A STUDY OF THE CORRELATION IN SIZE BETWEEN THE LEAVES AND THE FRUIT OF THE VARIETIES OF PYRUS MALUS L.

BY

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THESIS

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY Janardan Sahasra Budhe

ENTITLED A Study of the Correlation in Size between the Leaves and the Fruit of the Varieties of Pyrus Malus L.

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF Master of Science in Horticulture

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Contents.

A Study of the Correlation in Size between the Leaves and the Fruit of the Varieties of Pyrus malus L.

Although considerable effort has been directed toward the breeding of apples, yet little is known concerning the variation and correlation of characters of this crop. Little or no evidence has been given to show what characters, if any, may be used as a basis of selection or whether all characters are so very variable and so affected by different seasons as to render impossible their use as a means of improvement as regards the size of the fruit.

Since apple trees are grown primarily for their fruit, it would be highly desirable from an economical standpoint to eliminate undesirable seedlings at an early age. The prevailing opinion among horticulturists seems to be that seedlings closely resembling the smooth appearance of our imroved varieties give best results as to the size, form, flavor, etc. of the fruit. "In regard to this point Mr. Joe A. Burton, who is in the charge of apple breeding work of the Indiana State Horticultural Society, states that he inquired of a prominent plant breeder if anything could be done in selection. Mr. Burton writes: "The following is his reply: Prominent buds, large smooth, regular, glossy leaves, large leaf stems, short distances between buds and a compact sturdy look are the best indications of a good apple among seedlings.[1]

Some of the most desirable characters of the applefruit are large size, regular shape, attractive color and good flavor.

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1 Md. Agr. Exp. Sta. Bul. 196, 1916.

From the economical stand point the large size of the fruit is of great importance in as much as it increases the returns by increasing the value of total crop as well as the grade of the individual fruit.

In the following pages the writer is attempting to show whether the size of the leaf and the size of the fruit are correlated and, if so, to establish this correlation as a satisfactory basis for selection of seedling stock.

I.

Materials.

Varieties used---Two types of materials, standard varieties and seedlings, were used in this effort to determine correlation between the size of the leaf and the size of the fruit of apple.

Tables I and 2 show the list of ten varieties with the average size of leaf and the numerical size value for the average size of fruit for each variety of the standard and the seedling types respectively.

Description of the trees---The standard varieties were seven-year old trees planted in nursery rows ten feet apart each way. There were three trees of each variety and eighty varieties in all. They received the same general care and cultural treatment as a small commercial orchard would receive.

The seedlings were eleven-years old transplanted in rows fifteen feet apart each way. They were obtained in 1909 from the following crosses:Five trees from Willowtwig x Oldenburg; nineteen trees from Shackleford x Oldenburg; two trees from Hall's No6 x Oldenburg; thirty-three trees from Oldenburg x Hall's No.6; twenty-

Table I. Standard varieties with avg. size of leaf & fruit.

Variety.	Leaf size	Fruit size
Akin	4.80	5
Alexander	3.85	8
Am. Summer Pearmain	3.68	5
Arkansas	4.29	6
" Black	3.14	4
Autumn Strawberry	4.34	5
Baldwin	4.06	7
Baxter	5.97	8
Benoni	3.92	3
Ben davis	3.93	7
Bietigheimer	5.19	10.
Bismark	4.70	8
Black ben davis	4.46	6
Black Gilliflower	4.17	5
Champion	3.56	6
Chalamoff	4.79	6
Chenango strwberry	4.42	5
Delicious	3.23	6
Domine	3.66	6
Dr. Mathews	3.43	8
Dudley	3.97	6
Early Harvest	3.83	4
Early Melon	3.38	7
" Ripe	2.62	5
Esopus	3.23	5
Fallawater	4.57	8
Fall Pippin	3.69	8
Fameuse	3.66	4
Fanny	3.50	5
Gano	3.53	6
Giant Geneton	2.93	5
Golden Sweet	3.48	5
Gravenstein	3.36	6
Grimes(Stark's)	2.81	6
Grimes(hobbs)	2.80	6
Henry Clay	2.80	5
Hubbardston	3.50	7
Huntsman	2.30	7
Ingram	3.47	5
Jefferues	3.22	5
Jonathan	2.90	5
King David	3.23	4
Kinnaird	2.69	6
Lady Sweet	2.66	7
Lawver	2.42	6
Liveland Raspberry	4.20	5
Lowell	2.69	6
Lowrey	3.37	5

