THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

Report

of

Committee on Examination

This is to certify that we the undersigned, as a committee of the Graduate School, have given Theodore Eugene Odland final oral examination for the degree of Master of Science . We recommend that the degree of Master of Science be conferred upon the candidate.

Minneapolis, Minnesota

July 28 1919

Chairman

THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

Report

of

Committee on Thesis

The undersigned, acting as a Committee of the Graduate School, have read the accompanying thesis submitted by Theodore Eugene Odland for the degree of Master of Science. They approve it as a thesis meeting the requirements of the Graduate School of the University of Minnesota, and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science.

H C Murray
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July 28 1919

THE RELATION BETWEEN WEIGHT OF SEED SOWN AND PLANT CHARACTERS IN TWO VARIETIES OF OATS (AVENA SATIVA)

A Thesis

Presented to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the Degree of

MASTER OF SCIENCE

By

Theodore E. Odland

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CONTENTS

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INTRODUCTION

In attempting to improve the grain crops by means of selection, one of the first questions that arises is, what effect has the size of seed used upon the yield and quality of the resulting crop? Also, may the several grain crops and varieties of these differ in their response to seed selection? It has been commonly thought that the selection of the largest, heaviest seed for planting would increase the yield. From the data obtained from much experimental work along this line, it seems that such a conclusion must be qualified in a number of important ways.

The methods of experimentation followed by different investigators on this question have differed considerably and the results have often been at variance or contradictory. Some experimentors have used the fanning mill for separating the seed into different grades; others have selected the seeds by hand, while in more recent work the individual seeds have been weighed. In the majority of the experiments a mixed population has been used, while in a few cases, seeds from plants originating from a single individual have been employed.

The methods of planting have also been varied, the seeds being planted at different rates both in drill rows and spaced at definite distances apart. If all the various methods followed be taken into consideration and also the differences due to environment and varieties used, the discrepancy in the results obtained could possibly be accounted for.

In the work reported in this paper, two varieties of oats,

Victory and Irish Victor, were used. To eliminate inheritance factors, seed from plants originating from a single individual was used in both varieties. The seeds were individually weighed and arranged in classes according to their weight. With this method the difference in weight represents a definite amount in each case which it would be impossible to secure by any other means. The differences in sizes are also larger than it would be possible to secure by machine or hand selection. In selecting by hand it is also difficult to make a distinction between large, plump seed and large seed of light weight. The same objection holds when machine selection, by means of a blast and screens, is used.

Investigators have also differed greatly in the manner of reporting the results obtained. While some have merely reported the general conclusions reached, others have given full details of the experiment with specific data on the results obtained. The biometrical method of computing and interpreting results has proven itself especially suitable and has, therefore, been used thruout this experiment for presenting and analysing the results obtained. This method is singularly well adapted for making a comparison between the performance of two or more varieties when the contrast is to be based on definite characters of the plants. In this paper the two varieties of oats are compared with respect to the amount of development of different characters, the variability of each, and in the correlation between weight of seed and the various characters of the resultant plants.

While the data presented in this paper are not extensive enough so that definite conclusions can be drawn from them, they are submitted as additional information on the question. More complete investigation is necessary in order to establish the varietal as well

as the seasonal and soil influences on these results.

REVIEW OF LITERATURE

Many experiments have been conducted to determine the relation between the size of seed planted and yield, and also to study the different factors which influence this relation. In some investigations the influence of the fertility of the soil in this regard has been considered, in others the climatological conditions, and in still others varietal differences have been studied. The results obtained are often conflicting, largely due to the different methods used in the investigations.

At this station Arny and Garber (1)* have reported the results of four years work with Marquis wheat. In this experiment the seeds were individually weighed and space planted. The biometrical method was employed for finding the correlation between weight of seed planted and the resultant plant characters and also to find the correlation between the different characters of the plants studied. It was found that the magnitude of the means varied according to environmental conditions. With a few exceptions, variation decreased generally with a decrease in means.

In each of the four years there was a fair correlation between weight of seed and height at second leaf and a considerably higher correlation for height at six weeks. This was interpreted to indicate that at the appearance of the second leaf the greater amount of food supply in the larger seed had not yet exerted its influence.

In the four year period for which the results were reported two seasons, 1915 and 1917, were characterized by very favorable

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* Numbers in parenthesis refer to bibliography.

weather conditions. The crops grown in 1914 and 1916 suffered from drought and black stem rust. The soil on which the plants were grown in 1916 and 1917 was in a poorer state of fertility than that on which the plants were grown in 1914 and 1915. The seeds used in 1916 and 1917 were smaller than those used in the other two years; the mean weights used were 32.580±0.393, 33.033±0.260, 25.779±0.226, and 19.014±0.237 mgm. respectively, for the four years. With the exception of height of tallest culm at maturity in 1917, the coefficients of correlation between weight of seed and resultant plant characters were all lower in 1914 and 1915 than in 1916 and 1917. This was interpreted to be due to three causes; weather conditions, difference in soil productivity, and the differences in mean weight of seed used in the two periods.

There was practically no correlation between size of seed used and height of tallest culm at maturity in 1916 and 1917; for average height of culms and average length of spikes the correlations were also low. A medium correlation was found between size of seed and each of the following: total length of culms, total length of spikes, number of culms, total weight, and yield of grain and straw. In 1914 and 1915 the coefficients for all plant characters at maturity were comparatively low and with a few exceptions, significantly lower in 1915 than in 1914. The lower coefficients in 1915 were apparently due to the more favorable climatic conditions in that year.

The results obtained in this experiment were interpreted as indicating that the correlation between weight of seed and resultant plant characters at maturity is not high and may be greatly modified or entirely obliterated by environmental conditions.

That the biometrical constants are greatly influenced by environmental conditions was also found by Love and Leighty (12) from

data obtained on a pure line of oats. With smaller means due to unfavorable conditions, less variability was found. A reduction in yield was caused by a reduction in number of kernels per plant rather than by a reduction of the relative size of kernels produced. High positive correlation was found between yield and number of kernels and number of culms per plant. The average kernel weight was not found closely correlated with any other character except average culm yield with which it was fairly consistantly correlated. Correlations were classified as fluctuating or stable according to their amount of response to seasonal conditions.

Leighty (10) made a study of the correlation of characters in pure lines of four varieties of oats. A comparison was made between correlation coefficients when single culms were used as a basis for the determinations and when the whole plant was used. There was a tendency for the coefficients to be higher when single culms were used but the differences were small in nearly all instances. In the four varieties grown, Great American, Early Champion, Welcome, and Sixty Day, a considerable difference in average yield per culm was found, ranging from 3.433±.096 decigrams for Early Champion to 8.217±.219 decigrams for Welcome. The number of kernels per culm was about the same for the different varieties and for this reason, it is pointed out, the differences in yield were due to the larger kernels produced by certain varieties. Varietal differences were also found in average height of plants, in average weight of straw per culm, and in the proportion of straw to grain. In amount of variability of the different characters, varietal differences were also found. The Welcome variety was the most variable in all characters except average weight of kernels.

The coefficients of correlation showing the relation

between characters of the same variety were found to agree rather closely for the different varieties. There were, however, some differences in the coefficients so that the conclusion reached was that the coefficients may vary in different varieties.

In comparing oats grown in hills and drills, no great differences in the amount of correlation was found. When differences were found, the higher correlations occurred with the plants grown in drill rows. In comparing plants grown under various degrees of crowding, it was found that the least variability occurs under the more crowded conditions. The smallest amount of correlation was found where the plants were the least crowded. The conclusion drawn is that differences due to spacing may amount to more than varietal differences.

Whitcomb (20) used 30 pure lines of each of two varieties of barley in making a comparison between constants obtained by using the entire plant as the basis and when the main culm was employed. The culm characters studied were average yield, average height, average number of kernels and spikelets, and average weight per kernel. The varieties used were Berkeley and New Zealand barley, both being of the two-rowed type. Using the main culm as the basis, small differences were found between the two varieties in the means for all the characters studied. For yield per culm, height of culm, and weight per kernel, the means were highest in the Berkeley barley. For number of spikelets and kernels per culm, the means were highest in the New Zealand variety. The amount of variability for all constants agreed very closely in the two varieties. The coefficients of correlation between the different characters of the respective varieties agreed fairly closely; the average of all correlation coefficients for Berkeley barley being .536$\pm$.025 and for New Zealand

.586±.024 with a difference of .050±.035. The difference is not significant. The author concluded that biometrical constants are of equal value and are comparable whether obtained by using the whole plant or single culms as the unit.

Atkinson (2) made a study of the correlation of characters in mixed populations of 8 spring wheat varieties using culms as the basis for the determinations. The characters studied were length of culm, the number and average weight of kernels, total weight of kernels per culm, and the number of rudimentary spikelets per culm. Considerable variation was found in the means and variability of these characters for the different varieties. The means for yield varied from 833±9.10 mg. per culm for Minnesota 169 to 1405±16.90 for Stanley. Variation in other characters showed a similar range. Coefficients of correlation between the different characters studied also showed considerable range in variation. The coefficients expressing the correlation between weight per kernel and yield varied from .837±.009 for Kubanka to .508±.022 for Bart Tremenia. This is a difference of .329±.024. For weight per kernel with number of kernels the extremes showed a difference of coefficients of .392±.033 for weight per kernel and length of culm .425±.037, for yield and length of culm .646±.033, and yield with number of rudimentary spikelets a difference of .162±.011. As an average of all varieties, Atkinson found a relatively high correlation between average weight of kernel and yield. He also found a fair amount of correlation between average weight of kernel and number of kernels, average weight of kernel and length of culm, and between yield and length of culm. This is taken to mean that selecting grain from the largest kernels is selecting grain from the tallest, heaviest producing culms. The data indicates that the correlations may differ with the different

varieties, especially if mixed populations are used.

Hutcheson (8) made a study of correlation of characters in oats using both pure lines and mixed populations. The plants were grown in three crops under widely varying conditions; the first crop was grown at the Cornell Experiment Station, the second at the Virginia Experiment Station, and the third was grown in the greenhouse at the Cornell Station. The seeds were individually weighed and space planted; for crop one the seeds were planted at three-inch distances in rows one foot apart, the seeds for crop number two were planted at one foot intervals in rows eighteen inches apart, while the seeds for the last crop were planted in four inch flower pots. In the last experiment, a small and a large seed were planted in each pot to have all plants growing under approximately the same conditions. In comparing pure lines with mixed populations, the conclusion is drawn that there is more correlation between the factors that make yield in pure lines than there is in mixed populations. Results obtained in all the crops were interpreted to show that the plump seed produced the taller and stronger plants and these in turn produced the greatest yield. A lack of correlation between size of seed planted and average weight of kernels harvested indicated that size of seed is not inherited. This was especially true in the pure lines.

Waldron (19) used 1000 oat culms selected from a mixed population grown under field conditions for a study of correlation of characters. A small negative correlation was found between average weight of kernels and the following: number of kernels per head, length of head, and length of culm. The conclusion drawn was that the large kernels are produced by the short strawed plants yielding the smaller number of kernels.

Love (11) in a study of the question of large and small grain obtained results at almost complete variance with those obtained by Waldron. Wheat plants grown under field conditions were used and positive correlation was found between average weight of kernels and each of the following: height of plant, number of grains and yield. There was also a fairly high correlation between yield and height of plants. The conclusion is drawn that the large seed comes from the tallest, heaviest yielding plants.

Myers (14) planted a variety of wheat on plots of different degrees of fertility to determine what effect the conditions of the soil has upon the different biometrical constants. He found that an increase in fertility decreases the variability and also the correlation between different characters.

Roberts (18) made a study of the influence of seasonal conditions on the plant characters using three pure lines of wheat. Less variability was found with favorable growing seasons. He found high positive correlation between number of culms and yield, also between culm length and number of grains per spike. The conclusion drawn is that seasonal and soil factors in good seasons are probably sufficient to offset hereditary distinctions in yield among strains of wheat.

Richardson (17) in determining the relation between the size of kernel and its position in the spike, found that the kernels decrease in size towards either extremity and particularily towards the apex. When three or more grains were produced in one spikelet, the inner or median kernels were usually small and undeveloped. With a large number of grains per spike there was a larger proportion of small kernels found.

