THE RELATION OF THE SIZE OF SEED TO THE

CHARACTER OF PLANT PRODUCED.

by

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THE RELATION OF THE SIZE OF SEED TO THE CHARACTER OF PLANT PRODUCED.

Historical.

During the past fifty years a number of investigators have reported results on the relative value of heavy and light or large and small seed grain. Each investigator has devised a some what different method, altho all have worked with the same general point of view in mind. Montgomery (1910) has classified the various methods used at different Stations as follows-

Methods of Selecting Seed.

I. Hand Selection.

(a) Large plump kernels and small plump kernels from the same head.

(b) Large plump kernels and small plump kernels from heads of different sizes.

(c) Large plump kernels and small plump kernels from a general sample.

(d) Plump kernels and shrivelled kernels from a general sample.

(e) Large kerneled and small kerneled varieties.

(f) Large kerneled and small kerneled pure lines within a variety.

2. Machine Selection.

(a) Large plump and small plump kernels from a general

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sample separated into lots by a system of screens.

(b) Kernels of several sizes by means of a system of screens.

(c) Heavy plump versus large and small light; grading by means of a combination of wind and screens as in a fanning mill.

3. Specific Gravity Selection.

(a) Kernels of high specific gravity and those of low specific gravity separated by means of solutions.

From the above it appears that at least ten different methods were used in preparing the seed and since many of the experiments were varied in other details it is safe to say that no two were carried out exactly alike.

In this paper the literature has been divided into three groups-

First, where equal numbers of large and small hand selected seed were grown in pots.

Second, where equal numbers of large and small hand selected seed were sown in plats at the usual rate of seeding.

Third, where separation was made by machine and the results compared with checks, or where no checks were used the large and small seed were compared.

Pot Cultures.

Voelcker (1904) carried on pot experiments with both wheat and barley. Separation of the kernels

was made by the use of screens, the large corn being the head corn as obtained directly from the dressing machine, while the small corn was obtained by further cleaning of the tail corn using finer sieves and removing the weed seeds and rubbish that generally accompany the "offal" corn. All broken corns were similarily removed till the sample was one of perfect sound tho small corn.
Twelve seeds were planted in each pot and later thinned to six and to proportionate numbers in the more thickly seeded tail corn lot. There was nothing much to distinguish the lots.
Below are the average results of two varieties of wheat for two years.

	Av. Weight. Grams.	Yield. Grams.
Head corn.	.583	I4.9I
Tail corn.	.249	I5.34
Tail corn = Head corn.	.583	I5.89

Below are the average results for one variety of barley for onw year.

	Av. Weight. Grams.	Yield. Grams.
Head corn.	.754	7.30
Tail corn.	.369	8.70
Tail corn = Head corn.	.754	7.75

The general conclusions were drawn that provided the grains have good germinating power, the smaller grains are just as good, or even better, to sow than the large grains, and so long as the small grains are unbroken and sound there is no reason for considering their germinating power inferior to that of the larger grains.

Williams (1905) planted twelve six inch pots with hand sorted seed of large and small grains. Eight grains were planted in each pot which later was thinned to six plants. The average weight of heavy seed per pot was .3907 grams and light .1837 grams. The average weight of threshed grain from the heavy kernels was 13.21 grams per pot and from the light kernels 15.68 grams per pot.

In all three pot culture experiments the initial growth from the large seed was stronger but this apparent advantage disappeared as growth developed. The average of these three experiments where equal numbers of large and small hand selected seed were grown in pots shows an increase of ten percent in favor of the small seed.

Where Equal Numbers of Large and Small Hand Selected Seed Were Grown in Plats.

Desprez(1895) selected large kernels from cultures of wheat grown from large seeds for several years and likewise selected small seeds from cultures grown year after year from small seeds. From three years results he noted that large kernels germinated better, grew more vigorously and that the crop from large kernels matured better than from the small kernels.

Deherain (1900) reports that the yields of wheat obtained from plats seeded with large kernels were slightly better than those where samll seed had been used.

Bolley (1901) working with wheat started his work in 1898 by planting a number of large and small kernels from the same head and the next year selecting one good head which was grown from one of the largest kernels and likewise one good head from the best stool which was grown from one of the smallest kernels. From the selected heads there were taken six of the largest No. 1 hard kernels and six of the smallest kernels that could be found which were perfect in form. The kernels were planted in soil of good even quality which had not received fertilizer for a number of years, in beds with rows a foot apart and the kernels four inches apart in the rows. The total weight of grain and straw produced from 800 large kernels was 6,857 grams, while the total weight of grain and straw produced from the 800 small kernels was 6,206 grams, a gain of 9.4 percent in favor of the large kernels. Another selection was made from a bin of well graded Scottish Fife wheat. Eight hundred of the largest, plumpest, finest colored grains were chosen and an equal number of the smallest kernels which were plump, hard and of similiar fine quality. These samples were seeded in well prepared adjoining beds with the kernels approximately one and one half inches apart each way. The total weight of heads produced by the 800 large kernels was 2,482 grams and the total weight of heads from the 800 small kernels was 2,203 grams, a difference of 289 grams or 11.2 percent in favor of the large kernels. Bolley states that this shows a marked gain in favor of the large kernels in this sort of selection. It demonstrates clearly that small kernels from the bin are not as good as large ones even tho the small kernels are selected with great care in regard to their physical qualities.

Gross(1901) in a study of barley found a positive correlation between the size of seed and height and number of heads per plant.

Lubanski (1901) working with winter wheat, barley, oats and sugar cane found that the influence on the yield and to some extent on the quality of the crop was in favor of the large seed.

Deherain and Dupont (1902) report that the yields of large and small grains of a number of varieties of wheat were in all cases in favor of large grains but a large difference in yield was obtained only when there was a marked difference in the weight of the grains.

Clark (1904) used seeds of grape, mustard, clover, timothy and peas. A definite correlation was found to exist between the specific gravity of seeds and their germination. Seeds of low specific gravity did not germinate at all, those of slightly higher specific gravity germinated poorly and in many cases produced comparatively weak plants while those of highest specific gravity showed the highest germination, except in the case of oil bearing seeds.

Williams (1905) planted hand sorted seed in plots four feet square in the field. The seed was selected for large and small grains. Unfavorable weather practically destroyed the plots planted from the small grains while those planted from the large grains made one fourth of a crop. The results seemed to indicate that the larger food supply carried by the larger kernels was of an advantage under unfavorable conditions.