Table1. (continued)

Variety.	leaf size	fruit size
McIntosh	3.42	6
McMohan	4.25	8
Minkler	3.23	6
Nero	3.73	6
Northern Spy	3.77	8
N. W. Greening	3.64	8
Oldenburg(Dutches of	3.67	5
Ontario	3.65	8
Ortley	2.96	6
Paragon	3.83	6
Ptten	4.09	6
Pewaukee	3.41	6
Ralls	2.78	5
Ramsdell Sweet	3.07	6
Red Astrachan	3.34	5
Red Canada	3.35	6
Red June	3.16	3
R. I. Greening	3.50	7
Roman stem	3.12	5
Romanite	2.85	4
Roman Beauty	3.05	7
Roxbury Russet	3.33	5
Salome	3.57	6
Senator	2.98	6
Shiawassee Beauty	3.39	4
Stark	3.84	7
Stayman Winesap	3.88	7
Summer Queen	3.30	5
Sutton	3.18	6
Sweet Bough	3.44	4
Tolman Sweet	2.75	4
Tompkins King	3.84	9

Table 2. Seedligs with average of leaf and fruit.

Variety.	Leaf size	Fruit size
Willowtwig x Oldenburg	4.24	4
"	4.82	6
	4.96	6
	5	6
	4.47	8
Shackleford x Oldenburg I	4.22	5
2	4.25	6
3	4.68	6
4	4.12	4
5	5.62	7
6	4.96	6
7	4.43	8
8	5.1'	8
9	5.9	6
10	4.64	7
11	4.5	6
12	4.59	8
13	4.13	8
14	4.77	9
15	5.44	8
16	4.34	6
17	4.76	9
18	4.66	5
19	5.10	6
Hall's #6 x Oldenburg I	4.91	5
2	4.16	6
Oldenburg x Halls #6 I	4.63	8
2	4.04	6
3	4.67	6
4	4.10	5
5	4.80	6
6	4.40	6
7	4.90	8
8	4.33	5
9	4.0	7
10	4.61	6
11	4.38	8
12	4.27	7
13	3.70	6
14	4.50	8
15	4.39	8
16	4.01	4
17	4.26	6
18	4.96	9
19	4.45	5

Table 2. (Continued)

Variety.	leaf size	fruit size
Oldenburg x Halls 20	5.02	9
21	4.61	6
22	5.33	7
23	4.13	6
24	4.35	8
25	4.25	6
26	3.87	7
7	4.88	8
8	4.52	8
9	2.56	6
30	4.20	5
31	4.02	8
32	4.30	8
33	4.67	8
Oldenburg x Yellow Transparent I	5.50	6
2	5.73	6
3	5.26	8
4	5.86	8
5	5.32	8
6	5.62	4
7	5.38	3
8	4.79	4
9	7.5	6
10	5.27	8
11	5.15	4
12	5.46	5
13	5.45	4
14	6.64	7
15	5.86	6
16	5.59	6
17	6.38	8
18	4.89	6
19	5.10	10
20	6.26	4
21	4.35	8
22	5.06	8
23	4.84	7
24	4.95	7
25	4.48	6
26	5.20	10
27	5.27	6
Domine x Yellow Transparent I	4.10	5
2	4.77	4
3	4.60	6
4	4.78	5
Yellow T. x Oldden burg I	4.92	8
2	4.89	6
Yellow T. x Domine I	4.86	6
2	5.80	8
Domine x Halls # 6	4.54	4
Oldenburg x Domine	4.20	8

seven trees from Oldenburg x Yellow Transparent; four trees from Domine x Yellow Trasparent; two trees from each of Yellow Transparent x Oldenburg and Yellow Transparent x Domine and one tree each from Domine x Hall's No.6 and Oldenburg x Domine. The trees were in sod and did not receive any fertilizers. Some of the trees began bearing in 1916 and all of the trees produced fruit in 1919.

II.

Method.

Collection of leaves---Two hundred normal-sized leaves from only the annual shoots of each standard variety were gathered during the last week in June 1921. The leaves were collected in paper bags, which eliminated any possible chance of variation in size by shrinkage or wilting due to the high summer temperature and insured their freshness till they were preserved. The leaves collected during a day were preserved the same day by putting them into two-quart Mason jars filled with preservative solution made from two parts of formalin, five parts of ninety-five per cent alcohol and fifty parts of water.

The leaves of the seedlings were collected and preserved in the same manner as for the standard varieties but the collection was made during the first week of October.

