BULLETIN

OF THE

Agricultural Experiment Station

OF THE

UNIVERSITY OF TENNESSEE

FIGURE 1 SEED SELECTION WITH MEDITERRANEAN WHEAT

Types of heads used: (1) Large, (2) Medium, (3) Small

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WINTER WHEAT

KNOXVILLE, TENNESSEE

The Agricultural Experiment Station

OF THE UNIVERSITY OF TENNESSEE

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Winter Wheat

Andrew M. Soule and Phares O. Vanatter

INTRODUCTION

The experiments undertaken with winter wheat on the University farm in 1900 and reported on in bulletin No 2, Vol XIII, were successfully continued the past year and the results of the work are herewith presented. Owing to the unusually late season and the great labor involved in working up the results of the 400 plats, it has been necessary to omit some features of general interest which will be reported on later. One that seems to be of especial importance is the influence of the climate of Tennessee on the gluten content of wheat and whether the quantity of this constituent may be increased through the medium of seed selection. Other important questions relate to the milling qualities of the various wheats and their value from the baker's standpoint. These investigations would occupy a good deal of time and the present results are published so that they may be in the hands of the farmers before the planting season.

THE PLATS One of the principal objections urged against the plat is the high yield, but the objection is not well founded, for the average yield of the plats treated in fertilizer and bare fallow was 32.76 bushels; if the paths are figured in, 21.54 bushels. THE PATHS CONSTITUTE ONE-THIRD OF THE WHOLE AREA ON WHICH NOTHING WAS GROWN, AND STILL A YIELD OF 21.54 BUSHELS IS THE RESULT OF THE CALCULATION—A YIELD MORE THAN TWICE AS GREAT AS THE AVERAGE OF THE STATE. Averaging the yield on the plats on which commercial fertilizers were used with cowpeas plowed under, 39.14 bushels of wheat is the yield per acre; INCLUDING THE PATHS IT BECOMES 25.71 BUSHELS. The average yield where cowpeas were cut off, plowed under, etc., was 39.76; FIGURING IN THE PATHS, 30.56 BUSHELS. The average yield of the varieties without the paths was 27.41 bushels; WITH THE PATHS, 21.16 bushels.

Yield of Wheat from Plats and from Plats and Paths, 1901

Name of Experiment	Average yield per acre from Plats	Yield per acre from Plats and Paths
Varieties of winter wheat	27.41	21.16
Fertilizers on wheat after cowpeas	39.14	25.71
Fertilizers after bare fallow	32.76	21.54
Cowpeas cut off, etc.	39.76	30.56

VARIETIES OF WINTER WHEAT In Table I the results of testing 45 varieties of wheat, mostly of American origin, are presented. These wheats were seeded October 10. The land was previously cropped in wheat. Immediately after harvest it was sown in cowpeas which were plowed under about the 13 of September and five tons of barnyard manure applied as a top dressing. The land was carefully prepared and the wheat broadcasted at the rate of two bushels per acre. The varieties of wheat the past year suffered severely both from attacks of rust and fly. The wheat growing on the thin land seemed to

TABLE I Experiments with Varieties of Winter Wheat, 1901

Number	Varieties: Name	Condition of Crop, January 3 and April 1, 1901	Date of Ripening	Height of Crop in Inches	Kind of Head	Color of Grain	Yield per Acre of Straw Tons	Yield per Acre of Grain Bus., 1901	Yield of Grain per Acre 1900, bu.	Average of two years, bu.	Weight per measured
			June								
1	Fulcaster	Very good	22	43.0	Be.	R	2.25	32.50	41.66	37.08	59
2	Improved Fulcaster	Quite thick and green	22	34.5	Be.	R	1.90	31.66	41.25	36.45	59
3	Poole	Thick and green	21	38.5	Ba.	R	2.01	31.83	40.20	36.01	56
4	Improved Poole	Very good	21	39.0	Ba.	R	1.88	33.00	38.95	35.97	56
5	Niger	A uniform plat	22	43.5	Be.	R	1.70	29.80	40.62	35.21	58
6	Kansas Mortg. Lifter	Very thin	21	42.5	Be.	R	2.62	36.66	33.54	35.10	56
7	Mediterranean	Good	22	44.5	Be.	R	2.38	33.66	36.45	35.05	60
8	Deitz Amber	Very good	22	43.0	Be.	R	1.98	30.66	38 95	34.80	59
9	Egyptian.	Rather thin	24	44.5	Be.	R	2.22	30.83	37.70	34.26	60
10	Red Prolific	Fresh and green	21	41.0	Ba.	R	2.13	30.33	37.50	33.91	57
11	Fultz	Fairly good	20	39.0	Ba.	R	1.75	27.60	40.20	33.90	58
12	Perfection	Stand, medium	21	38.5	Ba.	R	1.78	28.16	39.16	33.66	55
13	Harvest King	Very good stand	20	38.5	Ba.	R	1.50	27.33	39.79	33.56	57
14	Fulcaster (check)	Very good	22	43.5	Be.	R	2.25	32.50			
15	White Golden Cross	Thin	24	41.5	Be.	W	2.25	28.16	38.54	33.35	56
16	Blue Ridge	Extra fine plat	21	49.0	Be.	R	2.82	40.00	25.41	32.70	57
17	Red Russian	Uniform stand	24	40.5	Ba.	R	2.03	30.33	33.75	32.04	57
18	Currell's Prolific	Rather thin	22	39.0	Ba.	R	1.89	25.16	37.50	31.53	58
19	Blue Straw Fultz	Fair	17	46.0	Ba.	R	1.92	30.00	31.66	30.83	57
20	EarlyGennesseeGiant	Thin, poor germinat'n	24	39.0	Ba.	W	1.75	18.33	41.45	29.89	56
21	Early Ripe	A very fine plat	22	49.0	Ba.	R	2.25	35.50	23.75	29.62	58
22	Beardless Fulcaster	Extra good plat	21	48.0	Ba.	R	2.32	31.33	25 83	28.58	56
23	Dawson's Gol'n Chaff	Excellent	22	46.0	Ba.	W	2.84	36.33	20.83	28.58	57
24	Mealey	Good	20	49.0	Ba.	R	1.71	30.83	26.25	28.54	55
25	Red May	Extra good plat	18	45.0	Ba.	R	2.75	32.33	23.75	28.04	59
26	American Bronze	Very good	24	42.5	Ba.	R	1.70	26.83	26.87	26.85	58
27	Early Red Clawson	Poor stand	24	40.0	Ba.	R	1.80	20.00	32.91	26 45	54
28	Fulcaster (check),	Medium stand	22	44.5	Be.	R	2.25	32.50			
29	Rural N. Yorker, No. 6	A thin plat	24	39.5	Ba.	R	1.73	20.33	32.29	26.31	52
30	Velvet Chaff	Fair, good color	19	36.0	Be.	R	1.09	23.50	28.33	25.91	58
31	Forty Fold	Good	24	48.0	Ba.	W	2.45	26.50	25.20	25 85	52
32	Rice Wheat	Very fine	19	47.0	Ba.	R	2.43	31.33	19.37	25.85	60
33	Gold Coin	Poor	25	44.0	Ba.	W	1.85	18.83	30.00	24 41	54
34	Winter King	Very good	25	36.5	Ba.	W	1.83	19.16	29.58	24.37	54
35	New Columbia	Excellent	20	40.0	Ba.	R	2.17	27.50	20.60	24.05	56
36	White Wheat, No. 6	Very good	25	37.5	Ba.	W	1.68	18.00	29.37	23.68	52
37	Early Pearl	Rather poor	17	40.0	Ba.	R	1.22	16.66	29.16	22.91	58
38	Eclipse	Fair	24	42.0	Be.	R	1.76	26.33	17.08	21.70	57
39	Democrat	Medium	24	51.0	Be.	W	2.10	25.00	18.33	21.66	55
40	Valley	Very good	24	51.0	Ba.	R	2.45	28.16	13.75	20.95	58
41	Buck Wood's Hybrid	Very good	22	48.0	Ba.	R	1.96	27.00	13.85	20.42	56
42	New Monarch	Very good	24	47.0	Ba.	R	1.77	21.66	16.25	18.95	56
43	Red Cross	A fine plat	24	52.0	Be.	R	3.17	35.00	Only grown one year	Only grown one year	58
44	Fulcaster (check)	A fine plat	22	49.0	Be.	R	2.25	32.50			
45	Hopper	Medium	24	49.0	Be.	R	2.65	25.66			56
46	California Red	Medium	24	47.0	Ba.	R	2.43	24.00			56
47	Diamond Grit	Very good	25	55.0	Be.	R	2.48	20.33			56
48	Turkey Red	Fair	25	47.0	Be.	R	2.76	17.66			51

FIGURE 2 GENERAL VIEW OF WHEAT PLATS, UNIVERSITY FARM

suffer the most. The attack of the Hessian fly was most injurious to Early Red Clawson, Rural New Yorker No 6, Gold Coin, Winter King and White Wheat No 6, and least harmful to Niger, White Golden Cross, Mealey, Beardless Fulcaster, Blue Ridge, etc. While rust was severe on all varieties, it was especially bad on Early Gennessee Giant, Gold Coin, Harvest King, White Wheat No 6, and Turkey Red. The attacks of the rust and fly chiefly account for the lower yields obtained this year. The per cent of grain lodged was very small, being 20 per cent with Turkey Red; 15 per cent with California Red and Hopper; and 10 per cent with Fulcaster and Blue Ridge. The filling out of the wheat was not injured by the lodging.

Fig. 3 Fulcaster

The best yield of grain in 1901 was made by Blue Ridge, 40 bushels. Last year it did not do very well, the yield being 25.41 bushels. The excellent showing made in 1901 was probably effected by its situation, as the plat was so placed as to receive considerable deposit from the higher ground. Kansas Mortgage Lifter followed Blue Ridge with a yield of 36.66 bushels, the yield being three bushels larger than in 1900. Dawson's Golden Chaff was third with a yield of 36.33 bushels; last year the yield was 20.83 bushels. Possibly the wheat was better acclimated this year, and hence the increased yield. Early Ripe was fourth with a yield of 35.50 and Red Cross fifth with a yield of 35 bushels.

The leading variety of last year, Fulcaster, made an average yield of 32.5 bushels. It was grown on four check plats, and thus made a very satisfactory showing. Early Gennessee Giant which stood so well in 1900 went all to pieces in 1901; the rust seemed to effect it very seriously. Owing to the excessive rain during the wheat harvest of 1900, some of the grain sprouted, that of Gennessee Giant being among the number and the seed did not germinate well, accounting partially for the poor yield. Improved Fulcaster, Poole, Improved Poole, Egyptian, Red Prolific, Mediterranean, Red Russian, Beardless Fulcaster and Rice Wheat all made yields of more than 30 bushels to the acre, so that most of the varieties that did well last year, while not making the highest yields this year, made very satisfactory yields all things considered. Averaging the yields of both years together, Fulcaster heads the list with a yield of 37.08, Improved Fulcaster comes second with 36.45, Poole next with 36.01, then Improved Poole, 35.97, Niger, 35.21, Kansas Mortgage Lifter, 35.10 and Mediterranean, 35.05 bushels. The poorest yields in 1901 were made by Turkey Red, White Wheat No 6, Gennessee Giant, Gold Coin, Winter King, Early Red Clawson and Diamond Grit. The lowest yields, the average of two years trial, were made by Valley, Buckwood's Hybrid, New Monarch.

