Effect of Cultural Practices on Processed Cherry Quality[1,2]

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Abstract. Montmorency cherries were grown for 6 years in southeastern Pennsylvania with 3 kinds of cover crops and 3 levels of N fertilization. The largest fruit was produced with sudan grass cover and the smallest with rye grass-vetch cover. Level of N fertilization had little effect on fresh cherry size or soluble solids content. Similar drained weights and processed yields of canned cherries were obtained with all samples, regardless of orchard treatment. The canned cherries from low N treatment had most red color, and those from sudan grass plots had the least. N content of the canned cherries was correlated with the level of N fertilization. N content of cherries grown on sudan grass plots was relatively high, and that of fruit from rye grass plots was relatively low.

Cherry size, color, soluble solids content, and processed yield varied widely according to the year, the effect of year exceeding the effects of both cover crop and fertilizer level.

Introduction

Considerable information is available concerning the effects of weather and horticultural practices on the yield and quality of red tart cherries. Tukey and Tukey (18) found that excessive moisture during the final growth stage may increase cherry size and reduce soluble solids. Cain (4, 5, 6), Fisher (7) and Gilbert (8) showed the response of the cherry to various fertilizer treatments. They described the modifying effects of area, soil depth, cover crop, and moisture availability during and after fruit growth. They concluded that cover crops often compete with the cherry tree for both moisture and N, thereby affecting cherry size, yield and maturity.

Moore (17) stated that a defoliating disease, or one reducing water loss by transpiration, may increase cherry size. Langer and Fisher (15) found that size and growth may be affected also by the use of wax-containing sprays. Bedford and Robertson (1, 2, 3) reported that growing conditions, as influenced by temperature, moisture, and fertilizer, may affect the texture and drained weight of canned cherries. Recently, Lawver and Hartz (9, 16) have described some effects of sprays on the quality factors of fresh and canned cherries.

Hewetson (10, 11) reported that some cover crops, such as sudan grass when properly controlled, may increase the yield and size of

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cherries in southeastern Pennsylvania. Other cover crops such as rye grass may have the opposite effect by reducing the available N during growth of the fruit. Kenworthy (12, 13, 14) observed similar effects in Michigan orchards.

The study reported here was to determine, in the southeastern Pennsylvania area, the effects of N fertilization level and type of cover crop on the characteristics of the fresh tart cherry and on the quality and yield of the canned product.

Methods

The study was conducted 6 years, on a fairly heavy silt loam soil, with good drainage on Pennsylvania State University plots at Arendtsville, Pennsylvania. Treatment of the 27 subplots are shown in Table 1. Each of 3 types of cover crop and 3 N fertilizer levels was replicated 3 times in a manner designed to minimize interplot effects. Each subplot contained 6 trees, with a buffer tree row between the different types of cover crop but not between the different N fertilizer levels within each cover crop area.

The cover crops were sudan grass, rye grass, rye grass-vetch. Rye grass grew vigorously throughout the summer. Sudan grass and rye grass-vetch, however, were winter-killed and were disked into the soil in early June and reseeded after fruit harvest. Part of the results on these plots, therefore, may be attributed to semi-clean cultivation during the period of fruit growth.

Nitrogen treatments are shown in Table 1. Annual applications of P_2O_5 (35 to 40 lbs/acre) and K_2O (180 to 200 lbs/acre) were made also.

The orchard was set in 1949. The fertilizer-cover crop treatments were started in 1956, and continued through 1962.

Fruit Selection. Samples were picked from about ½ of the plots the first day of commercial harvest and from the remainder the following day. The fruit was picked in the morning and processed the afternoon of the same day. About 30 cherries were picked from each of the 4 corners of each of the 6 trees of each subplot, and were pooled to form one sample.

Table 1.—Plot plan of cherry orchard, showing arrangement of 3 cover crops and 3 levels of N fertilizer.

