DEVELOPMENT OF A METHOD TO DETERMINE MEALINESS IN PEACHES

By

JOSE ANTONIO MURILLO

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1992

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
December, 1994

DEVELOPMENT OF A METHOD TO DETERMINE

MEALINESS IN PEACHES

Thesis Approved:

Gerald H. Brusewitz

Thesis Adviser

Dean of the Graduate College

DEVELOPMENT OF A METHOD TO DETERMINE

MEALINESS IN PEACHES

Thesis Approved:

Gerald H. Brusewitz

Thesis Adviser

Dean of the Graduate College

ACKNOWLEDGMENTS

I would like to express my sincere appreciation to my advisor, Dr. Gerald H. Brusewitz for his advice, criticism, encouragement, and patience throughout the course of this study. I am also grateful to Dr. Niels O. Maness and Dr. Marvin L. Stone, members of my advisory committee, for guidance, assistance, and invaluable help throughout this study.

Thanks also to the staff and students of the Biosystems and Agricultural Engineering Department for their friendship and help provided in the various phases of this study.

A special note of gratitude is expressed to my parents and to Mary Joyce. Their love, support and encouragement have been invaluable throughout this project.

Finally, I would like to thank the Biosystems and Agricultural Engineering Department for their financial support throughout the term of this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Raised consumer perception of the high value of fresh fruit in the diet has caused an increase in its consumption. The potential for further market expansion will however, require further improvements in product quality. Competition between the various commodities will cause higher pressure on short season fruit such as peaches.

Next to visual appearance, firmness is the most important factor of quality. It is also important in determining shipping ability since soft fruits are highly susceptible to physical damage. Another textural factor is juiciness; consumers prefer juicy, not dry and mealy, flesh. Fruit firmness depends on skin toughness, flesh firmness, and internal structure (i.e., thickness of the flesh, stone size, and ease of separation from the flesh). Firmness is closely associated with ripening; as a fruit ripens, it softens (Kader and Mitchell, 1989).

To extend their life, fresh peaches can be cold stored, in some cases for long periods of time; for example when the supply of peaches is beyond demand, when the producer may want to wait for market improvements, or when peaches will be transported long distances. This research deals with the internal disorders that occur when peaches are stored at low temperatures for long periods of time. Internal disorders caused by improper storage often are not apparent until peaches are examined after ripening at room

temperature. Two different extremes may occur when chilling injury is present: one gives a dry and mealy (i.e., grainy) texture while the other one a wet and pasty texture.

Mealiness is a physiological disorder of peaches and nectarines found, after long periods of cold storage, when they fail to ripen normally resulting in a lack of juice and a dry, grainy texture. During the development of mealiness, free moisture (juice) is converted into bound moisture without any change in the total moisture content.

Mealiness in peaches can be determined in two different ways. The qualitative method of detecting mealiness is by making sensory evaluations with a taste panel. Texture appears to be a difficult quality parameter to judge with a high degree of precision. In part, this problem is caused by differences in personal preference and partly by influences of other factors such as temperature, juiciness, sweetness, and acidity (Sistrunk, 1985). The second, and only quantitative, method to detect mealiness is where the amount of free moisture or juice is measured and inversely related to mealiness.

The need for a fast, easy quantitative method that determines the changes in texture of a mealy peach was the driving force of this project. Texture of fresh peaches is considered to be as important as flavor and aroma for consumer preference. Problems with internal breakdown of fruit tissue decrease the marketability of peaches. Better quantitative methods to determine how storage affects internal breakdown in peaches are needed to better understand mealiness.

The objectives of this research were:

- To develop a procedure to determine, by rheological measurements, mealiness characteristics of peaches.

To establish the relationships between textural characteristics and mealiness in peaches as affected by storage time and cultivar.

CHAPTER II

LITERATURE REVIEW

Peach Storage

Peaches and nectarines are extremely perishable and do not lend themselves to long periods of storage; they can be kept for only 3 - 5 days at room temperature, while high humidity can extend shelf life to 2 - 3 weeks (Whitelock et al. 1994). Storage temperature just above 0° C can allow storage of most cultivars for 2 - 3 weeks but if peaches are held too long at or near 0° C they are subject to chilling injury, i.e. mealiness. Fruit so injured may appear normal when removed from cold storage, but do not ripen satisfactorily at high temperatures. They develop physiological or internal breakdown in which the flesh becomes dry and mealy or woolly (Anderson and Penney, 1975). Mealiness has been associated with low adhesion between neighboring cells, and a relatively high resistance to cell rupture. It is the breakdown of flesh into small pieces in the mouth, which tend to be dry.

To minimize the development of chilling injury two methods have been suggested: intermittent warming and delayed storage. Ben-Arie et al. (1970) was able to control the development of mealiness in 'Elberta' peaches by removing the fruit to ambient room temperature for 48 hours after 2 - 4 weeks of storage at 0° C. A 6 weeks' storage life was

thus obtained. Peaches suffered less with intermittent warming than with the delayed storage treatment.

The polysaccharides of peaches are the primary constituents responsible for the desirable texture in ripened fruit. Alterations in the pectic substances produced by deesterification, depolymerization, and solubilization of pectins during ripening are responsible for most of the changes in texture (Sistrunk, 1985). Pectins are found extensively in the middle lamella, the area between neighboring cell walls, and act as cementing agents holding the adjacent walls together (Kays, 1991).

In tissue with chilling damage (i.e. mealy), cell walls appear to remain structurally strong and able to resist the forces associated with mastication. Softening of the damaged tissue during ripening results in separation of the cells with less total cell rupture, causing the mealy, floury texture (Lill and Van Der Mespel, 1988). Von Mollendorff and De Villiers (1988), studying the role of pectolytic enzymes in the development of woolliness in peaches, found that an initial low polygalacturonase activity in peaches (which eventually became woolly) followed by a sudden increase during ripening produced an accumulation of high relative molecular mass pectic substances in the intercellular spaces. They suggest that this is probably the primary cause of mealiness in peaches.

The loss of juiciness accompanying woolly breakdown of stored peaches has been found to be unconnected with the loss of water vapor from fruit occurring during storage but correlated with the amount of expressible juice (Ben-Arie and Lavee, 1971). As peaches develop woolliness, free moisture (juice) is converted into bound moisture without any change in the total moisture content (Von Mollendorff and De Villiers, 1988).

Luza et al. (1992) concluded that the accumulation of pectic substances in the intercellular matrix are responsible for free moisture being converted into bound moisture.

Pectic substances are also responsible for the mechanical rigidity of the cell walls. During mastication the fracture of fruit tissue occurs between cells when the cell walls are stronger than the middle lamella. If the cell walls are weaker, fracture will occur across the cells. Only when the cells are fractured will liquid be released in sufficient quantities to allow the fruit to appear juicy. When rupture occurs in the middle lamella the juice will be confined within the cells and the fruit will appear to be mealy and lack juice (Szczesniak and Ilker, 1988).

The only existing quantitative method to determine the degree of mealiness in peaches and nectarines measures the apparent juice content of ripe fruit. The lowest values for extractable juice coincide with the highest incidence of woolly fruit. Von Mollendorff et al. (1989) found that the extractable juice from nectarines stored at −0.5° C for four weeks and ripened at 20° C was lowest at the second day and increased back up to a value nearly as high as the initial extractable juice value by the fifth day.

Chilling injury occurs at temperatures above freezing and below 10° C. The resulting internal breakdown symptoms can include tissue browning, a dry mealy texture when ripe ("dry fruit", "woolliness"), failure to ripen, translucency of flesh, failure to develop normal flesh color (sometimes reddening of the flesh), and usually a complete loss of characteristic flavor. Chilling injury can also reduce the fruit's resistance to invasion by disease organisms. At temperatures below freezing the formation of ice crystals cause a mechanical rupture of cell membranes, this type of breakdown is called freezing injury.

The freezing point of peach tissue is inversely related to its soluble solids content (SSC); the higher the SSC of a fruit, the lower the temperature it can tolerate without freezing. Among peaches, the highest freezing point encountered has been approximately -0.8° C (Mitchell and Kader, 1989 a).

The degree of chilling injury incurred by a plant or plant part depends on the duration and temperature to which it is exposed, and the species sensitivity to chilling temperatures. The lower the temperature to which a product is exposed below its threshold chilling temperature, the greater the severity of the eventual injury. The rate of development of injury symptoms in storage is also generally decreased with temperature; however, upon removal to non-chilling conditions the full manifestation of the stress becomes apparent. Likewise, the longer the duration of exposures to temperatures below the threshold, the greater the injury (Kays, 1991).

Peaches of distinct cultivars respond differently to cold storage. Late-season cultivars such as 'Parade' and 'Fairtime' tend to have a shorter storage life than early-season cultivars because of their high susceptibility to internal breakdown in cold storage. (Mitchell and Kader, 1989 b). In a study conducted in California by Luza et al. (1992) mealiness appeared first in 'Autumn Gem' (extra-late-season) and 'Fairtime' (late-season) and after ten more days of storage at 5° C in 'O'Henry' (mid-season) peaches.

Texture Measurement

Texture as a quality attribute is very important for fleshy fruits such as apples, peaches and pears. Texture measurement of food materials can be performed in different

ways such as compression, puncturing, shearing, cutting, and extrusion. All these different types of tests can be easily performed in the Instron universal testing machine. Test cells for each of these texture measurement methods can be fitted and built into this single unit. This instrument is, by far, the most widely used in texture measurement of food materials. Tests can be performed either in compression or tension, at a selected speed. Force measurements are recorded on a strip chart or sent to a computer.

Instrumental texture measurement of food materials has been widely studied. Bourne (1965), in puncture tests of apples, found that the presence of a sample's skin is undesirable during a pressure test because it adds another variable (shear strength of the skin) which is not related to the firmness of the flesh. Abbott et al. (1984) analyzed textural attributes of apples. Force-deformation curves were obtained by compressing apple tissue cylinders between two parallel, horizontal plates.

Mealiness has been recognized in other fresh produce besides peaches; apples (Harker and Hallett, 1992), potatoes (McComber et al., 1988), and tomatoes (Jackman et al., 1992). Even though it has also been found in these fruits, no method is available to quantify texture changes brought out by mealiness.

Frequency Analysis

The primary data recorded in sound or texture measurement is obtained in the time domain. These data may look hopelessly complex, but thanks to the fast Fourier transform (FFT) they yield simple interpretable data when transferred to the frequency domain. A direct calculation of an N - point Discrete Fourier Transform (DFT) requires

$(N - 1)^2$ multiplications. For large N, say N > 1000, this would require too much computer time. The term fast Fourier transform is used to describe a computer algorithm that enormously reduces the amount of computer time. The FFT reduces the calculation time by a factor of 200 when N = 1024, the FFT requires 5,120 multiplications, while the DFT requires 1,046,529 multiplications. The FFT is one of the greatest contributions to numerical analysis made in this century (Walker, 1991).

The use of the FFT is becoming increasingly common in food related studies. Lee et al. (1988) used FFT to determine the frequency components of sound generated during chews of fresh and stale samples of potato and tortilla chips. Barrett et al. (1992) assessed, by the power spectrum of the FFT, the jaggedness of the stress-strain relationship of two kinds of puffed extrudates stored under different humidity conditions.

Rohde et al. (1993), working with breadsticks and pretzels exposed to different humidities, speculated that the jaggedness of the force-deformation curves, which is most probably a manifestation of the material crunchiness or crumbliness, can be quantified by a single numerical index, i.e., the mean magnitude of the power spectrum. Also, Nuebel and Peleg (1993), after exposing cereals to different relative humidities, expressed jaggedness of the force-displacement curve in terms of the mean magnitude of the power spectrum determined by FFT.

CHAPTER III

MATERIALS, EQUIPMENT, AND METHODS

Probe Development

Five different shear type probes were considered for quasi-static force-displacement tests on fresh fruit such as pears and apples. A single solid blade shear-compression (Kramer, 1961) probe was tried but the idea discarded due to the problem of constantly increasing friction with penetration into the sample and irregular lubrication of its walls with the fruit's juice. A second probe tested was a modification of the first one in which the middle part of the probe was removed to eliminate the friction problem. This second probe design was also discarded because it produced poor repeatability between samples. The next probe was a modification of the second one but instead of having a flat surface cutting into the sample, the end of the probe was v-shaped. Probes with two different angles (30° and 45°) were made. Both produced unsatisfactory results due to lack of repeatability and because the sample split apart as soon as the probe fully entered the sample. The fifth probe used a 1.36 mm diameter taut wire to do the cutting. This probe provided good repeatability without any cracking or splitting of the sample. It also appeared to be highly sensitive to changes in texture of the samples. The wire probe was selected from among all the probes and it is shown on Figure 1.

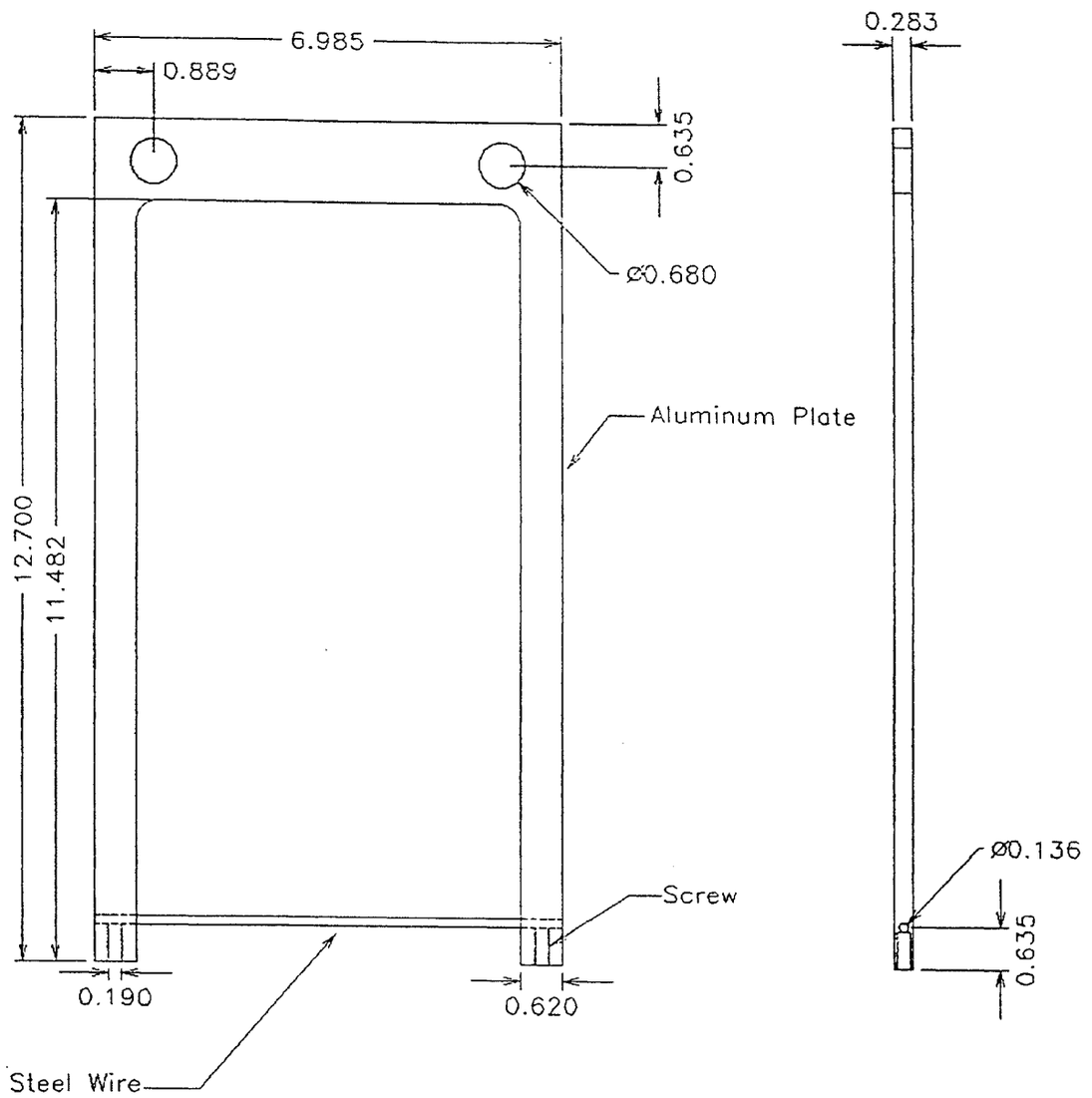


Figure 1. Wire Probe.

The wire probe was tested using peanut butter as a standard repeatable sample material. Creamy and crunchy peanut butter were selected to represent a range in texture between two extremes. Peanut butter was placed in 3 cm diameter paper cups and placed in a 4°C environmental chamber for at least 12 hours for the samples to become more firm. A very obvious difference in the shape of the force-displacement curves was observed. A very jagged curve was obtained for the crunchy peanut butter and a very smooth curve for the creamy (Figure 2). The jaggedness of the force-displacement curve was used as an indicator of the non-smoothness of the sample.

Development of Extractable Juice Test

The method outlined by Dawson et al. (1992) was reviewed for our testing. Variables considered were: location of plugs, speed of centrifugation, and time of centrifugation. Peaches, purchased from a local grocery store, were tested to determine the effect of location of the plugs on extractable juice; measurements were made at the stem, middle, and blossom for both blush and green sides of the peach. No significant difference was found in extractable juice between these three locations. Centrifugation speeds of 5000 and 6000 x g were found not to have any influence on the juice extracted; averages of 18.3 and 18.5 % were obtained respectively. Also, centrifugation time did not have great influence. Because of smaller standard deviation values for extractable juice on the blush side of the peach than on the green side, it was decided to take samples from blush side of the peach. Another reason to stay with only one side of the peach is that extractable juice was found to yield higher values for the blush side than for the green side.

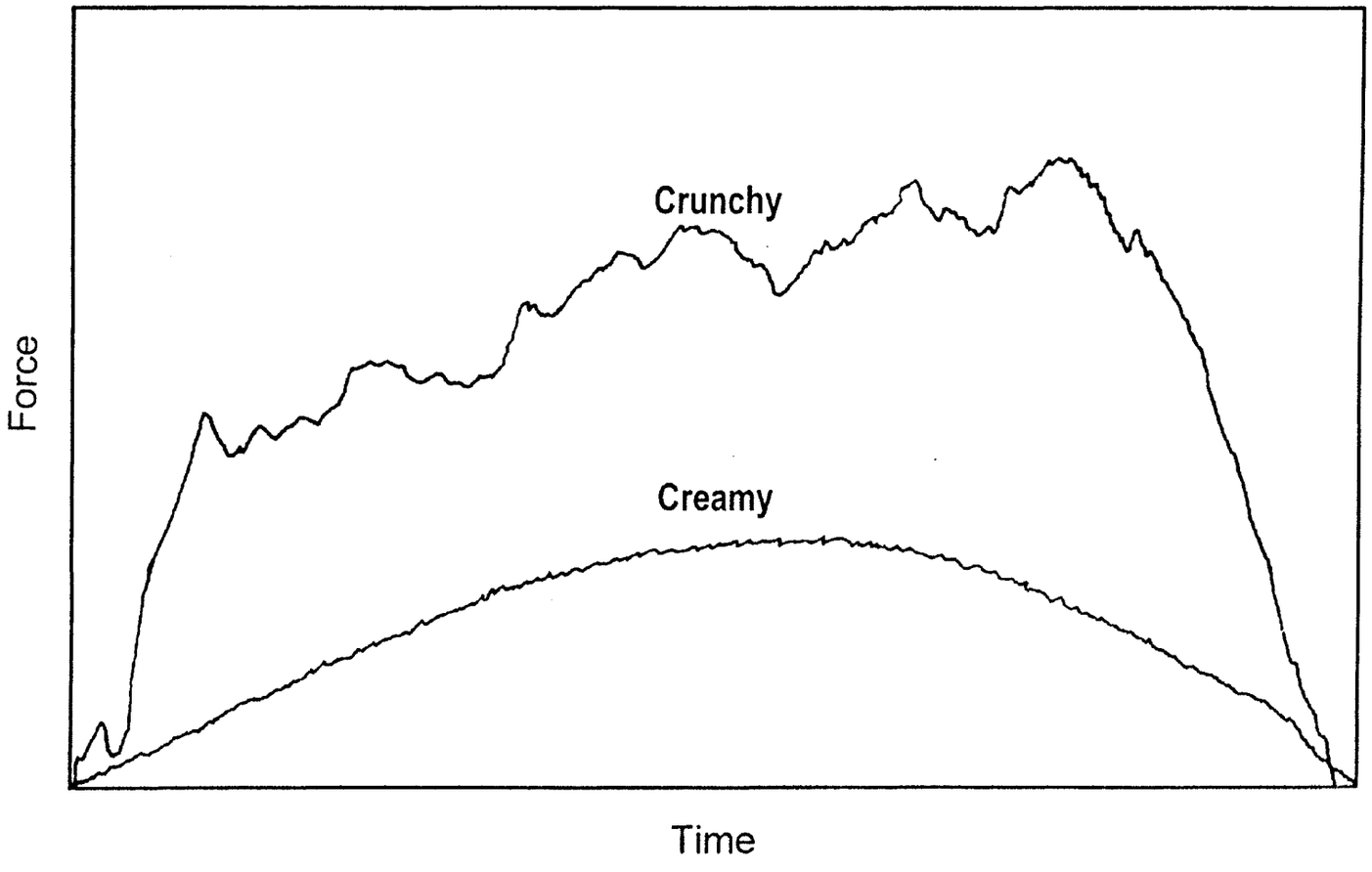


Figure 2. Force-Displacement Curve for Peanut Butter.

Experimental Procedure

Peaches of five different cultivars (Sentinel, Cresthaven, Topaz, Parade, and Fairtime) were hand picked early in the morning from trees at the Oklahoma Fruit Research Station near Perkins, Oklahoma during the months of June through September. Only one cultivar was picked each time. Due to the short distance to the laboratory, peaches were packed in boxes one to two layers deep to avoid bruising during transport. Peaches of good quality, showing no signs of damage (bruises, wholes, worms) were selected for the experiment. Threshold mature peaches were further selected by ground color using a Chroma Meter CR-300 (Minolta Camera Co., Osaka, Japan).

For each cultivar, twelve peaches were selected for immediate measurement of texture and extractable juice. Approximately 80 peaches from each cultivar were stored without touching each other in boxes in an environmental chamber at temperatures ranging between -1° and 1°C. To minimize moisture loss during storage the boxes were covered with perforated plastic sheets to increase the relative humidity surrounding the peaches. A group of ten peaches was selected randomly and weighed before and after storage to monitor moisture loss. A Hygrothermograph H-302 (Weather Measure Corporation, Sacramento, CA) was also placed inside the environmental chamber to monitor its temperature and humidity during storage.

After four weeks, peaches were taken out of storage and placed on tables to ripen at room temperature (22° to 25°C). Peaches were again covered with plastic to minimize moisture loss. They were divided into four groups of twelve peaches and both texture and extractable juice tests were performed on them at 24-hour intervals during ripening.

Whole peach firmness was measured with a 1.11-cm diameter Effegi Fruit Pressure Tester FT-327 (Effegi, Alfonsine, Italy) at the blush side as close as possible to where the texture sample was to be taken.

The first test was the measurement of flesh texture and mealiness. A cylindrical plug of 1.5 to 2.0-cm length obtained from 2-3 mm below the peach surface was removed from the blush side of the peach with a 2.3-cm inside diameter cork borer. A universal testing machine (Instron Corporation, Canton, MA) with a 50-kg compression load cell and a cross head speed of 20 mm/min was used to compress the plugs with the wire probe. As the wire probe pushed through the plugs, they split in half along their longest axis. The two halves were placed inside plastic bags and then into an ice bath for extractable juice tests within 3 hours. Force-displacement curves were plotted on a strip chart recorder and also digitized and sent to a microcomputer by a Keithley System 570 Data Acquisition Workstation (Keithley Instruments, Inc., Cleveland, OH).

The second part of the test was for extractable juice. Samples from the split plugs were cut again to fit into two preweighed 5-cc syringes with glass wool added to serve as filters. Syringes were placed inside 50-ml centrifuge tubes. A 1-cm cylinder cut from syringes was placed between the tip of the syringe and the inside of the centrifuge tube to prevent the extractable juice from being absorbed onto the tip of the syringe during centrifugation. The samples were placed in a Centrifuge Model J2-21 (Beckman Instruments Inc., Fullerton, CA) for 5 min at 5000 g (7000 rpm). Weight of juice exuded out of the syringe (to the nearest mg) was used to compute extractable juice.

Stony Hard peaches, which were expected to exhibit mealiness, were shipped in from New Jersey for testing in September. Ten peaches were tested upon arrival, thirty other peaches were subjected to continuous 100 ppm ethylene treatment to increase ripening rate and were tested at 24, 48, and 72 hours. Fifteen extra peaches (controls) which were not subjected to any treatment were divided into three groups of five peaches. Each group was also tested for texture and extractable juice at 24, 48, and 72 hours.

Data and Signal Analysis

A sample of the force-displacement recording that identifies the parameters analyzed is shown on Figure 3. The magnitude of the first peak of the force-displacement curve was measured from the strip charts. The first peak was found to occur in the first 5.0 mm (15 s) of probe penetration. The slope of the curve from zero to the first peak, was measured by calculating the slope of a 0.7 - mm (2 - s) interval of the curve on the straightest part from the beginning of the test to the first peak. The average force during a 6.7 - mm (20 - s) period, after the occurrence of first peak, was calculated from digitized data and called the steady state force. A crude frequency analysis was also performed in this 6.7 - mm period by counting the number of peaks of sizes greater than 12.5, 37.5, and 50.0 g. The size was measured by observing the change in force from valley to peak as the probe penetrated the sample, without accounting for width of the peaks. Calculations were manually done for these three scales between 5.0 and 11.7 mm (15 and 35 seconds). Force-displacement curves representatives of all five days of testing are shown on Figures 4 a, 4 b, and 4 c.

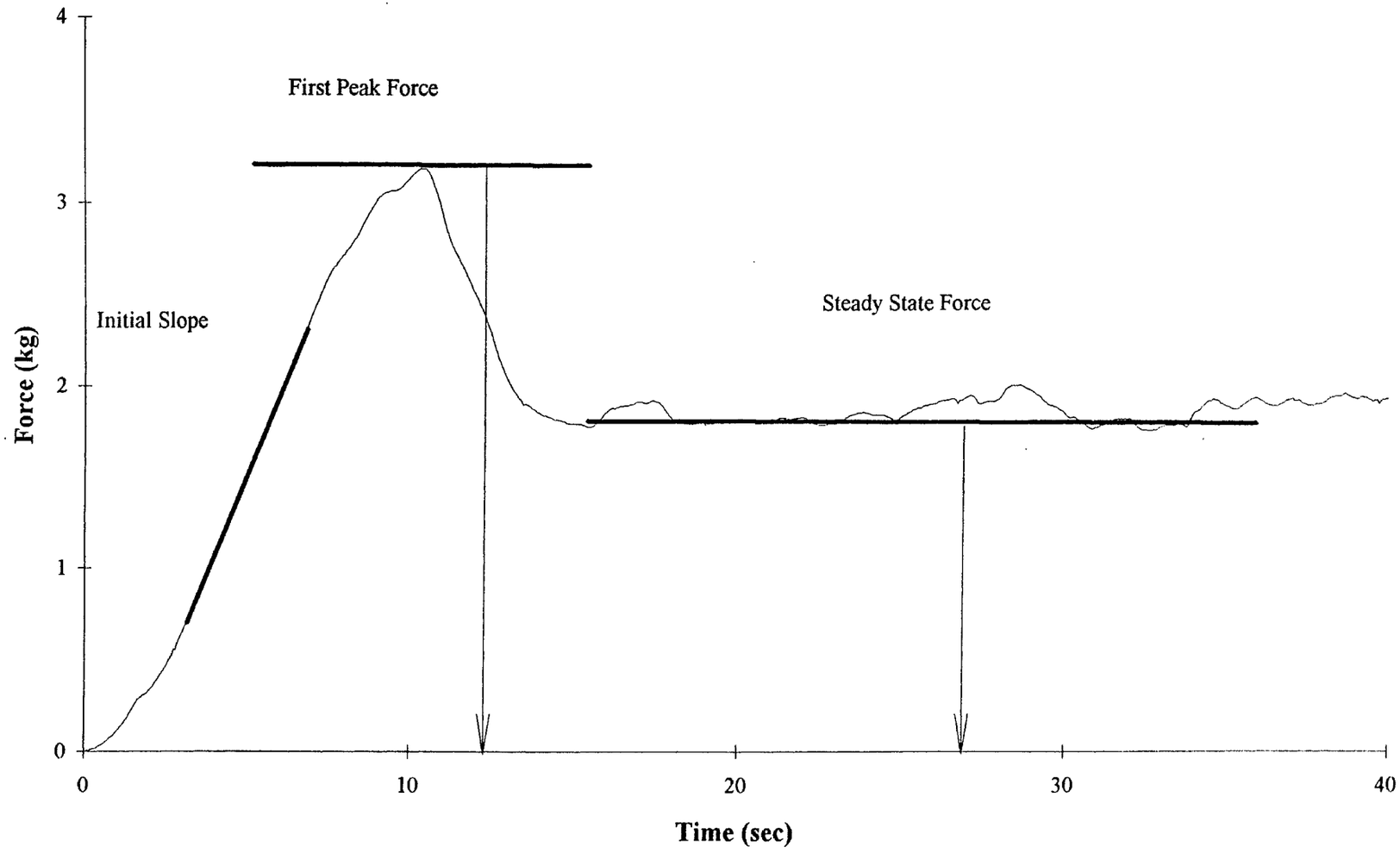


Figure 3. Force vs. time (displacement) for peach sample.

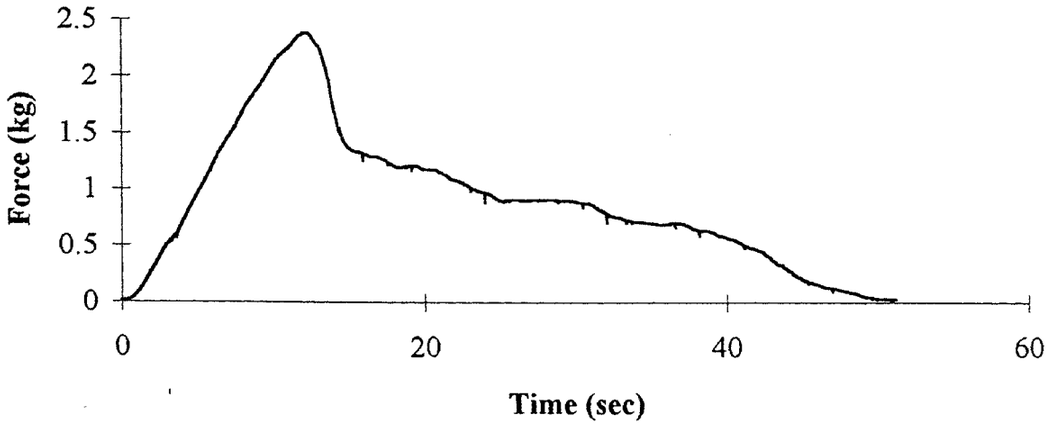


Figure 4 a. Force-time (displacement) curve Before Storage.

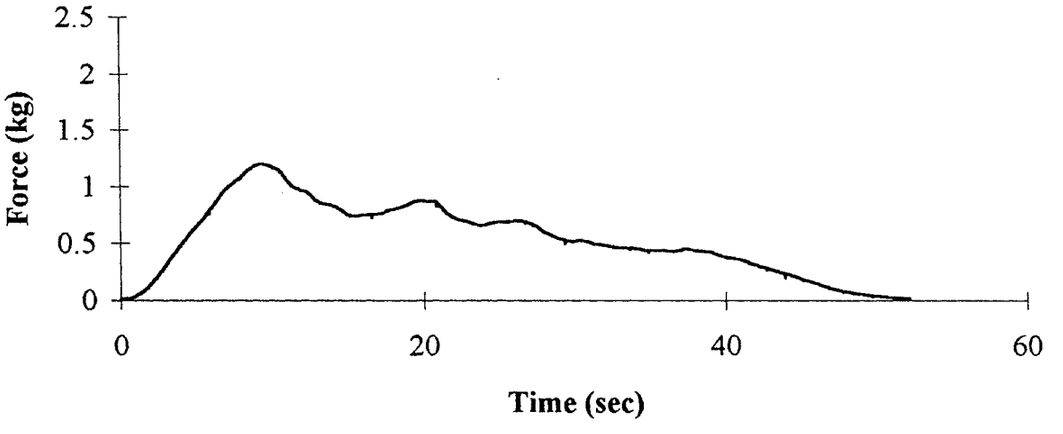


Figure 4 b. Force-time (displacement) curve Day 1.