Fig. 4 Improved Fulcaster

Eclipse, Democrat and Early Pearl, varying from 22.91 to 18.95 bushels. Turkey Red wheat which has done so remarkably well in Kansas and other western states, and whose milling qualities are very superior, did not do well last year. It will take it some time to become accustomed to its new habitat and it is possible that it may do better another season, and as it is such a fine variety in the west, it is hoped that it will prove more satisfactory in the future.

Fig. 5 Improved Poole

All things considered to date, Fulcaster, Poole, Mediterranean and Harvest King are among the most satisfactory of the wheats grown and probably are better adapted than any of the others for general culture in the state. They are all fairly hardy varieties, as free from rust as any, possessed of good straw, and equally immune from the attacks of the fly. Fultz is generally accounted an excellent variety but did not do at all well in 1901. THE BEST MILLING WHEATS AMONG ALL THE VARIETIES GROWN TO DATE ARE FULCASTER, NIGER, MEDITERRANEAN, IMPROVED FULCASTER, AND DEITZ AMBER; THE POOREST MILLING VARIETIES ARE WHITE GOLDEN CROSS, EARLY GENNESSEE GIANT AND FULTZ. The importance of securing a variety of wheat well adapted to the climate and soil conditions of the state is strongly emphasized by the results in Table I. Varieties that take kindly to the conditions prevailing in the state will under the same treatment give considerably higher yields than many that are now cultivated. It is important that a careful study be made of the variety question. The yields of bald and bearded wheat were as follows: 13 bald varieties, 31.70 bushels; 26 bearded varieties, 28.18 bushels.

WEIGHT PER MEASURED BUSHEL

Only three varieties equalled and surpassed the standard weight. They were Rice wheat, 60.5 pounds; Egyptian, 60.5 pounds and Mediterranean, 60 pounds. Dietz Amber and Red May weighed 59.5; Fulcaster and Improved Fulcaster, 59 pounds. Turkey Red and White Wheat No 6 only weighed 51 and 52.5 pounds respectively. The weight per measured bushel was not so good as in 1900 and is attributable chiefly to the combined attacks of the fly and rust. On many of the variety plats short strawed small heads were thrown up by injured stools. These produced inferior seed of light weight.

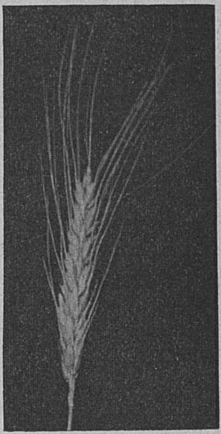


Fig. 6 Niger

FOREIGN VARIETIES OF WHEAT

Experiments were commenced with a number of foreign varieties of wheat in 1900 to determine their adaptability to Tennessee conditions. During the past year a number of other varieties from Japan and Australia were tested. All of these with the exception of three have proved unsatisfactory. The work with foreign wheat will be continued.

IMPROVEMENT OF WHEAT

While the mere testing of varieties of wheat is to be condemned, the introduction of some excellent standard varieties from the several domestic or foreign wheat districts may be productive of satisfactory results and prove more effective than any that might be produced by hybridization. If an introduced variety should prove acceptable, it would save many years of labor and the expenditure of much time and money, and all the well established varieties whose qualities are desirable should first be given a proper trial. Until the variety question has been worked out on some such rational basis, attention should be given to field trials to determine their relative merit and adaptability. Those which have given the most general satisfaction in a particular district, such as Fulcaster, Poole, Fultz, Mediterranean, etc., should be selected and cross-bred with the object of eradicating undesirable qualities and engrafting new and valuable ones. A general classification of wheat with some of the most marked qualities characteristic of each group, follows:

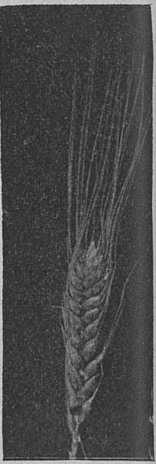


Fig. 7 Early Gennessee Giant

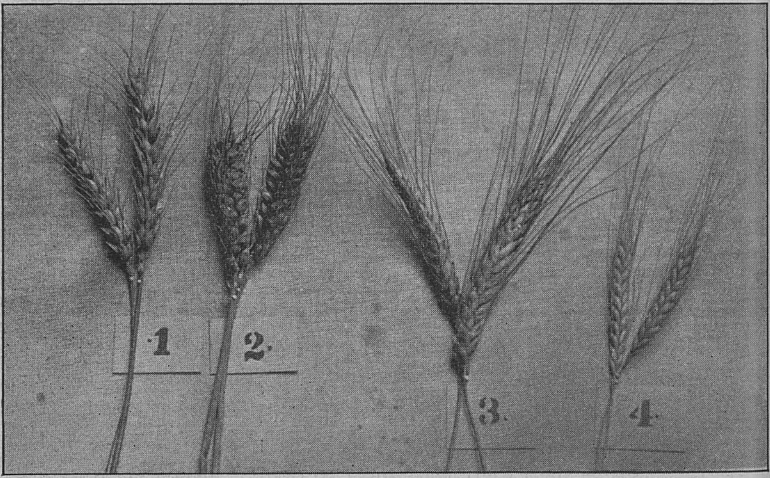


FIGURE 8 FOUR GROUPS OF WINTER WHEAT GROWN AT TENNESSEE EXPERIMENT STATION IN 1901

1 Common Bread—Triticum vulgare
2 Club or Square-head—Triticum compactum
3 Durum—Triticum durum
4 Emmer—Triticum dicoccum

CLASSIFICATION OF WHEATS

Common Bread Wheat	Triticum vulgare	High gluten content for bread making; some varieties yield well, are hardy, mature early and withstand drought
Club or Square-head	Triticum compactum	High yielding power, stiff straw, non-shattering
Poulard	Triticum turgidum	Value for making macaroni; resistance to rust and drought
Durum	Triticum durum	Value for making macaroni and other pastes; resistance to drought and rust.
Polish Wheat	Triticum polonicum	Value for making macaroni; resistance to drought and rust.
Spelt	Triticum spelta	Power to hold the grain in the head; very fertile; hardy
Emmer	Triticum dicoccum	Power to hold the grain in the head; resistance to drought and rust.
Einkorn	Triticum monococcum	Power to hold the grain in the head, resistance to rust, drought and cold; stiff straw

SEED SELECTION Some very gratifying improvements in wheat have been effected by seed selection. Some of the best varieties and those having the widest dissemination have been secured by picking out what are apparently sporting heads of wheat from large fields and "roguing" them until a distinct character of head and grain had been obtained. Some of the best varieties produced in this manner are Fultz, White Clawson, Blue Stem, etc.

It is doubtful if the value of selection has ever been thoroughly worked out. As selection can be practiced by every farmer, the station proposes to lay particular stress on that feature of wheat improvement until definite results have been ascertained for or against the system. By selecting from extra large fine heads with plump grains, good straw and freedom from rust, it may be feasible to engraft as many useful qualities on a variety as can be secured by some other methods.

That our wheat needs to be improved and can be improved are facts apparent to all, and the time has come in the culture of wheat when every farmer must give more attention to the quality of seed he uses. Knowing that some wheats are more rust resistant than others; that some mature earlier, are more vigorous and less subject to the attacks of the fly, and that the character of grain produced varies greatly in quality, there is every reason why improvement should be sought. Probably the best way for the farmer to do this is to sow a small amount of carefully selected seed from choice heads on a well prepared piece of land, selecting the heads again the next year and threshing separately, each year picking those plants that seem to present the qualities sought. The plan may be regarded as impracticable, but the supposition is incorrect. It takes but little time to do the work and in view of the increased yields, the matter should never be neglected. The idea that there is not sufficient time to do it is like innumerable other fancies. It is not time, but the disposition and energy that prevents a matter so important as the improvement of seed wheat being neglected on the average farm.

For general selection from the grain, a series of sieves of a suitable size may be used. Those shown in the accompanying illustration are out of a set of 60 sieves used at the University farm for cleaning all varieties of

TABLE II Showing the Original Method of Seed Selection from Poole Wheat, 1900

Method of Selection Practiced	No. of Grains	Average Number of Grains per		Total Weight of Grain, lbs. and ounces	Character of Grains Planted	No. of Grains per ounce of Seed Sown	Number of* Grains Sown per Plat	
		Head	Ounce				No.	Weight Ounces
1200	......	......	......	......	Large...	636	7632	12.0
Large Heads....	35,412	29.5	736	2.15	Small...	833	7632	9.2
1600	......	......	......	......	Large...	700	7632	10.9
Medium Heads..	25,623	16.1	797	2.03	Small...	967	7632	7.9
3200	......	......	......	......	Large...	803	7632	9.5
Small Heads....	27,643	8.6	909	1.15	Small...	1074	7632	7.1
General Selection								
Large Grains..	......	......	......	......	Large...	636	7632	12.0
Medium Grains	......	......	......	......	Medium.	723	7632	10.6
Small Grains..	......	......	......	......	Small...	1046	7632	7.6

Mediterranean Wheat, 1900

Method of Selection Practiced	No. of Grains	Average Number of Grains per Head	Average Number of Grains per Ounce	Total Weight of Grain, lbs. and ounces	Character of Grains Planted	No. of Grains per ounce of Seed Sown	Number of* Grains Sown per Plat No.	Weight Ounces
1200	......	......	......	......	Large...	567	6804	12.0
Large Heads....	34,412	28.7	641	3.57	Small...	732	6804	9.2
1600	......	......	......	......	Large...	615	6804	11.0
Medium Heads..	25,669	16.1	670	2.63	Small...	764	6804	8.9
3200	......	......	......	......	Large...	658	6804	10.3
Small Heads....	35,525	11.2	765	2.15	Small...	835	6804	8.1
General Selection								
Large Grains..	......	......	......	......	Large...	567	6804	12.0
Medium Grains	......	......	......	......	Medium.	673	6804	10.1
Small Grains..	......	......	......	......	Small...	970	6804	7.0

*The sample bought was treated like the others in every respect.

grain, from peas to the finest grass. Sieve No 1 has 18 meshes to the inch; sieve No 2, four; sieve No 3, 11; and sieve No 4, three. Sieves Nos 2 and 4 were used to obtain the large grains, the medium grains and the small grains shown beside the complete sample in Figure 10. By the use of these two sieves, 50 per cent of the large grains (numbering 625 to the ounce), 30 per cent of the medium grains (numbering 834 per ounce), and 21 per cent of the small grains (numbering 1230 per ounce), were taken from the complete sample as shown in the illustration. By sending to a factory where sieves are manufactured, the necessary sheets can be obtained and the sieves made of any desirable size. They will cost practically nothing and it would take but a few hours on a rainy day to hand sieve all the seeds used on the farm, and from our results it should pay handsomely.