Love (1911) sowed hand picked seed from a number of varieties of oats and found that in every case the larger yield was obtained from the heavier seed. In another test with oats in which large and small kernels from the same head were compared the large seed gave the greater yield. Love states that if the large (heavy) seed of wheat(also oats) are used for planting they will come from the tallest, heaviest yielding individuals. Then if there is a tendency for the parent plant to reproduce its type a larger yield may be expected from the heavier seed.

Zavitz (1913) made selections of seeds of peas, barley and wheat by means of screens and hand picking. Fresh seed were taken each year from the general crop of grain. For the large plump sample the grains selected were of a uniform character and for the shrunken sample none but shrunken grains were used, the last selection being made regardless of the size of the kernels. The sample of broken grains in the case of barley contained nothing but grains which had been broken crosswise, split grains in the case of winter

wheat contained nothing but grains which had been broken lengthwise, and split seed in the case of peas cantained peas which were split and not broken. The grains from which these selections were made was all threshed with a grain separator and the splitting and breaking of grains was therefore done in the usual process of threshing. In the selection of large plump seed one half pound was carefully weighed from each class of grain, the large plump seed of each kind of grain was then counted and a corresponding number was taken of the medium sized grain, the small plump grain and the shrunken grain. In the case of broken or split grain twice the number of half kernels as compared with whole kernels were used. The different selections were carefully sown upon plots of similiar size.
The average results of each of these selections which were made from six to nine years are shown in tabular form below-
Seed hand selected, usual rate of seeding, equal number of each grade, no checks used.

Class of Grain.	Selections.	Years Tested.	Bu. Grain to the A.	T. Straw to the A.
Oats	Large seed	7	62.0	1.9
	Medium size	7	54.1	1.8
	Small seed	7	46.6	1.8
Barley	Large plump	6	53.8	1.5
	Small plump	6	50.4	1.5
	Shrunken seed	6	46.0	1.4
	Broken seed	6	43.2	1.3
Spring Wheat	Large plump	8	21.7	1.4
	Small plump	8	18.0	1.3
	Shrunken seed	8	16.7	1.2
Winter Wheat	Large plump	6	46.9	2.6
	Small plump	6	40.4	2.2
	Shrunken seed	6	39.1	2.1
	Split seed	6	9.3	0.6
Peas	Large seed	6	28.1	1.3
	Small seed	6	23.0	1.1
Peas	Sound seed	9	29.2	1.4
	Split seed	9	10.2	0.6

In the experiments which have been conducted at Guelph from six to nime years with each of eleven different classes of farm crops the average results show that the large seed surpasses the small seed by 19.1 per cent for grain crops, 40.3 percent for rape and 60.1 percent for root crops. Another experiment has been conducted for five years in succession in which both small and large seed of each of four varieties of oats have been planted at seven different distances apart. The object of the experiment has been to determine if the maximum yield which could be obtained from large plump seed would be different from the maximum yield which could be obtained from small plump seed. From the results of five years experiment the maximum yields from the large plump seed have been greater than the maximum yields from the small plump seed in fully 90 percent of all of the tests which have been made. Just how much greater was not stated in the report.

Cummings (1914) reports trials with hand selected sweet peas, squash, pumpkins, lettuce, spinach, parsley, radishes and beans. He concludes that the weight and size of the plants compared at different stages of growth show a continuous and permament advantage in favor of large seed. Plants grown from large seed possess more leaves of greater surface area and hence greater assimilative powers.

A summary of the results of the above experiments where equal numbers of large and small hand selected seeds were used and sown in plats at the usual rate of seeding shows an advantage of about 15 percent in favor of the large seed.

Separatiom of the kernels made by machine and the results compared with checks or where no checks were used the large and small kernels were compared, equal volumes of each grade were sown unless otherwise stated.

Harper (1891) found that wheat from seed testing 63 pounds to the bushel as separated by the fanning mill, grew more evenly, heads were larger and better developed, the plats freer from weeds, ripened more uniformily and matured earlier than wheat from 61 pound seed. Wheat from 55 pound seed was the poorest of all, grew unevenly and was very weedy.

Latta (1891) reports seed separated by the fanning mill into large and small grades. Seed passing thru the screen was designated as "small" and that passing over the screen as "large". All impurities and light chaffy seed were removed in both cases by heavy blast of the fan. The average yield for three years from the largest seed was 30.54 bushels to the acre and from the smallest 27.97 bushels to the acre, a difference of 2.57 bushels in favor of the large seed. Latta says that this amply repays for extra labor of careful cleaning and screening both of which are essential to plump seed free from all impurities.

Sanborn (1892) obtained different grades of seed by first separating by means of a grader into classes of large, medium, small and shrivelled seed. Then the large dense seed and the large light seed were obtained by separating the large seed by means of brine. Results were in favor of the large seed and the large light seed while the large dense seed fell down with the shrivelled. The small were nearly as good as the large seed and better than the medium. Nothing conclusive can be drawn from this.

Waters and Weld (1893) report one years work with hand selected versus machine selected seed. There was a very slight difference in yield in favor of the hand selected seed. This difference however was so small as easily to be within the limit of experimental error.

Georgeson (1897) graded oats with a fanning mill into light,common and heavy. The common was the seed just as it came from the thresher and commonly called the check. Plats were seeded with a shoe press drill at the rate of three bushels to the acre by measure. The results of trials for eight successive seasons are in favor of the heavy seed. The light seed yielded 33.37 bushels to the acre, common 39.74 bushels to the acre and the heavy 45.87 bushels to the acre. This was a gain of 11 percent of the heavy over the check.

Hickman (1901) graded seed into "selected seed" , "second grade" and "unscreened". The selected grade consisted of the largest grains while the second grade consisted of the best of the wheat that passed thru in screening out of the first grade, the unscreened was the entire lot as it came from the thresher. No light seed was used, all seed used was of as good or better grade as that coming from the thresher. The average of three varieties for nine years shows a yield for the selected seed of 17.73 bushels to the acre, for the second grade of 16.21 bushels and for the unscreened of 16.33 bushels to the acre. The results show that in this experiment the quality of the seed did not influence to any extent the quantity and quality of the crop.

Soule and Vanatter (1901) conducted experiments for three years in which large and small kernels separated by sieves were compared with unselected seed. The large seeds each year after the first were selected from the crop grown from large seed the previous year. The same was true of the small seed. The average difference in yield at the end of three years was 2.06 bushels in favor of the large seed when compared with the commercial sample and 5.18 bushels in favor of the large grains over the small grains. After the experiment had been carried on in different parts of the field for two years longer the difference in yield was only 0.32 bushels to the acre in favor of the large grains.

