VARIATIONS AND CORRELATIONS IN WHEAT

by

John Barclay Smith, B. S. in Agr.

SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS

in the

GRADUATE SCHOOL

of the

UNIVERSITY OF MISSOURI

1916

*Approved
5/15/16
C. B. Hutchison*

Table of Contents

	Page
Introduction	1
Review of Literature	
Variation	2
Correlations	5
Methods	12
Material	17
The Constants	20
Means	23
Standard Deviations	26
Coefficients of Variability	30
The Graphs	34
Coefficients of Correlation	38
Summary	90
Literature Cited	92

Introduction

Much interest is being displayed in the improvement of small grains. Methods of effecting an advance in the yield or quality of wheat, oats, barley, and other grains are being extensively investigated. Recently the theory of pure lines has been applied as a method of such improvement and some very favorable results have been obtained. This method requires a very close analysis of the material dealt with, and consequently biometry has been brought into use. Biometry enables the breeder to determine accurately the relation of different plant characters to each other or of different groups of plants to each other. A knowledge of these relations is a great aid to the breeder as a guide to further work.

The point especially sought for in this investigation is the relation between mixed populations and pure lines of the same variety. It is desired to know whether a character is more or less variable or more or less highly correlated in a pure line than in a mixed population. What generalities can be drawn in regard to the relations between pure lines and mixed populations? The following discussion will throw some light on the question.

REVIEW OF LITERATURE

Variation

Since the time of Darwin an immense amount of study has been done on the phenomenon of variation. Darwin demonstrated that all individuals of a species differed from one another to some extent. Later workers by better methods of observation and by the greatly extended scope of their observations, demonstrated the tremendous extent of variability. Statistical studies brought to light many facts that escaped the casual observer. Laws and relations that before had never been thought of or had existed only in theory, now became established facts. The field opened up by this study was immense and even now, after a half century, only a bare beginning has been made.

Statistical studies of variation in agricultural plants are confined for the most part to the last ten or fifteen years. The plant breeding laboratories of Cornell, Kansas and North Dakota Experiment Stations have contributed largely to this work. The work on wheat reported by these stations will be briefly reviewed.

Roberts' (1911) studies in variation in pure lines of wheat show that for the characters, length of spike, number of culms, number of spikelets, number of flowers per spikelet, and number of kernels per spike, respectively, the relative variability through three strains is substantially the same. Some slight differences are not-

ed, however, in spike length and the number of spikelets per head. He does not make a comparison between a pure line and a mixed population. Comparisons of the variability of the same pure lines from year to year show decided differences. He gives good evidence that seasonal and "place variations" influence very markedly the biometrical constants of certain characters of wheat. Some characters are affected more than others. The better growing season is found to reduce variability.

Myers (1911) in studying the effects of fertility on variation, found that increased fertility decreased variability. This is consistent with Roberts' results. Love (1911) working with peas, buckwheat, and corn, found, however, that increase in fertility increased variability. DeVries "Die Mutation Theorie" (Darbyshire and Farmer 1909) points out that increased nutrition produces increased variability. He states that the nutrition of the mother plant on the seed has a great influence on the variability of the plant offspring, even greater influence in many cases, than nutrition during vegetative life itself. Darwin (1868) states, "Of all causes that induce variability, excess of food whether or not changed in nature, is probably the most powerful."

According to Love and Leighty (1914) in their work on variation in oats, an increased mean is always attended with an increased standard deviation and a decreased

mean with a decreased standard deviation.

Leighty (1914) in some independent but similar studies found the same to be true generally, but noted some exceptions.

Bearing directly on the point of comparison between pure lines and mixed populations, is the work of Johansen on his nineteen pure lines of beans. Comparing the standard deviations of each pure line with the same constant of the whole population of pure lines (Table 1), it is seen that the latter is higher in all except line A. The standard deviation of line A is 14 milligrams

Table #1

Line	No.of Beans	σ	Line	No.of Beans	σ
A	145	109	L	273	69
B	475	93	M	295	71
C	282	76	N	357	78
D	307	84	O	219	65
E	255	75	P	106	75
F	241	76	Q	305	69
G	533	78	R	83	66
H	418	70	S	159	72.5
J	712	74	T	<u>141</u>	<u>64</u>
K	188	66	Total 5494 $\sigma = 95.3$		

higher than the standard deviation of the mixed population, 109 as compared with 95. It will be sufficient to mention that when the beans were divided into lines on the basis of some character other than weight of seed,

it was found that the standard deviations always ranged above or below that of the mixed population, although mostly below.

Correlations

The amount of work that has been done in studies of correlations in the wheat plant is as yet comparatively slight. Much less has been reported. A great many references are available which cite general observations on the relation between one character and another, but these observations are not based on strict biometric ratios nor are they expressed in such terms. These throw some light on the problem in hand and will be briefly considered.

DeVries (1907) in citing an illustration of the great practical worth of biometry as a means of improving a plant, points out the work done on barley by Dr. Nilsson at Svalof, Sweden. The barley as cultivated in the central part of Sweden for the purposes of brewers had a very weak straw and in unfavorable seasons it would lodge, involving the loss of large parts of the harvest. After many years of selecting in the ordinary way and getting no results, Dr. Nilsson tried another method. He found a barley with strong haulms but less desirable as to the quality of its grain. He had observed that there was a relation between some marks of the hairs on the base of the scales and the composition of the albumen of the grain. Long,

straight hairs are correlated with coarse kernels, but short and crisp, more or less wooly hairs are indicative of those qualities which stamp a barley as a good kind for the brewery. On this assumption Dr. Nilsson began to search his stiff strawed variety for compact heads with suitable qualities of hairiness. Thousands of plants were examined out of which some sixty plants were selected. They were given a comparative test and finally the best one selected. It combined good brewing qualities with a strong haulm. When placed on the market this new variety soon displaced the old one. Its superior qualities have been of immense practical value to the farmers of Sweden.

DeVries (1907) points out several instances where being aware of a correlation between two apparently independent characters has helped the breeder to make great strides in the improvement of his plant.

In reviewing the work of various experimenters we find some conflicting data. Two characters that are directly correlated in one set of results are much less directly or indirectly correlated in another. Lawes and Gilbert (Lyons 1905) are quoted as attributing these apparent inconsistencies to variations in soil, climate and varieties.

Lyons (1905) is of the opinion that soil and climate conditions are great factors in determining the relation of yield to other characters of the plant.

Körnische and Werner are quoted (Lyons 1905) as stat-

ing that more straw and less grain are produced in moist climates than in dry. The thickness of straw and the weight of kernels from 100 heads are greater, while the percentage by weight of kernels to straw is much less in a moist climate. Haberlandt is quoted (Lyons 1905) as stating that a dry climate produces a kernel of especially heavier weight.

Lawes and Gilbert (1880) found that almost invariably a season favoring a long, continuous growing of the plant after heading, resulted in large yield of grain, high weight per bushel, and a plump kernel with low nitrogen content.

Georgeson (1893) found that there was a relation between maturity of seed used and yield of crop, the immature seed giving less yield than the mature.

Lyons (1905) found that with an increase in the weight of the kernel there is a corresponding increase in the number of kernels on the plant up to a certain point beyond the average kernel weight, then there will be a decrease and inversely. He found no relation between the average weight of kernel and the number of kernels on a spike. Newman (1912) in reviewing the work of Svalof, points out that a rising number of kernels in the spikelet was generally found with a corresponding increase in the weight of kernels. It simply indicates general vigor. This being true of the spikelet, would probably be true also of the spike. If it is, then this conflicts with

Lyons' observation. In accord with Lyons' statement on the relation of the average weight of kernel and the total number of kernels per plant, is that of Love (1911) who finds a correlation coefficient of $.251 \pm .033$ for these two characters. This coefficient indicates a slight tendency for the two characters to vary together. Lyons (1905) observed that there was little correlation between size of head and average size of kernel. Runker (1890) reports that the longest spikes produce the heaviest kernels, also that there is a direct correlation between weight of the spike and the average weight of kernels.

Love (1911) reports a correlation of $.278 \pm .033$ for height of plant and average weight of kernel. This would not be considered a very close correlation. Myers (1911) for the same characters, found a correlation of $.480 \pm .025$ which is relatively high. He states that the work of Love, just noted, is directly comparable to his own, the only difference being that Love's work was on pure lines while his was on mixed populations. It will be noted that there is a wide discrepancy.

Roberts (1911) states that there is high correlation ($.8345 \pm .0712$) between the number of culms per plant and the weight of grain per spike. Roberts attaches a great deal of significance to this point. He says that tillering is in all probability the most important vegetative phenomenon in the growth of the wheat plant so far as yield is concerned, since it is so highly correlated with

weight of grain per head.

Myers (1911) in making comparisons of correlations on soils of varying fertility, found a coefficient of .013 ± .032 for the number of culms and the average weight of culms per plant on ordinary soil.

Myers (1911) observed that an increased weight of straw is attended with an increased weight of grain. He adds, "This relation is most marked in the case of the individual culms." The coefficients are not expressed.

Both Roberts (1911) and Love (1911) found a high correlation between length of culm and size of the spike. Lyons (1905) finds that the tallest plants have the longest heads.

Newman (1912) in considering size of spike in its relation to yield, states that most often a large spike is indicative of a large yield but many times the best yielding varieties have small heads. He finds that a heavy head is highly correlated with a high yield. He finds that large kernels are often associated with large yields but he states that in pure lines the greatest yielders usually have average sized kernels. Lyons (1905) notes that the average weight of kernel increases with increased yield per head. He states also that as yield per plant decreases the average weight of kernel decreases. He finds a direct correlation between yield and volume of kernel and yield and the specific gravity of the kernel.

Sanborn (1893) reports that wheat seed of high specific gravity produced heavier kernels than seed with low specific gravity though actual yield was not increased.

Lyons (1905) commenting on yield and specific gravity relations, said low yield from low specific gravity seed may be due to the fact that such seed is not normal, but seed medium or high in specific gravity probably are equal in productive capacity.

Vestergaard (Newman 1912) found no correlation within pure lines between the weight of 1000 kernels and yield.

Indiana, Kansas, North Dakota, Tennessee, Nebraska, Ontario, and New South Wales experiment stations all report (Hunt 1910) that large kernels produce larger yields than smaller kernels.

Love (1911) found a correlation of $.327 \pm .031$ between yield and average weight of grains. This indicates some correlation between these two characters.

Between yield and the number of kernels per plant Love (1911) finds a correlation of $.985 \pm .001$. This is almost a perfect correlation. A high coefficient is to be expected, yet in this case it seems abnormally high.

Love (1911) gives a coefficient of correlation of $.294 \pm .032$ for the characters yield and height of plant. He states that he would expect a closer correlation between height of plant and yield but explains that a high yielding plant often has a few very short culms which would affect the average height very much altho the modal

height would still be great.

Lyons (1905) finds that increased yield goes hand in hand with increased tillering and increased height. Newman (1912) observed that tillering might have an important influence on yield but a strong tillering propensity might be objectionable. A great number of tillers might be put out at the expense of seed production. He states that such cases have been observed.

The value of a correlation, as an aid to the plant breeders, is variously estimated. During the first years at Svalof entire dependence was placed on biometrical methods to guide the breeder in his selections. Later it was decided that the worth of a plant could not be judged entirely on the basis of morphological characters and more dependence must be placed on direct judgment. Bolen and Tedin (Newman 1912) found plants having supposedly undesirable characters producing better results than plants especially selected for the desirable characters which they manifested. To these men this was a severe blow to their estimation of the importance of correlations in forming direct judgment as to practical values. Johannsen, Ravn and other workers (Newman 1912) of recent years have pointed out the futility of trying to judge practical qualities from other characters in accordance with the idea of correlations.

On the other hand, we find DeVries giving an unqualified support to the value of "judging of the worth

of single plants on the ground of seemingly insignificant marks." He can see infinite possibilities for the plant breeder in this method of attack. Several workers in the United States are placing confidence in the method but not to the extent perhaps that DeVries does.

Nilsson best sums up the situation when he says, "A progressive system of plant improvement cannot be a one sided system, but must embrace all possible methods of reaching the desired end." He thus takes a middle ground where correlation has its place and gets due recognition, but does not displace all other methods of plant improvement.

Methods

In a study of a group of plants such as this work involves, and such as was involved in all the work just referred to, it is necessary to make a number of measurements and resolve differences and resemblances of plant characters into exact mathematical terms. Plants are described as having so many culms, so many kernels, such and such heights and so on through a long list of measurements. These values are brought together and summarized into various mathematical coefficients which are expressions of various characteristics of the group of plants. This process is known as the science of Biometry.

The expressions which will be used in this study are mean, standard deviation, coefficient of variability, and

coefficient of correlation. It is without the scope of this paper to describe how these constants are derived. It will suffice to discuss briefly their significance.

The Mean "M" is an expression of the average value of the character in question for a particular group of individuals. It is a fair expression of type but is not to be relied on always for in some cases it may be misleading. Davenport (1907) cites an illustration to show how it might be misleading. "In a community of paupers, there lives a millionaire. Now the mean wealth of the community would be fairly high. Still the prevailing type would be paupers." The mean is to be depended upon as an expression of type only when it represents a group large enough and of such character that it coincides fairly closely with one's judgment as to the prevailing type. For purposes of comparison we can only use means, measured with the same unit, on the same character in different groups.

The Standard Deviation is an index to the variability of the individuals of a group, around the mean. It expresses accurately the degree to which the individuals within the group tend to wander, so far as the character in question is concerned. If the breeder is working toward a fixed ideal type it enables him to judge what progress he is making by comparing from time to time the indices of variability. Two different groups or races may be judged as to their relative value as regards a

specific character by comparing their standard deviations. It is not ordinarily practicable to compare the standard deviation of one character with that of a different character for two reasons: first, the one mean may be much larger than the other; and second, the two may be expressed in entirely different units, as grams and centimeters in which case direct comparison would be an absurdity.

The coefficient of variability, an abstract expression of variability reduced to a unit basis of type, affords the breeder a means of comparing any character as to its stability with any other character regardless of the size of its mean, the unit in which it was measured, or the time or place the comparison is made. While standard deviation restricts the breeder to a consideration of only one character, the coefficient of variability permits a comparison between any characters, no matter how divergent, whether on the same or different species or between plants and animals. This is of great importance. The breeder can thus know the real character of the whole population with which he works and can judge at all times of the trend of his race, whether it is going forward toward the ideal type or regressing away from it. He does not simply dabble in the whirlwind of variability and leave everything to chance.

The Coefficient of Correlation is an index to the relationship that exists between two characters. It has been observed that separate characters tend to move to-

gether to a greater or less degree. This relation is expressed in a ratio based on unity. For instance, one character taken as the subject is seen to vary in a certain direction and corresponding to this another character taken as relative is seen to vary equally as much and in the same direction, then we say there is a perfect positive correlation. The relation is expressed by the ratio 1. On the other hand if an increase in one character is followed by a proportional decrease in the other, then the ratio is -1 or perfect negative correlation. If the characters move entirely independent of each other there is said to be a zero correlation. There are all degrees of correlation between 1 and -1. The character yield in wheat may be associated with number of culms per plant, say 70 or 80 per cent. Any other two characters may be associated, say 20 or 30 per cent or may be opposed to each other to the extent of 40 or 50 per cent. We seldom find a relationship existing which is absolute, denoting a direct causation, or one which is negative, signifying mutual exclusion.

There are instances where we must distinguish between causal correlation and mere associations. Bailey and Gilbert (1915) give four rules for testing the validity of a correlation. It is valid:-

"1. If when the first is present the second is present also.

2. If when the first increases in amount the second also invariably increases in amount also.

3. If when the first is absent, the second is invariably absent also.

4. If when the first decreases in amount the second also invariably decreases in amount."

Two more rules might be added to this to make it include negative correlations as well as positive.

5. If, when one is present the other is invariably absent.

6. If, when one increases the other invariably decreases and vice versa.

It is clear that after sufficient number of trials these rules could be applied to differentiate between a causal correlation and an accidental association. The judgment of the breeder can often be relied upon to distinguish between these two cases.

Probable Errors always accompany the constants to give us an expression of the amount of confidence we can place in our constant. There is the random element of chance involved when only a part of population is selected for study. It is probable that the specimens selected are not exactly representative and it is this difficulty that the probable error corrects. It indicates, with certainty that we can expect the true value to fall within its limits as often as it falls without. The larger the number of individuals we use the greater is the chance that our group is representative of the entire population and the less will be our probable error.

Material

The material used in this investigation consisted of four cultures of wheat including two varieties. A pure line and a mixed population of Fulcaster grown at the Missouri Experiment Station, and a pure line and a mixed population grown at the Cornell University Experiment Station, were employed. The prime object of the experiment was to study the phenomenon of acclimatization. This study of variations and correlations within mixed populations and pure lines is more or less incidental.

The seed was planted in four plots, 30 feet by 40 feet in size. One kernel was planted to the hill and the hills were one foot apart each way. The hills thus represented one plant, which stood out quite alone, with sufficient space for maximum development. All plants that survived the winter conditions in this open method of planting, thrived exceedingly well during the spring and summer months. Tillering was much above that of average conditions and growth was vigorous.

Every normal plant was harvested regardless of its general character, its size or its position in the plot. After a string had been tied around the culms to keep them together, they were cut off at the surface of the ground. The plants were not labeled but the plots were kept entirely separate and identified.

The material was then removed to the laboratory and

and measured. Out of the thousand to twelve hundred plants of each variety or strain, four hundred were selected at random, the only exercise of choice being in cases where the plant was not entire, through shattering or breaking. Twelve characters were measured and the measurements were tabulated for later reduction. The ordinary precautions were used to secure the greatest practicable degree of accuracy.

The characters measured and the units of measurement used were as follows:

1. Weight of plant in decigrams.
2. Number of culms per plant.
3. Average length of culm per plant in millimeters.
4. Average number of internodes per culm per plant.
5. Average length of internodes per culm per plant in millimeters.
6. Average length of spike per plant in millimeters.
7. Average number of spikelets per spike per plant.
8. Weight of grain per plant in decigrams.
9. Average weight of kernel per plant in milligrams.
10. Weight of straw per plant in decigrams.
11. Per cent of grain to straw.
12. Number of kernels per plant.

The average length of culm per plant was found by dividing the total length of all the culms of a single plant by the number of culms. The average number of internodes per culm per plant was found by dividing the total

number of internodes of all the culms of a plant by the number of culms. Similarly the average length of internodes per culm per plant, the average length of spike per plant and the average number of spikelets per spike per plant were derived. The average weight of kernels per plant is found by dividing the weight of grain by the number of kernels. The weight of straw is found by subtracting the weight of grain from the weight of the plant. The per cent of grain to straw was found by dividing the weight of the grain by the weight of the straw.

After all these data were thus reduced to totals and averages as concrete expressions of the type of the characters for which they stood, they were transferred to 3 x 5 inch cards especially ruled and numbered for the purpose. Each card contained all the data for a single plant. A card would appear somewhat as shown below.

Dawson's Golden Chaff			Mixed Population		
Plant no. 162			(1914)		
1	2	3	4	5	6
400	10	878	5.3	165	107
7	8	9	10	11	12
22.2	125	29	275	45.3	417
13	14	15	16	17	18

With the data on these cards, it was easy to group the plants according to similarities as regards any one or two characters. This was what was done. The cards were first grouped according to yield in decigrams, two decigrams being taken as the factor. Then within each one of these groups a secondary distribution was made for each of the other characters which resulted in the distribution tables shown in figures No.s 1 to 44 inclusive. From these tables were calculated the mean, the standard deviation, the coefficient of variability and the coefficient of correlation. The mode could be determined by inspection.