McAlpine (13) separated a sample of oats into three grades:

"Singles", "Firsts", and "Seconds". The Singles were primary kernels that had only the rudiments of a secondary kernel, the Firsts were the ordinary primary seeds, while the Seconds consisted of the smaller secondary kernels. The experiment was carried on in the season of 1909 at the West of Scotland Agricultural College. Four thousand seeds of each grade were used. The seeds were sown under field conditions on small plots containing 14½ square feet. Duplicate plots were used for each of the three kinds of seed both on unfertilized and fertilized land. One thousand seeds were sown on each plot which made the rate of seeding between 4 and 5 bushels per acre. The yields were computed on a percentage basis after weighing the grain from each plot. On unmanured ground, the Firsts yielded 24 percent more than the Singles and 57 percent more than the Seconds On manured ground, the Singles and Seconds yielded the same and 34 percent less than the Firsts.

Grantham (7) in a study of the tillering habits of winter wheat, space planted shrivelled and plump kernels of different varieties. The seeds were planted six inches apart both ways, each plat consisting of 250 plants. The experiment extended over a period of three seasons. The first season a plot of each grade of seed was planted both on fertilized and unfertilized ground, while in the other two years only one plot of each grade was planted. In the first season, the plants from the large, plump seed tillered more and yielded higher than the plants from the shrivelled seed both on the fertilized and unfertilized plats. The increase in tillering and yield was highest on the unfertilized ground. In one of the other two seasons, the shrivelled seed produced the most tillers and highest yield while in the other season the larger seed was superior.

Kiesselbach and Helm (9) conducted extensive experiments

on the relation of size of seed to yield in different varieties of wheat and oats. The seeds were planted both at definite distances apart and under field conditions at different rates of seeding. In a 5-year trial with Kherson oats, the small kernels yielded 11 percent less than the large when equal numbers were sown, but there was no difference in yield when equal weights of seed were used. Similar results were obtained over a 2-year period with Scotch Fife spring wheat, the small seeds yielding 10 percent less than the large when equal numbers were sown, but only 1 percent less when equal weights were used. Small seeds of Turkey winter wheat yielded 4 percent less than the large seeds when sown at equal numbers, but the yields were the same from the two grades when equal weights of seeds were planted. As an average of all three trials, there was no appreciable difference in yield between the two grades when equal weights of seed were used, but when equal numbers were sown, there was a difference of 8 percent in favor of the large seed. When equal weights were used, the amount sown was based on the rate normal for the large seed.

Continuous fanning mill selection was employed over a period of 12 years with Turkey and Big Frame winter wheats also Kherson oats. A similar test with American Banner oats was carried on for 8 years. In each trial, the crop from the lightest one-fourth was compared with the crop from the heaviest one-fourth. The small seed of Turkey wheat yielded 0.3 bushels less per acre than the large seed. With Big Frame wheat the difference was 1.4 bushels in favor of the large seed; and with Kherson oats the large seed outyielded the small by 0.74 bushel. With American Banner oats, however, there was an increase of 3.67 bushels per acre in favor of the large seed.

A one year test was conducted with hand selected large and small seeds of Scotch Fife and Marquis spring wheat, also Kherson oats. The seeds were space planted 6 by 10 inches apart to permit maximum development of the plants. The plants from the small seeds yielded 41 percent less than those from the large seed with Marquis, 30 percent less with Scotch Fife and 12 percent less with Kherson oats. In another test small and large seeds were planted both alone and in competition. As an average of two spring wheat varieties and two varieties of winter wheat, the small seed yielded 24 percent less than the large when the two grades were sown in competition with each other. When each grade was planted alone, the small seed yielded 11 percent less than the large.

Montgomery (15) in an 8 year trial with fanning mill selection using two varieties of winter wheat, separated the seed into three grades: lightest light, heaviest heavy, and unscreened. At the end of the period, no differences could be found in either the quantity or quality of the grain from the different kinds of seed used.

In a later experiment, Montgomery (16) investigated the effect of competition on the plants from large and small seeds. He found that when large and small seeds were planted together, under competitive conditions, the highest mortality resulted among plants from the small seed. This showed that the larger seed produced the stronger plants. The conclusion drawn was that since under competition the plants from the smaller seed are largely eliminated, fanning mill selection did not result in any marked permanent improvement in either the yield or quality of the grain.

Burnett (3) in a test covering seven years used the fanning mill to make a continuous selection of the heaviest oats for seed.

These selected oats were then planted under field conditions and their resultant crop yield compared with those from unselected seed. Altho no data are given as to the yields obtained from these two grades of seed, the author states that a small gain was obtained for the large seed but the results were not considered consistent enough to warrant the conclusion that the increase was due to the accumulative effect of fanning the seed.

Georgeson, Burtis, and Otis (5) conducted a 4-year trial with heavy, light, and unscreened wheat. The heavy and light grades were separated by means of a fanning mill, while the unscreened wheat was taken as it came from the thrasher. All grades were sown at the uniform rate of 1½ bushels per acre. The wheat was planted on 1/20th acre plots with four replicates each year. The crops from the heavy and unscreened seed yielded practically the same and outyielded the light grade by approximately 1½ bushels per acre.

In a later bulletin the same authors (6) report the results of an 8-year field trial with oats. Heavy, light, and unscreened oats were selected and planted in the same manner as the wheat reported on before. All grades were seeded at the rate of 3 bushels per acre. As an average of the entire period, the heavy seed produced 3 bushels more per acre than the light and 1 bushel more than the unscreened. These results were similar to those secured with wheat.

Williams and Welton (22) separated oats by means of the fanning mill into large and small grades. These were sown both at uniform and varied rates, the object in the varied rate being to get the same number of seeds per acre. In a 5-year period, the crop from the large seed averaged 4 bushels more per acre than the crop from the small seed. The experiment was continued for 4 years more

introducing an unscreened grade. At the end of that time, the large seed had shown no advantage over the unscreened. At the uniform rate of seeding, the small seed yielded as high as the other two grades, while at the varied rate, it yielded 2 bushels per acre less. In another trial, hand selected primary kernels outyielded secondary kernels three years out of five.

In a later experiment with wheat, Williams (21) using large, small, and unscreened seed, no advantage was secured from using large seed. In another trial, large and small seeds were hand selected from 10 pure lines of winter wheat over a period of 6 years. In this test there was a gain of 48 percent in favor of the large seed.

Zavitz (23) reports the results of three different experiments with seed selection. In one of these, a continuous selection of seed has been made with Joanette oats for 21 years. The seed each year is separated into large plump and light seed grades. The author does not mention how this seed selection was made or under what conditions the oats were sown but states that the large plump seed produced an average of 63.7 bushels per acre and the small plump an average of 51.4 bushels for the period. In another experiment with four varieties of oats over a period of 6 years, the large seed has produced the heavier yields in 90 percent of the trials. The author states that the oats have been planted at seven different distances apart in this experiment but does not give any further details in regard to the way in which the experiment was conducted. In another trial covering a period of from 3 to 9 years with hand-selected large and small seeds of the different small grains, the large seed proved the more efficient in every case. The large plump seed outyielded the small plump seeds in oats by an average of 15.4 bushels

per acre, in barley the difference was 3.4 bushels, in spring wheat 3.7, in winter wheat 6.5, and in spring rye 3 bushels per acre. The large seed also produced the heavier kernels which indicates that the varieties worked with did not consist of pure lines.

METHODS OF INVESTIGATION

The material for this experiment was secured by hand selecting and weighing on a chemical balance, approximately 500 seeds each of two varieties of oats. To eliminate hereditary differences, seed from a line originating from a single plant was used in each variety. The seeds were space planted and the different constants used in the study were obtained from the resulting plants. The plants were grown on the University Farm at St. Paul, Minnesota during the season of 1917. The seeds were separated into classes according to weight, each class having as nearly as possible the same number of seeds. The main object in this paper is to compare the effect of the size of seed on the resultant plant characters in the two varieties.

In a study of this character, the percentage of hull to grain becomes an important factor; a large, thickhulled seed may have no more stored food available for the plant which is produced than a smaller seed with a larger percentage of grain. As an average of a large number of determinations made at this station, primary oat kernels have given a 5 percent higher hull percentage than the secondary. In separating the seeds into classes, then, by weight, the smaller secondary kernels have an advantage over the larger primary kernels in the hulling percentage.

The soil on which the plants were grown is classified as Hempstead silt loam. It is in a good state of fertility and is well

adapted for oat growing. A four-year rotation consisting of wheat, meadow, barley, and silage corn is followed on the field where the individual plant plot was located. Eight tons of manure is applied preceding corn in each cycle.

The growing season of 1917 was very favorable for the crop. The rainfall was about normal and well distributed while the mean temperature was slightly below normal. In table 1 are given the monthly averages for rainfall and temperature.

Table 1.

Precipitation and temperature for the growing season of 1917 and the normal for 1873-1903. Minneapolis, Minn.

Months	Rainfall			Temperature		
	Normal Inches	1917 Inches	Dev. Inches	Normal Deg.F.	1917 Deg.F.	Dev. Deg.F.
April	2.44	1.70	-.74	46.4	41.9	-4.5
May	3.20	3.52	+.32	57.3	54.6	-2.7
June	3.70	3.46	-.24	67.1	63.3	-3.8
July	4.20	4.45	+.25	72.1	73.0	+0.9
August	3.70	2.84	-.86	70.0	67.9	-2.1

Fig. I shows graphically the daily precipitation and mean temperatures for the growing season.

The two varieties of oats used are both medium early, the Irish Victor is of the Silvermine type while the Victory is a Lincoln type oat. In variety tests at this station both have done well in comparison with other varieties. A number of hull percentage determinations have been made for each variety but no appreciable difference was found between the two.

The seeds for planting were selected by hand from a bulk sample of each variety. The seeds were first arranged in classes according to size by appearance in order to facilitate weighing. After this each kernel was weighed separately on a chemical balance. The weights were read to the fourth decimal place and recorded to the

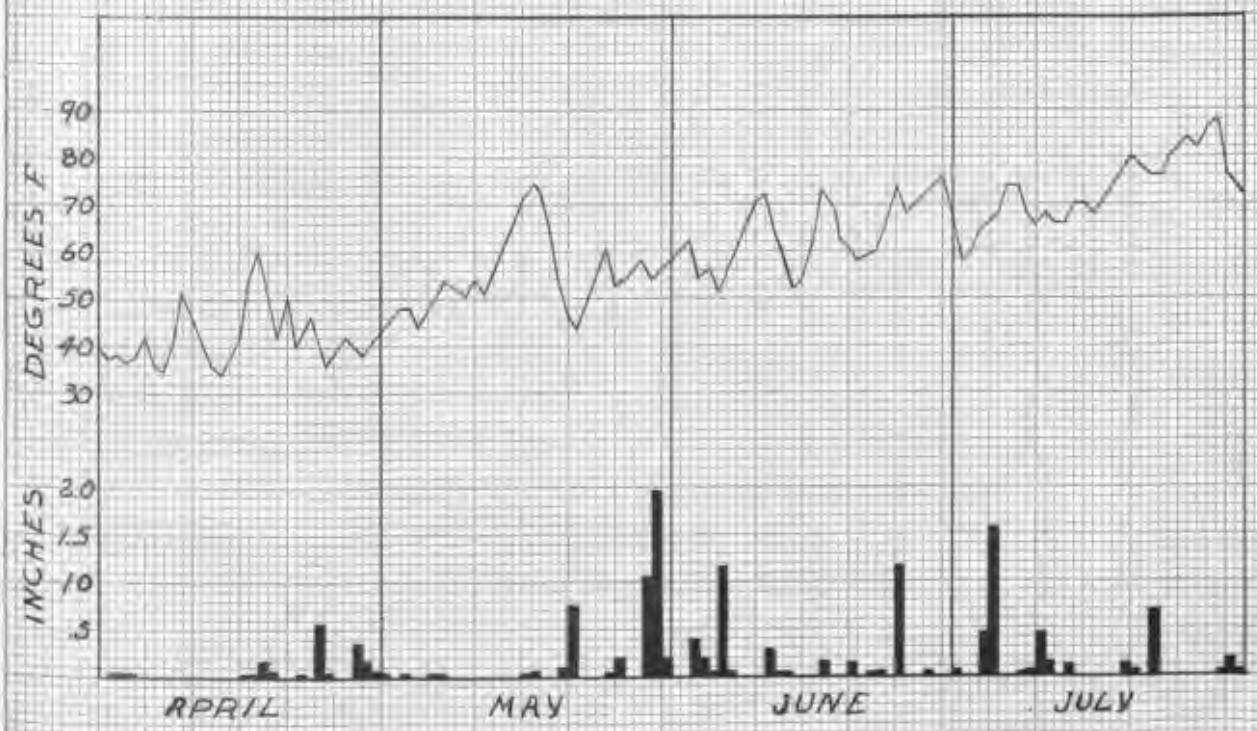

Fig. 1. Graph showing daily precipitation and mean temperatures for the growing season of 1917.

nearest third. The seeds were space planted 4 inches each way to insure equal growing opportunity for all plants. A numbered pot label was inserted in the soil near each seed to identify the plant. The seeds were all planted on the same day and at the same depth. Whenever a seed failed to grow or the plant died for some reason, another plant of the same line from a nearby plot was substituted in order to give all plants the same amount of space. These substituted plants were discarded at harvest time. Border rows were also planted on all sides so that the outside rows would have the same conditions as the others.

