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EXPERIMENTS WITH OATS.

J. F. DUGGAR.

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Experiments With Oats.

BY J. F. DUGGAR.

SUMMARY.

Among a number of varieties of oats tested none was found superior in yield to the common Red Rust Proof oat.

Varieties which produced moderate yields of grains and relatively large amounts of tall fine straw were Myer's Turf and Hatchett's Black. These and related varieties are hardy, and are valuable for grazing and for forage.

In three different experiments Red Rust Proof oats sown in November yielded 7.9, 11.8, and 9.7 bushels per acre more than the same kind of seed sown from February 9 to March 1. The average increase in these three experiments due to fall sowing was 9.8 bushels.

The period between October 1 and November 15 is suggested as the best time for sowing the bulk of the crop of Red Rust Proof oats in central Alabama.

A comparison of cotton seed and cotton seed meal applied both in fall and spring was rendered inconclusive by reason of unfavorable weather.

Cowpea vines, plowed under, increased the yield of oats sown in February to the extent of 10.4 bushels per acre. The yield of fall-sown oats on land where cowpea vines had been plowed under (after 11 bushels of peas per acre had been picked) was 28.6 bushels per acre against 7.1 bushels on a plot previously abandoned to weeds and crab grass, a gain of 21.5 bushels of oats.

The plot on which only the roots and stubble of cowpea vines were plowed under yielded 34.4 bushels of oats per acre

against 9.7 bushels where German millet stubble had been plowed under, an increase of 24.7 bushels of oats per acre. Considering yield of peas and of hay and yield of the succeeding oat crop, it was more profitable to cut cowpeas for hay than to pick the peas and plow under the vines.

Nitrate of soda applied as a top dressing on both fall-sown and spring-sown oats, was most profitable when applied not later than the last of March, or at least 55 days before the grain was mature.

Eighty pounds of nitrate of soda per acre afforded a profit when applied in March. In one experiment this amount of nitrate of soda afforded a yield of 29.3 bushels of oats per acre, while 160 lbs. of nitrate of soda per acre resulted in a yield of 34.1 bushels. This was an increase over the plot receiving no nitrate of soda of 12.9 bushels with the smaller quantity of fertilizer and 17.7 bushels with the larger amount; there was a greater profit on the investment when 80 pounds was employed.

On soil well supplied with vegetable matter, plots receiving 660 lbs. of slaked lime per acre at time of planting yielded more than plots not limed. But slaked lime applied as a top dressing in March on oats growing on sandy land deficient in vegetable matter failed to increase the yield.

In a co-operative fertilizer experiment conducted near Auburn with oats sown in February, drought caused the crop to fail on all plots. The greatest resistance to drought and the largest yields were obtained on the plots receiving kainit.

Scalding seed oats for 10 to 15 minutes in water kept at a temperature of 130 to 135 degrees Fahrenheit effectually prevented smut here. This is a standard, cheap, and effective method of preventing smut, and the saving resulting from this treatment of seed oats is usually 5 to 20 per cent. of the crop, and sometimes more.

VARIETIES.

Several varieties of oats were imported from France, and these were compared in the season of 1896-97 with varieties obtained from T. W. Wood & Sons, Richmond, Va., and with

home grown oats of the Red Rust Proof variety. Nearly all of the varieties from France were evidently spring oats and these proved too tender for fall sowing in this latitude. Winter killing of from one-third to two-thirds of the plants on these plots was the cause of the low yields. One foreign variety, Gray Winter, proved hardy, and for two years it has kept a rather high rank among the varieties tested. All varieties, except the Naked or Hull-less, were sown at the rate of 44 pounds of seed per acre.

The eleventh-acre plots were arranged in two series, side by side, Plot 10 being opposite and near Plot 1, Plot 18 opposite Plot 9, and so on. The field, which embraced a hill-top on which there was a deep sandy, poor soil, produced a crop of cotton in 1896. The plots seemed to be of the same fertility, but the yields of the check plots of Red Rust Proof oats suggest that there was a gradual decline in the fertility from Plot 1 to 9 and from Plot 10 to 18.

Varieties of oats sown November 16, 1896.