Lyon (1902) worked with wheat for two years at the Nebraska Station separating the seed into grades of heavy, ordinary and light with a fanning mill. The heavy seed gave a yield of 27.8 bushels to the acre, the ordinary 26.3 bushels to the acre and the light a yield of 22.8 bushels to the acre. The advantage in yield of the heavy over the ordinary was only 1.5 bushels to the acre and the ordinary over the light only 3.5 bushels to the acre.

Cobb (1903) reports that the yield from large plump kernels of wheat obtained from screening is always greater than from equal numbers of small or shrivelled seed. Superior yields from large and plump grain is sufficiently pronounced to justify the cost of first class cleaning of ordinary wheat for seed purposes.

Williams (1903) graded seed oats into heavy, light and common by means of a fanning mill run at high speed. The results of nine years show an average yield for heavy seed of 3.68 bushels of grain and 111 pounds of straw to the acre more thanthe light seed. The common seed has an average of 2.14 bushels to the acre more than the light and 1.54 bushels less than the heavy. In the case of oats Williams recommends sowing only the heaviest seed obtained by thorough screening

Williams (1905) concludes that the selection of grain whether by the means of the fanningmill or by hand does not promise anything in the way of permament improvement in wheat. He further states however that in extremely unfavorable seasons the extra amount of food furnished the young plant by large kernels places it within a position to withstand greater hardships and is accordingly and advantage to it.

Montgomery (1908) used a fanning mill so constructed that the wheat to be separated was delivered into an upward wind blast, the lighter seeds being carried over by the wind while the heavier fell against the blast into a receptacle below. The wheat was separated into two equal portions and designated 'lighter half' and 'heavier half'. The lighter half was again separated, the lighter portion being known as the 'lightest light', the heavier half was also separated and the heavier half known as the 'heaviest heavy' . The crop from the lightest light was separated into four parts and the lightest fourth retained. The crop from the heaviest heavy also was separated and the heaviest fourth retained. The check was wheat sown continuously without separation. Below are the average of eight years results-

	Turkey Red	Big Frame	Av. Both.
Ordinary	31.5	28.5	30.0
Lightest light	32.1	26.0	28.5
heaviest heavy	32.2	28.2	30.2

After eight years continuous selection by the fanning mill it was not possible by careful examination to note any difference eith in the quality or the quantity of the crop produced from the light and heavy seed. Questions were sent by Montgomery to various Experiment Stations in the Central and Western States on December 31" 1906. The quwstions were as follows;

1. Have you any experience or reliable data which would prove conclusively that the continued use of the fanning mill to remove the shrunken and very light grains from wheat will intend to increase the crop ?

2. After the light, shrunken and shrivelled grains• and foreign partivles have been removed from the wheat, is there any evidence that further separation of the same according to the specific gravity of the same, that is, into heavy and light seed, and this practice continued for a number of years, would affect one way or another the yield of the crop?

Answers from eight Stations were received and were uniformily to the effect that except for the purpose of removing foreign matter and weed seeds, both of which would be troublesome in securing a uniform stand, or obnoxious weeds which might infect the land, there was no good evidence that the continuous use of the fanning mill would either improve the quality or increase the quantity of the yield. Montgomery states further that if a screeh is used to separate a sack of wheat into two lots, say about half and half, it is evident that not only is the grain from each plant separated into two parts, a portion going into each lot, but the grain from each head is also separated, a portion going into each lot. There is no reason to believe that the large grains froma particular head or plant of wheat will yield better than the small, any more than the large grains of corn on an ear will yield better than the small. As to the fanning mill the greatest difficulty is that the selections are not continuous, since it is apt to be a different strain of plants having the light grain each year. One year the late maturing plants may suffer most from drought and are light, the next year the early plants may suffer most, another year it may be the plants that lodge the most.

In 1903 Williams and Welton (1911) divided two bushels of Velvet Chaff wheat by means of a popular fanning mill into three distinct grades, the separation being made by means of wind blast and sieves. The wheat was run thru the mill several times before satisfactory grades were secured. Three grades have been continued. The seed for each successive seeding of the first grade wheat has been obtained from the preceeding crop of first grade, an effort being made to secure as nearly as possible a duplicate of the original grade each season. In case of the second grade there has been no cleaning or gading of seed since 1908, the seed being used just as it came from the thresher. In preparing the seed for the third grade the larger and heavier kernels have been rejected each year. The test has been run in duplicate. In one set of plots the rate of seeding has been uniformly eight pecks to the acre, in the other the rate has been varied to conform to the size of the kernel, the aim being to put more nearly the same number of kernels on each plot. The size of the plots usually were one tenth acre, but occasionally one twentieth of an acre. Below are the average results for ten years-

	Yield in bushels to the acre.		
	Seeding uniform.	Seeding varied.	Average.
First	31.26	31.26	31.26
Second	31.40	30.92	31.16
Third	31.25	30.70	30.97

Williams and Welton conclude after seven years tests in which the selection of the seed has been continuous, that there is no special advantage in rejecting the medium to small kernels of seed wheat provided that they are free from disease.

By averaging the results of all experiments where separation was made by machine it is seen that the large seed have produced slightly larger yields than both the ungraded and small seed.

Methods and Material Used.

The problem was attact in two different ways. The first method was by hand selection where large perfect and small perfect kernels were selected and weighed and a number of the large perfect kernels and a number of the small perfect kernels were cut down and weighed. The object of the hand selecting and reducing in size of the kernels was to determine whether or not the large kernels produced larger yields and if larger yields were produced whether or not these yields were due to a greater amount of food stored in the larger kernel. The machine selected seed were separated out by means of the fanning mill, the object being to determine whether or not the large perfect seed from the bin yielded heavier than the small perfect seedfrom the bin. Seeding was at the usual rate of a bushel and a peck to the acre and at a varied rate.

Hand Selection.

The variety of wheat used was Fultz. The heads were selected from a plat seeded with a commercial variety or mixed population. Each head was threshed separately by means of a small separator containing only the cylinder and driven by a small motor. Fifteen kernels were selected from each head, nine of them being the largest that could be found and yet of about the same size, color and weight. Only clear bright amber colored kernels were chosen. Six of the kernels were as small as could be found and yet of about the same weight. The weight of each kernel in milligrams was determined and recorded. Any variation in the density of the kernel could be determined as soon as the kernel was put on the balance. All extremely light or heavy kernels were discarded. Three of the large kernels and three of the small ones were placed in small envelopes and labeled while three of the large ones were cut down to about the same weight as the small ones by simply taking the germ end of the kernel between the fingers and rubbing the opposite end on a piece of fine sand paper. Three more of the large kernels were cut down smaller than the small whole kernels and three of the small kernels cut down to about the large kernels that were cut the most. This gave five classes of kernels as follows.