The plants were measured in the field to obtain the height at appearance of the second leaf and at six weeks. About a week before harvest, each plant was tagged with a number corresponding to the stake number. The plants were pulled by hand and the upper portion wrapped in paper to prevent shattering. After harvesting, the plants were hung up in the seed house to dry.

After the plants had dried out thoroughly, the roots were cut off and the plant weighed to get the total weight per plant. The culms were then counted and measurements taken to secure the following data: length of tallest culm, total and average length of culms, total and average length of panicles per plant. The panicles were then cut off and the grain carefully threshed and weighed. The kernels from each plant were counted and the average weight of kernels per plant computed. The weight of the grain was subtracted from the total weight of the plant, as found after the roots had been removed, to obtain the weight of the straw.

After all the data for each plant had been entered in the field book, it was transferred to a card for convenience in throwing correlation tables. All calculations necessary for the tables have been carefully checked.

COMPARISON OF BIOMETRICAL CONSTANTS

The statistical method is used thruout this paper in measuring and comparing the various characters of the two oat varieties under study. The constants determined for each variety are the mean, the standard deviation, the coefficient of variation, and the coefficient of correlation, together with the probable error of each of these. The means represent the average value of each character for any group of plants considered together; they serve as a definite basis for comparing the development of any character in different varieties.

Within any variety or type a certain amount of variation in the different characters will always be found. The standard deviations are used as a means of measuring the amount of variability for the different characters in each variety. The standard deviation is measured in definite units and consequently it can only be used where the same character is compared in two varieties. For this purpose it is the most satisfactory measure of variation.

The coefficient of variability is also used to measure the variation in the different plant characters. This constant is expressed as a percentage of the mean and so makes a comparison between characters measured in different units possible.

The tendency of two characters to move together or of their independence of one another is shown by the coefficients of correlation. In this study the relation between the weight of seed and the various characters of the resultant plants is shown in each case by this constant. In all cases the relation of the probable error to the coefficient indicates whether the correlation may be considered significant or not.

In comparing the constants for a character in the two varieties, the probable error is again used to determine the significance of the difference. This probable error is found by extracting the square root of the sum of the squares of the probable errors of the two numbers. If the difference is less than approximately three times its probable error it is not considered significant.

THE MEANS. In Table 2 are given the means and their differences for each of the characters in the two oat varieties. In considering first the means for the weight of seed used, the difference is 1.0078±.3647 milligrams in favor of the Victory oats. This difference is less than three times its probable error and is, therefore, not considered significant. For all purposes of comparison, then, the seed used in the two varieties can be considered as being of the same average weight. However, since the seed was arbitrarily selected by hand and the same number, as nearly as possible, placed in corresponding weight classes, this does not mean that, as a type, the two varieties have the same size of kernel.

The means for height at second leaf were 5.9463±.0189 cm. for Victory and 6.1486±.0318 cm. for Irish Victor with a difference of .2023±.0370 cm. in favor of the latter. This difference is small but may be considered as significant; it is nearly six times its probable error.

At six weeks the heights of the plants were 17.9981±.0652 cm. for Victory and 17.9054±.0952 cm. for Irish Victor. The difference, .0927±.1149 cm., is less than its probable error and is not significant. At this stage, then, the plants were of the same average height in the two varieties.

In height of tallest culm, the mean for the Irish Victor oats is greater by 1.4424±.2977 cm. while for average height of culms

Table 2.

Means and differences for each of the characters of Victory and Irish Victor Oats.

Characters studied	Victory	Irish Victor	Differences
Weight of individual seeds planted, mgm.	26.0078±.2585	25.0000±.2572	1.0078±.3647
Height of plant at second leaf, cm.	5.9463±.0189	6.1486±.0318	.2023±.0370
Height of plant at six weeks, cm.	17.9981±.0652	17.9054±.0952	.0927±.1149
Height of tallest culm at maturity, cm.	122.0233±.2052	123.4657±.2157	1.4424±.2977
Average height of culms per plant, cm.	119.6031±.2210	117.9811±.2240	1.6220±.3131
Total length of culms per plant, cm.	155.6031±1.5807	239.2199±2.7242	83.6168±1.7378
Number of culms per plant	1.3113±.0144	2.0402±.0232	.7289±.0273
Number of seeds per plant	100.6420±.8199	128.3156±1.5316	27.6736±1.7378
Total weight of plants, dgm.	67.856 ±.5456	81.4279±.9492	13.5719±1.0954
Weight of straw per plant, dgm.	37.93 ±.3202	46.1040±.5387	8.1740±.6267
Weight of grain per plant, dgm.	30.2568±.2395	36.0142±.4237	5.7574±.4867
Average weight of seeds per plant, mgm.	29.642± .0407	27.9574±.0473	1.6846 ±.0624
Average length of panicles per plant, cm.	21.2257±.0581	20.5035±.0597	.7222±.0830
Total length of panicles per plant, cm.	27.9981±.2711	42.2553±.4840	14.2572±.5548

the difference is 1.6220±.3131 cm., the Victory oats being the taller. These differences are each about five times their probable errors and are, therefore, probably significant. When the height of the culms is considered, these differences are very small. Fig. II shows graphically the frequency distribution for average height of culms.

For average length of panicles per plant the difference in means is .7222±.0830 cm. in favor of the Victory oats. This difference is approximately eight times its probable error. When the average length of the panicle is taken into consideration, this difference is comparatively small.

The means for average weight of kernels harvested are 29.6420±.0407 and 27.9574±.0473 dgm. for the Victory and Irish Victor respectively with a difference of 1.6846±.0624 dgm. in favor of the former. This difference is significant and indicates that, as a type Victory oats have a somewhat larger kernel than the Irish Victor. Fig. III shows graphically the frequency distribution for average weight of kernels for the two varieties.

The greatest relative difference in means is found in the number of culms per plant. The mean for Irish Victor is 2.0402±.023 and 1.3113±.0144 for Victory with a difference of .7289±.0273 in favor of the former. From this it is seen that the Irish Victor oats produced approximately 50 percent more culms per plant than the Victory oats. In Fig. IV the frequency distribution for this character is shown graphically. This large difference in number of culms seems to have a very marked influence on many of the other plant characters studied. Table 2 shows that the means for the Irish Victor oats are considerably higher than the means for the Victory in each of the following characters: total length of culms,

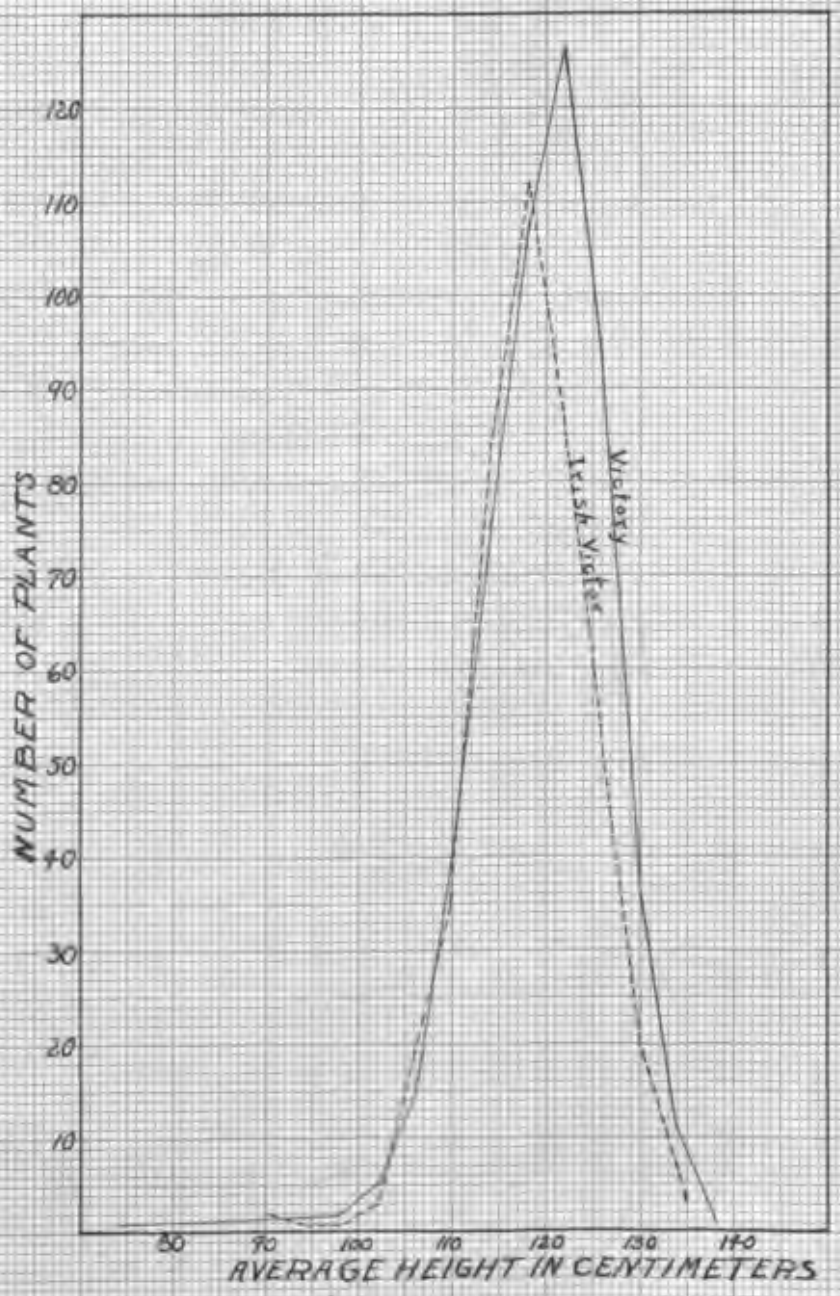

Fig. 11. Graph showing frequency distribution of oat plants for average height of culms.

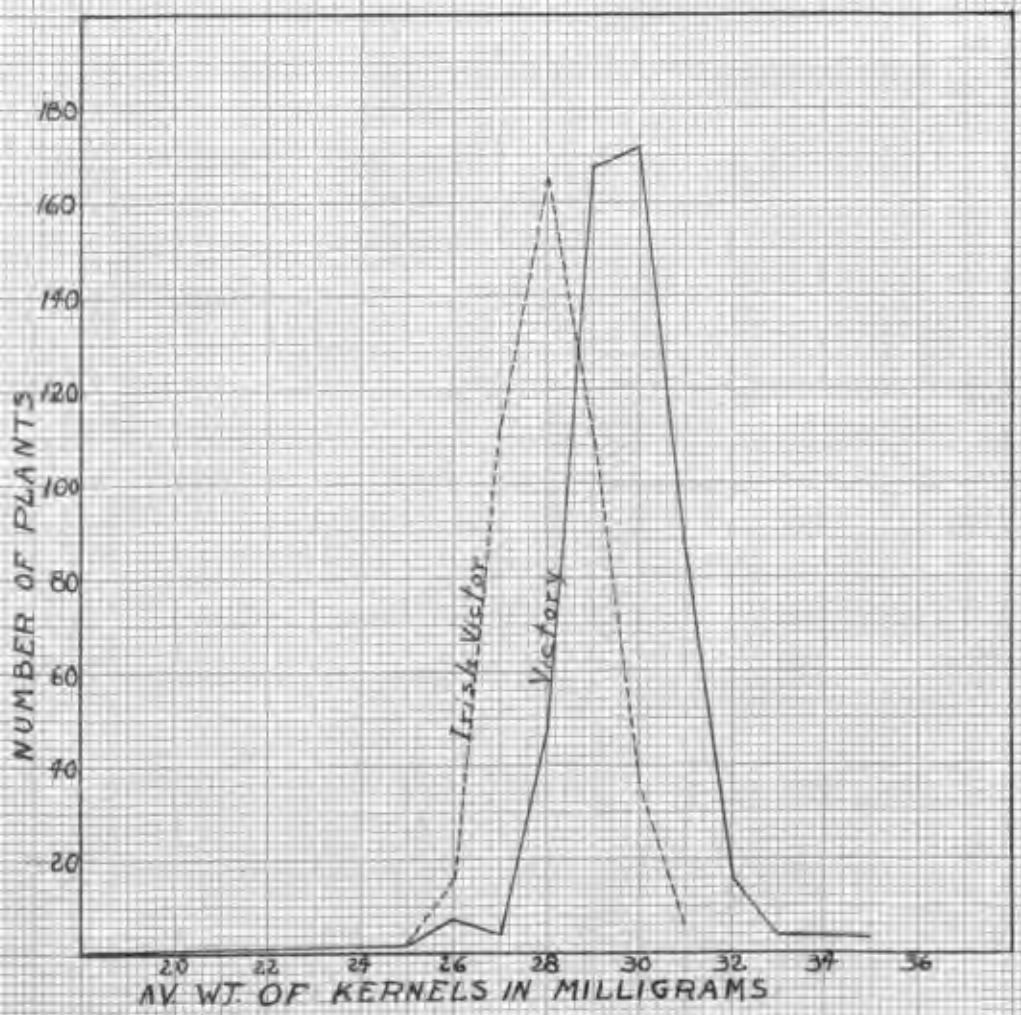

Fig. 111. Graph showing frequency distribution of oat plants for average weight of kernels.