Plot No.	VARIETY	SEED FROM	YIELD PER ACRE		Percent. Grain
			Straw	Grain	
			Lbs.	*Bus.*	
1	Red Rust Proof	Ala. Expt. Station	888	23.6	46
*3	Red Rust Proof	Ala. Expt. Station	901	19.7	41
*6	Red Rust Proof	Ala. Expt. Station	744	16.1	41
7	Hull-less Oats	France	653	4.4	18
8	Giant White Abundance	T. W. Wood & Sons, Va.	321	3.1	26
9	White Hungarian	France	603	2.8	14
10	Yellow Giant	France	1,019	5.4	14
11	Hatchett's Black	T. W. Wood & Sons, Va.	1,219	17.7	32
12	Red Rust Proof	Ala Expt. Station	1,074	29.7	47
13	Gray Winter	France	1,354	18.4	30
14	Beardless	T. W. Wood & Sons, Va	802	14.9	38
15	Red Rust Proof	Ala. Expt. Station	892	23.5	46
16	Red Rust Proof	T. W. Wood & Sons, Va	879	20.3	43
17	Early Siberian	France	939	9.9	24
18	Virginia Gray	T. W. Wood & Sons, Va.	1,317	28.8	40

In this test Virginia Gray and Red Rust Proof stand first in yield of grain.

* The plots not represented in the above table formed part of another experiment.

Seed of some of the above mentioned varieties was saved and sown November 6, 1897, together with a few additional varieties. In the same field was also a test of productiveness of a "spring strain" against a "fall strain" of Red Rust Proof oats. Both strains were originally from the same source, the only difference being that the seed for Plots 10 and 13 were from a crop sown in February, 1897, the "fall strain" from a crop sown in November, 1896.

Varieties of oats sown November 6, 1897.

Plot No.	VARIETY	SEED FROM	YIELD PER ACRE		Per Ct. Grain
			Straw	Grain	
			Lbs.	*Bus.*	
1	Delaware Winter...	Delaware, crop of '96..	783	10.6	30.4
2	Virginia Gray.....	T. W. Wood & Sons, Va.	924	13.9	31.5
3	Virginia Gray.....	* Ala. Expt. Station....	1,071	15.7	32.
4	Red Rust Proof.....	Ala. Expt. Station.....	1,800	30.8	41.3
5	Myer's Turf.....	Miss. Expt. Station.....	1,456	15.4	25.3
6	Gray Winter.....	† Ala. Expt. Station...	1,476	19.5	29.7
7	Hatchett's Black...	* Ala. Expt. Station...	1,057	20.8	38.7
8	Beardless	* Ala. Expt. Station...	1,155	27.1	42 9
9	Early Siberian.....	* Ala. Expt. Station...	1,129	13.9	28.5
10	Red Rust Proof (spring strain)	Ala. Expt. Station.....	936	27 0	48.
11	Red Rust Proof (fall strain)	Ala. Expt. Station.....	1,122	21.7	38.1
12.	Red Rust Proof (fall strain)	Ala. Expt. Station ...	978	28.8	48.5
13	Red Rust Proof (spring strain)	Ala. Expt. Station.....	1,055	30.3	47.9

In this test the Red Rust Proof variety leads in the production of grain, closely followed by Beardless; Hatchett's Black and Gray Winter rank next. If we omit Plot 11, the figures for which are shown by the low percentage of grain to be abnormal or erroneous, there is no material difference between the "spring strain" and "fall strain" of Red Rust Proof oats. This practical equality occurred in a mild winter, during which no oats of this variety were at all injured by cold on the farm of this experiment station. Possibly in a severe winter the results would be different.

* Originally from T. W. Wood & Sons, Richmond, Va.; seed grown in Alabama only one year.

† Originally from France; seed grown in Alabama only one year.

February 17, seven varieties of oats named in the table below were sown on "branch bottom land." On account of inequalities in the soil, causing poor and irregular growth over nearly all plots, except on a small strip at the east end of each, only this small measured portion of each plot was harvested. This vitiates the experiment somewhat, the yields in the following tables representing only the best portions of each plot:

Varieties of oats sown February 17, 1898.

Plot No.	VARIETY.	SEED FROM	YIELD PER ACRE		Percent Grain.
			Straw	Grain	
			Lbs.	*Bus.*	
1	May	Opelika, Ala.	1790	35.9	39.9
2	Red Rust Proof	Ala. Expt. Sta.	1149	23.4	39.6
3	Burt	Miss. Expt. Sta.	1658	41.4	41.7
4	Virginia Gray	*Ala. Expt. Sta.	472	5.2	26.4
5	Red Rust Proof	Ala. Expt. Sta.	1403	37.8	46.3
6	Myer's Turf	Miss. Expt. Sta.	907	5.7	16.6
7	Blk. Belgian Winter	France	.....	**	.....
8	Black Mesdag	France	1046	6.2	15.9

In this test of "spring-sown" oats Burt was most productive, followed by May and Red Rust Proof. The winter varieties failed, one winter variety maturing no grain at all.

What is the Best Variety of Oats?

It seems that there is no one variety best for all conditions. The Red Rust Proof is the only one in the list tested by us which is worthy of the name of a "general purpose" oat in this locality. It can be sown both in fall and in late winter in this latitude. It is generally not greatly injured by rust, but is rust resistant rather than rust proof. The straw is short, an objection on very poor or stony land, since short straw means loss in harvesting. The height of straw can be increased by the liberal use of nitrogenous fertilizers, such as cotton seed, cotton seed meal, and nitrate of soda.

