Red Tart Cherry Fruit Quality: Measuring Fruit Firmness Objectively
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FARM SCIENCE

Red Tart Cherry Fruit Quality: Measuring Fruit Firmness Objectively

by A. L. Kenworthy and Lowell Silsby[1]

INTRODUCTION

Red tart cherry fruit firmness has been measured in research studies since 1966 using a Durometer[2], Type 00. The durometer was used to determine fruit firmness as related to various treatments (Alar, fertilizers, delayed harvest, mechanical harvest, cooling, etc.)

THE DUROMETER

The Durometer (Fig. 1) is a spring activated instrument that is durable and reliable. It has a 3/32-in. spherical indenter that does not puncture the fruit. The instrument scale reads from 0-100 with 100 representing 4 oz resistance to the indenter.

Fruit firmness measured with the Durometer was compared with flesh firmness measured with a Magness-Taylor pressure tester with a 5/16-in. plunger. Paired measurements were made on the same fruit. First the Durometer reading was taken, then a disc of peel was removed and a reading taken with the pressure tester on flesh firmness. A highly significant correlation between the two readings was shown. Also, several identical readings can be made with the Durometer on a single fruit.

Fig. 1. The Durometer, Type 00, is used to measure red tart cherry fruit firmness. Indenter at bottom is 3/32 in. in diameter with spherical point; 100 on the scale equals 4 oz.

The Durometer is used by holding the fruit between the fingers with the indenter centered on the fruit side. The fruit is then pressed firmly against the bottom plate. Excessive pressure with fingers or against

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[2]Shore Instrument and Mfg. Co., Jamaica, New York.

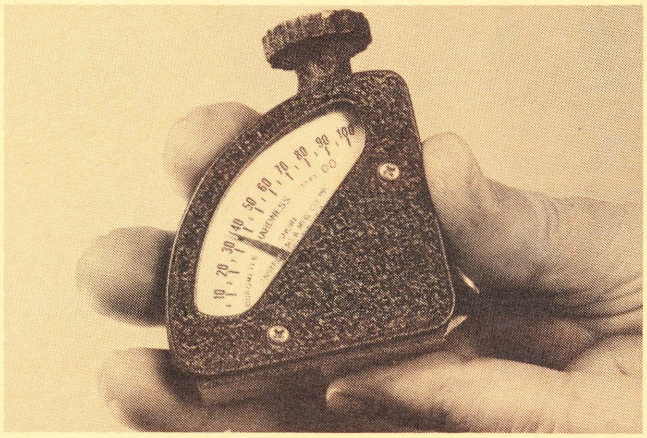

Fig. 2. The Durometer used to measure red tart cherry fruit firmness. As indenter is depressed a reading is obtained. Reading must be taken while indenter is depressed.

bottom plate may increase the reading. The reading is taken while the fruit is held in place. The reading will be higher if the indenter is placed on the suture (Fig. 2).

FRUIT FIRMNESS VARIABLES

Fruit firmness determinations prior to harvest may be made on hand picked or unharvested fruit. Random samples were used when measuring fruit firmness at harvest. Fruit at the top of the cooling tank were used to measure firmness after cooling. A determination usually involved 100 fruit or fruit from 10 trees or 10 tanks.

Table 1 shows firmness prior to harvest varied between seasons and that as the harvest season progressed fruit firmness decreased. Bruising by strong winds was observed to either prevent the softening of fruit or to increase fruit firmness (Table 2). This effect may persist for 1 or 2 weeks.

Table 1. Red tart cherry fruit firmness before harvest (within 24 hours) (influence of season and delayed harvest; Durometer units)

	Week			
Year	1	2	3	4
1966	49.9	48.7	47.1	
1967	53.7	48.2	47.7	46.2
1968	52.2	50.9	46.9	43.9
1969	54.4	52.1	51.4	
Average	51.8	50.0	48.3	

Table 2. Red tart cherry fruit firmness (influence of wind on firmness; Durometer units)

	Week			
Year	1	2	3	4
1966	49.2	48.3	48.9(a)	
1967	47.5	47.9(a)	49.1	44.9

(a) Wind 24 hours or more prior to measurement.

The effect of mechanical harvesting and cooling on fruit firmness is shown in Table 3. The average values indicate a loss of 11.5 units upon mechanical harvesting and 7.7 units of re-firming on the cooling pad with a net loss of 6.8 units during the harvest and cooling operations. Mechanical harvesting reduced firmness more in one location than another. Re-firming decreased more as harvest season progressed.

Table 4 presents data showing firmness as a percentage of fruit reading below a selected durometer value. For comparison, scores for raw and pitted products and yield of pitted product (% of raw product) are shown. These data indicate that with an average pre-harvest firmness of 58.8 units, harvesting and cooling resulted in 29.8 % of the fruit reading below 40 Durometer units and 3.5% below 30 units. When pitted, 19.1% were below 20 units and 4.8% below 10 units. Not all loss of firmness in the processing plant is due to the pitting operation. Each drop or transfer of cherries reduces firmness. This loss may amount to more than 5% in firmness by the time the fruit passes the electric eye sorter.