The fruit---It was practically impossible to secure enough representative fruit of all the standard varieties from which weights could be secured directly for this study. Therefore, the data pertaining to the size of the fruit of these varieties had to be collected from descriptions given in some of the experiment sta-

tion publications, books and nursery catalogues.[2]

Measurement of the leaves---The leaves were measured by the use of a planimeter,(see Fig. I) manufactured by Keuffler and Esser Co. New York. Each leaf to be measured was laid flat on the table and was covered with a piece of transparent glass about eight inches long, five inches wide and one-eighth of an inch thick. The areas of the leaves were recorded in square inches nearest to tenth of a square inch.

The measurements of the leaves for each variety were added together and the sum was divided by the total number of leaves two hundred. This gave the average area of a leaf fo each variety.

The size of the fruit---The size of the fruit for the different standard varieties was taken by the following method: The description of the sizes of the fruit given in the publications referred to elsewhere designate the sizes of the fruit of the different varieties in general terms such as very large, large, medium, small, very small, above medium, below medium, etc. These designations were given definite numerical values, taking ten as the maximum size. Thus the numerical value for the "very large" would be ten, for the "large" eight, for the"medium" six and so on. Intermediate sizes were given intermediate values. Thus the"below medium"size is intermediate between the"medium"and the "small" and, therefore, its numerical value is five.

Professor C.S.Crandall, who kindly gave the data concerning the sizes of the fruit of the seedlings, collected the fruit and described the sizes in the same general terms as large, very large, etc. Therefore, the numerical size values for the seedling

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2. Authors and names of these publications are given in the bibliography.

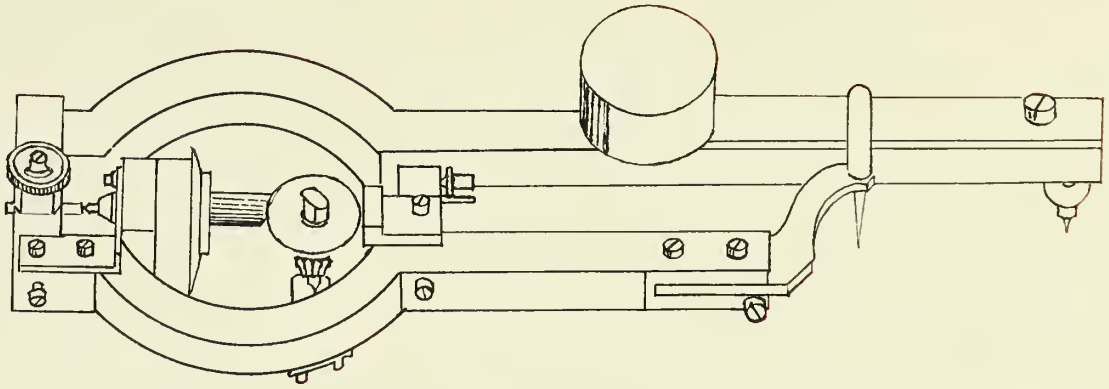

Fig.1 The Planimeter.

fruit were based on the same scale used in designating the sizes of the fruit of the standard varieties.

Mathematical calculations--All the mathematical calculations in the biometrical part of this study were made as described by Davenport(4&5)[3] and Rietz(16) and Smith. The fractions were corrected to the third decimal places.

III

Accuracy of Data and Sources of Error.

Accuracy of the data as to the leaves---The data concerning the leaves of both the standard varieties and the seedlings seem to be accurate enough to give fairly correct results. For,due care was taken to preserve the leaves while they were fresh, thus eliminating the possibility of variation in the size of the picked leaves by shrinkage and wilting due to the high summer temperature.

The leaves were measured by the use of a planimeter as as described elsewhere. The planimeter used was fine enough to give approximately correct measurements. Thus there is no reason to believe that there is inaccuracy in the measurements of the leaves.

Accuracy of the data as to the fruit---As described elsewhere the numerical size values of the fruit of the standard varieties were based on the descriptions of the fruit by men from different parts of the country and therefore the size of the fruit of these varieties is not greatly liable to inaccuracy.

The same may be sai d of the size of the seedling fruit;

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3. Numbers in perenthesis refer to the names in the bibliography.