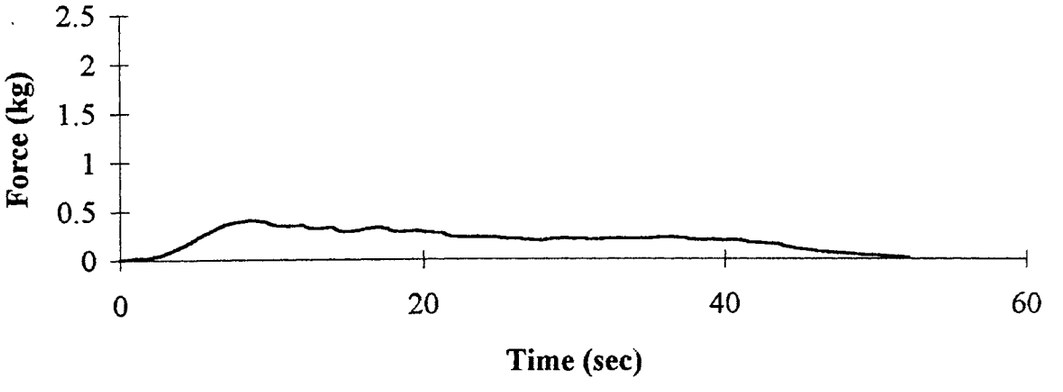


Figure 4 c. Force-time (displacement) curve Days 2, 3, and 4.

Frequency analysis was performed on the digitized force-displacement curves which were originally recorded at a sampling rate of 100 points per second. Files of 5000 to 6000 points were obtained depending on the length of the peach plug. Problems of noise were encountered while analyzing the data by observing that there were large drops in force at a few points and these appeared with some regularity. Also, an extremely large increase in force of a single point was found to occur during the first few seconds of testing. These specific changes in force were only observed in the digitized data and not on the Instron strip charts. A FORTRAN program was written to compare the change in amplitude between two consecutive points. If the difference in amplitude was found to be greater than a set value, previously identified for each particular day and cultivar, the point was changed to the average of the points immediately before and after the particular "assumed bad" point. The large increase in force was also removed in the same manner with this program.

To reduce the total number of data points for FFT analysis, every fifth data point was selected from the entire compression test. Reducing the sampling rate left the total curve with approximately 1100 points, close to the 1024 points required for the FFT analysis. The sampled, noise-reduced curves still showed the sharpest peaks (highest frequency) just like the original data.

To improve visualizing the whole spectrum of frequencies, the magnitude of the low frequencies was reduced using the following technique. Force-displacement curves were fitted with a polynomial model (Barrett et al., 1992) using the program "Table Curve 2D" (Jandel Scientific, San Rafael, CA). The following polynomial model was selected because it fits the data with r^2 values over 0.9 in most cases.

$$y = a + b(\ln x) + c(\ln x)^2 + d(\ln x)^3 + \cdots\cdots + j(\ln x)^9$$

where: y : fitted force amplitude.

x : time increment.

a - j : regression coefficients.

The difference between the actual points and the fitted values was computed and called the residual. The whole residual curve was then multiplied by a half sine curve window with an amplitude of 0 to +1 to ensure that the curve would begin and end at zero since the FFT assumes that the signal is periodic. Without this 'window', a high frequency component could be introduced by the sharp transition caused by the periodic assumption.

Table Curve was again used for the FFT frequency analysis. Frequency spectrums ranging from DC to 10 Hz (one half of sampling rate) were obtained. To characterize the general shape of the spectrum, areas were computed for 16 specific bandwidths at intervals of 0.19 Hz (10 frequency increments) starting at DC and ending at 3.04 Hz (no change in magnitudes of frequencies were observed after 3 Hz). Area ratios were obtained by dividing these areas by the area under the last 100 frequency increments (8.10 to 10 Hz) and multiplying times 10 to obtain ratios of areas of the same bandwidth. Large area ratios mean that there are more low frequencies than high frequencies and vice versa.

Another way of characterizing the amount of frequencies in the FFT curve is to obtain the area under the whole spectrum of frequencies, i.e. from DC to 10 Hz. These areas under the frequency spectrum are proportional to areas under the force-displacement curves.

The process used to obtain these frequency ratios and areas from the original force-displacement curves is shown graphically on Figures 5 a through 5 g. The frequency spectrum of the original force-displacement curve and of the polynomial are shown on Figure 5 h; the big difference in magnitude between very low and high frequencies makes understanding of the spectrum very difficult, the spectrum of residuals offers a better view at low magnitudes.

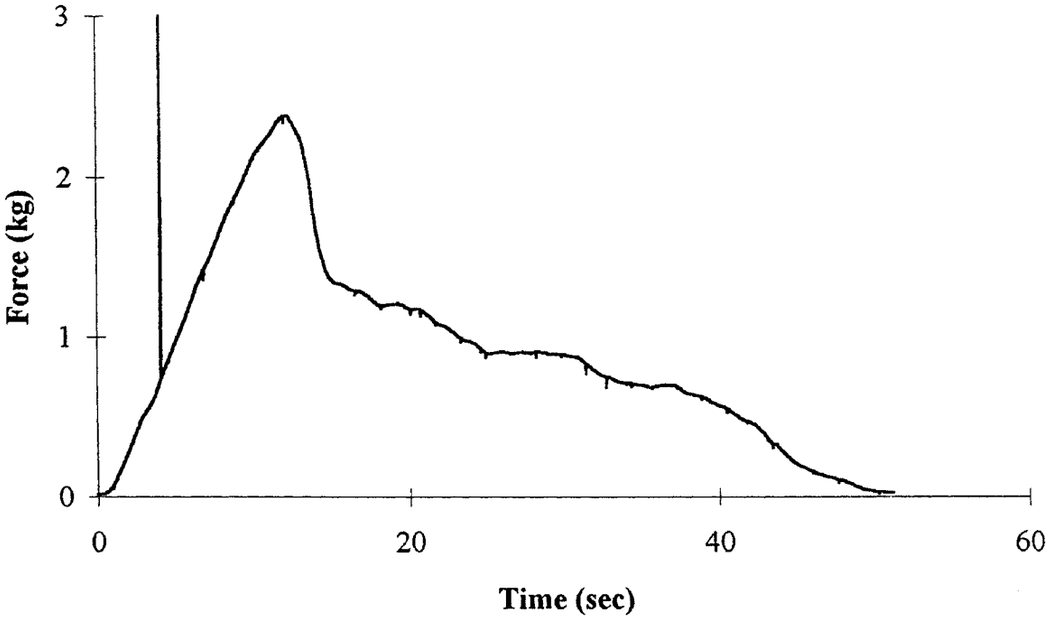


Figure 5 a. Original Force-Displacement Curve. Sampling Rate: 100 Hz

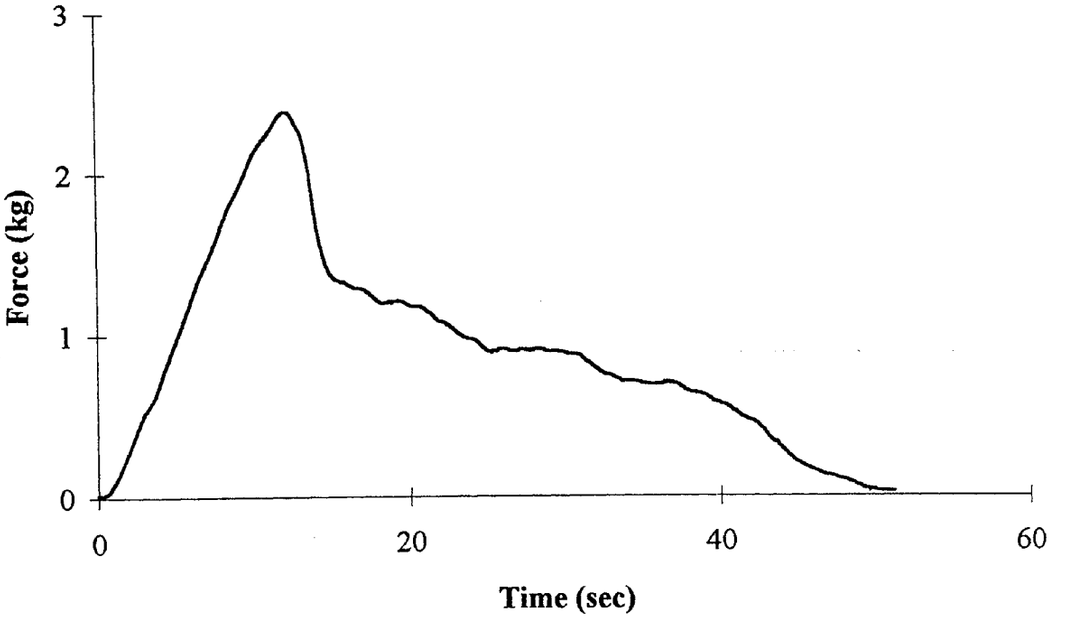


Figure 5 b. Filtered Force-Displacement Curve.

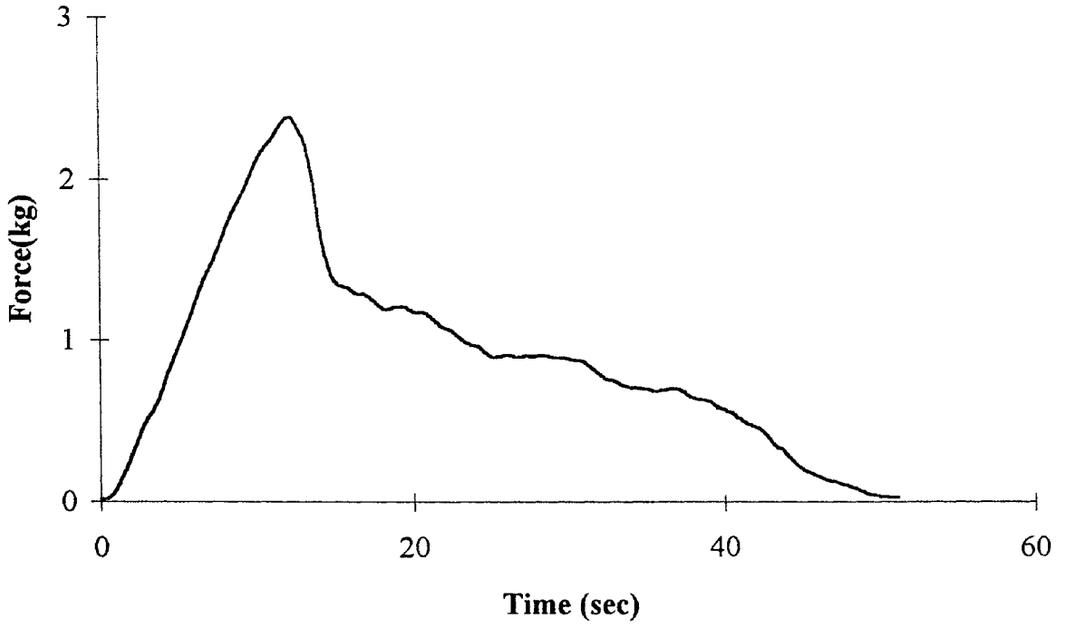


Figure 5 c. Reduced Force-Displacement. Sampling Rate: 20 Hz. 1024 points shown.

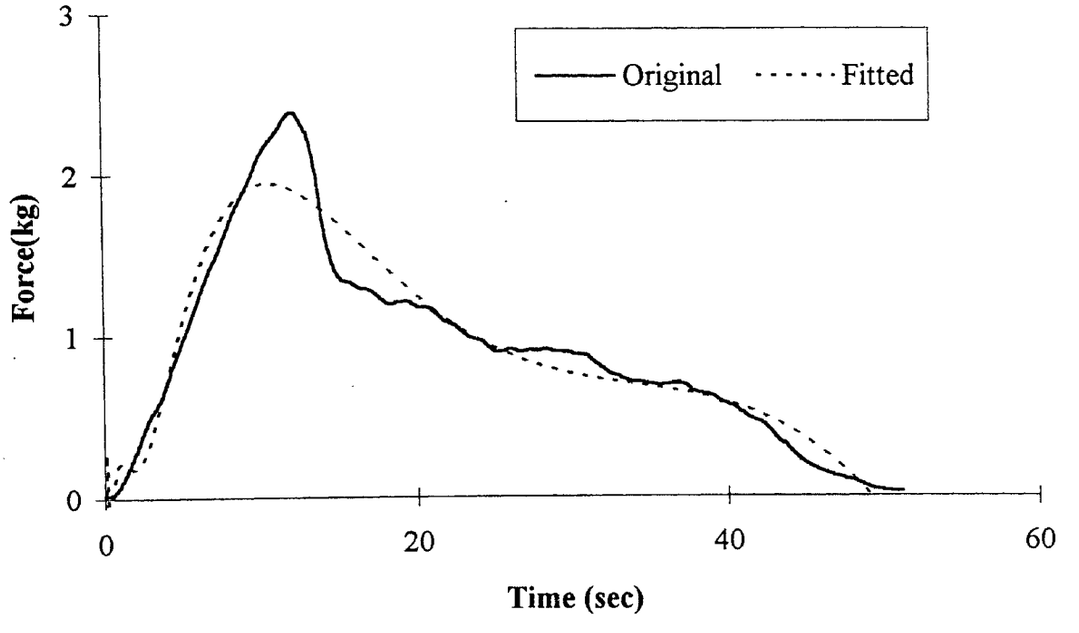


Figure 5 d. Polynomial Fit Force-Displacement Curves.

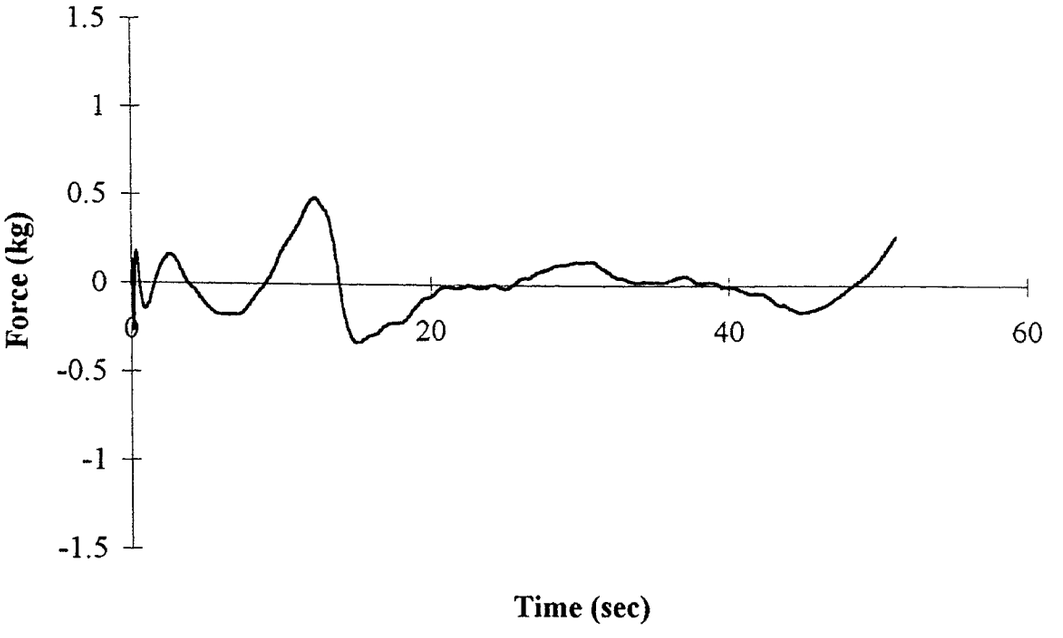


Figure 5 e. Residuals Curve of Original minus Fitted.

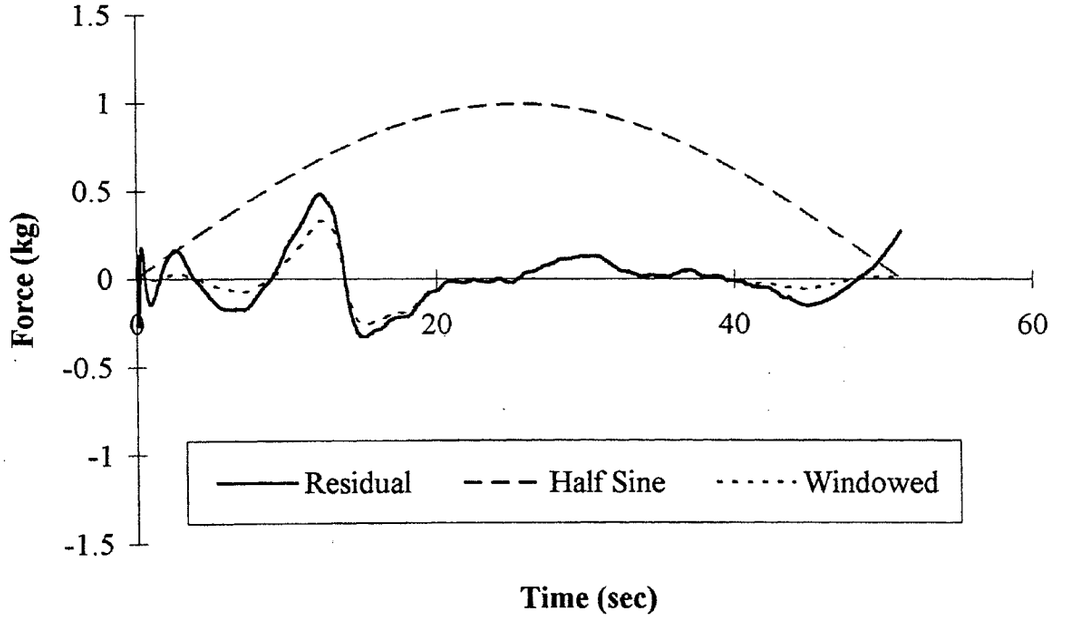


Figure 5 f. Windowed Curve of Residual x Half Sine.

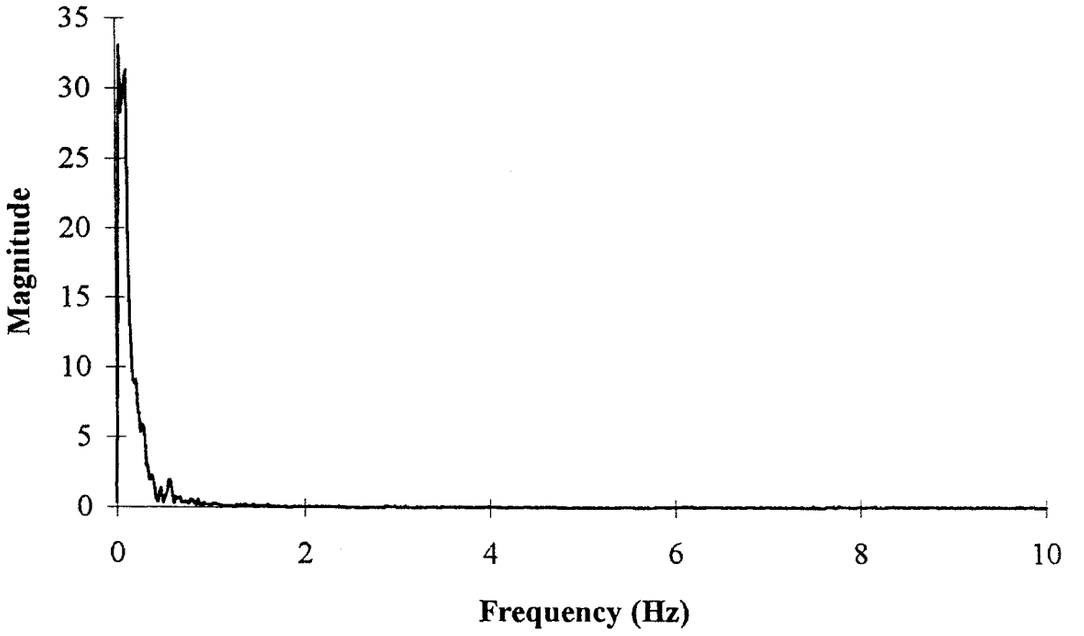


Figure 5 g. Frequency Spectrum of Windowed Curve. 512 points.

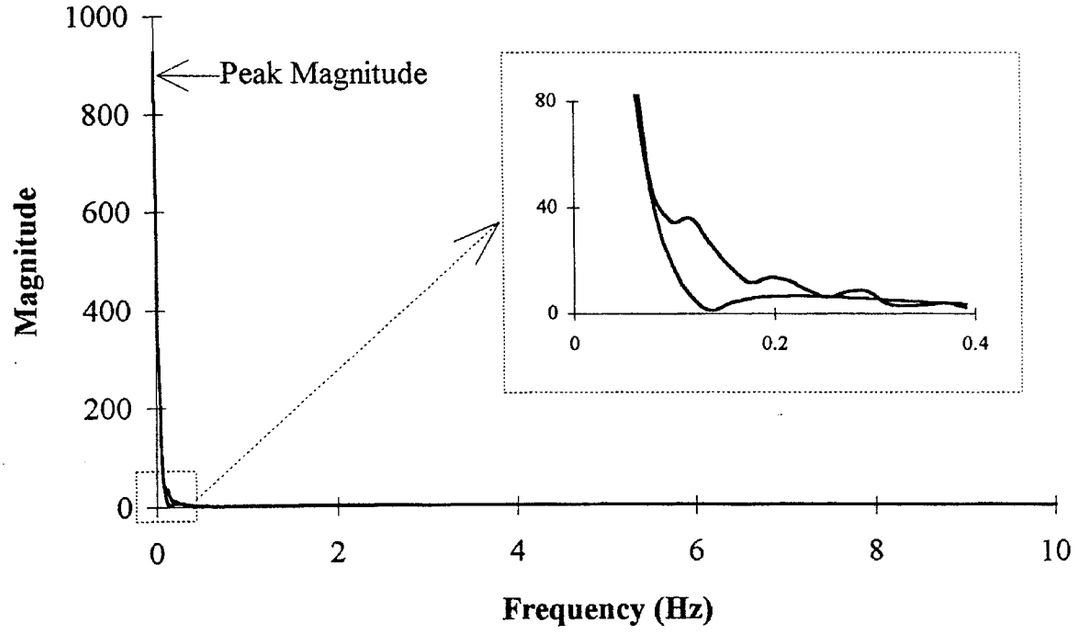


Figure 5 h. Frequency Spectrum of Original and Polynomial. 512 points.

CHAPTER IV

RESULTS AND DISCUSSION

The results are shown for all cultivars in the order in which they were harvested, with 'Stony Hard' peaches shown last because this cultivar had a different treatment prior to texture and mealiness tests. In the tables, testing prior to any treatment (before storage or exposure to ethylene) is called 'Initial' time. Day 1 through day 4 indicate the number of days peaches were allowed to ripen, after 28 days of cold storage, and before testing was performed. In the case of 'Stony Hard' number of days refers to the time of exposure to ethylene. Date of harvest and average moisture loss of ten peaches of each cultivar during 28 days of storage are given in Table I. Low moisture loss of 'Cresthaven' and 'Parade' compared to the other cultivars is probably due to cultivar differences since the same storage conditions (time, temperature, and covering) were applied to all cultivars.

Table I. Date of harvest and moisture loss during storage

Cultivar	Date of Harvest	Moisture Loss, %
Sentinel	7/12/93	17
Topaz	7/26/93	15
Cresthaven	8/16/93	6
Parade	9/13/93	6
Fairtime	9/24/93	14

Extractable Juice

The measured extractable juice by centrifugation varied with cultivar (Table II). No drastic change in extractable juice was observed with ripening for any of the six cultivars. 'Fairtime' was the only cultivar that behaved as expected; extractable juice decreased from 32.5 % at the time of harvest to a lowest of 13.5 % at day 2 and increased at a slower rate to 23.6 % at day 4. According to these results the highest incidence of mealiness was present in 'Fairtime' peaches. This agrees with Mitchell and Kader (1989 b), who stated that late-season cultivars ('Fairtime' for example) are more prone to chilling injury than early-season cultivars.

The other cultivars, 'Sentinel', 'Topaz', 'Cresthaven', 'Parade', and 'Stony Hard' did not show any considerable changes in the amount of free juice with ripening time. In most cases the percentage of extractable juice did not change from day to day. Extractable juice for 'Sentinel' and 'Parade' was lowest at day 1 and day 2 respectively, raised to a value higher than the initial extractable juice value by day 3 and continued increasing to day 4. Considering the standard deviations (Table II), no statistical difference existed among days in either of these cultivars. These results do not indicate any large degree of mealiness in any of these four cold stored cultivars nor in the one treated with ethylene.

Effegi Firmness

Whole peach firmness as measured by one penetration of the Effegi probe is shown in Table III. In general, highest firmness was observed at the time of harvest, no change

Table II. Extractable Juice in %. Mean (Standard Deviation)

Cultivar	Initial		Day 1		Day 2		Day 3		Day 4	
Sentinel	15.19	(3.94)	12.07	(8.44)	12.95	(8.80)	17.90	(7.66)	17.91	(5.11)
Topaz	18.62	(4.52)	9.96	(3.14)	11.28	(3.47)	12.43	(3.74)	14.40	(3.75)
Cresthaven*	18.95	(3.10)	-------		21.91	(2.62)	24.34	(4.63)	25.14	(3.92)
Parade	21.09	(4.08)	18.53	(4.69)	16.98	(5.32)	24.59	(4.52)	30.66	(6.33)
Fairtime	32.47	(5.59)	22.40	(6.08)	13.50	(3.91)	16.84	(5.86)	23.60	(9.90)
Stony Hard**	17.88	(4.83)	20.16	(3.98)	12.90	(3.67)	14.02	(3.82)	-------	
S.H. Cntrls.***	-------		19.38	(6.89)	13.02	(4.45)	15.93	(3.92)	-------	

* Initial had 12 replicates while days 2, 3, and 4 had 7 replicates.

** Ethylene treated. 24 hr interval from initial to day1.

*** No treatment. 24 hr interval from initial to day 1.

Table III. Effegi Firmness in N. Mean (Standard Deviation)

Cultivar	Initial	Day 1	Day 2	Day 3	Day 4
Sentinel	82.9 (4.9)	46.8 (20.3)	21.5 (9.6)	15.0 (9.1)	6.7 (3.3)
Topaz	89.1 (10.3)	80.4 (11.0)	30.9 (20.8)	8.5 (3.4)	6.7 (2.4)
Cresthaven*	88.8 (14.2)	-------	15.4 (4.1)	8.3 (2.3)	9.2 (2.6)
Parade	61.2 (5.9)	37.2 (7.8)	16.2 (3.9)	10.6 (1.6)	7.1 (1.8)
Fairtime	57.3 (6.1)	46.4 (11.2)	19.3 (5.5)	13.6 (9.5)	5.0 (0.3)
Stony Hard**	83.2 (16.6)	39.7 (11.6)	15.6 (2.1)	11.3 (2.2)	-------
S.H. Cntrls.***	-------	-------	40.8 (9.9)	51.2 (24.1)	-------

* Initial had 12 replicates while days 2, 3, and 4 had 7 replicates.

** Ethylene treated. 24 hr interval from initial to day1.

*** No treatment. 24 hr interval from initial to day 1.

during storage until day 1, sudden decrease by day 2, and stayed constant or slightly decreased until day 4. 'Sentinel', 'Topaz', 'Cresthaven', and 'Stony Hard' had the highest initial firmness values ranging from 82.9 to 89.1 N. Their standard deviations ranged from 4.9 to 16.6 N which indicates that they had similar firmnesses before storage. 'Parade' and 'Fairtime' had lower firmnesses, 61.2 and 57.3 N respectively. Both cultivars with standard deviations of approximately 6 N are statistically no different from each other. 'Sentinel' and 'Topaz' both started before storage with firmness of about 85 N and decreased to 6.7 N by day 4. The greatest difference among these two cultivars is that a much bigger drop of firmness was observed by day 1 compared to before storage in 'Sentinel' (44 %) than in 'Topaz' (10 %). 'Parade' lost about 40 % of its firmness and 'Fairtime' peaches lost 20 % of their firmness during storage. 'Stony Hard' firmness decreased by 52 % after one day of exposure to ethylene.

From day 1 to day 2 of ripening all cultivars dropped from 54 to 62 % of firmness. After day 2, only small changes in firmness in all cultivars were observed. All cultivars, except 'Stony Hard', finished at day 4 with firmness below 10 N.

'Parade' shows the smallest variation among peaches by having standard deviations that range from 1.6 to 7.8 N while 'Topaz' has the largest standard deviations ranging from 2.4 to 20.8 N.

First Peak Force

The force values at the first peak of the force-displacement curves are shown in Table IV. This first peak is a measure of tension forces present when the probe first

Table IV. First Peak Force in N. Mean (Standard Deviation)

Cultivar	Initial	Day 1	Day 2	Day 3	Day 4
Sentinel	33.1 (6.7)	32.7 (9.7)	2.6 (0.7)	2.3 (0.8)	2.1 (0.5)
Topaz	33.2 (5.4)	34.6 (5.5)	3.9 (1.6)	2.1 (1.3)	1.8 (0.7)
Cresthaven*	41.7 (5.8)	-------	5.4 (1.7)	4.8 (2.1)	4.0 (0.7)
Parade	27.3 (5.8)	12.3 (4.4)	3.6 (0.5)	3.0 (0.6)	2.7 (0.6)
Fairtime	15.6 (3.9)	12.8 (3.8)	3.0 (1.2)	2.7 (1.1)	1.2 (0.3)
Stony Hard**	36.0 (11.0)	13.6 (4.7)	3.2 (0.4)	2.8 (0.4)	-------
S.H. Cntrls.***	-------	34.8 (10.9)	36.7 (2.2)	35.3 (11.6)	-------

* Initial had 12 replicates while days 2, 3, and 4 had 7 replicates.
** Ethylene treated. 24 hr interval from initial to day1.
*** No treatment. 24 hr interval from initial to day 1.

penetrates the sample. Instron firmness data changed from day to day in exactly the same shape pattern as the data from Effegi firmness. In general, the highest force was found before storage, it stayed fairly constant throughout storage until day 1, drastically decreased by day 2, and slightly decreased or stayed constant until day 4. This type of pattern was the same for all five cold stored cultivars and also 'Stony Hard'. According to these measurements, 'Cresthaven' (41.7 N) peaches were the most firm at the time of harvesting and 'Fairtime' (15.6 N) the least firm.

'Sentinel', 'Topaz', and 'Fairtime' showed little change in first peak force during the 28 days of storage and first day of ripening, but 'Parade' peaches dropped 1/2 during this same time period. First peak force of 'Stony Hard' control peaches did not change during the first four days. For the ethylene treated peaches, peak force dropped 62 % by day 1.

From day 1 to day 2 the biggest drop in first peak force, 8 % of previous force, was observed in 'Sentinel' peaches. The second biggest drop in first peak force is in 'Topaz' in which force dropped by day 2 to approximately 11 % of day 1. The other three cultivars dropped only to about 25 % of the force by day 2. After day 2, there were only small changes in the first peak force of any of the cultivars; peak forces at day 3 and day 4 stayed fairly constant or slightly dropped.

'Sentinel', 'Topaz', 'Parade', and 'Stony Hard' started at similar firmness (around 30 N) at the time of harvest. 'Cresthaven' initially was more firm (41.7 N) and 'Fairtime' was less firm (15.6 N).

The magnitude of the firmness measured by the Effegi penetrometer was 2 to 2.5

times greater than the force measured by the Instron's first peak force. This is probably due to the greater surface area of penetration of the Effegi probe (97 mm^2) compared to the wire probe (49 mm^2).