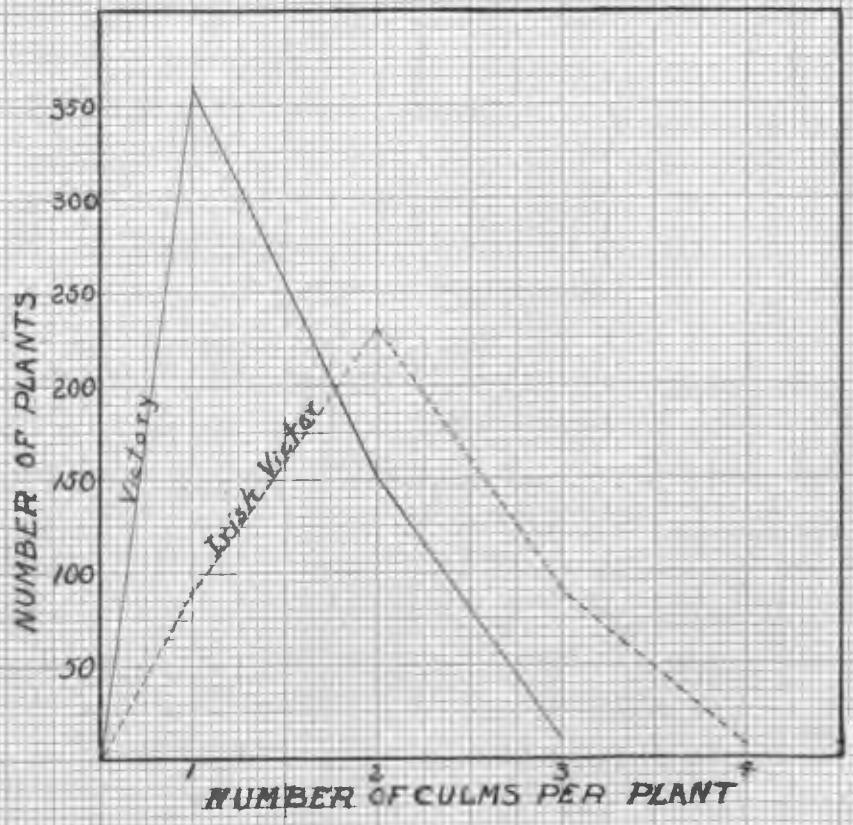

Fig. IV. Graph showing frequency distribution of oat plants for average number of culms.

total length of panicles, total weight of plant, weight of straw, number of kernels per plant, and yield. Of these characters, the least difference proportionally between the two varieties is found in yield. The average yield per plant for Irish Victor is 36.0142± .4237 dgm. and for Victory 30.2568±.2395 dgm. with a difference of 5.7574±.4867 dgm. In this case the larger number of kernels per plant in the Irish Victor oats is offset somewhat by the larger kernels in the Victory oats, thus making the difference in yield less. Fig. V shows the frequency distribution of the oat plants for yield of kernels.

STANDARD DEVIATIONS. The standard deviations are used as one of the methods of measuring the variability of the different characters of the two oat varieties. This method is very satisfactory when the same unit is used for measuring the mean. Where different units are used for this purpose, the coefficient of variability is better adapted.

Table 3 shows the standard deviations for the characters studied and their differences in the two varieties.

For height at second leaf the standard deviation is .6357±.0134 cm. for Victory and .9710±.0225 cm. for Irish Victor with a difference of .3353±.0262 cm. This is a larger difference than might be expected from the small difference in the means at this stage. At six weeks, when there is no significant difference in the means, the standard deviation for height in the Victory oats is 2.1908±.0461 cm. and in Irish Victor 2.9030±.0673 cm. with a difference of .7122±.0816 cm. This difference is small but is more than eight times its probable error and is probably therefore significant. No significant differences are found in the standard deviations for height of tallest culm or average height of culms respectively

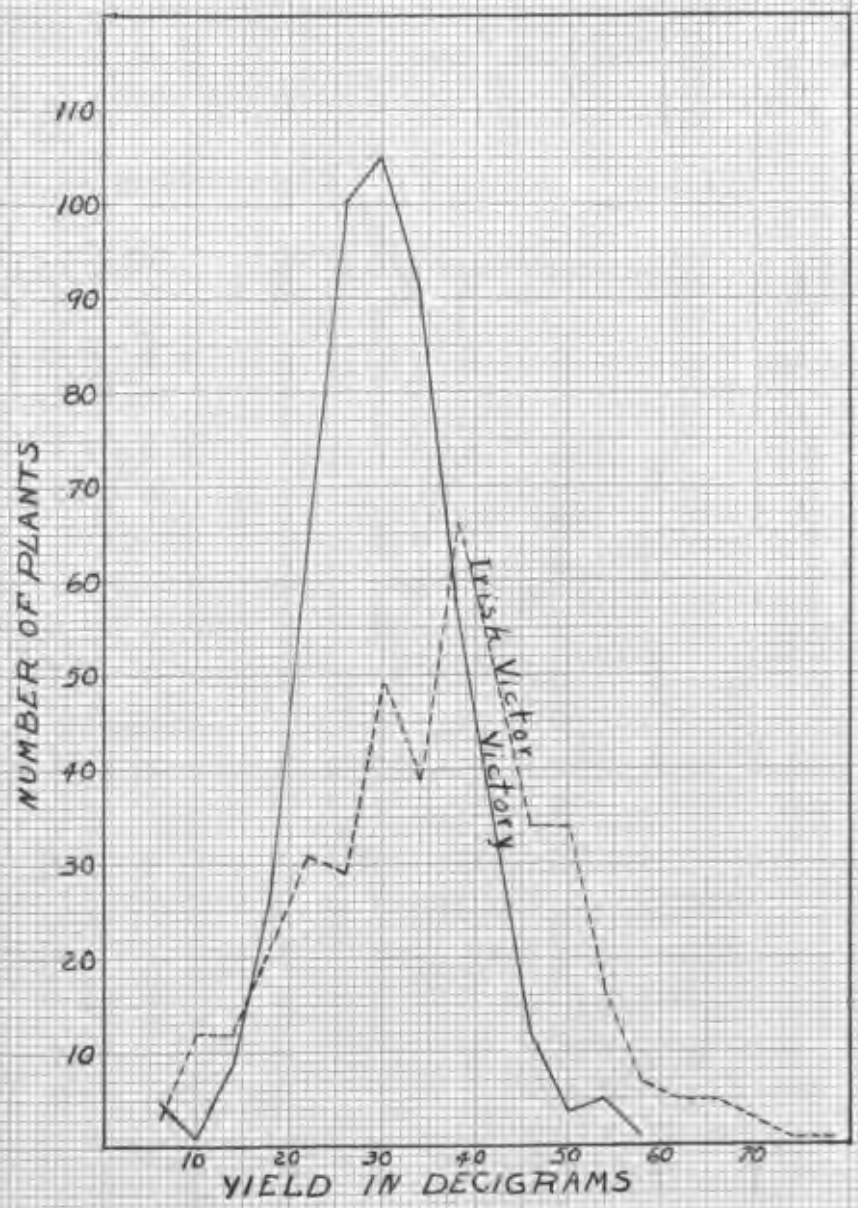

Fig. 7. Graph showing frequency distribution of oat plants for yield.

Table 3.

Standard deviations and differences for each of the characters of Victory and Irish Victor Oats.

Characters studied	Victory	Irish Victor	Differences
Weight of individual seeds planted, mgm.	8.6903± .1828	7.8424± .1819	.8749± .2579
Height of plant at second leaf, cm.	.6357± .0134	.9710± .0225	.3353± .0262
Height of plant at six weeks, cm.	2.1908± .0461	2.9030± .0673	.7122± .0816
Height of tallest culm at maturity, cm.	6.8989± .1452	6.5787± .1526	.3202± .2330
Average height of culms per plant, cm.	7.43 ± .1563	6.8320± .1584	.5980± .2225
Total length of culms per plant, cm.	53.1311±1.1179	83.0796±1.9266	29.9485±2.2249
Number of culms per plant	.4835± .0102	.7084± .0164	.2249± .0193
Number of seeds per plant	27.5610± .5799	46.7095±1.0832	19.1485±1.2288
Total weight of plants, dgm.	18.3379± .3858	28.9472± .6713	10.6093± .7743
Weight of straw per plant, dgm.	10.7622± .2264	16.4278± .3810	5.6656± .4432
Weight of grain per plant, dgm.	8.0521± .1694	12.9209± .2996	4.8688± .3442
Average weight of seeds per plant, mgm.	1.3667± .0288	1.4417± .0334	.0750± .0441
Average length of panicles per plant, cm.	1.9517± .0411	1.8204± .0422	.1313± .0589
Total length of panicles per plant, cm.	9.1137± .1918	14.7621± .3423	5.6484± .3924

between the two varieties. In the former case the difference is .3202±.2330 cm. and in the latter .5980±.2225 cm. In comparing the height of the tallest culm and the average height of culms per plant as to variability, they are found to be of approximately equal uniformity in both varieties. This agrees with the findings of Leighty (10) with oats and Whitcomb (20) with barley that individual culms and the whole plant have the same value for use as a basis for biometrical studies.

As shown in table 3, the variation in average weight of kernels harvested is very small as measured by the standard deviation. For Victory the deviation is 1.3667±.0288 mgm. and for Irish Victor 1.4417±.0334 mgm. with a difference of .0750±.0441 mgm., which is not significant. In average length of panicles per plant, the standard deviations are also small with no difference between the two varieties.

In the characters where the means were considerably higher in the Irish Victor oats, the standard deviations are proportionally higher. This holds for the following characters: total length of culms per plant, number of culms, number of kernels per plant, total weight of plants, weight of straw, weight of grain, and total length of panicles. This agrees with the observations noted by Arny and Garber (1) with wheat that in general a reduction in the magnitude of the means is accompanied by less variability.

COEFFICIENTS OF VARIABILITY. In table 4 are given the coefficients of variability for the different characters and their differences in the two varieties of oats.

Measured by this standard, the Irish Victor oats shows the greater variability for height at second leaf and at six weeks. This was also the case when the standard deviations were used as the measure of variability. The Victory oats also showed more uniformity

Table 4.

Coefficients of variability and differences for each of the characters of Victory and Irish Victor Oats.

Characters studied	Victory	Irish Victor	Differences
Weight of individual seeds planted, mgm.	33.41±.7775	31.37±.7958	2.04±1.1136
Height of plant at second leaf, cm.	10.69±.2275	15.79±.3752	5.10± .4387
Height of plant at six weeks, cm.	12.17±.2598	16.21±.3857	4.04± .4651
Height of tallest culm at maturity, cm.	5.65±.1189	5.33±.1236	.32± .1715
Average height of culms per plant, cm.	6.21±.1307	5.79±.1343	.42± .1873
Total length of culms per plant, cm.	34.15±.7979	34.73±.8973	.58±1.2000
Number of culms per plant	36.87±.8749	34.72±.8970	2.15±1.2530
Number of seeds per plant	27.39±.6180	36.40±.9494	9.01±1.1314
Total weight of plants, dgm.	27.02±.6086	35.55±.9227	8.53±1.1045
Weight of straw per plant, dgm.	28.37±.6432	35.63±.9252	7.26±1.1225
Weight of grain per plant, dgm.	26.61±.5982	35.88±.9330	9.27±1.1091
Average weight of seeds per plant, mgm.	4.61±.0970	5.16±.1197	.45± .1539
Average length of panicles per plant, cm.	9.19±.1934	8.88±.2059	.31± .2823
Total length of panicles per plant, cm.	32.55±.7539	34.94±.9038	2.39±1.1748

as measured by the coefficient of variability in the following characters; number of seeds per plant, total weight of plants, weight of straw, and weight of grain. This is in agreement with the standard deviations. In the characters total length of culms, number of culms, and total length of panicles per plant, the standard deviations showed significant differences in variation between the two varieties but the coefficients of variability show no such differences. This emphasizes the value of employing both methods for measuring variability; the standard deviation as a definite unit and the coefficient of variability as a relative measure of variation.