METHOD OF SEED SELECTION AT THE UNIVERSITY FARM

Table II shows the original method of seed selection pursued with Poole and Mediterranean wheats. The same general plan was followed in making selections of large and small grains from large heads, large and small grains from medium heads, and large and small grains from small heads, and a general selection made from a field grown sample of large, medium and small grains, and as a check against all the work, a sample of grain was bought in the open market and sown on check plats. A wonderful variation is shown

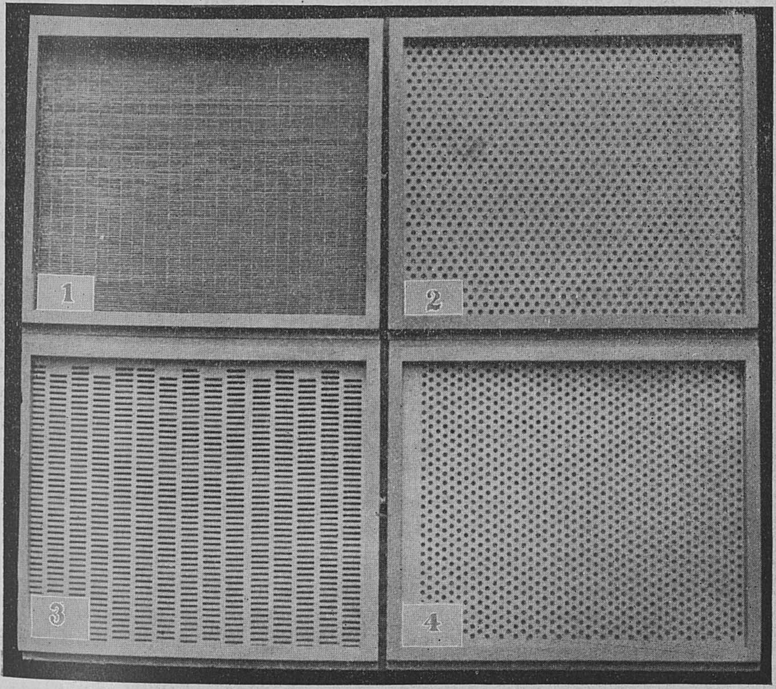


FIGURE 9 SIEVES USED IN MAKING SEED SELECTIONS

in these tables. For example, with Poole wheat, 1200 large heads contained 35,412 grains, 1600 medium heads contained 25,623, and 3200 small heads contained 27,643, an average of 29.5, 16.1 and 8.6 grains per head. It is evident that if by continuous selection from large heads the number of grains in the heads could be increased to 27.8, the yield would be largely increased. The number of grains from large heads required to make an ounce was less than in any of the other selections. The number of grains in an ounce of seed also varied greatly, being largest of course with the small grains and least with the large grains. In order that the experiment might be fair to all selections, a uniform number of seeds was sown on each plat; in the case of Poole, 7632, and 6804 of Mediterranean.

SEED SELECTION WITH MEDITERRANEAN AND POOLE WHEAT

The results of seed selection with Mediterranean and Poole wheat are shown in Tables III and IV. While the tests are not conclusive, owing to the great amount of variation that will naturally prevail in selections until the work is carried on for a longer period of time, some interesting inferences may be drawn. It is observed in both instances that the average of the large grains in all the selections lead. The average of

TABLE III Seed Selection with Mediterranean Wheat, 1901

Plat No.	Method of Selection Practiced	Date of Ripening	Height of Crop in inches	Total weight of Crop per Acre—Lbs.	Yield per Acre of		Yield per Acre of		Ratio of Grain to Straw in Crop—Lbs.	Average Number of Grains	
					Grain—Lbs.	Straw—Lbs.	Grain—Bushels	Straw—Tons		Per Head	Per Oz.
I	*Large Heads.*	June									
1	Large Grains.	24	47.5	6000	1760	4240	29.3	2.12	1:2.41	17.6	712
2	Small Grains.	24	45	4880	1360	3520	22.7	1.76	1:2.59	16.4	787
II	*Med'm Heads*										
1	Large Grains.	24	47	5840	1760	4080	29.3	2.04	1:2.31	19.4	705
2	Small Grains.	24	47	6000	1744	4256	29.0	2.13	1:2.44	18.4	730
III	*Small Heads.*										
1	Large Grains.	24	46.5	6144	1728	4416	28.8	2.21	1:2.55	18.4	760
2	Small Grains.	24	47	5920	1568	4352	26.1	2.18	1:2.78	18.3	750
IV	*Gen'l Select'n*										
1	Large Grains.	24	48	6368	1824	4544	30.4	2.27	1:2.49	19.3	682
2	Med'm Grains	24	46.5	5056	1376	3680	22.9	1.84	1:2.68	16.0	766
3	Small Grains.	24	45.5	5164	1472	3692	24.5	1.85	1:2.51	18.1	732
4	Sample boug't	24	44.5	4480	1360	3120	22.6	1.56	1:2.94	14.7	800

the large grains with Mediterranean was 29.4 bushels; with Poole, 27; the average of the small grains in all selections with Mediterranean was 25.6, and with Poole, 22.6; a difference of about four bushels to the acre in favor of the large grains. The difference between large and small grains from large heads was quite marked and always in favor of the large grains. It is noticeable that the large and small grains from medium heads in both instances gave practically the same results. The most surprising feature was the splendid showing made by large and small grains from small heads which was practically as good in the case of both varieties as the results obtained from the large heads. The sample bought in the case of Mediterranean did only fairly well; in the case of Poole it made a very creditable yield.

The most peculiar feature observed is that the large grains in the general selection made by sifting out the choicest seed by means of hand sieves gave better results than the hand-picked, hand-threshed, and laboriously prepared and carefully preserved samples of the other selections. IT SEEMS EVIDENT FROM THESE RETURNS THAT THE LARGEST AND CHOICEST GRAINS ARE IN THE LARGE HEADS AND SHOULD NATURALLY BE THE BEST NOURISHED AND CONTAIN THE LARGEST SUPPLIES OF PLANT FOOD. If this is true, they should produce the strongest and most vigorous plants. It has been held that a general selection of wheat by means of sieves, as in this instance, would prove unsatisfactory. If future experiments demonstrate in accord with this year's that the largest and plumpest grains are in the large heads and can be selected out by means of sieves, the farmer could very easily and simply improve the yield of his wheat four or more bushels per acre at practically no cost to himself. The question of seed selection and the improvement of wheat strains is one of vital importance to the industry in the southern states, and these experiments will be continued and enlarged from year to year until sufficient data has accumulated to correctly estimate the value and utility of such methods on the average farm. IN THE MEANTIME, WHILE IT WOULD BE UNSAFE TO DRAW ANY DEFINITE CONCLUSIONS, THE INDICATIONS ARE THAT IT WILL CERTAINLY PAY THE FARMER WELL TO GET SOME SMALL SIEVES AT A COST OF A FEW CENTS, SUCH AS ARE SHOWN IN FIGURE 9, AND SOW ONLY THE CHOICEST AND PLUMPEST OF HIS GRAINS OF WHEAT THE COMING YEAR.

TABLE IV Seed Selection with Poole Wheat, 1901

Plat No.	Method of Selection Practiced	Date of Ripening	Height of Crop in inches	Total weight of Crop per Acre—Lbs.	Yield per Acre of		Yield per Acre of		Ratio of Grain to Straw in Crop—Lbs.	Average Number of Grains	
					Grain—Lbs.	Straw—Lbs.	Grain—Bushels	Straw—Tons		Per Head	Per Oz.
I	*Large Heads.*	June									
1	Large Grains.	21	42	4300	1568	2732	26.1	1.37	1:1.78	18.5	852
2	Small Grains.	21	37	3328	992	2336	16.5	1.17	1:2.35	16.9	910
II	*Med'm Heads*										
1	Large Grains.	21	39	4480	1568	2912	26.1	1.46	1:1.85	17.7	905
2	Small Grains.	21	41	4448	1504	2944	25.1	1.47	1:1.95	19.7	861
III	*Small Heads.*										
1	Large Grains	21	43	4960	1680	3280	28.0	1.64	1:1.95	18.6	825
2	Small Grains.	21	42	4928	1440	3479	24.0	1.74	1:2.41	17.6	930
IV	*Gen'l Select'n*										
1	Large Grains.	21	42	5088	1680	3408	28.0	1.70	1:1.95	18.4	825
2	Med'm Grains	21	42	4768	1408	3360	23.5	1.68	1:2.38	16.7	877
3	Small Grains.	21	41	4640	1488	3152	24.8	1.58	1:2.18	17.7	955
4	Sample boug't	21	43	4640	1616	3024	26.9	1.51	1:1.87	19.4	945

FERTILIZER EXPERIMENTS WITH WINTER WHEAT

The fertilizer experiments with winter wheat in 1901 were in part a repetition of those commenced in 1900, the same land and plats being used. On one of the ranges, cowpeas were sown immediately after harvest and plowed under about the 13 of September. The peas made a good growth, being a foot to a foot and a half high, and would probably have yielded one ton of cured hay. The other series was immediately plowed after harvest and summer fallowed. It was frequently worked through the season in order to conserve the moisture and to thoroughly pulverize the soil and render it friable. After the cowpeas were plowed under, the land was immediately rolled and carefully cultivated. Both pieces of land were in excellent me-