A. Large whole kernels.

B. Small whole kernels.

C. Large kernels made equal in weight to the small whole kernels.

D. Large kernels made very small.

E. Small kernels made very small.

Each kernel was weighed after cutting and the three kernels belonging to each class were made to weigh about the same. Two hundred and twelve heads were used making six hundred and thirty six kernels in each class and a total of three thousand one hundred and eighty kernels.

On October the third these kernels were planted in hills one foot apart each way with one kernel in each hill. This was to eliminate competition between plants as much as possible so that where kernels failed to grow the surrounding plants would not be materially affected. The seed was planted fairly late in the fall in order to avoid if possible any attack of the Hessian fly which had been prevalent thro this part of the state the past season. The seed bed was in excellent condition having been plowed three weeks before and well disked and harrowed. The bed was laid off with a marker run in each direction and then the rows opened up with a garden hand plow. The planting order was determined by placing each envelope containing a seed on the floor and thoroughly shuffeling and then drawing out one at a time and numbering, this number being the place that the seed was given in the row. By this method the kernels from each head were scattered over the plat to eliminate as far as possible variation in yield thru variation in soil, that is to minimize the influence of place variation.

The kernels were covered with a garden rake special care being taken to cover each kernel at approximately the same depth. As the ground was moist at the time of seeding the kernels germinated and came up in normal time. On October the thirty first the number of living plants was determined and this taken as an index of the number of kernels in each class that germinated. Below are the results obtained-

Class.	Number Failing to Germinate.	Percent of Total Number Planted.
A.	38	5.97
B.	38	5.97
C.	144	22.64
D.	149	23.58
E.	136	21.38

There was no difference in the germination of large and small perfect seed as shown by class A (large seed) and class B (small seed). Cutting the kernels prevented the germination of about one fifth of all of the kernels in classes C, D and E. The injury however was practically the same whether the kernel was cut a small or large amount as shown by classes C and D. Class E is the group of small kernels made smaller being the ultimate size of the kernel planted and same as that of the large kernels made small and large kernels made very small.

The winter was an excellent one for wheat there being a few cold spells but during each one the ground was covered with snow so that the wheat came thru in good condition. On March the twentieth a count was again made of the number of plants living and the percent frozen out during the winter determined. The table below shows the results-

Class.	No. Plants Remaining After Count Oct. 31.	No. Frozen Out During Winter.	Percent Frozen Out.
A.	598	27	4.51
B.	598	32	5.35
C.	492	53	10.97
D.	487	70	14.16
E.	500	71	14.20

Only five plants or 0.84 percent more of the small perfect seed froze out during the winter than did the large perfect seed; this is a very slight difference. Both the large and small seed that were made very small froze out worse than did the large seed that were cut only a little.

On April the third the plat was cultivated by means of a hand hoe owing to the fact that the ground was cracking open very badly. This cultivation consisted merely of chopping up the top two or three inches of the soil to make a fine mulch. Conditions were uniform over the entire plat. From all appearences the wheat was doing well until attacked by the chinch bugs which were first noticed April 26 and in two days time had made their appearence in large numbers. On April 28 each plant was thoroughly sprayed with Nicotine Sulphate (brand 'Black 40') one ounce to three gallons of water. The spray was put on with a double cylinder bucket spray pump. As the fine dirt mulch afforded excellent hiding places for the chinch bugs the plat was thoroughly wet down by means of a garden hose on April 29. Each plant was again sprayed May 1 however kerosene emulsion was substituted for the Nicotine Sulphate. The kerosene emulsion was found to be just as effective and much cheaper. It was made by heating one and one half gallons of soft water to boiling and adding three quarters of a pound of soap which had been cut into small pieces and thoroughly dissolving the pieces in the boiling water. The soap solution was then removed from the fire and three gallons of kerosene added and stirred constantly for about ten minutes or until the kerosene was emulsified and did not rise to the top of the solution in droplets. This stock solution was sufficient to make sixty gallons of spray solution. The plants were again sprayed on May 10, 12, 22, June land 5. It was impossible to keep the plants entirely free from chinch bugs at all times but the number was greatly checked by the spraying. There were also numerous rains during this period which were of great benefit to the wheat. These rains did not check the chinch bugs to any great extent, however, as seen by the number of bugs on unsprayed adjoining wheat. The plat received no other cultivation except that mentioned above but on May 8 all weeds and grass were pulled. On June 30 each plant was numbered and pulled. The plants were then tied in bundles, wrapped in shock covers and taken to the seed room where the plants were hung on individual nails on racks so that the air could circulate quite freely and allow the plants to cure readily. When cured the roots were clipped off, total weight of plant taken and the number of culms determined. The heads were then threshed, cleaned and the grain weighed. All data was taken on 3" by 5" cards in order to avoid transferring when working out Biometrical constants. Below is a table showing the number of plants lost during spring and summer and the number harvested.

Class.	No. Plants March 20.	No. Harvested.	No. Lost Spring & Summer.
A.	571	419	152
B.	566	354	212
C.	439	207	225
D.	417	166	251
E.	429	186	243

In class A, the large whole kernels, 152 plants were lost during the spring and summer while in class B, the small whole kernels, 212 plants were lost. Comparing classes C, D and E, the classes that were cut down, we have the following-

Class.	Orig. Mean Wt. of Kernel.	Mean Wt. Kernel Planted.	No. Plants Lost Spring & Summer.
C.	.0405 Gms.	.0284 Gms.	225
D.	.0408 "	.0234 "	251
E.	.0283 "	.0233 "	243

If there was a relation between the original weight of kernel and the number of plants that lived until maturity we would expect the number of plants lost in class E to be much greater. The original weight of kernel however does not seem to have any influence on the number of plants that lived to maturity. There does seem to be some relation between the weight of kernel planted and the number of plants lost. The size of kernel planted is about the same in classes D and E but a few more plants were lost in D then E as would be expected since D is the class that was originally large but made very small. The table below shows the number of plants lost during the season-

Class.	No. Planted.	No. Harvested.	No. Lost.	Percent.
A.	636	419	217	34.12
B.	636	354	282	44.34
C.	636	207	429	67.40
D.	636	166	470	73.90
E.	636	186	450	70.75

Ten percent more plants were lost in class B where small whole kernels were planted than in class A where large whole kernels were planted. In class C the kernels were not made as small as in class D and 6.5 percent more plants were lost in class D than class C. In class E small kernels were made very small, the weight of kernel planted being about the same as in class D where the large kernels were made very small but the number of plants lost was not quite so great. The difference however is not great.