In both varieties of oats, the least variability was found in the size of individual kernels per plant harvested, being 4.61± .0970 for Victory and 5.16±.1197 for Irish Victor. Between the two varieties there is no significant difference in variation in this character. The uniformity in size of seed harvested is an indication that the type for this character is fairly well established in both varieties.

In general, the table shows that variation, as measured by the coefficient of variability, agrees fairly consistently with the variation as shown by the standard deviation.

COEFFICIENTS OF CORRELATION. The correlation between the weight of seed planted and the various characters of the resultant plants varied from a small negative to a moderately high positive correlation. The correlations and their differences in the two varieties are shown by the coefficients of correlation grouped in table 5.

The coefficients of correlation agree very closely, as shown in this table, for the respective characters of the two varieties. In only two instances, height at second leaf and average

Table 5.

Coefficients of correlation between size of seed sown and resultant plant characters and their differences in Victory and Irish Victor Oats.

Characters studied	Victory	Irish Victor	Differences
Weight of individual seeds planted, mgm.			
Height of plant at second leaf, cm.	.4883±.0227	.6849±.0174	.1966±.0286
Height of plant at six weeks, cm.	.5435±.0209	.5893±.0214	.0458±.0299
Height of tallest culm at maturity, cm.	.0954±.0295	.0605±.0327	.0349±.0440
Average height of culms per plant, cm.	-.0192±.0297	.0554±.0327	.0362±.0430
Total length of culms per plant, cm.	.2130±.0284	.1872±.0316	.0258±.0426
Number of culms per plant	.2038±.0285	.1787±.0317	.0251±.0426
Number of seeds per plant	.2901±.0272	.2765±.0303	.0136±.0407
Total weight of plants, dgm.	.2769±.0275	.2874±.0301	.0105±.0408
Weight of straw per plant, dgm.	.2712±.0276	.3027±.0298	.0315±.0406
Weight of grain per plant, dgm.	.2915±.0272	.2684±.0304	.0231±.0408
Average weight of seeds per plant, mgm.	-.1295±.0292	-.1091±.0324	.0204±.0436
Average length of panicles per plant, cm.	-.0247±.0297	.1838±.0317	.2085±.0434
Total length of panicles per plant, cm.	.2158±.0284	.2209±.0312	.0051±.0422

length of panicles per plant, are there any significant differences between the coefficients of correlation in the two varieties.

The coefficients of correlation between weight of seed planted and height at second leaf (tables 6 & 7) are .6849±.0174 for Irish Victor and .4883±.0227 for Victory with a difference of .1966± .0286 in favor of the former. These results agree with those obtained by Hutcheson (8) also working with oats. He found a coefficient of correlation of .521±.024, in pure lines, between size of seed planted and height of plants before second leaf. In a mixed population the coefficient of correlation was .620±.022. These coefficients are considerably higher than those found by Arny and Garber (1) between weight of seed planted and height at second leaf with Marquis wheat. In a four-year period they found coefficients of correlation ranging from .114±.027 to .259±.028.

At height at six weeks (tables 8 & 9) the coefficients are .5435±.0209 for Victory and .5893±.0214 for Irish Victor with a difference of .0458±.0299. This difference is less than two times its probable error and, therefore, not considered significant.

In neither variety is there a difference which can be considered significant between the coefficients of correlation obtained between weight of seed planted and height at second leaf and coefficients obtained at six weeks. From these results, then, it would appear that the size of seed planted has approximately the same amount of influence on the growth of the plant at second leaf as it has at six weeks. This differs somewhat from the results reported by Arny and Garber (1) with Marquis wheat. They found a decidedly greater correlation between size of seed and height at six weeks than at the appearance of the second leaf. The two experiments agree,

	2.4-2.7	2.7-3.0	3.0-3.3	3.3-3.6	3.6-3.9	3.9-4.2	4.2-4.5	4.5-4.8	4.8-5.1	5.1-5.4	5.4-5.7	5.7-6.0	6.0-6.3	6.3-6.6	6.6-6.9	6.9-7.2	7.2-7.5	7.5-7.8	Totals
10-12							1	4	4	6	3		1						19
12-14						1	1		5	7	9	8	2						33
14-16								5	7	6	2	5	6	1	1				33
16-18									1	5	9	8	6	3		1			33
18-20								1	5	3	6	12	2	4	1				34
20-22								1	2	7	6	6	4	6	1	1			34
22-24									3	1	6	5	15	4	2				36
24-26									1	1	10	9	5	5	1	3	1		36
26-28										3	3	6	9	2	4	4	2		33
28-30								2		3	2	7	12	6	3				35
30-32	1									3	6	9	12	3		1			35
32-34										2		4	9	6	9	4	1	1	36
34-36								1		1	8	2	10	3	4	1	1	1	32
36-38										1	3	1	8	9	6	4	1		33
38-40									1	1	1	1	11	10	6	2			33
40-42									1		2	1	4	5	2	2	2		19
Totals	1	0	0	0	0	1	2	14	30	50	76	84	116	67	40	23	8	2	514

Table No. 6. Correlation between weight of individual seeds, in milligrams, subject; and height of plants at second leaf, in centimeters, relative. Victory.

$r = .4883 \pm .0227$

	3.0-3.3	3.3-3.6	3.6-3.9	3.9-4.2	4.2-4.5	4.5-4.8	4.8-5.1	5.1-5.4	5.4-5.7	5.7-6.0	6.0-6.3	6.3-6.6	6.6-6.9	6.9-7.2	7.2-7.5	7.5-7.8	7.8-8.1	8.1-8.4	8.4-8.7	Totals
10-12					3	4	1	2												10
12-14		3	2		4	3	8	5	3		2									30
14-16	1	1			2	1	5	9	5	3	3	1								31
16-18		1		1		1	4	3	4		12	2	2							29
18-20		1				2	1	1	6	4	7	5	3		1					31
20-22					1	3	2	1	4	6	7	5	3		1					33
22-24				1		2	2	1		5	6	6	5	2	2					32
24-26		1						3	1	4	9	5	6	2						31
26-28					1		1		2	4	8	8	4	4						32
28-30						1	1	1	1	2	4	8	5	3	6	1				33
30-32							2	1			7	1	4	9	5	1	1			31
32-34						1			2	6		2	5	7	3	3				29
34-36									3	1	1	2	3	10	7	3		1		31
36-38								1	1		1		5	8	1	8	4	1		30
38-40												1	1	2	1	4			1	10
Totals	1	6	2	2	11	18	27	28	32	35	67	46	46	47	27	20	5	2	1	423

Table No. 7. Correlation between weight of individual seeds, in milligrams, subject; and height of plants at second leaf, in centimeters, relative. Irish Victor.

$r = .6849 \pm .0174$

	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Totals
10-12							1	2	4	8	3	1											19
12-14	1					1			15	7	7	2											33
14-16							3	3	5	7	6	7	2										33
16-18									3	2	13	13	2										33
18-20								2	3	8	11	5	2	2	1								34
20-22								1	2	3	9	10	7	2									34
22-24								1	2	4	9	8	5	2	2	1					1	1	36
24-26								1	1	3	9	9	7	4	2								36
26-28									1		8	6	8	8	1	1							33
28-30				1			1	1	1	2		10	6	10	2	1							35
30-32								1	1	2	2	11	13	2	3								35
32-34									2		3	8	7	10	4	2							36
34-36							1		1	1	4	4	10	6	5								32
36-38									2		2	2	6	10	6	4	1						33
38-40						1				1	3	1	8	9	10								33
40-42										3		1		6	5	1	2	1					19
Totals	1	0	0	1	0	2	6	12	43	51	89	98	83	71	41	10	3	1	0	0	1	1	514

Table No. 8. Correlation between weight of individual seeds, in milligrams, subject; and height of plants at six weeks, in centimeters, relative, Victory.

$r = .5435 \pm .0209$

	8.0- 8.8	8.8- 9.6	9.6-10.4	10.4-11.2	11.2-12.0	12.0-12.8	12.8-13.6	13.6-14.4	14.4-15.2	15.2-16.0	16.0-16.8	16.8-17.6	17.6-18.4	18.4-19.2	19.2-20.0	20.0-20.8	20.8-21.6	21.6-22.4	22.4-23.2	23.2-24.0	Totals
10-12						1	3	3	1	2											10
12-14	2	1		1		4	3		3	3	7	2	1	3							30
14-16				2	2		2		4	4	8	6	1	1	1						31
16-18				1	1			2		5	5	4	6	3	2						29
18-20				1		1			3	1	1	9	7	3	2	2		1			31
20-22	1			1		1	1	4	1	1	2	6	7	3	1	3	1				33
22-24			2	2	1		2				4	7	4	4	3	1	2				32
24-26							1			2	2	1	2	8	7	5	3				31
26-28								1	1	2	1		4	7	7	5	3		1		32
28-30								1		2	1	3	4	7	5	8	2				33
30-32									2		1	3	1	4	5	10	3	2			31
32-34					1			1		2	2	2		2	1	9	5	2		2	29
34-36										1	2	2	1	3	1	12	5	1	1	2	31
36-38						1				1	1	1	2	4		7	4	6	3		30
38-40												1	1			1	2	3	2		10
Totals	3	1	2	8	5	8	12	12	15	26	37	47	41	52	35	63	30	15	7	4	423

Table No. 9. Correlation between weight of individual seeds, in milligrams, subject; and height of plants at six weeks, in centimeters, relative. Irish Victor.

$r = .5893 \pm .0214$

however, in showing that the influence of the weight of seed planted on the resultant plants is greater at six weeks than it is at maturity of the plant.

For height of tallest culm at maturity (tables 10 & 11) the coefficients of correlation are .0954±.0295 for Victory and .0605±.0327 for Irish Victor with a difference of .0349±.0440. This difference is less than its probable error and, therefore, not significant. In the Victory oats the coefficient of correlation between weight of seed planted and height of tallest culm is barely three times its probable error, while in the Irish Victor there is no significant correlation between weight of seed planted and this character.

No correlation is found in either variety between weight of seed planted and average height of culms at maturity (tables 12 & 13). When the coefficients obtained for weight of seed planted and average height of culms per plant are compared with those obtained for weight of seed planted and height of tallest culm, no significant difference between these are found. This is in agreement again with Leighty (10) and Whitcomb (20) that either a single culm or an average of the culms of a plant can be used as a basis for determination and the same results will be obtained. From this data, then, it would seem that the weight of seed planted has only a very small, if any, influence on the height of the resultant plants at maturity.

For average weight of seeds planted and average weight of kernels per plant harvested (tables 26 & 27) there are small negative correlations of -.1295±.0292 in the Victory oats and -.1091±.0324 in the Irish Victor. Altho the correlations are small in both cases they suggest that possibly the varieties may not be pure lines for size of seed. In a pure line no correlation would be expected

	72-76	76-80	80-84	84-88	88-92	92-96	96-100	100-104	104-108	108-112	112-116	116-120	120-124	124-128	128-132	132-136	Totals
10-12											2	6	4	4	3		19
12-14	1							1	2	2	5	9	9	4			33
14-16									1	1	8	5	5	10	2	1	33
16-18											2	5	14	11		1	33
18-20										2	1	5	9	10	7		34
20-22											1	3	13	12	5		34
22-24								1		2	2	8	13	2	3	5	36
24-26								1			4	4	13	10	4		36
26-28											2	5	20	3	1	2	33
28-30					2						1	2	10	9	10	1	35
30-32							1				2	11	14	4	3		35
32-34									1		4		9	10	9	3	36
34-36					1			1	3		4	7	12	3	1		32
36-38												3	9	10	8	3	33
38-40			1				1					6	12	11	2		33
40-42											1	2	8	4	4		19
Totals	1	0	1	0	3	0	2	4	7	7	39	81	174	117	62	16	514

Table No. 10. Correlation between weight of individual seeds, in milligrams, subject; and height of tallest culm at maturity, in centimeters, relative. Victory.