The Constants

The constants have already been discussed as to their definition and interpretation. A discussion of their relations as influenced by the conditions of this problem shall now be taken up.

As stated in the introduction this study is a comparison of the constants of mixed populations and pure lines. In what way if any, is a constant of a mixed population different from a similar constant of a pure line? Are these differences such that a general rule can be formulated to explain their occurrence? A hasty survey of tables 3, 4, 5, and 6, will show that the constants for pure lines are in some cases higher than those of the mixed population and in some cases lower. Graphs 1 and 2 show how the co-

Table 2

Characters	Is the Pure Line above or below the Mixed Population?							
	Fulcaster				Dawson's Golden Chaff			
	M	C	r		M	C	r	
Yield of Grain	Below	Below	Below		Below	Below	Below	
Weight of Plant	Below	Below	Below	Below	Below	Below	Below	Above
Number of Culms	Below	Below	Below	Equal	Below	Below	Above	Above
Ave. Length of Culms	Above	Above	Above	Above	Above	Below	Below	Above
Ave. No. of Internodes	Above	Above	Above	Above	Below	Above	Above	Below
Ave. Length of Internodes	Above	Above	Above	Above	Above	Below	Below	Below
Ave. Length of Spikes	Below	Below	Below	Below	Below	Below	Below	Below
Ave. No. of Spikelets	Above	Above	Equal	Above	Below	Below	Below	Below
Ave. Weight of Kernels	Below	Above	Above	Below	Above	Below	Below	Above
Weight of Straw	Below	Below	Below	Below	Below	Below	Below	Above
Per cent of Grain to Straw	Below	Above	Above	Below	Above	Below	Below	Above
Number of Kernels	Below	Below	Below	Below	Below	Below	Above	Below

efficients of variability for pure lines fluctuate around the coefficients of variability of mixed populations as a base. Graphs 3 and 4 show how the coefficients of correlation for pure line fluctuate around those of the mixed population taken as a base. The relations of the constant are shown in another way in table 2. In this table a comparison is made between the line and population as regards any one character and any of its constants. Also the two varieties may be compared by following the lines across. This casual survey will suffice to show the general trend of the relations which this material exhibits.

Looked at thus hastily, the impression is that there are at least a few discrepancies. Records are not available to tell us what type of plant was selected as the parent of the pure line. It is natural to suppose that a plant somewhat above the average of the mixed population was selected. Whatever the selection, it seems that judging from the means, the pure lines are not as good as the mixed populations although in certain characters the pure line does show an advantage. The standard deviation is expected to be greater in mixed populations because there we have in addition to the fortuitous variations, the hereditary variations, while in pure lines we have only the latter. In these data there occurs instances where the standard deviation is greater in the pure lines. For the same reasons it would be expected that the coefficients

Graph 1, showing how C of pure line of Fulcaster fluctuates around that of mixed population as a base.

Graph 2, showing how C of pure line of Dawson's Golden Chaff fluctuates around that of mixed population as a base.

Yield of Grain

Weight of Plant

Number of Culms

Ave. Length of Culms

Ave. No. of Internodes

Ave. Length of Internodes

Ave. Length of Spike

Ave. No. of Spikelets

Ave. Wt. of Kernel

Weight of Straw

% of Grain to Straw

Number of Kernels

Graph 3, showing how r of the pure line of Fulcaster fluctuates around that of mixed population as a base.

Graph 4, showing how r of the pure line of Dawson's Golden Chaff fluctuates around that of the mixed population as a base.

Weight of Plant

Number of Culms

Average Length of Culms

Average Number of Internodes

Average Length of Internodes

Average Length of Spike

Average Number of Spikelets

Average Weight of Kernel

Weight of Straw

% of Grain to Straw

Number of Kernels

of variability in pure lines should be less than in mixed populations. Such is not always the case in these data. The correlation coefficient is, presumably, not affected in any special manner by being in a mixed population or pure line. The degree of correlation is a matter of inheritance and environment and may be greater or less as the chance of selection or place happens to make it. Some of these apparent discrepancies may be explained.

Mean

Since the environmental influences for the pure lines and mixed populations are practically identical we may assume that the differences which exist between these groups of plants are due, for the most part, to heredity. Keeping this assumption in mind let us consider the means of the various characters. In the pure line of Fulcaster the means are below those of the mixed population in eight characters and above in four. In Dawson's Golden Chaff the ratio is the same but for different characters in two cases. According to the pure line theory a pure line is constituted of a group of characters whose means may be above or below the means of the race from which it was selected. It is not by mere chance then that eight means in the pure lines are below those of the mixed populations and that four are above, but at the time the pure line selection was made those hereditary qualities were taken, which precluded any other possibilities except a lesser

Table 3

MEANS

Characters	Fulcaster Mixed	Fulcaster Line	Dawson's Golden Chaff - Mixed	Dawson's Golden Chaff - Line
Yield of Grain	17.226 ± .3289	15.478 ± .2854	18.988 ± .3068	16.648 ± .2680
Weight of Plant	58.618 ± 1.043	55.101 ± .9622	59.379 ± .9522	49.206 ± .7351
Number of Culms	18.067 ± .2489	17.291 ± .2277	15.012 ± .1888	13.421 ± .1702
Ave. Length of Culms	79.384 ± .3419	81.196 ± .4003	78.449 ± .3233	84.096 ± .2454
Ave. No. of Internodes	5.147 ± .0325	5.195 ± .0096	5.204 ± .0116	4.794 ± .0130
Ave. Length of Internodes	151.834 ± .5015	153.426 ± .5534	148.896 ± .6120	170.031 ± .5256
Ave. Length of Spikes	109.171 ± .3981	108.756 ± .3875	105.474 ± .2879	99.351 ± .2605
Ave. No. of Spikelets	19.918 ± .0535	20.092 ± .0543	20.910 ± .0399	20.106 ± .0365
Ave. Wt. of Kernels	26.444 ± .1230	25.957 ± .1325	27.746 ± .1568	28.626 ± .1223
Weight of Straw	413.217 ± 7.244	394.162 ± 6.906	414.113 ± 6.618	324.748 ± 4.796
% of Grain to Straw	40.263 ± .2206	38.312 ± .2711	43.335 ± .3448	50.295 ± .3153
Number of Kernels	618.844 ± 10.287	562.182 ± 9.354	624.684 ± 9.391	556.045 ± 8.396

yield, a smaller average weight per plant, a smaller average number of culms, or a greater average length of culms, etc.

There is an objection to holding to this rule too rigidly, however. It is possible that the hereditary tendency to produce few culms has contributed to making longer culms, even longer culms than could be attributed to heredity directly. When the plant could not use its food supply in making a great number of culms it would naturally turn that supply to making stronger and longer culms. Hence it is reasonable to suppose that the environmental factor of unlimited food supply in this case, affected the size of the culm, making it surpass its inheritance. While environment acts here only indirectly through the agency of heredity, it is nevertheless an environmental effect. Environment tends to balance the plant, in this particular instance, while heredity tends to unbalance it.

It is difficult to assign the relative importances of these two factors, as influencing the mean. Heredity is undoubtedly the strongest determiner when the environment is optimum or better. There are so many possibilities of interaction between the two factors, however, depending on the parts of the plant affected, the degree of the influence and the time it is set to work. When on account of heredity there are but few culms per plant, the resulting relatively large food supply causes the culms to grow to excessive length. With longer culms there comes usually

a greater average number of internodes per culm per plant, and always a greater average length of internode. Increased size of kernel may be ascribed to the fact that there are fewer heads and fewer number of kernels per plant. Greater per cent of grain to straw can be attributed to a similar interrelation between the parts of the plant. These relations sum themselves up in the principle of compensation.

The means, as they appear in this study then, are the result of a strong heredity force and a lesser environmental influence. While the environmental factor is constant for all lines and populations, it cannot react on all of them in the same way. Where heredity acts to change the balance of the plant in one place, environment reacts to compensate it in a particular way, while another change would involve an entirely different reaction. Hence, we can say that environment does play a part in determining the means of plants, and not acting the same on different plants or different groups of plants, it plays a very important role in establishing the relations between the means of different plants and of different groups of plants.

Standard Deviation

The Standard Deviations constants of the pure lines are not consistantly above or below the standard deviation constants of the mixed population. As has been already stated, the standard deviations of the pure lines would be

Table 4

STANDARD DEVIATION CONSTANTS

Characters	Fulcaster Mixed	Fulcaster Line	Dawson's Golden Chaff - Mixed	Dawson's Golden Chaff - Line
Yield of Grain	9.729 ± .2326	8.400 ± .2018	9.041 ± .2169	7.920 ± .1896
Weight of Plant	30.866 ± .7380	28.319 ± .6805	28.056 ± .6733	21.719 ± .5199
Number of Culms	7.362 ± .1760	6.702 ± .1610	5.564 ± .1335	5.031 ± .1204
Ave. Length of Culms	10.113 ± .2418	11.782 ± .2831	9.528 ± .2286	7.250 ± .1735
Ave. No. of Internodes	.271 ± .0064	.284 ± .0068	.343 ± .0082	.387 ± .0092
Ave. Length of Internodes	14.835 ± .3547	16.288 ± .3914	18.034 ± .4328	15.528 ± .3717
Ave. Length of Spikes	11.775 ± .2815	11.405 ± .2740	8.483 ± .2035	7.696 ± .1842
Ave. No. of Spikelets	1.583 ± .0378	1.600 ± .0384	1.177 ± .0282	1.080 ± .0258
Ave. Wt. of Kernels	3.640 ± .0870	3.901 ± .0937	4.621 ± .1109	3.613 ± .0864
Weight of Straw	214.272 ± 5.123	203.259 ± 4.884	195.014 ± 4.680	141.688 ± 3.392
% of Grain to Straw	6.525 ± .1560	7.980 ± .1917	10.160 ± .2438	9.315 ± .2230
Number of Kernels	304.279 ± 7.275	275.301 ± 6.615	276.720 ± 6.641	248.042 ± 5.938

expected to be below those of the mixed populations. In Fulcaster six characters of the pure line show greater deviation than the same characters in mixed population. Those characters are average length of culms per plant, average number of internodes per culm per plant, average length of internodes per culm per plant, average number of spikelets per spike per plant, average weight of kernels and per cent of grain to straw. In Dawson's Golden Chaff only one character, the average number of internodes per culm per plant, has more deviation in pure line than in the mixed population and eleven have less. Dawson's Golden Chaff more nearly marks up with expectations than Fulcaster.

It will be noticed that in many cases the standard deviation is greater in the pure line where the mean for that character is also greater. Leighty and Love (1914) in their work on oats, observe that increased mean is associated with greater variation. In the Fulcaster variety in this study every increased mean in pure line is attended with increased standard deviation. Judging from the data on Fulcaster alone, it appears that the work of Myers (1912) is in a measure corroborated, namely, that conditions favoring increased growth or higher means, favored variability. In Dawson's Golden Chaff, however, increased means in pure lines are attended with decreased variability. In one character the average number of internodes per culm per plant, the mean is decreased while the standard deviation

is increased. Judging from correlation coefficients and by distribution tables of this character, it is quite independent in its relations to other characters and is quite independent of environmental conditions. Heredity, it seems, is the large determining factor for this character.

There are two cases in the Fulcaster variety where decreased means in pure lines is attended with increased variation. The characters referred to are average weight of kernels per plant, and per cent of grain to straw per plant. Nilsson (Newman 1912) observed that greater or less yield did not materially affect the size of the kernels on the average but usually a less yield was due to the decreased number of kernels. However, a decreased number of kernels per spike per plant was usually associated with a greater per cent of small grains. In these data the mean yield, the mean number of kernels, and the mean average weight of kernels in the pure line are below those means of the mixed population and it is probable that the same conditions exist as to the variability on the size of kernels as in Nilsson's studies, hence an explanation of the increased variability in this case.

The per cent of grain to straw expresses a relation between the yield of grain and the yield of straw for each individual plant. A correlation between yield of grain and yield of straw indicates a similar relation for the population. It is seen that the correlation coefficient for yield of grain and weight of straw per plant is

less for pure line than for mixed population. In other words, there are more cases in the mixed population where yield of grain and straw respectively do move together and maintain a constant ratio than in the pure line. It is therefore evident that there is more variation in the ratio between yield of grain and yield of straw in pure lines than in mixed populations. Why there should be less correlation between these two characters in the pure line and therefore more variation in the ratio between them, will be brought out in the discussion of the correlation coefficients.

Coefficients of Variability

The coefficients of variability give evidence in regard to the comparative variability of the different characters. As for one character in the pure line and the same character in the mixed population for Fulcaster, the same general relations are shown by the coefficients of variability as by standard deviation, except in the case of the average number of spikelets where the coefficients are identical. A similar comparison in Dawson's Golden Chaff shows more variability in the pure line than in the mixed population for three characters, number of culms, average number of internodes, and number of kernels. It will be recalled that the standard deviation showed greater variation in only one character in the pure line, namely the average number of internodes. A consideration of

Table 5

COEFFICIENTS OF VARIABILITY

Characters	Fulcaster Mixed	Fulcaster Line	Dawson's Golden Chaff - Mixed	Dawson's Golden Chaff - Line
Yield of Grain	56.4 ± 1.7010	54.2 ± 1.6410	47.6 ± 1.3771	47.5 ± 1.3699
Weight of Plant	52.6 ± 1.5672	51.3 ± 1.5230	47.2 ± 1.3620	44.1 ± 1.2442
Number of Culms	40.7 ± 1.1232	38.7 ± 1.0601	37.0 ± 1.0022	37.4 ± 1.0129
Ave. Length of Culms	12.7 ± .3085	14.5 ± .3557	12.1 ± .2946	8.6 ± .2074
Ave. No. of Internodes	5.2 ± .1246	5.4 ± .1301	6.59 ± .1567	8.07 ± .1928
Ave. Length of Internodes	9.7 ± .2341	10.6 ± .2575	12.1 ± .2946	9.1 ± .2196
Ave. Length of Spikes	10.7 ± .2587	10.4 ± .2526	8.04 ± .1932	7.7 ± .1854
Ave. No. of Spikelets	7.9 ± .1900	7.9 ± .1910	5.6 ± .1348	5.3 ± .1272
Ave. Wt. of Kernels	13.7 ± .3336	15.0 ± .3684	16.6 ± .4092	12.6 ± .3064
Weight of Straw	51.8 ± 1.5353	51.5 ± 1.5312	47.09 ± 1.3544	43.6 ± 1.2263
% of Grain to Straw	16.2 ± .3973	20.8 ± .5210	23.4 ± .5915	18.5 ± .4578
Number of Kernels	49.1 ± 1.4292	48.9 ± 1.4287	44.2 ± 1.2510	44.6 ± 1.2624

table 5 will show that the difference between the coefficients of variability for the other two characters in Dawson's Golden Chaff named above, is very slight, much less than the probable error.

It is interesting to note that the difference between the coefficients of variability of any one character for the mixed population and pure line in either of the varieties is less than five times their probable errors, the one exception to this being average length of culms in Dawson's Golden Chaff. In this case the difference is only a little more than five times the probable errors. This points to the fact that aside from the heredity variations as shown by the means the mixed populations are no more variable than the pure lines.

As between the different characters within a line or population there is a range in variability from 56.4 $\pm$ 1.7010 for yield in Fulcaster mixed population to 5.2 $\pm$.1246 for average number of internodes in the same group of plants. As stated previously any one character is fairly constant in variability in all populations and lines. The characters yield, weight of plant, number of culms, weight of straw, and number of kernels, all show a high per cent of variability ranging somewhere between 57 per cent and 37 per cent. The characters, average length of culms, average number of internodes, average length of internodes, average length of spikes, average length of spikelets, average weight of kernel and per cent of grain, fall into a

group with a relatively low per cent of variability, ranging somewhere between 5 per cent and 24 per cent. It is at once evident that the larger or gross characters show the greater variability while the more specific characters show less. If the per cent of grain is taken out of the lower group, the upper limit of its range is reduced by 8 per cent, thus still more distinctly defining the two groups. The per cent of grain to straw does not really constitute a character but represents the relation between two of the grosser characters and should really fall in a class by itself.

In considering the average length of culms per plant, the question arose as to the effect on standard deviation and coefficient of variability of that character, if the culms were not averaged by the plant but were taken each as an individual unit. The constants found by calculating on that basis were as follows:

	Standard Deviation
Fulcaster population	21.710 $\pm$.1213
Fulcaster line	21.955 $\pm$.1260
Dawson's Golden Chaff population	18.309 $\pm$.1129
Dawson's Golden Chaff line	14.325 $\pm$.0932
	Coefficient of Variability
Fulcaster population	27.25 $\pm$.1629
Fulcaster line	26.93 $\pm$.1652
Dawson's Golden Chaff population	23.47 $\pm$.1521
Dawson's Golden Chaff line	17.50 $\pm$.1173

These constants compared with the original data on length of culms in tables 4 and 5 shows that this latter method gives coefficients approximately twice as large as the former method. The differences between the pure lines and mixed populations are relatively less pronounced. The probable errors are less. It is probable that the second method expresses with a greater degree of accuracy, the variability of the character since no averages are introduced to offset the individual differences of the culms. For purposes of comparison when the plant is generally being taken as the unit, the former method is, however, entirely satisfactory.

The Graphs

The relations of any character in a mixed population with the same character in a pure line of the same variety, are brought out descriptively in the following graphs. The mean is shown precisely. The amplitude and the modal character of the distribution for each character in each line and population appear in contrast. Knowing the relations as brought out by the constants, these graphs prove very interesting.

In all graphs the blue line represents the pure line of the variety and the red line represents the mixed population. The mean of the character appears in the corresponding color. The means will not be discussed here as they have been reviewed earlier in the paper. The curves

of the yields in the Fulcaster variety (Graph 5) are both irregular. The pure line is only slightly less irregular than the mixed population, and the amplitude is almost as great. The curves of the yields of Dawson's Golden Chaff (Graph 6) are even more irregular and there is less difference in the characters of the two curves than in the Fulcaster variety. Yield is not a unit character but probably depends upon a number of factors, hence it would be expected to be irregular, both in pure line and mixed population.

The curves for weight of plant (Graphs 7 & 8) are strikingly similar in both varieties. They are all bi-modal but rather smooth. The modal height of the pure line in Dawson's Golden Chaff is somewhat greater than that of the mixed population and the amplitude is less. In Fulcaster the modal height is greater but the amplitude is practically the same.

The distribution curves for the character, number of culms, (Graphs 9 & 10) show a marked regularity in Dawson's Golden Chaff. The amplitude is practically equal but the modal height is greater in the pure line. In Fulcaster there are four modal points in the mixed population and two in the pure line. The amplitudes are about equal but the modal height is greater in the pure line.

The character, average length of culms, is distinctly bi-modal in the pure line of Fulcaster (Graph 11) while the mixed population is more regular. The amplitude is greater than in the mixed population, while the modal height is less.

Character - Yield of Grain
Fulcaster

Graph 5

Character - Yield of Grain
Dawson's Golden Chaff

Graph 6

In Dawson's Golden Chaff (Graph 12) the pure line has much greater modal height, less amplitude, and is more regular.