*Originally from T. W. Wood & Sons, Richmond Va.; seed grown in Alabama only one year.

**Failed to produce seed when sown in February.

In hardiness or resistance to winter killing Red Rust Proof is surpassed by the group of varieties embracing Myer's Turf, Virginia Gray, Delaware Winter, and Gray Winter. All these "grazing oats" are nearly or quite identical in most qualities, though apparently differing among themselves in productiveness. All are hardy, have tall fine straw, a low percentage of grain and a long season of growth. Two varieties of this group have proved totally unfit for sowing in February. Varieties of this type are preferred for grazing or forage.

For sowing after Christmas the choice is between Red Rust Proof and Burt or May, the last two as grown here appearing to be identical.

The Red Rust Proof is in most general repute, but some farmers prefer the Burt.

As to the relative productiveness of Red Rust Proof and Burt, the latter stood first in the experiment noted above, and in a test of the two varieties made in the spring of 1896; in that test unfavorable weather and late sowing caused both varieties to fail, Burt yielding 9.4 bushels per acre and Red Rust Proof only 7.8 bushels. Additional evidence is needed before we can be sure that there is any material difference in the productiveness of these two varieties sown after Christmas.

In time of ripening Burt and its equivalent (May) are earlier than the Red Rust Proof. Here Burt matured one to two weeks before Red Rust Proof sown at the same date in spring and only one to three days later than fall sown Red Rust Proof oats. The latter variety matured 12 to 19 days earlier when sown in November than when sown in February. Myer's Turf, Virginia Gray, and Gray Winter were ten to twelve days later in maturing than Red Rust Proof sown at the same date in the fall. Hatchett's Black, a hardy and moderately productive variety, matures between Red Rust Proof and Myer's Turf.

Where a large oat crop is grown it is advantageous to avoid having the entire crop ripen at once. This is an argument in favor of sowing several varieties.

TIME OF SOWING.

November 16, 1896, Red Rust Proof oats were sown on two plots on very poor, sandy soil, which had produced a crop of cotton in 1896. Lying between these two plots was another which was not sown until the first of the following March. In each case Red Rust Proof oats, at the rate of 44 pounds per acre, were sown broadcast on the plowed ground and covered with a cultivator. The fertilizer was applied at the time of planting in each case, and was worked into the soil with a smoothing harrow. The fertilizer was applied at the same rate on each of the three plots, viz:

33 lbs. muriate of potash per acre.
110 lbs. cottonseed meal per acre.
198 lbs. acid phosphate per acre.

Total, 341 lbs. per acre.

Although the November sowing occurred later than was desirable, the plants of the Red Rust Proof variety sown at this time were not appreciably damaged by cold. The fall-sown oats were ripe May 31, the spring-sown oats June 12, a difference of 12 days in time of harvesting.

Fall-sown vs. spring-sown oats.

Plot.	DATE OF SOWING	YIELD PER ACRE	
		Straw	Grain
		Lbs.	*Bu.*
1	November 16, 1896	888	23.6
2	March 1, 1897	587	13.8
3	November 16, 1896	901	19.7
Av. 1 & 3	November 16, 1896	895	21.7
Gain from fall sowing		308	7.9

In this case there was a gain of 7.9 bushels per acre, or 57% in favor of fall-sowing, even when the date of sowing was delayed until the middle of November to allow time for gathering the preceding cotton crop.

November 23, 1897, on soil somewhat similar to that on

which the preceding experiment was made, Red Rust Proof oats were sown on one plot and an adjoining plot was left to be sown late in the winter.

February 9, 1898, this second plot was sown, all conditions of preparation, amount of seed, and fertilizer, being identical on the two plots. On each plot the fertilizer was applied at the same time as the seed, in November and February respectively.

The fertilizer consisted of;

160 lbs. acid phosphate per acre.
160 lbs. cotton seed meal "
40 lbs. muriate of potash "

Total, 360 lbs.

The yield was 18.2 bushels per acre on the fall-sown plots, and 6.4 bushels per acre on the plot sown in February.

The extremely dry weather of the latter part of the spring injured the crop on both plots, but its effects were most severely felt by spring sown oats, which being 19 days later in maturing were cut short by the continuous drought. In ordinary seasons, or on soil better supplied with moisture, there would doubtless have been less difference in yield.

Another test bearing on this subject was made in 1897-98. This was made on better land than that used in the preceding experiment.

As before, all conditions on both plots were made equal except that one plot was sown November 26, and the other February 9.

The yield was 23.8 bushels per acre with the fall sown oats and 14.1 bushels with Red Rust Proof oats sown in February, a gain of 9.7 bushels per acre as the result of sowing in the fall.