Steady State Force

The average forces in the 6.7 - mm (20 - s) period after the first peak are shown in Table V. Unlike the first peak and Effegi firmness which measure initial penetration or maximum force, this parameter measures the force to continue to push the wire probe through the sample. The highest steady state force was again found before storage, it decreased steadily until day 2, and continued decreasing but at a much slower rate or it stayed fairly constant until day 4.

The force to push the probe through the peach sample before storage was the highest for 'Topaz' peaches (20.70 N) and the lowest for 'Fairtime' peaches (6.28 N). The other four cultivars had approximately the same steady state force (10.67 - 12.82 N). After 28 days of storage, 'Sentinel' and 'Fairtime' managed to maintain their firmness while 'Topaz', 'Parade , and 'Stony Hard' dropped to approximately 50 % of their original steady state force.

From day 1 to day 2 there was again a big drop in firmness ranging from 50 to 80 % of the steady state force for all the cold stored cultivars, except 'Cresthaven'. At this same time there was an unexpected increase for both treated and control 'Stony Hard' peaches; steady state force almost doubled.

After day 2 the steady state force stays constant or slightly decreases until day 4 in

Table V. Steady State Force in N. Mean (Standard Deviation)

Cultivar	Initial	Day 1	Day 2	Day 3	Day 4
Sentinel	12.82 (3.38)	10.16 (7.28)	1.65 (0.43)	1.53 (0.27)	1.83 (0.48)
Topaz	20.70 (4.61)	9.22 (1.29)	4.93 (2.49)	2.86 (1.43)	1.76 (0.46)
Cresthaven	11.42 (2.63)	-------	3.04 (0.94)	2.90 (1.31)	2.13 (0.39)
Parade	10.67 (1.49)	6.45 (1.41)	2.10 (0.31)	1.86 (0.26)	1.55 (0.39)
Fairtime	6.28 (1.03)	4.89 (0.54)	1.97 (1.02)	2.49 (0.80)	1.01 (0.20)
Stony Hard*	11.38 (3.73)	4.75 (1.02)	7.39 (1.37)	1.33 (0.30)	-------
S.H. Cntrls.**	-------	9.87 (2.12)	15.93 (5.30)	14.84 (4.28)	-------

Results of 5 replicates.

* Ethylene treated. 24 hr interval from initial to day1.

** No treatment. 24 hr interval from initial to day 1.

all five cold stored cultivars. In ethylene treated 'Stony Hard' peaches there is a big decrease from day 2 to day 3 (from 7.39 to 1.33 N) while the control peaches maintain a constant steady state force from day 2 to day 3.

At the time of harvest 'Parade' and 'Fairtime' peaches were less firm by steady state, first peak, and Effegi firmness measurements than 'Sentinel', 'Topaz' , 'Cresthaven', and 'Stony Hard'. This implies a strong correlation between these firmness parameters.

Initial Slope

The initial slope for five replicates is shown in Table VI. This parameter, like first peak force and steady state force, is a measure of the firmness of the fruit; the higher the slope value the greater the peach's firmness.

'Topaz' and 'Cresthaven' peaches had the highest slopes of all cultivars at the time of harvest; they both started at approximately 4.3 N/s. 'Stony Hard' and 'Sentinel' followed with 3.71 and 3.31 N/s respectively, but because of standard deviations of 0.87 and 1.06 N/s they were not statistically different from the previous two cultivars. 'Parade' is next smaller with 2.72 N/s and with a standard deviation of 0.30 N is statistically no different from 'Stony Hard' and 'Sentinel'. The cultivar with the smallest slope at the time of harvest is 'Fairtime'; it has a slope of 1.97 N/s and also the smallest standard deviation (0.20 N/s) which makes it statistically different from the other cultivars.

By day 1 of ripening, 'Parade' and 'Stony Hard' peaches showed the highest decrease in slopes, dropping to approximately 42 % of their initial value. 'Sentinel' and 'Topaz' peaches had less change by dropping to about 20 % of the slope values obtained

Table VI. Initial Slope in N/s. Mean (Standard Deviation)

Cultivar	Initial	Day 1	Day 2	Day 3	Day 4
Sentinel	3.31 (1.06)	2.61 (1.40)	0.89 (0.28)	0.62 (0.35)	0.48 (0.05)
Topaz	4.28 (0.50)	3.44 (0.55)	2.01 (1.64)	2.24 (2.04)	1.91 (1.71)
Cresthaven	4.32 (0.40)	-------	0.91 (0.26)	0.54 (0.46)	0.68 (0.23)
Parade	2.72 (0.30)	1.60 (0.51)	0.92 (0.26)	0.59 (0.08)	0.58 (0.11)
Fairtime	1.97 (0.20)	1.89 (0.20)	0.84 (0.37)	0.77 (0.24)	0.26 (0.11)
Stony Hard*	3.71 (0.87)	2.10 (0.43)	4.46 (0.66)	0.73 (0.18)	-------
S.H. Cntrls.**	-------	3.33 (0.85)	3.26 (0.44)	2.81 (0.72)	-------

Results of 5 replicates.

* Ethylene treated. 24 hr interval from initial to day1.

** No treatment. 24 hr interval from initial to day 1.

before storage. The lowest change in slope was found in 'Fairtime' and control 'Stony Hard' peaches which dropped only 4 and 10 %, respectively.

From day 1 to day 2 'Sentinel' dropped 66 % and 'Fairtime' dropped 56 % in slope. 'Parade' and 'Topaz' were next by dropping 42 % of the previous day's slope. 'Stony Hard' peaches showed an unusual increase, more than double, from day 1 to day 2 while control peaches of this same cultivar did not show any change. From day 2 to day 4 there was no drastic change in slope values within a given cultivar. By day 4, control 'Stony Hard' peaches had the highest slope, 2.81 N/s. Of all the cold stored cultivars, 'Topaz' finished with the highest slope, 1.91 N/s. 'Fairtime' peaches began with the smallest slope and also finished with the smallest, 0.26 N/s; this particular cultivar had statistically smaller slope than any of the other cultivars at these two particular days, but not so in the intermediate days.

Number of Peaks

The number of peaks of at least 12.5, 37.5, and 50 g in the force-displacement curve for five replicates are shown in tables VII, VIII, and IX respectively. For all three force magnitudes (i.e. size of peaks), the number of peaks for both 'Sentinel' and 'Topaz' was highest before storage and decreased slowly thereafter. 'Cresthaven' did not show any change in the number of peaks, for any of the force magnitudes, throughout the ripening days. On the average, 'Parade' showed a slight decrease from before storage until day 4. 'Fairtime' shows some difference in the number of peaks among force magnitudes; for the 12.5 g scale (small peaks) the largest number of peaks is found before

Table VII. Number of Peaks Larger Than 12.5 g. Mean (Standard Deviation)

Cultivar	Initial	Day 1	Day 2	Day 3	Day 4
Sentinel	7.0 (4.0)	3.2 (0.8)	2.6 (1.1)	1.8 (1.3)	2.6 (0.9)
Topaz	11.6 (2.4)	5.4 (1.7)	6.0 (1.2)	4.0 (0.7)	2.4 (0.5)
Cresthaven	1.4 (0.9)	-------	0.8 (0.8)	1.2 (0.8)	0.6 (0.9)
Parade	3.0 (0.7)	2.4 (0.9)	1.0 (1.0)	1.0 (0.7)	0.6 (0.9)
Fairtime	5.8 (2.0)	3.2 (1.1)	3.2 (1.3)	2.4 (0.9)	1.2 (0.8)
Stony Hard*	3.2 (1.5)	2.2 (0.8)	3.4 (2.6)	0.2 (0.4)	-------
S.H. Cntrls.**	-------	1.6 (0.6)	2.0 (1.4)	1.4 (0.6)	-------

Results of 5 replicates.

* Ethylene treated. 24 hr interval from initial to day1.

** No treatment. 24 hr interval from initial to day 1.

Table VIII. Number of Peaks Larger Than 37.5 g. Mean (Standard Deviation)

Cultivar	Initial	Day 1	Day 2	Day 3	Day 4
Sentinel	3.2 (3.8)	1.2 (0.8)	0.6 (0.9)	0.4 (0.5)	0.4 (0.5)
Topaz	5.2 (1.6)	1.4 (0.9)	1.8 (1.8)	1.2 (0.8)	0.2 (0.4)
Cresthaven	0.2 (0.4)	-------	0.0	0.0	0.2 (0.4)
Parade	1.8 (1.1)	1.4 (0.9)	0.0	0.0	0.0
Fairtime	0.8 (0.8)	1.6 (1.5)	0.8 (0.8)	1.0 (1.2)	0.0
Stony Hard*	0.2 (0.4)	0.6 (0.5)	1.0 (1.2)	0.0	-------
S.H. Cntrls.**	-------	0.0	0.8 (0.5)	0.6 (0.6)	-------

Results of 5 replicates.

* Ethylene treated. 24 hr interval from initial to day1.

** No treatment. 24 hr interval from initial to day 1.

Table IX. Number of Peaks Larger Than 50.0 g. Mean (Standard Deviation)

Cultivar	Initial	Day 1	Day 2	Day 3	Day 4
Sentinel	2.6 (3.0)	0.6 (0.5)	0.4 (0.5)	0.0	0.2 (0.4)
Topaz	4.0 (1.2)	0.8 (0.4)	1.4 (1.3)	0.8 (0.8)	0.0
Cresthaven	0.2 (0.4)	-------	0.0	0.0	0.0
Parade	1.6 (1.1)	1.4 (0.9)	0.0	0.0	0.0
Fairtime	0.6 (0.9)	1.0 (1.0)	0.8 (0.8)	0.8 (0.8)	0.0
Stony Hard*	0.0	0.4 (0.5)	0.4 (0.5)	0.0	-------
S.H. Cntrls.**	-------	0.0	0.8 (0.5)	0.4 (0.6)	-------

Results of 5 replicates.

* Ethylene treated. 24 hr interval from initial to day1.

** No treatment. 24 hr interval from initial to day 1.

storage and it decreases after that while for the 37.5 and 50.0 g scales (medium and large peaks) the number of peaks does not change significantly during storage and ripening. In the case of 'Stony Hard' peaches, there are approximately three times as many small peaks as medium and large peaks but they all decrease to the same value at day 4.

The largest number of peaks is found at the 12.5 g scale, i.e., the smaller the size of peaks the greater their number. Statistically, the largest decrease in number of peaks from the 12.5 g scale to the 37.5 and 50.0 g scale, is found to occur for 'Sentinel', 'Topaz', and 'Fairtime' peaches. The other three cultivars only show a slight or no decrease in the number of peaks as the peak size increases. The number of peaks among 37.5 and 50.0 g scales within a particular cultivar is approximately equal. The number of peaks, of a particular size, also appears to change equally from day to day.

Jaggedness

Jaggedness of the force-displacement curves, as quantified by FFT frequency analysis, showed that low frequencies are more dominant than high frequencies. The largest magnitudes are found below 2 Hz, magnitudes at higher frequencies are relatively negligible (Figure 6).

At harvest, all six cultivars show the highest concentration of frequencies in the first 0.19 Hz interval; by day 1 (after 28 days storage) the magnitude of the frequencies at this interval increases three times, by day 2 it decreases back to approximately the same magnitude as before storage, and it continues decreasing for days 3 and 4.

The magnitude of the ratios, within a specific day, decreases exponentially with

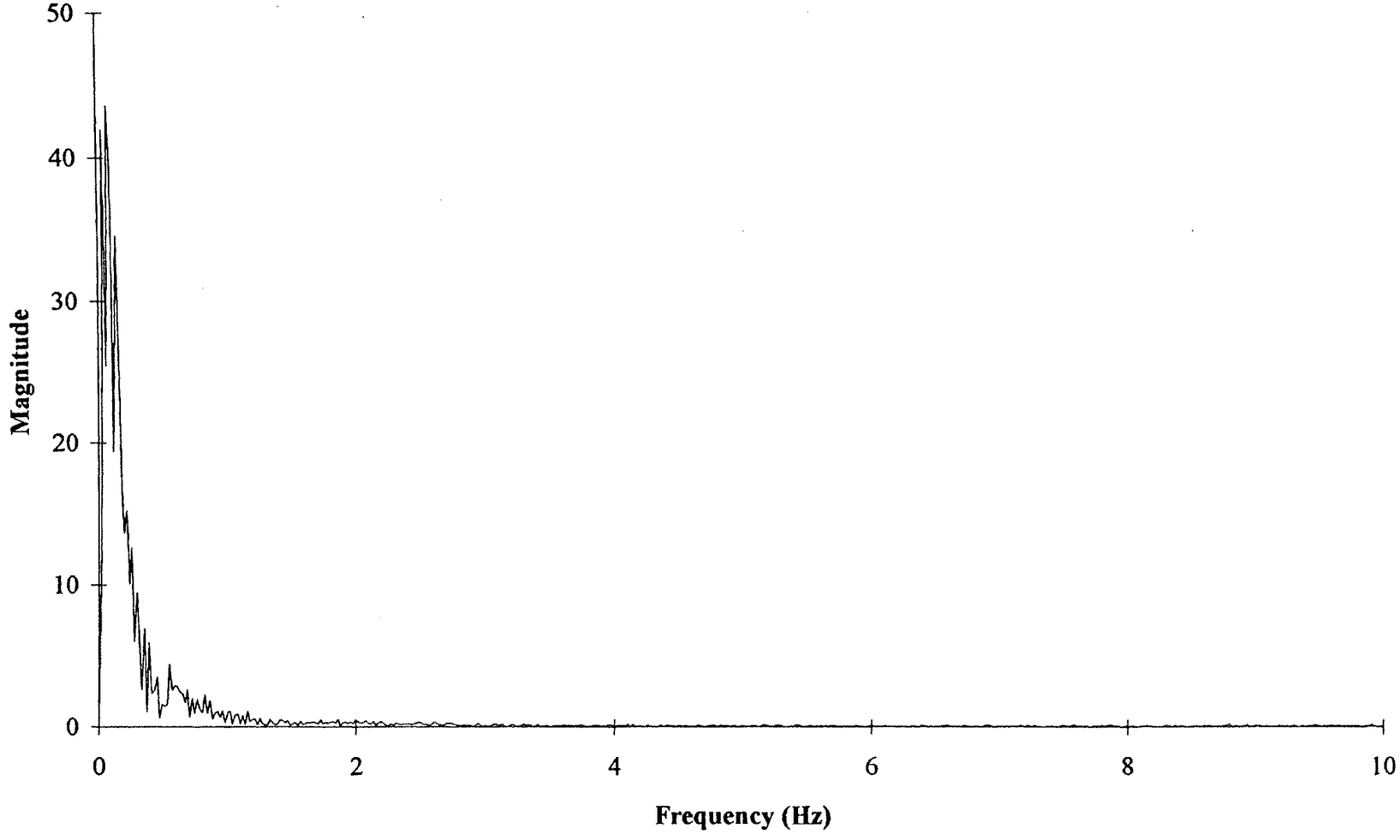


Figure 6. Frequency Spectrum for 'Topaz'. Before Storage.

increasing frequency from Ratio 1 (i.e., 0 to 0.19 Hz ÷ 8.10 to 10 Hz) to Ratio 16 (2.85 to 3.04 Hz ÷ 8.10 to 10 Hz), see Figure 7. The greatest decrease in magnitude is found at the lowest frequency, i.e., from Ratio 1 to Ratio 2. The magnitude of the ratios does not change considerably after 1.5 Hz. Ratios R1, R5, R10, and R15 of all six cultivars are provided in Table X. The other ratios are shown in the Appendix.

For 'Sentinel', 'Topaz', and 'Fairtime' the R1 ratio is the highest at day 1. 'Parade' is the only cultivar that has the highest ratio at the time of harvest. 'Sentinel' and 'Fairtime' have the highest ratios always at day 1. Although there was no data on day 1 for 'Cresthaven' it appears that the highest ratios might have occurred before storage like in the case of 'Parade' because of the very high values obtained for R1 through R5 at this day.

On the average, all ratios (R1 to R16) on days 2, 3, and 4 of 'Sentinel' peaches are similar. In 'Topaz' peaches, all ratios with the exception of R1 in day 3 and day 4, are also similar. 'Parade's ratios were equal for days 3 and 4. 'Fairtime' peaches on the other hand, do not show this resemblance in results at the last two days of ripening but did earlier at day 2 and day 3.

Ethylene treated 'Stony Hard' peaches show a decrease in all frequency ratios after one day of ripening. Ratios R1 and R2 on days 1 and 2 decrease in magnitude, but ratios R3 through R16 increase on these same days. From day 2 to day 3 all ratios decrease in magnitude. Control peaches behave in the opposite way by increasing frequency ratios from initial time to day 1. From day 1 to day 2 control peaches decrease all frequency ratios and from day 2 to day 3 there is again an increase. Although there is an unusual

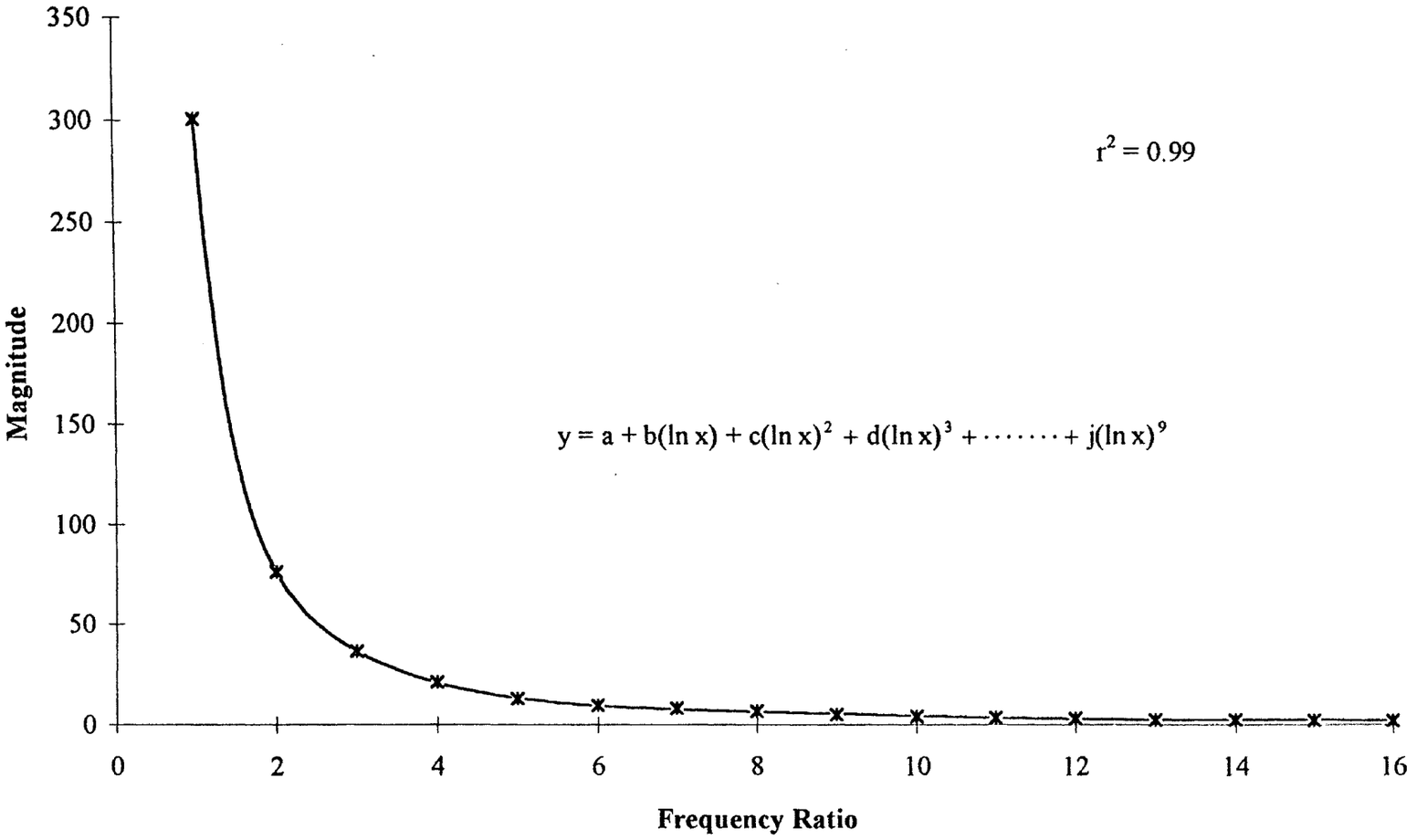


Figure 7. Magnitudes vs. Frequency Ratio for 'Sentinel' Day 4.
for example: R2 = (0.19 - 0.39) / (8.10 - 10)

Table X. Magnitude of Select Frequency Ratios. Mean (Standard Deviation)

Cultivar	Initial	Day 1	Day 2	Day 3	Day 4
		R1			
Sentinel	444 (185)	990 (566)	320 (244)	328 (130)	300 (144)
Topaz	744 (298)	1035 (229)	628 (424)	433 (245)	345 (240)
Cresthaven	1213 (370)	------	406 (115)	332 (168)	371 (117)
Parade	727 (225)	524 (228)	297 (78)	227 (89)	228 (58)
Fairtime	460 (271)	1337 (562)	324 (168)	310 (188)	181 (60)
Stony Hard	1086 (425)	617 (404)	362 (93)	210 (57)	------
S.H. Cntrls.	------	1955 (712)	1405 (572)	2259 (1133)	------
		R5			
Sentinel	14.9 (10.7)	38.2 (39.6)	14.3 (11.1)	12.3 (4.7)	12.7 (5.8)
Topaz	26.3 (18.4)	27.0 (19.5)	22.4 (15.7)	14.9 (5.0)	15.1 (4.8)
Cresthaven	34.7 (35.5)	------	15.9 (3.1)	17.2 (6.0)	18.2 (5.9)
Parade	21.0 (20.0)	10.9 (3.9)	14.1 (6.2)	12.5 (6.9)	10.5 (4.0)
Fairtime	8.94 (4.87)	22.2 (7.6)	16.1 (7.2)	15.0 (5.6)	10.1 (2.3)
Stony Hard	45.2 (37.9)	10.3 (4.5)	17.3 (5.8)	10.1 (2.7)	------
S.H. Cntrls.	------	116 (63)	56.4 (44.8)	101 (92)	------
		R10			
Sentinel	3.62 (2.29)	7.88 (8.95)	3.48 (1.96)	3.58 (1.23)	4.00 (1.31)
Topaz	6.25 (3.31)	4.50 (4.93)	5.24 (3.18)	3.89 (1.23)	4.33 (1.78)
Cresthaven	6.35 (8.03)	------	3.70 (0.98)	5.93 (2.60)	4.97 (1.00)
Parade	3.74 (2.88)	2.07 (0.38)	4.14 (1.67)	3.12 (1.18)	2.72 (1.03)
Fairtime	2.44 (1.12)	5.12 (1.94)	3.27 (1.17)	3.70 (1.17)	2.83 (0.82)
Stony Hard	9.11 (8.38)	2.29 (0.41)	4.35 (2.19)	2.64 (0.63)	------
S.H. Cntrls.	------	25.2 (14.6)	11.2 (10.6)	24.4 (19.2)	------
		R15			
Sentinel	1.97 (0.72)	3.26 (3.43)	1.89 (1.17)	1.96 (0.61)	1.95 (0.54)
Topaz	2.27 (0.94)	1.80 (2.07)	2.26 (0.85)	1.69 (0.42)	2.00 (0.80)
Cresthaven	2.34 (2.82)	------	1.86 (0.65)	2.38 (0.99)	2.08 (0.53)
Parade	1.69 (0.84)	1.23 (0.22)	1.78 (0.60)	1.53 (0.46)	1.48 (0.28)
Fairtime	1.40 (0.47)	2.41 (0.83)	1.73 (0.42)	1.93 (0.55)	1.72 (0.27)
Stony Hard	3.38 (2.56)	1.34 (0.28)	2.20 (1.61)	1.63 (0.50)	------
S.H. Cntrls.	------	8.69 (5.32)	4.78 (4.03)	8.39 (7.86)	------

behavior, these results are not statistically different. There is no change, within a particular ratio, from day to day.

Area Under Frequency Spectrum

As in firmness related parameters, the highest values of area under the frequency spectrum were found in 'Sentinel', 'Topaz', 'Cresthaven', and 'Stony Hard' (10.12 to 15.51) and the lowest values in 'Parade' and 'Fairtime' (3.48 and 8.50 respectively), Table XI.

For 'Fairtime' peaches, the area of the whole frequency spectrum started at 3.5 before storage and stayed fairly constant until day 1. This parameter appears to be not a measure of the mealiness of a sample but a measure of its firmness. Other parameters such as Effegi firmness, first peak force, steady state force, and slope of the curve are mostly a measure of the fruit's firmness.

The area under the frequency spectrum slightly increased from before storage to day 1 of ripening for 'Sentinel' and 'Topaz' peaches. There was a big decrease in area during this same period of time for 'Parade' and 'Stony Hard' peaches. 'Fairtime' did not show a significant change in area during this storage period. For all five cold stored cultivars there is a big decrease in areas from day 1 to day 2. After day 2 only a slight decrease or no change in area was observed; this compares with the change in firmness found for the other parameters. All five cultivars finished at day 4 with areas less than 1 and again 'Fairtime' peaches had the lowest magnitude.

Control 'Stony Hard' peaches increased in area from day to day (15.64 before

Table XI. Areas Under Frequency Spectrum. Mean (Standard Deviation)

Cultivar	Initial	Day 1	Day 2	Day 3	Day 4
Sentinel	11.29 (4.47)	12.45 (9.16)	1.20 (1.15)	0.70 (0.23)	0.72 (0.26)
Topaz	10.12 (2.83)	15.19 (4.19)	3.22 (5.10)	1.05 (0.50)	0.87 (0.51)
Cresthaven*	15.51 (4.64)	-------	0.82 (0.20)	0.74 (0.33)	0.73 (0.15)
Parade	8.50 (3.49)	2.53 (1.02)	0.66 (0.16)	0.49 (0.10)	0.48 (0.13)
Fairtime	3.48 (1.69)	3.25 (1.20)	0.74 (0.33)	0.64 (0.30)	0.38 (0.11)
Stony Hard**	15.64 (7.58)	2.94 (1.72)	2.64 (0.55)	0.48 (0.10)	-------
S.H. Cntrls.***	-------	17.76 (8.89)	17.95 (9.43)	18.07 (10.49)	-------

* Initial had 12 replicates while days 2, 3, and 4 had 7 replicates.

** Ethylene treated. 24 hr interval from initial to day1.

*** No treatment. 24 hr interval from initial to day 1.

treatment to 18.07 at day 3), but because standard deviation values of 7.58 to 10.49, no statistical difference can be concluded. Area under the frequency spectrum also appears to be a measurement of firmness for these particular peaches since a slight increase in Effegi firmness was similarly observed.

Cultivar Comparison

The changes in the measured parameters are listed by cultivars during storage in Table XII and during ripening, i.e., day 1 to day 2, in Table XIII.

Mealiness, as measured by extractable juice, was not detected in 'Sentinel', 'Cresthaven' and 'Stony Hard' peaches. A slight increase in extractable juice was observed with ripening which is characteristic of normal, non-mealy peaches. 'Parade' peaches had the lowest extractable juice at day 2 but it was not statistically different from the previous two days; it showed a considerable increase by day 3 and finished at day 4 with a value 45 % higher than at the time of harvest. This indicates that the peaches were extremely juicy (non-mealy) by day 4. 'Topaz' and 'Fairtime' are the only cultivars in which mealiness was slightly induced. 'Topaz' had its lowest value of extractable juice immediately after storage and increased thereafter but it never got any higher than at the time of harvest. In 'Fairtime' peaches extractable juice values dropped more than in the other cultivars, the lowest value was found at day 2 and it increased thereafter but never higher than its initial value.

Two different patterns of change over time are observed in Effegi firmness, one is a considerable decrease in firmness after storage and the other is no change in firmness.

Table XII. Change in Parameters During Storage, %

Cultivar	Extractable Juice	Effegi Firmness	First Peak Force	Steady State Force	Initial Slope	Number of Peaks 12.5 g	Frequency Ratio - FFT R1	Frequency Ratio - FFT R5	FFT Area
Sentinel	-21	-44	-1	-21	-21	-54	123	156	10
Topaz	-47	-10	4	-55	-20	-53	39	2	50
Cresthaven	-----	-----	-----	-----	-----	-----	-----	-----	-----
Parade	-12	-39	-55	-40	-41	-20	-30	-48	-70
Fairtime	-31	-19	-18	-22	-4	-45	191	148	-7
Stony Hard*	13	-52	-62	-58	-43	-31	-43	-77	-81
S.H. Cntrls.**	8	-----	-3	-13	-10	-50	80	157	14

* Ethylene treated. 24 hr interval from initial to day1.

** No treatment. 24 hr interval from initial to day 1.

Table XIII. Change in Parameters From Day 1 to Day 2, %

Cultivar	Extractable Juice	Effegi Firmness	First Peak Force	Steady State Force	Initial Slope	Number of Peaks 12.5 g	Frequency Ratio - FFT R1	Frequency Ratio - FFT R5	FFT Area
Sentinel	7	-54	-92	-84	-66	-19	-68	-63	-90
Topaz	13	-62	-89	-47	-41	11	-39	-17	-79
Cresthaven	-----	-----	-----	-----	-----	-----	-----	-----	-----
Parade	-8	-56	-71	-67	-43	-58	-43	29	-74
Fairtime	-40	-58	-77	-60	-56	0	-76	-27	-77
Stony Hard*	-36	-61	-76	55	112	55	-41	68	-10
S.H. Cntrls.**	-33	-----	5	61	-2	25	-28	-51	1

* Ethylene treated. 24 hr interval from initial to day1.

** No treatment. 24 hr interval from initial to day 1.

'Parade', 'Stony Hard' and 'Sentinel' peaches decreased 43 to 74 % in firmness respectively. 'Topaz' and 'Fairtime' slightly decreased in firmness (10 to 19 %) but not enough to be statistically significant. All cultivars generally show a 55 to 60 % decrease from day 1 to day 2 and continue decreasing slightly until day 4.

First peak force stayed fairly constant during storage for all cultivars with the exception of 'Parade' and 'Stony Hard' which decreased 55 and 62 %, respectively. First peak force decreased the most (70 to 92 %) from day 1 to day 2 and stays fairly constant thereafter in all cultivars.

Steady state force has two possible trends just like Effegi firmness. 'Topaz', 'Parade', and 'Stony Hard' peaches show a significant decrease during storage while 'Sentinel' and 'Fairtime' show no change during storage. From day 1 to 2 of ripening all cultivars continue to decrease in steady state force except for 'Stony Hard' which unexpectedly increases. Steady state force at days 2, 3, and 4 is not statistically different among cultivars.

As in the other three firmness parameters, initial slope of the force-displacement curve shows two different trends. 'Sentinel', 'Topaz', and 'Fairtime' peaches show no change in initial slope after storage while 'Parade' and 'Stony Hard' peaches decrease approximately 42 % of that measured before storage. At days 2, 3, and 4 the slopes of all cultivars within a given day are statistically similar to each other, except for 'Stony Hard' which shows a value higher at day 2 than before ethylene treatment.

The number of small peaks (12.5 g scale) in the force-displacement curve at the time of harvest was very different from cultivar to cultivar with average values ranging

from 1.4 for 'Cresthaven' to 11.6 for 'Topaz' peaches. This variability decreases significantly after storage to 2.2 for 'Stony Hard' and 5.4 for 'Topaz'. The number of peaks continues to decrease until day 4 for all cultivars. 'Topaz' appears to have the most jagged curves of all cultivars because it had the highest number of peaks throughout most of the days and 'Cresthaven' the smoothest curves because it had the lowest number of peaks in all five days. For medium (37.5 g) and large size peaks (50 g) 'Topaz' peaches continued to have the largest number of peaks and 'Cresthaven' the least, but the number of peaks decreased as the size got larger. The number of peaks decreases to a point that 'Cresthaven' and 'Parade' peaches have no peaks for days 2, 3, and 4 larger than any of these last two scales.