The average number of internodes show considerable irregularity. (Graphs 13 & 14). In this character Dawson's Golden Chaff appears to be less affected by the pure line selection. The whole population of the pure line is shifted downward and the amplitude is greatly increased over the mixed population. It is essentially tri-modal while the mixed population has four modal points. The highest modal point is somewhat above that of the mixed population. In Fulcaster the curves are smoother. The pure line is perhaps not as regular as the mixed population. The amplitudes are equal but the modal height of the mixed population is slightly greater. The number of internodes is a character which might be regarded as an elementary character and therefore would be expected to give a smooth curve in a pure line. The figures shown here do not bear out this assumption, particularly Graph 14.

The curves of the average length of internodes in Dawson's Golden Chaff (Graph 16) are very smooth, have a narrow amplitude and are high. The mode of the mixed population is slightly higher than of the pure line. Aside from the fact that the pure line population is shifted downward somewhat, the two curves are essentially the same. In the Fulcaster the curves for this character (Graph 15) are not regular. The pure line is distinctly bi-modal and the modal height is much less than in the mixed population. The

DEPARTMENT OF ENGINEERING, UNIVERSITY OF
FOR SALE BY THE UNIVERSITY CO-OPERATIVE STORE, COLUMBIA, MO.

Character - Average Length of Culms
Fulcaster

Graph 11

PLATE A - FOR SALE BY THE UNIVERSITY CO-OPERATIVE STORE, COLUMBIA, MO.

DEPARTMENT OF ENGINEERING, UNIVERSITY OF MO.

Character - Average Number of Internodes
Fulcaster
Graph 13

amplitudes of the two populations are practically equal and relatively broad.

The average length of spike gives relatively smooth curves (Graphs 17 & 18). The pure line of Fulcaster has two modal points but one is not sharp. The modal height of the mixed population exceeds that of pure line somewhat. The amplitudes are about equal. The population of the pure line is moved upward considerably from that of the mixed population. The modal character of the line is relatively smooth and not sharp while in the population the modes are well defined. The pure line shows a greater modal height while the population has the greater amplitude.

The average number of spikelets gives, in the pure line of Fulcaster (Graph 19), a curve somewhat smoother, but more dull in modal character, narrower in amplitude and less in modal height than in the mixed population. In Dawson's Golden Chaff, the population of the pure line is shifted downward somewhat. (Graph 20). The modal height is higher in the pure line but otherwise the curves are essentially the same.

The curves of the average weight of kernels, (Graphs 21 & 22) are very smooth, narrow and high. The amplitudes are practically the same in all the curves but the modal heights are greater in the pure lines in both varieties.

The weight of straw gives curves (Graphs 23 & 24) which are irregular, low in modal height, and wide in amplitude. In Fulcaster there is very little difference between the curves of the line and the population, except that modal

75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0

725 825 925 1025 1125 1225 1325 1425 1525

Character - Average Length of Spikes
Fulcaster

Graph 17

Character - Average Weight of Kernels
Fulcaster

Graph 21

Character - Weight of Straw
Dawson's Golden Chaff

Graph 24

height is slightly greater in the pure line. The pure line and mixed populations are bi-modal. In Dawson's Golden Chaff the pure line has a considerably greater modal height and a narrower amplitude. The population of the pure line is shifted downward somewhat also. The pure line is distinctly bi-modal while the population is tri-modal.

The curves of the per cent of grain to straw (Graphs 25 & 26) are smooth, tall, and narrow. The modal height in the pure line of Fulcaster is slightly less than in the mixed population and the amplitude is greater. In Dawson's Golden Chaff the modal height is greater in the pure line and the amplitude identical to the mixed population.

The curves of the number of kernels (Graphs 27 & 28) are rather irregular in character. In Fulcaster there are two modal points, one very much below the other, and not so sharp. The modal height of the pure line is much above that of the mixed population. The mixed population has three modal points but two of them are very low. The amplitudes are about equal. In Dawson's Golden Chaff the mode is not well defined and is somewhat lower than the mixed population. The mixed population is distinctly tri-modal. The amplitude is somewhat narrower in the line than in the population.

Coefficients of Correlation

The coefficients expressing the correlation between

yield and other characters under consideration are given in table 6. By a comparison of these data it is seen that the correlations can be divided into two more or less distinct classes. Between yield and four of the other characters the coefficients of correlation for the lines and populations in both varieties approximate each other very closely. The correlation is also very high for these four cases. The other class embraces the coefficients of correlation for yield and the remaining seven characters. This group of data shows less regularity in the degree of correlation for any one character through the lines and populations of the two varieties. In further contrast there appears in this group less correlation than in the other. This division is more or less arbitrary but can be in a measure justified.

The two classes into which the correlations were divided coincide in all except one character, the length of culms with the two classes into which the coefficients of variability were divided. The length of culms may properly belong in the first class although it could not be placed there on the basis of uniformity in degree of correlation in lines and populations in the two varieties. Supposing that it does belong there, the first class includes the correlations between yield and all the more gross characters, being similar to the first division of the coefficients of variability and the second class includes the correlation between yield and the more specific characters.

The gross characters spoken of above as constituting

Table 6

CORRELATION CONSTANTS

YIELD and	Fulcaster Mixed	Fulcaster Line	Dawson's Golden Chaff - Mixed	Dawson's Golden Chaff - Line
Weight of Plant	.972 ± .0018	.965 ± .0023	.939 ± .0040	.955 ± .0029
Number of Culms	.917 ± .0053	.917 ± .0054	.856 ± .0090	.881 ± .0075
Ave. Length of Culms	.688 ± .0178	.739 ± .0154	.749 ± .0148	.862 ± .0086
Ave. No. of Internodes	.465 ± .0264	.621 ± .0208	.249 ± .0318	.231 ± .0320
Ave. Length of Internodes	.633 ± .0202	.674 ± .0185	.624 ± .0207	.535 ± .0241
Ave. Length of Spikes	.700 ± .0172	.666 ± .0189	.583 ± .0224	.547 ± .0237
Ave. No. of Spikelets	.666 ± .0188	.688 ± .0178	.616 ± .0210	.490 ± .0257
Ave. Weight of Kernel	.642 ± .0198	.506 ± .0252	.476 ± .0262	.487 ± .0258
Weight of Straw	.954 ± .0030	.945 ± .0036	.875 ± .0079	.911 ± .0057
% of Grain to Straw	.515 ± .0248	.3209 ± .0302	.351 ± .0297	.459 ± .0267
Number of Kernels	.979 ± .0014	.971 ± .0019	.979 ± .0014	.970 ± .0020

the first class, are yield and weight of plant, yield and number of culms, yield and average length of culms, yield and weight of straw, and yield and number of kernels.

Number of kernels, however, is probably a unit character.

The more specific characters referred to are yield and number of internodes, yield and length of internodes, yield and average length of spike, yield and average number of spikelets, yield and average weight of kernels, and yield and per cent of grain to straw.

The particular significance that can be attached to this grouping is that it tells where the high, stable correlations may be expected and where the lower, fluctuating correlations may be looked for. Within the first group the correlations for a mixed population or a line, for one variety or another will be high and very nearly identical. For instance, the correlation between yield and number of kernels (which best illustrates the point) is $.979 \pm .0014$ for Fulcaster mixed, $.971 \pm .0018$ for Fulcaster line, $.979 \pm .0014$ for Dawson's Golden Chaff mixed, and $.970 \pm .0020$ for Dawson's Golden Chaff line. It is obvious that such a correlation would not fluctuate, especially when it is known that size of kernel does not fluctuate very much with yield.

In the other group the correlations for the lines and populations, for one variety and another are seen to vary from one another in any uncertain amount. For instance, the correlation between yield and average number of internodes,

is $.465 \pm .0264$ for Fulcaster, mixed; $.621 \pm .0208$ for Fulcaster, line; $.249 \pm .0318$ for Dawson's Golden Chaff, mixed; and $.231 \pm .0320$ for Dawson's Golden Chaff, line.

Here it is observed that there are at once wide differences and close similarities. Other comparisons could be made to further substantiate the above assumption.

There are two factors which influence the degree of correlation between two characters. One is heredity and the other is environment. In this respect correlation is on a par with the means. It is evident that a coefficient of correlation may vary according to the way heredity and environment may react upon each other in either one or both of the characters in question. Where the two characters that are being correlated are such that environment and heredity must necessarily affect both alike and in practically the same degree, it can always be expected that the correlation will be high and very stable. On the other hand, if two characters are so independent of one another that heredity and environment may act indifferently as regards the one and the other, then it can be expected that the correlation may be either high or low but usually low. Correlations of such characters are very unstable, or fluctuating. There is, of course, no sharp line of demarkation between these two extremes.

Seeing how the coefficients of correlation are influenced, it appears evident at the outset that the constants of pure lines would have no more definite relation to the

mixed population from which it was derived than would be warranted by the qualities of the hereditary characters so isolated. If, by chance, the mean of a character isolated in the pure line should be such that it would react with the environment to move upward only very slowly with the yield, while the mean of the race for that character moved rapidly with the yield, then the pure line would show little correlation and the mixed population would show high correlation. The chance of selection might affect the correlation coefficient in any conceivable manner so it cannot be predicted whether there will be greater or less correlation in the pure line than in the mixed population.

Some proof of this assumption is to be pointed out by comparing the constants for yield and any other single character through the four groups of plants. It will be noted by referring to table 6 that the coefficient of correlation for a pure line may be above the mixed population in one variety and below in the other variety. Yield and per cent of grain to straw gives for Fulcaster, mixed, a coefficient of $.515 \pm .0248$; for Fulcaster, line $.3209 \pm .0302$; for Dawson's Golden Chaff, mixed $.351 \pm .0297$; for Dawson's Golden Chaff, line $.459 \pm .0267$ which illustrates the point. The correlation of the characters yield and average length of internodes, show a similar relation between lines and populations.

There may be a wide disparity in one variety and a marked similarity in the other. The yield and average

number of internodes illustrates this point. In the Fulcaster, mixed, the coefficient for these characters is $.465 \pm .0264$ and line $.621 \pm .0208$; for Dawson's Golden Chaff, mixed $.249 \pm .0318$ and line $.231 \pm .0320$. Yield and average number of spikelets and yield and average weight of kernels show similar relations.

The coefficient of correlation of the pure line is above that of the population in both varieties in the case of yield and average length of culms. Fulcaster mixed is $.688 \pm .0178$, line $.739 \pm .0154$; Dawson's Golden Chaff, mixed $.749 \pm .0148$, line $.862 \pm .0086$. For the characters of yield and average length of spike, there is less correlation in line than in the population. For these characters the coefficient for Fulcaster, mixed is $.700 \pm .0172$, line $.666 \pm .0189$; for Dawson's Golden Chaff, mixed $.583 \pm .0224$, line $.547 \pm .0237$.

Again the two varieties may be almost identical as regards the constants for yield and some one character. This is shown in the characters yield and number of kernels where for Fulcaster mixed, the coefficient is $.979 \pm .0014$ and line $.971 \pm .0019$; for Dawson's Golden Chaff, mixed $.979 \pm .0014$ and line $.970 \pm .0020$. Yield and weight of plant, yield and number of culms, and yield and weight of straw correspond with yield and number of kernels.

One year's work does not warrant making any definite predictions from the relations pointed out above. The changing of environment from place to place or year to year

will make repetitions of this work not highly comparable to this work. However, additional investigation would throw some interesting light on the subject. It is safe to say that those characters which give high and practically identical constants in both varieties here will always give results very similar to this, while the remaining characters will be found to vary considerably from year to year or place to place.

Fulcaster, mixed.

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-99.9	100-109.9	110-119.9	120-129.9	130-139.9	140-149.9	150-159.9	160-169.9	Total
0-1.9	5	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
2-3.9	3	12	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	17
4-5.9	.	9	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20
6-7.9	.	2	19	9	1	.	.	.	.	.	.	.	.	.	.	.	.	31
8-9.9	.	.	6	18	.	.	.	.	.	.	.	.	.	.	.	.	.	24
10-11.9	.	.	1	18	14	2	1	.	.	.	.	.	.	.	.	.	.	36
12-13.9	.	.	.	6	25	6	.	.	.	.	.	.	.	.	.	.	.	37
14-15.9	.	.	.	.	9	19	.	.	.	.	.	.	.	.	.	.	.	28
16-17.9	.	.	.	.	.	21	13	.	.	.	.	.	.	.	.	.	.	34
18-19.9	.	.	.	.	1	4	19	2	.	.	.	.	.	.	.	.	.	26
20-21.9	.	.	.	.	.	1	14	15	2	1	.	.	.	.	.	.	.	33
22-23.9	.	.	.	.	.	.	5	7	4	.	.	.	.	.	.	.	.	16
24-25.9	.	.	.	.	.	.	.	8	7	4	.	.	.	.	.	.	.	19
26-27.9	.	.	.	.	.	.	.	.	11	5	.	.	.	.	.	.	.	16
28-29.9	.	.	.	.	.	.	.	1	3	2	.	.	1	.	.	.	.	7
30-31.9	.	.	.	.	.	.	.	.	2	3	3	3	.	.	.	.	.	11
32-33.9	.	.	.	.	.	.	.	.	.	2	3	4	.	.	.	.	.	9
34-35.9	.	.	.	.	.	.	.	.	.	1	3	5	.	.	.	.	.	9
36-37.9	.	.	.	.	.	.	.	.	.	1	1	2	1	1	.	.	.	6
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	1	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	3
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	2
44-45.9	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	2
46-47.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
48-49.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
Total	8	24	39	51	50	53	52	33	29	19	10	15	4	4	3	3	1	398

Weight of grain per plant in decigrams, subject.
 Weight of plant in decigrams, relative.
 $r = .972 \pm .0018$

Figure 1

Fulcaster, mixed.

	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-19	20-21	22-23	24-25	26-27	28-29	30-31	32-33	34-35	36-37	38-39	40-41	42-43	Total
0-1.9	1	4	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
2-3.9	1	7	5	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	17
4-5.9	.	.	5	6	5	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20
6-7.9	.	.	.	8	10	8	4	1	.	.	.	.	.	.	.	.	.	.	.	.	.	31
8-9.9	.	.	.	1	5	8	6	4	.	.	.	.	.	.	.	.	.	.	.	.	.	24
10-11.9	.	.	.	2	1	12	10	6	1	3	1	.	.	.	.	.	.	.	.	.	.	36
12-13.9	.	.	.	.	4	8	9	8	7	.	1	.	.	.	.	.	.	.	.	.	.	37
14-15.9	.	.	.	.	2	2	5	11	5	3	.	.	.	.	.	.	.	.	.	.	.	28
16-17.9	.	.	.	.	1	5	6	6	7	8	5	2	.	.	.	.	.	.	.	.	.	34
18-19.9	.	.	.	.	1	2	5	6	7	3	1	1	.	.	.	.	.	.	.	.	.	26
20-21.9	.	.	.	.	.	.	.	3	10	10	5	4	.	.	1	.	.	.	.	.	.	33
22-23.9	.	.	.	.	.	.	.	.	3	5	3	1	2	2	.	.	.	.	.	.	.	16
24-25.9	.	.	.	.	.	.	.	.	1	5	4	3	1	3	2	.	.	.	.	.	.	19
26-27.9	.	.	.	.	.	.	.	.	2	1	4	4	2	1	1	1	.	.	.	.	.	16
28-29.9	.	.	.	.	.	.	.	.	.	1	2	2	1	.	.	1	.	.	.	.	.	7
30-31.9	.	.	.	.	.	.	.	.	.	.	1	.	5	2	2	1	.	.	.	.	.	11
32-33.9	.	.	.	.	.	.	.	.	.	.	.	1	2	1	3	1	1	.	.	.	.	9
34-35.9	.	.	.	.	.	.	.	.	.	.	.	.	2	1	2	3	.	1	.	.	.	9
36-37.9	.	.	.	.	.	.	.	.	.	.	.	1	2	1	2	.	.	.	.	.	.	6
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	1	.	.	.	.	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	3
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	2
44-45.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	2
46-47.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1
48-49.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
Total	2	11	11	20	27	44	42	44	42	43	29	18	17	12	13	13	6	2	0	1	1	398

Weight of grain per plant in decigrams, subject.
 Number of culms per plant, relative.
 $r = .917 \pm .0053$

Figure 2

Fulcaster, mixed.

	43-45.9	46-48.9	49-51.9	52-54.9	55-57.9	58-60.9	61-63.9	64-66.9	67-69.9	70-72.9	73-75.9	76-78.9	79-81.9	82-84.9	85-87.9	88-90.9	91-93.9	94-96.9	97-99.9	100-102.9	Total
0-1.9	1	1				1	2		1												6
2-3.9				2		2	3	6	2	2											17
4-5.9						3	4	1	3	4	1	1	1								20
6-7.9						1	3	6	2	3	4	6	3	3							31
8-9.9							3	1	4	7	2	4	2	1							24
10-11.9							1		3	5	3	7	4	6	2						36
12-13.9							1		2	2	5	9	6	7	2	1	1		1		37
14-15.9				1				2		2	5	2	10	2	4						28
16-17.9									3	1	6	7	1	7	2	2	2	3			34
18-19.9									2	1	2	4	3	2	5	3	1	2		1	26
20-21.9										1	2	5	6	6	7	2	1	2	1		33
22-23.9								1			1		4	3	1	1	2	1	1	1	16
24-25.9										1	1	1	4	2		5	1	4			19
26-27.9												3	1	4	2	3	2			1	16
28-29.9												1				2	2	2			7
30-31.9														3	3	1	1	2	1		11
32-33.9													2	1	1	3		1	1		9
34-35.9										1			2	2	1	1		2			9
36-37.9														2	1		1	1		1	6
38-39.9													1		1		1		1		4
40-41.9																1	1			1	3
42-43.9																1				1	2
44-45.9														1						1	2
46-47.9																	1				1
48-49.9																	1				1
Total	1	1	0	3	0	9	17	17	22	29	38	50	50	52	52	25	18	21	6	7	398

Weight of grain per plant in decigrams, subject.
Average length of culms per plant in millimeters,
relative.
 $r = .688 \pm .0178$

Figure 3

Fulcaster, mixed.

	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	Total
0-1.9	1	1	.	1	1	.	.	1	.	1	.	.	.	.	.	.	6
2-3.9	.	.	2	1	2	4	.	5	2	1	.	.	.	.	1	.	17
4-5.9	.	.	1	1	1	3	.	5	4	1	1	2	.	.	1	.	20
6-7.9	.	.	2	2	2	5	4	4	2	5	1	2	1	.	.	1	31
8-9.9	.	.	.	1	3	2	2	6	6	2	1	1	.	.	.	.	24
10-11.9	.	.	.	.	1	2	3	9	7	2	6	4	2	.	.	.	36
12-13.9	.	.	1	.	.	4	3	6	10	4	2	4	2	.	.	1	37
14-15.9	.	.	1	1	.	.	3	5	10	2	4	2	.	.	.	.	28
16-17.9	.	.	1	.	.	1	3	5	4	3	8	4	3	2	.	.	34
18-19.9	.	.	.	.	.	2	1	7	6	2	4	2	2	.	.	.	26
20-21.9	.	.	.	.	.	.	3	5	6	4	5	6	1	2	.	1	33
22-23.9	.	.	.	.	1	.	2	.	3	1	2	4	3	.	.	.	16
24-25.9	.	.	.	.	.	.	1	.	5	6	3	2	1	1	.	.	19
26-27.9	.	.	.	.	.	.	1	2	2	2	2	1	2	1	2	1	16
28-29.9	.	.	.	.	.	.	.	1	.	1	1	2	1	1	.	.	7
30-31.9	.	.	.	.	.	.	.	1	.	2	1	4	2	.	.	1	11
32-33.9	.	.	.	.	.	.	2	.	.	1	1	1	.	1	3	.	9
34-35.9	.	.	.	.	.	.	.	3	1	2	.	1	.	2	.	.	9
36-37.9	.	.	.	.	.	.	.	.	2	.	1	.	1	2	.	.	6
38-39.9	.	.	.	.	.	.	.	.	.	.	1	1	1	.	1	.	4
40-41.9	.	.	.	.	.	.	.	.	.	1	.	1	1	.	.	.	3
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	2
44-45.9	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	2
46-47.9	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
48-49.9	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
Total	1	1	8	6	11	23	28	66	70	43	45	44	25	14	8	5	398

Weight of grain per plant in decigrams, subject.
Average number of internodes per culm per plant,
relative.

$$r = .465 \pm .0264$$

Figure 4

Fulcaster, mixed.