The results for all three experiments just mentioned are brought together in the following table:

Average results of fall-sown vs. spring-sown oats.

DATE OF SOWING	Percent. grain in sheaf oats	Yield of grain per acre	Yield of straw per acre	Increase of grain from fall sowing
Experiment No. 1.	*Percent.*	*Bus.*	*Lbs.*	*Bus.*
November 18, 1896..	45	21.7	895	**7.9**
March 1, 1897	43	13.8	587	
Experiment No. 2.				
November 23, 1897.	38	18.2	958	**11.8**
February 9, 1898..	47	6.4	228	
Experiment No. 3.				
November 26, 1897	43	23.8	994	**9.7**
February 9, 1898	51	14.1	440	
Averages.				
Sown in November	42	21.2	949	**9.8**
Sown in February and March	47	11.4	418	

The averages in the above table show that oats sown in November were more productive than those sown February 9–March 1 to the extent of 9.8 bushels of grain and 531 pounds of straw per acre.

In 100 pounds of unthreshed oats there was 47 pounds of grain with spring sowing, and only 42 with fall sowing, a difference due to the extra height of straw of fall-sown oats.

The average date of harvesting the Red Rust Proof variety was May 26 when sown in November, and June 11 when sown in February or early March. This difference of 16 days in time of maturing renders fall oats less liable to suffer from drought or other unfavorable weather conditions.

It is almost universally admitted that throughout the greater part of Alabama oats sown in the fall afford larger yields than do "spring-sown oats"—by which term is meant oats sown any time in the latter half of winter or in early spring.

And yet the proportion of fall-sown oats is unfortunately small. The chief causes for the failure of farmers to sow large areas of fall oats are two; (1) depredations of live stock which are so generally allowed to run at large in winter, and (2) the fear that fall oats may be winter killed.

The remedy for the depredations of stock is obvious, although its discussion is not in place here. Moreover, on many farms there are enclosed fields from which all stock can be easily excluded.

The danger of winter killing is usually overestimated and the losses from this cause can be reduced by choosing the best date for sowing. Moreover, oats sown in January or February also run some degree of the same risk, though less frequently killed than oats sown from Nov. 15 to Dec. 15.

Several instances are in mind where in this vicinity both spring-sown and fall-sown oats were killed on the same field during the same winter, the latter having been planted in January or February, after the fall oats had been destroyed.

As intimated above, winter killing of oats is sometimes due to sowing at the wrong time in the fall. The farmer who, in this latitude, is just beginning to sow oats when Thanksgiving Day comes, a case not uncommon, is inviting this danger.

To withstand the alternate freezes and thawings of winter, oats should be sown early enough to develop a strong root system before cold weather. On the other hand, it occasionally happens that Red Rust Proof oats are sown so early in the fall that on rich land they throw up seed heads before the cold weather of early spring has passed, and in this "booting" stage they are very susceptible to injury from cold. It is impossible to name any date as absolutely the best for sowing, since this varies with different localities, with different soils in the same locality, and even with different seasons.

Observation indicates that in the central part of Alabama it is advisable to sow the bulk of the crop of Red Rust Proof oats between October 1 and November 15. These dates are not set as extreme limits even for the Red Rust Proof variety. Hardier varieties, as Turf, Virginia Gray, etc., may be sown earlier. The attempt to grow spring-sown oats on poor land has brought frequent failure and has done much to discourage the culture of oats in the South. If spring-sown oats are to be produced at a profit, they must have good land, and especially they need low lying fields that are comparatively drought

proof. Of course fall-sown oats succeed best also on rich land, but these can often be produced at a profit on land too poor to afford a profitable crop of spring oats.

Even if fall oats should be completely winter killed one year in three, the two remaining crops of fall oats, according to our experiments and observations, would afford more profit than three crops of spring oats. Another consideration in favor of fall oats is the fact that the winter growiug vegetation tends to prevent injurious leaching of the valuable nitrates from the soil. This is especially important on rich soils.

That spring sowing is more convenient in some respects is a fact not to be ignored. For example, it permits oats to follow cotton, a crop which is not usually removed in time for oats to be sown at the favorable period in the fall. This objection to fall sowing may be overcome by adopting a rotation in which oats follow corn, thus:

First year, cotton;
Second year, corn;
Third year, fall-sown oats, followed by cowpeas;
Fourth year, cotton again.

Or where a larger proportion of cotton and a smaller proportion of the other crops is desired, cotton might be the crop during the first and second years of the rotation, followed by corn, which in the fourth year is followed by oats (or other small grain) and cowpeas.

Both the above named rotations allow the oats to be sown in the fall, the corn crop being easily removed in time for this.

Cotton Seed and Cotton Seed Meal as Fertilizers for Oats.