$r = .0954 \pm .0295$

	88- 92	92- 96	96-100	100-104	104-108	108-112	112-116	116-120	120-124	124-128	128-132	132-136	Totals
10-12							1	2	3	4			10
12-14		2	1		3		3	1	6	7	4	3	30
14-16				1		1	2	3	5	11	8		31
16-18						2		6	3	11	3	4	29
18-20							1	4	7	11	5	3	31
20-22	1		1		1		1	1	8	11	8	1	33
22-24	1					2	1	5	9	7	4	3	32
24-26					1	1		1	6	13	8	1	31
26-28							4	4	8	9	5	2	32
28-30								4	11	11	6	1	33
30-32							1	6	12	8	4		31
32-34							7		6	13	3		29
34-36						1	1	3	11	10	4	1	31
36-38								6	11	10	3		30
38-40								3	1	1	3	2	10
Totals	2	2	2	1	5	7	22	49	107	137	68	21	423

Table No. 11. Correlation between weight of individual seeds, in milligrams, subject; and height of tallest culm at maturity, in centimeters, relative. Irish Victor

$r = .0605 \pm .0327$

	72- 76	76- 80	80- 84	84- 88	88- 92	92- 96	96-100	100-104	104-108	108-112	112-116	116-120	120-124	124-128	128-132	132-136	136-140	Totals
10-12											2	6	4	4	3			19
12-14	1							1	2	3	7	10	8	1				33
14-16									1	3	10	4	4	8	2	1		33
16-18										2	2	8	11	9		1		33
18-20									1	4	2	3	8	11	5			34
20-22										1	3	8	11	9	2			34
22-24								1		6	4	8	8	3	1	5		36
24-26								1		3	10	5	7	8	2			36
26-28								1		4	3	9	11	4		1		33
28-30					2					1	8	5	7	5	6	1		35
30-32							1		4	2	3	8	10	4	3			35
32-34									1	3	5	3	6	9	7	1	1	36
34-36					1			1	3	3	7	4	9	3	1			32
36-38									1		2	9	11	6	3	1		33
38-40			1				1			3	6	10	5	7				33
40-42									1		1	7	7	2	1			19
Totals	1	0	1	0	3	0	2	5	14	38	75	107	127	93	36	11	1	514

Table No. 12. Correlation between weight of individual seeds, in milligrams, subject; and average height of culms, in centimeters, relative. Victory.

$r = -.0192 \pm .0297$

	88- 92	92- 96	96-100	100-104	104-108	108-112	112-116	116-120	120-124	124-128	128-132	132-136	Totals
10-12					2		1	1	4	2			10
12-14	1	1	1		5	1	4	7	1	6	3		30
14-16				2	1	3	3	8	7	5	2		31
16-18				1	2	2	5	9	3	4	2	1	29
18-20						3	4	10	9	4	1		31
20-22	2				4	3	6	4	7	4	2	1	33
22-24	1					6	8	8	4	2	2	1	32
24-26					2	6	6	5	6	3	3		31
26-28						2	11	13	4	2			32
28-30						1	6	7	11	6	2		33
30-32						3	5	13	7	2	1		31
32-34					1		11	6	6	4	1		29
34-36					1	3	5	10	7	4	1		31
36-38					1	3	7	9	8	2			30
38-40						1	2	2	2	3			10
Totals	4	1	1	3	19	37	84	112	86	53	20	3	423

Table No. 13. Correlation between weight of individual seeds, in milligrams, subject; and average height of culms, in centimeters, relative. Irish Victor.

$r = .0554 \pm .0327$

between the size of the seed planted and size of kernels harvested.

Between weight of seed planted and average length of panicles per plant harvested (tables 28 & 29) there is no correlation in the Victory oats, while there is a medium correlation of .1838± .0317 in the Irish Victor. Between the two varieties there is a difference of .2085±.0434 in the coefficients of correlation for the two characters. This difference is nearly five times its probable error and, therefore, probably significant. From these results it seems that the weight of seed had an influence on this character in the Irish Victor but not in the Victory oats.

In both varieties there is a medium positive correlation between size of seed planted and each of the following characters of the resultant plants: number of culms per plant, total length of culms, number of seeds, total weight of plant, weight of straw, weight of grain, and total length of panicles per plant. The correlations range from .1787±.0317 for number of culms in Irish Victor to .3027±.0298 for weight of straw per plant in the same variety (tables 14-25 & 30-31). In comparing the coefficients of correlation for each of these characters, respectively in the two varieties, no significant differences are found between any corresponding pair. From this it appears that these characters are considerably associated in oats. This agrees with the results obtained by Arny and Garber (1) with wheat. In a favorable year, then, the correlation between weight of seed planted with yield and other associated characters will be only moderate. Under spacing conditions similar to those used in this experiment, the amount of tillering shown by the plant during its early growth will be a fairly reliable indication of the relative yields that can be expected.

	75- 90	90-105	105-120	120-135	135-150	150-165	165-180	180-195	195-210	210-225	225-240	240-255	255-270	270-285	285-300	300-315	315-330	330-345	345-360	360-375	Totals
10-12			8	11																	19
12-14	1	2	16	9						1	4										33
14-16			10	15						4	4										33
16-18			7	21						2	3										33
18-20			5	22						4	1	2									34
20-22			3	20						1	7	2							1		34
22-24		1	9	17						3	4	1					1				36
24-26		1	7	15						3	8	2									36
26-28			5	14					1	4	7	2									33
28-30	2		3	16						2	8	3						1			35
30-32		1	8	17					1	6	2										35
32-34			4	20	1					3	5	3									36
34-36		4	7	13						5	3										32
36-38			3	14						1	8	5					1			1	33
38-40	1	1	4	10						3	13	1									33
40-42			2	9						2	5	1									19
Totals	4	10	101	243	1	0	0	0	2	44	82	22	0	0	0	0	2	1	1	1	514

Table No. 14. Correlation between weight of individual seeds, in milligrams, subject; and total length of culms, in centimeters, relative. Victory.

$r = .2130 \pm .0284$

	80-100	100-120	120-140	140-160	160-180	180-200	200-220	220-240	240-260	260-280	280-300	300-320	320-340	340-360	360-380	380-400	400-420	420-440	440-460	460-480	480-500	Totals
10-12			5				2	2	1													10
12-14	2	4	4			1	2	6	5	1			2	3								30
14-16		3	4				1	5	7	1		1	2	5	2							31
16-18		4	3				2	7	5			1	1	5	1							29
18-20		3	2				2	12	8				1		3							31
20-22	1	1	5		1		4	6	6				5	1	3							33
22-24	1	5	2				1	13	5	1			2	1	1							32
24-26		3	5				2	7	6				4	3	1							31
26-28		5					1	16	6				1	3								32
28-30		2	8				1	7	5				3	3	2	1					1	33
30-32		3	3				1	15	3				1	3	2							31
32-34		6	2				1	8	6				1	4	1							29
34-36		3	2				1	10	5				2	4	2	2						31
36-38							2	8	7				1	6	1			1		3	1	30
38-40							1	2	3					1	2					1		10
Totals	4	42	45	0	1	1	24	124	78	3	0	2	26	42	21	3	0	1	0	4	2	423

Table No. 15. Correlation between weight of individual seeds, in milligrams, subject; and total length of culms, in centimeters, relative. Irish Victor.

$r = .1872 \pm .0316$

	1	2	3	Totals
10-12	19			19
12-14	28	5		33
14-16	25	8		33
16-18	28	5		33
18-20	27	7		34
20-22	23	10	1	34
22-24	27	8	1	36
24-26	23	13		36
26-28	19	14		33
28-30	21	13	1	35
30-32	26	9		35
32-34	25	11		36
34-36	24	8		32
36-38	17	14	2	33
38-40	16	17		33
40-42	11	8		19
Totals	359	150	5	514

Table No. 16. Correlation between weight of individual seeds, in milligrams, subject; and number of culms per plant, relative. Victory.

$r = .2038 \pm .0285$

	1	2	3	4	Totals
10-12	5	5			10
12-14	10	15	5		30
14-16	7	14	10		31
16-18	7	14	8		29
18-20	5	22	4		31
20-22	7	17	9		33
22-24	8	20	4		32
24-26	8	15	8		31
26-28	5	23	4		32
28-30	10	13	9	1	33
30-32	6	19	6		31
32-34	8	15	6		29
34-36	5	16	10		31
36-38		17	8	5	30
38-40		6	3	1	10
Totals	91	231	94	7	423

Table No. 17. Correlation between weight of individual seeds, in milligrams, subject; and number of culms per plant, relative. Irish Victor.

$r = .1787 \pm .0317$

	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110-120	120-130	130-140	140-150	150-160	160-170	170-180	180-190	190-200	200-210	Totals
10-12					4	6	2	6	1												19
12-14	1			3	1	5	8	7	2	1	2		1	1	1						33
14-16				1	1	4	8	3	6		4	2	4								33
16-18						1	5	7	10	4	2	1	2	1							33
18-20						2	3	9	3	5	6	4		1	1						34
20-22							2	9	7	4	2	3	3	3				1			34
22-24					2		7	4	4	6	5	3	3		1		1				36
24-26				1	1	3	4	4	5	9	1	4	2	1		1					36
26-28				1		1	2	5	5	5	4	2	5	2				1			33
28-30	2				1	2		5	5	5	5	7	1		1		1				35
30-32			1			2	2	8	6	8	4	1	3								35
32-34					1	2	3	3	8	8	2	2	6		1						36
34-36	1			2	1		3	3	5	6	5	2	2	1	1						32
36-38					1	1	2	3	3	4	5	3	3	3	3		1			1	33
38-40		1				1	1	3	6	2	3	5		8	1	1		1			33
40-42								2	2	6	4	1	3				1				19
Totals	4	1	1	8	13	30	52	81	78	73	54	40	38	21	10	2	4	3	0	1	514

Table No. 18. Correlation between weight of individual seeds, in milligrams, subject; and number of seeds per plant, relative. Victory.

$r = .2901 \pm .0272$

	15-30	30-45	45-60	60-75	75-90	90-105	105-120	120-135	135-150	150-165	165-180	180-195	195-210	210-225	225-240	240-255	255-270	270-285	285-300	Totals
10-12				1	5	1	1	1	1											10
12-14	1	5	1	3	2	2	1	5	3	1	5	1								30
14-16		2	2	1	1	3	3	5	2	6	1	4		1						31
16-18		1	2	2	3	2	4	3	3	4	3	1	1							29
18-20		1	2		2	2	7	7	1	5	2		1	1						31
20-22	1	2		3	1	6	2	1	7	3	4	1	2							33
22-24	1	2	2	2	1	5	6	3	4	3	2		1							32
24-26		2		1	2	5	6	2	6	2	5									31
26-28			3		1	3	8	6	5	5			1							32
28-30				2	5	4	3	2	5	4	4	1			2				1	33
30-32			1	3	1	2	5	6	7	2	2	1		1						31
32-34			4	4		1	1	4	2	6	4		2	1						29
34-36			1		3	2	3	3	4	5	3	4	1			2				31
36-38						3	3	4	4	3	1	3	3	2	1	2	1			30
38-40							1	1	1		3		1	1	1	1				10
Totals	3	15	18	22	27	41	54	53	55	49	39	16	13	7	4	5	1	0	1	423

Table No. 19. Correlation between weight of individual seeds, in milligrams; subject; and number of seeds per plant, relative. Irish Victor.

$r = .2765 \pm .0303$

	6-12	12-18	18-24	24-30	30-36	36-42	42-48	48-54	54-60	60-66	66-72	72-78	78-84	84-90	90-96	96-102	102-108	108-114	114-120	120-126	126-132	132-138	138-142	Totals
10-12						5	5	4	4	1														19
12-14	1				3	2	5	9	7			2	1	1	1		1							33
14-16					1	3	3	6	4	6		4	4	1	1									33
16-18							1	4	8	7	5	5		1	2									33
18-20							2	3	6	6	3	6	5	1		1		1						34
20-22								2	4	9	5	3	1	4	3		1	1		1				34
22-24					1	1	1	4	7	2	4	6	3	3	1	1	1			1				36
24-26				1		1	3	3	3	5	6	3	5	3	1	1		1						36
26-28							2	2	2	6	4	7	1	1	5	3								33
28-30		2				1	1	1	3	4	5	5	4	5	1	1		1	1					35
30-32				1			2	3	4	10	5	4	5	1										35
32-34						1	2	2	4	7	7	3	1	4	4		1							36
34-36		1			3		1	3	4	5	5	4	1	3	1	1								32
36-38						1	2	3		4	5	3	2	3	3	4	2						1	33
38-40			1				1		4	5	2	5		4	4	4	1	2						33
40-42								1	1	4	3	3	2	2	2			1						19
Totals	1	3	1	2	8	15	31	50	65	81	59	63	35	37	29	16	7	7	1	2	0	0	1	514

Table No. 20. Correlation between weight of individual seeds, in milligrams, subject, and total weight of individual plants, in decigrams, relative. Victory.