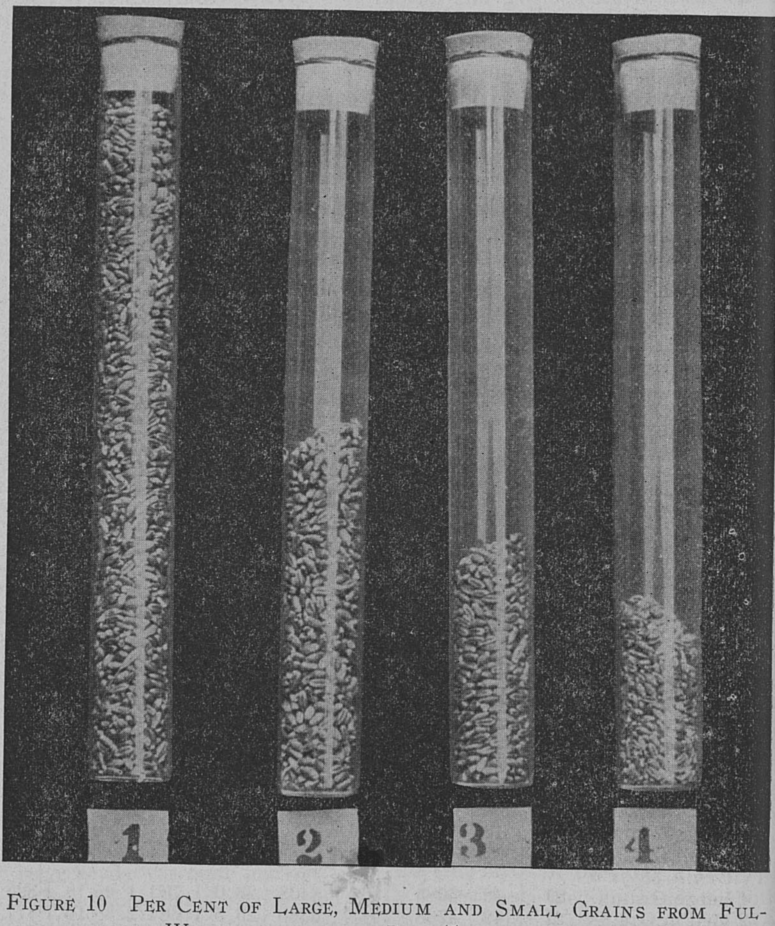


FIGURE 10 PER CENT OF LARGE, MEDIUM AND SMALL GRAINS FROM FULCASTER WHEAT, AFTER BEING RUN THROUGH HAND SIEVES NOS. 3 AND 4, SHOWN IN FIGURE 10

chanical condition at the time of seeding. The fertilizer was applied on October 16, and the wheat sown broadcast on the same day. The fertilizer was distributed over the soil and incorporated by means of a harrow. The variety of wheat used was Fulcaster, and the results of the experiment are presented in Tables V and VI. They are not as markedly in favor of the use of commercial fertilizers as one might suppose. One might reasonably expect the returns from commercial fertilizers to be more pronounced, and their failure to enhance the yields may be attributable to the excellent preparation which the land underwent. The preparation of the soil is a vitally important item in crop production, and the thorough culture which this soil underwent naturally rendered available a very considerable quantity of plant food, which in the case of poor culture would not have been obtainable, so that on a soil in bad physical condition, it is likely the commercial fertilizer would have given relatively better results.

Bare Fallow. Many persons have advocated a single heavy application of fertilizer as compared with the distribution of the same amount over a longer period. In order to determine the status of the question,

APPLYING LARGE AND SMALL AMOUNTS OF FERTILIZERS

large and small amounts of acid phosphate, lime, a complete home-mixed fertilizer, a complete ready-mixed fertilizer, and barnyard manure were compared. In the case of phosphates from Tennessee rock, South Carolina rock and basic slag, 250 pounds were applied in 1900 and 1901 and 500 pounds applied in 1900. Better average results were obtained in every instance from the double application. The lowest cost of a bushel of increase in 1900 was with 250 pounds of basic slag, 47 cents, and in 1901, 38 cents, or an average of 42 cents for both years. The lowest average for both years where a double application was made was with acid phosphate from South Carolina rock, 34 cents. Where 500 pounds were used in a single application the best returns were shown the second year, the lowest cost being with 500 pounds of acid phosphate from Tennessee rock, 27 cents, the average cost per bushel of increase for both years being 48 cents. Fifty bushels of lime at a single application gave an increase of 6.8 bushels the first year and 4.3 the second year, the average cost for the two years being 27 cents. This was the cheapest increase made by the use of a single fertilizer. The danger of using a large amount of fertilizer at one application is clearly shown by the use of 100 bushels of lime. The first year an increase of three bushels was obtained, while the second year there was a loss. As the ground was uniform, the difference could only arise from the injurious effect of so much lime on the soil and the germination of the seed. A moderate application of a home-mixed fertilizer for two years gave better results than a large application of the same fertilizer for one year, the cost of a bushel of increase for both years being 52 cents as against 64 cents in favor of the double application. The results of using light and heavy applications of a complete fertilizer were so unsatisfactory that they are scarcely worth considering, the cost of a bushel of increase being unreasonably high in every instance. With barnyard manure the best results were obtained the first year from the use of five tons, the cost of a bushel of increase being 26 cents. The second year the best returns were secured from the use of 10 tons the first year and five tons the second year, the cost of a bushel of increase being 26 cents and the average for both years 31 cents.

COWPEAS PLOWED UNDER

Where cowpeas were plowed under the results of using the double and single applications of fertilizer are quite evenly divided. With the phosphates the best results were uniformly obtained from the double application; the cost of a bushel of increase with cowpeas plowed under being 17 cents with basic slag, 19 cents with acid phosphate from Tennessee rock, and 20 cents with acid phosphate from South Carolina rock. The heavy single application of a home-mixed complete fertilizer gave the best return and a double application of a complete ready-mixed fertilizer. With barn-

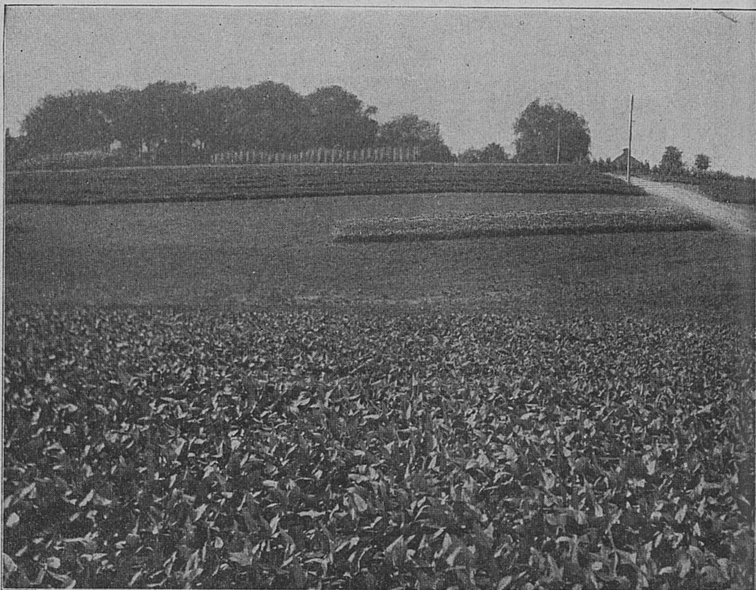


FIGURE 11 COWPEAS AFTER WHEAT

yard manure the best returns were obtained from an application of five tons in both years, the cost of a bushel of increase being 22 cents. When 15 tons were applied the first year, the cost of a bushel of increase was 39 cents, while with 10 and five tons respectively, the first and second year, the cost was 40 cents.

THE INFLUENCE OF NITROGENOUS FERTILIZERS

The use of nitrogenous fertilizers after bare fallow was not satisfactory, the average cost of a bushel of increase for the two years being 97 cents. It might be supposed that nitrate of soda would materially increase the yield of straw, but such has not been the case, the average height and yield of straw being practically the same where nitrate of soda and other fertilizers were used. The average length of straw in both series of plats was excellent and the appearance remarkably uniform, especially where the cowpeas were plowed under. The plowing under of the cowpeas seemed to increase the length of straw slightly but did not produce a weak straw and the crops stood up remarkably well.

INJURY BY HESSIAN FLY The fertilizer plats were apparently not affected by the fly, the best argument that can be adduced to show the importance of having the land in excellent condition and well supplied with plant food. It is hard on any other basis to understand why the fly should attack some of the varieties in contiguous portions of the field and injure them quite seriously and have apparently no effect on the fertilizer ranges.

TABLE V Fertilizer Experiments with Winter Wheat after Bare Fallow 1901

Plat Number	Kind of Fertilizer Used	Pounds of Fertilizer Used per Acre		Length of Straw—inches	Yield per Acre of		Increase from Fertilizer—bushels		Cost of Fertilizer per Acre	Cost of a bushel of increase in		Average of Both Years
		1900	1901		Straw Tons	Grain Bus.	1900	1901		1900	1901	
										$	$	$
1	No Fertilizer	....	....	50.0	1.99	30.8	....	.....		.....	.....	.....
2	Nitrate of Soda	150	150	50.0	2.16	30.7	6.3	.1	$3 00	46	3 00	97
3	Acid Phosphate (Tenn.)	250	250	50.0	2 43	36.7	1.8	5.9	1 50	85	25	39
4	Acid Phosphate (S. C.)	250	250	50.0	2.54	37.9	.8	7.1	1 50	1 78	19	38
5	Basic Slag	250	250	50.5	2.36	35.7	4.0	4.9	1 88	47	38	42
6	Acid Phosphate (Tenn.)	500	....	50.0	2.07	35.2	1.8	4.4	3 00* ......†	1 70	27	48
7	Acid Phosphate (S. C.)	500	....	49.5	2.24	33.7	2.1	2.9	3 00* ......†	1 43	29	60
8	Basic Slag	500	....	48.5	2.28	34.8	3.3	4.0	3 75* ....†	1 12	38	51
9	Muriate of Potash	75	75	47.5	2 28	32.5	6.2	1.7	1 69	27	99	43
10	No Fertilizer	....	....	48.5	2.12	30.8	.....	.....	.....	.....	.....	.....
11	Lime	50 bus.	....	47.5	2.25	34.2	6.8	3.4	2 75* ......†	42	32	27
12	Lime	100 bus.	....	48.0	1 77	28.5	3.0	2.3	5 50* ......†	1 82	.....	7 86
13	Nitrate of Soda Acid Phosphate	75 150	75 150	48.5	2.42	33.5	4.2	2.7	2 40	58	89	68
14	Blood and Bone	225	225	48.5	2.17	31.0	1.2	.2	2 81	2 44	.....	4 01
15	Nitrate of Soda Muriate of Potash	75 37.5	75 37.5	46.5	1.99	26.3	6.5	4.5	2 34	36	.....	2 34
16	Acid Phosphate Muriate of Potash	150 37.5	150 37.5	46.0	2.19	28.9	4.1	1.9	1 74	43	.....	1 58
17	Nitrate of Soda Acid Phosphate Muriate of Potash	50 100 25	100 200 50	47.0	2.27	35.2	8.1	4.4	2 16* 4 33†	27	98	52
18	Nitrate of Soda Acid Phosphate Muriate of Potash	150 300 75	....	46.0	1.91	32.5	8 5	1 7	6 49* ......†	76	1 53	64
19	Complete Fertilizer	150	150	46.0	2.00	30 0	.7	.8	2 10	2 87	.....	5 74
20	Complete Fertilizer	300	150	46.0	1.95	31.0	2 3	.2	4 20* 2 10†	1 83	.....	3 00
21	Complete Fertilizer	450	....	45.0	2.11	31.5	4.6	.7	6 30* .....†	1 37	3 60	1 19
22	Farmyard Manure	5 tons	5 tons	46.0	2.67	34.3	7.7	3.5	2 00* 2 00†	26	57	36
23	Farmyard Manure	10 tons	5 tons	47.0	3.03	38.5	11.7	7.7	4 00* 2 00†	34	26	31
24	Farmyard Manure	15 tons	....	49.0	2.88	36.7	11.2	5.9	6 00* ......†	54	41	35

*1900. †1901.

