 9032	95	11.4	28.3	4940	74	90	10.2	18.7	3685	70
Lumina	88	7.5	16.7	4440	45	90	8.6	6.9	1590	37
New Eng. Pie	95	4.4	14.7	6700	44	93	3.8	8.8	4605	53
Oz	96	3.4	18.2	18805	7	87	3.2	8.0	5025	78
Pro Gold 500	95	15.5	35.6	4605	53	89	13.0	18.0	2765	48
Spirit	88	9.9	26.1	5275	65	91	8.2	16.8	4105	67
Wizard	79	11.8	24.7	4190	98	39	9.9	3.7	755	78

*Total yield = Yield of fruit/65 ft. row x 83.75 (#65-foot segments in 5445 linear feet of row/A)

Table 4. Losses of harvested pumpkins during 4 weeks of unprotected storage.

	WINDSOR		MT. CARMEL	
	1992 %	1993 %	1992 %	1993 %
Cultivar				
Autumn Gold	100	-	30	-
Aspen	-	64	-	72
Baby Bear	-	41	-	34
Big Autumn	-	33	-	66
Connecticut. Field	21	78	21	78
Ghost Rider	90	88	46	68
Howden	27	-	20	-
JSS 9032	-	74	-	70
Lumina	-	45	-	37
New England Pie	-	44	-	53
Oz	47	7	56	78
Pro Gold 500	-	53	-	48
Spirit	-	65	-	67
Wizard	100	98	33	78

Post-harvest loss of fruit

Although harvested pumpkins should be protected from rain and frost to reduce post-harvest losses, all fruit were unprotected during October to resemble conditions in pick-your-own operations. At both locations, there were 2-4 light frosts (30-32F) and 2-3 moderate frosts (26-29F) each year. Frost damage appeared as water-soaked, discolored patches on the shoulders of the fruit. The weakened handles severed from the fruit when lifted.

In 1992, post-harvest loss of Connecticut Field and Howden was least at both sites, Table 4. Post harvest loss of Oz averaged about 50% at each site. At Windsor, large post-harvest losses of Autumn Gold, Ghost Rider, and Wizard were due to frost damage and rotting by Phytophthora.

In 1993, among all cultivars, post-harvest loss of Oz was least at Windsor but among the greatest at Mt. Carmel. At Mt. Carmel, Oz matured at least 3 weeks earlier than at Windsor and the more mature fruit were damaged more readily. Among the large pumpkins, Big Autumn and Pro Gold 500 were less damaged by frost than Connecticut Field, Ghost Rider, and Wizard.

FRUIT CHARACTERISTICS

Several fruit characteristics, observed during the trials, may assist the grower in the selection of cultivars, Table 5. These characteristics varied slightly from site to site and depended upon weather, disease, and speed of maturity. Weather and disease controlled vine health. Vines stunted by drought or disease produced smaller fruit and thinner handles.

WEIGHT DISTRIBUTION

Commercial seed catalogues generally rate cultivars according to their weight class; i.e. 10-15 lbs, 20-25 lbs, etc.

Table 5. Characteristics of pumpkin fruit (average of Windsor and Mt. Carmel)

	Color	Ribbing	Handle thickness	Shape	Shape Uniformity
Autumn Gold	Deep orange	Moderate, deep	Medium	Globe	Somewhat uniform
Aspen	Light orange	Moderate, shallow	Medium	Upright globe	Somewhat variable
Baby Bear	Orange	Many, deep	Thin	Flattened globe	Uniform
Big Autumn	Orange	Few, shallow	Medium	Upright globe	Somewhat variable
Connecticut Field	Light orange	Many, deep	Medium to thick	Upright to globe	Variable
Ghost Rider	Deep orange	Moderate, shallow	Medium to thick	Upright	Somewhat variable
Howden	Deep orange	Many, deep	Thick	Upright to globe	Variable
JSS 9032	Orange	Moderate, deep	Thick	Upright globe	Somewhat variable
Lumina	White*	Few, deep	Thin	Flattened globe	Uniform
New England Pie	Deep, orange	Many, deep	Medium	Flattened globe	Uniform
Oz	Orange	Smooth	Thick	Globe	Very uniform
Pro Gold 500	Deep orange	Many, deep	Thick	Upright globe	Uniform
Spirit	Light orange	Few, shallow	Medium	Upright globe	Somewhat uniform
Wizard	Deep orange	Many, deep	Medium	Globe	Uniform

*Overmature or stressed fruit may develop a grayish-green cast.

Table 6. Percent distribution among weight classes (lb) of pumpkin fruit at Windsor and Mt. Carmel. The underlined numbers represent the median weight class.