In order to compare cotton seed with cotton seed meal, and to note the effects of each when applied in fall and in spring, the following experiment was made. November 17, 1897, on poor sandy land, five plots of Red Rust Proof oats were sown. All plots on that date were fertilized with 200 lbs. of acid phosphate and 30 lbs. of muriate of potash per acre, a combination which for brevity may be designated "mixed minerals." In addition two plots received 472 lbs.

per acre of cotton seed, and another plot received 200 lbs. per acre of cotton seed meal. The cotton seed, as well as the meal and mineral fertilizers were harrowed in.

March 4, a top dressing of 472 pounds of cotton seed per acre was applied to another plot and 200 pounds per acre of cotton seed meal was sown broadcast on yet another plot. Fertilizers applied in spring were not harrowed in.

The oats were cut May 23.

Results of applying cottonseed and cottonseed meal to oats in fall and spring.

NITROGENOUS FERTILIZER PER ACRE	When applied	YIELD PER ACRE	
		Grain	Straw
		Bus.	*Lbs.*
472 lbs. cottonseed (av. 2 plots)	Nov. 17	15.7	834
200 lbs. cottonseed meal	Nov. 17	17.8	969
472 lbs. cottonseed	March 4	14.5	730
200 lbs. cottonseed meal	March 4	14.2	775

Positive conclusions are not warranted because all plots in this sandy field were so severely injured by drought.

It can scarcely be doubted that under normal conditions cottonseed can be more profitably applied to oats in fall than as a top dressing in spring.

Observation, not however founded upon exact experiment, leads to the belief that the same is true for cottonseed meal.

An experiment comparing cottonseed, cottonseed meal, and nitrate of soda as fertilizers for spring oats was begun in 1896, but the general failure of spring-sown oats rendered valueless the data obtained in this test, as also that of experiments relative to thickness of seeding and to effects of different phosphates on oats.

Cowpeas and Velvet Beans as Fertilizers for Oats.

On sandy soil in 1896 several plots were sown broadcast with the Wonderful variety of cowpeas, and an adjacent plot was sown broadcast with German millet. The German millet was plowed under, as was also the peavines, the peas having been previously picked.

February 18, 1897, Red Rust Proof oats were sown after the above mentioned crops, using in both cases 100 pounds of acid phosphate and 80 pounds of nitrate of soda per acre.

After cowpeas the oat straw grew to be three to four inches taller than on the plot preceded by German millet. The yields were as follows:

Oats following cowpeas and German millet, 1897.

	YIELD PER ACRE	
	Grain	Straw
	Bus.	*Lbs.*
Oats after cowpeas, vines plowed under	22.8	788
Oats after German millet, plowed under	12.4	559
Difference per acre	10.4	229

In this case cowpeas were more valuable than German millet as fertilizer for the following oat crop, the difference in favor of cowpeas being 10.4 bushels of oats per acre and 229 pounds of straw.

An experiment to ascertain the manurial values of cowpeas and velvet beans, and to compare the relative fertilizer value of the entire vines with that of the roots and stubble of both plants, was begun in 1897. May 14, 1897, on poor sandy soil Wonderful cowpeas were sown on two plots, velvet beans (a leguminous plant closely related to cowpeas), on two plots, and German millet on a fifth plot. A sixth plot was prepared and fertilized but left without seed, to grow up in crab grass, poverty weed, etc. Cowpeas and velvet beans were sown in drills two feet apart, German millet broadcast. The millet was cut for hay July 16, yielding 994 pounds per acre. The cowpeas on one plot were picked September 10, yielding 11 bushels per acre.

The velvet beans did not mature seed.

In September, 1897, cowpeas on one plot and velvet beans on one plot were cut for hay and the stubble plowed under. The vines of cowpeas on one plot and of velvet beans on another were also plowed under on the above mentioned date. Then oats were sown at a uniform rate on all four plots, also

on the plot where German millet stubble had been plowed under and on the one where crab grass and various weeds had just been buried by the plow.

On all plots oats were fertilized with 220 pounds per acre of acid phosphate and 44 pounds of muriate of potash, no nitrogen being supplied except that contained in the remains of preceding crops of cowpeas, velvet beans, etc.

Yield per acre of oats grown after stubble or vines of cowpeas, velvet beans, etc.

Plot No.		YIELD PER ACRE	
		Grain	Straw
		Bus.	*Lbs.*
1	Oats after velvet bean vines	28.6	1206
6	Oats after velvet bean stubble	38.7	1672
	Average after velvet bean vines and stubble	**33.6**	**1439**
4	Oats after cowpea vines	28.8	1463
3	Oats after cowpea stubble	34.4	2013
	Average after cowpea vines and stubble	**31.6**	**1738**
2	Oats after crab grass and weeds	7.1	231
5	Oats after German millet	9.7	361
	Average, after non-leguminous plants	**8.4**	**296**

From early spring there was a marked difference in the appearance of the several plots, the plants being much greener and taller where either the stubble or vines of cowpeas had been plowed under.