RESULTS WITH FERTILIZERS ON BARE FALLOW, 1901

No fertilizer on bare fallow gave an average yield of 30.8 bushels in 1901. Comparing other plats with this, it is observed that nitrate of soda and muriate of potash at the rate of 75 and 37.5 pounds, acid phosphate and muriate of potash at the rate of 150 and 37.5 pounds and a complete ready-mixed fertilizer at the rate of 150 pounds, all showed a loss. Uniform gains were made over the returns of 1900 wherever phosphates were applied singly, showing the need of that particular element in Tennessee soils. The increase from phosphates where 250 pounds were used averaged 5.96 bushels, and where 500 pounds were used, 3.76 bushels. In 1900 the average was 2.2 bushels and 2.4 bushels respectively. Fifty pounds of nitrate of soda, 100 pounds of acid phosphate and 25 pounds of muriate of potash gave an increase of 8.1 bushels in 1900 at a cost of 27 cents per bushel. Doubling the amounts of this fertilizer in 1901 resulted in an increase of only 4.4 bushels at a cost of 98 cents, a gain in favor of the lighter and more frequent applications. The complete fertilizer, both home-mixed and ready-mixed, were not so satisfactory on bare fallow as the phosphates alone. The use of barnyard manure produced a large increase, though not as large as in 1900.

COST OF A BUSHEL OF INCREASE ON BARE FALLOW, 1901

The lowest average cost of a bushel of increase for 1901 was 19 cents with 250 pounds of acid phosphate from South Carolina rock; the next was from 250 pounds of acid phosphate from Tennessee rock, 25 cents; and the next, from the use of five tons of barnyard manure, 26 cents. In 1900 the lowest cost of a bushel of increase resulted from the use of a complete home-mixed fertilizer consisting of 50 pounds nitrate of soda, 100 pounds acid phosphate and 25 pounds muriate of potash, 27 cents. Where the use of fertilizer failed to show a gain, the cost of a bushel of increase would be so abnormally high that it has not been worked out. Where an increase was shown, the highest cost was from the use of a complete fertilizer, 450 pounds in 1900, the results of both years corresponding in this particular. Averaging both years, the lowest cost of a bushel of increase was with 50 bushels of lime applied in 1900, 27 cents; the next with 10 tons of barnyard manure in 1900 and five tons in 1901, 31 cents; and the next with 250 pounds of phosphates applied in 1900 and 1901, 34 cents. Barnyard manure at the rate of 15 tons in a single application followed with 35 cents, and barnyard manure at the rate of five tons in 1900 and 1901, 36 cents. IN EVERY INSTANCE THE PHOSPHATES ARE WELL TO THE FORE; MURIATE OF POTASH ALONE HAS NOT SHOWN UP WELL; BLOOD AND BONE HAS BEEN UNSATISFACTORY, AND A SINGLE APPLICATION OF 100 BUSHELS OF LIME, THE SAME. THE COMPLETE READY-MIXED FERTILIZERS WERE UNPROFITABLE, WHILE THE HOME-MIXED COMPLETE FERTILIZERS WERE NOT SO ECONOMICAL AS EITHER THE PHOSPHATES, LIME OR BARNYARD MANURE.

COMMERCIAL FERTILIZERS WITH COWPEAS PLOWED UNDER

The influence of plowing under cowpeas and using the same amounts of commercial fertilizer as on bare fallow is shown in Table VI. A marked increase in the yield of grain is shown. As already mentioned, the cowpeas plowed under would probably have made a ton of hay, which, leaving out the cost of harvesting, and considering the market price at the time of plowing under the crop, would be worth about $8. It seems fair to estimate the uniform increase shown by the plats where the cowpeas were plowed under at five bushels per acre, which at the present price of wheat would about pay for one-half of the peas plowed under. As the influence of the peas will be felt through several years and as it was a catch crop grown between wheat crops, it is likely that future experiments will show that plowing

TABLE VI Fertilizer Experiments with Winter Wheat after Cowpeas Plowed Under, 1901

Plat No.	Kind of Fertilizer Used	Amount of Fertilizer Used per Acre		Length of Straw —Inches	Yield per Acre of		Increase from Fertilizer —Bus.			Cost of Fertilizer per Acre	Cost of a Bushel of Increase with Fertilizer	
		1900	1901		Straw —Tons	Grain —Bus.	1900	1901	And Cowpeas Under		Along 1900-1901	And Cowpeas Under
1	No Fertilizer	.....	.....	51.0	2.89	32.5	.....	.....	.....	.....	.....	.....
2	Nitrate of Soda	150	150	51.5	2.93	35.8	6.3	.1	3.3	$3 00	$ 97	$ 91
3	Acid Phos. (Tenn.)	250	250	51.0	2.89	40.3	1.8	5.9	7.8	1 50	39	19
4	Acid Phos. (S. C.)	250	250	52.0	2.90	40.0	.8	7.1	7.5	1 50	34	20
5	Basic Slag	250	250	51.0	3.10	43.4	4.0	4.9	10.9	1 88	42	17
6	Acid Phos. (Tenn.)	500	.....	52.0	2.81	37.0	1.8	4.4	4.5	3 00* .....†	48	27
7	Acid Phos. (S. C.)	500	.....	52.5	3.08	38.3	2.1	2.9	5.8	3 00* .....†	60	21
8	Basic Slag	500	.....	52.0	3.08	34.8	3.3	4 0	2.3	3 75* .....†	51	65
9	Muriate of Potash	75	75	52 0	2.86	35.3	6.2	1.7	2.8	1 69	43	60
10	No Fertilizer Check	.....	.....	51.0	2.78	32.5	.....	.....	.....	.....	.....	.....
11	Lime	50 bus.	.....	49.5	2.87	39.3	6.8	3.4	6.8	2 75* .....†	27	16
12	Lime	100 bus.	.....	48.5	2.77	37.7	3.0	2.3	5.2	5 50* .....†	7 86	42
13	Nitrate of Soda Acid Phosphate	75 150	75 150	50.5	2.99	43.0	4.2	2.7	10.5	2 40	68	23
14	Blood and Bone	225	225	49.5	2.85	41.8	1.2	.2	9.3	2 81	4 01	30
15	Nitrate of Soda Muriate of Potash	75 37.5	75 37.5	50.0	2.81	43.0	6.5	4.5	10.5	2 34	2 34	22
16	Acid Phosphate Muriate of Potash	150 37.5	150 37.5	50.5	2.94	43.7	4.1	1.9	11.2	1 74	1 58	16
17	Nitrate of Soda Acid Phosphate Muriate of Potash	50 100 25	100 200 50	50.0	2.83	42.5	8.1	4.4	10.0	2 16* 4 33†	52	43
18	Nitrate of Soda Acid Phosphate Muriate of Potash	150 300 50	.....	49.5	2.95	39.2	8.5	1.7	6.7	6 49* .....†	64	39
19	Complete Fertilizer	150	150	49.5	2.90	39.3	.7	.8	6.8	2 10	5 74	31
20	Complete Fertilizer	300	150	49.0	2.89	40.3	2.3	.2	7.8	4 20* 2 10†	3 00	27
21	Complete Fertilizer	450	.....	47.5	2.65	34.2	4.6	.7	1.7	6 30* .....†	1 19	1 48
22	Barnyard Manure	5 tons	5 tons	49.5	2.89	41.8	7.7	3.5	9.3	2 00* 2 00†	36	22
23	Barnyard Manure	10 tons	5 tons	50.0	2.88	37.5	11.7	7.7	5.0	4 00* 2 00†	31	40
24	Barnyard Manure	15 tons	.....	50.0	2.94	38.7	11.2	5.9	6.2	6 00* .....†	35	39

*1900 †1901

under a catch crop of peas will pay. If the peas had not been plowed under, it is certain that the results would not have been so good.

The quality of wheat obtained from the plats was a very superior sample, and if wheat is to be grown continuously, it is absolutely necessary that some return be made to the soil, and CONSIDERING THE RESULTS FROM THE USE OF COMMERCIAL FERTILIZERS, IT IS EVIDENT THAT COWPEAS PLOWED UNDER WILL GIVE LARGER RETURNS FOR THE SAME RELATIVE COST THAN THE COMMERCIAL FERTILIZER ALONE. While it would always seem best to cut off the peas and apply barnyard manure, the same results can hardly be expected from such treatment, and whenever barnyard manure is not available, as it seldom is on the average Tennessee farm by reason of the small number of stock kept, the most economical use that can be made of a catch crop of cowpeas is to convert it into soil humus. It is certain that something must be done, as evidenced by the low average yields of wheat in the state, and all things considered, cowpeas offer the best solution of the problem at the present time.

FIGURE 12 COMMERCIAL FERTILIZERS WITH COWPEAS PLOWED UNDER

COMPARATIVE VALUE OF THE DIFFERENT FERTILIZERS WITH COWPEAS PLOWED UNDER

As would be expected, nitrogen, applied with cowpeas plowed under was unsatisfactory. Phosphates in two applications at the rate of 250 pounds gave excellent returns, though no better apparently where 500 pounds were put on in a single application than on the bare fallow of 1900. Both 50 and 100 bushels of lime showed a splendid increase over the bare fallow. Nitrate of soda and acid phosphate and blood and bone both made a large increase, 10.5 and 9.3 bushels respectively. Nitrate of soda and muriate of potash, and acid phosphate and muriate of potash also made large gains, 10.5 and 11.2 bushels respectively, while nitrate of soda, acid phosphate and muriate of potash, applied at the rate of 100, 200 and 50 pounds, gave an increase of 10 bushels, more than double that shown by the same fertilizer on bare fallow. A complete ready-mixed fertilizer when applied at the rate of 150 pounds in two applications and 300 and 150 pounds in two applications made a fair increase, 6.8 and 7.8 bushels respectively. As these fertilizers, however, and many others fail to show a satisfactory yield on bare fallow and very indifferent yields in 1900, the increase would naturally be credited chiefly to the cowpeas plowed under. Barnyard manure did very well, especially where five tons were applied each year. It would not be expected to make such satisfactory returns with the cowpeas as they supply a sufficiency of humus.