Sources of Error as to the leaves---As to the leaves there seem to be three possible ways through which error might have occurred. First is the selection of population. In selecting leaves from several trees there is probably some chance for commiting errors. It is ~~almost~~ impossible to select leaves of exactly representative ~~uniform~~ size. There will be included both the large and the small leaves, because of the guess work that is to be relied upon in the process of selecting population of this nature. But the chances are that such errors might greatly be mitigated by the chance picking of smaller and larger leaves alike.

The second source is the number of population selected from each variety. In this case two hundred leaves represent the total population for each variety. It may be questioned whether this number is large enough to really represent the total population Of course, the larger the number of individuals so selected the more accurate the results would be. But in statistical studies of this nature "the number to be taken should depend to a certain extent upon the variability of the material. If the material shows but little variabilitya smaller number needs be taken than if the population were much more variable".[4] In the particular case in hand the population is not greatly variable--- the coefficients of variability for the standard varieties and the seedlings are I7.I5 and I3.8 respectively.

The third source is the individual tree variation within the varieties or misnaming of varieties in the nurseries. It is well known that there often wide variations in the individuals of one variety. It is possible,therefore, that some of the varieties

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4 Ill. Exp. Sta. Bul. II9.

under consideration are not "true to type" as regards the size of their leaves. This appears more likely due to the misnaming of varieties in the nurseries, for example, huntsman has usually good sized leaves ranging from medium to above medium. But it was found that all the trees of this variety in the University orchards had small leaves. Surely,then,this is due to the misnaming of variety and not due to the variation in the individual variety.

Sources of error as to the fruit---There are,at least,two possible sources of error; first is the variation in size due to local causes such as temperature,moisture, soil conditions, methods of cultivation, plant food supply, etc. But in view of the fact that the determination of the average size of the fruit is based upon the averages for many seasons and the experience of many observers located in many different parts of the country, before the final designation of the average size of a variety is made, it is less probable that there are variations of this kind.

The second source is the individual tree variation in varieties. This variation may be more or less depending upon the cicumstances. Therefore this source of error should not be greatly emphasised.

IV

Presentation of the Data and Biometric Constants

After necessary preliminary considerations it is now opportune to present the data obtained as described in the preceeding pages of this paper.

The correlation tables---Tables 3 and 4 show the correlation tables for the standard varieties and the seedlings respectively. In both of these correlation tables the size of the leaf is subject and the size value for the fruit is relative.

Biometric constants---The mean is obtained by multiplying the value of each class by the number of individuals contained in it. The products are added and the sum is divided by the entire number of individuals or variates.

The mean enables one to know how any strain or variety is likely to behave on the average in regard to its various characters. In case of symmetrical variation the mean is identical with the mode. But none of the means obtained in this study is identical with the mode. Therefore the variation in the size of the leaf and the size of the fruit, under consideration, is decidedly a "skew" variation as is shown by graphical representations in Figs. II, III, IV and V .

Standard deviation--To find the standard deviation: find the deviation of each class from the mean; add the products, divide by the total number of variates and extract the square root.

"Standard deviation forms a measure of the degree of scatter of variates". "It is a good measure of deviation from the mean. It is therefore a variability reckoned from that point.

Table 4

Size of Leaf	Size of fruit 3	4	5	6	7	8	9	10	Totals
3				1					1
3.5									
4		1		3	2	1			7
4.5		3	6	9	1	11			30
5		2	3	13	3	7	4		32
5.5	1	2	1	3	1	5		2	15
6		1		3	1	2			7
6.5		1				1			2
7					1				1
7.5				1					1
Totals	1	10	10	33	9	27	4	2	96

$r = 0.0406 \pm$

	Fruit	Leaf
Mean	= 6.5204	M = 4.979 ±
σ	= 1.506	σ = 0.687 ±
C.V.	= 23.098	C.V = 13.8 ±

Correlation table for the size of the leaf and the size of the fruit of the seedlings

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Table 3.

	3	4	5	6	7	8	9	10	Totals
2.5				1	1				2
3		2	5	7	2				16
3.5	1	4	10	7	3	1			26
4	1	1	2	9	4	5	1		23
4.5			4	2		1			7
5			1	1		2			4
5.5								1	1
6						1			1
Totals	2	7	22	27	10	10	1	1	80

$r = 0.354$

	fruit	Leaf
Mean	= 5.93 ±	3.73 ±
σ	= 1.34 ±	0.64 ±
C.V	= 22.59 ±	17.15 ±

Correlation table for the size of the Leaf and the size of the fruit of the standard varieties