The jaggedness of the force-displacement curves was measured with greater precision with the frequency ratios from FFT analysis. 'Sentinel', 'Topaz', and 'Fairtime' peaches show a large increase in the magnitude of the frequency ratios starting before and continuing to after storage while 'Parade' and 'Stony Hard' peaches showed a decrease in magnitude. 'Sentinel' and 'Fairtime' are the only cultivars in which the highest magnitudes are found at day 1 for all ratios (R1 - R16). 'Topaz' has the highest magnitudes at day 1 only from R1 to R3 and after that the highest magnitudes are found before storage. 'Cresthaven', 'Parade', and 'Stony Hard' have the highest magnitudes before storage. From day 2 to day 4 the magnitude of frequencies either decreases or stays fairly constant for all cultivars. By counting the number of times a particular cultivar has the highest magnitude within the five test days (Table X of R1, R5, R10, and R15) we see that 'Cresthaven' peaches appear to produce the most jagged force-displacement

curves out of all five cold stored cultivars. In the same manner 'Parade' peaches appear to produce the smoothest force-displacement curves of all cultivars since it has the majority of the lowest ratio values.

'Sentinel', 'Topaz', and 'Fairtime' peaches maintained the area under the frequency spectrum during storage unlike 'Parade' and 'Stony Hard' peaches which showed a significant decrease. At the time of harvest 'Stony Hard' peaches had the largest area overall and 'Cresthaven' peaches had the largest area of all cold stored cultivars, but during the four days of ripening 'Topaz' peaches had the largest areas. At the time of harvest all cultivars were similar with the exception of 'Fairtime' which had considerably smaller areas. By the last day of ripening all cultivars had similar areas with the exception of 'Fairtime's small areas which coincide with the lowest values of the other firmness parameters.

Correlations with Effegi Firmness

First peak force was correlated to Effegi firmness using linear regression for the combined values of all five days (Table XIV). The two firmness measures appear to be well correlated with r^2 values ranging from 0.73 for 'Sentinel' to 0.95 for 'Cresthaven' peaches. 'Fairtime', like in most of the other parameters, has the lowest slope (0.282 N/N) and is followed by 'Topaz' (0.389 N/N). The other four cultivars have approximately equal slopes ranging from 0.438 N/N for 'Sentinel' peaches to 0.464 N/N for 'Stony Hard' peaches. In general, for each unit change in Effegi firmness there is a 0.45 unit change in first peak force.

Table XIV. Correlations With Effegi Firmness

Cultivar	First Peak Force Intercept	Slope	r^2	Area* Intercept	Slope	r^2
Sentinel	-1.324	0.438	0.74	-4.581	1.634	0.50
Topaz	-1.550	0.389	0.84	-6.033	1.525	0.79
Cresthaven	0.059	0.461	0.95	-12.714	1.854	0.92
Parade	-1.923	0.442	0.85	-10.850	1.348	0.68
Fairtime	-0.922	0.282	0.88	-1.766	0.651	0.74
Stony Hard	-3.453	0.464	0.92	-21.494	1.973	0.73

* Area under frequency spectrum from 0 to 10 Hz.

Area under the frequency spectrum was also correlated with Effegi firmness, obtaining lower r^2 values ranging again from 0.50 for 'Sentinel' to 0.92 for 'Cresthaven'. The lowest slope is found again in 'Fairtime' (0.651 1/N) and after that the slopes gradually increase from 'Parade' (1.358 1/N) to 'Stony Hard' (1.973 1/N). Slopes greater than one imply that area under the frequency spectrum is more sensitive than Effegi to differences in fruit firmness. The slopes for area under the frequency spectrum vs. Effegi firmness are widely variable unlike first peak force. Depending on the cultivar, changes in area under the frequency spectrum are about 35 % smaller to 100 % greater than changes in Effegi firmness. Individual graphs showing the data points and their respective regression equations for every cultivar are shown in the Appendix.

CHAPTER V

CONCLUSIONS

Parameters derived from FFT analysis of the force-displacement response of a wire probe through a 2.3-cm diameter by 2-cm long plug sample show good potential as a method to quantify peach texture disorders found in mealy and pasty peaches.

The firmness related parameters of first peak force, steady state force, and initial slope behaved very much like Effegi firmness. A very good correlation of first peak force was obtained with Effegi firmness. Another parameter that appeared to be a measure of firmness was the area under the spectrum of frequencies; it followed the same pattern of change with days as the firmness parameters.

Of the two parameters obtained from frequency analysis, a ratio of two areas appears to be the best parameter to quantify jaggedness or non smoothness of the force-displacement curves of peach samples. Area under the frequency spectrum appears to be only a measurement of firmness i.e., it correlated very well with Effegi firmness for 'Cresthaven' peaches ($r^2 = 0.92$).

Even though incidence of mealiness was not as high as expected, according to extractable juice, some changes in texture were observed after 28 days of storage and one day of ripening. Significant textural differences were observed between day 1 and day 2

of ripening. No differences in any of the textural parameters was found between days 2, 3, and 4 of ripening.

CHAPTER VI

SUGGESTIONS FOR FUTURE STUDY

The main problem encountered in this research was that mealiness was not induced to as high a degree as desired. Maybe growing conditions on this particular year affected the potential for peaches to become mealy. Different storage temperatures, humidities, and time periods should be tested for late-season cultivars to increase chances of obtaining a high incidence of mealiness. With peaches having a greater degree of mealiness, possibly the results of using the method would have been even better. This frequency analysis method can be used to detect differences in texture, but without high confidence that peaches will indeed turn mealy, we cannot completely test for correlation of these texture changes with mealiness.

Since peach cell size is very small, using a smaller diameter wire in the Instron probe might increase the degree of sensitivity to textural changes. For the diameter wire utilized for our experiment we are undoubtedly obtaining texture change of an average of many cells. It would be better to minimize the number of cells affected by the probe. A better and more accurate understanding of mealiness might then be possible.

A problem that needs to be solved is the noise encountered when digitizing the force-displacement curves. Due to the shape of the force-displacement curve at these 'bad points' we do not think they were caused by any vibration of the wire probe. Noise must

be attributed to electrical problems within the Instron electronics or the data acquisition system. By filtering the data, we attempted to remove only these 'bad points' but in the process we might have eliminated valuable information for our mealiness detection analysis.

Since most of the texture changes were observed immediately after peaches were taken from storage and during the following one to two days of ripening, testing should be performed more often during this period of time.

BIBLIOGRAPHY

Abbott, J.A.; A.E. Watada; and D.R. Massie. 1984. Sensory and instrument measurement of apple texture. J. Amer. Soc. Hort. Sci. 109(2):221-228.

Anderson, R.E. and R.W. Penney. 1975. Intermittent warming of peaches and nectarines stored in a controlled atmosphere or air. J. Amer. Soc. Hort. Sci. 100(2):151-153.

Barrett, A.M.; M.D. Normand; M. Peleg; and E. Ross. 1992. Characterization of the jagged stress-strain relationships of puffed extrudates using the Fast Fourier Transform and Fractal analysis. J. of Food Science. 57(1):227-232, 235.

Ben-Arie, R.; S. Lavee; and S. Guelfat-Reich. 1970. Control of woolly breakdown of 'Elberta' peaches in cold storage, by intermittent exposure to room temperature. J. Amer. Soc. Hort. Sci. 95(6):801-803.

Ben-Arie, R. and S. Lavee. 1971. Pectic changes occurring in Elberta peaches suffering from woolly breakdown. Phytochemistry. 10:531-538.

Bourne, M.C. 1965. Studies on punch testing of apples. Food Technology. 19:413-415.

Dawson, D.M.; L.D. Melton; and C.B. Watkins. 1992. Cell wall changes in nectarines (Prunus persica). Plant Physiology. 100:1203-1210.

Harker, F.R. and I.C. Hallett. 1992. Physiological changes associated with development of mealiness of apple fruit during cool storage. HortScience 27:1291-1294.

Jackman, R.L.; H.J. Gibson; and D.W. Stanley. 1992. Effects of chilling on tomato fruit texture. Physiologia Plantarum. 86:600-608.

Kader, A.A. and F.G. Mitchell. 1989. Maturity and Quality, p. 194. In: LaRue, J.H. and R.S. Johnson (eds.). Peaches, Plums, and Nectarines - Growing and Handling for Fresh Market. Publ. 3331, Univ. of California, Div. of Agr. and Natural Resources.

Kays, S.J. 1991. Postharvest Physiology of Perishable Plant Products. New York: Van Nostrand Reinhold.

Kramer, A. 1961. The shear-press, a basic tool for the food technologist. Food Scientist. 5(1):7-16.

Lee, W.E.; A.E. Deibel; C.T. Glemblin; and E.G. Munday. 1988. Analysis of food crushing sounds during mastication: frequency-time studies. J. of Texture Studies. 19:27-38.

Lill, R.E. and G.J. Van Der Mespel. 1988. A method for measuring the juice content of mealy nectarines. Scientia Horticulturae. 36:267-271.

Luza, J.G.; R. Van Gorsel; V.S. Polito; and A.A. Kader. 1992. Chilling injury in peaches: A cytochemical and ultrastructural cell wall study. J. Amer. Soc. Hort. Sci. 117(1):114-118.

McComber, D.R.; E.M. Osman; and R.A. Lohnes. 1988. Factors related to potato mealiness. J. of Food Science. 53:1423-1426

Mitchell, F.G. and A.A. Kader. 1989 a. Storage, p.216-217. In: LaRue, J.H. and R.S. Johnson (eds.). Peaches, Plums, and Nectarines - Growing and Handling for Fresh Market. Publ. 3331, Univ. of California, Div. of Agr. and Natural Resources.

Mitchell, F.G. and A.A. Kader. 1989 b. Factors Affecting Deterioration Rate, p.167. In: LaRue, J.H. and R.S. Johnson (eds.). Peaches, Plums, and Nectarines - Growing and Handling for Fresh Market. Publ. 3331, Univ. of California, Div. of Agr. and Natural Resources.

Nuebel, C. and M. Peleg. 1993. Compressive stress-strain relationships of two puffed cereals in bulk. J. of Food Science. 58(6):1356-1360, 1374.

Rohde, F.; M.D. Normand; and M. Peleg. 1993. Characterization of the power spectrum of force-deformation relationships of crunchy foods. J. of Texture Studies. 24:45- 62.

Sistrunk, W.A. 1985. Peach Quality Assessment: Fresh and Processed, p. 12. In: Patee, H. E. (ed.). Evaluation of Quality of Fruits and Vegetables. New York: AVI Publishing Co.

Szczesniak, A.S. and R. Ilker. 1988. The meaning of textural characteristics-juiciness in plant foodstuffs. J. of Texture Studies. 19:61-78.

Von Mollendorff, L.J. and O.T. De Villiers. 1988. Role of pectolytic enzymes in the development of woolliness in peaches. J. of Horticultural Science. 63(1):53-58.

Von Mollendorff, L.J.; O.T. De Villiers; and G. Jacobs. 1989. Effect of time examination and ripening temperature on the degree of woolliness in nectarines. J. of Horticultural Science. 64(4):443-447.

Walker, J.S. 1991. Fast Fourier Transform. Florida: CRC Press.

Whitelock, D.P.; G.H. Brusewitz; M.W. Smith; and X. Zhang. 1994. Humidity and airflow during storage affect peach quality. Hort Science. 29(7):798-801.

APPENDIX

Appendix A

Extractable Juice Data, %
(Two samples from each peach)

Cultivar: Sentinel

#	Initial		Day 1		Day 2		Day 3		Day 4	
1	18.09	16.81	10.60	3.87	5.23	4.91	13.00	11.75	17.96	27.68
2	17.12	17.96	18.48	13.90	19.63	19.76	14.05	8.85	24.86	27.37
3	13.17	10.23	13.62	19.13	10.34	7.25	7.64	6.27	15.87	17.19
4	16.45	15.25	6.51	6.01	25.20	21.73	28.77	26.44	16.78	16.78
5	11.00	15.05	11.36	8.45	37.70	35.81	30.85	24.61	10.48	10.61
6	13.17	14.29	2.69	5.89	5.91	7.14	15.45	14.26	19.42	19.13
7	19.79	11.96	2.96	8.12	11.17	12.41	15.13	19.73	16.13	20.58
8	10.42	12.96	14.16	9.76	13.39	7.96	12.85	14.61	22.84	20.55
9	17.28	23.05	12.91	8.57	11.98	12.71	19.16	13.84	17.13	20.43
10	23.13	20.94	9.12	13.36	5.58	11.11	11.73	13.09	19.46	15.69
11	13.20	10.00	36.76	34.76	12.39	12.55	33.49	27.96	6.34	11.49
12	12.80	10.30	14.67	14.84	18.57	11.21	24.06	22.04	20.31	14.65

Cultivar: Topaz

#	Initial		Day 1		Day 2		Day 3		Day 4	
1	20.40	22.60	8.49	5.94	7.86	7.65	13.57	10.79	14.08	12.41
2	23.03	26.23	14.26	7.51	8.64	8.59	14.33	14.15	11.86	10.25
3	24.57	21.88	13.74	14.16	9.85	9.53	15.20	14.41	20.01	19.43
4	15.33	14.86	6.08	4.63	11.89	11.97	7.88	10.61	20.45	23.92
5	14.97	17.87	13.57	10.89	5.17	6.04	7.71	8.70	12.63	15.92
6	16.87	19.28	12.25	10.75	11.80	16.94	11.35	14.83	13.63	11.20
7	15.41	10.68	11.39	9.20	11.91	15.46	10.60	13.85	13.66	15.37
8	21.61	15.27	7.39	7.97	14.28	14.15	11.03	12.27	11.68	12.22
9	19.81	25.08	7.33	8.12	6.34	8.26	16.80	17.07	15.68	14.25
10	25.72	18.45	11.50	11.52	11.64	11.90	15.85	21.27	16.03	15.20
11	15.65	17.18	7.57	8.63	16.71	14.58	11.08	13.59	14.45	14.70
12	11.17	12.96	17.18	8.92	14.77	14.91	5.32	6.09	7.16	9.45

Appendix A (Continued)

Cultivar: Cresthaven

#	Initial		Day 1	Day 2		Day 3		Day 4	
1	15.58	16.12	-------	24.10	24.08	28.34	27.95	23.01	23.64
2	15.25	17.99	-------	20.37	19.98	19.88	26.96	26.47	24.20
3	16.78	16.98	-------	16.99	18.51	30.76	27.99	26.40	25.53
4	21.46	21.44	-------	26.77	21.96	22.16	23.21	30.63	26.34
5	26.29	21.60	-------	23.67	22.98	16.45	15.54	30.64	31.33
6	18.29	18.33	-------	19.15	22.98	26.69	23.15	17.59	22.75
7	19.55	21.61	-------	23.13	22.09	28.21	23.47	20.63	22.77
8	20.50	17.66	-------	-------		-------		-------	
9	20.63	15.97	-------	-------		-------		-------	
10	21.98	18.10	-------	-------		-------		-------	
11	17.02	12.05	-------	-------		-------		-------	
12	22.92	20.91	-------	-------		-------		-------	

Cultivar: Parade

#	Initial		Day 1		Day 2		Day 3		Day 4	
1	14.59	21.99	18.88	21.35	16.22	21.56	25.98	31.21	22.19	31.12
2	24.23	27.48	23.02	16.10	19.38	22.92	28.44	26.44	32.01	29.94
3	28.86	20.19	23.47	18.49	6.28	11.81	23.23	23.86	21.57	19.36
4	24.58	23.07	16.27	15.52	20.80	19.71	20.56	25.54	25.32	23.63
5	20.33	19.64	21.63	17.39	12.31	7.88	20.56	24.47	31.37	31.85
6	21.54	17.00	22.15	23.73	11.43	15.13	18.86	19.47	44.50	36.76
7	13.05	16.33	18.59	25.17	22.45	26.54	21.09	21.99	23.52	21.28
8	27.47	20.78	24.25	20.83	9.95	13.59	18.54	18.89	33.65	32.13
9	17.43	20.25	15.31	15.29	14.77	21.89	26.55	26.24	34.21	33.77
10	21.94	15.78	21.14	22.59	14.58	18.82	18.44	26.43	39.56	37.47
11	24.85	22.51	14.29	8.83	16.92	17.86	27.65	33.62	30.56	31.87
12	19.47	22.87	8.69	11.70	20.82	24.01	31.86	30.19	32.48	35.67

Appendix A (Continued)

Cultivar: Fairtime

#	Initial		Day 1		Day 2		Day 3		Day 4	
1	41.53	38.26	20.70	17.98	12.24	10.05	14.39	20.48	5.38	8.20
2	29.67	26.35	27.78	20.05	17.20	11.60	20.71	19.84	30.81	31.16
3	34.53	28.35	16.73	12.06	22.94	24.41	11.84	13.50	32.44	22.31
4	35.91	29.00	28.15	26.35	14.80	11.70	8.61	9.39	25.33	23.75
5	43.56	35.93	22.80	25.60	9.02	12.12	24.73	20.05	23.93	29.70
6	33.88	39.09	21.84	32.04	16.20	11.37	17.40	19.71	6.89	4.90
7	33.35	35.81	19.56	16.60	14.85	12.63	16.53	10.06	20.58	21.80
8	26.62	32.50	19.33	24.92	16.15	15.03	14.63	14.90	43.18	37.77
9	27.31	25.97	27.81	30.19	11.79	13.62	9.18	6.98	18.73	25.60
10	26.76	24.25	11.80	18.49	10.17	11.98	23.79	23.60	29.19	32.23
11	37.39	38.11	33.36	28.74	11.23	7.12	15.88	14.64	20.40	27.93
12	29.96	25.08	14.57	20.07	13.11	12.69	25.93	27.46	27.74	16.59

Cultivar: Stony Hard

#	Initial		Day 1		Day 2		Day 3	
1	17.71	16.47	21.54	24.77	13.21	10.54	12.14	13.82
2	6.67	21.22	18.03	16.67	5.16	7.29	-------	
3	28.59	22.48	18.75	26.62	-------		10.23	11.56
4	12.51	17.71	15.84	18.55	13.85	15.20	18.53	16.80
5	16.62	17.11	12.37	22.29	20.54	13.46	9.26	12.91
6	23.13	19.72	24.41	23.77	11.09	11.86	8.28	13.66
7	17.27	22.43	16.58	15.89	13.60	12.42	10.83	10.21
8	18.55	14.28	23.70	15.08	-------		16.54	16.44
9	12.12	12.69	21.53	19.82	15.34	10.36	22.34	12.65
10	19.78	20.62	21.85	25.15	16.58	15.83	17.15	18.96

Cultivar: Stony Hard Control

#	Initial	Day 1		Day 2		Day 3	
1	-------	22.29	17.04	14.05	18.96	8.35	17.93
2	-------	24.66	20.76	15.69	15.99	13.51	18.96
3	-------	31.21	26.77	9.92	10.26	21.60	18.37
4	-------	14.61	14.55	19.23	11.79	18.88	12.82
5	-------	10.45	11.47	6.91	7.40	15.06	13.85

Appendix B

Effegi Firmness Data, kg

Cultivar: Sentinel

DAY	Sample											
	1	2	3	4	5	6	7	8	9	10	11	12
Initial	9.2	8.9	7.9	8.4	8.4	7.7	7.7	8.6	8.4	8.3	9.1	8.8
1	6.3	0.9	6.0	6.4	6.3	3.4	6.9	6.1	4.8	5.7	1.4	2.3
2	3.2	2.5	2.8	1.0	1.0	4.1	1.5	1.1	2.6	1.6	2.1	2.8
3	1.7	1.0	2.0	0.7	0.5	3.2	0.5	1.5	1.5	1.4	1.0	3.3
4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.2	1.3	0.5	1.2	0.5

Cultivar: Topaz

DAY	Sample											
	1	2	3	4	5	6	7	8	9	10	11	12
Initial	7.8	8.6	7.9	7.9	10.0	8.4	9.2	9.3	10.4	8.7	11.0	9.8
1	9.8	7.8	7.9	9.8	8.0	6.7	7.9	6.8	10.0	7.5	8.4	7.7
2	9.4	1.3	4.0	2.5	2.0	2.2	2.7	4.1	2.6	2.0	2.5	2.5
3	0.8	0.7	0.6	1.3	1.7	0.5	0.7	1.0	0.5	0.8	0.8	1.0
4	0.7	0.6	0.5	0.8	0.5	0.7	1.0	0.5	0.5	0.5	0.6	1.3

Appendix B (Continued)

Cultivar: Cresthaven

DAY	Sample											
	1	2	3	4	5	6	7	8	9	10	11	12
Initial	8.1	11.7	9.1	7.4	8.8	7.5	10.7	8.5	9.2	8.5	11.3	7.8
1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
2	1.3	1.9	1.6	2.1	1.9	1.0	1.2	-----	-----	-----	-----	-----
3	0.6	1.1	0.6	0.7	0.9	1.2	0.8	-----	-----	-----	-----	-----
4	1.4	1.1	0.7	1.0	0.6	0.9	0.9	-----	-----	-----	-----	-----

Cultivar: Parade

DAY	Sample											
	1	2	3	4	5	6	7	8	9	10	11	12
Initial	6.6	7.1	6.1	6.3	6.8	6.6	6.1	6.1	5.1	6.2	5.2	6.7
1	4.3	3.6	4.3	3.7	3.8	2.0	5.0	4.2	3.5	2.8	4.5	3.8
2	1.5	1.5	2.3	1.6	1.7	2.0	0.9	1.3	1.5	1.6	1.6	2.3
3	1.0	1.1	1.2	1.0	1.1	0.8	1.1	0.8	1.1	1.3	1.3	1.2
4	0.7	0.7	0.5	0.6	0.9	1.0	0.6	0.5	0.6	0.7	1.0	0.9

Appendix B (Continued)

Cultivar: Fairtime

DAY	Sample											
	1	2	3	4	5	6	7	8	9	10	11	12
Initial	5.7	6.2	5.5	6.0	6.8	6.6	5.4	5.4	5.3	5.3	5.1	6.8
1	2.6	4.0	5.4	4.4	5.4	4.2	5.4	4.5	5.8	4.0	7.0	4.0
2	2.4	1.0	3.1	1.7	2.4	1.9	1.5	1.9	1.6	1.5	2.3	2.3
3	0.5	2.5	0.5	1.5	0.6	1.2	1.1	3.5	0.9	1.3	2.5	0.5
4	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.5	0.5	0.5

Cultivar: Stony Hard

DAY	Sample									
	1	2	3	4	5	6	7	8	9	10
Initial	10.2	8.2	8.7	7.3	4.8	9.3	7.2	9.8	9.0	10.3
1	6.5	3.2	4.6	3.0	3.7	2.3	5.0	3.7	4.5	4.0
2	1.7	1.6	1.5	1.5	1.6	2.0	1.6	1.8	1.4	1.2
3	1.2	1.3	0.9	0.7	1.0	1.2	1.4	1.3	1.1	1.4

Stony Hard Control

DAY	Sample				
	1	2	3	4	5
Initial	-----	-----	-----	-----	-----
1	-----	-----	-----	-----	-----
2	3.4	4.4	2.9	5.4	4.7
3	3.4	8.8	3.1	6.7	4.6

Appendix C

First Peak Force Data, kg

Cultivar: Sentinel

Days	Samples											
	1	2	3	4	5	6	7	8	9	10	11	12
Initial	3.80	3.80	3.70	3.50	3.40	3.70	1.90	4.40	3.00	2.40	3.10	3.80
1	2.60	3.85	4.75	4.75	3.25	1.75	3.35	2.95	2.75	------	------	------
2	0.26	0.17	0.25	0.19	0.22	0.31	0.27	0.38	0.37	------	------	------
3	0.18	0.18	0.33	0.12	0.20	0.32	0.31	0.29	0.27	0.33	0.14	0.16
4	0.16	0.27	0.19	0.16	0.20	0.17	0.21	0.17	0.24	0.29	0.27	------

Cultivar: Topaz

Days	Samples											
	1	2	3	4	5	6	7	8	9	10	11	12
Initial	2.85	2.65	2.90	4.10	2.60	3.80	3.95	3.55	3.25	4.05	3.75	3.15
1	3.85	4.05	3.55	4.10	3.45	2.10	3.85	3.55	3.25	3.20	4.10	3.25
2	0.30	0.55	0.32	0.28	0.30	0.27	0.37	0.81	0.39	0.36	------	------
3	0.15	0.15	0.17	0.24	0.58	0.15	0.16	0.15	0.11	0.14	0.18	0.35
4	0.17	0.15	0.11	0.12	0.18	0.22	0.28	0.15	0.20	0.08	0.23	0.30

Appendix C (Continued)

Cultivar: Cresthaven

Days	Samples											
	1	2	3	4	5	6	7	8	9	10	11	12
Initial	3.65	4.15	4.40	3.50	4.75	3.85	3.95	4.70	4.10	3.90	5.65	4.45
1	------	------	------	------	------	------	------	------	------	------	------	------
2	0.37	0.70	0.56	0.68	0.49	0.29	0.74	------	------	------	------	------
3	0.32	0.75	0.32	0.34	0.44	0.83	0.40	------	------	------	------	------
4	0.47	0.47	0.35	0.35	0.32	0.51	0.36	------	------	------	------	------

Cultivar: Parade

Days	Samples											
	1	2	3	4	5	6	7	8	9	10	11	12
Initial	2.90	2.40	2.30	1.75	2.90	3.25	3.30	2.90	3.80	3.05	1.95	2.90
1	1.22	1.47	1.83	1.46	1.57	0.65	1.81	0.96	1.75	0.82	0.81	0.68
2	0.41	0.34	0.39	0.41	0.34	0.34	0.41	0.34	0.26	0.35	0.44	0.38
3	0.34	0.27	0.30	0.24	0.27	0.24	0.39	0.30	0.40	0.40	0.29	0.27
4	0.23	0.34	0.36	0.38	0.28	0.26	0.22	0.24	0.30	0.18	0.21	0.27

Appendix C (Continued)

Cultivar: Fairtime

Days	Samples											
	1	2	3	4	5	6	7	8	9	10	11	12
Initial	1.30	1.35	1.50	1.30	2.50	1.75	2.05	1.35	1.10	1.35	1.65	1.85
1	0.57	1.13	1.55	1.30	1.67	1.33	1.39	1.69	1.63	0.54	1.58	1.25
2	0.33	0.23	0.61	0.49	0.22	0.27	0.17	0.29	0.28	0.24	0.26	0.23
3	0.17	0.25	0.23	0.43	0.17	0.18	0.34	0.52	0.21	0.24	0.38	0.18
4	0.10	0.15	0.13	0.14	0.14	0.10	0.10	0.14	0.17	0.09	0.15	0.11

Cultivar: Stony Hard

Days	Samples									
	1	2	3	4	5	6	7	8	9	10
Initial	3.7	3.65	4.6	3.85	1.5	4.15	1.8	4.6	4.45	4.4
1	2.38	1.73	1.68	1.65	0.83	1	0.93	1.05	1.2	1.4
2	0.37	0.33	------	0.27	0.29	0.39	0.28	------	0.33	0.35
3	0.25	------	0.26	0.34	0.3	0.26	0.33	0.22	0.32	0.31

Cultivar: Stony Hard Control

Days	Samples				
	1	2	3	4	5
Initial	------	------	------	------	------
1	3.78	3.38	1.78	4.63	4.23
2	------	3.75	3.50	3.70	4.05
3	3.98	4.55	1.90	4.03	3.05

Appendix D

Steady State Force Data, kg

Cultivar: Sentinel

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	1.388	0.334	0.241	0.138	0.174
2	1.287	1.984	0.162	0.165	0.118
3	1.532	1.013	0.163	0.180	0.232
4	1.595	1.551	0.150	0.179	0.171
5	0.730	0.297	0.124	0.116	0.237

Cultivar: Topaz

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	1.526	0.997	0.255	0.217	0.172
2	1.845	1.007	0.276	0.550	0.174
3	2.583	0.734	0.813	0.260	0.234
4	2.596	0.892	0.715	0.218	0.108
5	1.998	1.069	0.452	0.215	0.208

Cultivar: Cresthaven

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	1.122	------	0.285	0.209	0.266
2	1.616	------	0.405	0.442	0.166
3	1.019	------	0.296	0.155	0.226
4	1.142	------	0.169	0.237	0.191
5	0.921	------	0.393	0.436	0.238

Appendix D (Continued)

Cultivar: Parade

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	1.138	0.656	0.202	0.171	0.145
2	0.989	0.714	0.231	0.178	0.201
3	0.879	0.436	0.176	0.173	0.118
4	1.256	0.651	0.203	0.235	0.200
5	1.176	0.833	0.259	0.193	0.127

Cultivar: Fairtime

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	0.604	0.447	0.381	0.229	0.068
2	0.529	0.485	0.195	0.282	0.110
3	0.761	0.500	0.161	0.143	0.123
4	0.567	0.471	0.144	0.246	0.103
5	0.741	0.591	0.124	0.368	0.109

Cultivar: Stony Hard

Sample	Initial	Day 1	Day 2	Day 3
1	1.297	0.509	0.815	0.113
2	0.493	0.630	0.811	0.174
3	1.235	0.408	0.625	0.103
4	1.339	0.363	0.595	0.159
5	1.436	0.510	0.923	0.130

Cultivar: Stony Hard Controls

Sample	Initial	Day 1	Day 2	Day 3
1	------	1.286	------	1.517
2	------	0.899	2.421	1.567
3	------	0.717	1.338	0.950
4	------	1.124	1.253	2.015
5	------	1.004	1.482	------

Appendix E

Initial Slope Data, kg/sec

Cultivar: Sentinel

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	0.427	0.135	0.093	0.037	0.050
2	0.436	0.375	0.056	0.040	0.045
3	0.369	0.382	0.073	0.123	0.054
4	0.271	0.352	0.099	0.070	0.053
5	0.185	0.088	0.131	0.047	0.042

Cultivar: Topaz

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	0.357	0.411	0.108	0.067	0.050
2	0.435	0.352	0.097	0.137	0.040
3	0.453	0.273	0.190	0.061	0.048
4	0.498	0.396	0.157	0.046	0.044
5	0.438	0.319	0.103	0.051	0.061

Cultivar: Cresthaven

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	0.423	------	0.128	0.037	0.074
2	0.430	------	0.081	0.019	0.051
3	0.505	------	0.095	0.078	0.105
4	0.447	------	0.056	0.015	0.045
5	0.396	------	0.103	0.127	0.072

Appendix E (Continued)

Cultivar: Parade

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	0.303	0.171	0.087	0.067	0.060
2	0.253	0.216	0.085	0.053	0.077
3	0.237	0.085	0.094	0.053	0.053
4	0.293	0.144	0.066	0.059	0.057
5	0.302	0.202	0.138	0.070	0.049

Cultivar: Fairtime

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	0.181	0.200	0.148	0.057	0.007
2	0.191	0.214	0.059	0.104	0.034
3	0.214	0.183	0.085	0.049	0.027
4	0.190	0.162	0.087	0.094	0.034
5	0.230	0.203	0.051	0.088	0.029

Cultivar: Stony Hard

Sample	Initial	Day 1	Day 2	Day 3
1	0.375	0.234	0.566	0.087
2	0.226	0.264	0.387	0.051
3	0.435	0.169	0.424	0.082
4	0.419	0.167	0.447	0.059
5	0.436	0.238	0.448	0.093

Cultivar: Stony Hard Controls

Sample	Initial	Day 1	Day 2	Day 3
1	------	0.313	------	0.315
2	------	0.336	0.304	0.391
3	------	0.213	0.289	0.192
4	------	0.441	0.348	0.265
5	------	0.396	0.388	0.271

Appendix F

Frequency Ratios of FFT Analysis
Mean (Standard Deviation)