Plot no.	Cover crop								
	Sudan grass	Rye grass	Rye grass-vetch	Rye grass	Sudan grass	Rye grass-vetch	Sudan grass	Rye grass-vetch	Rye grass
	Nitrogen level[a]								
1–9	L	L	L	H	H	H	M	M	M
10–18	M	M	M	L	L	L	H	H	H
19–27	H	H	H	M	M	M	L	L	L

[a]M = 1/3 lb of $NaNO_3$ per tree the first year, plus an increase of 1/3 lb per tree each year for 5 succeeding years, or a total of 7 lb during the 6 years.
H = 3M, a total of 21 lb during 6 years.
L = M/3, a total of 2-1/3 lb during 6 years.

Processing. The cherries were processed in the laboratory of the C. H. Musselman Company, Biglerville, Pennsylvania. After removal of defective and immature fruit, average cherry weight and soluble solids content (refractometer) were determined. Cherries were held in ice water for 4 to 5 hours and then pitted with a 6-needle laboratory pitter. Precisely 360 g of the pitted cherries were placed into each of 4 No. 303 cans. The cans were topped with hot water, exhausted to a center temperature of 170° F, sealed, and cooked 12 minutes at 212°. They were then cooled, cased, and stored at room temperature for evaluation 4 to 6 months later.

Product Evaluation. The canned cherries were evaluated on the basis of drained weight, soluble solids, objective color, and N content. Drained weight was determined by allowing the fruit to drain on an 8 mesh screen for 2 minutes. Objective color was measured at 520 mμ on a General Electric Spectrophotometer[5] after 1 part of the filtered juice was diluted with 3 parts water. The N content of the pureed fruit was determined by the Kjeldahl method (19).

RESULTS AND DISCUSSION

Cherry Size. Effects of the treatments on cherry size during the 6-year period are summarized in Table 2. The cherries produced on the sudan grass plots were slightly but significantly larger than those on the rye grass-vetch plots. Low level of N fertilization produced slightly larger cherries than did the medium and high levels. Apparently, the amount of N in the low level plots was sufficient to prevent the development of extreme deficiency symptoms. The year to year variations in cherry size were relatively large (Table 3).

Soluble Solids. The level of N had no significant effect on the soluble solids content of the cherries (Table 2). The type of cover crop had only a slight effect on soluble solids content. Cherries from the rye grass plot were somewhat higher in soluble solids than those from the sudan grass or rye grass-vetch plots. In contrast, the effect of year on soluble solids content was variable (Table 3).

Yield of Pitted Fruit. Neither the type of cover crop nor the level of N fertilization had much effect on the yield of pitted cherries (Table 2). The differences in pitted yield were small and, for the most part, not statistically significant. The only exception was the fruit from the medium N plots, which gave a significantly higher pitted yield than that from the other plots.

Processed Yield. An item of major importance to the canner is processed yield. He seeks the maximum number of cases of canned cherries per ton of fresh fruit. Total processed yield (ratio of drained weight to fresh weight) is dependent largely on sorting losses, pitting losses, and shrinkage of fruit during cooking. In the present tests, the processed yields of cherries from all of the experimental plots were similar (Table 2) with no differences attributable

[5]Mention of company or trade name does not imply endorsement by the Department over others not named.

Table 2.—Effect of N fertilizer and type of cover crop on fresh cherry size, soluble solids, pitted yield, yield of canned cherries, color of product, and N content (6 year avg.).

N leve	Cover crop				Cover crop			
	Sudan grass	Rye grass	Rye grass-vetch		Sudan grass	Rye grass	Rye grass-vetch	
	Wt of 100 fresh cherries, g			Avg	Yield of canned cherries, %[e]			Avg
H	429	420	406	418^{b}	70.84	70.53	70.24	70.54^{a}
M	430	426	413	423^{b}	71.38	70.62	70.50	70.83^{a}
L	439	431	423	431^{a}	70.59	70.88	70.78	70.75^{a}
Avg	433^{a}	426^{b}	414^{c}	424	70.94^{a}	70.67^{a}	70.51^{a}	70.71
	Soluble solids, %				Color-transmittance, %[f]			
H	14.00	13.89	14.26	14.05^{a}	22.62	23.47	19.91	22.00^{b}
M	13.95	14.07	13.81	13.94^{a}	23.85	20.61	20.69	21.72^{b}
L	13.84	14.39	13.96	14.06^{a}	21.93	18.02	20.52	20.16^{a}
Avg	13.93^{b}	14.12^{a}	14.01^{b}	14.02	22.80^{a}	20.70^{b}	20.37^{b}	21.29
	Yield of pitted cherries, %[d]				N content of canned product, %[g]			
H	84.33	84.08	83.51	83.99^{b}	.1289	.1269	.1231	.1263^{a}
M	84.92	84.53	84.28	84.58^{a}	.1228	.1104	.1169	.1167^{a}
L	84.03	84.07	84.27	84.12^{b}	.1162	.0959	.1048	.1056^{c}
Avg	84.43^{a}	84.23^{a}	84.04^{a}	84.23	.1226^{a}	.1111^{b}	.1149^{c}	.1162