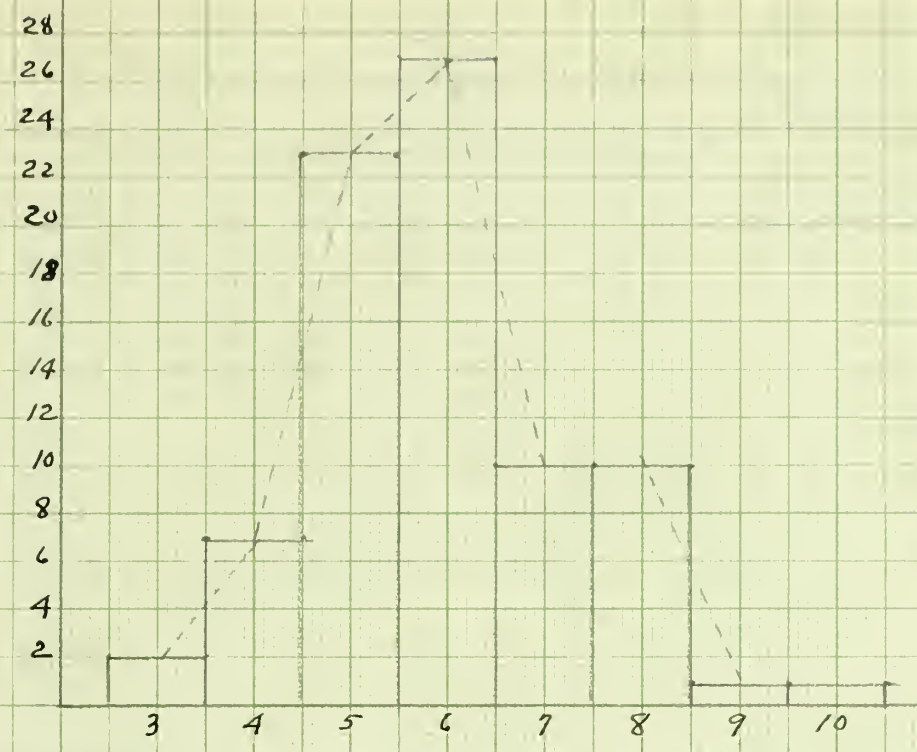

Fig. II

Frequency Polygon and Curve for the Size of the fruit of the Standard Varieties

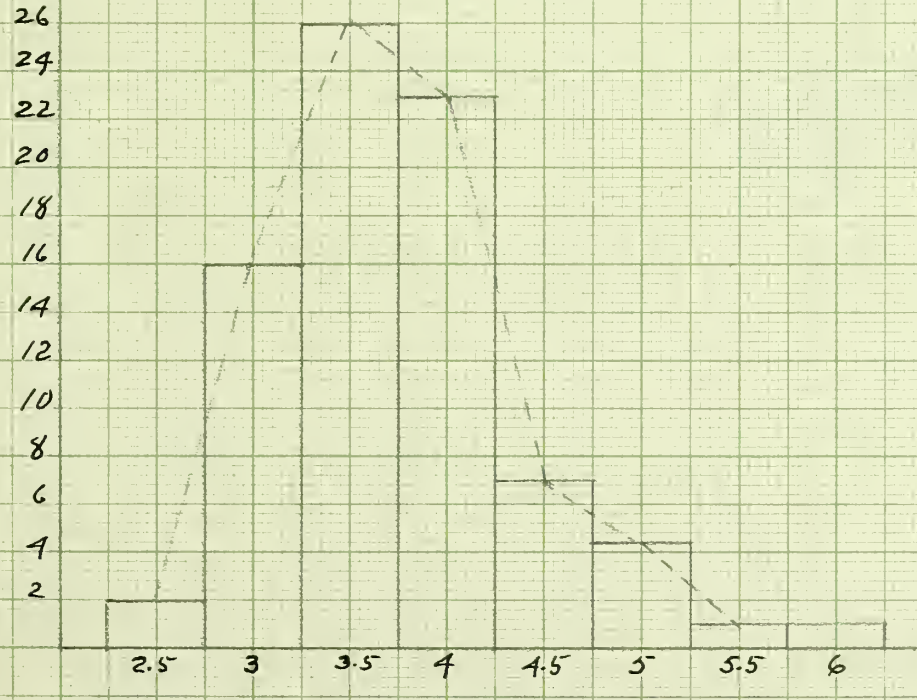

Fig. III

Frequency polygon and Curve for the size of the leaf of the cultivated Varieties.