Cultivar: Sentinel

Ratio	Initial		DAY 1		DAY 2		DAY 3		DAY 4	
R1	444	(185)	990	(566)	320	(244)	328	(130)	300	(144)
R2	95.3	(58.9)	255	(209)	82.3	(52.2)	75.5	(34.0)	76.0	(33.8)
R3	42.8	(29.6)	108	(102)	34.4	(25.1)	35.0	(15.9)	36.4	(13.0)
R4	22.6	(16.6)	61.6	(62.4)	21.6	(14.2)	18.3	(6.2)	21.1	(9.8)
R5	14.9	(10.7)	38.2	(39.6)	14.3	(11.1)	12.3	(4.7)	12.7	(5.8)
R6	9.72	(6.98)	25.3	(27.5)	10.1	(6.4)	9.94	(4.79)	9.35	(3.61)
R7	7.40	(5.22)	17.9	(19.8)	7.21	(5.72)	7.19	(3.19)	7.88	(3.02)
R8	5.79	(3.58)	13.2	(14.7)	5.25	(2.87)	5.77	(1.95)	6.50	(2.47)
R9	4.57	(3.21)	10.3	(11.5)	4.70	(3.93)	4.35	(1.44)	4.95	(1.36)
R10	3.62	(2.29)	7.88	(8.95)	3.48	(1.96)	3.58	(1.23)	4.00	(1.31)
R11	2.98	(1.72)	6.33	(7.33)	3.23	(2.38)	3.02	(1.06)	3.47	(1.21)
R12	2.75	(1.38)	5.26	(5.93)	2.67	(1.18)	2.43	(0.69)	2.87	(0.89)
R13	2.26	(1.04)	4.54	(4.95)	2.56	(1.74)	2.40	(1.01)	2.34	(0.43)
R14	2.09	(0.78)	3.73	(4.13)	1.97	(0.93)	2.07	(0.65)	2.29	(0.51)
R15	1.97	(0.72)	3.26	(3.43)	1.89	(1.17)	1.96	(0.61)	1.95	(0.54)
R16	1.79	(0.45)	2.86	(3.12)	1.78	(0.81)	1.77	(0.58)	2.00	(0.40)

Appendix F (Continued)

Cultivar: Topaz

Ratio	Initial		DAY 1		DAY 2		DAY 3		DAY 4	
R1	744	(298)	1035	(229)	628	(424)	433	(245)	345	(240)
R2	166	(75)	230	(102)	172	(107)	90.5	(38.9)	86.8	(45.8)
R3	73.5	(35.3)	86.8	(51.3)	77.9	(44.8)	47.5	(16.3)	45.3	(21.6)
R4	45.8	(24.6)	44.8	(31.3)	35.7	(23.9)	24.0	(7.7)	22.2	(9.1)
R5	26.3	(18.4)	27.0	(19.5)	22.4	(15.7)	14.9	(5.0)	15.1	(4.8)
R6	18.2	(12.8)	17.3	(13.5)	15.4	(10.3)	11.2	(3.5)	12.0	(6.5)
R7	12.5	(7.9)	11.1	(10.1)	10.9	(7.0)	7.41	(2.49)	8.27	(5.93)
R8	10.6	(6.8)	8.52	(7.78)	8.90	(5.19)	5.81	(2.03)	6.64	(3.55)
R9	7.78	(4.97)	6.03	(6.01)	6.87	(3.87)	4.52	(1.33)	5.37	(2.51)
R10	6.25	(3.31)	4.50	(4.93)	5.24	(3.18)	3.89	(1.23)	4.33	(1.78)
R11	4.97	(2.41)	3.42	(4.20)	4.23	(1.98)	3.21	(0.77)	3.60	(1.25)
R12	3.66	(1.62)	2.78	(3.49)	3.31	(1.72)	2.93	(0.62)	3.08	(1.05)
R13	3.37	(1.61)	2.48	(2.92)	2.90	(1.34)	2.27	(0.71)	2.55	(0.67)
R14	2.88	(1.42)	2.28	(2.42)	2.50	(1.03)	2.06	(0.54)	2.27	(0.98)
R15	2.27	(0.94)	1.80	(2.07)	2.26	(0.85)	1.69	(0.42)	2.00	(0.80)
R16	2.06	(1.05)	1.63	(1.71)	1.96	(0.68)	1.86	(0.56)	1.99	(0.47)

Appendix F (Continued)

Cultivar: Cresthaven

Ratio	Initial		DAY 1	DAY 2		DAY 3		DAY 4	
R1	1213	(370)	-------	406	(115)	332	(168)	371	(117)
R2	318	(148)	-------	93.0	(23.5)	98.4	(38.3)	86.6	(19.5)
R3	130	(80)	-------	63.6	(19.4)	58.6	(21.4)	56.2	(10.0)
R4	63.2	(53.8)	-------	30.4	(6.2)	31.8	(13.9)	28.4	(4.1)
R5	34.7	(35.5)	-------	15.9	(3.1)	17.2	(6.0)	18.2	(5.9)
R6	22.8	(24.9)	-------	12.2	(3.7)	16.0	(6.6)	12.8	(5.4)
R7	16.0	(17.9)	-------	7.42	(2.33)	8.40	(3.07)	9.44	(3.28)
R8	10.9	(13.8)	-------	6.24	(1.93)	9.50	(3.58)	6.58	(1.90)
R9	8.35	(10.34)	-------	4.45	(0.95)	5.86	(1.86)	5.98	(2.04)
R10	6.35	(8.03)	-------	3.70	(0.98)	5.93	(2.60)	4.97	(1.00)
R11	4.99	(6.31)	-------	3.45	(0.64)	4.18	(1.48)	3.67	(0.80)
R12	4.18	(5.05)	-------	2.80	(1.04)	3.76	(2.18)	3.09	(0.55)
R13	3.47	(4.06)	-------	2.51	(0.68)	2.92	(0.90)	2.78	(0.78)
R14	2.84	(3.49)	-------	2.23	(0.43)	2.86	(1.19)	2.09	(0.48)
R15	2.34	(2.82)	-------	1.86	(0.65)	2.38	(0.99)	2.08	(0.53)
R16	2.27	(2.37)	-------	1.85	(0.44)	1.95	(0.75)	1.90	(0.32)

Day 2 to Day 4 are means of only 7 replicates.

Appendix F (Continued)

Cultivar: Parade

Ratio	Initial		DAY 1		DAY 2		DAY 3		DAY 4	
R1	727	(225)	524	(228)	297	(78)	227	(89)	228	(58)
R2	200	(99)	100	(45)	87.0	(43.2)	62.8	(22.5)	60.0	(20.5)
R3	82.1	(52.3)	48.6	(14.3)	53.2	(17.2)	43.0	(12.2)	35.5	(14.3)
R4	38.4	(33.6)	20.6	(6.1)	24.9	(9.9)	16.8	(5.5)	17.7	(9.8)
R5	21.0	(20.0)	10.9	(3.9)	14.1	(6.2)	12.5	(6.9)	10.5	(4.0)
R6	14.0	(12.2)	6.76	(1.38)	11.1	(4.9)	7.98	(1.89)	7.07	(3.11)
R7	9.36	(7.70)	5.22	(1.39)	7.62	(3.18)	5.66	(1.65)	5.22	(2.31)
R8	6.82	(5.40)	3.76	(1.19)	5.79	(2.98)	4.65	(1.85)	4.31	(1.68)
R9	5.26	(3.88)	2.69	(0.60)	4.95	(2.83)	3.50	(1.31)	3.57	(1.48)
R10	3.74	(2.88)	2.07	(0.38)	4.14	(1.67)	3.12	(1.18)	2.72	(1.03)
R11	2.97	(2.21)	2.12	(0.63)	3.60	(1.06)	2.52	(0.75)	2.47	(0.82)
R12	2.58	(1.52)	1.61	(0.50)	2.70	(1.09)	2.08	(0.68)	2.13	(0.91)
R13	2.20	(1.43)	1.34	(0.30)	2.35	(1.05)	1.81	(0.61)	1.83	(0.65)
R14	1.85	(1.11)	1.25	(0.31)	2.08	(1.00)	1.63	(0.57)	1.67	(0.47)
R15	1.69	(0.84)	1.23	(0.22)	1.78	(0.60)	1.53	(0.46)	1.48	(0.28)
R16	1.56	(0.84)	1.21	(0.29)	1.50	(0.54)	1.40	(0.34)	1.47	(0.40)

Appendix F (Continued)

Cultivar: Fairtime

Ratio	Initial		DAY 1		DAY 2		DAY 3		DAY 4	
R1	460	(271)	1337	(562)	324	(168)	310	(188)	181	(60)
R2	85.6	(70.0)	195	(86)	94.8	(48.6)	86.7	(33.4)	61.7	(22.8)
R3	39.8	(28.0)	68.7	(24.0)	49.0	(20.6)	46.1	(15.1)	33.4	(13.3)
R4	15.6	(10.5)	39.8	(15.4)	24.3	(12.0)	21.1	(6.4)	16.8	(6.6)
R5	8.94	(4.87)	22.2	(7.6)	16.1	(7.2)	15.0	(5.6)	10.1	(2.3)
R6	5.41	(2.55)	17.0	(7.3)	10.1	(3.5)	10.4	(4.4)	7.49	(2.17)
R7	3.80	(1.78)	10.9	(3.6)	7.94	(2.55)	8.01	(3.40)	4.75	(1.32)
R8	3.14	(1.41)	8.24	(2.66)	5.73	(1.61)	6.63	(2.30)	4.17	(1.00)
R9	2.57	(1.26)	6.03	(2.23)	4.18	(1.74)	4.95	(2.08)	3.30	(1.32)
R10	2.44	(1.12)	5.12	(1.94)	3.27	(1.17)	3.70	(1.17)	2.83	(0.82)
R11	1.95	(0.83)	4.28	(1.03)	3.47	(0.87)	3.26	(0.59)	2.42	(0.63)
R12	1.60	(0.48)	3.33	(1.19)	2.49	(0.85)	2.35	(0.59)	2.19	(0.69)
R13	1.47	(0.53)	2.89	(0.64)	2.26	(0.48)	2.34	(0.73)	2.05	(0.61)
R14	1.41	(0.49)	2.37	(0.48)	1.88	(0.51)	2.06	(0.60)	1.73	(0.41)
R15	1.40	(0.47)	2.41	(0.83)	1.73	(0.42)	1.93	(0.55)	1.72	(0.27)
R16	1.07	(0.30)	1.96	(0.65)	1.70	(0.48)	1.69	(0.39)	1.49	(0.35)

Appendix F (Continued)

Cultivar: Stony Hard

Ratio	Initial		Day 1		Day 2		Day 3	
R1	1086	(425)	617	(404)	362	(93)	210	(57)
R2	305	(179)	98.7	(73.4)	84.5	(16.1)	49.7	(12.0)
R3	137	(84)	43.8	(24.9)	56.2	(12.3)	31.5	(8.5)
R4	73.4	(55.9)	18.0	(9.6)	24.5	(9.1)	13.4	(3.3)
R5	45.2	(37.9)	10.3	(4.5)	17.3	(5.8)	10.1	(2.7)
R6	30.3	(25.4)	6.96	(2.19)	12.1	(5.3)	5.38	(1.19)
R7	22.0	(18.4)	5.39	(1.93)	7.37	(3.75)	5.01	(0.74)
R8	15.9	(14.1)	3.49	(0.80)	6.71	(4.64)	4.45	(0.91)
R9	11.9	(10.6)	3.01	(0.87)	4.94	(2.68)	2.97	(0.58)
R10	9.11	(8.38)	2.29	(0.41)	4.35	(2.19)	2.64	(0.63)
R11	7.53	(6.47)	2.11	(0.51)	4.26	(2.17)	2.25	(0.31)
R12	5.84	(5.21)	1.77	(0.44)	2.93	(2.12)	1.96	(0.56)
R13	4.93	(4.04)	1.65	(0.55)	2.49	(1.25)	1.79	(0.78)
R14	4.18	(3.25)	1.50	(0.29)	2.39	(1.73)	1.74	(0.84)
R15	3.38	(2.56)	1.34	(0.28)	2.20	(1.61)	1.63	(0.50)
R16	3.15	(1.96)	1.28	(0.23)	1.80	(0.98)	1.34	(0.31)

All five days are averages of only 10 samples

Appendix F (Continued)

Stony Hard Controls

Ratio	Initial	Day 1		Day 2		Day 3	
R1	-------	1955	(712)	1405	(572)	2259	(1133)
R2	-------	621	(310)	340	(179)	672	(381)
R3	-------	302	(155)	151	(103)	307	(190)
R4	-------	178	(101)	88.3	(66.7)	169	(129)
R5	-------	116	(63)	56.4	(44.8)	101	(92)
R6	-------	78.1	(44.4)	37.2	(32.1)	67.5	(65.1)
R7	-------	57.2	(32.7)	27.8	(22.9)	50.4	(45.1)
R8	-------	41.6	(24.4)	19.3	(17.1)	39.7	(32.6)
R9	-------	32.0	(19.0)	14.7	(14.1)	31.0	(24.8)
R10	-------	25.2	(14.6)	11.2	(10.6)	24.4	(19.2)
R11	-------	19.7	(11.5)	9.67	(8.39)	19.9	(15.1)
R12	-------	16.1	(9.4)	7.56	(6.72)	15.6	(12.3)
R13	-------	12.9	(7.5)	6.33	(5.72)	12.6	(10.8)
R14	-------	11.0	(6.6)	5.06	(4.73)	9.82	(8.67)
R15	-------	8.69	(5.32)	4.78	(4.03)	8.39	(7.86)
R16	-------	7.60	(4.62)	4.02	(3.13)	7.07	(6.63)

Day 0 is same as Day 0 of ethylene treated 'Stony Hard' peaches.
Day 1 to Day 3 are means of only 5 replicates.

Appendix G

Area Under 0.19 Hz Bandwidth Intervals
for example, A2 = area under (0.39 - 0.20) Hz

Cultivar: Sentinel

Initial	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	10.1166	2.6161	1.2189	0.6300	0.4775	0.2911	0.2514	0.2031	0.1607	0.1483	0.1235	0.1181	0.1085	0.1034	0.0962	0.0923	0.0441
2	9.2382	1.5867	0.4427	0.1377	0.1141	0.0727	0.0698	0.0479	0.0454	0.0452	0.0351	0.0364	0.0258	0.0232	0.0298	0.0268	0.0159
3	8.8192	1.5330	0.7830	0.3260	0.1577	0.1178	0.0913	0.0640	0.0494	0.0366	0.0279	0.0270	0.0300	0.0238	0.0277	0.0281	0.0139
4	7.1621	1.9301	0.7387	0.5053	0.3335	0.2055	0.1633	0.1468	0.1017	0.0833	0.0596	0.0551	0.0537	0.0433	0.0369	0.0318	0.0179
5	11.3354	1.5582	0.6056	0.3187	0.2269	0.1575	0.0834	0.1001	0.0631	0.0565	0.0565	0.0481	0.0425	0.0419	0.0358	0.0334	0.0187
6	6.0700	1.6462	0.8114	0.3738	0.1964	0.0999	0.0708	0.0641	0.0441	0.0281	0.0256	0.0318	0.0178	0.0171	0.0139	0.0158	0.0120
7	8.3783	1.5119	0.7844	0.4386	0.2975	0.1533	0.1239	0.0879	0.0641	0.0502	0.0399	0.0358	0.0232	0.0262	0.0215	0.0252	0.0153
8	6.5355	3.4700	1.6757	0.9423	0.6286	0.4155	0.3086	0.2204	0.1779	0.1387	0.1057	0.0919	0.0703	0.0554	0.0462	0.0351	0.0137
9	6.9490	0.6920	0.2181	0.1399	0.0596	0.0775	0.0404	0.0438	0.0272	0.0183	0.0207	0.0183	0.0154	0.0150	0.0143	0.0195	0.0122
10	6.3856	0.7864	0.3413	0.2305	0.1293	0.0627	0.0525	0.0336	0.0267	0.0189	0.0166	0.0178	0.0209	0.0197	0.0147	0.0136	0.0125
11	3.1008	0.5097	0.2607	0.1163	0.1389	0.0687	0.0641	0.0588	0.0286	0.0481	0.0336	0.0340	0.0297	0.0302	0.0297	0.0202	0.0143
12	0.5235	0.4645	0.2875	0.1503	0.1443	0.1483	0.1213	0.0741	0.1039	0.0579	0.0558	0.0421	0.0297	0.0336	0.0389	0.0309	0.0122

Day 1	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	11.5481	2.4251	0.8137	0.3913	0.1687	0.1175	0.0826	0.0538	0.0473	0.0407	0.0222	0.0217	0.0231	0.0151	0.0122	0.0116	0.0064
2	2.3235	0.2690	0.1230	0.0561	0.0334	0.0295	0.0195	0.0114	0.0074	0.0077	0.0104	0.0094	0.0079	0.0066	0.0088	0.0042	0.0067
3	8.7884	2.3424	1.0930	0.5551	0.3459	0.2280	0.1652	0.1198	0.0882	0.0644	0.0521	0.0426	0.0344	0.0278	0.0210	0.0164	0.0073
4	9.9319	2.3320	0.7075	0.3588	0.2133	0.1034	0.0645	0.0519	0.0409	0.0235	0.0186	0.0168	0.0141	0.0137	0.0110	0.0109	0.0084
5	13.2090	6.1672	3.0850	1.9119	1.2807	0.8991	0.6707	0.5081	0.3979	0.3151	0.2607	0.2122	0.1764	0.1488	0.1241	0.1130	0.0097
6	15.4508	4.9832	2.3175	1.3691	0.7970	0.5133	0.3472	0.2574	0.1989	0.1480	0.1150	0.0978	0.0881	0.0726	0.0640	0.0557	0.0088
7	9.0579	2.5225	1.1825	0.7214	0.4272	0.2976	0.1946	0.1246	0.0976	0.0674	0.0542	0.0384	0.0323	0.0211	0.0185	0.0147	0.0066
8	5.3242	0.3729	0.1427	0.1135	0.0560	0.0255	0.0364	0.0313	0.0172	0.0143	0.0111	0.0090	0.0084	0.0091	0.0083	0.0082	0.0065
9	7.5207	1.4685	0.3152	0.1567	0.1921	0.0922	0.0531	0.0408	0.0351	0.0225	0.0260	0.0189	0.0154	0.0139	0.0169	0.0107	0.0069
10	4.3386	0.9058	0.3816	0.2447	0.1490	0.1072	0.0707	0.0593	0.0437	0.0376	0.0290	0.0261	0.0230	0.0171	0.0147	0.0164	0.0075
11	2.6947	0.5154	0.1860	0.0922	0.0609	0.0579	0.0468	0.0441	0.0325	0.0329	0.0273	0.0275	0.0206	0.0216	0.0199	0.0185	0.0100
12	0.5563	0.1145	0.1030	0.0393	0.0254	0.0194	0.0168	0.0128	0.0131	0.0115	0.0075	0.0070	0.0083	0.0073	0.0062	0.0068	0.0053

Cultivar: Sentinel

Day 2	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.7488	0.1020	0.0526	0.0253	0.0201	0.0139	0.0118	0.0068	0.0111	0.0065	0.0060	0.0080	0.0051	0.0067	0.0057	0.0036	0.0061
2	0.3818	0.0869	0.0684	0.0286	0.0225	0.0159	0.0119	0.0144	0.0092	0.0082	0.0090	0.0070	0.0101	0.0093	0.0078	0.0069	0.0066
3	0.4257	0.1708	0.0794	0.0538	0.0193	0.0221	0.0109	0.0065	0.0073	0.0066	0.0052	0.0047	0.0046	0.0036	0.0025	0.0028	0.0014
4	0.3299	0.0793	0.0446	0.0231	0.0205	0.0181	0.0098	0.0081	0.0081	0.0057	0.0054	0.0048	0.0031	0.0038	0.0024	0.0035	0.0017
5	0.3418	0.1200	0.0387	0.0286	0.0198	0.0159	0.0105	0.0098	0.0052	0.0048	0.0040	0.0034	0.0037	0.0032	0.0029	0.0029	0.0016
6	3.0380	0.6399	0.3075	0.1612	0.1378	0.0800	0.0719	0.0375	0.0491	0.0261	0.0307	0.0161	0.0228	0.0135	0.0160	0.0115	0.0030
7	0.6112	0.1009	0.0435	0.0209	0.0161	0.0141	0.0109	0.0069	0.0064	0.0043	0.0045	0.0041	0.0033	0.0021	0.0018	0.0019	0.0014
8	0.7127	0.1450	0.0544	0.0353	0.0282	0.0150	0.0135	0.0102	0.0062	0.0074	0.0054	0.0068	0.0055	0.0035	0.0041	0.0037	0.0019
9	0.3968	0.1168	0.0348	0.0320	0.0200	0.0104	0.0101	0.0082	0.0060	0.0056	0.0044	0.0036	0.0036	0.0024	0.0032	0.0032	0.0014
10	0.4456	0.1477	0.0679	0.0373	0.0202	0.0132	0.0086	0.0068	0.0053	0.0045	0.0036	0.0033	0.0030	0.0023	0.0024	0.0026	0.0016
11	0.5145	0.1407	0.0475	0.0243	0.0133	0.0126	0.0072	0.0060	0.0046	0.0045	0.0034	0.0028	0.0026	0.0018	0.0022	0.0024	0.0016
12	0.3733	0.1365	0.0430	0.0495	0.0288	0.0178	0.0105	0.0114	0.0084	0.0049	0.0049	0.0049	0.0032	0.0035	0.0025	0.0021	0.0015

Day 3	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.4241	0.0645	0.0327	0.0196	0.0087	0.0089	0.0057	0.0063	0.0032	0.0041	0.0030	0.0028	0.0018	0.0017	0.0022	0.0023	0.0012
2	0.3080	0.1059	0.0330	0.0295	0.0171	0.0089	0.0098	0.0087	0.0057	0.0051	0.0045	0.0031	0.0026	0.0027	0.0028	0.0016	0.0012
3	0.8191	0.1982	0.0842	0.0375	0.0230	0.0224	0.0149	0.0102	0.0072	0.0055	0.0060	0.0041	0.0042	0.0043	0.0039	0.0037	0.0013
4	0.3826	0.0375	0.0169	0.0125	0.0079	0.0056	0.0044	0.0033	0.0038	0.0018	0.0018	0.0016	0.0025	0.0017	0.0018	0.0017	0.0013
5	0.5155	0.0844	0.0344	0.0198	0.0142	0.0136	0.0103	0.0050	0.0062	0.0039	0.0031	0.0021	0.0030	0.0030	0.0018	0.0019	0.0012
6	0.3227	0.0652	0.0371	0.0227	0.0173	0.0078	0.0047	0.0075	0.0052	0.0034	0.0026	0.0025	0.0028	0.0016	0.0019	0.0016	0.0013
7	0.4652	0.1121	0.0312	0.0144	0.0106	0.0088	0.0086	0.0064	0.0038	0.0037	0.0033	0.0028	0.0014	0.0023	0.0014	0.0025	0.0012
8	0.5417	0.1086	0.0580	0.0245	0.0227	0.0156	0.0138	0.0068	0.0046	0.0053	0.0036	0.0035	0.0038	0.0027	0.0030	0.0022	0.0011
9	0.2811	0.1384	0.0728	0.0355	0.0186	0.0232	0.0156	0.0126	0.0090	0.0063	0.0055	0.0041	0.0027	0.0028	0.0030	0.0022	0.0014
10	0.4009	0.1000	0.0434	0.0233	0.0176	0.0104	0.0052	0.0083	0.0056	0.0044	0.0032	0.0045	0.0033	0.0029	0.0021	0.0015	0.0013
11	0.1812	0.0416	0.0263	0.0159	0.0086	0.0067	0.0067	0.0047	0.0040	0.0035	0.0037	0.0026	0.0023	0.0021	0.0026	0.0023	0.0015
12	0.3437	0.0924	0.0648	0.0245	0.0206	0.0201	0.0098	0.0083	0.0084	0.0075	0.0060	0.0032	0.0061	0.0037	0.0035	0.0038	0.0013

Appendix G (Continued)

Cultivar: Topaz

Day 1	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	12.7101	3.0547	1.4581	0.7582	0.4058	0.2713	0.1719	0.1371	0.0869	0.0595	0.0447	0.0358	0.0302	0.0226	0.0152	0.0143	0.0089
2	10.5772	2.8984	0.9104	0.3883	0.2743	0.1708	0.0850	0.0891	0.0605	0.0386	0.0245	0.0193	0.0182	0.0176	0.0094	0.0103	0.0097
3	9.9283	1.9713	0.6183	0.4796	0.2181	0.1011	0.0624	0.0546	0.0333	0.0238	0.0242	0.0266	0.0189	0.0186	0.0118	0.0110	0.0098
4	11.8923	2.7451	0.9202	0.5769	0.2976	0.1338	0.0630	0.0393	0.0385	0.0216	0.0165	0.0159	0.0108	0.0142	0.0130	0.0088	0.0100
5	9.5092	2.1588	0.8282	0.3305	0.1570	0.0798	0.0562	0.0236	0.0173	0.0192	0.0156	0.0104	0.0124	0.0116	0.0082	0.0090	0.0088
6	5.6320	0.9030	0.4032	0.2012	0.0749	0.0326	0.0279	0.0187	0.0151	0.0136	0.0086	0.0116	0.0121	0.0100	0.0105	0.0111	0.0099
7	12.0304	2.8722	0.6650	0.1312	0.1134	0.1982	0.1712	0.1168	0.0840	0.0384	0.0202	0.0099	0.0151	0.0191	0.0160	0.0184	0.0118
8	10.6627	1.4864	0.3204	0.1311	0.1118	0.0827	0.0378	0.0475	0.0214	0.0185	0.0214	0.0146	0.0126	0.0142	0.0117	0.0112	0.0101
9	10.7560	1.9828	0.8825	0.3564	0.2777	0.1606	0.1322	0.1017	0.0535	0.0619	0.0290	0.0277	0.0205	0.0155	0.0172	0.0109	0.0114
10	8.6670	1.7124	0.7559	0.3755	0.2443	0.1320	0.0719	0.0429	0.0351	0.0262	0.0190	0.0126	0.0117	0.0224	0.0114	0.0096	0.0106
11	13.0342	4.4300	2.0340	1.1890	0.7837	0.5370	0.3907	0.2963	0.2318	0.1905	0.1612	0.1328	0.1135	0.0967	0.0820	0.0689	0.0098
12	8.6529	1.2764	0.4849	0.3485	0.2480	0.1652	0.0708	0.0581	0.0477	0.0274	0.0208	0.0123	0.0181	0.0101	0.0092	0.0120	0.0099

Day 2	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	10.3094	3.5337	1.6616	0.9668	0.6397	0.4258	0.2983	0.2118	0.1671	0.1242	0.0932	0.0752	0.0603	0.0465	0.0421	0.0331	0.0102
2	0.5071	0.1476	0.0694	0.0410	0.0390	0.0242	0.0245	0.0164	0.0194	0.0146	0.0126	0.0123	0.0101	0.0110	0.0114	0.0083	0.0093
3	2.3093	0.5834	0.2331	0.1044	0.0421	0.0419	0.0343	0.0418	0.0247	0.0224	0.0162	0.0115	0.0130	0.0090	0.0113	0.0079	0.0075
4	0.4439	0.1609	0.1135	0.0425	0.0308	0.0217	0.0156	0.0141	0.0103	0.0091	0.0051	0.0046	0.0055	0.0039	0.0033	0.0030	0.0014
5	0.2790	0.1232	0.0461	0.0171	0.0124	0.0113	0.0070	0.0049	0.0039	0.0033	0.0038	0.0029	0.0028	0.0016	0.0021	0.0014	0.0013
6	0.5012	0.1416	0.0613	0.0358	0.0196	0.0113	0.0072	0.0057	0.0061	0.0040	0.0048	0.0024	0.0030	0.0028	0.0026	0.0026	0.0014
7	1.0440	0.2704	0.1145	0.0559	0.0318	0.0203	0.0164	0.0085	0.0104	0.0061	0.0067	0.0038	0.0034	0.0038	0.0026	0.0032	0.0015
8	2.0365	0.4616	0.1788	0.0672	0.0349	0.0225	0.0194	0.0169	0.0101	0.0069	0.0069	0.0061	0.0047	0.0037	0.0038	0.0037	0.0015
9	0.9143	0.2163	0.1048	0.0778	0.0512	0.0238	0.0155	0.0167	0.0114	0.0065	0.0053	0.0050	0.0045	0.0051	0.0039	0.0030	0.0015
10	1.8841	0.4624	0.1542	0.0530	0.0308	0.0289	0.0160	0.0181	0.0118	0.0083	0.0075	0.0070	0.0059	0.0041	0.0025	0.0031	0.0015
11	1.2333	0.3510	0.1762	0.0714	0.0436	0.0347	0.0212	0.0163	0.0150	0.0148	0.0076	0.0064	0.0051	0.0049	0.0048	0.0036	0.0014
12	0.6174	0.1684	0.1066	0.0339	0.0276	0.0187	0.0168	0.0120	0.0083	0.0071	0.0070	0.0040	0.0025	0.0032	0.0034	0.0028	0.0014

Cultivar: Topaz

Day 3	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.6290	0.1562	0.0818	0.0279	0.0193	0.0154	0.0143	0.0084	0.0083	0.0042	0.0059	0.0034	0.0036	0.0030	0.0019	0.0021	0.0015
2	0.4933	0.0760	0.0534	0.0297	0.0177	0.0110	0.0098	0.0075	0.0047	0.0034	0.0035	0.0041	0.0030	0.0030	0.0024	0.0022	0.0015
3	0.5539	0.0758	0.0318	0.0227	0.0121	0.0097	0.0054	0.0050	0.0044	0.0046	0.0032	0.0031	0.0015	0.0020	0.0020	0.0031	0.0014
4	0.5455	0.1468	0.0812	0.0427	0.0245	0.0227	0.0122	0.0104	0.0088	0.0046	0.0068	0.0058	0.0040	0.0043	0.0023	0.0033	0.0015
5	1.7903	0.2881	0.1277	0.0523	0.0409	0.0237	0.0175	0.0167	0.0112	0.0078	0.0061	0.0050	0.0049	0.0045	0.0040	0.0031	0.0015
6	0.6771	0.1574	0.0456	0.0225	0.0129	0.0217	0.0109	0.0080	0.0060	0.0058	0.0041	0.0047	0.0043	0.0036	0.0018	0.0014	0.0014
7	0.2558	0.0832	0.0532	0.0253	0.0214	0.0111	0.0060	0.0070	0.0059	0.0066	0.0034	0.0042	0.0034	0.0028	0.0029	0.0040	0.0014
8	0.3549	0.0830	0.0508	0.0251	0.0133	0.0109	0.0072	0.0059	0.0035	0.0034	0.0033	0.0027	0.0017	0.0021	0.0019	0.0018	0.0014
9	0.7170	0.1478	0.0865	0.0403	0.0248	0.0174	0.0111	0.0091	0.0074	0.0056	0.0055	0.0051	0.0041	0.0036	0.0022	0.0037	0.0017
10	0.4938	0.0797	0.0584	0.0336	0.0224	0.0218	0.0079	0.0052	0.0065	0.0054	0.0044	0.0056	0.0019	0.0019	0.0026	0.0019	0.0014
11	0.4858	0.1521	0.0974	0.0586	0.0292	0.0137	0.0162	0.0120	0.0060	0.0091	0.0053	0.0045	0.0041	0.0028	0.0030	0.0030	0.0015
12	0.8703	0.1947	0.0931	0.0545	0.0310	0.0233	0.0158	0.0096	0.0089	0.0097	0.0066	0.0045	0.0046	0.0035	0.0035	0.0043	0.0017