	WINDSOR						MT. CARMEL					
	<5	5-10	10-15	15-20	20-25	>25	<5	5-10	10-15	15-20	20-25	>25
Cultivar												
Autumn Gold	-	40	20	20	20	-	13	50	37	-	-	-
Aspen	-	21	40	21	18	-	6	28	42	20	2	2
Baby Bear	100	-	-	-	-		100	-	-	-	-	-
Big Autumn	3	11	30	30	21	5	14	34	36	14	2	-
Connecticut Field*	-	23	30	17	14	16	4	28	25	22	13	8
Ghost Rider*	14	47	33	3	3	-	15	45	30	9	1	-
Howden	-	-	9	18	18	55	-	13	17	33	27	10
JSS 9032	12	22	47	15	2	2	16	36	30	14	4	-
Lumina	15	72	13	-	-	-	10	53	37	-	-	-
New England Pie	76	24	-	-	-	-	84	16	-	-	-	-
Oz*	100	-	-	-	-	-	100	-	-	-	-	-
Pro Gold 500	-	13	42	26	15	4	6	25	30	30	9	-
Spirit	10	43	38	3	6	-	16	62	16	6	-	-
Wizard*		10	24	41	20	5	-	4	33	30	33	- -

* Average of 2 years

These catalogue ratings are very general and represent average weights attained by pumpkins growing under favorable temperature, moisture, nutrient supply, and freedom from disease. In my trials each cultivar produced a population of fruit that encompassed several weight classes, Table 6. In 1993, the median weight classes of Autumn Gold, Big Autumn, Howden and JSS 9032 were one class greater at Windsor than at Mt. Carmel, the result of a more favorable supply of moisture. Clearly, at Windsor, Howden produced the heaviest fruit followed by Big Autumn. The medians of Aspen, Autumn Gold, Connecticut Field, JSS 9032, Pro Gold 500, and Wizard were in the 10-15 lb class at both sites. As

expected, Baby Bear, New England Pie, and Oz mostly fell in the <5 lb class at both sites. The medians of Aspen, Connecticut Field, Ghost Rider, JSS 9032, Lumina, Pro Gold 500, and Wizard fell one or two weight classes below those reported in commercial catalogues. These lower medians were undoubtedly due to unfavorable growing conditions in 1992 (too wet) at both sites and 1993 (too dry) at Mt. Carmel. In 1993, the greater plant population increased the average yield/A of most cultivars, but the fruit size was smaller.

MANAGEMENT STRATEGIES

Site selection

In 1992, average yields of all cultivars at Mt. Carmel was 10,800 lb/A greater than at Windsor; in 1993, it was 25,000 lb/A less. Although the yields of pumpkins in 1992 and 1993 were highly dependent upon weather and disease control, the fine sandy loam soils at Mt. Carmel provided a greater moisture holding capacity than the sandy soil at Windsor. Sandy soils require more frequent light irrigations than loamy soils. An important consideration is the location of the field. Growing sites that permit good air movement are less susceptible to disease infections than small fields surrounded by tall trees that inhibit air movement. Pumpkins in fields at the base of narrow valleys are more susceptible to damage by early frosts than in fields on upper slopes. Pick-your-own fields are at greater risk in low-lying areas where early frosts are known.

Selection of cultivars

The ideal cultivar produces a high yield of uniformly shaped fruit and withstands damage from frost and disease. Some growers report that their customers prefer a somewhat upright globe-shaped fruit that is deep orange in color. For pumpkins exceeding 20 lbs, Howden has the greatest yield, followed by Connecticut Field. The fruit of Connecticut Field is more variable in size than Howden and has more fruit with flat surfaces.

For pumpkins in the 10-20 lb range, Big Autumn, JSS 9032, and Pro Gold 500 had excellent yields. Pro Gold 500 was more uniform in shape, had thicker handles, and greater durability in unprotected storage than Big Autumn or JSS 9032. Big Autumn, with its precocious yellow gene, had yellow coloration at the base of its handle and post-harvest loss due to frost damage was greater than Pro Gold 500 or JSS 9032.

Among the cultivars weighing less than 5 lbs, Oz had the greatest yield and uniformity of fruit. Its post-harvest loss was variable. Baby Bear and Oz were the most prolific producers of fruit. The fruit of Oz weighed twice as much as Baby Bear.

Insect and disease control

Pumpkin fruit and vines are highly susceptible to disease and infestation by vine borers and cucumber beetles. For disease control, regular applications of fungicides, especially during periods of cool, wet weather, were necessary to insure greater yield of fruit. In fields where black rot and Phytophthora are known, pre-plant incorporation of fungicide may be necessary. Additional applications of fungicides every 7-10 days to developing vines and fruit in late-June through August should control infection. If cucumber beetles and vine borers have been observed in late-June, insecticides applied weekly through mid-July will control populations until they naturally decline.

Post-harvest storage

Pumpkins can be stored at 50-55F and 70-75% relative humidity for several months (Ashley 1992). For 3-4-week storage prior to Halloween pumpkins can be placed in a dry area where temperatures do not fall below 32F or covered with plastic sheets or tarpaulins to protect them when frost threatens. Fruit left in the field for pick-your-own clientele cannot be protected from frost. Selection of cultivars that are more resistant to frost damage is an alternative. Among the large and medium size pumpkins, Howden, and Pro Gold 500 lost fewest fruit to frost damage. The miniature pumpkin, Baby Bear, was more resistant to frost damage than Oz.

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