When the oats began to tiller, or branch, the difference increased, the plants supplied with nitrogen, through the decay of the stubble or vines of cowpeas and velvet beans, tillering freely and growing much taller than the plants following German millet or crab grass.

May 18, 1898, oats on all plots were cut.

In this experiment the average yield of oats was 33.6 bushels after velvet beans, 31.6 bushels after cowpeas, and only 8.4 bushels after non-leguminous plants (crab-grass, weeds and German millet).

Here is a gain of 24.2 bushels of oats and nearly three-fourths of a ton of straw as a result of growing leguminous or

soil-improving plants, instead of non-leguminous plants, during the preceding season.

Undoubtedly this is an extreme, and not an average, case. If cottonseed meal, or other nitrogenous fertilizer, had been used on all the plots of oats, the plants on plots 2 and 5 would have made much better growth, and the difference in favor of the leguminous plants would have been reduced.

A gain of five to fifteen bushels of oats per acre as a result of plowing under cowpea stubble or vines would make the growing of cowpeas for fertilizer a profitable operation, and it is far safer to count on such an increase as that obtained in our first experiment, (10.4 bushels), rather than to expect such an exceptional increase as that obtained in this last experiment.

An unexpected result of this experiment is the larger crop on the plots where only the stubble was left than on those where the vines of cowpeas and velvet beans were plowed under. The plots were of nearly uniform fertility, as judged by the location and by the uniform growth of cotton on all plots in 1896. While admitting the possibility that the two west plots (plots 3 and 6) were slightly richer than the two on the east (plots 1 and 4), the writer thinks that the difference in yield was almost wholly due (1) to the fact that the vines (especially those of the velvet beans) were not properly buried by the small plow employed, and (2) that the seed bed for oats was more compact where only stubble was plowed under, a point of advantage, doubtless, in such a dry winter as that of 1897–98. It does not follow that the land will be permanently benefited by a cowpea stubble to a greater extent than by cowpea vines. The reverse is probably true. The effect of both stubble and vines on late corn, following oats, is now being determined. It is usually more profitable, where many head of live stock are kept, to save the cowpea hay and plow under only the stubble than to pick the peas and plow under the vines.

Time of Applying Nitrate of Soda.

Nitrate of soda is valuable for its nitrogen, of which it contains about 16 per cent. Nitrogen in this form usually

costs somewhat more per pound than in the form of cotton-seed meal. Nitrate of soda is more quickly available than cottonseed meal, and hence finds its most appropiate use on vegetable or other crops in which quick growth is desired. In Europe it is also extensively used on field crops, especially as a top dressing in spring for small grain. Scattered over growing grain in the spring it does not need to be worked into the soil, but if the soil is damp a top dressing of nitrate of soda is quickly diffused. Its favorable effect may often be seen in a week in the deeper green and accelerated growth of the plants.

Three series of experiments, two with fall sown oats, and one with spring oats, were made here to determine the best time of applying nitrate of soda.

On Red Rust Proof oats sown in the fall on sandy upland nitrate of soda, at the rate of 80 lbs. per acre was applied, broadcast at several different dates in the spring of 1896. In addition to the nitrate of soda, a complete fertilizer containing cotton seed meal had been used at time of sowing.

The dates of application and condition of soil and plants at the several dates follow:

March 28.—Oats well branched, some leaves 6 inches long, soil rather moist, rain a few days after fertilizer was applied.

April 21.—Plants beginning to throw up seed stems, land very dry and no rain fell until eight days after fertilizer was used.

April 30.—Plants beginning to head, soil moist, rain on preceding night and also on the second day after the application of the nitrate of soda.

May 12.—Heads open on all plants, soil very dry; a shower fell two days later.

The grain on all plots, which were one-tenth acre in size, was harvested May 27.

The results are given in the following table:

Time of applying nitrate of soda on fall sown oats, 1896.

80 LBS. NITRATE OF SODA PER ACRE APPLIED	No. of days before harvest	YIELD PER ACRE		Increase per acre from nitrate
		Grain	Straw	
		Bus.	*Lbs.*	*Bus.*
No nitrate of soda (av. 2 plots)		16.4	590	
March 28 (av. 2 plots)	60	29.3	923	12.9
April 21 (av. 2 plots)	35	19.1	680	2.7
April 30 (av. 2 plots)	27	21	886	4.6
May 12 (1 plot)	15	20.7	747	4.3
One-half on March 28 One-half on April 30	60 27	23.5	939	7.1

The largest average yield, 29.3 bushels per acre, was obtained by applying 80 pounds per acre of nitrate of soda March 28.