COMPARING THE COST OF A BUSHEL OF INCREASE WITH FERTILIZERS ON BARE FALLOW AND WITH COWPEAS PLOWED UNDER

Comparing the cost of a bushel of grain with fertilizer alone in 1900 and 1901 and with cowpeas under, some interesting returns are found. Bear in mind that in both Tables V and VI where the whole application of fertilizer was made in 1900, 40 per cent has been estimated as available for the crop of 1901 and it is on this basis that the figures presented have been worked out. It is impossible to discuss the results shown in detail but some of the more striking will be considered. It is observed that the lowest cost of a bushel of increase where cowpeas were plowed under was 16 cents with 50 bushels of lime; with acid phosphate and muriate of potash at the rate of 150 and 37.6, 16 cents. It would be expected that acid phosphate and muriate of potash applied with cowpeas would give good results, owing (1) to the apparent need of acid phosphate in Tennessee soils, and (2) to the large supplies of these elements needed by the pea to make its best growth. THE BENEFIT OF PLOWING UNDER PEAS IS THUS CLEARLY DEMONSTRATED, AS THE USE OF LIME ALONE ON BARE FALLOW FOR TWO SEASONS GAVE A BUSHEL OF INCREASE AT A COST OF 27 CENTS, AND ACID PHOSPHATE AND MURIATE OF POTASH AT A COST OF $1.58. Basic slag and acid phosphate at the rate of 250 pounds gave a bushel of increase where cowpeas were plowed under at a cost of 17, 19 and 20 cents, and where bare fallow was pursued for two years, at a cost of 42, 39 and 34 cents, respectively, demonstrating the importance of phosphates generally and especially so where cowpeas are put under. Nitrate of soda and acid phosphate at the rate of 75 and 150 pounds gave a bushel of increase with cowpeas under a cost of 23 cents; on bare fallow, 68 cents. Acid phosphate at the rate of 500 pounds in a single application gave a bushel of increase at a cost of 21 cents and 60 cents respectively; nitrate of soda and muriate of potash at the rate of 75 and 37.5 pounds in two applications, at a cost of 22 cents and $2.34 respectively. A complete ready-mixed fertilizer at the rate of 150 pounds with cowpeas under made a bushel of increase at a cost of 31 cents; on bare fallow, $5.74. Barnyard manure with cowpeas under at the rate of five tons in two applications made a bushel of increase at a cost of 22 cents; on bare fallow, 36 cents; at the rate of 10 and five tons in two applications, the cost was 40 cents and 31 cents respectively. WHERE COWPEAS ARE PLOWED UNDER, IT SEEMS THAT APPLICATIONS OF LIME, PHOSPHATES AND POTASH TOGETHER WILL GIVE THE BEST RESULTS.

The cost of the various fertilizers was practically the same as in 1900. In Tennessee acid phosphate, South Carolina rock and basic slag, four cents is allowed for each available pound of phosphoric acid, making the two former cost $12 per ton and the latter $15 per ton. In muriate of potash available potash is figured at 4½ cents per pound, making this fertilizer cost $45. Lime is figured at 5½ cents per bushel, blood and bone $25 per ton, a complete fertilizer at $28, barnyard manure at 50 cents per load, and a home-mixed fertilizer at the market price of the ingredients. It is evident from the results of the fertilizer tests on bare fallow that many of the fertilizers are too expensive for general use on the farm. For example, acid phosphate, 16 per cent available, ordinarily retails at $16 per ton, though it only costs about $2.75 to secure the rock ready for treatment at the doors of the fertilizer factory. As this is an important and useful ingredient on the farm, it looks as though the fertilizer companies are making a mistake in not placing this substance on a more reasonable basis so the farmers can afford to use it more freely. In fact, if we mistake not, the cost of acid phosphate is higher in Tennessee, notwithstanding the immense amount mined here, than in the states further north. What has been said here of acid phosphate is true of some other fertilizers as well. It is evident that many of the ready-mixed fertilizers as placed on the market are not satisfactory and will not give profitable returns. If the farmer will buy the raw ingredients and mix them himself, satisfactory returns will generally be obtained. There is no secret about mixing fertilizers, and the farmers must buy in carload lots, either individually or by means of co-operative organizations, and defend themselves from imposition and fraud. Artificial fertilizers will pay if used intelligently, if the proper ingredients are obtained. Never pay for reverted or citrate soluble phosphates and other forms of unavailable plant foods that are always incorporated in an analysis of a given sample. The only thing useful to the farmer is available plant food and if he buys that at a fair price, it will often pay him to use it, though he should not indulge very extensively in the use of mixed fertilizers until he has proven that cowpeas plowed under, barnyard manure, lime, phosphates and muriate of potash are ineffectual on his soil.

FERTILIZERS WITH WINTER WHEAT ON IMPOVERISHED SOIL

It has been said that the real influence of fertilizers can not be determined on a soil that has been cultivated in a rotation of crops for a number of years. In order to study the problem intelligently, a series of 1-50 acre plats numbering about 50 were laid off in duplicate on a piece of extremely poor and impoverished soil. The amounts of fertilizer used, together with the yields of straw and grain per acre, and the increase over no fertilizer, etc., are shown in Table VII. The average of all plats on which no fertilizer was plowed under was 19.4 bushels. Many of the fertilizers were unsatisfactory, especially nitrate of soda and cotton seed meal. In the case of cotton seed meal, which is in itself a complete fertilizer though not well balanced, this was probably due to the seed wheat coming too closely in contact with the meal. Cotton seed meal has a very injurious effect on germination, as witnessed on all the plats on which it was used as a fer-

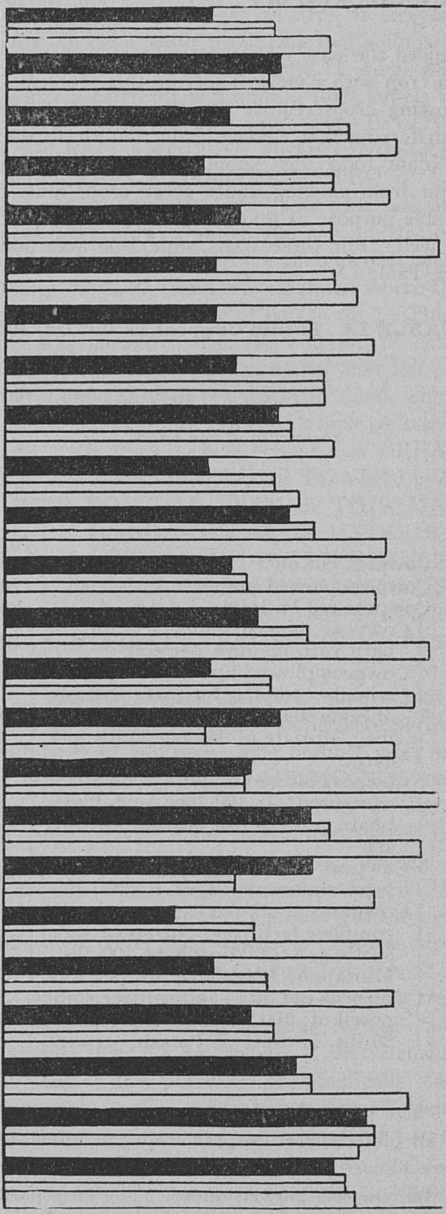
TABLE VII Fertilizers with Winter Wheat on Impoverished Land, 1901

Plat No.	Kind of Fertilizer Used	Amount of Fertilizer used per acre—lbs.	Length of Straw—inches	Yield per Acre of		Increase from Fertilizer, bus.	Cost of Fertilizer per Acre	Cost of 1 Bushel of Increase
				Straw Tons	Grain Bus.			
1	No Fertilizer	......	42.0	.86	19.4	......	......	......
2	Nitrate of Soda	150	43.2	1.05	18.5	.9	$3.00	......
3	Cotton Seed Meal	250	43.0	1.14	19.2	.2	2.75	......
4	Cotton Seed Meal	500	45.5	1.24	20.4	1.0	5.50	$5.50
5	Dried Blood	250	45.5	1.47	22.1	2.7	5.00	1.85
6	Acid Phosphate (Tenn.)	250	43.0	1.37	22.8	3.4	1.50	.44
7	Acid Phosphate (S. C.)	250	43.5	1.16	20.4	1.0	1.50	1.50
8	Basic Slag	250	43.5	1.16	20.4	1.0	1.88	1.88
9	Acid Phosphate (Tenn.)	500	42.5	1.24	23.4	4.0	3.00	.75
10	Acid Phosphate (S. C.)	500	45.0	1.35	23.8	4.4	3.00	.68
11	Basic Slag	500	44.0	1.36	23.3	3.9	3.75	.99
12	Bone Meal	250	44.0	1.27	21.4	2.0	4.12	2.06
13	No Fertilizer	......	44.5	1.27	19.4	......	......	......
14	Muriate of Potash	75	45.0	1.24	21.1	1.7	1.69	.99
15	Kainit	150	44.5	1.23	20.7	1.3	1.65	1.38
16	Lime	25 bu.	45.0	1.24	20.9	1.5	1.38	.92
17	Lime	50 bu.	44.0	1.24	22.5	3.1	2.75	.89
18	Blood and Bone	250	46.0	1.12	19.6	.2	3.12	......
19	Nitrate of Soda Acid Phosphate	75 150	48.0	1.73	26.3	6.9	2.40	.35
20	Nitrate of Soda Muriate of Potash	75 50	48.0	1.57	25.5	6.1	2.63	.43
21	Acid Phosphate Muriate of Potash	150 50	47.0	1.48	23.8	4.4	2.03	.46
22	Nitrate of Soda Acid Phosphate Muriate of Potash	50 100 25	47.0	1.59	25.8	6.4	2.16	.34
23	Nitrate of Soda Acid Phosphate Muriate of Potash	100 200 50	48.0	1.78	31.3	11.9	4.33	.36
24	No Fertilizer	......	46.0	1.53	19.4	......	......	......
25	Ober's Complete Fertili'r	175	46.0	1.33	21.6	2.2	2.10	.95

tilizer, though its effect could probably have been avoided had it been discovered in time. COTTON SEED MEAL, AS WELL AS OTHER FERTILIZERS, SHOULD BE APPLIED QUITE DEEPLY AND ENTIRELY AWAY FROM THE SEED OR THE RESULTS WILL LIKELY BE DISASTROUS. Observing this precaution, it is believed that cotton seed meal will give better returns, and of course it is desirable that it should as it furnishes the cheapest form of organic nitrogen available to the farmer. As a matter of fact, it should first be fed and then returned to the soil in the form of barnyard manure, but if nitrogen has to be purchased, it is the cheapest form obtainable, commercially speaking.