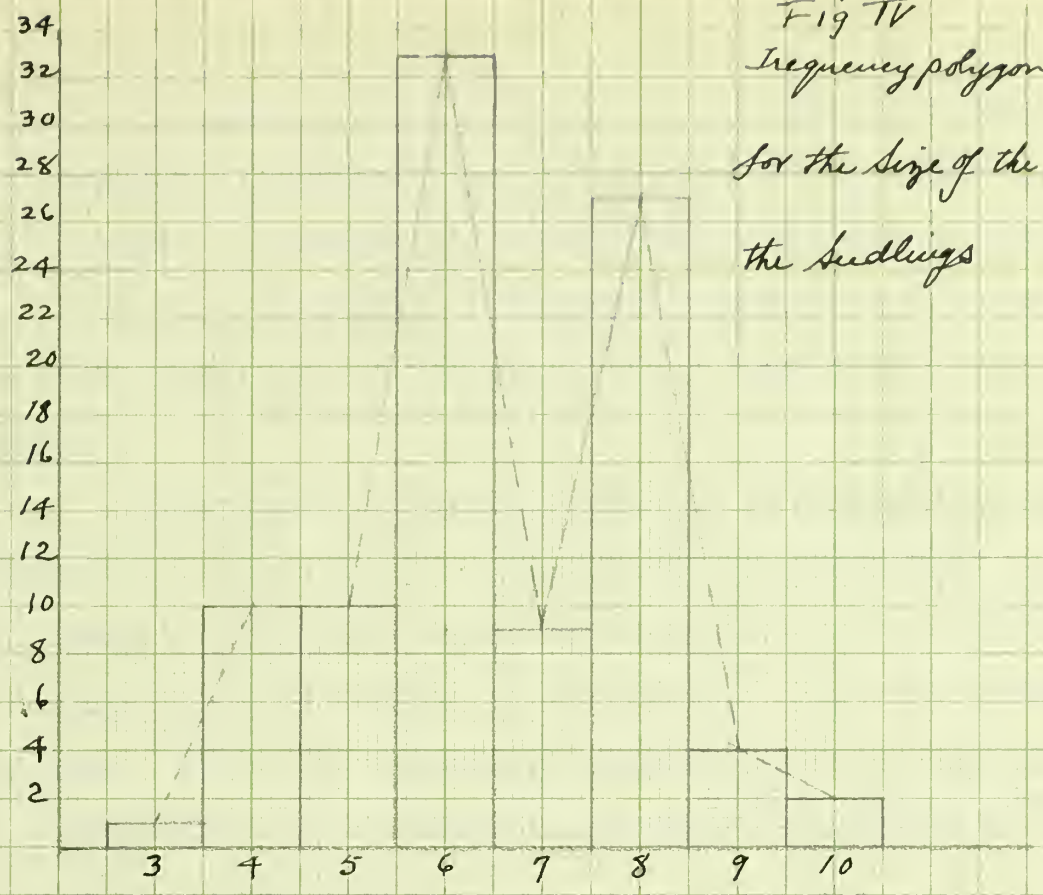

Fig IV

Frequency polygon and Curve for the Size of the fruit of the Seedlings

Fig V.

Frequency Polygon and Curve for the Size of the leaf of the Seedlings

"The practical value of standard deviation is that it stands as a definite measure of variabilityof the population in question and if records be kept the variability of any race be compared from year to year". It is the best index of variation that is in use for the same or like characters of different lots of material measured in the same units.

Coefficient of variability---It is obtained by dividing the standard deviation by the mean and and by multiplying the quotient by one hundred. It is also an index of variation for comparing one case of variation with another as regards the degree of scatter of the variates. It is of value, particularly, when the variation of unlike characters of different lots of material measured in dissimilar units are compared.

Coefficient of correlation---Rietz and Smith(18) define the correlation coefficient as follows: "The correlation coefficient may be defined as the mean product of deviation of corresponding variates from their mean value in units of the standard deviation". It is a measure of the extent to which one character varies in agreement with another. A correlation table has two principal uses according to Castle, who says "The correlation table has found two principal uses (1) to show what part or processes of an organism vary in unison and to what extent they so vary and (2) to measure heredity. The first use of the correlation table is of more importance here since it is the object of this study to consider the correlation, if any, between the size of the leaf and the size of the fruit of apple.

Rietz and Smith (18) define correlation as follows:"Two

characters --say length and circumference of ears of corn--are said to be correlated when with any selected value (x) of the one character we find that the values of the other character, are not equally likely to be associated".