	100-104	105-109	110-114	115-119	120-124	125-129	130-134	135-139	140-144	145-149	150-154	155-159	160-164	165-169	170-174	175-179	180-184	185-189	190-194	Total
0 - 1.9	1	2	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	6
2 - 3.9	.	.	1	.	3	5	4	4	.	.	.	.	.	.	.	.	.	.	.	17
4 - 5.9	.	1	.	2	3	4	3	1	1	3	1	.	1	.	.	.	.	.	.	20
6 - 7.9	.	.	.	.	.	2	3	1	3	3	7	1	1	.	.	.	.	.	.	31
8 - 9.9	.	.	.	.	.	1	7	3	4	4	1	3	1	.	.	.	.	.	.	24
10 - 11.9	.	.	.	.	.	2	.	6	4	5	12	4	3	.	.	.	.	.	.	36
12 - 13.9	.	.	.	1	.	.	1	2	3	7	5	10	3	3	1	.	1	.	.	37
14 - 15.9	.	.	.	.	1	.	1	.	5	4	7	4	3	.	2	.	1	.	.	28
16 - 17.9	.	.	.	.	.	1	1	3	4	6	4	5	3	4	3	.	.	.	.	34
18 - 19.9	.	.	.	.	.	.	1	.	1	3	5	4	2	7	1	1	1	.	.	26
20 - 21.9	.	.	.	.	.	.	.	.	1	5	10	6	5	4	.	2	.	.	.	33
22 - 23.9	.	.	.	.	.	.	1	.	.	3	1	3	1	3	2	1	1	.	.	16
24 - 25.9	.	.	.	.	.	.	.	.	1	2	5	.	2	3	4	2	.	.	.	19
26 - 27.9	.	.	.	.	.	.	.	.	1	1	3	3	4	3	1	.	.	.	.	16
28 - 29.9	.	.	.	.	.	.	.	.	.	.	.	1	2	1	3	.	.	.	.	7
30 - 31.9	.	.	.	.	.	.	.	.	.	1	1	1	4	1	2	1	.	.	.	11
32 - 33.9	.	.	.	.	.	.	.	.	.	1	2	.	1	3	1	1	.	.	.	9
34 - 35.9	.	.	.	.	.	.	.	.	.	1	3	.	3	1	.	1	.	.	.	9
36 - 37.9	.	.	.	.	.	.	.	.	.	1	.	1	1	1	1	1	.	.	.	6
38 - 39.9	.	.	.	.	.	.	.	.	.	1	.	1	1	.	1	.	.	.	.	4
40 - 41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	3
42 - 43.9	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	2
44 - 45.9	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	2
46 - 47.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
48 - 49.9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
Total	1	3	1	3	8	16	23	30	28	51	68	48	41	35	24	12	4	1	1	398

Weight of grain per plant in decigrams, subject.
Average length of internodes per culm per plant in millimeters, relative.
 $r = .633 \pm .0202$

Figure 5

Fulcaster, mixed.

	70-74	75-79	80-84	85-89	90-94	95-99	100-104	105-109	110-114	115-119	120-124	125-129	130-134	135-139	140-144	145-149	150-154	Total
0-1.9	1	1	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	6
2-3.9	.	2	1	4	4	4	1	1	.	.	.	.	.	.	.	.	.	17
4-5.9	.	2	.	5	6	4	2	.	.	1	.	.	.	.	.	.	.	20
6-7.9	.	.	.	3	8	3	9	4	3	.	.	.	.	.	.	.	1	31
8-9.9	.	.	.	.	6	5	10	2	.	1	.	.	.	.	.	.	.	24
10-11.9	.	.	.	1	3	1	13	9	6	3	.	.	.	.	.	.	.	36
12-13.9	.	1	.	.	1	1	7	10	10	6	1	.	.	.	.	.	.	37
14-15.9	.	.	.	.	.	2	1	9	7	6	1	.	2	.	.	.	.	28
16-17.9	.	.	.	.	1	.	4	1	9	5	2	2	.	.	.	.	.	34
18-19.9	.	.	.	.	.	.	3	4	1	3	3	2	.	.	.	.	.	26
20-21.9	.	.	.	.	.	.	1	6	10	13	2	1	.	.	.	.	.	33
22-23.9	.	.	.	.	.	.	2	3	6	2	3	.	.	.	.	.	.	16
24-25.9	.	.	.	.	.	.	.	4	6	3	5	1	.	.	.	.	.	19
26-27.9	.	.	.	.	.	.	1	1	2	5	5	1	1	.	.	.	.	16
28-29.9	.	.	.	.	.	.	.	1	.	3	2	1	.	.	.	.	.	7
30-31.9	.	.	.	.	.	.	.	3	3	1	3	1	.	.	.	.	.	11
32-33.9	.	.	.	.	.	.	.	1	2	1	1	1	3	.	.	.	.	9
34-35.9	.	.	.	.	.	.	.	.	1	5	1	1	1	.	.	.	.	9
36-37.9	.	.	.	.	.	.	.	.	1	3	.	1	1	.	.	.	.	6
38-39.9	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	1	.	4
40-41.9	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.	3
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	2
44-45.9	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	2
46-47.9	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
48-49.9	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
Total	1	6	3	15	29	20	54	69	78	62	34	15	9	1	0	1	1	398

Weight of grain per plant in decigrams, subject.
Average length of spike per plant in millimeters,
relative.
 $r = .700 \pm .0172$

Figure 6

Fulcaster, mixed.

	130-134	135-139	140-144	145-149	150-154	155-159	160-164	165-169	170-174	175-179	180-184	185-189	190-194	195-199	200-204	205-209	210-214	215-219	220-224	225-229	230-234	235-239	Total
0-1.9	1	.	.	.	1	.	2	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	6
2-3.9	.	.	.	.	.	2	1	1	5	3	1	2	1	.	1	.	.	.	.	.	.	.	17
4-5.9	.	.	.	.	.	.	.	2	6	5	1	4	2	.	.	.	.	.	.	.	.	.	20
6-7.9	.	.	.	.	.	.	.	4	2	4	4	6	3	6	.	1	1	.	.	.	.	.	31
8-9.9	.	.	.	.	.	.	.	1	1	1	5	6	4	3	2	1	.	.	.	.	.	.	24
10-11.9	.	.	.	.	.	.	.	.	.	1	3	4	10	6	5	5	1	1	.	.	.	.	36
12-13.9	.	.	.	.	.	1	.	.	.	.	5	2	8	3	8	6	2	1	1	.	.	.	37
14-15.9	.	.	.	.	.	.	.	.	.	.	1	2	1	6	9	6	.	3	.	.	.	.	28
16-17.9	.	.	.	.	.	1	.	1	2	.	.	.	3	5	10	5	3	3	1	.	.	.	34
18-19.9	.	.	.	.	.	.	.	.	1	.	.	2	1	4	6	4	4	2	1	1	.	.	26
20-21.9	.	.	.	.	.	.	.	.	1	.	.	.	1	4	7	7	11	1	1	.	.	.	33
22-23.9	.	.	.	.	.	.	.	.	.	.	.	1	.	1	2	3	5	3	1	.	.	.	16
24-25.9	.	.	.	.	.	.	.	.	.	.	.	2	.	1	4	3	3	4	1	1	.	.	19
26-27.9	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	2	3	3	3	1	.	.	16
28-29.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	1	1	.	1	.	7
30-31.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	2	4	1	.	.	.	11
32-33.9	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1	2	1	1	1	.	1	9
34-35.9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	3	1	1	1	.	.	.	9
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	1	2	.	.	.	6
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	2	.	.	.	.	3
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	1	2
44-45.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	2
46-47.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
48-49.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
Total	1	0	0	0	1	4	3	9	19	15	20	32	34	42	61	53	45	33	19	4	1	2	398

Weight of grain per plant in decigrams, subject.
Average number of spikelets per spike per plant,
relative.

$$r = .666 \pm .0188$$

Figure 7

Fulcaster, mixed,

	8-9	10-11	12-13	14-15	16-17	18-19	20-21	22-23	24-25	26-27	28-29	30-31	32-33	34-35	36-37	Total
0-1.9	1	1	.	1	1	.	1	.	.	1	.	.	.	.	.	6
2-3.9	.	.	.	2	4	2	2	3	3	.	.	1	.	.	.	17
4-5.9	.	.	.	.	.	.	8	7	1	2	2	.	.	.	.	20
6-7.9	.	.	.	.	1	.	4	7	8	5	6	.	.	.	.	31
8-9.9	.	.	.	.	.	1	.	5	8	7	1	1	.	.	1	24
10-11.9	.	.	.	.	.	.	1	7	14	10	3	1	.	.	.	36
12-13.9	.	.	.	.	.	.	.	3	7	16	9	2	.	.	.	37
14-15.9	.	.	.	.	.	.	1	2	5	10	7	3	.	.	.	28
16-17.9	.	.	.	.	.	.	.	2	10	11	6	2	2	1	.	34
18-19.9	.	.	.	.	.	.	.	.	4	8	8	6	.	.	.	26
20-21.9	.	.	.	.	.	.	.	1	3	14	9	6	.	.	.	33
22-23.9	.	.	.	.	.	.	.	.	2	3	5	6	.	.	.	16
24-25.9	.	.	.	.	.	.	.	.	2	4	8	5	.	.	.	19
26-27.9	.	.	.	.	.	.	.	.	.	2	8	5	1	.	.	16
28-29.9	.	.	.	.	.	.	.	1	.	.	2	3	1	.	.	7
30-31.9	.	.	.	.	.	.	.	.	.	1	3	6	1	.	.	11
32-33.9	.	.	.	.	.	.	.	.	.	.	5	2	2	.	.	9
34-35.9	.	.	.	.	.	.	.	.	.	.	5	4	.	.	.	9
36-37.9	.	.	.	.	.	.	.	.	.	.	2	3	.	1	.	6
38-39.9	.	.	.	.	.	.	.	.	.	.	3	1	.	.	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	3
42-43.9	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	2
44-45.9	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	2
46-47.9	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
48-49.9	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
Total	1	1	0	3	6	3	17	38	67	94	94	62	8	2	2	398

Weight of grain per plant in decigrams, subject.
Average weight of kernel per plant in milligrams,
relative.
 $r = .642 \pm .0198$

Figure 8

Fulcaster, mixed.

	0-49	50-99	100-149	150-199	200-249	250-299	300-349	350-399	400-449	450-499	500-549	550-599	600-649	650-699	700-749	750-599	800-849	850-899	900-949	950-999	1000-1049	1050-1099	1100-1149	Total	
0-1.9	3	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
2-3.9	1	7	7	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	17	
4-5.9	.	10	9	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	
6-7.9	.	.	31	21	4	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	31	
8-9.9	.	.	.	61	24	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	24	
10-11.9	.	.	.	1	42	53	2	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	36	
12-13.9	.	.	.	.	38	187	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	37	
14-15.9	.	.	.	.	.	46	126	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	
16-17.9	.	.	.	.	.	.	28	158	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	34	
18-19.9	.	.	.	.	.	.	.	21	110	3	.	.	.	.	.	.	.	.	.	.	.	.	.	26	
20-21.9	.	.	.	.	.	.	.	15	139	3	.	.	.	2	.	.	.	.	.	.	.	.	.	33	
22-23.9	.	.	.	.	.	.	.	1	15	34	2	.	.	.	.	.	.	.	.	.	.	.	.	16	
24-25.9	.	.	.	.	.	.	.	.	2	65	24	.	.	.	.	.	.	.	.	.	.	.	.	19	
26-27.9	.	.	.	.	.	.	.	.	.	24	63	1	.	.	.	.	.	.	.	.	.	.	.	16	
28-29.9	.	.	.	.	.	.	.	.	1	.	32	.	.	2	.	.	.	.	.	1	.	.	.	7	
30-31.9	.	.	.	.	.	.	.	.	.	.	21	23	.	.	33	.	.	.	.	.	.	.	.	11	
32-33.9	.	.	.	.	.	.	.	.	.	.	.	.	.	22	23	2	.	.	.	.	.	.	.	9	
34-35.9	.	.	.	.	.	.	.	.	.	.	.	.	.	31	23	3	.	.	.	.	.	.	.	9	
36-37.9	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	2	.	.	.	1	.	.	.	6	
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	1	.	1	4	
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	.	3	
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	2	
44-45.9	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	2	
46-47.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	
48-49.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	
Total	4	10	20	29	32	40	34	34	42	36	24	22	12	20	7	9	7	2	1	4	2	3	2		398

Weight of grain per plant in decigrams, subject.
 Weight of straw per plant in decigrams, relative.
 $r = .954 \pm .0030$

Figure 9

Fulcaster, mixed.

	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	Total
0-1.9	2	1	1	.	1	.	.	.	.	.	1	.	6
2-3.9	1	.	2	6	3	1	2	1	1	.	.	.	17
4-5.9	.	.	2	6	3	6	1	2	.	.	.	.	20
6-7.9	.	.	2	5	9	4	9	1	1	.	.	.	31
8-9.9	.	.	.	2	3	7	8	4	.	.	.	.	24
10-11.9	.	.	1	4	5	13	9	2	2	.	.	.	36
12-13.9	.	.	.	1	3	11	11	8	2	1	.	.	37
14-15.9	.	.	.	.	1	15	7	1	4	.	.	.	28
16-17.9	.	.	.	.	2	15	15	2	.	.	.	.	34
18-19.9	.	.	.	.	1	6	12	7	.	.	.	.	26
20-21.9	.	.	.	.	2	8	15	6	1	1	.	.	33
22-23.9	.	.	.	.	1	2	6	5	.	2	.	.	16
24-25.9	.	.	.	.	.	4	7	7	1	.	.	.	19
26-27.9	.	.	.	.	.	3	8	5	.	.	.	.	16
28-29.9	.	.	.	1	.	.	2	3	.	.	.	1	7
30-31.9	.	.	.	.	.	3	3	3	1	1	.	.	11
32-33.9	.	.	.	.	.	1	4	3	1	.	.	.	9
34-35.9	.	.	.	.	.	.	5	2	2	.	.	.	9
36-37.9	.	.	.	.	.	1	2	1	1	1	.	.	6
38-39.9	.	.	.	.	.	2	2	.	.	.	.	.	4
40-41.9	.	.	.	.	.	1	2	.	.	.	.	.	3
42-43.9	.	.	.	.	.	.	2	.	.	.	.	.	2
44-45.9	.	.	.	.	.	.	1	.	.	.	.	1	2
46-47.9	.	.	.	.	.	.	1	.	.	.	.	.	1
48-49.9	.	.	.	.	.	.	1	.	.	.	.	.	1
Total	3	1	8	25	34	103	135	63	17	6	1	2	398

Weight of grain per plant in decigrams, subject.
 Per cent of grain to straw, relative.
 $r = .515 \pm .0248$

Figure 10 .

Fulcaster, mixed.

	0-99	100-199	200-299	300-399	400-499	500-599	600-699	700-799	800-899	900-999	1000-1099	1100-1199	1200-1299	1300-1399	1400-1499	1500-1599	1600-1699	Total
0-1.9	5	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
2-3.9	.	16	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	17
4-5.9	.	8	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20
6-7.9	.	.	18	12	1	.	.	.	.	.	.	.	.	.	.	.	.	31
8-9.9	.	.	3	18	2	1	.	.	.	.	.	.	.	.	.	.	.	24
10-11.9	.	.	.	6	11	19	.	.	.	.	.	.	.	.	.	.	.	36
12-13.9	.	.	.	.	22	15	.	.	.	.	.	.	.	.	.	.	.	37
14-15.9	.	.	.	.	6	18	4	.	.	.	.	.	.	.	.	.	.	28
16-17.9	.	.	.	.	.	9	22	3	.	.	.	.	.	.	.	.	.	34
18-19.9	.	.	.	.	.	.	18	8	.	.	.	.	.	.	.	.	.	26
20-21.9	.	.	.	.	.	.	8	22	2	1	.	.	.	.	.	.	.	33
22-23.9	.	.	.	.	.	.	.	10	6	.	.	.	.	.	.	.	.	16
24-25.9	.	.	.	.	.	.	.	3	10	5	1	.	.	.	.	.	.	19
26-27.9	.	.	.	.	.	.	.	.	9	7	.	.	.	.	.	.	.	16
28-29.9	.	.	.	.	.	.	.	.	1	4	1	.	1	.	.	.	.	7
30-31.9	.	.	.	.	.	.	.	.	.	5	5	1	.	.	.	.	.	11
32-33.9	.	.	.	.	.	.	.	.	.	.	3	6	.	.	.	.	.	9
34-35.9	.	.	.	.	.	.	.	.	.	.	.	8	1	.	.	.	.	9
36-37.9	.	.	.	.	.	.	.	.	.	.	1	3	2	.	.	.	.	6
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	.	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	3
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	2
44-45.9	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	2
46-47.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
48-49.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
Total	5	35	34	36	42	62	52	46	38	22	11	18	6	9	0	0	2	398

Weight of grain per plant in decigrams, subject.
 Number of kernels per plant, relative.
 $r = .979 \pm .0014$

Figure 11

Fulcaster, line.

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-99.9	100-109.9	110-119.9	120-129.9	130-139.9	140-149.9	150-159.9	Total
0-1.9	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
2-3.9	1	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20
4-5.9	.	16	7	1	.	.	.	.	.	.	.	.	.	.	.	.	24
6-7.9	.	1	15	5	1	1	.	.	.	.	.	.	.	.	.	.	23
8-9.9	.	.	4	33	1	.	.	.	.	.	.	.	.	.	.	.	38
10-11.9	.	.	.	19	25	1	.	.	.	.	.	.	.	.	.	.	45
12-13.9	.	.	1	2	23	10	2	.	.	.	.	.	.	.	.	.	38
14-15.9	.	.	1	.	9	28	3	.	.	.	.	.	.	.	.	.	41
16-17.9	.	.	1	.	.	13	12	1	.	.	.	.	.	.	.	.	27
18-19.9	.	.	.	.	2	17	9	1	.	.	.	.	.	.	.	.	29
20-21.9	.	.	.	.	.	8	13	1	.	1	.	.	.	.	.	.	23
22-23.9	.	.	.	.	.	1	10	7	2	.	.	.	.	.	.	.	20
24-25.9	.	.	.	.	.	.	1	10	5	.	.	1	.	.	.	.	17
26-27.9	.	.	.	.	.	.	.	3	10	1	.	.	.	.	.	.	14
28-29.9	.	.	.	.	.	.	1	.	4	3	1	.	.	.	.	.	9
30-31.9	.	.	.	.	.	.	.	1	2	.	1	.	.	.	.	.	4
32-33.9	.	.	.	.	.	.	.	.	.	2	2	.	.	.	.	.	4
34-35.9	.	.	.	.	.	.	.	1	.	2	2	.	.	.	.	.	5
36-37.9	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	.	3
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	2
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	3
Total	5	36	29	60	59	56	42	35	24	23	9	7	5	2	1	3	394

Weight of grain per plant in decigrams, subject.