Table 4. Red tart cherry fruit firmness (influence of harvesting, cooling and pitting; Durometer measurements; 1972)

	Location			
	1	2	3	Average
Pre-harvest (units)	58.6	57.5	60.2	58.8
After Soak				
Below 40 Units (%)	42.8	29.5	17.0	29.8
Below 30 Units (%)	7.0	2.5	1.0	3.5
Pitted Fruit				
Below 20 Units (%)	23.4	21.8	12.0	19.1
Below 10 Units (%)	7.0	1.5	5.8	4.8
Raw Product Score (%)	84.0	87.1	—	—
USDA Score (%)	94.0	96.7	95.7	95.7
Yield (%)(a)	80.5	75.7	74.7	77.7

(a) Yield = [lb pitted fruit/lb raw fruit]x 100

When several individuals determined pre-harvest firmness on a single sample at different locations on different dates, variability that occurred is shown in Table 5. The range in firmness values reflects differences between individuals, most of whom had not used the Durometer previously. This indicates training or practice would be desirable. Average values indicate a low variability with about nine fruit being needed for an accuracy of 5 Durometer units. The range of values indicates that, on individual observations, the variability may be higher and the number of fruit necessary for a 5-unit accuracy may be as high as 22. Thus, a 20-fruit sample should be used to assure accuracy for the most variable samples.

Table 6 shows similar data for post-harvest measurements made on fruit from the top of the tanks on the cooling pad. A sample size of 30 fruit should be used to assure a 5-unit accuracy of the most variable sample.

Table 3. Red tart cherry fruit firmness (influence of mechanical harvesting and cooling; Durometer units; 1973)

Orchard	Week	On Tree	Mechanical Harvest (Loss)		Cooled (Re-firm)	
1	1	51.4	43.2	8.2	53.9	10.7
	2	45.0	37.0	8.0	47.4	10.4
2	1	50.4	37.6	12.8	47.2	9.6
	2	52.9	39.5	13.4	44.6	5.1
	3	52.9	37.5	15.4	40.6	3.0
	Average	50.5	39.0	11.5	46.7	7.7

Table 5. Red tart cherry fruit firmness (pre-harvest; several orchards, individuals, locations, dates; 31 observations; Durometer units; 1973)

	Range	Average
Firmness	46.8-58.6	52.0
Standard Deviation	5.4-31.6	11.8
Coefficient Variation	4.4-12.0	6.5
Estimated Sample Size Needed(a)	5-22	8.6

(a) Number of fruit necessary for accuracy within 5 Durometer units.

Table 6. Red tart cherry fruit firmness (post-harvest, two locations, several individuals, 13 observations; Durometer units; 1973)

	Range	Average
Firmness	43.8-53.3	47.2
Standard Deviation	20.3-61.8	32.0
Coefficient Variation	8.1-13.8	12.0
Estimated Sample Size Needed(a)	13-31	23.0

(a) Number of fruit necessary for accuracy within 5 Durometer units.

SUMMARY

The Durometer, Type 00, is a reliable instrument for measuring red tart cherry fruit firmness. It is easy to use and durable. With proper use of the Durometer, a grower can determine fruit firmness prior to harvest and at various stages of harvesting and handling. Also, he can determine fruit firmness on the cooling pad prior to delivery to the processor, thus assuring adequate re-firming.

The processor can use the Durometer to objectively measure firmness of pitted fruit. Thus, the Durometer can eliminate the subjective measurement of fruit firmness in determining raw product grade and determining "character" for the pitted product score.

The following values could be used:

Raw Product

Pre-harvest: above 40 units but below 60.
Sample Size: 20-25 fruit minimum

After cooling: above 30 units with less than 10% below 30.
Sample Size: 30-50 fruit minimum

Pitted Product: above 10 units with less than 10% below 10.
Sample Size: 100 fruit