According to Leighty(15) "The correlation coefficient is of special value in relation to selection". Inthe processes invoved[1] in selection for any one character the correlation in the succeeding generations may be modified in inexplicable ways by the modification of one character, unles the correlationsof the parents are known".

Probable error is a measure of the reliabilityof a statistical conclusion. "The need of such a measure rests on the fact that the number of observations on which the conclusion rests is finite, that is, the number of observations in the class concerning which generalization is made.

Classification of correlation---Webber (21) has classified correlation into four groups: (1) Environmental (2) Mopnological (3) Physiological and (4) Coherital. Realy there is no class distinction between morphological and physiological correlations. The correlation considered in this paper may come under morpho-physiological class.

The classification given by East(6) is simpler in its main divisions : (1) Somatic and (2) Gametic, but the subdivisions he gives are not well defined . The correlation under consideration may be classed as the somatic correlation.

Love (16) and Leighty classify correlation as (1) Fluctuating and (2) Stable; these divisions are based "on the behavior

of the relationship of the characters concerned when the variation occurs in the environmental conditions such as exist in different years or in different locations.

V

Discussion

In discussing the results just presented it is highly desirable, in order to avoid confusion, to consider these correlation tables separately. For in one case positive correlation is obtained, while in the other there appears no correlation of the characters concerned.

Correlation between the size of the leaf and the size of the fruit in seedlings is only four per cent and therefore negligible. The failure to obtain correlation between these characters of the seedlings may be due to several factors. One of these appears to affect the characters concerned, especially the size of the fruit, directly.

It is the condition of the orchard. The orchard is in sod. Experimental results obtained at the New York Experiment Station show conclusively that sodded trees produce fruit with extreme variation in size. "A tree in sod would bear on one branch, not other; fruit on one side would be large, on another would be small". So was the seedling fruit extremely variable in size. As to the size and general conditions of the sodded trees leaves Hedrick says "the number and the size of the leaves tell the same tale of some kind of interference in the protoplasmic activities in the leaves on the sodded trees. It required but a glance to satisfy oneself that the leaves on the tilled trees were larger and more numerous and therefore total leaf area much greater on the tilled than on the sodded trees

trees". This explains clearly at least one reason why no correlation between the size of the leaf and the size of the fruit of the seedlings was found.

These facts render the data regarding the seedlings quite worthless.

Correlation in standard varieties---The standard varieties show a definite correlation between the size of the leaf and the size of the fruit. The correlation is positive and it is thirty-five per cent. In other words , this means then, that thirty-five per cent of the causes or the factors that increase the size of the leaf also simultaneously increase the size of the fruit. Whether this interrelation is inherent or internal or it is external remains to be seen. Some plant breeder or horticulturist may prove it ~~same~~ in the future.

It is well known that proper cultural methods tend to increase the size of the fruit. Hedrick(II) found that"the tilled apples average larger. It is apparent, too, that if the relative size, indicated by the proportion of 5to 7, holds for the whole crop, as we think it does, there is a greater proportion of culls and seconds in the sodded than in the tilled plats when size alone is considered". The following table substantially supports this statement.

[5]Table 5 Comparison of size of apple on sod and tillage plats.

Plat.	No. of apples per barrel	Weight per barrel	Average Wt. of apples
Sod--------	436	136 lbs.	5.01oz.
Tillage----	309	136 "	7.04 "

Pickett has found that "while fertilizers failed to

N.Y. Sta. Bul. 314.

stimulate a greater production of fruit buds they clearly improved the size and the quality of the fruit".

Gourley's experiments show that cultural methods and application of fertilizers to apple orchards increase the size of the fruit. Table 6 illustrates this point very well. In this number one apples measure 2.5 inches or over in diameter; No. 2 apples measure from 2 to 2.5 inches in diameter and the rest not included in theses two classes are culls.

[6] Table 6 Influence of treatments on yield and size

Plot	Treatment	Yield in pounds	Size: %No.1
I	Sod----------	135	54
2	Tillage alternate yr.	157	60
3	" " "	225	62
4	Clean cultivation----	262	55
5	Tillage & cover crop	268	56
6	Tillage cover crop & complete fertilizer	258	56
7	AS No. 6	2I0	57
8	As No. 6	I99	6I
9	" " "	2I9	66
I0	" " "	240	7I

Stewart (I8) who has been one of the foremost workers in this line supports the foregoing statement with numerous experimental data. He says" under certain conditions,at least, the size of apples can be influenced by fertilization and also by cultural

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6. Modified table from N.J. Ag. Exp. Sts. Bul. I90, I9I9.

methods. Their average size is also influenced by innerent or internal causes as shown by the differences in size between varieties and also probably by some of the differences between individual trees of the same variety".