Weight of plant in decigrams, relative.

$r = .965 \pm .0023$

Figure 12

Fulcaster, line.

	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-19	20-21	22-23	24-25	26-27	28-29	30-31	32-33	34-35	36-37	38-39	40-41	Total
0-1.9	1	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
2-3.9	2	4	7	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20
4-5.9	.	3	5	9	6	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	24
6-7.9	.	.	2	3	10	6	1	.	1	.	.	.	.	.	.	.	.	.	.	.	23
8-9.9	.	.	.	1	6	11	12	8	.	.	.	.	.	.	.	.	.	.	.	.	38
10-11.9	.	.	.	.	4	8	12	12	6	3	.	.	.	.	.	.	.	.	.	.	45
12-13.9	.	.	.	.	3	2	8	15	7	2	1	.	.	.	.	.	.	.	.	.	38
14-15.9	.	.	.	.	.	4	14	9	7	2	4	1	.	.	.	.	.	.	.	.	41
16-17.9	.	.	.	.	.	1	1	14	7	2	2	.	.	.	.	.	.	.	.	.	27
18-19.9	.	.	.	.	.	.	1	1	9	5	10	2	1	.	.	.	.	.	.	.	29
20-21.9	.	.	.	.	.	.	.	.	3	10	5	4	.	1	.	.	.	.	.	.	23
22-23.9	.	.	.	.	.	.	.	.	3	3	5	3	4	2	.	.	.	.	.	.	20
24-25.9	.	.	.	.	.	.	.	.	.	2	6	5	2	1	1	.	.	.	.	.	17
26-27.9	.	.	.	.	.	.	.	.	.	3	3	1	4	3	.	.	.	.	.	.	14
28-29.9	.	.	.	.	.	.	.	.	1	.	1	1	4	1	.	1	.	.	.	.	9
30-31.9	.	.	.	.	.	.	.	.	.	1	.	1	1	1	.	.	.	.	.	.	4
32-33.9	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	1	.	.	.	.	4
34-35.9	.	.	.	.	.	.	.	.	.	.	1	.	1	2	1	.	.	.	.	.	5
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	3
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	2
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	3
Total	5	10	14	20	29	32	49	59	44	34	37	19	18	11	5	4	0	2	3	1	394

Weight of grain per plant in decigrams, subject.
 Number of culms per plant, relative.
 $r = .917 \pm .0054$

Figure 13

Fulcaster, line.

	47-49.9	50-52.9	53-55.9	56-58.9	59-61.9	62-64.9	65-67.9	68-70.9	71-73.9	74-76.9	77-79.9	80-82.9	83-85.9	86-88.9	89-91.9	92-94.9	95-97.9	98-100.9	101-103.9	104-106.9	107-109.9	110-112.9	113-115.9	Total
0-1.9	.	2	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
2-3.9	2	1	3	1	2	3	4	2	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	20
4-5.9	.	.	.	.	4	6	4	.	4	1	1	2	1	.	.	1	.	.	.	.	.	.	.	24
6-7.9	.	.	.	.	3	2	2	4	6	1	1	1	2	2	.	1	.	.	.	.	.	.	.	23
8-9.9	.	.	.	.	1	3	2	7	5	1	4	2	2	2	.	.	.	.	.	.	.	.	.	38
10-11.9	.	.	.	.	1	.	2	5	6	1	2	5	5	3	4	1	.	.	1	.	.	.	.	45
12-13.9	.	.	.	.	.	.	1	3	5	7	8	7	7	2	2	3	.	.	.	.	.	.	.	38
14-15.9	.	.	.	.	.	.	.	2	4	5	6	1	5	7	3	5	2	.	1	.	.	.	.	41
16-17.9	.	.	.	.	.	.	.	.	1	3	4	2	2	6	4	3	.	1	1	.	.	.	.	27
18-19.9	.	.	.	.	.	.	.	.	.	3	4	3	5	6	1	2	1	1	2	.	.	.	1	29
20-21.9	.	.	.	.	.	.	.	.	.	.	3	2	3	4	3	3	2	2	1	.	.	.	.	23
22-23.9	.	.	.	.	.	.	.	.	.	1	1	2	4	3	3	3	.	3	.	.	.	.	.	20
24-25.9	.	.	.	.	.	.	.	.	.	.	1	.	1	2	4	2	4	1	1	1	.	.	.	17
26-27.9	.	.	.	.	.	.	.	.	.	.	1	.	1	1	1	3	4	3	.	.	.	.	.	14
28-29.9	.	.	.	.	.	.	.	.	.	.	.	.	.	3	1	1	2	1	1	.	.	.	.	9
30-31.9	.	.	.	.	.	.	.	.	.	.	.	1	.	1	1	.	1	.	.	.	.	.	.	4
32-33.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	2	.	1	.	.	.	4
34-35.9	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	1	.	1	1	.	.	.	5
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	1	.	3
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	2
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	1	.	.	3
Total	2	3	3	1	11	15	16	23	31	47	57	29	32	40	28	27	19	13	9	5	1	1	1	394

Weight of grain per plant in decigrams, subject.
Average length of culm per plant in millimeters, relative.
 $r = .739 \pm .0154$

Figure 14

Fulcaster, line.

	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	Total
0-1.9	.	.	.	1	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.	4
2-3.9	1	.	.	2	2	5	2	.	6	1	.	.	.	.	1	.	.	.	.	20
4-5.9	.	.	.	.	1	2	4	3	6	5	1	.	.	1	.	1	.	.	.	24
6-7.9	.	.	.	.	.	1	4	3	5	3	4	1	.	1	.	.	.	.	1	23
8-9.9	.	1	.	2	1	1	4	5	9	10	5	.	.	.	.	.	.	.	.	38
10-11.9	.	.	.	.	.	1	3	2	17	5	8	7	2	.	.	.	.	.	.	45
12-13.9	.	.	.	.	.	.	3	.	7	13	8	3	1	.	3	.	.	.	.	38
14-15.9	.	.	.	.	.	.	.	2	5	6	6	3	11	3	4	1	.	.	.	41
16-17.9	.	.	.	.	.	.	.	.	3	2	8	3	4	1	2	2	1	1	.	27
18-19.9	.	.	.	.	.	.	.	.	4	5	7	6	1	4	1	1	.	.	.	29
20-21.9	.	.	.	.	.	.	.	.	.	4	5	2	3	2	5	1	1	.	.	23
22-23.9	.	.	.	.	.	.	.	.	.	5	1	2	2	5	2	3	.	.	.	20
24-25.9	.	.	.	.	.	.	.	.	.	.	3	1	5	4	3	1	.	.	.	17
26-27.9	.	.	.	.	.	.	.	1	.	1	1	.	4	3	1	1	1	1	.	14
28-29.9	.	.	.	.	.	.	.	1	.	.	3	1	.	2	1	1	.	.	.	9
30-31.9	.	.	.	.	.	.	.	.	.	.	1	1	.	2	.	.	.	.	.	4
32-33.9	.	.	.	.	.	.	.	.	.	.	.	1	.	2	.	1	.	.	.	4
34-35.9	.	.	.	.	.	.	.	.	.	.	1	.	1	1	1	.	1	.	.	5
36-37.9	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	1	.	.	3
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	2
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	.	.	3
Total	1	1	0	5	4	10	21	15	66	61	62	31	55	53	27	13	6	2	1	394

Weight of grain per plant in decigrams, subject.
Average number of internodes per culm per plant,
relative.
 $r = .621 \pm .0208$

Figure 15

Fulcaster, line.

	100-104	105-109	110-114	115-119	120-124	125-129	130-134	135-139	140-144	145-149	150-154	155-159	160-164	165-169	170-174	175-179	180-184	185-189	190-194	Total
0-1.9	1	1	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	4
2-3.9	2	1	2	2	1	2	2	6	.	.	.	.	.	.	1	1	.	.	.	20
4-5.9	.	.	.	1	3	4	5	1	2	4	1	1	1	.	1	.	.	.	.	24
6-7.9	.	.	.	.	1	5	2	3	6	2	2	1	.	.	1	.	.	.	.	23
8-9.9	.	.	.	.	.	2	4	5	10	8	3	3	2	1	.	.	.	.	.	38
10-11.9	.	.	.	1	.	.	4	3	6	10	7	8	4	.	1	.	1	.	.	45
12-13.9	.	.	.	.	.	.	1	1	10	9	3	4	8	1	1	.	.	.	.	38
14-15.9	.	.	.	.	.	1	.	2	8	4	4	6	5	8	1	1	1	.	.	41
16-17.9	.	.	.	.	.	.	.	.	5	2	4	5	4	2	4	1	.	.	.	27
18-19.9	.	.	.	.	.	.	.	.	1	3	4	5	6	2	3	3	1	1	.	29
20-21.9	.	.	.	.	.	.	.	.	1	.	5	4	3	3	5	.	2	.	.	23
22-23.9	.	.	.	.	.	.	.	.	.	2	2	7	4	1	2	1	1	.	.	20
24-25.9	.	.	.	.	.	.	.	.	.	1	1	2	2	3	4	2	1	1	.	17
26-27.9	.	.	.	.	.	.	.	.	.	.	1	.	2	4	2	5	.	.	.	14
28-29.9	.	.	.	.	.	.	.	.	.	.	.	.	2	2	3	2	.	.	.	9
30-31.9	.	.	.	.	.	.	.	.	.	1	.	.	2	.	.	.	1	.	.	4
32-33.9	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	2	.	.	1	4
34-35.9	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	1	1	1	.	5
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	1	.	3
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	2
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	1	.	3
Total	3	2	2	4	5	15	18	21	50	46	38	47	47	32	29	19	10	5	1	394

Weight of grain per plant in decigrams, subject.
Average length of internodes per culm per plant
in millimeters, relative.
 $r = .674 \pm .0185$

Figure 16

Fulcaster, line.

	75-79	80-84	85-89	90-94	95-99	100-104	105-109	110-114	115-119	120-124	125-129	130-134	135-139	Total
0-1.9	.	1	2	.	1	.	.	.	.	.	.	.	.	4
2-3.9	2	5	.	7	3	.	.	1	1	.	.	.	.	20
4-5.9	.	4	4	4	3	4	2	2	1	.	.	.	.	24
6-7.9	.	1	4	2	4	5	3	2	2	.	.	.	.	23
8-9.9	.	.	2	7	7	9	9	4	.	.	.	.	.	38
10-11.9	.	.	.	3	7	16	9	7	2	.	.	.	1	45
12-13.9	.	.	.	2	2	11	10	7	4	1	.	.	1	38
14-15.9	.	.	.	.	3	6	8	7	14	2	1	.	.	41
16-17.9	.	.	.	.	.	3	5	3	8	8	.	.	.	27
18-19.9	.	.	.	.	1	2	6	7	6	2	2	2	1	29
20-21.9	.	.	.	.	.	.	8	6	3	4	2	.	.	23
22-23.9	.	.	.	.	1	.	1	3	8	5	2	.	.	20
24-25.9	.	.	.	.	.	.	.	3	7	5	2	.	.	17
26-27.9	.	.	.	.	.	.	.	4	2	4	4	.	.	14
28-29.9	.	.	.	.	.	.	1	1	3	4	.	.	.	9
30-31.9	.	.	.	.	.	.	1	1	.	2	.	.	.	4
32-33.9	.	.	.	.	.	.	.	1	1	2	.	.	.	4
34-35.9	.	.	.	.	.	.	.	1	3	.	1	.	.	5
36-37.9	.	.	.	.	.	.	.	.	1	2	.	.	.	3
38-39.9	.	.	.	.	.	.	.	.	1	.	1	.	.	2
40-41.9	.	.	.	.	.	.	.	.	1	.	.	.	.	1
42-43.9	.	.	.	.	.	.	.	.	3	.	.	.	.	3
Total	2	11	13	25	32	56	63	60	71	41	15	2	3	394

Weight of grain per plant in decigrams, subject.
Average length of spike per plant in millimeters,
relative.

$$r = .666 \pm .0189$$

Figure 17

Fulcaster, line.

	140-144	145-149	150-154	155-159	160-164	165-169	170-174	175-179	180-184	185-189	190-194	195-199	200-204	205-209	210-214	215-219	220-224	225-229	230-234	Total
0-1.9	.	.	.	1	.	2	.	.	1	.	.	.	.	.	.	.	.	.	.	4
2-3.9	.	.	1	1	.	3	5	5	2	.	1	.	2	.	.	.	.	.	.	20
4-5.9	1	.	.	.	.	.	4	5	2	5	3	.	1	3	.	.	.	.	.	24
6-7.9	.	.	.	.	.	1	2	4	4	4	2	1	2	1	1	1	.	.	.	23
8-9.9	.	.	2	.	.	.	.	3	6	7	7	7	4	.	2	.	.	.	.	38
10-11.9	.	.	.	.	.	.	1	.	4	6	12	9	5	4	1	2	1	.	.	45
12-13.9	.	.	.	.	.	.	.	1	2	3	8	9	6	7	.	1	1	.	.	38
14-15.9	.	.	.	.	.	.	.	1	.	2	2	9	4	6	8	6	2	1	.	41
16-17.9	.	.	.	.	.	.	.	.	.	2	1	1	4	7	5	4	3	.	.	27
18-19.9	.	.	.	.	.	.	.	.	.	.	.	4	7	2	7	3	5	1	.	29
20-21.9	.	.	.	.	.	.	.	.	.	1	1	.	6	3	4	5	1	1	1	23
22-23.9	.	.	.	.	.	1	.	.	1	.	.	.	2	4	3	7	2	.	.	20
24-25.9	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	8	4	1	.	17
26-27.9	.	.	.	.	.	.	.	.	.	.	.	.	.	2	5	3	1	3	.	14
28-29.9	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	2	4	.	1	9
30-31.9	.	.	.	.	.	.	.	.	.	.	1	.	.	2	1	.	.	.	.	4
32-33.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1	.	4
34-35.9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	2	.	.	5
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	3
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	2
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	2	.	.	3
Total	1	0	3	2	0	7	12	19	22	30	38	41	43	44	46	46	29	9	2	394

Weight of grain per plant in decigrams, subject.
Average number of spikelets per spike per plant,
relative.
 $r = .688 \pm .0178$

Figure 18

Fulcaster, line.

	14-15	16-17	18-19	20-21	22-23	24-25	26-27	28-29	30-31	32-33	34-35	36-37	38-39	40-41	==	54-55	Total
0-1.9	1	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	4
2-3.9	1	.	2	6	5	3	.	2	.	.	.	.	.	.	.	1	20
4-5.9	.	1	1	5	7	4	5	1	.	.	.	.	.	.	.	.	24
6-7.9	1	.	.	6	7	5	2	1	1	.	.	.	.	.	.	.	23
8-9.9	.	.	.	4	13	11	6	3	.	.	1	.	.	.	.	.	38
10-11.9	.	.	.	3	12	15	11	3	1	.	.	.	.	.	.	.	45
12-13.9	.	.	.	2	4	8	15	5	2	.	2	.	.	.	.	.	38
14-15.9	.	.	.	1	2	8	17	12	1	.	.	.	.	.	.	.	41
16-17.9	.	.	.	.	2	8	10	5	2	.	.	.	.	.	.	.	27
18-19.9	.	.	.	.	1	7	11	8	1	1	.	.	.	.	.	.	29
20-21.9	.	.	.	.	.	1	14	5	3	.	.	.	.	.	.	.	23
22-23.9	.	.	.	1	.	1	11	5	.	1	.	.	.	.	.	1	20
24-25.9	.	.	.	.	.	1	5	8	1	1	1	.	.	.	.	.	17
26-27.9	.	.	.	.	.	.	4	5	4	1	.	.	.	.	.	.	14
28-29.9	.	.	.	.	.	.	5	2	.	1	.	.	.	1	.	.	9
30-31.9	.	.	.	.	.	.	.	.	2	1	1	.	.	.	.	.	4
32-33.9	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	4
34-35.9	.	.	.	.	.	.	1	2	1	.	.	.	1	.	.	.	5
36-37.9	.	.	.	.	.	.	.	2	.	1	.	.	.	.	.	.	3
38-39.9	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	2
40-41.9	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
42-43.9	.	.	.	.	.	.	.	1	2	.	.	.	.	.	.	.	3
Total	3	1	4	30	53	72	119	74	22	7	5	0	1	1	2		394

Weight of grain per plant in decigrams, subject.
Average weight of kernel per plant in milligrams,
relative.
 $r = .506 \pm .0252$

Figure 19

Fulcaster, line.

	0-49	50-99	100-149	150-199	200-249	250-299	300-349	350-399	400-449	450-499	500-549	550-599	600-649	650-699	700-749	750-799	800-849	850-899	900-949	950-999	1000-1049	1050-1099	1100-1149	Total
0-1.9	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
2-3.9	.	12	7	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20
4-5.9	.	2	14	7	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	24
6-7.9	.	.	1	12	5	3	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	23
8-9.9	.	.	.	3	21	12	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	38
10-11.9	.	.	.	.	6	21	13	4	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	45
12-13.9	.	.	.	1	.	6	15	10	4	1	1	.	.	.	.	.	.	.	.	.	.	.	.	38
14-15.9	.	.	.	1	.	3	6	16	12	3	.	.	.	.	.	.	.	.	.	.	.	.	.	41
16-17.9	.	.	1	.	.	.	1	4	14	4	2	1	.	.	.	.	.	.	.	.	.	.	.	27
18-19.9	.	.	.	.	.	.	.	1	7	8	8	3	2	.	.	.	.	.	.	.	.	.	.	29
20-21.9	.	.	.	.	.	.	.	.	.	12	6	3	1	.	.	.	1	.	.	.	.	.	.	23
22-23.9	.	.	.	.	.	1	.	.	.	1	6	7	2	1	2	.	.	.	.	.	.	.	.	20
24-25.9	.	.	.	.	.	.	.	.	.	.	1	4	8	2	1	.	.	.	.	1	.	.	.	17
26-27.9	.	.	.	.	.	.	.	.	.	.	.	1	4	4	4	1	.	.	.	.	.	.	.	14
28-29.9	.	.	.	.	.	.	.	.	.	1	.	.	1	3	3	.	1	.	.	.	.	.	.	9
30-31.9	.	.	.	.	.	.	.	.	.	.	1	.	.	2	.	.	1	.	.	.	.	.	.	4
32-33.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	.	.	.	.	.	.	4
34-35.9	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1	2	.	.	.	.	.	.	.	5
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	.	.	3
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	2
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	3
Total	2	16	23	25	33	46	38	35	38	30	27	19	18	13	13	4	5	2	1	2	0	1	3	394

Weight of grain per plant in decigrams, subject.
 Weight of straw per plant in decigrams, relative.
 $r = .945 \pm .0036$

Figure 20

Fulcaster, line.