Figure 1 gives the mean, standard deviation, coefficient of variability and their probable errors for all of the characters measured for each class. In comparing the mean weight of plant, straw, grain and number of culms for class A, the large whole kernels, with class B, the small whole kernels, it is evident that class A has outyielded class B. The mean weight of kernel planted for class A was .0409 grams and for class B .0281 grams so the larger kernel has outyielded the smaller one. As to the variation in the two classes there is hardly any difference as shown by the standard deviation and the coefficient of variability. The coefficient of variability is greater for the weight of grain than for any of the other characters measured. In comparing the same characters for class C, the large kernels made small, class D the large kernels made very small and class E the small kernels

Clas

A.
Larg
W

B.
Smal
W

C.
Larg
S

D.
Larg
Very

E.
Smal
Very

A. &
Comb

D. &
Comb

made very small it is seen that there is scarcely any difference in the mean weight of plant, weight of straw, weight of grain and number of culms of these three classes. Also the mean weight of kernel planted is nearly the same, being .0284 grams for class C, .0234 grams for class D, and .0233 grams for class E. The original mean weight of kernel in classes C and D is practically the same being .0405 grams for class C and .0408 grams for class D. There is a marked difference however in the mean original weight of kernel for classes C and D as compared with E as the mean original weight of kernel for E is .0283 grams. As stated above the mean weight of plant, straw, grain and number of culms for classes C, D and E is practically the same, then it must be the size of the kernel planted and not the original size of the kernel that influences the plant.

Correlations.

As shown by figure 2 there is practically no correlation between the weight of kernel planted and the weight of plant secured in class A. Figures 3, 4, and 5 show the correlation between the weight of kernel planted and the weight of straw, grain and number of culms for class A. The highest correlation is with the number of culms which is .1019 $\pm$ .0326. The range of r is from one to three times as great as the probable error so that for class A there is but a slight positive correlation between the weight of kernel planted (being also the original weight of kernel in this class) and the characters measured.

Figures 6, 7, 8 and 9 show the correlation between the weight of kernel planted and the weight of plant, straw, grain and number of culms for class B. In class B the correlation is less than in class A, in fact practically no correlation exists.

As shown by figures 10, 11, 12 and 13 classes A and B were combined and correlations determined for the weight of kernel planted and weight of plant, straw, grain and number of culms. These correlations are from four to seven times as great as the probable errors so that a slight but positive correlation exists.

Classes D and E were combined and correlations between the weight of kernel planted and the weight of plant, straw, grain and number of culms determined as shown by figures 14, 15, 16 and 17. The correlation between the weight of kernel planted and weight of plant and straw is negative but as the correlation is less than the probable error it could not be considered a negative correlation but simply no correlation.

The correlation was determined in classes D and E combined between the original weight of kernel and weight of plant, straw, grain and number of culms as shown by figures 18, 19, 20 and 21. The coefficient of correlation is from one to two times the probable error and negative in all cases but one and that is the weight of grain where it is less than tha probable error and positive. In this class the correlation is very slight and has a tendency to be negative.

The coefficient of correlation to be of importance must be at least ten times as great as its probable error. None of the coefficients of correlation determined in this work have been as great as ten times their probable error.

	0-I0	I0-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-I00	I00-II0	II0-I20	
32-34	I												I
34-36		2	4										6
36-38	8	I3	8	4	2	I	I		I		I		39
38-40	I2	29	26	I6	I7	6	I	2	I				II0
40-42	I7	29	22	2I	8	II	3	3	I				II5
42-44	I5	26	23	24	8	6	6	I				I	II0
44-46	3	4	6	3	3	3		2					24
46-48		2	5		I								8
48-50		I	2	I		I	I						6
	56	I06	96	69	39	28	I2	8	3	0	I	I	4I9

Fig. 2. Class A.

Weight of kernel planted in milligrams subject.

Weight of plant produced in grams relative.

$r = .070 \pm .033$

	0-I0	I0-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	
32-34	I									I
34-36		4	2							6
36-38	I3	I2	8	3	I	I		I		39
38-40	2I	35	25	20	6	I	2			II0
40-42	2I	40	25	I3	I2	2	2			II5
42-44	25	3I	30	I2	7	4			I	II0
44-46	3	5	8	2	4	2				24
46-48		6	I	I						8
48-50		3		I	I	I				6
	84	I36	99	52	3I	II	4	I	I	4I9

Fig. 3. Class A.

Weight of kernel planted in milligrams subject.

Weight of straw per plant in grams relative.

r = .055 ± .033

	0-3	3-6	6-9	9-I2	I2-I5	I5-I8	I8-2I	2I-24	24-27	27-30	30-33	
32-34	I											I
34-36	2	3	I									6
36-38	I8	I3	I	3	I	I			I		I	39
38-40	42	23	23	I3	6	I		I	I			II0
40-42	47	24	I7	I3	8	3	3					II5
42-44	34	33	20	I2	3	5		2		I		II0
44-46	7	5	7	3	I		I					24
46-48	2	3	2	I								8
48-50	2	I	2			I						6
	I55	I05	73	45	I9	II	4	3	2	I	I	4I9

Fig. 4. Class A.

Weight of kernel planted in milligrams subject.

Weight of grain produced in grams per plant relative.

r = .030 ± .033

	I-3	4-6	7-9	I0-I2	I3-I5	I6-I8	I9-2I	22-24	25-27	
32-34	I									I
34-36		I	4	I						6
36-38	5	I6	8	4	3	I	I		I	39
38-40	I3	25	27	24	I3	5		I	2	II0
40-42	I4	27	27	2I	II	8	6	I		II5
42-44	I2	28	24	I7	I5	5	2	5	2	II0
44-46	2	5	5	3	3	3	I		2	24
46-48		3	3	I	I					8
48-50		I	2		I		I		I	6
	47	I06	I00	7I	47	22	II	7	8	4I9

Fig. 5. Class A.

Weight of kernel planted in milligrams subject.

Number of culms per plant relative.

$r = .I02 \pm .033$

	0-I0	I0-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	
20-22	3	I	3	2						9
22-24	7	7	2		3		2			2I
24-26	I2	I5	I0	7	5	I	I			5I
26-28	I6	26	20	8	8	4	I			83
28-30	24	26	26	23	II	3	I	I	I	II6
30-32	4	I4	9	7		4	I		I	40
32-34	3	4	9	6	2					24
34-36	2	2	I	I	I		I			8
36-38		I				I				2
	7I	96	80	54	30	I3	7	I	2	354

Fig. 6. Class B.