$r = .2759 \pm .0275$

	8- 16	16- 24	24- 32	32- 40	40- 48	48- 56	56- 64	64- 72	72- 80	80- 88	88- 96	96-104	104-112	112-120	120-128	128-136	136-144	144-152	152-160	160-168	168-176	Totals
10-12					2	5		1	1	1												10
12-14		3	3	1	4	1	1	2	3	3	2	1	5	1								30
14-16		1	2	1	1	1	2	2	3	6		5	2	4		1						31
16-18			1	2	1	5	1	1	4	3	3	3	3		1	1						29
18-20			1	2	1	2	2	1	5	7	3	3	1	1	1		1					31
20-22		1	2		2	2	4	4	1	2	6	3	2	2	2							33
22-24	1		3	1	2	1	2	6	3	3	4	2	2	1		1						32
24-26			2		1	1	6	2	4	3	5	3	3	1								31
26-28				3	1	1		5	7	5	5	2	2		1							32
28-30				1	1	4	5	1	4	3	2	4	3	2			1	1			1	33
30-32				2	2		2	5	3	6	6	1	1	1	1	1						31
32-34				4	3	1		1	1	6	2	4	3	1	2	1						29
34-36				1		3		3	3	4	3	3	4	3	1	1		1	1			31
36-38							2	1	2	7	3	2	1	4	1	1	3		2		1	30
38-40								1	1		1		2	1	1			1	2			10
Totals	1	5	14	18	21	27	27	36	45	59	45	36	34	22	11	7	5	3	5	0	2	423

Table No. 21. Correlation between weight of individual seeds, in milligrams, subject; and total weight of individual plants, in decigrams, relative. Irish Victor.

$r = .2874 \pm .0301$

	4-8	8-12	12-16	16-20	20-24	24-28	28-32	32-36	36-40	40-44	44-48	48-52	52-56	56-60	60-64	64-68	68-72	72-76	76-80	80-84	84-88	Totals
10-12					5	5	5	4														19
12-14	1			3	3	9	7	5		1	2	1		1								33
14-16				1	4	6	6	4	3	5	2	1	1									33
16-18					1	2	8	10	5	4		2	1									33
18-20					1	1	5	8	7	7	3			1		1						34
20-22							5	8	7	3	2	4	2	1	1		1					34
22-24					2	4	5	5	4	5	6	2	1		1		1					36
24-26				1	1	4	3	5	8	1	6	3	3			1						36
26-28				1		1	4	5	4	8	1	1	5	3								33
28-30	1	1			1	2	2	3	6	4	4	7	1		2	1						35
30-32			1			3	3	12	5	5	4	2										35
32-34					1	4	3	7	6	5	1	5	2		2							36
34-36		1		3	1	2	5	6	7	1	3	3										32
36-38					1	3	2	3	5	4	3	3	4	1	2						1	33
38-40			1			1	3	5	3	5	1	5	6	2	2							33
40-42						1	1	5	3	1	2	4	1	1								19
Totals	2	2	2	9	21	48	67	95	73	59	40	43	27	10	10	3	2	0	0	0	1	514

Correlation between weight of individual seeds, in milligrams, subject; and weight of straw per plant, in decigrams, relative. Victory.

Table No. 22.

$r = .2712 \pm .0275$

	8-12	12-16	16-20	20-24	24-28	28-32	32-36	36-40	40-44	44-48	48-52	52-56	56-60	60-64	64-68	68-72	72-76	76-80	80-84	84-88	88-92	92-96	Totals
10-12				1	4	2		1	1	1													10
12-14	1	5		1	4	1	1	3	2	1	3	2	2	4									30
14-16	1	1	1	1	1	2	1	1	4	4	2		5	5	1		1						31
16-18		1	1	2		4		2	5	1	4	2	3	1	2	1							29
18-20			2	1	2	1	2	1	3	7	2	5		2	1	1			1				31
20-22		2	2		2	4	2	3	1		5	4	2	3	1	2							33
22-24	1	1	3	1	1	1	3	3	4	3	4	2	2	1	1		1						32
24-26		2			2		6	1	6	1	3	5	1	3	1								31
26-28				3	2			4	7	5	5	1	3	1		1							32
28-30				1	2	5	1	1	3	4	3	1	3	5	1		1		1			1	33
30-32				4			2	3	4	5	5	3	1	1	1	1	1						31
32-34			1	4	2	1			1	2	4	5	2	2	2	2	1						29
34-36				1	1	2		3	2	3	2	4	3	3	3	1		1		2			31
36-38							1	2	1	5	5	1	2	3	2	1	1	2	1		2	1	30
38-40								1		1	1		1	1	1	1				1	2		10
Totals	3	12	10	20	23	23	19	29	44	43	48	35	30	35	17	11	6	3	3	3	4	2	423

Table No. 23. Correlation between weight of individual seeds, in milligrams, subject; and weight of straw per plant, in decigrams, relative. Irish Victor.

$r = .3027 \pm .0298$

	4-8	8-12	12-16	16-20	20-24	24-28	28-32	32-36	36-40	40-44	44-48	48-52	52-56	56-60	60-64	64-68	Totals
10-12				7	6	5	1										19
12-14	1		3	5	7	11		3	1	1	1						33
14-16			1	3	9	7	3	6	3	1							33
16-18				1	3	12	10	4	1	2							33
18-20					6	8	5	7	6	2							34
20-22					2	10	8	5	4	2	2		1				34
22-24				2	7	4	6	8	5	2	1		1				36
24-26			1	2	6	4	14	2	5	1		1					36
26-28			1	1	2	7	6	6	4	5		1					33
28-30	2			1	2	5	7	9	6	1	1	1					35
30-32		1		1	3	7	11	10	2								35
32-34				2	3	5	12	6	4	4							36
34-36	1		3		3	5	5	9	4	1	1						32
36-38				1	3	4	4	8	4	4	3	1		1			33
38-40	1			1	1	4	6	4	5	6	3		2				33
40-42						2	7	4	4	1			1				19
Totals	5	1	9	27	63	100	105	91	58	33	12	4	5	1	0	0	514

Table No. 24. Correlation between weight of individual seeds, in milligrams, subject; and weight of seed per plant, in decigrams, relative. Victory.

$r = .2915 \pm .0272$

	4- 8	8-12	12-16	16-20	20-24	24-28	28-32	32-36	36-40	40-44	44-48	48-52	52-56	56-60	60-64	64-68	68-72	72-76	76-80	Totals
10-12				1	3	3	1		2											10
12-14	1	4	1	1	5		3	2	5	2	2	3	1							30
14-16		1	2	1	2	2	2	3	6	2	4	4	1	1						31
16-18		1	1	2	3	3	1	3	4	6	1	2	1	1						29
18-20			3		1	4	3	4	7	4	1	2	1		1					31
20-22	2	2		2	2	3	5	1	3	6	2	3	2							33
22-24		2	2	1	2	2	8	3	3	3	2	3		1						32
24-26		2			2	4	5	3	4	5	3	3								31
26-28				3	1	1	6	6	7	5	1	1	1							32
28-30				3	4	3	2	4	3	4	3	4			1	1			1	33
30-32			1	3	1		7	2	8	4	3		1	1						31
32-34			1	6	1	2		2	6	1	5	2	1	2						29
34-36			1		4	1	2	3	3	5	4	4	2			2				31
36-38						1	3	2	5	4	2	1	5	1	3		2	1		30
38-40							1	1		1	1	2	1			2	1			10
Totals	3	12	12	23	31	29	49	39	66	52	34	34	17	7	5	5	3	1	1	423

Table No. 25. Correlation between weight of individual seeds, in milligrams, subject; and weight of seed per plant, in decigrams, relative. Irish Victor.

$r = .2684 \pm .0304$

	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	Totals
10-12											3	6	5	5					19
12-14									2	1	3	12	9	4	2				33
14-16									1		4	7	13	5	2			1	33
16-18											1	10	15	5	1	1			33
18-20											2	8	13	7	3	1			34
20-22											2	14	13	3		2			34
22-24											2	7	11	15	1				36
24-26											4	14	11	4	3				36
26-28									1	1	2	9	10	10					33
28-30									1		2	11	14	7					35
30-32								1		1	1	11	14	4	3				35
32-34									1		4	13	13	5					36
34-36						1			1	1		13	11	2	1	1		1	32
36-38								1			6	15	5	6					33
38-40	1										9	12	7	3				1	33
40-42											3	7	7	1	1				19
Totals	1	0	0	0	0	1	0	2	7	4	48	169	171	86	17	5	0	3	514

Table No. 26. Correlation between weight of individual seeds, in milligrams, subject and average weight of seeds per plant, in milligrams, relative. Victory.

$r = -.1295 \pm .0292$

	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Totals
10-12								1	1	2	5	1			10
12-14								1	1	4	9	8	5	2	30
14-16								1	1	8	12	4	4	1	31
16-18				1					1	3	13	7	4		29
18-20							1		2	7	11	9	1		31
20-22							1	1		4	10	13	4		33
22-24									1	9	14	5	3		32
24-26								1	1	7	12	6	3	1	31
26-28								1	3	7	10	5	5	1	32
28-30				1					2	5	13	10	2		33
30-32								1		7	18	5			31
32-34	1				1				1	10	7	6	3		29
34-36		1						2	3	10	8	5	1	1	31
36-38										6	16	6	2		30
38-40										3	7				10
Totals	1	1	0	2	1	0	2	9	17	92	165	90	37	6	423

Table No. 27. Correlation between weight of individual seeds, in milligrams, subject; and average weight of seeds per plant, in milligrams, relative. Irish Victor.

$r = -.1091 \pm .0324$

	12.5-13.5	13.5-14.5	14.5-15.5	15.5-16.5	16.5-17.5	17.5-18.5	18.5-19.5	19.5-20.5	20.5-21.5	21.5-22.5	22.5-23.5	23.5-24.5	24.5-25.5	25.5-26.5	Totals
10-12								4	5	5	3	1	1		19
12-14	1			1			6	8	7	6	3	1			33
14-16						1	3	8	7	6	6		2		33
16-18						2		5	9	8	6	2	1		33
18-20						1	5	1	8	7	4	4	4		34
20-22							2	5	9	9	4	4	1		34
22-24						2	5	7	7	5	5	3	2		36
24-26						2	8	5	8	4	6	1	1	1	36
26-28					1	4	1	7	8	5	5	2			33
28-30	1	1					8	6	6	4	1	6	2		35
30-32						3	6	6	7	7	2	3	1		35
32-34							6	5	7	5	7	3	3		36
34-36		1			1	4	1	4	7	8	5	1			32
36-38						2	3	5	9	6	2	1	5		33
38-40			1				7	3	9	5	7	1			33
40-42						2	3	1	3	4	2	1	2	1	19
Totals	2	2	1	1	2	23	64	80	116	94	68	34	25	2	514

Table No. 28. Correlation between weight of individual seeds, in milligrams, subject; and average length of panicles per plant, in centimeters, relative. Victory.

$r = -.0247 \pm .0297$

	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Totals
10-12									2		2	3	2		1		10
12-14	1			2				1	3	4	8	6	2	3			30
14-16								3	1	5	6	10	4	2			31
16-18								2	1	4	5	6	7	3	1		29
18-20								1		5	9	11	4	1			31
20-22					1	1		1	2	4	10	7	2	3	2		33
22-24				1					4	7	6	9	5				32
24-26									6	1	9	8	5		2		31
26-28									1	6	10	12	1	2			32
28-30					1					5	6	8	4	6	2	1	33
30-32									1	4	9	12	1	3	1		31
32-34								1	1	3	9	7	7		1		29
34-36										4	8	6	5	7	1		31
36-38					1				3		5	10	8	3			30
38-40											2	1	5	1		1	10
Totals	1	0	0	3	3	1	0	9	25	52	104	116	62	34	11	2	423

Table No. 29. Correlation between weight of individual seeds, in milligrams, subject; and average length of panicles per plant, in centimeters, relative.
Irish Victor.