	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	Total
0-1.9	2	1			1													4
2-3.9	1		1	5	6	3	3			1								20
4-5.9			2	3	8	5	3	2		1								24
6-7.9	1		1	6	6	4	3	1			1							23
8-9.9				2	9	18	7		2									38
10-11.9			1	5	10	20	7	2										45
12-13.9			1	3	5	15	10	2	1				1					38
14-15.9	1				9	13	12	4	1								1	41
16-17.9				1	3	12	8	2		1								27
18-19.9				1	5	12	9	1	1									29
20-21.9			1		2	3	17											23
22-23.9					3	6	8	2							1			20
24-25.9			1	1	1	5	8	1										17
26-27.9					1	7	4	2										14
28-29.9						1	7				1							9
30-31.9						1	1	1		1								4
32-33.9							4											4
34-35.9							1	2	1		1							5
36-37.9							3											3
38-39.9						1	1											2
40-41.9						1												1
42-43.9						2	1											3
Total	5	2	9	27	69	129	117	23	6	4	3	0	1	0	1	0	1	394

Weight of grain per plant in decigrams, subject.
 Per cent of grain to straw, relative.
 $r = .3209 \pm .0302$

Figure 21

Fulcaster, line.

	0-99	100-199	200-299	300-399	400-499	500-599	600-699	700-799	800-899	900-999	1000-1099	1100-1199	1200-1299	1300-1399	1400-1499	Total
0-1.9	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
2-3.9	2	18	.	.	.	.	.	.	.	.	.	.	.	.	.	20
4-5.9	.	12	11	1	.	.	.	.	.	.	.	.	.	.	.	24
6-7.9	.	.	17	5	1	.	.	.	.	.	.	.	.	.	.	23
8-9.9	.	.	2	26	10	.	.	.	.	.	.	.	.	.	.	38
10-11.9	.	.	.	10	32	3	.	.	.	.	.	.	.	.	.	45
12-13.9	.	.	.	2	23	12	1	.	.	.	.	.	.	.	.	38
14-15.9	.	.	.	.	7	31	2	1	.	.	.	.	.	.	.	41
16-17.9	.	.	.	.	.	8	17	2	.	.	.	.	.	.	.	27
18-19.9	.	.	.	.	.	1	13	15	.	.	.	.	.	.	.	29
20-21.9	.	.	.	.	.	.	3	17	5	.	.	.	.	.	.	23
22-23.9	.	.	.	.	1	.	.	5	13	.	1	.	.	.	.	20
24-25.9	.	.	.	.	.	.	.	2	10	4	1	.	.	.	.	17
26-27.9	.	.	.	.	.	.	.	1	5	8	.	.	.	.	.	14
28-29.9	.	.	.	.	.	.	.	1	.	3	5	.	.	.	.	9
30-31.9	.	.	.	.	.	.	.	.	2	1	1	.	.	.	.	4
32-33.9	.	.	.	.	.	.	.	.	.	.	1	3	.	.	.	4
34-35.9	.	.	.	.	.	.	.	.	1	.	.	1	3	.	.	5
36-37.9	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	3
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	3
Total	6	30	30	44	74	55	36	44	34	16	9	5	5	4	2	394

Weight of grain per plant in decigrams, subject.
 Number of kernels per plant, relative.
 $r = .971 \pm .0019$

Figure 22

Dawson's Golden Chaff, mixed.

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-99.9	100-109.9	110-119.9	120-129.9	130-139.9	140-149.9	Total
0-1.9	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
2-3.9	2	8	.	.	.	.	.	.	.	.	.	.	.	.	.	10
4-5.9	.	9	6	.	.	.	.	.	.	.	.	.	.	.	.	15
6-7.9	.	6	18	6	.	.	.	1	.	.	.	.	.	.	.	31
8-9.9	.	.	13	17	2	.	.	.	.	.	.	.	.	.	.	32
10-11.9	.	.	1	14	10	1	1	.	.	.	.	.	.	.	.	27
12-13.9	.	.	.	4	23	5	.	.	.	1	.	.	.	.	.	33
14-15.9	.	.	.	1	8	9	3	.	.	.	.	.	.	.	.	21
16-17.9	.	.	.	.	7	15	12	1	.	.	.	.	.	.	.	35
18-19.9	.	.	.	.	2	15	17	3	1	1	.	.	.	.	.	39
20-21.9	.	.	.	.	.	2	9	8	2	1	.	.	.	.	.	22
22-23.9	.	.	.	.	.	.	8	12	4	1	1	.	.	.	.	26
24-25.9	.	.	.	.	.	.	3	14	8	2	.	.	.	.	.	27
26-27.9	.	.	.	.	.	.	1	1	9	5	.	.	.	.	.	16
28-29.9	.	.	.	.	.	.	1	1	7	6	3	2	.	.	.	20
30-31.9	.	.	.	.	.	.	.	1	3	1	5	1	.	.	.	11
32-33.9	.	.	.	.	.	.	.	.	1	2	1	3	1	1	.	9
34-35.9	.	.	.	.	.	.	.	.	.	4	2	1	1	.	.	8
36-37.9	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	3
38-39.9	.	.	.	.	.	.	.	.	.	1	1	.	2	.	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
42-43.9	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	3
-----	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
54-55.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
Total	4	25	38	43	52	47	54	42	35	25	13	8	8	2	1	395

Weight of grain per plant in decigrams, subject
 Weight of plant in decigrams, relative.
 $r = .939 \pm .0040$

Figure 23

Dawson's Golden Chaff, mixed.

	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-19	20-21	22-23	24-25	26-27	28-29	30-31	32-33	34-35	Total
0-1.9	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
2-3.9	4	2	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	10
4-5.9	.	3	5	4	3	.	.	.	.	.	.	.	.	.	.	.	.	15
6-7.9	.	4	8	10	4	3	2	.	.	.	.	.	.	.	.	.	.	31
8-9.9	.	1	5	5	11	7	3	.	.	.	.	.	.	.	.	.	.	32
10-11.9	.	.	2	5	5	7	6	2	.	.	.	.	.	.	.	.	.	27
12-13.9	.	.	.	2	9	12	5	4	.	1	.	.	.	.	.	.	.	33
14-15.9	.	.	.	2	2	3	6	3	4	1	.	.	.	.	.	.	.	21
16-17.9	.	.	.	1	3	5	8	9	8	1	.	.	.	.	.	.	.	35
18-19.9	.	.	.	1	1	4	11	11	7	4	.	.	.	.	.	.	.	39
20-21.9	.	.	.	.	.	4	3	7	2	3	3	.	.	.	.	.	.	22
22-23.9	.	.	.	.	.	1	2	7	9	3	4	.	.	.	.	.	.	26
24-25.9	.	.	.	.	.	.	2	9	7	1	7	1	.	.	.	.	.	27
26-27.9	.	.	.	.	.	2	1	1	6	2	3	1	.	.	.	.	.	16
28-29.9	.	.	.	.	.	.	1	3	4	5	3	2	2	.	.	.	.	20
30-31.9	.	.	.	.	.	.	.	.	3	3	3	2	.	.	.	.	.	11
32-33.9	.	.	.	.	.	.	.	.	2	3	1	2	1	.	.	.	.	9
34-35.9	.	.	.	.	.	.	.	.	.	2	4	2	.	.	.	.	.	8
36-37.9	.	.	.	.	.	.	.	.	.	1	.	1	.	1	.	.	.	3
38-39.9	.	.	.	.	.	.	.	.	1	.	.	1	1	.	1	.	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	3
-----	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
54-55.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
Total	4	12	23	31	38	48	50	56	53	50	28	12	5	2	2	0	1	395

Weight of grain per plant in decigrams, subject.
 Number of culms per plant, relative.
 $r = .856 \pm .0090$

Figure 24

Dawson's Golden Chaff, mined.

	40-42.9	43-45.9	46-48.9	49-51.9	52-54.9	55-57.9	58-60.9	61-63.9	64-66.9	67-68.9	70-72.9	73-75.9	76-78.9	79-81.9	82-84.9	85-87.9	88-90.9	91-93.9	94-96.9	97-99.9	100-102.9	103-105.9	106-108.9	Total
0-1.9	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
2-3.9	.	.	1	.	.	.	2	3	2	.	1	.	.	.	.	1	.	.	.	.	.	.	.	10
4-5.9	.	.	.	.	1	1	.	6	3	2	.	2	.	.	.	.	.	.	.	.	.	.	.	15
6-7.9	.	.	.	.	.	1	2	1	4	7	4	6	2	2	1	.	.	.	.	.	1	.	.	31
8-9.9	.	.	.	.	.	.	.	3	6	9	4	5	3	1	.	1	.	.	.	.	.	.	.	32
10-11.9	.	.	.	.	.	.	1	3	1	3	7	1	2	3	4	1	.	1	.	.	.	.	.	27
12-13.9	.	.	.	.	.	.	.	.	1	3	7	6	7	3	3	2	1	.	.	.	.	.	.	33
14-15.9	.	.	.	.	.	.	.	.	1	3	2	3	5	4	1	.	1	1	.	.	.	.	.	21
16-17.9	.	.	.	.	.	.	.	.	1	3	4	7	6	5	5	.	2	1	1	.	.	.	.	35
18-19.9	.	.	.	.	.	.	.	.	.	1	1	13	7	3	9	2	3	.	.	.	.	.	.	39
20-21.9	.	.	.	.	.	.	.	.	.	.	1	3	5	3	3	3	3	.	1	.	.	.	.	22
22-23.9	.	.	.	.	.	.	.	.	.	.	1	2	6	4	4	2	3	.	3	1	.	.	.	26
24-25.9	.	.	.	.	.	.	.	.	.	.	.	1	7	6	5	7	.	.	.	1	.	.	.	27
26-27.9	.	.	.	.	.	.	.	.	.	.	.	2	1	3	3	2	2	.	1	1	1	.	.	16
28-29.9	.	.	.	.	.	.	.	.	.	.	.	.	3	3	2	4	2	3	.	1	.	1	1	20
30-31.9	.	.	.	.	.	.	.	.	.	.	.	.	1	3	2	1	2	2	.	.	.	.	.	11
32-33.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4	1	3	.	.	.	9
34-35.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	3	.	1	.	1	.	8
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	1	.	.	3
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	1	1	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	1	.	.	.	3
-----	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
54-55.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
Total	7	0	1	0	2	2	5	16	19	31	32	51	55	43	45	28	21	17	9	10	3	3	1	395

Weight of grain per plant in decigrams, subject.

Average length of culm per plant in milligrams, relative.

$r = .749 \pm .0148$

Figure 25

Dawson's Golden Chaff, mixed.

	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	6.1	Total
0-1.9	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	2
2-3.9	1	.	.	.	.	.	.	.	.	2	1	1	1	.	1	1	1	.	.	.	1	10
4-5.9	1	1	.	1	2	.	.	.	2	4	1	2	.	1	.	.	.	.	.	.	.	15
6-7.9	.	.	1	1	1	1	1	4	.	5	2	4	3	1	4	2	.	.	.	.	1	31
8-9.9	.	.	1	1	1	1	1	1	1	5	5	8	2	3	1	.	1	.	.	.	.	32
10-11.9	.	.	2	.	1	.	.	1	1	2	3	2	2	4	3	4	1	1	.	.	.	27
12-13.9	.	.	.	.	.	2	2	.	1	5	6	4	4	5	4	.	.	.	.	.	.	33
14-15.9	.	.	.	.	1	.	.	3	.	1	2	5	4	1	2	1	1	.	.	.	.	21
16-17.9	.	2	.	.	.	.	2	4	.	1	2	4	1	1	6	1	.	1	.	.	.	35
18-19.9	.	.	.	.	.	1	1	4	1	3	3	5	7	4	7	3	.	.	.	.	.	39
20-21.9	.	.	.	1	.	.	1	.	.	2	1	2	5	4	4	2	.	.	.	.	.	22
22-23.9	.	.	.	1	1	2	.	3	.	.	.	1	5	8	3	2	.	.	.	.	.	26
24-25.9	.	.	.	.	.	.	.	3	1	2	.	1	4	7	3	3	2	.	.	1	.	27
26-27.9	.	.	.	.	.	.	.	.	.	.	.	2	1	6	4	.	3	.	.	.	.	16
28-29.9	.	.	.	.	.	.	.	2	.	1	4	3	1	2	5	1	.	1	.	.	.	20
30-31.9	.	.	.	.	.	.	1	1	.	2	.	.	2	1	.	1	2	1	.	.	.	11
32-33.9	.	.	.	.	.	.	.	1	.	1	.	.	.	.	3	1	3	.	.	.	.	9
34-35.9	.	.	.	.	.	.	.	1	.	1	1	1	.	2	.	1	1	.	.	.	.	8
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	.	.	3
38-39.9	.	.	.	.	.	.	.	1	.	.	1	.	.	.	1	.	1	.	.	.	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
42-43.9	.	.	.	.	.	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	3
54-55.9	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
Total	2	3	4	5	7	7	10	30	7	40	33	45	52	50	52	24	16	5	0	2	1	395

Weight of grain per plant in decigrams, subject.
Average number of internodes per plant, relative
 $r = .249 \pm .0318$

Figure 26

Dawson's Golden Chaff, mixed.

	85-89	90-94	95-99	100-104	105-109	110-114	115-119	120-124	125-129	130-134	135-139	140-144	145-149	150-154	155-159	160-164	165-169	170-174	175-179	180-184	185-189	190-194	195-199	200-204	205-209	Total
0-1.9	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
2-3.9	.	.	1	.	2	1	2	3	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	10
4-5.9	.	.	.	.	.	.	2	1	4	3	3	1	1	.	.	.	.	.	.	.	.	.	.	.	.	15
6-7.9	.	.	.	.	.	.	3	3	7	9	1	3	2	2	.	.	.	.	1	.	.	.	.	.	.	31
8-9.9	.	.	.	.	.	.	2	5	6	5	3	.	4	2	1	2	.	1	.	.	.	.	1	.	.	32
10-11.9	.	.	.	.	.	.	2	4	3	5	6	3	1	1	.	1	1	.	.	.	.	.	.	.	.	27
12-13.9	.	.	.	.	.	.	.	1	2	8	7	4	5	1	.	2	1	.	1	.	.	1	.	.	.	33
14-15.9	.	.	.	.	.	.	1	.	3	1	6	4	2	.	2	2	.	.	.	.	.	.	.	.	.	21
16-17.9	.	.	.	.	.	.	2	1	2	3	8	3	6	5	2	1	.	1	1	.	.	.	.	.	.	35
18-19.9	.	.	.	.	.	.	1	.	2	7	5	4	8	2	5	3	1	1	.	.	.	.	.	.	.	39
20-21.9	.	.	.	.	.	.	.	.	2	.	5	4	3	1	3	1	2	1	.	.	.	.	.	.	.	22
22-23.9	.	.	.	.	.	.	.	1	1	2	2	3	2	3	3	3	2	3	.	1	.	.	.	.	.	26
24-25.9	.	.	.	.	.	.	.	.	.	.	4	5	2	4	7	2	.	2	1	.	.	.	.	.	.	27
26-27.9	.	.	.	.	.	.	.	.	.	.	1	2	3	3	1	2	2	2	.	.	.	.	.	.	.	16
28-29.9	.	.	.	.	.	.	.	.	.	.	.	.	3	4	4	2	1	.	2	1	1	.	.	1	1	20
30-31.9	.	.	.	.	.	.	.	.	.	1	.	1	.	1	1	3	1	3	.	.	.	.	.	.	.	11
32-33.9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	2	2	.	.	1	.	.	.	1	9
34-35.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	2	1	2	.	.	.	.	.	8
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1	.	.	.	.	.	.	.	3
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	1	1	.	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	1	.	.	.	.	3
-----	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
54-55.9	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Total	1	0	1	0	3	2	6	18	20	31	46	49	41	45	32	28	22	20	13	5	4	2	2	2	2	395

Weight of grain per plant in decigrams, subject.

Average length of internodes per culm per plant in milligrams, relative.

$r = .624 \pm .0207$

Figure 27

Dawson's Golden Chaff, mixed.

	70-74	75-79	80-84	85-89	90-94	95-99	100-104	105-109	110-114	115-119	120-124	125-129	130-134	135-139	Total
0-1.9	1	.	1	.	.	.	.	.	.	.	.	.	.	.	2
2-3.9	1	.	2	3	1	1	2	.	.	.	.	.	.	.	10
4-5.9	.	.	2	1	5	4	3	.	.	.	.	.	.	.	15
6-7.9	.	.	1	3	10	3	4	7	1	.	1	1	.	.	31
8-9.9	.	.	.	.	6	10	10	4	1	1	.	.	.	.	32
10-11.9	.	.	.	1	3	5	8	6	2	1	1	.	.	.	27
12-13.9	.	.	.	2	1	1	12	10	4	3	.	.	.	.	33
14-15.9	.	.	.	.	1	3	10	3	4	.	.	.	.	.	21
16-17.9	.	.	.	.	1	4	9	12	7	1	.	.	1	.	35
18-19.9	.	.	.	.	.	2	12	18	7	.	.	.	.	.	39
20-21.9	.	.	.	.	.	3	3	9	6	1	.	.	.	.	22
22-23.9	.	.	.	.	.	1	2	9	7	6	.	.	1	.	26
24-25.9	.	.	.	.	.	.	7	7	10	3	.	.	.	.	27
26-27.9	.	.	.	.	.	.	1	6	6	1	2	.	.	.	16
28-29.9	.	.	.	.	.	.	2	8	8	1	.	.	.	1	20
30-31.9	.	.	.	.	.	.	.	5	4	2	.	.	.	.	11
32-33.9	.	.	.	.	.	.	.	2	5	2	.	.	.	.	9
34-35.9	.	.	.	.	.	.	.	2	3	2	1	.	.	.	8
36-37.9	.	.	.	.	.	.	.	1	.	2	.	.	.	.	3
38-39.9	.	.	.	.	.	.	1	1	1	1	.	.	.	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
42-43.9	.	.	.	.	.	.	1	.	1	1	.	.	.	.	3
-----	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
54-55.9	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
Total	2	0	6	10	28	37	87	110	78	28	5	1	2	1	395

Weight of grain per plant in decigrams, subject.
Average length of spike per plant in millimeters,
relative.

$$r = .583 \pm .0224$$

Figure 28

Dawson's Golden Chaff, mixed.

	17.5-17.9	18.0-18.4	18.5-18.9	19.0-19.4	19.5-19.9	20.0-20.4	20.5-20.9	21.0-21.4	21.5-21.9	22.0-22.4	22.5-22.9	23.0-23.4	23.5-23.9	24.0-24.4	24.5-24.9	25.0-25.4	Total
0-1.9	1.	1.	1.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
2-3.9	2	1	3	1	2	.	.	1	.	.	.	.	.	.	.	.	10
4-5.9	1	3	.	6	1	2	2	.	.	.	.	.	.	.	.	.	15
6-7.9	2	1	2	5	5	7	3	3	1	1	.	.	1	.	.	.	31
8-9.9	1	.	1	4	6	9	6	2	3	.	.	.	.	.	.	.	32
10-11.9	.	.	2	4	2	7	4	4	2	2	.	.	.	.	.	.	27
12-13.9	1	.	2	2	3	3	6	6	5	4	1	.	.	.	.	.	33
14-15.9	.	.	.	2	1	7	2	4	3	2	.	.	.	.	.	.	21
16-17.9	.	.	2	.	2	6	7	10	3	2	3	.	.	.	.	.	35
18-19.9	.	.	.	1	2	4	12	8	7	3	2	.	.	.	.	.	39
20-21.9	.	.	.	.	.	3	5	7	4	3	.	.	.	.	.	.	22
22-23.9	.	.	.	.	1	3	7	8	5	1	.	1	.	.	.	.	26
24-25.9	.	.	.	.	.	.	5	7	12	3	.	.	.	.	.	.	27
26-27.9	.	.	.	.	.	1	2	3	6	3	1	.	.	.	.	.	16
28-29.9	.	.	.	.	1	.	1	6	5	1	4	.	.	1	.	1	20
30-31.9	.	.	.	.	.	.	1	2	5	2	.	.	.	1	.	.	11
32-33.9	.	.	.	.	.	.	.	1	2	6	.	.	.	.	.	.	9
34-35.9	.	.	.	.	.	.	.	1	2	2	1	2	.	.	.	.	8
36-37.9	.	.	.	.	.	.	.	.	1	.	1	1	.	.	.	.	3
38-39.9	.	.	.	.	.	.	.	1	.	3	.	.	.	.	.	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
42-43.9	.	.	.	.	.	.	.	1	.	2	.	.	.	.	.	.	3
-----	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
54-55.9	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
Total	8	5	13	25	26	52	63	75	66	41	13	4	1	2	0	1	395

Weight of grain per plant in decigrams, subject.
Average number of spikelets per spike per plant,
relative.

$$r = .616 \pm .0210$$

Figure 29

Dawson's Golden Chaff, mixed.