Weight of kernel planted in milligrams subject.

Weight of plant produced in grams relative.

$r = .055 \pm .036$

	0-I0	I0-20	20-30	30-40	40-50	50-60	60-70	70-80	
20-22	3	I	4	I					9
22-24	8	8		3	2				2I
24-26	I4	I6	I4	5	2				5I
26-28	24	30	I4	I2	2	I			83
28-30	30	3I	34	I7	I	2	I		II6
30-32	6	I9	6	4	4			I	40
32-34	4	5	II	4					24
34-36	3	I	2	I		I			8
36-38		I		I					2
	92	II2	85	48	II	4	I	I	354

Fig. 7. Class B.

Weight of kernel planted in milligrams subject.

Weight of straw per plant in grams relative.

$r = .023 \pm .036$

	0-3	3-6	6-9	9-I2	I2-I5	I5-I8	I8-2I	2I-24	
20-22	4	3	2						9
22-24	II	5			5				2I
24-26	24	I4	7	3	2		I		5I
26-28	43	I8	9	6	4	2	I		83
28-30	55	2I	I8	I3	7		I	I	II6
30-32	I8	I0	7	3	2				40
32-34	8	II	4		I				24
34-36	4	I	I			2			8
36-38	I				I				2
	I68	83	48	25	22	4	3	I	354

Fig. 8. Class B.

Weight of kernel planted in milligrams subject.

Weight og grain produced per plant in grams relative.

r = .04I ± .036

	I-3	4-6	7-9	I0-I2	I3-I5	I6-I8	I9-2I	22-24	25-27	28-30	
20-22	2	2	2	2	I						9
22-24	5	6	5	I		I	2		I		2I
24-26	II	II	I8	6	I	I	3				5I
26-28	I4	24	25	8	7	3	I	I			83
28-30	I9	29	28	2I	8	7	4				II6
30-32	5	7	II	5	7	3			I	I	40
32-34	I	7	II	4	I						24
34-36	I	3		3	I						8
36-38		I				I					2
	58	90	I00	50	26	I6	I0	I	2	I	354

Fig. 9. Class B.

Weight of kernel planted in milligrams subject.

Number of culms per plant relative.

r = .020 ± .036

	0-I0	I0-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-I00	I00-II0	II0-I20	
20-22	3	I	3	2									9
22-24	7	7	2		3		2						2I
24-26	I2	I5	I0	7	5	I	I						5I
26-28	I6	26	20	8	8	4	I						83
28-30	24	26	26	23	II	3	I	I	I				II6
30-32	4	I4	9	7		4	I		I				40
32-34	4	4	9	6	2								25
34-36	2	4	5	I	I	I							I4
36-38	8	I4	7	5	2	2	I		I		I		4I
38-40	I3	27	26	I6	I8	5	2	2	I				II0
40-42	I5	3I	22	2I	8	II	3	3	I				II5
42-44	I6	26	24	23	7	6	6	I				I	II0
44-46	3	4	6	3	3	3		2					24
46-48		2	5		I								8
48-50		I	2	I		I	I						6
	I27	202	I76	I23	69	4I	I9	9	5	0	I	I	773

Fig. I0. Classes A & B.

Weight of kernel planted in milligrams subject.

Weight of plant produced in grams relative.

r = .I5I ± .024

	0-I0	I0-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	
20-22	3	I	4	I						9
22-24	8	8		3	2					2I
24-26	I4	I6	I4	5	2					5I
26-28	24	30	I4	I2	2	I				83
28-30	30	3I	34	I7	I	2	I			II6
30-32	6	I9	6	4	4			I		40
32-34	5	6	I0	4						25
34-36	3	5	4	I		I				I4
36-38	I3	I3	8	4	I	I		I		4I
38-40	2I	35	25	20	6	I	2			II0
40-42	2I	40	25	I3	I2	2	2			II5
42-44	25	30	3I	I2	7	4			I	II0
44-46	3	5	8	2	4	2				24
46-48		6	I	I						8
48-50		3		I	I	I				6
	I76	248	I84	I00	42	I5	5	2	I	773

Fig. II Classes A& B.

Weight of kernel planted in milligrams subject.

Weight of straw produced per plant in grams relative.

r = .I53 ± .024

	0-3	3-6	6-9	9-I2	I2-I5	I5-I8	I8-2I	2I-24	24-27	27-30	30-33	
20-22	4	3	2									9
22-24	II	5			5							2I
24-26	24	I4	7	3	2		I					5I
26-28	43	I8	9	6	4	2		I				83
28-30	54	2I	I9	I3	6		2	I				II6
30-32	I9	9	7	3	I	I						40
32-34	9	II	4		I							25
34-36	6	4	2		2							I4
36-38	I9	I3	I	3	I	2			I		I	4I
38-40	42	23	23	I3	6	I		I		I		II0
40-42	47	24	I7	I3	I0	2	2					II5
42-44	34	35	I8	I2	2	6	2		I			II0
44-46	7	4	8	3	I			I				24
46-48	2	3	2	I								8
48-50	2	I	2			I						6
	323	I88	I2I	70	4I	I5	7	4	2	I	I	773

Fig. I2 Classes A & B.

Weight of kernel planted in milligrams subject.

Weight of grain produced per plant in grams relative.

$r = .099 \pm .024$

	I-3	4-6	7-9	I0-I2	I3-I5	I6-I8	I9-2I	22-24	25-27	28-30	
20-22	2	2	2	2	I						9
22-24	5	6	5	I		I	2		I		2I
24-26	II	II	I8	6	I	I	3				5I
26-28	I4	24	25	8	7	3	I	I			83
28-30	I9	29	28	2I	8	7	4				II6
30-32	5	7	II	5	7	3			I	I	40
32-34	2	7	II	4	I						25
34-36	I	4	4	4	I						I4
36-38	5	I7	8	4	4	I	I		I		4I
38-40	I3	25	27	24	I3	5		I	2		II0
40-42	I4	27	27	20	II	9	6	I			II5
42-44	I2	28	24	I7	I5	5	2	5	2		II0
44-46	2	5	5	3	3	3	I		2		24
46-48		3	3	I	I						8
48-50		I	2	I			I		I		6
	I05	I96	200	I2I	73	38	2I	8	I0	I	773

Fig. I3 Classes A & B.

Weight of kernel planted in milligrams subject.

Number of culms produced per plant relative.