[a,b,c]Average "a" is significantly different at .05 from those averages not having "a"; those followed by "b" are significantly different from those not having "b", etc.
[d]Yield = 100 x pitted wt/fresh wt.
[e]Yield = 100 x drained wt/fresh wt.
[f]Values = % transmittance at wavelength of 520 mμ.
Water = 100%; lowest values indicate greatest redness.
[g]Wet wt basis.

to level of N fertilization or type of cover crop. The minor fresh fruit differences had no carry-over effect on processed yield.

Cherry Color. The cultural treatments had important effects on the color of the juice of the canned product as measured by light transmittance (Table 2). The juice of cherries from the low N plots was significantly redder after canning than from those grown on the medium and high N plots. Likewise, cherries produced on the sudan grass plots were significantly less red than those produced on the rye grass and rye grass-vetch plots.

Table 3.—Effect of year on characteristics of fresh and canned red tart cherries.

Factor	Year						Avg
	1957	1958	1959	1960	1961	1962	
Fresh Fruit							
Wt of 100 cherries, g	406	484	376	441	391	451	425
Soluble solids content, %[a]	14.0	13.5	13.2	13.1	15.5	13.8	13,9
Pitted wt, %[b]	83.5	83.5	83.3	84.5	86.8	84.0	84.3
Canned Fruit							
Drained wt, %[c]	82.8	83.9	83.2	81.4	86.2	85.0	83.8
Processed yield, %[d]	69.2	70.1	69.3	68.9	73.1	72.1	70.5
Color, light transmittance, %[e]	17.8	17.2	10.3	13.0	27.4	38.8	20.8
N content, %[f]	.126	—	.132	.127	.114	.127	.125

[a]Fresh refractometer.
[b]Pitted wt/fresh wt x 100.
[c]Drained wt/put in wt x 100.
[d]Processed yield is ratio of drained wt to original fresh wt x 100.
[e]Transmittance of water = 100.0%. Lowest values indicate the greatest redness.
[f]Wet wt basis.

Nitrogen Content. The cherries assimilated N in accordance with its concentration in the plots (Table 2). Fruit from the high N plots contained the most N, and those from the low N plots contained the least.

Fruit grown on the sudan grass plots contained a relatively high proportion of N. As indicated previously, these plots were essentially free of vegetation at the time of maximum cherry growth. This condition apparently favored the uptake of applied N by the tree. In contrast, the N content of cherries grown on the rye grass plots was relatively low. The vigorously growing rye grass apparently competed successfully with the cherry tree for a share of the available N.

Effect of Year. In comparison with the effects of cover crops and N fertilizer levels, the effects of year on the characteristics of the fresh and canned cherries were large. Each successive year the cherries differed considerably in size, some annual variations ranging from 376 to 484 g per 100 cherries (Table 3). Considerable differences in soluble solids content and pitted weight of the fresh cherries were obtained also. After canning, the cherries showed year to year variations in drained weight, processed yield, color, and N content.

An interesting corollary is that cherries grown in Pennsylvania and Michigan during 1957 through 1960 showed parallel and similar annual variations in size. For example, in 1958 and 1960 the cherries produced in both states were relatively large; in 1957 and 1959 they were relatively small (3). Apparently, similar climatic growth conditions prevailed over wide areas during these years.

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