ACKNOWLEDGMENTS

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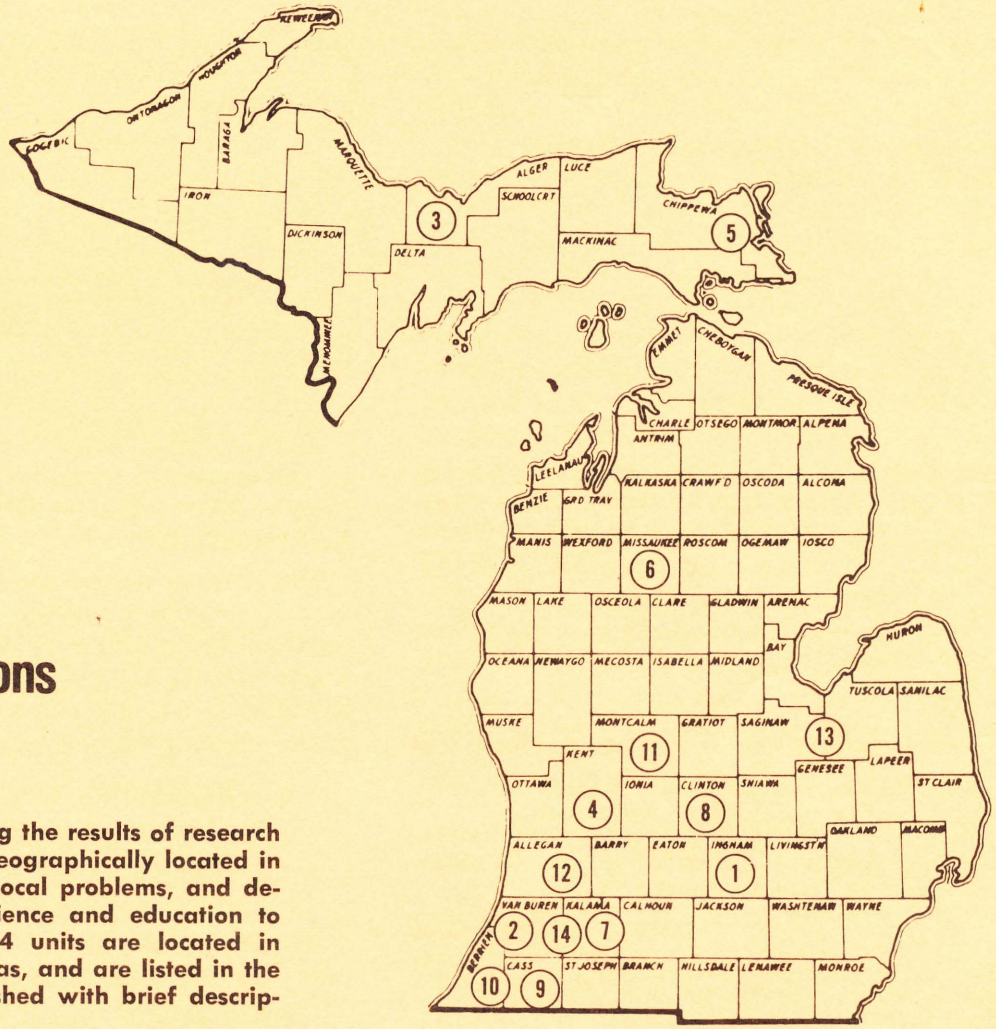
Outlying Field Research Stations



These research units bring the results of research to the users. They are geographically located in Michigan to help solve local problems, and develop a closeness of science and education to the producers. These 14 units are located in important producing areas, and are listed in the order they were established with brief descriptions of their roles.

(1) Michigan Agricultural Experiment Station. Headquarters, 101 Agriculture Hall. Established 1888. Research work in all phases of Michigan agriculture and related fields.

(2) South Haven Experiment Station, South Haven. Established 1890. Breeding peaches, blueberries, apricots. Small fruit management.

(3) Upper Peninsula Experiment Station, Chatham. Established 1907. Beef, dairy, soils and crops. In addition to the station proper, there is the Jim Wells Forest.

(4) Graham Horticultural Experiment Station, Grand Rapids. Established 1919. Varieties, orchard soil management, spray methods.

(5) Dunbar Forest Experiment Station, Sault Ste. Marie. Established 1925. Forest management.

(6) Lake City Experiment Station, Lake City. Established 1928. Breeding, feeding and management of beef cattle and fish pond production studies.

(7) W. K. Kellogg Farm and Bird Sanctuary, Hickory Corners, and W. K. Kellogg Forest, Augusta. Established 1928. Forest management, wildlife studies, mink and dairy nutrition.

(8) Muck Experimental Farm, Laingsburg. Plots established 1941. Crop production practices on organic soils.

(9) Fred Russ Forest, Cassopolis. Established 1942. Hardwood forest management.

(10) Sodus Horticultural Experiment Station, Sodus. Established 1954. Production of small fruit and vegetable crops. (land leased)

(11) Montcalm Experimental Farm, Enrican. Established 1966. Research on crops for processing, with special emphasis on potatoes. (land leased)

(12) Trevor Nichols Experimental Farm, Fennville. Established 1967. Studies related to fruit crop production with emphasis on pesticides research.

(13) Saginaw Valley Beet and Bean Research Farm, Saginaw. Established 1971. Studies related to production of sugar beets and dry edible beans in rotation programs.

(14) Kalamazoo Orchard, Kalamazoo. Established 1974. Research on integrated pest control of fruit crops.

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