Experiments conducted at the New Hamshire and New York Experiment Stations show that the conditions that tend to increase the size of the fruit also at the same time increase the size of the leaf in about the same proportion. Table 7 gives the results obtained at New York Agricultural Experiment Station.

Table7 Showing the increase in the weight of leaf and fruit.

Fertilizer	Weight of leaf Green	Dry	No. of apples	Avg. Wt. per apple
Stable manure---------	95.9	42.2	I,I34	6.4
Phosphoric acid-------	88.5	40.6	I,I63	6.I
" " & K --	90.9	4I.2	I,I26	6.3
" " K & N	99.5	43.5	I,II5	6.5
Check-----------------	80.I	36.9	I,748	6.2

Note.--Check plat received clean cultivation; fifteen check trees ten in all other treatments.

Later on Hedrick(II) found that "tilled apples are nearly one-third larger than those grown under sod--a very telling advantage in crop production". "To those who have been in orchard in harvest time, however, figures are unnecessary to show that tillage gives more and larger apples--in no other way the tale of deletereousness of the sod told so strikingly as to the eye at picking time when the zise and number of fruits are compared". As to the leaves "It was found, in short, that the leaves of the tilled trees weigh one and one-third as much as those of the sodded trees, indicating one and one-third greater efficiency of the foliage of the

tilled trees".

Gourley (8) has also obtained very striking results showing the influence of different treatments on the size of the fruit and the size of the leaf. His results are summerized in the following table:

Table 8.Comparative results for size factors.

Treatments.	Yield:5-yr. average	Size of fruit as by% of 5-yr. avg.	Area of leaves No.I 1913	Fresh wt. of leaves 1913
Sod----------	100	100	100	100
Cultivation alternate years----------	132	168	107	111
Same as above--------	176	165	113	117
Clean culture--------	213	142	119	123
Cultivation &covercrop	216	135	124	123
Cultivation covercrop &complete fertilizer-	191	165	129	135
Same as above--------	195	155	126	131
" "&-excess-P	166	168	126	131
" " " " N.	163	196	125	128
" " " " K	161	206	131	134

Potash seems to have more influence on the size ofthe leaf and the size of the fruit alike. Stewart(18) also states that potash has a distinct value in increasing the average size of the apples. It appears that the sizeof theleaves which received the fertilizers other than potash is somewhat larger than that receiving other treatments of culture. this may be due to the fact that fertilizers were applied in excess. It can be seen from table 9

that leaf contains a larger percentage of nutrient materials than the fruit. It is probable therefore that the leaves utilized more fertilisers, which were in excess, in increasing their size than they really require. Hence the size of the leaves receiving fertilizer was larger in proportion to the size of the fruit than the size of the leaves under clean culture.

[7] Table 9. Analysis of apple: fruit, leaves and wood.

Part of plant	Dry sub.	N %	P_2O_5	K_2O	CaO	MgO	Fe_2O_3	Total plant food
Wood----	52	.62	.20	.36	I.6	.24	.03	3.35
Leaves--	34	2.I5	.44	I.34	2.48	.75	.I25	8.6
Fruit---	I5.4	.43	.I7	I.I0	.08	.09	.02	2.035

Hedrick(II), Gourley(8) and Stewart(I8) agree on the statement that under normal conditions moisture supply is the dominant factor in influencing the average size of the fruit. According to Heinicke(I2) "water supply is a factor increasing the size of leaves". "The vigorous spurs have larger leaves than the weak spurs, because they have a greater diameterof conducting tissue and hence can obtain more sap". And that "the vigorous spurs bear large apples.

From the above discussion it clearly appears that there is a correlation between the size of the leaves and the size of the fruit of the apple.

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VI

Conclusions.

The data presented and discussed in this paper show that

1. The seedlings have a very low percentage of correlation between the size of the leaves and the size of the fruit.

2. The size of the leaf and the size of the fruit of the standard varieties are correlated.

3. Different cultural methods appear to show that the treatments that increase the size of the fruit also increase the size of the leaf.

4. Large fruit is associated with large leaves and vise versa.

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