Here the increase per acre attributed to $2 worth of nitrate of soda was 12.9 bushels, worth at 40 cents per bushel $5.16, leaving a net profit of $3.16 per acre from the use of this fertilizer at this date. A profit was also obtained by applying 40 pounds of nitrate of soda March 28 and an equal quantity April 30. The yield was less, however, than when the entire amount was applied March 28.

Nitrate of soda applied under very unfavorable conditions April 21 brought financial loss. Later applications, although under rather favorable soil conditions, were unprofitable.

The preceding experiment was in its essential points repeated in 1897–98. Red Rust Proof oats were sown on four plots on a reddish loam soil November 17, 1897. The fertilizer used on each plot at the time of sowing consisted of 200 pounds of acid phosphate and 472 pounds of cotton seed per acre. In addition nitrate of soda at the rate of 80 pounds per acre was employed as a dressing in the spring, two plots being thus treated March 4, 1898, a third plot on March 29, and a fourth plot on April 27. The soil was damp when the two earlier applications were made and barely dry on the surface at the time of making the last one.

The crop was harvested May 23.

The results follow:

Time of applying nitrate of soda to fall-sown oats, 1898.

80 LBS. NITRATE OF SODA APPLIED	No. of days before harvest	YIELD PER ACRE	
		Grain	Straw
		Bus.	*Lbs.*
March 4 (av. 2 plots).....	80	35.0	1801
March 29.....	55	34.3	1901
April 27.....	26	18.8	878

In this, as in the preceding experiment, nitrate of soda was more effective when applied in March than when used in the latter part of April.

Comparing the yields obtained from the application in March with the yield from the last top dressing, which was apparently ineffective, we are justified in concluding that both of the earlier applications of nitrate of soda returned a profit.

An experiment in applying a top dressing of nitrate of soda on spring oats was made in 1896 on reddish loam soil. Red Rust Proof were sown January 27, 1896, all plots receiving equal quanities of a fertilizer containing phosphoric acid and potash, but no nitrogen. Nitrate of soda at the rate of 120 lbs. per acre was applied as a top dressing at several dates, namely:

March 28, when the plants had leaves 3 to 4 inches long;

April 28, when the plants were beginning to throw up seed stems;

And May 6, when many of the panicles (heads) were showing.

On lot of nitrate of soda was divided, half being applied March 28 and the balance April 28. On all these dates there was sufficient moisture in the soil to dissolve the nitrate of soda.

The oats were cut May 29.

Time of applying nitrate of soda to spring-sown oats, 1896.

120 LBS. NITRATE OF SODA APPLIED	No. of days before harvest	YIELD PER ACRE		Increase per acre from nitrate
		Grain	Straw	
		Bus.	*Lbs.*	*Lbs.*
No nitrate of soda	...	10.4	376	.....
March 28	62	20.3	.....	9.9
April 28 (av. 2 plots)	31	13.1	414	2.7
May 6	23	10.8	357	.4
One-half March 28 / One-half April 28	62 / 31	13.5	433	3.1

The results with spring oats confirm the teachings of the experiments with fall-sown oats. From these experiments it appears that the earlier top dressing of nitrate of soda returned a profit. It is evident that nitrate of soda when used as a top dressing on oats should be applied not later than the last of March and at least 55 days before the grain is mature.

In regard to the amount of nitrate of soda which can be profitably used in spring as a top dressing for oats, extensive experiments have not been made here. A single test in 1896 on fall sown oats gave a yield of

34.1 bushels with 160 lbs. nitrate of soda,
29.3 bushels with 80 lbs. of nitrate of soda,
16.4 bushels with no nitrate of soda.

The larger and smaller amounts were applied as a top dressing on the same day, March 29. The use of 80 pounds per acre resulted in a profit; the increase due to the additional 80 pounds just about covered the cost of the additional fertilizer. Eighty pounds per acre is certainly safer than a larger quantity, although a heavier application sometimes proves best.

Effect of Lime.

February 1, 1896, Red Rust Proof oats were sown on four plots of land previously used for truck crops. The soil was rich and more abundantly supplied with vegetable matter than most of the upland in this locality. All plots were fertilized alike with a complete fertilizer, except that two plots received in addition slaked lime at the rate of 660 pounds per acre.

In spite of the unfavorable season the yields were satisfactory, the two limed plots averaging 38.5 bushels per acre, the two plots not limed 25.6 bushels. There was on comparatively rich land a difference of 12.9 bushels of oats per acre in favor of the limed plots.

March 11, 1898, quick lime from the Anniston Lime and Stone Company, was weighed out at the rate of 1,000 pounds per acre, and after being slaked, was applied as a top dressing on oats sown in the fall.