$r = .I36 \pm .024$

	0-I0	I0-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	
I4-I6		I								I
I6-I8		I								I
I8-20	7	8	2		I	I			I	20
20-22	I9	I9	I6	5	2	4	2			67
22-24	39	56	26	9	2	3				I35
24-26	23	28	I9	7	3	2				82
26-28	7	II	9	5	4		I			37
28-30	2	I	I	2						6
30-32	3									3
	I00	I25	73	28	I2	I0	3	0	I	352

Fig. I4 Classes D & E.

Weight of kernel planted in milligrams subject.

Weight of plant produced in grams relative.

r = -.024 ± .036
(minus)

	0-I0	I0-20	20-30	30-40	40-50	50-60	60-70	70-80	
I4-I6		I							I
I6-I8		I							I
I8-20	9	8		I	I			I	20
20-22	2I	23	I5	4	2	2			67
22-24	57	50	22	2		4			I35
24-26	3I	30	I5	5	I				82
26-28	I0	I2	II	3	I				37
28-30	2	I	I	2					6
30-32	3								3
	I33	I26	64	I7	5	6	0	I	

Fig. I5. Classes D & E.

Weight of kernel planted in milligrams subjewt.

Weight of straw produced per plant in grams relative.

r = -.020 ± .036
(minus)

	0-3	3-6	6-9	9-I2	I2-I5	I5-I8	
I4-I6	I						I
I6-I8	I						I
I8-20	I5	2	2		I		20
20-22	38	I7	3	6	3		67
22-24	92	25	I4	2	I	I	I35
24-26	46	22	9	3	2		82
26-28	I4	I3	4	3	2	I	37
28-30	4	I	I				6
30-32	3						3
	2I4	80	33	I4	9	2	352

Fig. I6. Classes D.& E.

Weight of kernel planted in milligrams subject.

Weight of grain produced per plant in grams relative.

r = .08I ± .036

	I-3	4-6	7-9	I0-I2	I3-I5	I6-I8	I9-2I	22-24	25-27	28-30	
I4-I6		I									I
I6-I8		I									I
I8-20	7	9	2			I				I	20
20-22	I5	24	I2	6	5	4	I				67
22-24	36	55	25	I0	6	2	I				I35
24-26	I7	32	I4	I4	4			I			82
26-28	7	I0	II	3	5		I				37
28-30	2		2	2							6
30-32	2	I									3
	86	I33	66	35	20	7	3	I	0	I	352

Fig. I7. Classes D & E.

Weight of kernel planted in milligrams subject.

Number of culms per plant relative.

r = .045 ± .036

	0-I0	I0-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	
20-22		2	I							3
22-24	2	4	2	I		I				I0
24-26	7	2	5	I	2				I	I8
26-28	8	22	5	3		2				40
28-30	I7	34	I8	6	I	I				77
30-32	8	6	3	2	I	I				2I
32-34	3	2	4	3	2					I4
34-36	I	4	2				I			8
36-38	7	4	2	I	I		I			I6
38-40	II	I3	I3		2	2				4I
40-42	20	I5	I2	3	2	2	I			55
42-44	9	I5	3	6		I				34
44-46	6	2	3	2						I3
46-48	I				I					2
	I00	I25	73	28	I2	I0	3	0	I	352

Fig. I8. Classes D & E.

Original weight of kernel in milligrams subject.

Weight of plant produced in grams relative.

$r = -.044 \pm .036$ (minus)

	0-I0	I0-20	20-30	30-40	40-50	50-60	60-70	70-80	
20-22		2	I						3
22-24	3	4	2			I			I0
24-26	9	I	5	2				I	I8
26-28	I3	20	5	I	I				40
28-30	25	33	I7	I		I			77
30-32	8	8	3	I	I				2I
32-34	4	3	4	3					I4
34-36	2	3	2			I			8
36-38	I0	3	I	I		I			I6
38-40	I5	I4	8	2		2			4I
40-42	23	2I	6	3	2				55
42-44	I3	I2	6	2	I				34
44-46	7	2	4						I3
46-48	I			I					2
	I33	I26	64	I7	5	6	0	I	352

Fig. I9. Classes D & E.

Original weight of kernel in milligrams subject.

Weight of straw produced per plant in grams relative.

r = -.042 ± .036
(minus)

	0-3	3-6	6-9	9-I2	I2-I5	I5-I8	
20-22	I	2					3
22-24	7	I	I	I			IO
24-26	IO	5		2	I		I8
26-28	27	5	6	I		I	40
28-30	48	20	6	I	2		77
30-32	I2	6	2	I			2I
32-34	5	4	2	2	I		I4
34-36	4	2	I		I		8
36-38	IO	2	3		I		I6
38-40	27	IO	I	2	I		4I
40-42	32	I2	7	2	I	I	55
42-44	22	8	3	I			34
44-46	8	3	I	I			I3
46-48	I				I		2
	2I4	80	33	I4	9	2	352

Fig. 20. Classes D & E.

Original weight of kernel in milligrams subject.

Weight of grain produced per plant in grams relative.

r = .OIO ± .036

	I-3	4-6	7-9	I0-I2	I3-I5	I6-I8	I9-2I	22-24	25-27	28-30	
20-22		2	I								3
22-24	3	4	I		I	I					I0
24-26	5	6	2	3		I				I	I8
26-28	8	I6	8	2	5	I					40
28-30	7	37	20	II	2						77
30-32	6	8	4		2			I			2I
32-34	3	3	5	I	2						I4
34-36		3	2	2	I						8
36-38	6	4	2	I	2	I					I6
38-40	I0	I9	5	3	3	I					4I
40-42	22	I5	I0	4		2	2				55
42-44	9	I3	3	7	I		I				34
44-46	6	3	3	I							I3
46-48	I				I						2
	86	I33	66	35	20	7	3	I	0	I	352

Fig. 2I. Classes D & E.

Original weight of kernel in milligrams subject.

Number of culms produced per plant relative.

r = −.089 ± .036 (minus)

Machine Selection.

The seed for this part of the experiment was secured from Dr. W.L. Dysart, a farmer living six miles east of Columbia. He had secured his seed wheat from the Missouri Experiment Station the year before so it was known that his seed was of a good commercial variety of Fultz. The seed was run thru a fanning mill, the mill being run at a very high rate of speed thereby dividing the sample into two nearly equal parts. The heaviest part was again run thru twice securing the heaviest heavy. The light was also run thru twice securing the lightest light. All trash and broken kernels had been removed before separation begun. A sample of the original seed with the trash removed was saved for the check. The heaviest heavy tested 61.5 pounds to the bushel, the check 59.5 and the lightest light 56.75 pounds to the bushel. Two rates of seeding were used. In the first the same number of kernels was planted of the heaviest heavy, check and lightest light and in the second the same weight of seed of heaviest heavy, check and lightest light was planted. Plats used in this work were 21.5' x 4' or 1/500 part of an acre. By seeding the check plat at the rate of one and one fourth bushels to the ~~approximate~~ acre the number of kernels put on the check plat was 2420 so that in the first method of seeding,that is by number, 2420 kernels of the heaviest heavy, check and lightest light was put on each plat. The number of kernels per gram was determined by weighing out five ten gram samples and counting the number of kernels in each sample and dividing this number by ten, the number of grams used. The average of the five samples was taken as the number of kernels in one gram. The table below shows the number of kernels per gram and the number of grams used.