Day 4	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.5173	0.1197	0.0686	0.0393	0.0161	0.0214	0.0148	0.0070	0.0082	0.0073	0.0051	0.0057	0.0041	0.0035	0.0031	0.0033	0.0012
2	0.2605	0.0926	0.0413	0.0226	0.0137	0.0118	0.0068	0.0075	0.0069	0.0029	0.0040	0.0015	0.0029	0.0018	0.0027	0.0024	0.0014
3	0.3605	0.0473	0.0451	0.0204	0.0135	0.0081	0.0052	0.0046	0.0025	0.0061	0.0040	0.0031	0.0020	0.0016	0.0026	0.0018	0.0013
4	0.2870	0.1169	0.0651	0.0166	0.0164	0.0114	0.0053	0.0080	0.0071	0.0054	0.0038	0.0031	0.0034	0.0023	0.0015	0.0025	0.0013
5	0.1960	0.1164	0.0554	0.0365	0.0202	0.0148	0.0104	0.0124	0.0060	0.0069	0.0063	0.0053	0.0031	0.0029	0.0024	0.0034	0.0015
6	0.6104	0.1612	0.0707	0.0386	0.0321	0.0250	0.0130	0.0067	0.0079	0.0069	0.0061	0.0060	0.0039	0.0037	0.0041	0.0034	0.0015
7	1.3399	0.2459	0.1300	0.0612	0.0330	0.0335	0.0344	0.0230	0.0172	0.0097	0.0086	0.0066	0.0041	0.0068	0.0058	0.0041	0.0015
8	0.5391	0.0998	0.0864	0.0366	0.0303	0.0208	0.0097	0.0130	0.0085	0.0078	0.0069	0.0049	0.0046	0.0048	0.0039	0.0031	0.0016
9	0.3308	0.0737	0.0380	0.0225	0.0166	0.0080	0.0092	0.0059	0.0046	0.0026	0.0026	0.0033	0.0030	0.0024	0.0019	0.0019	0.0015
10	0.1867	0.0583	0.0228	0.0153	0.0135	0.0082	0.0055	0.0055	0.0048	0.0032	0.0026	0.0040	0.0030	0.0020	0.0015	0.0021	0.0012
11	0.2485	0.0869	0.0363	0.0242	0.0219	0.0079	0.0051	0.0054	0.0068	0.0038	0.0039	0.0033	0.0032	0.0028	0.0020	0.0026	0.0014
12	1.0671	0.2739	0.1187	0.0469	0.0330	0.0356	0.0231	0.0156	0.0113	0.0112	0.0079	0.0053	0.0060	0.0044	0.0029	0.0033	0.0015

Cultivar: Cresthaven

Initial	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	7.9546	1.4649	0.6574	0.2898	0.1279	0.0851	0.0510	0.0224	0.0295	0.0236	0.0152	0.0137	0.0092	0.0111	0.0076	0.0104	0.0077
2	8.7238	2.7145	1.0601	0.6144	0.3695	0.2592	0.2290	0.1713	0.1550	0.1391	0.1226	0.1143	0.1057	0.0987	0.0917	0.0841	0.0355
3	10.4738	1.7073	0.5433	0.1651	0.1037	0.0837	0.0625	0.0321	0.0234	0.0206	0.0162	0.0167	0.0148	0.0137	0.0133	0.0116	0.0092
4	7.8741	1.7192	0.5638	0.2054	0.1200	0.0520	0.0566	0.0256	0.0218	0.0149	0.0141	0.0120	0.0077	0.0101	0.0060	0.0066	0.0068
5	12.0492	2.3571	0.8821	0.2307	0.0588	0.0547	0.0423	0.0228	0.0209	0.0185	0.0156	0.0146	0.0123	0.0112	0.0108	0.0114	0.0072
6	8.1398	1.7356	0.5893	0.2598	0.0660	0.0587	0.0408	0.0200	0.0194	0.0084	0.0112	0.0156	0.0167	0.0079	0.0065	0.0088	0.0065
7	9.0567	2.4431	1.0017	0.4554	0.2335	0.1205	0.0686	0.0384	0.0172	0.0194	0.0144	0.0155	0.0092	0.0099	0.0106	0.0101	0.0077
8	10.5740	3.2716	1.4273	0.7997	0.4729	0.2973	0.1888	0.1288	0.0884	0.0581	0.0426	0.0343	0.0266	0.0194	0.0140	0.0096	0.0070
9	9.4742	2.9026	1.1365	0.5719	0.3152	0.2000	0.1478	0.1126	0.0844	0.0588	0.0455	0.0329	0.0258	0.0187	0.0119	0.0168	0.0077
10	10.0845	2.9974	1.3568	0.7552	0.4341	0.3075	0.1983	0.1303	0.0925	0.0703	0.0510	0.0355	0.0312	0.0204	0.0186	0.0153	0.0072
11	13.7301	5.3748	2.7244	1.6738	1.0632	0.7477	0.5536	0.4187	0.3216	0.2526	0.2006	0.1644	0.1328	0.1145	0.0928	0.0809	0.0084
12	9.9015	2.6334	0.8598	0.2742	0.1372	0.0456	0.0247	0.0259	0.0284	0.0227	0.0159	0.0121	0.0167	0.0090	0.0101	0.0152	0.0090

Day 2	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.3475	0.0909	0.0442	0.0339	0.0206	0.0091	0.0073	0.0046	0.0052	0.0029	0.0034	0.0022	0.0021	0.0022	0.0020	0.0020	0.0012
2	0.6272	0.1485	0.0871	0.0416	0.0133	0.0171	0.0082	0.0059	0.0052	0.0033	0.0038	0.0033	0.0027	0.0027	0.0020	0.0017	0.0012
3	0.6298	0.1555	0.0849	0.0475	0.0199	0.0211	0.0090	0.0064	0.0046	0.0052	0.0032	0.0020	0.0027	0.0021	0.0017	0.0024	0.0012
4	0.5151	0.0959	0.1064	0.0276	0.0219	0.0146	0.0078	0.0067	0.0043	0.0042	0.0043	0.0029	0.0037	0.0026	0.0030	0.0031	0.0011
5	0.5961	0.1114	0.0779	0.0447	0.0197	0.0188	0.0147	0.0085	0.0067	0.0061	0.0039	0.0037	0.0041	0.0023	0.0021	0.0019	0.0012
6	0.2878	0.0632	0.0458	0.0248	0.0136	0.0097	0.0054	0.0075	0.0037	0.0034	0.0044	0.0031	0.0020	0.0028	0.0012	0.0019	0.0011
7	0.3599	0.1091	0.0792	0.0326	0.0224	0.0110	0.0093	0.0121	0.0073	0.0056	0.0053	0.0060	0.0035	0.0036	0.0034	0.0021	0.0012

Appendix G (Continued)

Cultivar: Cresthaven

Day 3	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.2192	0.0839	0.0541	0.0380	0.0208	0.0157	0.0074	0.0055	0.0057	0.0054	0.0042	0.0019	0.0030	0.0019	0.0011	0.0017	0.0010
2	0.6702	0.2021	0.0873	0.0670	0.0351	0.0357	0.0178	0.0175	0.0109	0.0112	0.0077	0.0057	0.0048	0.0040	0.0031	0.0018	0.0012
3	0.1905	0.0421	0.0489	0.0146	0.0114	0.0079	0.0056	0.0043	0.0030	0.0025	0.0026	0.0024	0.0023	0.0021	0.0016	0.0012	0.0010
4	0.2480	0.0956	0.0355	0.0301	0.0191	0.0151	0.0079	0.0117	0.0080	0.0043	0.0030	0.0033	0.0024	0.0038	0.0021	0.0019	0.0011
5	0.5131	0.1595	0.0688	0.0267	0.0220	0.0174	0.0090	0.0142	0.0069	0.0077	0.0044	0.0036	0.0029	0.0027	0.0036	0.0021	0.0012
6	0.6498	0.1027	0.1166	0.0504	0.0154	0.0228	0.0124	0.0136	0.0062	0.0112	0.0072	0.0097	0.0052	0.0060	0.0048	0.0039	0.0012
7	0.2090	0.1133	0.0589	0.0280	0.0140	0.0147	0.0076	0.0101	0.0062	0.0057	0.0046	0.0037	0.0028	0.0023	0.0031	0.0031	0.0012

Day 4	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.6205	0.0947	0.0711	0.0382	0.0297	0.0254	0.0171	0.0090	0.0106	0.0074	0.0056	0.0039	0.0025	0.0027	0.0030	0.0028	0.0011
2	0.3924	0.1047	0.0745	0.0273	0.0162	0.0158	0.0101	0.0089	0.0055	0.0052	0.0042	0.0042	0.0029	0.0026	0.0021	0.0019	0.0011
3	0.2668	0.0686	0.0627	0.0360	0.0204	0.0095	0.0093	0.0061	0.0061	0.0053	0.0040	0.0027	0.0033	0.0027	0.0024	0.0020	0.0011
4	0.4531	0.1140	0.0505	0.0286	0.0138	0.0149	0.0086	0.0053	0.0057	0.0051	0.0034	0.0030	0.0024	0.0022	0.0014	0.0019	0.0011
5	0.4632	0.1286	0.0591	0.0292	0.0193	0.0104	0.0094	0.0080	0.0064	0.0040	0.0035	0.0028	0.0023	0.0013	0.0021	0.0018	0.0011
6	0.2511	0.0782	0.0670	0.0316	0.0264	0.0142	0.0120	0.0090	0.0079	0.0054	0.0044	0.0036	0.0047	0.0024	0.0029	0.0023	0.0011
7	0.4557	0.0876	0.0529	0.0305	0.0152	0.0091	0.0068	0.0047	0.0043	0.0065	0.0035	0.0039	0.0035	0.0025	0.0023	0.0022	0.0012

Cultivar: Parade

Initial	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	5.5738	1.6876	0.4636	0.1475	0.0910	0.0956	0.0709	0.0669	0.0545	0.0473	0.0397	0.0358	0.0395	0.0257	0.0284	0.0283	0.0077
2	4.0008	0.9504	0.2125	0.0909	0.0555	0.0319	0.0202	0.0208	0.0155	0.0090	0.0111	0.0092	0.0081	0.0047	0.0083	0.0089	0.0066
3	4.2738	0.7000	0.4054	0.1702	0.0633	0.0611	0.0311	0.0173	0.0213	0.0119	0.0111	0.0140	0.0100	0.0072	0.0087	0.0057	0.0076
4	2.5037	0.2342	0.2007	0.0687	0.0428	0.0268	0.0200	0.0139	0.0103	0.0133	0.0090	0.0080	0.0085	0.0082	0.0083	0.0054	0.0059
5	4.3406	0.8347	0.4036	0.1814	0.0669	0.0620	0.0510	0.0306	0.0230	0.0202	0.0166	0.0160	0.0106	0.0085	0.0084	0.0077	0.0073
6	6.9734	2.6222	1.2292	0.7434	0.4542	0.2979	0.1927	0.1293	0.1003	0.0761	0.0595	0.0420	0.0340	0.0300	0.0212	0.0182	0.0069
7	5.7956	2.0604	0.9277	0.4341	0.2522	0.1700	0.1134	0.0648	0.0488	0.0314	0.0208	0.0156	0.0100	0.0146	0.0087	0.0090	0.0082
8	6.0986	1.9101	0.9384	0.4690	0.2504	0.1735	0.0917	0.0716	0.0463	0.0290	0.0161	0.0190	0.0133	0.0110	0.0076	0.0088	0.0079
9	8.9742	2.4586	1.3163	0.7201	0.3894	0.2116	0.1418	0.1108	0.0765	0.0477	0.0371	0.0276	0.0221	0.0159	0.0127	0.0117	0.0075
10	6.9152	1.9373	0.5891	0.2000	0.0979	0.0457	0.0461	0.0483	0.0388	0.0230	0.0203	0.0222	0.0179	0.0213	0.0141	0.0148	0.0079
11	2.9774	0.9380	0.2823	0.0836	0.0344	0.0259	0.0163	0.0156	0.0131	0.0111	0.0077	0.0098	0.0076	0.0074	0.0098	0.0076	0.0066
12	5.4023	1.3953	0.3177	0.0956	0.0588	0.0421	0.0334	0.0143	0.0165	0.0086	0.0112	0.0076	0.0104	0.0076	0.0105	0.0105	0.0069

Day 1	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	1.8284	0.2186	0.1411	0.0629	0.0284	0.0170	0.0186	0.0112	0.0070	0.0080	0.0056	0.0042	0.0035	0.0038	0.0048	0.0038	0.0033
2	1.8452	0.3667	0.1395	0.0422	0.0258	0.0199	0.0143	0.0145	0.0075	0.0059	0.0063	0.0048	0.0043	0.0045	0.0037	0.0040	0.0030
3	2.0300	0.3174	0.2302	0.0892	0.0580	0.0305	0.0254	0.0199	0.0100	0.0096	0.0106	0.0047	0.0058	0.0049	0.0050	0.0037	0.0032
4	1.5506	0.3946	0.2001	0.0682	0.0223	0.0238	0.0154	0.0105	0.0064	0.0060	0.0063	0.0040	0.0044	0.0031	0.0044	0.0045	0.0033
5	3.2625	0.6174	0.1751	0.0874	0.0585	0.0237	0.0144	0.0084	0.0105	0.0082	0.0050	0.0053	0.0053	0.0031	0.0036	0.0055	0.0036
6	0.7716	0.2545	0.1328	0.0518	0.0473	0.0181	0.0155	0.0122	0.0091	0.0068	0.0059	0.0045	0.0041	0.0029	0.0033	0.0036	0.0033
7	2.8160	0.5841	0.2465	0.1078	0.0427	0.0243	0.0259	0.0175	0.0128	0.0073	0.0113	0.0091	0.0062	0.0047	0.0038	0.0034	0.0034
8	1.3147	0.3578	0.1081	0.0569	0.0279	0.0196	0.0160	0.0080	0.0063	0.0067	0.0061	0.0048	0.0042	0.0032	0.0040	0.0047	0.0033
9	2.4762	0.4026	0.1943	0.0739	0.0334	0.0317	0.0124	0.0101	0.0092	0.0059	0.0072	0.0039	0.0035	0.0037	0.0031	0.0027	0.0035
10	0.8789	0.1253	0.0983	0.0465	0.0190	0.0230	0.0161	0.0155	0.0079	0.0061	0.0075	0.0047	0.0048	0.0045	0.0051	0.0029	0.0035
11	1.0440	0.1293	0.1212	0.0430	0.0305	0.0179	0.0123	0.0096	0.0106	0.0049	0.0068	0.0050	0.0025	0.0050	0.0034	0.0032	0.0030
12	0.8834	0.1942	0.1196	0.0756	0.0331	0.0160	0.0172	0.0093	0.0078	0.0056	0.0042	0.0073	0.0040	0.0048	0.0041	0.0051	0.0029

Cultivar: Parade

Day 2	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.3630	0.2034	0.1019	0.0337	0.0319	0.0227	0.0141	0.0133	0.0146	0.0091	0.0069	0.0056	0.0039	0.0045	0.0025	0.0028	0.0012
2	0.2254	0.0594	0.0481	0.0239	0.0094	0.0085	0.0090	0.0064	0.0056	0.0041	0.0044	0.0037	0.0033	0.0025	0.0034	0.0031	0.0014
3	0.4027	0.1600	0.0801	0.0471	0.0276	0.0231	0.0161	0.0138	0.0089	0.0068	0.0053	0.0059	0.0058	0.0049	0.0034	0.0027	0.0012
4	0.3659	0.1504	0.0791	0.0414	0.0195	0.0137	0.0073	0.0069	0.0080	0.0055	0.0051	0.0032	0.0030	0.0017	0.0023	0.0018	0.0011
5	0.3771	0.0834	0.0369	0.0177	0.0104	0.0078	0.0037	0.0035	0.0029	0.0025	0.0024	0.0028	0.0014	0.0013	0.0012	0.0012	0.0011
6	0.2765	0.0800	0.0683	0.0273	0.0123	0.0129	0.0087	0.0065	0.0049	0.0061	0.0042	0.0028	0.0030	0.0019	0.0024	0.0012	0.0011
7	0.5004	0.1457	0.0730	0.0445	0.0209	0.0182	0.0132	0.0080	0.0051	0.0061	0.0047	0.0020	0.0021	0.0032	0.0023	0.0015	0.0012
8	0.2924	0.0586	0.0491	0.0183	0.0142	0.0113	0.0074	0.0034	0.0044	0.0040	0.0030	0.0023	0.0030	0.0017	0.0018	0.0015	0.0012
9	0.3235	0.0468	0.0424	0.0154	0.0131	0.0066	0.0050	0.0031	0.0022	0.0031	0.0041	0.0030	0.0020	0.0015	0.0014	0.0012	0.0011
10	0.2408	0.0744	0.0642	0.0239	0.0120	0.0096	0.0088	0.0053	0.0046	0.0026	0.0027	0.0024	0.0016	0.0019	0.0016	0.0010	0.0011
11	0.5234	0.0952	0.0645	0.0195	0.0096	0.0072	0.0058	0.0051	0.0037	0.0036	0.0037	0.0023	0.0016	0.0015	0.0013	0.0014	0.0013
12	0.2857	0.0645	0.0398	0.0371	0.0164	0.0147	0.0086	0.0063	0.0048	0.0047	0.0039	0.0023	0.0026	0.0028	0.0018	0.0020	0.0012

Day 3	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.4862	0.0408	0.0409	0.0127	0.0079	0.0083	0.0048	0.0048	0.0022	0.0025	0.0029	0.0016	0.0023	0.0015	0.0014	0.0013	0.0011
2	0.2784	0.0460	0.0299	0.0122	0.0079	0.0062	0.0048	0.0027	0.0028	0.0034	0.0023	0.0016	0.0016	0.0013	0.0011	0.0014	0.0012
3	0.2360	0.0469	0.0391	0.0195	0.0086	0.0099	0.0057	0.0035	0.0047	0.0025	0.0019	0.0016	0.0014	0.0012	0.0020	0.0014	0.0013
4	0.1359	0.0620	0.0493	0.0226	0.0186	0.0088	0.0082	0.0051	0.0041	0.0029	0.0025	0.0022	0.0019	0.0026	0.0013	0.0018	0.0011
5	0.1935	0.0764	0.0396	0.0192	0.0153	0.0100	0.0064	0.0049	0.0046	0.0026	0.0027	0.0029	0.0023	0.0016	0.0015	0.0014	0.0010
6	0.1596	0.0473	0.0357	0.0113	0.0075	0.0057	0.0054	0.0029	0.0029	0.0022	0.0020	0.0017	0.0017	0.0009	0.0011	0.0012	0.0013
7	0.2246	0.0866	0.0528	0.0208	0.0142	0.0103	0.0085	0.0089	0.0038	0.0053	0.0033	0.0029	0.0020	0.0018	0.0018	0.0016	0.0012
8	0.3405	0.0819	0.0530	0.0193	0.0166	0.0079	0.0071	0.0044	0.0027	0.0039	0.0037	0.0028	0.0017	0.0023	0.0023	0.0013	0.0011
9	0.2888	0.1118	0.0753	0.0325	0.0340	0.0122	0.0079	0.0086	0.0075	0.0063	0.0044	0.0037	0.0038	0.0023	0.0025	0.0025	0.0011
10	0.2777	0.0796	0.0559	0.0180	0.0117	0.0087	0.0057	0.0067	0.0037	0.0025	0.0022	0.0020	0.0017	0.0021	0.0023	0.0016	0.0011
11	0.2361	0.0568	0.0531	0.0162	0.0119	0.0100	0.0080	0.0051	0.0036	0.0038	0.0030	0.0025	0.0019	0.0025	0.0015	0.0016	0.0010
12	0.1908	0.1045	0.0505	0.0218	0.0118	0.0088	0.0035	0.0046	0.0043	0.0039	0.0029	0.0024	0.0018	0.0016	0.0017	0.0017	0.0011

Cultivar: Parade

Day 4	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.1670	0.0454	0.0319	0.0129	0.0067	0.0058	0.0055	0.0043	0.0041	0.0019	0.0021	0.0015	0.0017	0.0024	0.0016	0.0017	0.0012
2	0.2301	0.0773	0.0390	0.0260	0.0169	0.0098	0.0065	0.0052	0.0047	0.0049	0.0021	0.0026	0.0024	0.0015	0.0014	0.0016	0.0011
3	0.3971	0.0895	0.0748	0.0500	0.0193	0.0150	0.0124	0.0091	0.0084	0.0052	0.0049	0.0050	0.0031	0.0029	0.0021	0.0025	0.0011
4	0.3019	0.0609	0.0420	0.0215	0.0099	0.0058	0.0027	0.0045	0.0025	0.0018	0.0030	0.0016	0.0012	0.0017	0.0015	0.0019	0.0012
5	0.3312	0.0997	0.0684	0.0275	0.0137	0.0095	0.0073	0.0057	0.0030	0.0029	0.0027	0.0030	0.0031	0.0018	0.0024	0.0017	0.0012
6	0.2095	0.0649	0.0251	0.0177	0.0150	0.0080	0.0063	0.0034	0.0044	0.0028	0.0019	0.0028	0.0020	0.0014	0.0013	0.0012	0.0011
7	0.1946	0.0718	0.0357	0.0130	0.0075	0.0078	0.0050	0.0038	0.0026	0.0031	0.0027	0.0017	0.0014	0.0018	0.0018	0.0020	0.0011
8	0.2574	0.0595	0.0330	0.0097	0.0090	0.0062	0.0053	0.0046	0.0041	0.0029	0.0036	0.0026	0.0021	0.0022	0.0015	0.0018	0.0010
9	0.3326	0.1265	0.0505	0.0217	0.0200	0.0154	0.0086	0.0089	0.0053	0.0045	0.0030	0.0029	0.0036	0.0028	0.0018	0.0017	0.0013
10	0.2513	0.0509	0.0299	0.0153	0.0066	0.0036	0.0042	0.0029	0.0035	0.0033	0.0030	0.0019	0.0013	0.0015	0.0017	0.0018	0.0012
11	0.2059	0.0344	0.0207	0.0091	0.0088	0.0051	0.0031	0.0036	0.0025	0.0016	0.0019	0.0013	0.0016	0.0013	0.0015	0.0009	0.0011
12	0.2282	0.0451	0.0344	0.0183	0.0100	0.0051	0.0042	0.0032	0.0034	0.0022	0.0026	0.0019	0.0016	0.0015	0.0016	0.0011	0.0011

Cultivar: Fairtime

Initial	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	1.6978	0.2483	0.1683	0.0571	0.0209	0.0171	0.0113	0.0093	0.0098	0.0120	0.0102	0.0092	0.0059	0.0064	0.0067	0.0070	0.0064
2	1.3600	0.3494	0.1535	0.0484	0.0230	0.0174	0.0152	0.0103	0.0079	0.0106	0.0111	0.0110	0.0058	0.0078	0.0076	0.0062	0.0082
3	2.1927	0.3089	0.1273	0.0345	0.0392	0.0242	0.0103	0.0128	0.0110	0.0094	0.0098	0.0055	0.0071	0.0051	0.0062	0.0042	0.0038
4	1.1282	0.3145	0.1705	0.1294	0.1256	0.1276	0.1261	0.1254	0.1250	0.1252	0.1269	0.1244	0.1242	0.1245	0.1249	0.1251	0.1206
5	4.2769	1.0919	0.4366	0.1648	0.0502	0.0313	0.0251	0.0195	0.0085	0.0146	0.0088	0.0051	0.0049	0.0057	0.0061	0.0048	0.0042
6	2.0525	0.4007	0.1546	0.0743	0.0436	0.0335	0.0175	0.0162	0.0149	0.0103	0.0083	0.0076	0.0068	0.0074	0.0046	0.0044	0.0042
7	2.5247	0.5490	0.2660	0.0985	0.0658	0.0292	0.0178	0.0166	0.0157	0.0105	0.0086	0.0085	0.0052	0.0044	0.0060	0.0047	0.0036
8	1.5331	0.1816	0.1335	0.0633	0.0479	0.0279	0.0180	0.0163	0.0195	0.0187	0.0158	0.0073	0.0085	0.0106	0.0100	0.0070	0.0039
9	1.2703	0.2722	0.1344	0.0441	0.0363	0.0216	0.0200	0.0118	0.0099	0.0081	0.0065	0.0048	0.0063	0.0057	0.0045	0.0027	0.0048
10	2.1940	0.1546	0.0799	0.0434	0.0299	0.0159	0.0120	0.0099	0.0089	0.0067	0.0060	0.0073	0.0044	0.0063	0.0049	0.0047	0.0042
11	1.8687	0.3108	0.1597	0.0876	0.0432	0.0229	0.0200	0.0140	0.0089	0.0080	0.0049	0.0061	0.0100	0.0046	0.0065	0.0037	0.0043
12	2.5326	0.5219	0.2382	0.0799	0.0447	0.0312	0.0254	0.0190	0.0120	0.0142	0.0090	0.0094	0.0076	0.0064	0.0064	0.0038	0.0037

Cultivar: Fairtime

Day 1	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.7260	0.1719	0.0922	0.0465	0.0270	0.0244	0.0144	0.0158	0.0123	0.0067	0.0062	0.0055	0.0046	0.0038	0.0037	0.0036	0.0018
2	2.8122	0.4371	0.1130	0.0745	0.0558	0.0628	0.0332	0.0258	0.0194	0.0177	0.0109	0.0100	0.0059	0.0054	0.0068	0.0063	0.0018
3	3.5049	0.3752	0.1173	0.0583	0.0443	0.0267	0.0263	0.0146	0.0154	0.0112	0.0085	0.0071	0.0068	0.0045	0.0061	0.0039	0.0016
4	2.3066	0.4633	0.1465	0.0664	0.0277	0.0188	0.0214	0.0127	0.0112	0.0118	0.0102	0.0073	0.0066	0.0057	0.0039	0.0042	0.0019
5	3.2016	0.2697	0.1294	0.0475	0.0344	0.0277	0.0181	0.0144	0.0079	0.0094	0.0080	0.0041	0.0039	0.0035	0.0027	0.0025	0.0018
6	2.2028	0.3142	0.1212	0.0741	0.0411	0.0302	0.0136	0.0123	0.0099	0.0091	0.0056	0.0061	0.0050	0.0041	0.0051	0.0035	0.0017
7	2.1534	0.2627	0.1215	0.1143	0.0371	0.0240	0.0150	0.0143	0.0080	0.0060	0.0060	0.0023	0.0058	0.0032	0.0037	0.0025	0.0017
8	3.2714	0.2081	0.0877	0.0511	0.0251	0.0335	0.0196	0.0101	0.0069	0.0074	0.0091	0.0052	0.0053	0.0052	0.0031	0.0025	0.0018
9	3.4357	0.8497	0.2806	0.1214	0.0746	0.0492	0.0236	0.0198	0.0126	0.0111	0.0104	0.0082	0.0059	0.0056	0.0073	0.0040	0.0022
10	0.3970	0.1468	0.0455	0.0342	0.0207	0.0144	0.0141	0.0099	0.0065	0.0060	0.0054	0.0061	0.0049	0.0035	0.0034	0.0026	0.0019
11	3.0158	0.5308	0.1255	0.0717	0.0460	0.0216	0.0142	0.0102	0.0097	0.0061	0.0064	0.0035	0.0040	0.0036	0.0036	0.0027	0.0020
12	2.4080	0.3678	0.1650	0.1278	0.0619	0.0436	0.0265	0.0227	0.0128	0.0103	0.0080	0.0086	0.0048	0.0042	0.0039	0.0049	0.0020

Day 2	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.4249	0.0768	0.0680	0.0354	0.0204	0.0095	0.0095	0.0074	0.0045	0.0043	0.0051	0.0018	0.0031	0.0027	0.0017	0.0014	0.0013
2	0.2886	0.1259	0.0345	0.0254	0.0132	0.0136	0.0109	0.0103	0.0069	0.0029	0.0035	0.0028	0.0026	0.0024	0.0035	0.0025	0.0014
3	1.0522	0.2905	0.1135	0.0739	0.0406	0.0256	0.0149	0.0105	0.0107	0.0081	0.0062	0.0061	0.0038	0.0043	0.0029	0.0031	0.0013
4	0.3993	0.0944	0.0713	0.0285	0.0261	0.0159	0.0126	0.0092	0.0049	0.0034	0.0060	0.0039	0.0030	0.0022	0.0016	0.0022	0.0013
5	0.4386	0.1883	0.1016	0.0361	0.0299	0.0119	0.0095	0.0048	0.0048	0.0035	0.0044	0.0032	0.0038	0.0024	0.0024	0.0027	0.0012
6	0.2164	0.0750	0.0638	0.0270	0.0165	0.0089	0.0084	0.0052	0.0047	0.0038	0.0046	0.0033	0.0021	0.0023	0.0021	0.0024	0.0011
7	0.4590	0.0868	0.0481	0.0338	0.0204	0.0127	0.0132	0.0053	0.0039	0.0046	0.0045	0.0023	0.0021	0.0022	0.0016	0.0018	0.0012
8	0.1860	0.0977	0.0575	0.0270	0.0147	0.0127	0.0092	0.0069	0.0029	0.0057	0.0042	0.0028	0.0033	0.0024	0.0026	0.0026	0.0014
9	0.4280	0.0886	0.0477	0.0184	0.0262	0.0117	0.0139	0.0071	0.0046	0.0031	0.0038	0.0035	0.0032	0.0025	0.0018	0.0017	0.0013
10	0.2720	0.0934	0.0313	0.0096	0.0105	0.0082	0.0075	0.0073	0.0039	0.0036	0.0038	0.0024	0.0027	0.0021	0.0021	0.0025	0.0013
11	0.3321	0.1283	0.0510	0.0281	0.0134	0.0137	0.0073	0.0091	0.0078	0.0040	0.0037	0.0030	0.0022	0.0015	0.0023	0.0018	0.0011
12	0.3934	0.0816	0.0428	0.0211	0.0097	0.0090	0.0030	0.0037	0.0033	0.0022	0.0023	0.0025	0.0022	0.0014	0.0015	0.0009	0.0013

Cultivar: Fairtime

Day 3	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.3401	0.0732	0.0491	0.0255	0.0128	0.0122	0.0076	0.0080	0.0056	0.0029	0.0031	0.0029	0.0033	0.0019	0.0017	0.0017	0.0012
2	0.4152	0.1056	0.0815	0.0350	0.0188	0.0165	0.0118	0.0080	0.0042	0.0060	0.0047	0.0031	0.0037	0.0021	0.0025	0.0020	0.0011
3	0.1646	0.0665	0.0453	0.0192	0.0123	0.0092	0.0077	0.0050	0.0040	0.0033	0.0036	0.0029	0.0019	0.0016	0.0016	0.0016	0.0012
4	0.5040	0.1160	0.0530	0.0300	0.0162	0.0090	0.0071	0.0059	0.0046	0.0043	0.0040	0.0022	0.0028	0.0023	0.0021	0.0014	0.0012
5	0.2044	0.0617	0.0615	0.0197	0.0195	0.0089	0.0054	0.0111	0.0051	0.0047	0.0033	0.0017	0.0044	0.0023	0.0031	0.0022	0.0011
6	0.1622	0.0946	0.0472	0.0156	0.0148	0.0126	0.0109	0.0076	0.0059	0.0052	0.0046	0.0028	0.0020	0.0030	0.0028	0.0018	0.0011
7	0.2501	0.0901	0.0441	0.0257	0.0205	0.0134	0.0099	0.0094	0.0065	0.0047	0.0041	0.0031	0.0026	0.0023	0.0017	0.0021	0.0012
8	0.6377	0.1432	0.0725	0.0354	0.0282	0.0133	0.0146	0.0115	0.0092	0.0061	0.0042	0.0043	0.0024	0.0032	0.0030	0.0028	0.0011
9	0.2202	0.1184	0.0265	0.0227	0.0220	0.0110	0.0062	0.0057	0.0067	0.0034	0.0029	0.0020	0.0023	0.0026	0.0022	0.0016	0.0010
10	0.1499	0.0583	0.0387	0.0190	0.0090	0.0070	0.0061	0.0038	0.0022	0.0020	0.0024	0.0019	0.0019	0.0014	0.0014	0.0016	0.0011
11	0.9094	0.1931	0.0806	0.0299	0.0219	0.0258	0.0181	0.0100	0.0107	0.0052	0.0042	0.0028	0.0030	0.0037	0.0023	0.0026	0.0012
12	0.2939	0.0567	0.0275	0.0096	0.0062	0.0038	0.0038	0.0037	0.0026	0.0024	0.0030	0.0021	0.0014	0.0014	0.0015	0.0014	0.0010