	10-11	12-13	14-15	16-17	18-19	20-21	22-23	24-25	26-27	28-29	30-31	32-33	34-35	36-37	38-39	40-41	42-43	44-45	46-47	48-49	50-51	52-53	54-55	56-57	Total	
0-1.9	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
2-3.9	.	.	.	.	1	1	4	.	.	2	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	10
4-5.9	1	.	.	.	3	2	3	2	.	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15
6-7.9	.	.	.	1	3	2	5	4	11	1	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	31
8-9.9	.	.	.	1	2	2	4	7	8	3	3	.	.	1	.	.	.	1	.	.	.	.	.	.	.	32
10-11.9	.	.	.	.	.	1	6	5	4	8	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	27
12-13.9	.	.	1	.	.	2	2	6	7	6	7	1	.	.	.	.	.	.	.	.	.	1	.	.	.	33
14-15.9	.	.	.	.	2	.	1	2	7	4	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	21
16-17.9	.	.	1	.	.	.	1	7	14	7	4	.	1	.	.	.	.	.	.	.	.	.	.	.	.	35
18-19.9	.	.	.	.	1	1	.	3	4	14	13	1	1	.	.	.	.	.	.	1	.	.	.	.	.	39
20-21.9	.	.	.	.	.	.	1	3	4	5	4	4	1	.	.	.	.	.	.	.	.	.	.	.	.	22
22-23.9	.	.	.	.	.	.	2	1	7	6	6	3	1	.	.	.	.	.	.	.	.	.	.	.	.	26
24-25.9	.	.	.	.	.	.	.	.	4	10	8	4	1	.	.	.	.	.	.	.	.	.	.	.	.	27
26-27.9	.	.	.	.	.	.	.	1	2	4	6	3	.	.	.	.	.	.	.	.	.	.	.	.	.	16
28-29.9	.	.	.	.	.	.	.	2	1	4	6	4	3	.	.	.	.	.	.	.	.	.	.	.	.	20
30-31.9	.	.	.	.	.	.	.	1	1	2	4	3	.	.	.	.	.	.	.	.	.	.	.	.	.	11
32-33.9	.	.	.	.	.	.	.	.	1	2	1	2	3	.	.	.	.	.	.	.	.	.	.	.	.	9
34-35.9	.	.	.	.	.	.	.	.	.	.	5	3	.	.	.	.	.	.	.	.	.	.	.	.	.	8
36-37.9	.	.	.	.	.	.	.	.	.	1	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	3
38-39.9	.	.	.	.	.	.	.	.	1	.	.	.	2	.	.	.	.	.	.	.	.	.	.	1	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
42-43.9	.	.	.	.	.	.	.	.	.	.	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	3
-----	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
54-55.9	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Total	1	0	2	2	12	12	30	44	76	82	76	36	16	2	0	0	0	1	0	1	0	1	0	1		395

Weight of grain per plant in decigrams, subject.
Average weight of kernel per plant in milligrams, relative.
 $r = .476 \pm .0262$

Figure 30

Dawson's Golden Chaff, mixed.

	0-49	50-99	100-149	150-199	200-249	250-299	300-349	350-399	400-449	450-499	500-549	550-599	600-649	650-699	700-749	750-799	800-849	850-899	900-949	950-999	Total
0-1.9	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
2-3.9	1	4	4	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
4-5.9	.	3	6	3	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15
6-7.9	.	1	7	11	9	2	.	.	.	.	.	.	1	.	.	.	.	.	.	.	31
8-9.9	.	.	1	10	10	7	4	.	.	.	.	.	.	.	.	.	.	.	.	.	32
10-11.9	.	.	.	2	6	7	5	6	.	.	.	1	.	.	.	.	.	.	.	.	27
12-13.9	.	.	.	.	4	10	9	6	2	1	.	.	.	.	.	1	.	.	.	.	33
14-15.9	.	.	.	.	2	3	4	4	5	2	1	.	.	.	.	.	.	.	.	.	21
16-17.9	.	.	.	.	.	4	4	7	10	8	1	1	.	.	.	.	.	.	.	.	35
18-19.9	.	.	.	.	.	1	2	12	8	10	3	1	1	.	1	.	.	.	.	.	39
20-21.9	.	.	.	.	.	.	1	2	4	6	5	3	.	.	1	.	.	.	.	.	22
22-23.9	.	.	.	.	1	.	.	1	5	6	7	3	.	2	.	.	1	.	.	.	26
24-25.9	.	.	.	.	.	.	1	.	3	4	8	8	.	2	1	.	.	.	.	.	27
26-27.9	.	.	.	.	.	.	.	1	.	1	1	6	3	3	1	.	.	.	.	.	16
28-29.9	.	.	.	.	.	.	.	1	.	1	4	2	5	2	3	.	1	1	.	.	20
30-31.9	.	.	.	.	.	.	.	.	.	1	2	1	.	2	4	.	1	.	.	.	11
32-33.9	.	.	.	.	.	.	.	.	.	.	1	.	2	.	1	.	1	2	.	2	9
34-35.9	.	.	.	.	.	.	.	.	.	.	.	1	3	.	2	.	1	1	.	.	8
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	3
38-39.9	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	2	.	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
42-43.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	.	3
-----	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
54-55.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
Total	2	9	18	27	35	34	30	40	37	40	33	27	16	12	15	3	5	7	2	3	395

Weight of grain per plant in decigrams, subject.
 Weight of straw per plant in decigrams, relative.
 $r = .875 \pm .0079$

Figure 31

Dawson's Golden Chaff, mixed.

	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	Total
0-1.9	.	.	.	1	.	.	.	.	.	1	.	.	.	.	2
2-3.9	.	.	1	4	2	1	.	.	1	1	.	.	.	.	10
4-5.9	.	1	1	1	3	3	2	1	1	1	.	.	1	.	15
6-7.9	2	.	1	6	3	6	5	5	1	1	.	1	.	.	31
8-9.9	.	.	.	4	7	7	3	3	6	1	.	1	.	.	32
10-11.9	.	1	.	3	5	6	6	3	1	1	.	1	.	.	27
12-13.9	.	1	.	2	3	8	8	7	1	3	.	.	.	.	33
14-15.9	.	.	.	1	3	6	4	2	2	1	2	.	.	.	21
16-17.9	.	.	.	.	4	12	10	2	4	2	1	.	.	.	35
18-19.9	.	.	.	2	2	6	11	7	8	1	2	.	.	.	39
20-21.9	.	.	.	1	.	6	7	4	1	2	1	.	.	.	22
22-23.9	.	.	.	1	3	1	8	6	4	3	.	.	.	.	26
24-25.9	.	.	.	.	.	3	7	10	3	2	1	.	.	1	27
26-27.9	.	.	.	.	.	3	6	4	1	1	.	.	1	.	16
28-29.9	.	.	.	.	2	2	4	4	3	3	1	.	.	1	20
30-31.9	.	.	.	.	.	1	4	2	.	2	1	1	.	.	11
32-33.9	.	.	.	.	2	2	2	.	1	1	1	.	.	.	9
34-35.9	.	.	.	.	.	1	1	2	1	2	1	.	.	.	8
36-37.9	.	.	.	.	.	1	2	.	.	.	.	.	.	.	3
38-39.9	.	.	.	.	.	.	1	1	.	1	1	.	.	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
42-43.9	.	.	.	.	.	.	.	.	1	2	.	.	.	.	3
54-55.9	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
Total	2	5	3	26	39	75	91	63	40	33	12	4	2	2	395

Weight of grain per plant in decigrams, subject.
 Per cent of grain to straw, relative.
 $r = .351 \pm .0297$

Figure 32

Dawson's Golden Chaff, mixed.

	0-99	100-199	200-299	300-399	400-499	500-599	600-699	700-799	800-899	900-999	1000-1099	1100-1199	1200-1299	1300-1399	1400-1499	1500-1599	1600-1699	Total
0-1.9	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
2-3.9	3	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
4-5.9	.	3	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15
6-7.9	.	1	21	8	1	.	.	.	.	.	.	.	.	.	.	.	.	31
8-9.9	.	.	3	25	3	1	.	.	.	.	.	.	.	.	.	.	.	32
10-11.9	.	.	.	8	19	.	.	.	.	.	.	.	.	.	.	.	.	27
12-13.9	.	.	.	2	19	10	1	.	.	1	.	.	.	.	.	.	.	33
14-15.9	.	.	.	.	6	11	2	2	.	.	.	.	.	.	.	.	.	21
16-17.9	.	.	.	.	1	9	25	.	.	.	.	.	.	.	.	.	.	35
18-19.9	.	.	.	.	.	5	26	4	2	2	.	.	.	.	.	.	.	39
20-21.9	.	.	.	.	.	1	8	8	5	.	.	.	.	.	.	.	.	22
22-23.9	.	.	.	.	.	.	5	8	10	3	.	.	.	.	.	.	.	26
24-25.9	.	.	.	.	.	.	.	10	14	3	.	.	.	.	.	.	.	27
26-27.9	.	.	.	.	.	.	.	2	7	5	2	.	.	.	.	.	.	16
28-29.9	.	.	.	.	.	.	.	.	5	10	4	1	.	.	.	.	.	20
30-31.9	.	.	.	.	.	.	.	1	.	5	4	1	.	.	.	.	.	11
32-33.9	.	.	.	.	.	.	.	.	.	5	2	2	.	.	.	.	.	9
34-35.9	.	.	.	.	.	.	.	.	.	.	5	3	.	.	.	.	.	8
36-37.9	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	3
38-39.9	.	.	.	.	.	.	.	.	.	.	.	3	.	.	1	.	.	4
40-41.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
42-43.9	.	.	.	.	.	.	.	.	.	.	.	1	.	2	.	.	.	3
-----	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
54-55.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
Total	5	11	36	43	49	37	67	35	43	34	18	12	1	2	1	0	1	395

Weight of grain per plant in decigrams, subject.
 Number of kernels per plant, relative.
 $r = .979 \pm .0014$

Figure 33

Dawson's Golden Chaff, line.

	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-99.9	100-109.9	Total
0-1.9	1	2	.	.	.	.	.	.	.	.	.	3
2-3.9	12	11	.	.	.	.	.	.	.	.	.	23
4-5.9	.	12	6	.	.	.	.	.	.	.	.	18
6-7.9	.	4	17	.	.	.	.	.	.	.	.	21
8-9.9	.	1	19	11	.	.	1	.	.	.	.	32
10-11.9	.	.	1	10	3	.	.	.	.	.	.	14
12-13.9	.	.	1	19	13	2	.	.	1	.	.	36
14-15.9	.	.	.	5	33	8	.	.	.	.	.	46
16-17.9	.	.	.	.	13	16	2	.	.	.	.	31
18-19.9	.	.	.	.	3	21	2	.	.	.	.	26
20-21.9	.	.	.	.	.	14	21	1	.	.	.	36
22-23.9	.	.	.	.	.	1	25	8	.	.	.	34
24-25.9	.	.	.	.	.	.	17	12	2	.	.	31
26-27.9	.	.	.	.	.	.	2	12	3	.	.	17
28-29.9	.	.	.	.	1	.	.	6	5	.	.	12
30-31.9	.	.	.	.	.	.	.	.	6	2	.	8
32-33.9	.	.	.	.	.	.	.	.	2	1	.	3
34-35.9	.	.	.	.	.	.	.	.	.	4	1	5
36-37.9	.	.	.	.	.	.	.	.	.	.	1	1
Total	13	30	44	45	66	62	70	39	19	7	2	397

Weight of grain per plant in decigrams,
subject.

Weight of plant in decigrams, relative.

$r = .955 \pm .0029$

Figure 34

Dawson's Golden Chaff, line.

	0-1	2-3	4-5	6-7	8-9	10-11	12-13	14-15	16-17	18-19	20-21	22-23	24-25	26-27	28-29	Total
0-1.9	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	3
2-3.9	1	5	13	4	.	.	.	.	.	.	.	.	.	.	.	23
4-5.9	.	2	2	7	3	3	1	.	.	.	.	.	.	.	.	18
6-7.9	.	.	1	10	7	3	.	.	.	.	.	.	.	.	.	21
8-9.9	.	.	1	7	11	11	1	1	.	.	.	.	.	.	.	32
10-11.9	.	.	.	1	6	6	1	.	.	.	.	.	.	.	.	14
12-13.9	.	.	.	1	2	10	15	5	1	1	1	.	.	.	.	36
14-15.9	.	.	.	.	1	8	13	14	7	1	2	.	.	.	.	46
16-17.9	.	.	.	.	.	4	9	8	7	3	.	.	.	.	.	31
18-19.9	.	.	.	.	.	3	7	8	6	1	1	.	.	.	.	26
20-21.9	.	.	.	.	.	.	5	9	15	5	1	.	1	.	.	36
22-23.9	.	.	.	.	.	.	2	12	7	7	6	.	.	.	.	34
24-25.9	.	.	.	.	.	.	1	5	11	9	3	2	.	.	.	31
26-27.9	.	.	.	.	.	.	.	2	3	5	3	2	2	.	.	17
28-29.9	.	.	.	.	.	.	1	1	.	1	5	4	.	.	.	12
30-31.9	.	.	.	.	.	.	.	.	.	4	3	.	1	.	.	8
32-33.9	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	3
34-35.9	.	.	.	.	.	.	.	.	.	.	2	.	2	.	1	5
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1
Total	1	7	19	31	30	48	56	65	57	57	30	8	6	1	1	397

Weight of grain per plant in decigrams, subject.
 Number of culms per plant, relative.
 $r = .881 \pm .0075$

Figure 35

Dawson's Golden Chaff, line.

	49-51.9	52-54.9	55-57.9	58-60.9	61-63.9	64-66.9	67-69.9	70-72.9	73-75.9	76-78.9	79-81.9	82-84.9	85-87.9	88-90.9	91-93.9	94-96.9	97-98.9	100-102.9	Total
0-1.9	.	1	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	3
2-3.9	2	.	1	2	4	3	5	2	.	.	.	.	1	2	.	1	.	.	23
4-5.9	.	.	.	2	.	2	2	8	1	1	.	1	.	.	1	.	.	.	18
6-7.9	.	.	.	.	.	1	2	.	4	5	4	3	1	.	.	1	.	.	21
8-9.9	.	.	.	.	.	.	2	3	8	7	4	5	2	.	.	1	.	.	32
10-11.9	.	.	.	.	.	.	.	1	2	2	2	3	3	1	.	.	.	.	14
12-31.9	.	.	.	.	.	1	2	3	4	5	4	9	5	2	1	.	.	.	36
14-15.9	.	.	.	.	.	.	.	3	2	10	11	10	9	1	.	.	.	.	46
16-17.9	.	.	.	.	.	.	.	.	.	4	6	8	8	3	2	.	.	.	31
18-19.9	.	.	.	.	.	.	.	1	2	.	2	6	8	3	1	3	.	.	26
20-21.9	.	.	.	.	.	.	.	.	.	2	2	8	14	5	4	1	.	.	36
22-23.9	.	.	.	.	.	.	.	.	.	.	3	4	11	9	4	2	1	.	34
24-25.9	.	.	.	.	.	.	.	.	.	1	1	3	11	8	4	1	2	.	31
26-27.9	.	.	.	.	.	.	.	.	.	.	3	.	3	4	2	3	2	.	17
28-29.9	.	.	.	.	.	.	.	.	.	.	.	2	4	3	2	.	.	1	12
30-31.9	.	.	.	.	.	.	.	.	.	.	.	.	.	4	4	.	.	.	8
32-33.9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	3
34-35.9	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2	1	.	.	5
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
Total	2	1	1	5	5	7	13	20	22	39	42	62	82	46	30	14	5	1	397

Weight of grain per plant in decigrams, subject.
Average length of culm per plant in millimeters,
relative.

$$r = .862 \pm .0086$$

Figure 36

Dawson's Golden Chaff, line.

	2.8	3.3	3.5	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	Total
0-1.9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	2	.	.	.	.	.	.	.	.	.	.	233
2-3.9	1	.	.	.	.	1	3	.	.	1	1	5	1	.	1	.	7	.	.	.	.	.	.	.	.	.	.	18
4-5.9	.	1	1	.	.	.	2	2	2	2	.	2	.	.	2	.	.	.	1	1	.	.	.	.	.	.	.	21
6-7.9	.	.	.	.	.	.	1	1	2	2	1	1	2	1	2	.	3	.	1	1	1	1	1	1	.	.	.	32
8-9.9	.	.	.	.	.	.	.	1	2	1	1	3	4	5	3	2	5	2	1	1	1	1	2	4	.	.	.	14
10-11.9	.	.	.	.	.	.	1	3	.	.	3	2	1	4	2	.	1	3	3	.	.	.	.	.	.	.	.	36
12-13.9	.	.	.	.	.	.	1	3	.	.	3	2	3	5	4	5	4	2	1	1	2	.	1	.	.	.	.	46
14-15.9	.	.	.	1	.	1	1	3	3	.	3	6	7	7	2	4	6	2	1	1	2	.	.	.	.	.	.	31
16-17.9	.	.	.	.	.	1	2	.	.	.	1	3	4	4	2	3	7	1	1	2	.	1	.	.	.	.	.	26
18-19.9	.	.	.	.	.	.	.	.	.	1	1	1	1	2	4	7	4	4	4	.	1	.	1	.	.	.	.	36
20-21.9	.	.	.	.	.	.	1	1	3	.	.	2	3	6	8	2	4	2	.	1	.	1	1	.	.	.	.	34
22-23.9	.	.	.	.	.	.	.	.	.	.	.	1	5	8	3	3	8	3	2	.	.	.	.	1	.	.	.	31
24-25.9	.	.	.	.	.	.	.	.	1	.	.	.	2	2	7	6	8	.	1	1	3	.	.	.	.	.	.	17
26-27.9	.	.	.	.	.	.	.	.	1	.	.	1	2	2	2	2	1	4	2	.	2	.	.	.	.	.	.	12
28-29.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	4	3	.	.	.	2	.	.	1	.	.	.	8
30-31.9	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	2	.	2	1	.	.	.	.	.	.	.	.	3
32-33.9	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	3	1	.	1	.	.	.	.	.	.	.	5
34-35.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Total	1	1	1	1	0	2	8	10	11	10	10	29	37	48	46	41	64	23	17	11	10	3	7	4	1	0	1	397

Weight of grain per plant in decigrams, subject.
Average number of internodes per plant, relative.
 $r = .231 \pm .0320$

Figure 37

Dawson's Golden Chaff, line.