$r = .1838 \pm .0317$

	12-15	15-18	18-21	21-24	24-27	27-30	30-33	33-36	36-39	39-42	42-45	45-48	48-51	51-54	54-57	57-60	60-63	Totals
10-12			4	13	2													19
12-14	1	1	11	14	1				2	1	2							33
14-16			6	17	2				2	5	1							33
16-18			3	22	3				2	2	1							33
18-20			2	17	8				4	2		1						34
20-22			1	17	5				1	5	3	1					1	34
22-24			7	15	5				4	2	2					1		36
24-26			4	16	3				2	10	1							36
26-28		1	4	12	2			1	3	5	4	1						33
28-30	2		3	8	8				3	7	3						1	35
30-32			6	16	4				4	5								35
32-34			4	15	6				2	5	4							36
34-36	1		5	17	1			1	1	4	2							32
36-38			2	9	6				3	5	5	1			1		1	33
38-40		1	1	13	1				5	5	6	1						33
40-42				8	3				5	1	1		1					19
Totals	4	3	63	229	60	0	0	2	43	64	35	5	1	0	1	1	3	514

Table No. 30. Correlation between weight of individual seeds, in milligrams, subject; and total length of panicles, in centimeters, relative. Victory.

$r = .2158 \pm .0284$

	8-12	12-16	16-20	20-24	24-28	28-32	32-36	36-40	40-44	44-48	48-52	52-56	56-60	60-64	64-68	68-72	72-76	76-80	80-84	84-88	88-92	Totals
10-12				4	1			3	2													10
12-14	1	1	4	4	1		2	1	8	3			2	2	1							30
14-16			3	4				4	8	2			5	4	1							31
16-18			2	4	1		1	3	6	4			2	4	2							29
18-20			2	3			1	6	13	2			1	2	1							31
20-22		1	1	3	2	1	1	3	8	4			3	6								33
22-24		1	4	3				8	10	2			1	3								32
24-26			1	5	2			4	10	1		3	2	3								31
26-28				5				7	15	1			1	3								32
28-30				7	3			2	8	3			5	2	1	1					1	33
30-32			1	4	1		1	3	12	3			2	4								31
32-34			3	4	1		1	1	9	4				3	3							29
34-36			1	4				2	8	5	1		2	5	1	2						31
36-38						1		1	10	5		2		2	4			1	2	2		30
38-40								1	3	1	1				2	1			1			10
Totals	1	3	22	54	12	2	7	49	130	40	2	5	26	43	16	4	0	1	3	2	1	423

Table No. 31. Correlation between weight of individual seeds, in milligrams, subject; and total length of panicles, in centimeters, relative. Irish Victor.

$r = .2209 \pm .0312$

AVERAGE YIELDS OF WEIGHT CLASSES

The average yield for each of the different weight classes of seed planted of the two varieties and the number of plants harvested of each class are given in table 32. The figures show a rather irregular gain in yield with an increase in weight of seed. In Figs. VI and VII the same data is given in the form of graphs showing the regression for weight of seed and yield for the two varieties.

Table 32.

Weight classes of seeds planted and average yield of resultant plants.

Weight of individual seeds planted mgm.	Victory		Irish Victor	
	Number of plants	Average weight of grain dgm.	Number of plants	Average weight of grain dgm.
10-12	19	22.0	10	26.8
12-14	33	24.5	30	30.6
14-16	33	27.2	31	36.2
16-18	33	28.9	29	34.5
18-20	34	30.6	31	35.2
20-22	34	32.2	33	33.0
22-24	36	31.1	32	32.5
24-26	36	29.3	31	34.5
26-28	33	31.9	32	34.7
28-30	35	31.0	33	37.6
30-32	35	29.2	31	35.2
32-34	36	31.0	29	35.3
34-36	32	29.1	31	39.9
36-38	33	34.7	30	47.0
38-40	33	35.0	10	51.0
40-42	19	34.0		

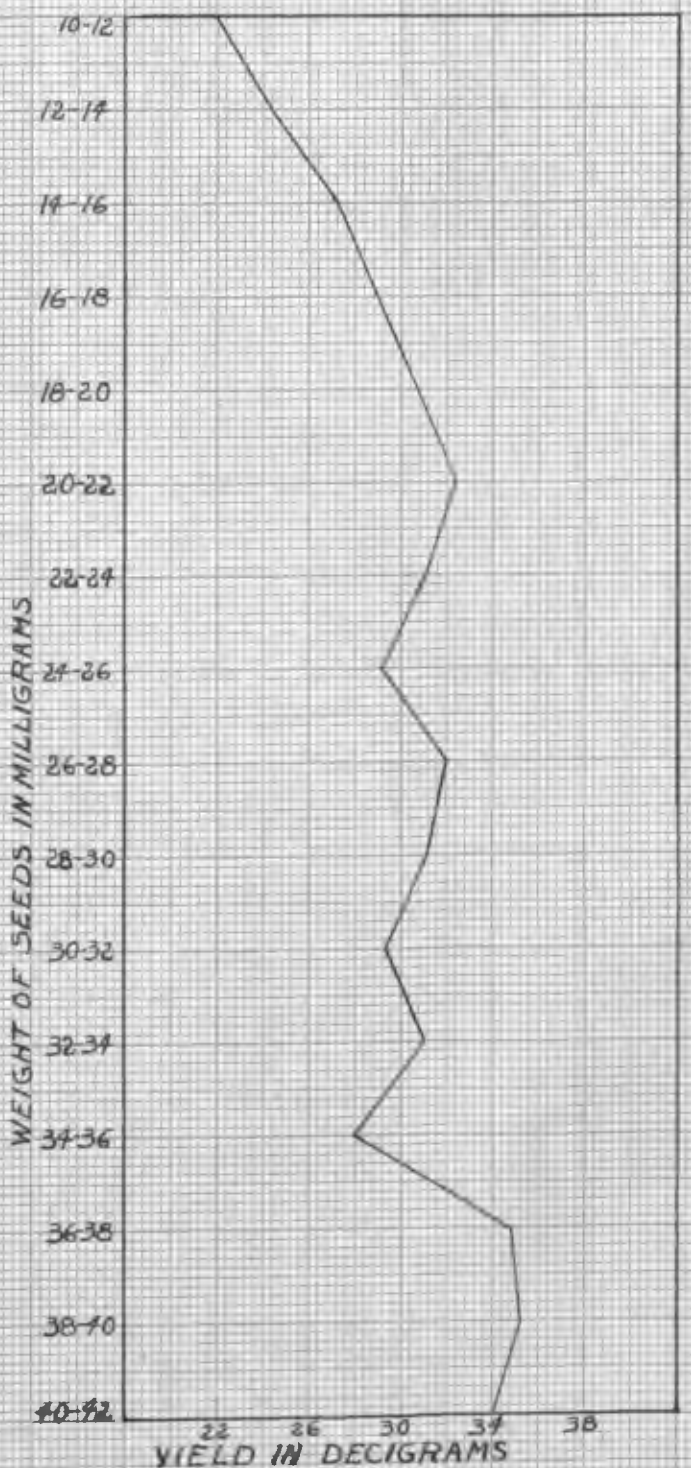

Fig. VI. Graph showing regression for average weight of seed and average yield per plant. Victory.

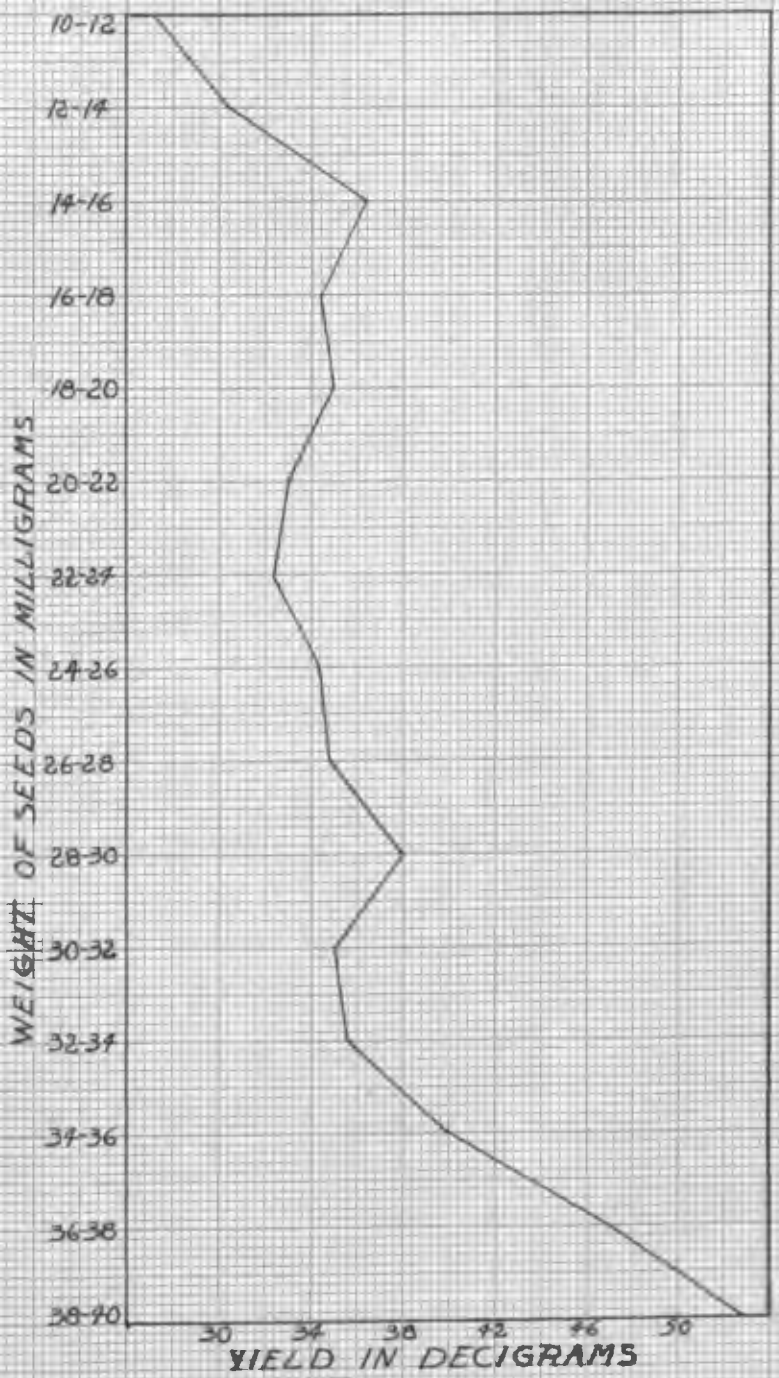

Fig. VII. Graph showing regression for average weight of seed and average yield per plant. Irish Victor.

SUMMARY AND GENERAL DISCUSSION

In this paper two varieties of oats have been compared with regard to the development of the various characters, their variability, and with respect to the influence of the weight of seed planted has had upon the resultant plants. The two varieties have been constantly compared in all respects in order to bring out varietal differences. The results obtained have been discussed under the various headings of the paper.

In development of the different characters, as shown by their means, some varietal differences occur. Thus, when space planted, the Victory oats have a larger kernel while the Irish Victor produces the largest number of kernels per plant. Under these conditions the Irish Victor produced more tillers per plant and was the heavier yielder in both grain and straw.

In variability as shown by the standard deviations and coefficients of variability, the two varieties were much alike. In both varieties the amount of variation increased with an increase in the means of any character.

The relation between the size of seed planted and the resultant plant characters was very similar in the two varieties. Only a small increase in yield per plant resulted from an increase in weight of seed planted. A small negative correlation was found between weight of seed planted and the average weight of the kernels harvested.

Based on these results, then, it would seem that, in a favorable season such as 1917 and on soil of good fertility, a moderate increase in the yield of oats can be expected from selecting

the heaviest kernels for seed. This increase is apparently due to the larger food supply in the heavier seed which give the resultant plants a more vigorous initial growth. No improvement in the quality of the resulting crop can be expected from such selection.

CONCLUSIONS

Based upon one season's study of two varieties of oats, the following conclusions seem apparent:

1. An increase in means is generally accompanied by an increase in variability.

2. Standard deviations and coefficients of variability agree rather consistently as measures of variation.

3. With only two minor exceptions, the coefficients showing the correlation between weight of seed and resultant plant characters agree consistently in the two varieties.

4. The influence of the weight of seed planted on the resulting oat plant is much more marked during the early stages of growth than is apparent at maturity.

5. The larger seeds produced the heavier tillering plants. An increase in the number of culms per plant resulted in larger yields per plant.

6. In the two varieties studied, a medium but consistent and positive correlation is found between weight of seed planted and each of the following characters of the resultant plants: number of culms, total length of culms, total length of panicles, total weight per plant, weight of straw, number of seeds, and weight of grain per plant.

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