Day 4	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.1202	0.0378	0.0253	0.0134	0.0096	0.0051	0.0039	0.0045	0.0034	0.0023	0.0016	0.0016	0.0021	0.0016	0.0018	0.0014	0.0010
2	0.2194	0.0713	0.0246	0.0188	0.0093	0.0070	0.0053	0.0037	0.0029	0.0024	0.0022	0.0020	0.0018	0.0015	0.0017	0.0010	0.0009
3	0.1820	0.0490	0.0402	0.0151	0.0077	0.0087	0.0057	0.0039	0.0023	0.0020	0.0025	0.0017	0.0013	0.0013	0.0017	0.0014	0.0009
4	0.1055	0.0473	0.0238	0.0093	0.0074	0.0036	0.0030	0.0024	0.0024	0.0019	0.0020	0.0019	0.0017	0.0015	0.0015	0.0014	0.0009
5	0.1579	0.0391	0.0273	0.0106	0.0079	0.0049	0.0035	0.0028	0.0025	0.0023	0.0017	0.0017	0.0018	0.0012	0.0018	0.0013	0.0009
6	0.1081	0.0524	0.0265	0.0133	0.0090	0.0073	0.0039	0.0043	0.0029	0.0026	0.0023	0.0013	0.0023	0.0017	0.0018	0.0019	0.0009
7	0.1668	0.0481	0.0188	0.0084	0.0107	0.0083	0.0035	0.0038	0.0026	0.0015	0.0015	0.0023	0.0010	0.0012	0.0013	0.0012	0.0012
8	0.2841	0.0559	0.0257	0.0141	0.0123	0.0084	0.0049	0.0033	0.0034	0.0037	0.0023	0.0022	0.0017	0.0017	0.0016	0.0013	0.0011
9	0.1285	0.0932	0.0648	0.0334	0.0131	0.0116	0.0077	0.0060	0.0069	0.0034	0.0036	0.0042	0.0032	0.0025	0.0016	0.0022	0.0010
10	0.1512	0.0574	0.0308	0.0217	0.0133	0.0099	0.0057	0.0053	0.0050	0.0040	0.0028	0.0022	0.0024	0.0021	0.0021	0.0019	0.0010
11	0.3134	0.1441	0.0694	0.0254	0.0158	0.0101	0.0047	0.0065	0.0032	0.0051	0.0041	0.0037	0.0035	0.0028	0.0022	0.0017	0.0012
12	0.2478	0.0540	0.0279	0.0176	0.0056	0.0052	0.0046	0.0038	0.0020	0.0029	0.0024	0.0019	0.0017	0.0016	0.0014	0.0012	0.0010

Cultivar: Stony Hard

Initial	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	10.1248	2.6911	1.1522	0.6224	0.3071	0.1892	0.1342	0.0780	0.0493	0.0344	0.0259	0.0153	0.0147	0.0163	0.0137	0.0166	0.0081
2	9.0276	3.0682	1.2329	0.5125	0.2820	0.1281	0.0829	0.0427	0.0342	0.0152	0.0250	0.0187	0.0163	0.0141	0.0134	0.0126	0.0085
3	13.6148	4.6065	2.2892	1.3546	0.8772	0.5871	0.4206	0.3166	0.2325	0.1849	0.1551	0.1111	0.0900	0.0772	0.0597	0.0518	0.0082
4	11.0520	3.2873	1.4020	0.9347	0.6092	0.4231	0.2954	0.2104	0.1593	0.1222	0.0920	0.0760	0.0573	0.0497	0.0377	0.0293	0.0082
5	2.3011	0.2507	0.1646	0.0722	0.0346	0.0429	0.0293	0.0271	0.0188	0.0193	0.0204	0.0141	0.0156	0.0128	0.0089	0.0142	0.0067
6	10.2982	3.2679	1.5116	0.8724	0.5583	0.3951	0.2957	0.2160	0.1784	0.1294	0.1085	0.0952	0.0696	0.0573	0.0488	0.0379	0.0087
7	2.7086	0.2001	0.1420	0.0672	0.0378	0.0260	0.0211	0.0175	0.0152	0.0117	0.0138	0.0102	0.0097	0.0086	0.0096	0.0101	0.0075
8	13.2450	4.6479	2.2503	1.3694	0.9210	0.6062	0.4489	0.3462	0.2555	0.2030	0.1532	0.1259	0.1097	0.0860	0.0701	0.0617	0.0095
9	10.2063	1.5078	0.7490	0.2899	0.1384	0.0733	0.0479	0.0301	0.0258	0.0277	0.0235	0.0164	0.0201	0.0228	0.0143	0.0158	0.0098
10	11.4429	2.8997	0.9339	0.2360	0.1402	0.1445	0.1286	0.0931	0.0625	0.0401	0.0308	0.0210	0.0229	0.0159	0.0152	0.0200	0.0092

Day 1	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	2.6944	0.3172	0.1371	0.0815	0.0354	0.0265	0.0219	0.0127	0.0125	0.0069	0.0085	0.0055	0.0045	0.0056	0.0043	0.0046	0.0034
2	5.4170	0.9794	0.3661	0.1432	0.0676	0.0385	0.0319	0.0158	0.0146	0.0095	0.0109	0.0084	0.0081	0.0053	0.0054	0.0050	0.0033
3	2.7972	0.2620	0.1522	0.0538	0.0597	0.0293	0.0213	0.0146	0.0143	0.0111	0.0074	0.0090	0.0103	0.0052	0.0055	0.0052	0.0038
4	2.3753	0.2396	0.1745	0.0556	0.0379	0.0267	0.0135	0.0101	0.0090	0.0094	0.0060	0.0046	0.0047	0.0033	0.0035	0.0049	0.0034
5	0.7505	0.1792	0.1023	0.0590	0.0260	0.0267	0.0193	0.0124	0.0109	0.0066	0.0072	0.0050	0.0056	0.0055	0.0055	0.0051	0.0032
6	1.3747	0.2041	0.0824	0.0491	0.0213	0.0150	0.0178	0.0119	0.0097	0.0065	0.0053	0.0051	0.0052	0.0049	0.0046	0.0030	0.0029
7	1.0563	0.1919	0.0958	0.0391	0.0233	0.0195	0.0141	0.0113	0.0112	0.0067	0.0056	0.0065	0.0041	0.0067	0.0038	0.0039	0.0037
8	1.2433	0.1661	0.0931	0.0320	0.0243	0.0153	0.0106	0.0076	0.0080	0.0076	0.0082	0.0071	0.0055	0.0036	0.0052	0.0050	0.0035
9	1.3498	0.3691	0.1215	0.0512	0.0257	0.0169	0.0131	0.0091	0.0061	0.0067	0.0071	0.0041	0.0057	0.0058	0.0035	0.0038	0.0038
10	2.1827	0.4898	0.1822	0.0512	0.0338	0.0250	0.0207	0.0141	0.0069	0.0079	0.0065	0.0056	0.0035	0.0058	0.0048	0.0037	0.0035

Appendix G (Continued)

Cultivar: Stony Hard

Day 2	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	1.4875	0.3427	0.2832	0.1035	0.1142	0.0710	0.0369	0.0326	0.0121	0.0212	0.0190	0.0137	0.0113	0.0075	0.0085	0.0108	0.0041
2	1.2401	0.3006	0.2230	0.1114	0.0777	0.0471	0.0190	0.0148	0.0155	0.0118	0.0138	0.0071	0.0062	0.0105	0.0065	0.0072	0.0051
3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
4	1.3592	0.5043	0.2622	0.1308	0.0698	0.0612	0.0287	0.0269	0.0243	0.0217	0.0197	0.0096	0.0119	0.0077	0.0081	0.0062	0.0045
5	1.6620	0.2635	0.1655	0.0693	0.0548	0.0274	0.0157	0.0142	0.0125	0.0128	0.0105	0.0056	0.0054	0.0058	0.0053	0.0049	0.0038
6	1.8228	0.3518	0.2497	0.0743	0.0915	0.0559	0.0371	0.0320	0.0206	0.0143	0.0181	0.0119	0.0088	0.0063	0.0069	0.0044	0.0042
7	1.0155	0.3124	0.1556	0.0607	0.0418	0.0219	0.0213	0.0120	0.0133	0.0117	0.0104	0.0069	0.0088	0.0066	0.0055	0.0026	0.0038
8	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
9	1.2862	0.3418	0.2768	0.0907	0.0457	0.0359	0.0227	0.0198	0.0204	0.0129	0.0127	0.0096	0.0084	0.0081	0.0071	0.0087	0.0038
10	2.1158	0.3986	0.2537	0.1822	0.0861	0.0867	0.0630	0.0705	0.0456	0.0380	0.0380	0.0325	0.0217	0.0273	0.0252	0.0150	0.0041

Day 3	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	0.1686	0.0392	0.0260	0.0115	0.0089	0.0045	0.0052	0.0028	0.0029	0.0029	0.0022	0.0020	0.0014	0.0012	0.0009	0.0011	0.0012
2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
3	0.3113	0.0771	0.0553	0.0251	0.0195	0.0073	0.0055	0.0053	0.0028	0.0046	0.0035	0.0035	0.0020	0.0020	0.0022	0.0019	0.0013
4	0.2725	0.0639	0.0406	0.0170	0.0153	0.0089	0.0070	0.0052	0.0042	0.0027	0.0030	0.0019	0.0019	0.0016	0.0018	0.0015	0.0013
5	0.3096	0.0481	0.0417	0.0196	0.0126	0.0087	0.0063	0.0065	0.0042	0.0046	0.0032	0.0027	0.0028	0.0027	0.0023	0.0020	0.0013
6	0.2053	0.0571	0.0305	0.0115	0.0095	0.0061	0.0052	0.0050	0.0037	0.0024	0.0025	0.0029	0.0023	0.0014	0.0018	0.0021	0.0011
7	0.3732	0.0763	0.0341	0.0167	0.0110	0.0066	0.0055	0.0060	0.0035	0.0039	0.0023	0.0019	0.0014	0.0016	0.0015	0.0013	0.0014
8	0.1522	0.0666	0.0560	0.0161	0.0111	0.0053	0.0062	0.0060	0.0030	0.0024	0.0027	0.0017	0.0019	0.0016	0.0022	0.0014	0.0012
9	0.2260	0.0464	0.0281	0.0132	0.0101	0.0051	0.0076	0.0076	0.0052	0.0027	0.0030	0.0031	0.0047	0.0048	0.0031	0.0020	0.0013
10	0.3527	0.0838	0.0422	0.0201	0.0156	0.0079	0.0076	0.0058	0.0039	0.0035	0.0027	0.0022	0.0019	0.0026	0.0026	0.0015	0.0012

Cultivar: Stony Hard Control

Day 1	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	10.4314	3.2187	1.4483	0.8474	0.5362	0.3696	0.2597	0.1837	0.1386	0.1099	0.0892	0.0697	0.0568	0.0439	0.0365	0.0307	0.0056
2	9.6695	3.4092	1.6192	0.9623	0.6163	0.4207	0.3103	0.2226	0.1667	0.1342	0.1007	0.0799	0.0649	0.0561	0.0406	0.0350	0.0042
3	2.8574	0.3410	0.1688	0.0431	0.0471	0.0202	0.0172	0.0106	0.0094	0.0094	0.0084	0.0080	0.0069	0.0066	0.0054	0.0057	0.0036
4	13.7512	5.1842	2.7053	1.5991	1.0814	0.7575	0.5687	0.4224	0.3406	0.2666	0.2178	0.1822	0.1470	0.1282	0.1059	0.0933	0.0066
5	11.5417	3.5309	1.7214	1.0774	0.6723	0.4391	0.3145	0.2326	0.1739	0.1315	0.0978	0.0801	0.0611	0.0521	0.0408	0.0353	0.0043

Day 2	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	15.9324	5.2166	3.0072	1.6416	1.1970	0.8111	0.6262	0.4810	0.4202	0.2654	0.2921	0.1940	0.2067	0.1641	0.1542	0.1337	0.0215
2	4.9964	1.0077	0.2498	0.0940	0.0434	0.0312	0.0284	0.0124	0.0143	0.0111	0.0131	0.0102	0.0071	0.0071	0.0074	0.0081	0.0053
3	9.6153	1.4979	0.8331	0.3895	0.1754	0.0861	0.0917	0.0551	0.0173	0.0216	0.0149	0.0132	0.0099	0.0096	0.0090	0.0074	0.0053
4	10.7496	3.2854	1.6157	1.0132	0.6525	0.4541	0.3351	0.2399	0.1864	0.1463	0.1137	0.0938	0.0748	0.0621	0.0544	0.0427	0.0051
5	12.1301	2.8760	0.7824	0.6417	0.4841	0.3129	0.1813	0.1230	0.0959	0.0724	0.0606	0.0507	0.0351	0.0197	0.0251	0.0220	0.0085

Day 3	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A100
1	14.1424	4.5463	2.2101	1.3442	0.8867	0.5950	0.4350	0.3279	0.2488	0.1922	0.1540	0.1274	0.1049	0.0814	0.0700	0.0590	0.0046
2	12.5526	4.5306	2.2193	1.3125	0.8479	0.6017	0.4259	0.3236	0.2532	0.1990	0.1614	0.1243	0.1072	0.0863	0.0772	0.0651	0.0050
3	1.9840	0.4436	0.2175	0.0559	0.0321	0.0322	0.0205	0.0165	0.0110	0.0072	0.0081	0.0087	0.0050	0.0055	0.0052	0.0038	0.0033
4	13.3536	3.1098	1.1368	0.4994	0.1554	0.0587	0.0793	0.0884	0.0769	0.0664	0.0559	0.0356	0.0241	0.0137	0.0074	0.0069	0.0046
5	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Appendix H

Area Under 0 - 10 Hz Spectrum from FFT Analysis

Cultivar: Sentinel

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	18.65	16.04	1.24	0.64	1.04
2	12.58	3.15	0.91	0.59	0.68
3	12.71	14.27	0.88	1.30	0.93
4	12.39	14.21	0.63	0.54	0.51
5	15.53	30.36	0.68	0.77	0.56
6	9.98	27.36	4.82	0.55	0.56
7	12.64	15.11	0.90	0.73	0.70
8	15.53	6.43	1.14	0.87	0.34
9	8.83	10.26	0.72	0.69	0.52
10	8.63	6.75	0.83	0.69	1.26
11	5.15	4.32	0.85	0.37	0.68
12	2.90	1.15	0.76	0.69	0.90

Cultivar: Topaz

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	8.93	19.60	19.11	1.04	0.90
2	9.36	15.95	1.30	0.78	0.53
3	5.98	13.97	3.78	0.79	0.58
4	8.19	17.15	0.94	0.99	0.60
5	12.03	13.57	0.57	2.47	0.56
6	8.81	7.72	0.87	1.04	1.06
7	16.98	16.94	1.66	0.56	2.02
8	11.62	13.37	2.95	0.62	0.94
9	10.26	15.27	1.53	1.16	0.58
10	7.17	12.51	2.76	0.81	0.39
11	11.05	24.40	2.07	0.96	0.52
12	11.05	11.81	1.10	1.40	1.72

Appendix H (Continued)

Cultivar: Cresthaven

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	11.06	-----	0.62	0.51	0.99
2	16.69	-----	1.01	1.23	0.72
3	13.64	-----	1.04	0.38	0.55
4	10.96	-----	0.87	0.53	0.76
5	16.09	-----	0.96	0.91	0.79
6	11.27	-----	0.52	1.09	0.57
7	13.78	-----	0.72	0.53	0.74
8	17.72	-----	-----	-----	-----
9	15.43	-----	-----	-----	-----
10	16.88	-----	-----	-----	-----
11	28.26	-----	-----	-----	-----
12	14.36	-----	-----	-----	-----

Cultivar: Parade

Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	8.87	2.48	0.88	0.66	0.34
2	5.69	2.63	0.48	0.45	0.47
3	6.09	2.97	0.86	0.42	0.75
4	3.38	2.44	0.76	0.37	0.51
5	6.33	4.41	0.60	0.42	0.62
6	13.31	1.46	0.56	0.33	0.41
7	10.26	4.04	0.89	0.49	0.40
8	10.45	2.07	0.52	0.59	0.45
9	14.85	3.39	0.52	0.65	0.65
10	10.36	1.38	0.50	0.52	0.43
11	4.69	1.56	0.79	0.46	0.34
12	7.69	1.51	0.54	0.46	0.40

Appendix H (Continued)

Cultivar: Fairtime

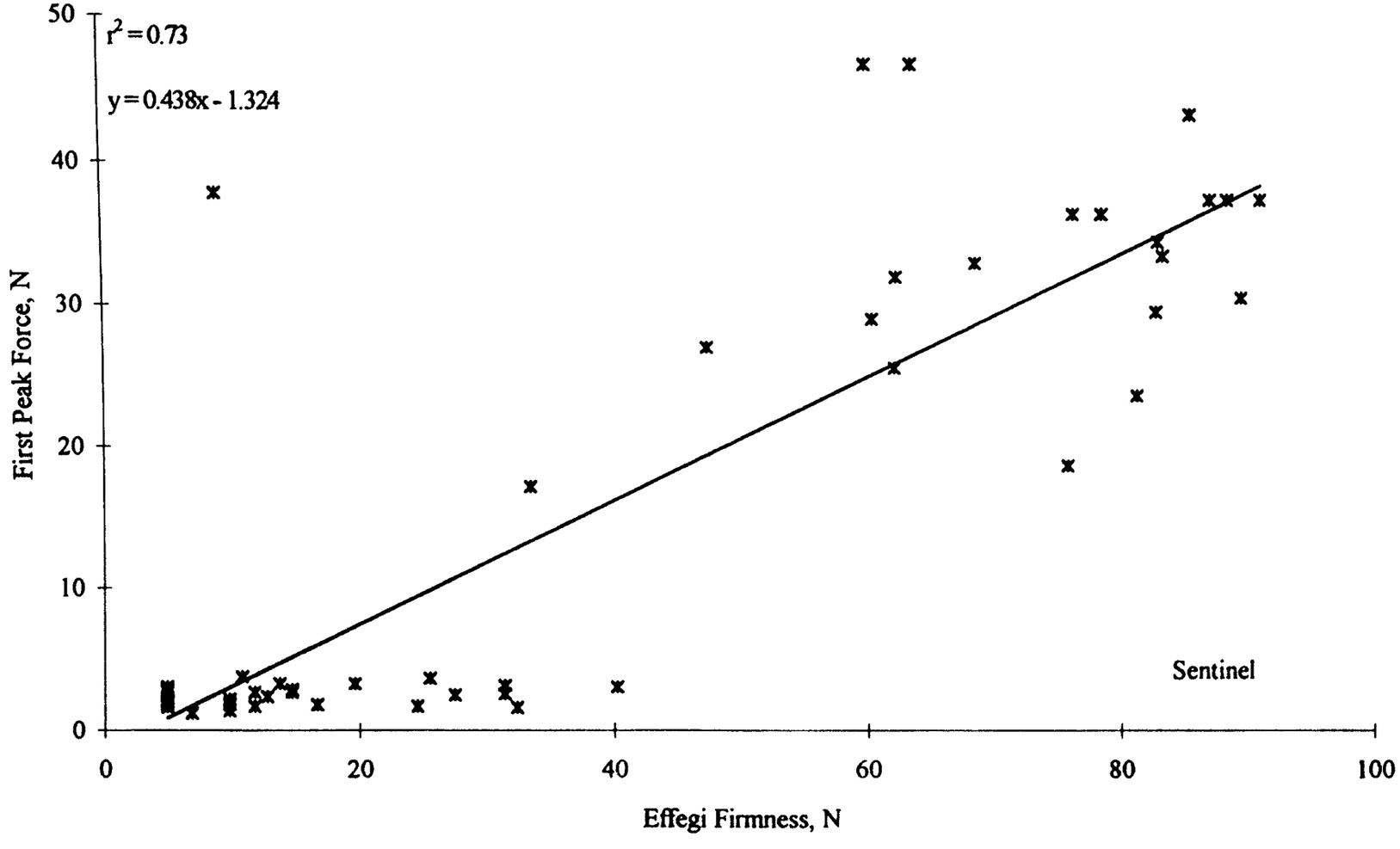
Sample	Initial	Day 1	Day 2	Day 3	Day 4
1	2.55	1.23	0.73	0.59	0.27
2	2.33	3.77	0.60	0.76	0.41
3	2.95	4.30	1.72	0.39	0.37
4	7.48	3.20	0.73	0.80	0.25
5	6.30	3.85	0.89	0.46	0.31
6	3.00	2.93	0.49	0.43	0.28
7	3.76	2.85	0.75	0.53	0.32
8	2.27	3.82	0.49	1.04	0.47
9	2.02	5.00	0.71	0.50	0.43
10	2.74	0.79	0.51	0.34	0.36
11	2.73	3.95	0.65	1.37	0.66
12	3.70	3.36	0.63	0.46	0.42

Cultivar: Stony Hard

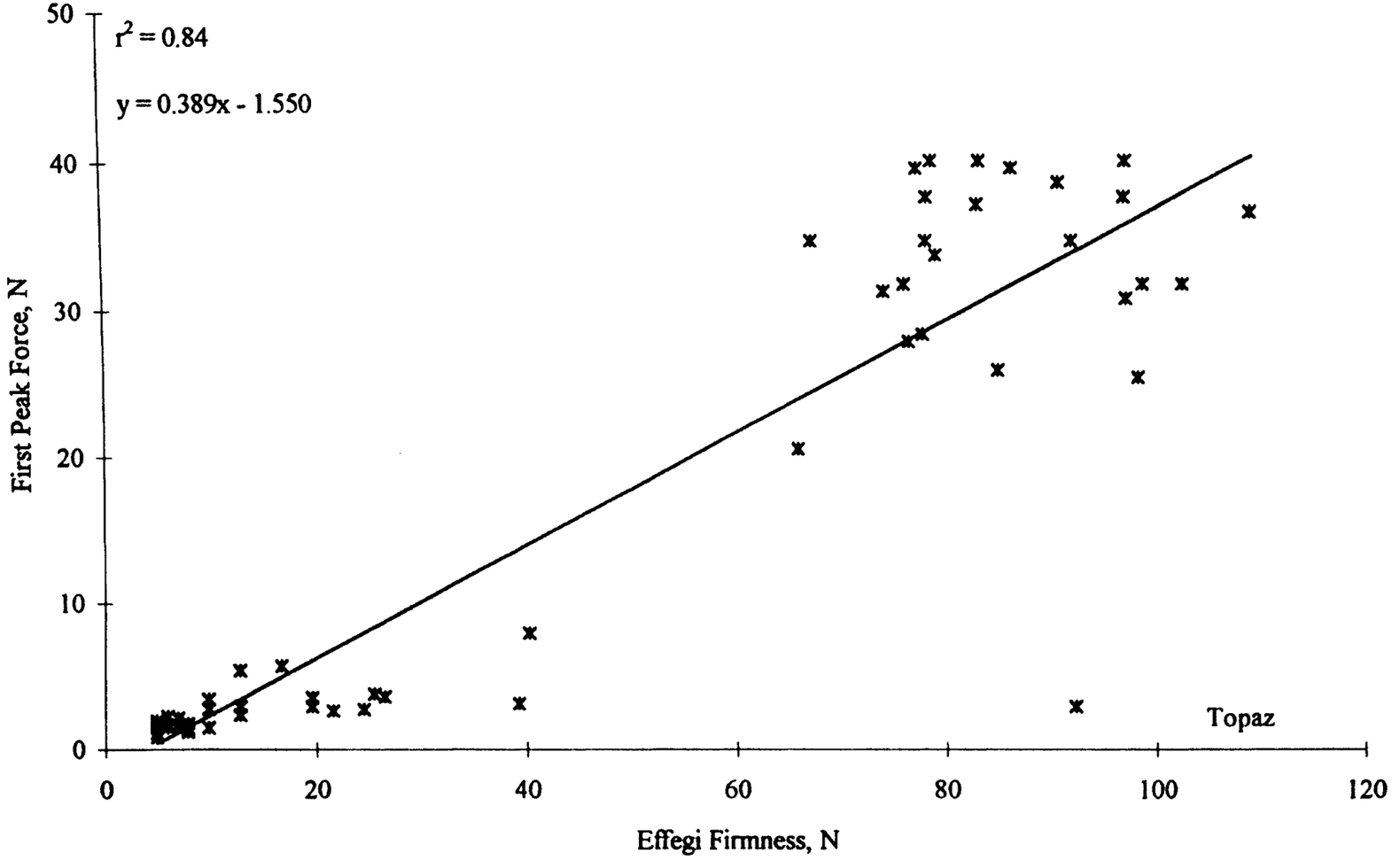
Sample	Initial	Day 1	Day 2	Day 3
1	15.78	3.49	2.73	0.32
2	14.87	7.26	2.29	-----
3	25.50	3.59	-----	0.57
4	19.19	3.10	2.73	0.49
5	3.29	1.35	2.48	0.53
6	18.58	1.93	2.96	0.40
7	3.58	1.62	1.85	0.59
8	25.42	1.77	-----	0.38
9	13.58	2.13	2.35	0.43
10	16.60	3.17	3.70	0.60

Stony Hard Controls

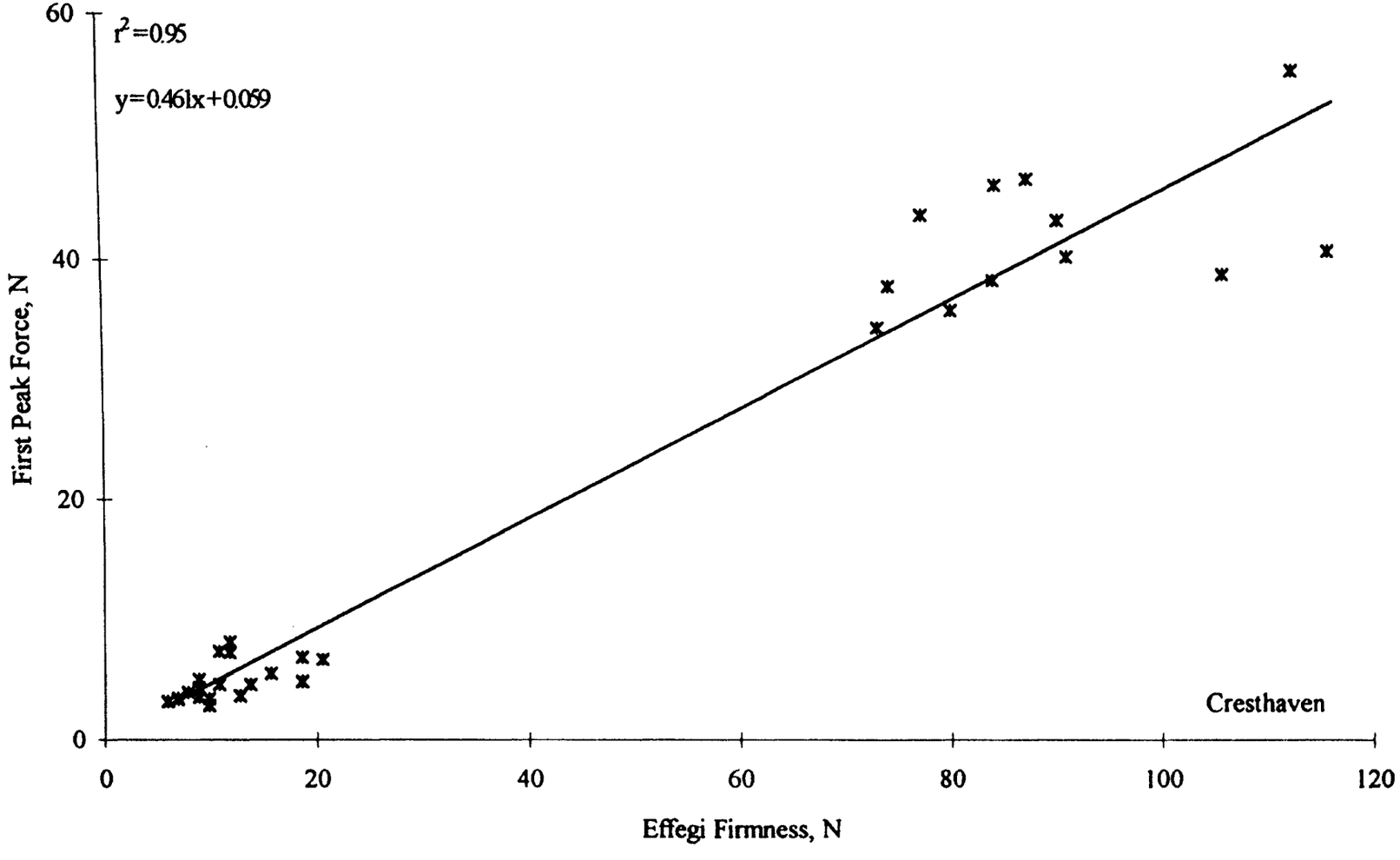
Sample	Initial	Day 1	Day 2	Day 3
1	-----	18.16	32.21	25.96
2	-----	18.17	6.74	24.38
3	-----	3.70	13.05	2.99
4	-----	28.28	19.50	18.94
5	-----	20.48	18.25	-----



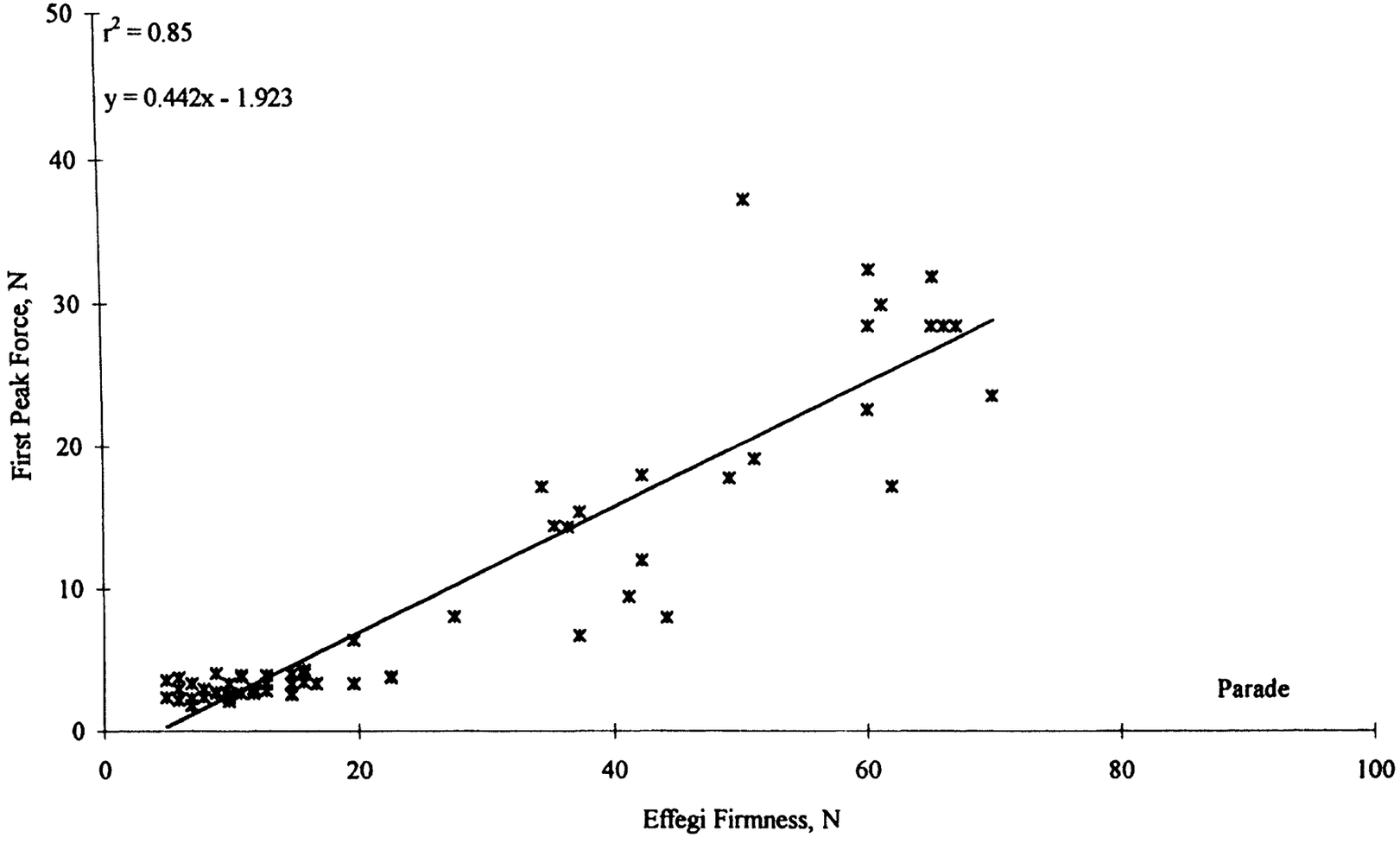
Appendix I 1. First Peak Force vs. Effegi Firmness of 'Sentinel'.