	Test # per Bu.	No. Kernels per Gram.	No. Gms. per Plat.	No. Kernels per Plat.
Heaviest heavy	61.50	32.6	75.05	2420
Check	59.50	36.7	67.22	2420
Lightest light	56.75	43.5	56.02	2420

Where the plats were seeded at the same weight of seed each was seeded at the rate of one and one fourth bushels to the acre by weight. At this rate the heaviest heavy plat received approximately 2260 kernels, the check 2420 kernels and the lightest light 2780 kernels. These plats were sown the same day as the hand selected seed and the seed bed was in equally as good condition. These plats joined the hand selected seed plats on the west with only an alley way between.

Below is the planting order-

1. Check.
2. Light by weight.
3. Light by number.
4. Check.
5. Heavy by weight.
6. Heavy by number.
7. Check.
8. Light by weight.
9. Light by number.
10. Check.
11. Heavy by weight.
12. Heavy by number.
13. Check.
14. Light by weight.
15. Light by number.
16. Check.
17. Heavy by weight.
18. Heavy by number.
19. Check.

All of the plats came thru the winter in good condition. No treatment whatever was given them , either cultivation or spraying for the chinch bugs. They were attacked by the first brood of chinch bugs but not so bad as the individual plats due perhaps to the fact that the individual plants being a foot apart warmed up quicker and afforded an excellent place for the bugs to feed. The attack was quite general as no one plat seemed to have any more than any of the others. On June twentieth ech plat was cut with a hand sickle, tied in bundles and shocked up. Each shock was covered with two shock covers for protection against rain. The wheat remained in the shock about a week when the bundles were scatteredout and allowed to dry for a day and hauled to the grain room where they were again scattered out until threshed about ten days later.

The table below shows the average yield for the plats planted with the same number of kernels of heavy, check and light seed.

	Weight of Grain and Straw.	Weight Straw.	Weight Grain.
Heavy	14.0 llbs.	9.50 llbs.	4.50 llbs.
Check	12.36 "	8.36 "	4.00 "
Light	11.50 "	8.00 "	3.50 "

The following table showsthe yield in pounds and bushels to the acre.

	Weight of Grain and Straw.	Weight Straw.	Weight Grain.
Heavy	7000 llbs.	4750 llbs.	37.50 Bu.
Check	6180 "	4180 "	33.33 "
Light	5750 "	4000 "	30.83 "

Below is a table showing the percent of grain to straw for each kind of seed.

	Percent Grain.	Percent Straw.
Heavy	32.22	67.78
Check	32.36	67.64
Light	30.43	69.57

It is readily seen that the heavier seed yielded more grain and straw than did the light or check when the same number of kernels were planted and that the check yielded more than the light. The percent of grain to straw is about the same for both heavy seed and check while the percent of grain to straw is less for the light seed than either heavy or the check.

The table below shows the results when the seed was planted at the same rate, that is at the rate of one and one fourth bushels to the acre.

	Grain & Straw.	Straw.	Grain.
Heavy	10.66 llbs.	7.00 llbs.	3.66 llbs.
Check	12.36 "	8.36 "	4.00 "
Light	14.16 "	9.08 "	5.08 "

The following table shows the yields in ponuds and bushels to the acre.

	Grain & Straw	Straw.	Grain.
Heavy	5330 llbs.	3500 llbs.	30.50 Bu.
Check	6180 "	4180 "	33.33 "
Light	7080 "	4540 "	34.00 "

The percent of grain to straw is shown in the following table.

	Percent Grain	Percent Straw.
Heavy	34.33	65.67
Check	32.36	67.64
Light	35.17	64.83

When sown at the same number of pounds to the acre the light seed yielded more than either the heavy or the check. The superior quality of the heavier seed was no doubt overcome by the greater number of plants to the plat of the light seed.

Quality of Grain Produced.

There was not very much difference in the quality of grain raised on the different plats. The following table shows the number of pounds to the bushel tested for the different grades of seed sown.

Same number of seed planted to the plat.

	Test. Pounds to the Bushel.
Heavy	58.33
Check	57.79
Light	57.33

Seed planted at the same rate, one and one fourth bushels to the acre.

	Test. Pounds to the Bushel.
Heavy	57.50
Check	57.79
Light	58.16

While there is but little difference in the quality of the grain it is apparent that the series which produced the greater yield also produced grain of a slightly higher quality.

Summary and Conclusions.

Hand Selection.

From the results secured it is apparent that the large plump whole seed outyielded the small plump whole seed as is shown by the mean weight of plant, kernel, grain and number of culms. (Fig. 1.)

Also that a larger percent of plants from large plump whole seed lived to maturity than did small plump whole seed.

When the kernels were reduced in size the mean weight of plant, straw, grain and number of culms were not influemced by the original weight of kernel. The mean weight of plant, straw, grain and number of culms were influenced however by the mean weight of kernel planted. This indicates that large grains form large plants and large yields because of a larger initial store of plant food. This difference is noticeable only when there is a marked difference in the weight of kernels planted.

The coefficients of correlation between weight of kernel planted and weight of plant, straw, grain and number of culms in classes A, B, A & B combined were found to be positive but very slight.

The coefficient of correlation between the original weight of kernel and the weight of plant, straw, grain and number of culms in classes D & E combined was found to be negative but so small as to be insignificant.

No coefficient of correlation was found to be over seven times as great as its probable error so was not large enough to be of importance. All Biometrical constants and coefficients of correlation were worked out according to Davenport's Principles of Breeding.

Machine Selections.

When equal numbers of heavy and light seed separated by a fanning mill were sown the heavy seed out yielded the check seed by eleven percent and the check out yielded the light seed by seven percent.

When the same amount of seed by weight was sown the light seed out yielded the check by twelve percent and the check out yielded the heavy seed by thirteen percent.

Just how great the injury from the attact of chinch bugs was cannot be determined, however the attact was very general and not confined to any certain part of the plat so the injury should be about the same for all classes of head selected seed and all plats of machine selected seed.

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