Acid phosphates when used alone at the rate of 250 and 500 pounds were not satisfactory, the increase shown being so slight as to render their use unprofitable. Muriate of potash, kainit, and lime at the rate of 50 bushels are also unprofitable, and blood and bone especially so. Where combinations of nitrate of soda and acid phosphate at the rate of 75 and 150 pounds and nitrate of soda and muriate of potash at the rate of 75 and 50 pounds were made, a large increase was made, being 6.9 and 6.1 bushels respectively. Acid phosphate and muriate of potash at the rate of 100 and 50 pounds made an increase of 4.4 bushels. The complete home-mixed fertilizer at the rate of 50 pounds nitrate of soda, 100 pounds acid phosphate and 25 pounds muriate of potash, and the same combinations when double in amount made a splendid increase, 6.4 and 11.9 bushels respectively. A complete ready-mixed fertilizer was unsatisfactory. The cost of a bushel of increase from the use of fertilizer on impoverished soil was high in every instance, the cheapest being with the complete home-mixed fertilizer, already mentioned, the lighter application costing 34 cents and the heavier, 36 cents. Nitrate of soda and acid phosphate at the rate of 75 and 150 pounds cost 35 cents, and acid phosphate at the rate of 250 pounds, 44 cents. The other applications were all extremely high, some of the phosphates costing $1.88 per bushel of increase, while with bone meal the cost was $2.06. THE ONLY SATISFACTORY FERTILIZERS TO USE ON IMPOVERISHED SOILS, AS SHOWN BY THESE RESULTS, IS A COMPLETE HOME-MIXED FERTILIZER AT THE RATE OF 175 AND 350 POUNDS, PREFERABLY THE SMALLER AMOUNT. One range of the impoverished soil has been already seeded to cowpeas. These will be plowed under in the fall and the same fertilizers applied and the experiment repeated. It is our opinion that the first need of the soil is humus and organic matter and that after a crop of cowpeas has been plowed under more profitable returns will be obtained. In figuring the cost of a bushel of increase the local market prices per ton following were used: Dried blood, $40; cotton seed meal, $22; kainit, $22; bone meal, $33. The cost of the other fertilizers is shown in the discussion under Tables V and VI. THE COMPARATIVE YIELD OF THE VARIOUS FERTILIZERS ON BARE FALLOW IN 1900 AND 1901 AND FERTILIZERS WITH COWPEAS PLOWED UNDER IS SHOWN IN THE GRAPHIC CHART, TABLE VIII. STUDY THE RESULTS CAREFULLY.

TABLE VIII **Graphic Chart Showing the Yield Obtained with Commercial Fertilizers in 1900-1901**



Plat No.	Kind of Fertilizer	Amount per Acre —Lbs.	Yield per Acre—bu.
1	No Fertilizer	....	25.4 30.8 32.5
2	Nitrate of Soda	150	31.7 30.7 35.8
3	Acid Phosphate (Tenn.)	250	27.2 36.7 40.3
4	Acid Phosphate (S. C.)	250	26.3 37.9 40.0
5	Basic Slag	250	29.4 35.7 43.4
6	Acid Phosphate (Tenn.)	500	27.2 35.2 37.0
7	Acid Phosphate (S. C.)	500	27.5 33.7 38.3
8	Basic Slag	500	28.8 34.8 34.8
9	Muriate of Potash	75	31.6 32.5 35.3
10	No Fertilizer	....	25.4 30.8 32.5
11	Lime	50 bus.	31.9 34.2 39.3
12	Lime	100 bus.	28.4 28.5 37.7
13	Nitrate of Soda Acid Phosphate	75 150	29.6 33.5 43.0
14	Blood and Bone	225	26.6 31.0 41.8
15	Nitrate of Soda Muriate of Potash	75 37.5	31.9 26 3 43.0
16	Acid Phosphate Muriate of Potash	150 37.5	29.5 28.9 43.7
17	Nitrate of Soda Acid Phosphate Muriate of Potash	50 100 25	33.5 35.2 42.5
18	Nitrate of Soda Acid Phosphate Muriate of Potash	150 300 75	33.9 32.5 39.2
19	Complete Fertilizer	150	24.7 30.0 39.3
20	Complete Fertilizer	300	27.7 31.0 40.3
21	Complete Fertilizer	450	29.9 31.5 34.2
22	Farmyard Manure	5 tons	33.1 34.3 41.8
23	Farmyard Manure	10 tons	37.1 38.5 37.5
24	Farmyard Manure	15 tons	36.6 36.7 38.7

Legend—Fertilizers on Bare Fallow, 1900 ▬ Fertilizers on Bare Fallow, 1901 ▭ Fertilizers with Cowpeas plowed under, 1901 ▭

SHOULD COWPEAS BE CUT OFF, PLOWED UNDER OR PASTURED OFF

The need of humus in the soils of Tennessee has frequently been referred to, and how to supply it cheaply is a question of practical and momentous importance. An experiment was commenced the past year consisting of various methods of handling the cowpea crop with a view of solving this problem. The most expensive element growing crops require is nitrogen, and as the legumes have the power of transferring that element from the air to the soil and making it available as plant food, they should apparently form the basis by which improvement from plowing under green crops must be attained, as they serve the double purpose of giving a plentiful supply of organic matter and nitrogen as well. For these trials, nine 1-50 acre plats were laid off in duplicate. See Table IX.

TABLE IX Should Cowpeas be Cut Off, Plowed Under or Pastured Off

Plat No.	Treatment of the Land	Date of Ripening	Height of Crop in Inches	Total Weight of Crop per Acre —Lbs.	Yield per Acre of	
					Grain —Bus.	Straw —Tons
		June				
1	Cowpeas cut off	20	46.3	6525	36.8	2.16
2	Cowpeas plowed under	20	47.0	6700	39.7	2.16
3	Cowpeas fed on land	20	44.5	6300	37.0	2.04
4	Cowpeas plowed under + 5 tons of barn yard manure per acre	20	45.7	6380	37.0	2.08
5	Cowpeas plowed under + a "Home-mixed" complete fertilizer: Nitrate of Soda 50 lbs.; Acid Phosphate 100 lbs.; Muriate of Potash 25 lbs. per acre	20	48.3	7185	38.4	2.44
6	Cowpeas plowed under + a fertilizer composed of: 100 lbs. Acid Phosphate, and 25 lbs. Muriate of Potash	20	48.0	7535	40.3	2.56
7	Cowpeas cut off + 5 tons of barn yard manure per acre	20	46.5	6410	40.9	1.98
8	Cowpeas cut off + a "Home-mixed" complete fertilizer: Nitrate of Soda 50 lbs.; Acid Phosphate 100 lbs.; Muriate of Potash 25 lbs. per acre	20	47.5	7510	43.5	2.45
9	Cowpeas cut off + a fertilizer composed of: 100 lbs. Acid Phosphate; 25 lbs. Muriate of Potash per acre	20	45.7	6850	41.8	2.17

The table of yields shows some very interesting results. The average of all plats where cowpeas were cut off was 36.8 bushels; where cowpeas were plowed under, 39.7, a difference of only about three bushels in favor of the cowpeas plowed under. The crop plowed under would undoubtedly have yielded 1.5 tons of hay. At the market price of last season, the hay would be worth $12 to $14 excluding the cost of harvesting, so that plowing under the crop, so far as the results of one year go, practically resulted in the loss of the hay. Cowpeas pastured off gave practically the same results, 37 bushels per acre, but there was a marked difference in the financial returns. On the basis of last year's work, an acre of cowpeas would have maintained a cow for 100 days, while producing two gallons of milk. If the milk were sold at 15 cents per gallon, it would be worth $30. In addition, the crop was not entirely eaten off and quite a little supply of humus, besides the droppings, was added to the soil. THAT COWPEAS SHOULD ALWAYS BE FED AND THE DROPPINGS RETURNED TO THE LAND IS CLEARLY DEMONSTRATED.

Plowing under cowpeas and adding manure at the same time was unsatisfactory. Where the cowpeas were plowed under and a complete fertilizer used, no better returns were obtained than where the cowpeas were plowed under alone, and practically the same result was obtained where the nitrogen was left off and acid phosphate and muriate of potash used. Thus, when a heavy crop of cowpeas was plowed under, the addition of commercial fertilizer was of practically no service, but remember that the experiment was carried on on a fairly good piece of red "mulatto" land, whose previous mechanical texture, it is true, was only fair, but which contained a good supply of plant food. THERE IS A LIKELIHOOD, A GREAT DANGER IN FACT, THAT SOME MAY CONCLUDE THAT PLOWING UNDER COWPEAS DOES NOT PAY. WHILE THIS MAY OCCASIONALLY BE TRUE ON GOOD SOIL, IT IS UNDOUBTEDLY UNTRUE ON POOR SOIL. NEITHER DO THE RESULTS SHOWN IN TABLE IX PROVE THAT IT WILL NOT PAY TO USE COMMERCIAL FERTILIZER WHEN COWPEAS ARE PLOWED UNDER ON POOR SOIL, ESPECIALLY PHOSPHORIC ACID AND MURIATE OF POTASH.

Where cowpeas were cut off and five tons of barnyard manure added, the results obtained were as good as where the cowpeas alone were plowed under and an artificial fertilizer used in addition. The highest yield obtained was where the cowpeas were cut off and a "HOME-MIXED" complete fertilizer used, 43.5 bushels. In reality this was not more profitable than where the cowpeas alone were plowed under when the cost of the fertilizer was considered, $2.16 per acre, the market price of four bushels of wheat at 54 cents. Cowpeas cut off and a fertilizer consisting of 100 pounds of acid phosphate and 25 pounds of muriate of potash gave a yield of 41.8 bushels. This was five bushels better than where the cowpeas were cut off and no other application made. The cost of the fertilizer was $1.20 per acre, so that the profit was slightly more than with the complete fertilizer. As would naturally be expected, the cowpeas being legumes and taking nitrogen from the air should supply a sufficiency of that element. Taking off the cost of the fertilizer which amounts to practically two bushels of wheat at the present market price, the cowpeas plowed under made as good returns as where the acid phosphate and muriate of potash were used in addition.

From the results of one season's work, which must be taken as a guide only until further trials have been conducted, it is evident that the best return was from pasturing cowpeas off on the land, and that the next most economical returns will be secured if the cowpeas are made into hay and the barnyard manure returned to the soil at the rate of five tons per acre. These experiments were made on fairly good land and this will not be true of poor soils or soils deficient in humus. It must not be concluded that it will not pay to use commercial fertilizers along with a crop of cowpeas plowed under. Keep in view the fact that cowpeas plowed under will be effective through a series of years, whereas, on land from which the crop is cut off and on soils treated in other ways, the results may not be so satisfactory in the future. Wheat or barley will be grown on the land next year but no cowpeas will be plowed under; probably the experiment will be continued for several years without plowing under any further crops, and in that way the residual effect of plowing under cowpeas can be ascertained. The disposition of the cowpea crop is one of the vital questions before our farmers. It is almost as valuable as alfalfa, more so than red clover, and is essentially a crop that should be fed and manufactured into beef and milk. But where barnyard manure is not available and where humus and nitrogen are essential in the soil, it will undoubtedly pay to plow under an occasional crop of cowpeas as it is necessary to have humus in the soil at all hazards if success in crop production is expected.