	105-109	110-114	115-119	120-124	125-129	130-134	135-139	140-144	145-149	150-154	155-159	160-164	165-169	170-174	175-179	180-184	185-189	190-194	195-199	200-204	205-209	Total
0-1.9	1	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
2-3.9	.	.	2	.	1	4	3	4	3	.	1	1	.	.	3	.	.	1	.	.	.	23
4-5.9	.	.	.	1	1	1	.	1	4	1	1	3	3	2	1	2	.	.	.	.	.	18
6-7.9	.	.	.	.	.	1	1	2	4	1	3	3	1	1	4	1	.	.	.	.	.	21
8-9.9	.	.	.	.	.	.	1	1	4	3	4	6	4	5	3	1	.	.	.	.	.	32
10-11.9	.	.	.	.	.	.	.	.	1	3	2	3	3	1	2	2	.	.	.	.	.	14
12-13.9	.	.	.	1	.	1	2	.	2	2	5	13	3	3	3	5	.	1	.	.	.	36
14-15.9	.	.	.	.	.	.	.	3	2	2	8	10	7	6	4	1	1	.	2	.	.	46
16-17.9	.	.	.	.	.	.	.	.	3	1	3	1	9	3	4	2	2	2	.	1	.	31
18-19.9	.	.	.	.	.	.	.	.	.	3	2	5	5	3	4	3	.	1	.	.	.	26
20-21.9	.	.	.	.	.	.	.	.	2	2	2	5	11	6	5	2	.	1	.	.	.	36
22-23.9	.	.	.	.	.	.	.	.	1	1	1	4	5	6	5	6	4	1	.	.	.	34
24-25.9	.	.	.	.	1	.	.	.	.	.	2	2	7	7	6	1	3	1	1	.	.	31
26-27.9	.	.	.	.	.	.	.	.	.	.	.	1	1	4	4	4	2	1	.	.	.	17
28-29.9	.	.	.	.	.	.	.	.	.	.	1	1	1	4	1	4	.	.	.	.	.	12
30-31.9	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2	1	1	1	.	.	.	8
32-33.9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	.	.	.	3
34-35.9	.	.	.	1	.	.	.	.	.	.	.	1	1	.	2	.	.	.	.	.	.	5
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1
Total	1	0	3	1	4	4	5	6	16	23	20	37	57	59	59	49	24	17	8	3	1	397

Weight of grain per plant in decigrams, subject.
Average length of internode per culm per plant
in millimeters, relative.
 $r = .535 \pm .0241$

Figure 38

Dawson's Golden Chaff, line.

	70-74	75-79	80-84	85-89	90-94	95-99	100-104	105-109	110-114	115-119	120-124	125-129	Total
0-1.9	1	.	.	.	2	.	.	.	.	.	.	.	3
2-3.9	1	3	6	5	5	.	.	.	1	1	1	.	23
4-5.9	.	.	3	5	4	4	1	1	.	.	.	.	18
6-7.9	.	.	.	5	5	7	2	1	1	.	.	.	21
8-9.9	.	.	2	8	4	12	4	1	.	1	.	.	32
10-11.9	.	.	.	1	2	5	5	1	.	.	.	.	14
12-13.9	.	.	.	1	8	13	7	5	2	.	.	.	36
14-15.9	.	.	.	2	11	18	11	3	.	1	.	.	46
16-17.9	.	.	.	1	4	13	7	5	1	.	.	.	31
18-19.9	.	.	.	.	2	7	7	8	1	.	.	1	26
20-21.9	.	.	.	.	4	10	13	6	3	.	.	.	36
22-23.9	.	.	.	.	.	9	16	8	1	.	.	.	34
24-25.9	.	.	.	.	1	4	14	10	2	.	.	.	31
26-27.9	.	.	.	.	1	2	6	8	.	.	.	.	17
28-29.9	.	.	.	.	1	.	6	4	1	.	.	.	12
30-31.9	.	.	.	.	.	1	3	3	1	.	.	.	8
32-33.9	.	.	.	.	.	.	.	2	.	1	.	.	3
34-35.9	.	.	.	.	.	.	3	2	.	.	.	.	5
36-37.9	.	.	.	.	.	.	.	1	.	.	.	.	1
Total	2	3	11	28	54	105	105	69	14	4	1	1	397

Weight of grain per plant in decigrams,
subject.

Average length of spike per plant in
millimeters, relative.

$r = .547 \pm .0237$

Figure 39

Dawson's Golden Chaff, line.

	16.0-16.4	16.5-16.9	17.0-17.4	17.5-17.9	18.0-18.4	18.5-18.9	19.0-19.4	19.5-19.9	20.0-20.4	20.5-20.9	21.0-21.4	21.5-21.9	22.0-22.4	22.5-22.9	23.0-23.4	23.5-23.9	24.0-24.9	Total
0-1.9	1			1			1		1									3
2-3.9	3	1	2	5	5	1	2	1			2							23
4-5.9	1	1		1	4	1	3	4	1	1			1					18
6-7.9				2	1	2	5	4	5	2								21
8-9.9				1	4	1	2	9	9	4	2							32
10-11.9					1	1	1	3	4	1	2		1					14
12-13.9						3	5	7	10	9	2							36
14-15.9					2	1	6	13	13	8	1	2						46
16-17.9							3	5	9	9	4	1						31
18-19.9							1	3	5	14	1	2						26
20-21.9			1		1		2	6	8	9	7	2						36
22-23.9							2	6	11	7	5	2					1	34
24-25.9								6	8	10	5	1	1					31
26-27.9						1	2	3	3	3	2	3						17
28-29.9								2	2	3	1	4						12
30-31.9								2		1	5							8
32-33.9								1		1		1						3
34-35.9									1	1	1	2						5
36-37.9									1									1
Total	4	2	5	10	18	11	35	75	90	84	40	20	3	0	1	0	1	397

Weight of grain per plant in decigrams, subject.
Average number of spikelets per spike per plant,
relative.

$$r = .490 \pm .0257$$

Figure 40

Dawson's Golden Chaff, line.

	16-17	18-19	20-21	22-23	24-25	26-27	28-29	30-31	32-33	34-35	36-37	38-39	40-41	42-43	44-45	46-47	48-49	50-51	52-53	54-55	Total
0-1.9	2	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
2-3.9	.	3	3	4	5	2	2	.	2	1	.	.	.	1	.	.	.	.	.	.	23
4-5.9	1	1	1	4	3	3	3	1	.	1	.	.	.	.	.	.	.	.	.	.	18
6-7.9	.	.	.	2	4	8	4	2	1	.	.	.	.	.	.	.	.	.	.	.	21
8-9.9	.	.	.	5	4	1	6	5	1	.	.	.	.	.	.	.	.	.	.	.	32
10-11.9	.	.	.	.	1	3	4	3	3	.	.	.	.	.	.	.	.	.	.	.	14
12-13.9	.	.	.	.	3	1	1	1	8	2	1	.	.	.	.	.	.	.	.	.	36
14-15.9	.	.	.	2	4	1	4	1	0	1	.	.	.	.	.	.	.	.	.	1	46
16-17.9	.	.	.	.	3	5	9	9	5	.	.	.	.	.	.	.	.	.	.	.	31
18-19.9	.	.	.	.	2	3	5	1	4	1	.	.	.	.	.	.	.	.	.	.	26
20-21.9	.	.	.	.	1	9	6	1	5	5	.	.	.	.	.	.	.	.	.	.	36
22-23.9	.	.	.	.	.	2	10	1	3	7	2	.	.	.	.	.	.	.	.	.	34
24-25.9	.	.	.	.	1	2	5	8	1	3	2	.	.	.	.	.	.	.	.	.	31
26-27.9	.	.	.	.	.	1	6	5	3	1	.	1	.	.	.	.	.	.	.	.	17
28-29.9	.	.	.	.	.	.	2	8	2	.	.	.	.	.	.	.	.	.	.	.	12
30-31.9	.	.	.	1	.	.	1	2	3	1	.	.	.	.	.	.	.	.	.	.	8
32-33.9	.	.	.	.	.	.	.	2	.	1	.	.	.	.	.	.	.	.	.	.	3
34-35.9	.	.	.	.	.	.	1	2	1	.	1	.	.	.	.	.	.	.	.	.	5
36-37.9	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Total	3	4	4	18	32	74	90	104	53	11	1	1	1	0	0	0	0	0	0	1	397

Weight of grain per plant in decigrams, subject.
Average weight of kernel per plant in milligrams, relative.
 $r = .487 \pm .0258$

Figure 41

Dawson's Golden Chaff, line.

	0-49	50-99	100-149	150-199	200-249	250-299	300-349	350-399	400-449	450-499	500-549	550-599	600-649	650-699	700-749	Total
0-1.9	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	3
2-3.9	6	13	3	.	.	.	.	.	.	1	.	.	.	.	.	23
4-5.9	.	2	10	5	1	.	.	.	.	.	.	.	.	.	.	18
6-7.9	.	1	8	10	2	.	.	.	.	.	.	.	.	.	.	21
8-9.9	.	.	5	12	11	1	1	.	.	.	.	2	.	.	.	32
10-11.9	.	.	.	3	6	4	1	.	.	.	.	.	.	.	.	14
12-13.9	.	.	.	1	14	16	2	1	1	.	.	.	.	.	1	36
14-15.9	.	.	.	.	4	19	14	7	2	.	.	.	.	.	.	46
16-17.9	.	.	.	.	.	9	14	4	3	1	.	.	.	.	.	31
18-19.9	.	.	.	.	.	2	13	9	2	.	.	.	.	.	.	26
20-21.9	.	.	.	.	.	.	5	11	14	6	.	.	.	.	.	36
22-23.9	.	.	.	.	.	.	.	7	16	8	3	.	.	.	.	34
24-25.9	.	.	.	.	.	.	.	6	11	9	3	1	1	.	.	31
26-27.9	.	.	.	.	.	.	.	1	2	8	4	.	2	.	.	17
28-29.9	.	.	.	1	.	.	.	.	1	3	6	1	.	.	.	12
30-31.9	.	.	.	.	.	.	.	.	.	1	5	2	.	.	.	8
32-33.9	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	3
34-35.9	.	.	.	.	.	.	.	.	.	.	.	.	4	.	1	5
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1
Total	6	18	28	31	38	51	50	46	52	37	21	9	7	0	3	397

Weight of grain per plant in decigrams, subject.
 Weight of straw per plant in decigrams, relative.
 $r = .911 \pm .0057$

Figure 42

Dawson's Golden Chaff, line.

	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	Total
0-1.9	1	2	.	.	.	.	.	.	.	.	.	.	.	.	3
2-3.9	.	.	.	1	3	5	4	2	5	2	1	.	.	.	23
4-5.9	.	.	1	4	2	4	1	3	1	.	1	1	.	.	18
6-7.9	.	.	.	.	1	4	6	3	5	1	.	1	.	.	21
8-9.9	1	1	.	.	2	5	8	5	4	3	2	1	.	.	32
10-11.9	.	.	.	.	.	1	4	2	3	3	1	.	.	.	14
12-13.9	.	1	.	1	1	1	2	10	10	7	2	.	.	1	36
14-15.9	.	.	.	.	.	3	11	10	9	8	5	.	.	.	46
16-17.9	.	.	.	.	.	1	3	7	10	7	3	.	.	.	31
18-19.9	.	.	.	.	.	.	2	4	9	8	2	1	.	.	26
20-21.9	.	.	.	.	.	.	5	9	10	9	3	.	.	.	36
22-23.9	.	.	.	.	.	.	3	6	14	7	4	.	.	.	34
24-25.9	.	.	.	.	.	.	2	2	7	14	3	2	1	.	31
26-27.9	.	.	.	.	.	.	2	.	7	5	2	1	.	.	17
28-29.9	.	.	.	1	.	.	.	.	5	4	1	1	.	.	12
30-31.9	.	.	.	.	.	.	.	.	3	4	1	.	.	.	8
32-33.9	.	.	.	.	.	.	.	.	.	3	.	.	.	.	3
34-35.9	.	.	.	.	.	.	.	1	1	3	.	.	.	.	5
36-37.9	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1
Total	2	4	1	7	9	24	53	65	103	88	51	8	1	1	397

Weight of grain per plant in decigrams, subject.
 Per cent of grain to straw, relative.
 $r = .459 \pm .0267$

Figure 43

Dawson's Golden Chaff, line.

	0-99	100-199	200-299	300-399	400-499	500-599	600-699	700-799	800-899	900-999	1000-1099	1100-1199	1200-1299	Total
0-1.9	3	.	.	.	.	.	.	.	.	.	.	.	.	3
2-3.9	9	14	.	.	.	.	.	.	.	.	.	.	.	23
4-5.9	.	12	6	.	.	.	.	.	.	.	.	.	.	18
6-7.9	.	.	20	1	.	.	.	.	.	.	.	.	.	21
8-9.9	.	.	10	22	.	.	.	.	.	.	.	.	.	32
10-11.9	.	.	.	9	5	.	.	.	.	.	.	.	.	14
12-13.9	.	.	.	1	31	4	.	.	.	.	.	.	.	36
14-15.9	.	.	.	.	13	28	5	.	.	.	.	.	.	46
16-17.9	.	.	.	.	1	19	11	.	.	.	.	.	.	31
18-19.9	.	.	.	.	.	8	15	3	.	.	.	.	.	26
20-21.9	.	.	.	.	.	.	22	12	2	.	.	.	.	36
22-23.9	.	.	.	.	.	.	6	21	7	.	.	.	.	34
24-25.9	.	.	.	.	.	.	.	18	11	1	1	.	.	31
26-27.9	.	.	.	.	.	.	.	4	8	5	.	.	.	17
28-29.9	.	.	.	.	.	.	.	.	2	9	1	.	.	12
30-31.9	.	.	.	.	.	.	.	1	1	5	1	.	.	8
32-33.9	.	.	.	.	.	.	.	.	.	1	2	.	.	3
34-35.9	.	.	.	.	.	.	.	.	.	1	2	2	.	5
36-37.9	.	.	.	.	.	.	.	.	.	.	.	.	1	1
Total	12	26	36	33	50	59	59	59	31	22	7	2	1	397

Weight of grain per plant in decigrams, subject.
 Number of kernels per plant, relative.
 $r = .970 \pm .0020$

Figure 44

Summary

From the foregoing study of the relations between the constants of a mixed population and a pure line in two varieties, the following deductions may be drawn:

1. There is no absolute regularity in the relations between the constants of mixed populations and pure lines.

2. The means of the various measured characters show the pure lines to be less vigorous than the mixed populations. In both varieties eight characters have lesser means in the pure lines than in the mixed populations.

3. The interactions of heredity and environment may influence the means in various ways and cause an unexpected relation between a character of a pure line and a mixed population.

4. The standard deviation constants of the pure line are not consistently above or below the standard deviation constants of the mixed population.

5. Increased standard deviation is in most cases, associated with an increased mean. Conditions favoring increased growth seem to favor variability.

6. The coefficients of variability show practically the same relations between the pure line and the mixed population for any one character as was shown by the standard deviation constants.

7. The variability of a character is fairly constant

for all lines and populations.

8. The measured characters fall into two groups, those of a composite make-up with high per cent of variability, and those more specific in constitution with a low per cent of variability.

9. The graphs illustrating the relations between the lines and populations show usually a smoother curve, a greater modal height and a somewhat narrower amplitude in the pure lines than in the mixed populations.

10. The coefficients of correlation for yield and the other measured characters fall into two groups. One group is characterized by high coefficients which are fairly constant for all lines and populations; the other group is characterized by relatively low coefficients with less regularity in the degree of correlation between the lines and populations.

11. The coefficients of the characters of the first group may be expected to be always high and stable. The coefficients of the characters of the second group may be expected to be always relatively low and fluctuating.

12. It cannot be predicted with certainty whether there will be greater or less correlation in the pure line than in the mixed population.

13. The literature reviewed corroborates in a measure the above deductions but additional studies would be necessary to establish them as facts.

Literature Cited

Bailey and Gilbert

1915 Plant Breeding. Rural Science Series 1-474.

Darbyshire and Farmer

1909 The Mutation Theorie. DeVries-Translation-1-582.

Darwin, Chas. R.

1868 The Variation of Animals and Plants Under Dom-
estication. 2 V: 1-473, 1-495.

Davenport, E.

1907 Principles of Breeding. 1-727.

DeVries, Hugh

1907 Plant Breeding Experiments of Nilsson and Bur-
bank. 1-360.

Georgeson, C. C.

1893 Experiments in Wheat. Kansas Exp. Sta. Bul. 40:
51-62.

Hunt, Thomas F.

1910 The Cereals in America. 1-421.

Johannsen, W.

1903 Erblichkeit in Population und reinen Linien.
1-68.

Lawes and Gilbert

1880 Our Climate and Our Wheat Crop. London.

Leighty, Clyde E.

1914 Variation and Correlation of Oats, Effect of
Differences in Environment, Varieties and Methods

of Biometrical Constants. Cornell Memoir No. 4:
1-216.

Love, H. H.

1911 Studies of Variation in Plants. Cornell Uni. Agr.
Exp. Sta. Bul. 297, 593-677.

Love, H. H. and Leighty, Clyde E.

1914 Variation and Correlation in Oats, Studies Showing
the Effect of Seasonal Changes on Biometrical
Constants. Cornell Memoir No. 3: 1-70.

Lyon, T. L.

1905 Improving the Quality of Wheat. Bureau of Plant
Industry Bul. No. 78, 1-120.

Leighty, Clyde H.

1912 Effect of Fertility Upon Variation and Correlation
in Wheat. A. B. A. Rep. 7: 61-74.

Newman, L. H.

1912 Plant Breeding in Scandinavia. 1-193.

Roberts, H. F.

1911 Variation and Correlation in Wheat. A. B. A.
Ann. Rep. 7(1911): 80-109.

Rünker, Kurt

1890 Ueber die Vertheilung des Korngewichtes an dem
Fruchstande einiger Getreideforten. Journal
für Landwirtschaft P. 309.

Sanborn, J. W.

1893 Utah Experiment Station Report P. 168.

UNIVERSITY OF MISSOURI

COLUMBIA

May 24th, 1916.

DEPARTMENT OF BOTANY

Dean Walter Miller,
Academic Hall.

My dear Dean Miller:

I am herewith returning the thesis
of Mr. John Smith, with my approval. It easily meets
all the requirements for a Master's thesis.

Yours very truly,

A handwritten signature in cursive script, reading "George M. Reed". The signature is written in dark ink and is positioned to the right of the typed name "George M. Reed".

GLR-MSM

University of Missouri - Columbia

010-100951613

378.7M71
XS m61

Thesis is never to leave this room.
Neither is it to be checked out over
night.

MU Libraries
University of Missouri --Columbia

MU Theses and Dissertations (Pre-1920)

Local identifier SmithJohnB1916

Capture information

Date captured	20160902
Scanner manufacturer	Zeutschel
Scanner model	OS 15000
Scanning system software	Omni scan v. 12.4 SR4 (1947) 64-bit
Optical resolution	600 dpi
Color settings	grayscale, 8 bit and color, 24 bit
File types	tiff

Source information-

Format	Book
Content type	Text [with graphs]
Source ID	010-100951613
Notes	Pages typed and single-sided. Title page has signature and perforated property stamp. Page 93 has ink property stamp. Approval letter follows final text page 93.

Derivatives - Access copy

Compression	Tiff compressed with LZW before conversion to pdf
Editing software	Adobe Photoshop CS5
Resolution	600 dpi
Color	Grayscale and color
File types	pdf
Notes	Grayscale pages cropped, canvassed, and images brightened. Color pages cropped and canvassed. Blank pages removed.