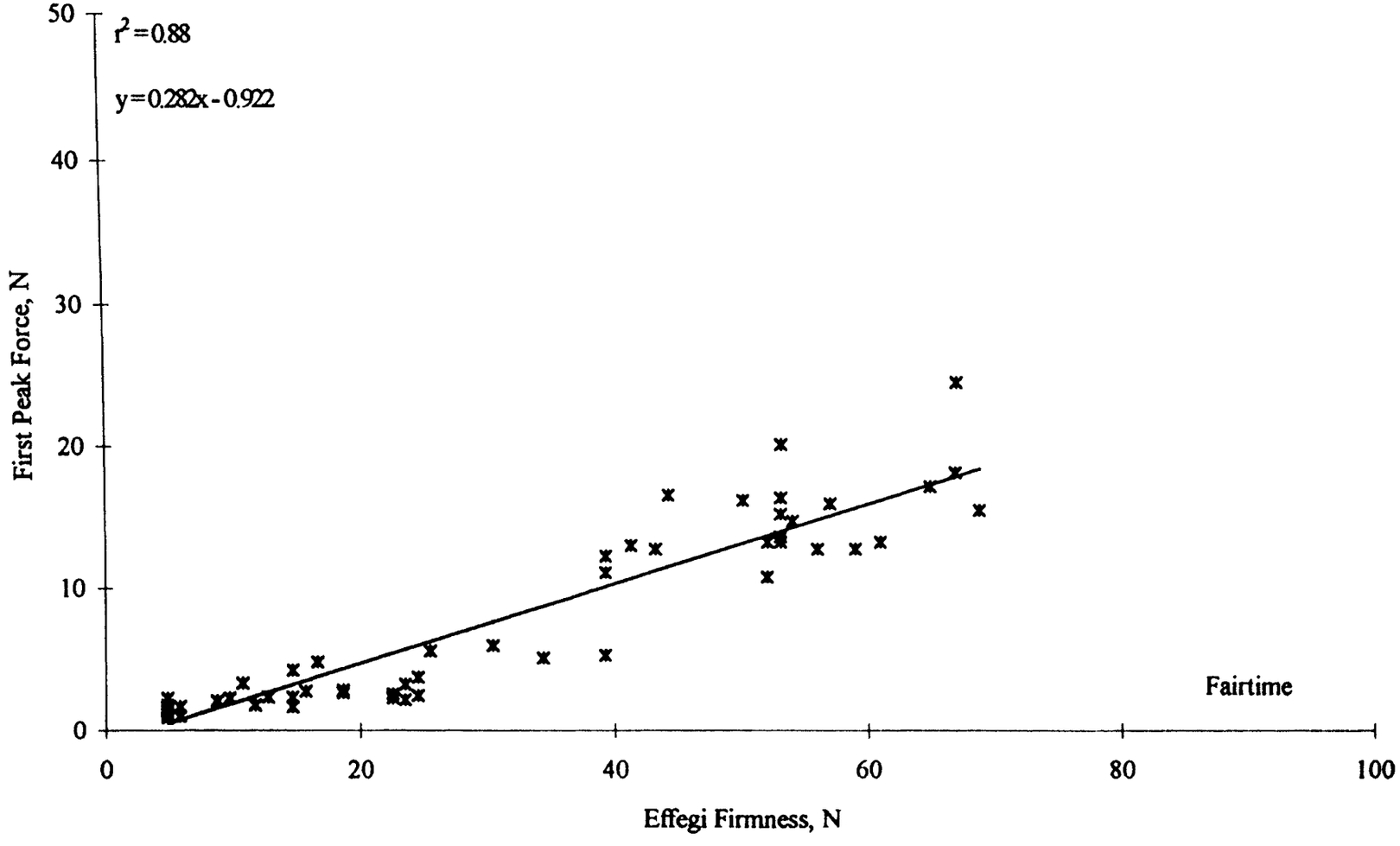
Appendix I 2. First Peak Force vs. Effegi Firmness for 'Topaz'.



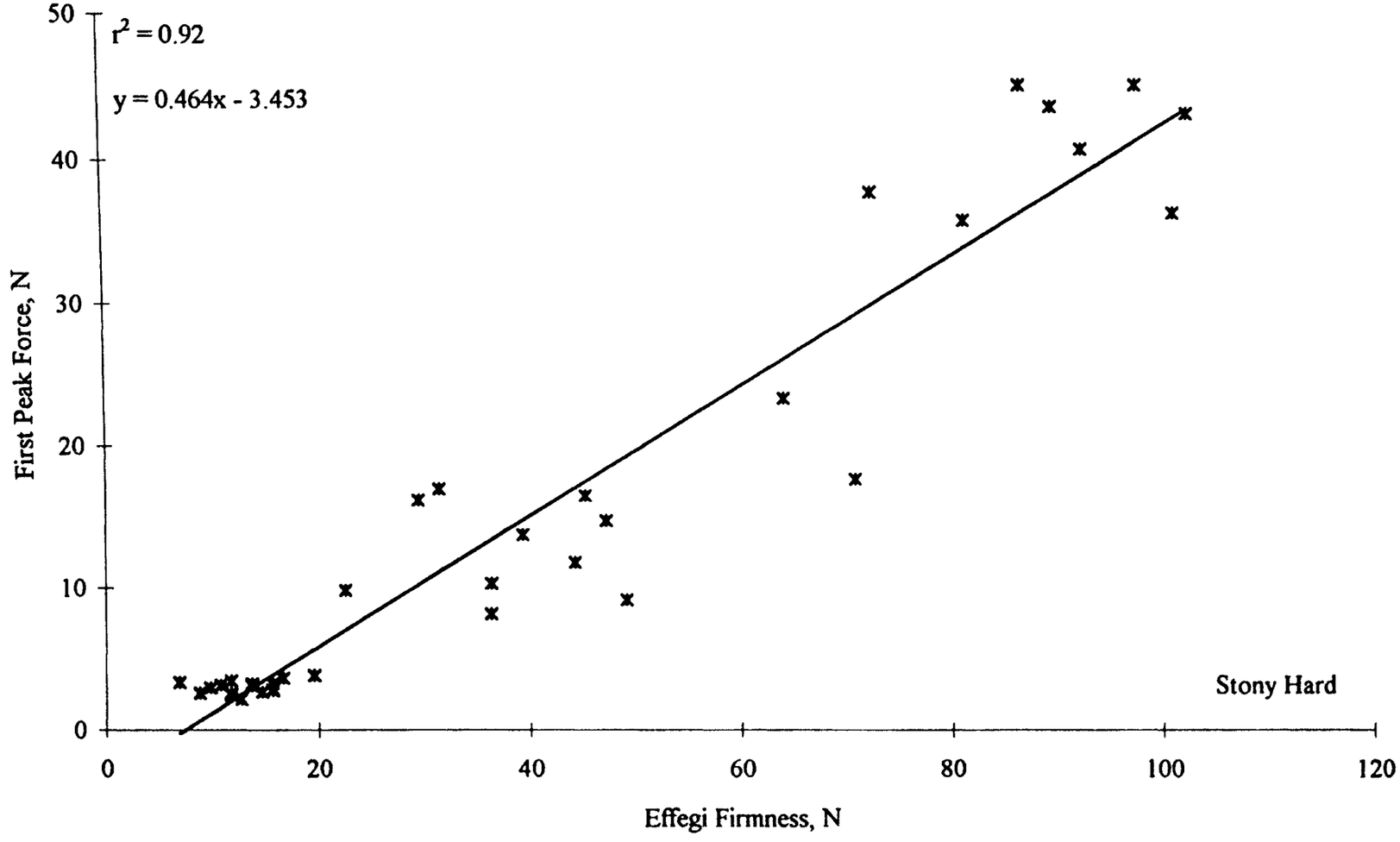
Appendix I 3. First Peak Force vs. Effegi Firmness for 'Cresthaven'.



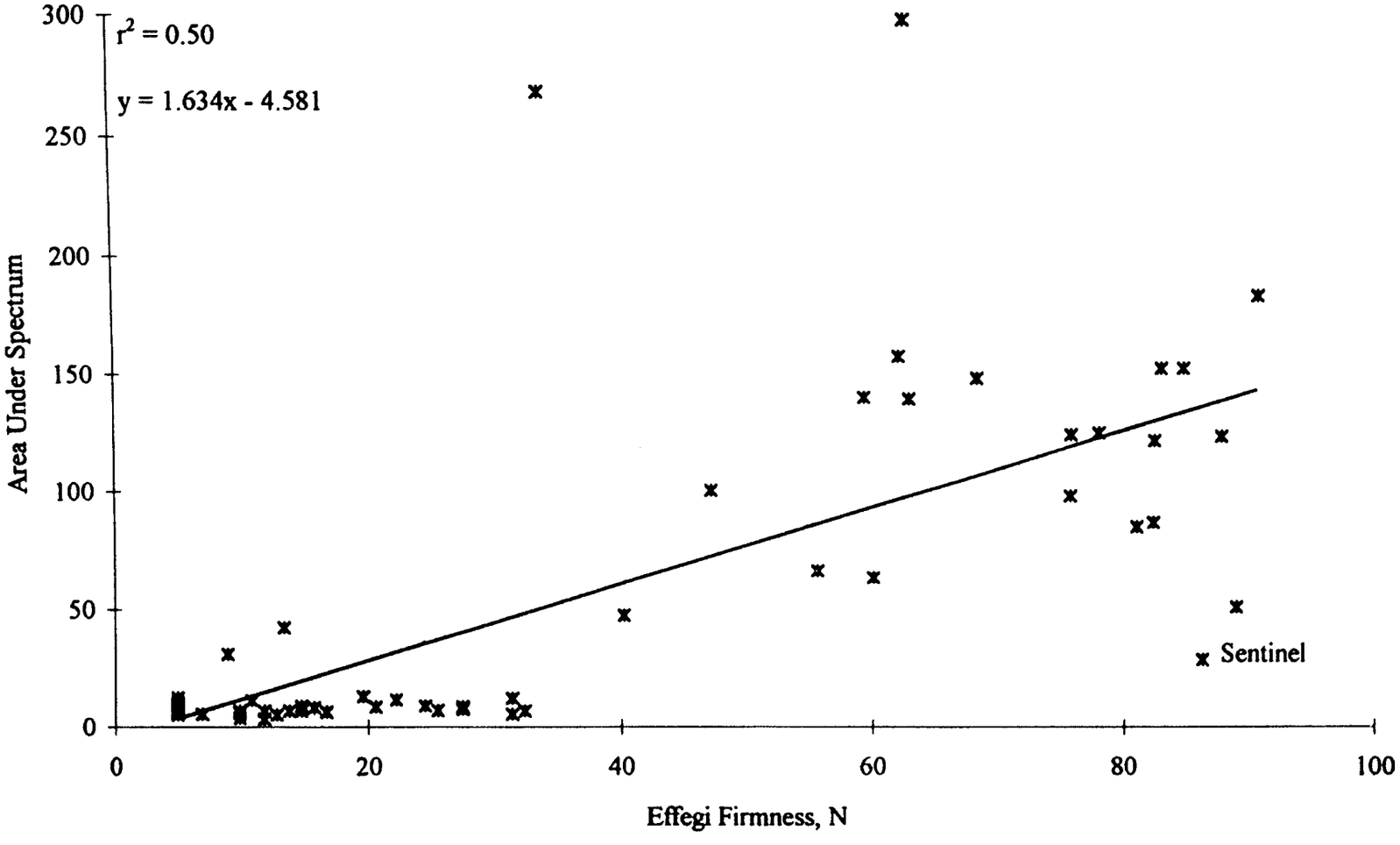
Appendix I 4. First Peak Force vs. Effegi Firmness for 'Parade'.



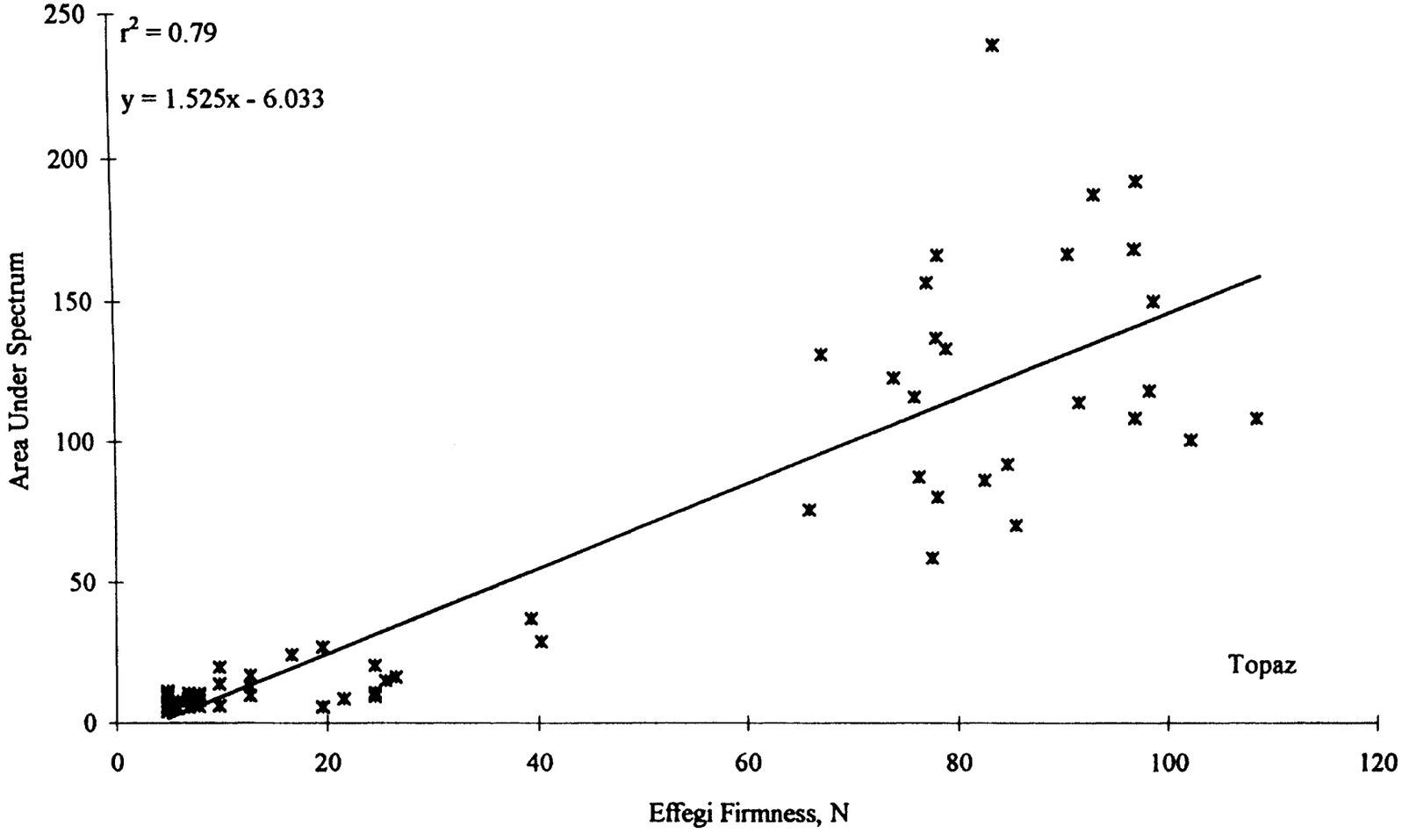
Appendix I 5. First Peak Forcec vs. Effegi Firmness for 'Fairtime'.



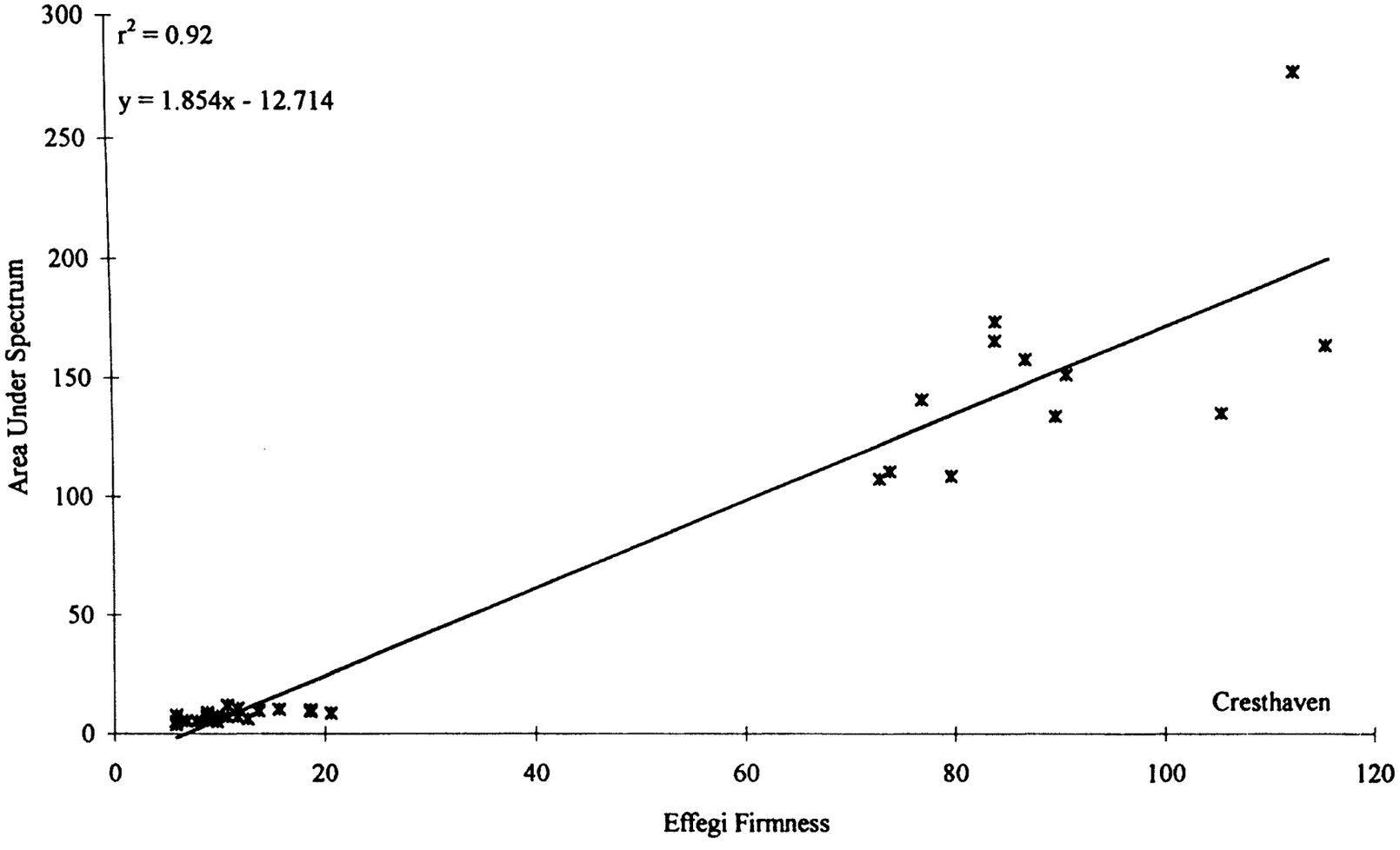
Appendix I 6. First Peak Force vs. Effegi Firmness for 'Stony Hard'.



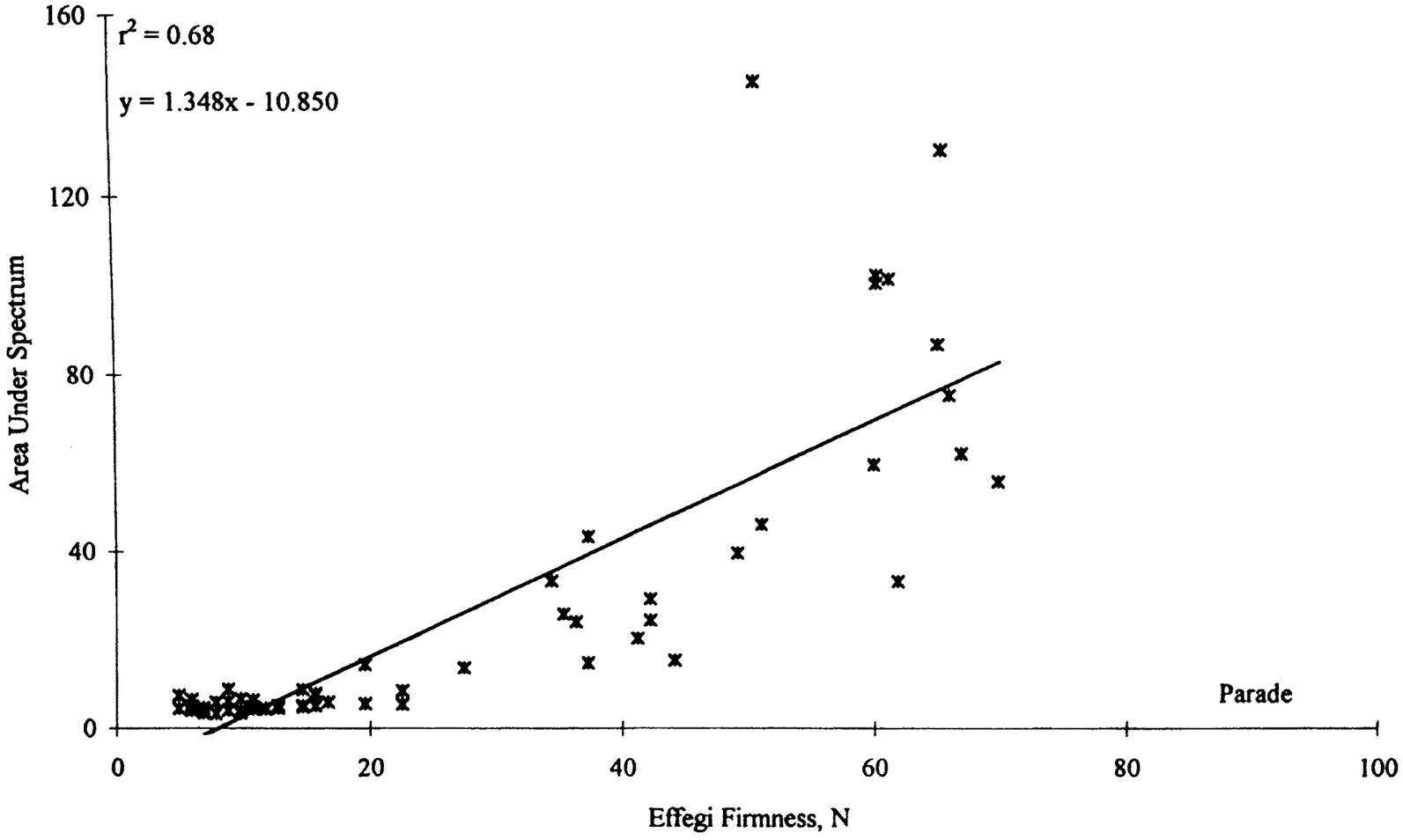
Appendix I 7. Area Under Spectrum vs. Effegi Firmness for 'Sentinel'.



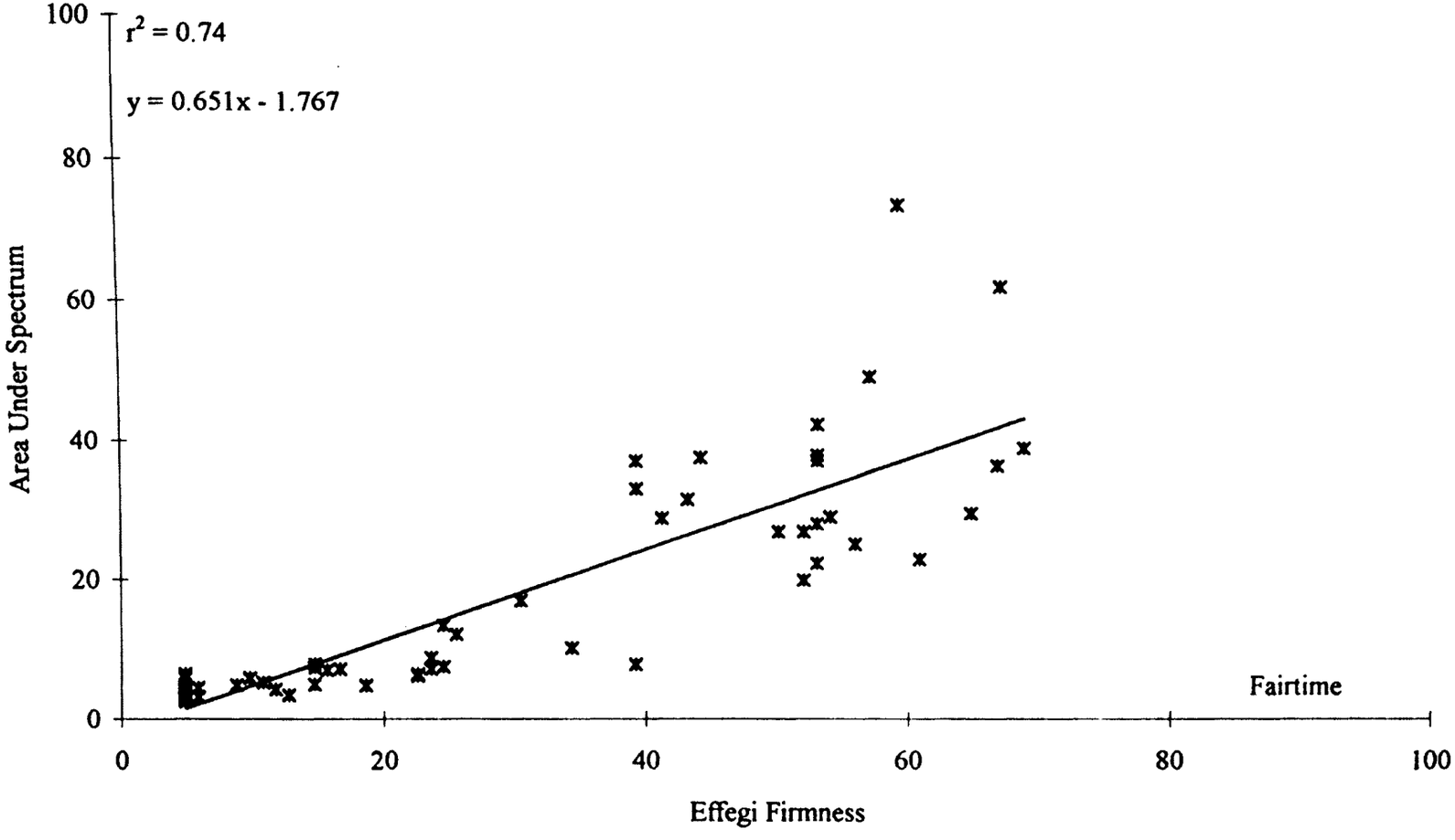
Appendix I 8. Area Under Spectrum vs. Effegi Firmness for 'Topaz'.



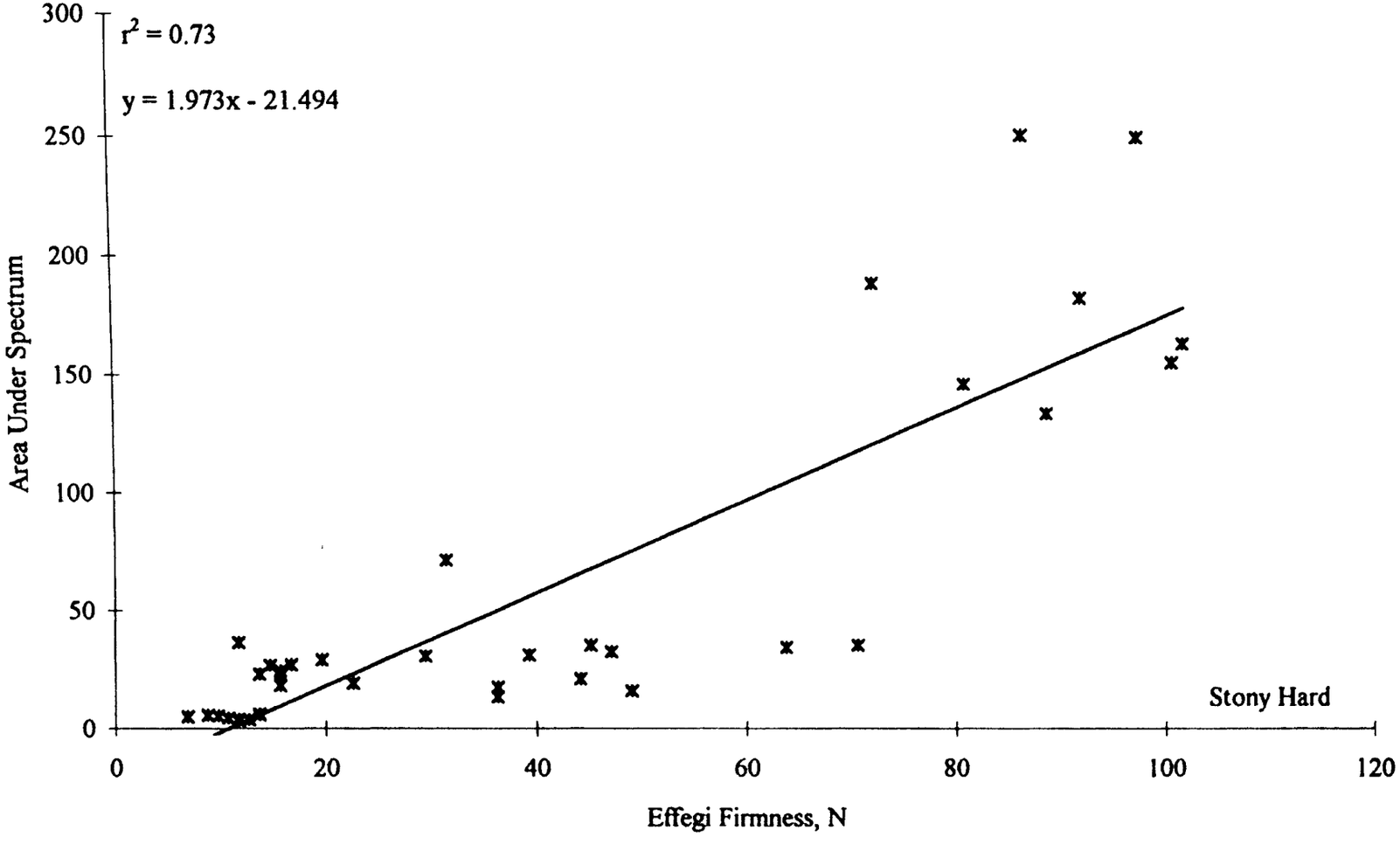
Appendix I 9. Area Under Spectrum vs. Effegi Firmness for 'Cresthaven'.



Appendix I 10. Area Under Spectrum vs. Effegi Firmness for 'Parade'.



Appendix I 11. Area Under Spectrum vs. Effegi Firmness for 'Fairtime'.



Appendix I 12. Area Under Spectrum vs. Effegi Firmness for 'Stony Hard'.

VITA

Jose A. Murillo

Candidate for the Degree of

Master of Science

Thesis: DEVELOPMENT OF A METHOD TO DETERMINE MEALINESS IN PEACHES

Major Field: Biosystems and Agricultural Engineering

Biographical:

Personal Data: Born in La Paz, Bolivia, January 27, 1970, the son of Antonio Murillo and Myriam Sangüeza de Murillo.

Education: Graduated from Colegio Franco-Boliviano, Santa Cruz, Bolivia in November 1987; received Bachelor of Science Degree in Agricultural Engineering from Oklahoma State University, Stillwater, Oklahoma in May 1992. Completed the requirements for the Master of Science degree with a major in Biosystems and Agricultural Engineering at Oklahoma State University in December 1994.

Experience: Employed by Oklahoma State University, Biosystems and Agricultural Engineering Department as an undergraduate and as a Graduate Research Assistant, 1991 to present.

Professional Membership: American Society of Agricultural Engineers