THE YIELD OF WHEAT FROM HOME-GROWN AND IMPORTED SEED

It is generally believed that wheat imported into Tennessee decreases in yield after the first year and that its germinating power becomes gradually impaired by reason of the warmer climate. As this is a matter of very considerable importance, an experiment was undertaken with Fulcaster, Diamond Grit and Dawson's Golden Chaff wheat to determine the true status of the case. See Table X. The wheats ripened between the 22 and 24 of June and the average height of the varieties was nearly normal.

TABLE X The Yield of Wheat from Home Grown and Imported Seed, 1901

Plat No.	Name of Variety Grown	Date of Ripening	Height of Crop—ins.	Total Wt. of Crop per Acre —pounds	Yield per Acre of Grain Bush.	Yield per Acre of Straw Tons
1	Fulcaster, 1st year	June 22	47.5	7190	33.5	2.59
2	Fulcaster, 2nd year	June 22	47.0	7100	35.0	2.50
3	Fulcaster, 1st year	June 22	47.0	6802	33.7	2.39
4	Fulcaster, 2nd year	June 22	47.0	7338	36.3	2.58
5	Diamond Grit, 1st year	June 25	44.0	4396	21.6	1.55
6	Diamond Grit, 2nd year	June 25	44.0	3848	20.8	1.30
7	Dawson's Golden Chaff, 1st year	June 24	38.0	4798	24.3	1.67
8	Dawson's Golden Chaff, *2nd year	June 24	35.0	3494	18.9	1.18

*Dawson's Golden Chaff was badly field grown by reason of the excessive rains in harvest, 1900. This may partly account for the poor yield.

In both trials the Fulcaster wheat grown the second year in Tennessee averaged two bushels higher than the imported seed. With Diamond Grit there was a difference of about one bushel in favor of the imported seed while with Dawson's Golden Chaff there was a difference of 5.4 bushels. As these are the results of a single test, definite conclusions can not be drawn from the experiment. The unfavorable showing made by Diamond Grit is probably due to the variety not being so well adapted to our soil and climate as the Fulcaster. The grain of Dawson's Golden Chaff grew some in the wet harvest season of 1900 and this likely accounts for its poor showing. Looking back over the results of 1900, it is found that this variety stood low on the list, while Fulcaster lead. A difference of two bushels in the yield in favor of Fulcaster grown in Tennessee the second year would amount to a considerable item on an average farm. The experiment will therefore be continued. It is natural to suppose that a wheat adapted to Tennessee conditions will not give the best results the first year, as it has not become thoroughly acclimated and has not had sufficient time to accommodate itself to its new environment.

DATES OF SEEDING WITH WINTER WHEAT

The results of seeding wheat on seven different dates in 1901 is shown in Table XI. The seed was sown on uniform ground of poor quality every 10 days from September 17 to November 15, inclusive. The land received no fertilizer except a very light crop of cowpeas grown after a wheat crop in 1900 plowed under. The height of the crop was practically uniform. The dates of ripening varied somewhat, depending on the date of seeding, though A DIFFERENCE OF 58 DAYS IN SEEDING, FROM SEPTEMBER 17 to NOVEMBER 15, MADE A VARIATION OF BUT SIX DAYS IN THE DATES OF RIPENING, confirming the opinion generally held that the date of planting does not materially influence the date of maturity in the case of wheat. None of the grain lodged, there was practically no smut, but there was a good deal of rust, all of the plants showing about an equal per cent. The first sown plats were seriously injured by the fly, though they stooled out remarkably well, and in the spring there was not much apparent difference in the stand. The difference in the yield is very marked in some instances, and especially so when the dates, September 17 and 24, are compared with October 15 and 25; the extreme difference in the yield between the dates, September 24 and October 25, being 14 bushels. As the land was uniform, the same amount of seed applied and the plats treated exactly alike, the variations observed must be largely attributed to the injury of the fly, and from these results, October 15 to 30 would seem to be the best time for seeding wheat. Last year's results indicated from October

TABLE XI Dates of Seeding with Fulcaster Wheat, 1901

Plat No.	Date of		Height of Crop—ins.	Total Weight of Crop per Acre—lbs.	Yield per Acre of		Ratio of Gain to Straw in Crop—lbs.
	Seeding	Ripening			Grain Bushels	Straw Tons	
1	September 17	June 21	42	4932	25.2	1.71	1 : 2.26
2	September 24	June 21	42	4542	23.7	1.56	1 : 2.09
3	October 4	June 22	43	5442	26.7	1.92	1 : 2.38
4	October 15	June 24	43	5602	30.7	1.88	1 : 2.08
5	October 25	June 24	42	6582	37.7	2.16	1 : 1.91
6	November 5	June 26	42	4282	29.7	1.25	1 : 1.40
7	November 15	June 27	41	5759	32.3	1.91	1 : 1.96

1 to 15, so that the date of seeding must depend on the season, and as the weather can not be forecasted, it is a difficult matter to know when the fall will come early or late. On the whole it is probably safer to defer seeding until October 15 to November 5. IT IS APPARENT THAT THE DATE OF SEEDING WHEAT DETERMINES TO A CONSIDERABLE DEGREE THE AMOUNT OF INJURY DONE BY THE FLY, AND IT IS FURTHER EVIDENT THAT IF WHEAT IS SOWN ON CAREFULLY PREPARED LAND OF GOOD QUALITY WHERE

FIGURE 13 TYPES OF EMMER AND SPELT WHEAT

Photograph secured through the courtesy of Prof. Carleton.

THERE IS AN ABUNDANT SUPPLY OF AVAILABLE FOOD THAT IT WILL STOOL OUT AND IN A MEASURE MAKE UP FOR THE ORIGINAL SHOOTS DESTROYED BY THE FLY. THESE SHOOTS, HOWEVER, WILL NOT BE SO VIGOROUS, NOR WILL THEY FILL SO WELL AS THOSE FIRST THROWN UP.

SPELT AND EMMER WHEAT

A good deal of excitement has been created by the advertisement of a cereal commonly known as Spelt, but which we understand from Prof. Carleton* is really an Emmer wheat. Spelt and Emmer both differ materially from other wheats, and are only used to a limited extent for human food. Spelt is quite as tall as wheat and the heads, as shown in the illustration, are loose, narrow and long. They are either bearded or bald and the grain is held very tightly in the chaff, even after threshing, so that it has something of the appearance of barley. The Spelt is grown chiefly in Germany, Italy and Spain, and is used principally as a stock food, and there are both winter and spring varieties. The true Emmer is grown quite extensively in Russia and Germany. The heads are generally bearded, short, compressed and flattened, and differ materially in appearance from Spelt. This is evident from an examination of the picture showing representatives of these two groups. Emmer, and not Spelt, therefore, is the plant which has been so highly recommended to the farmers of Tennessee. Grown at the experiment station in 1901—seeded October 18, it failed to maintain the general excellence which advertisements have claimed for it. The yield of grain was 1050 pounds per acre; the weight per measured bushel as it came from the machine, 24 pounds. The yield was thus about 43.7 bushels. The yield was not so good as with either winter oats or barley and the grain has but a limited adaptability compared with other cereals. It is not so valuable a stock food as either barley or oats, and as it is not relished by stock when made into hay, it does not seem to be worth much to our farmers. It will be to their interest to avoid paying fancy prices for something whose valuable qualities have been greatly exaggerated. About 75 per cent of the crop grown this year lodged and the yield of straw was about 2.35 tons per acre.

SUMMARY

1 As the result of two years' experiments, the time of seeding wheat varies in Tennessee from October 15 to November 5.

2 The lateness of seeding wheat will not make so much difference if the ground is well prepared and supplied with available plant food.

3. The yield of plats is generally considered too high, but if all the PATHS, constituting one-third of the whole area, are figured in, the average yield of the varieties was 21.16 bushels; of the fertilizers on bare fallow, 21.54; of the fertilizers with cowpeas under, 25.71; of the cowpeas plowed under, 30.56.

4 The Hessian fly injured Early Red Clawson, Rural New Yorker No. 6, Gold Coin, Winter King and White Wheat No 6 most severely.

5 Rust was worst on Early Gennessee Giant, Harvest King, White Wheat No 6 and Turkey Red.

6 In seed selection with Mediterranean and Poole wheat the average yield with large grains was 29.4 and 27 bushels, and with small grains, 25.6 and 22.6 bushels respectively.

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*Cerealist, division of vegetable physiology and pathology, U. S. department of agriculture, Washington, D. C.

7 It seems evident that the largest and choicest grains are in the largest heads and this being true, it will be a great advantage to select out the choicest and plumpest grains by means of hand sieves.

8 The best yielding varieties—the average of two years' trial, are Fulcaster, 37.08; Improved Fulcaster, 36.45; Poole, 36.01; Improved Poole, 35.97; Niger, 35.21; Kansas Mortgage Lifter, 35.10; and Mediterranean, 35.05 bushels.

9 In the fertilizer experiments with winter wheat after bare fallow, 250 pounds of acid phosphate in two applications produced a bushel of increase at a cost of 19 cents; 15 tons of barnyard manure in two applications (10 tons in 1900 and five tons in 1901) at a cost of 26 cents, and 50 bushels of lime in one application in 1900 at a cost of 32 cents.

10 In the fertilizer experiments with winter wheat after cowpeas plowed under, the best results were secured from the application of 50 bushels of lime in 1900 at a cost of 16 cents and 250 pounds of basic slag at a cost of 17 cents.

11 Basic slag and acid phosphates at the rate of 250 pounds gave a bushel of increase where cowpeas were plowed under at a cost of 17, 19 and 20 cents, and where bare fallow was pursued for two years, at an average cost of 42, 39 and 34 cents respectively.

12 In every instance the phosphates are well to the fore; muriate of potash alone has not shown up well; blood and bone has been unsatisfactory, and a single application of 100 bushels of lime, the same. The complete ready-mixed fertilizers were unprofitable, while the home-mixed complete fertilizers were not so economical as either phosphates, lime or barnyard manure.

13 The most satisfactory fertilizer used on impoverished soil was a complete home-mixed fertilizer consisting of 50 pounds nitrate of soda, 100 pounds acid phosphate and 25 pounds muriate of potash.

14 Cowpeas gave the greatest profit when pastured off on the land and next when made into hay.

15 There is a likelihood that some may conclude that plowing under cowpeas does not pay. This may be true on good soil but not on poor land and as the influence of a crop of peas plowed under will be felt for several years, it is too early to draw definite conclusions.

16 The results of using wheat from home-grown and imported seed are not conclusive, though an increase is shown in the second year by the varieties that are known to be well adapted to Tennessee.

17 The damage from Hessian fly was greatest on thin and impoverished land.

18 The so-called Spelt is really an Emmer wheat. It has little utility in Tennessee on account of the greater adaptability of other cereals.