The soil was poor and sandy and the yields correspondingly small, 12.1 bushels per acre on the limed plot and 13.7 bushels on the plot not limed and used as a check. Here there was no gain effected by liming; it should be noted, however, that poor, sandy soil and late application are conditions very unfavorable for lime.

January 29, oats were sown on poor, reddish land, with and without lime, the rate when lime was used being 640 pounds of slaked lime per acre. Stock broke into the field and injured the crop when the oats were ripening, hence the plots were not separately harvested. There was no difference in the growth on the limed and not limed plots, so far as could be judged by the eye.

Lime hastens the rotting of vegetable matter in the soil and can be most advantageously used when the soil is abundantly supplied with organic matter.

It is also highly beneficial on acid soils. To determine whether a soil is acid, buy at a drug store a piece of blue litmus paper, keep this in a stoppered bottle until convenient to use it. Then bring it in contact with the moist soil to be tested. If the blue color of the litmus paper changes to reddish the soil is acid and will probably be helped by an application of lime.

It should not be understood that the favorable effect of lime is confined to soils which show this acid reaction with litmus paper. The Agricultural Department of this station will supply litmus paper free of charge to anyone agreeing to make this test and to report results.

Co-operative Fertilizer Experiments.

This experiment was conducted according to directions by Mr. H. C. Crayton, on his farm about seven miles south of Auburn.

Twelve plots, each one-eighth acre, were used. The land was gray sandy upland. Red Rust Proof oats were sown February 10, and the fertilizers were harrowed in after the grain was sown. After the date of sowing there was only an insignificant rainfall. The long continued dry weather caused the failure of the oats sown in February.

On account of the extremely unfavorable conditions, resulting in a yield of only about one-half or one-third the usual crop on that soil, the yields given below fail to show the normal effects of fertilizers.

A fertilizer test reveals the manurial needs of a given soil only when the supply of moisture is sufficient to dissolve the fertilizer and cause a normal growth. The yields are here given for what they are worth.

Yields of oats in co-operative fertilizer test.

Plot No.	FERTILIZER		YIELD PER ACRE	
	Amount per acre	KIND	Straw	Grain
	Lbs.		*Lbs.*	*Bus.*
A	436	Cottonseed	192	2.8
B	240	Florida soft phosphate	168	2.6
1	200	Cottonseed meal	200	3.0
2	240	Acid phosphate	200	3.0
3	.....	No fertilizer	232	3.4
4	200	Kainit	328	5.1
5	200 240	Cottonseed meal Acid phosphate	300	4.4
6	200 200	Cottonseed meal Kainit	372	7.3
7	240 200	Acid Phosphate Kainit	248	4.2
8	.....	No fertilizer	232	3.4
9	200 240 200	Cottonseed meal Acid phosphate Kainit	712	10.0
10	200 240 100	Cottonseed meal Acid phosphate Kainit	472	5.6

The only fertilizer that showed any tendency to increase the yield was kainit. This does not necessarily indidate that the soil was more deficient in potash than in nitrogen and phosphoric acid. The favorable result is probably due to the effect of kainit on the moisture supply of the soil, a result which would not necessarily be so noticeable in seasons of normal rainfall.

Prevention of Smut.

Smut is the cause of much loss to those who grow oats in all parts of the United States. We have seldom noticed in Alabama a field of oats not treated for smut in which the injury due to smut could be estimated at less than five per cent. of the crop. In one locality visited just before the last crop was harvested no field was seen in which the loss could be estimated at less than twenty per cent. and in some fields it was evidently more than forty per cent.

There are several methods for treating smut. The one which is used on the Station Farm with entire success and which is believed to be the cheapest and the best for our conditions is the Jensen treatment. This consists in keeping the seed oats in hot water at a temperature of from 130 to 135 degrees Fahrenheit for 10 to 15 minutes. The temperature kills the spores (so-called "seed") of the fungus which produces smut but does not interfere with the germination of the oats.

An experiment to determine the amount of injury from smut was made on two plots of oats sown on poor sandy land February 12, 1896. Equal quantities of seed oats were weighed out for the two plots. The seed for one plot was then placed in water at a temperature of 130 to 135 degrees Fahrenheit for ten minutes. The yield of oats was 13.1 bushels per acre with seed not treated, and 14.2 bushels with scalded seed. This is a gain of 1.1 bushels per acre or about eight per cent., obtaind at the cost of only a few minutes labor.

A careful count was made of the sound and smutted heads growing on measured and equal areas on each plot. The average results showed that on the plot with seed not

scalded 5 9 per cent. of the heads were destroyed by smut. Not a single head of smut could be found on the plots sown with treated seed. The gain in yield was even greater than the number of diseased stalks would indicate. This represents a general truth, namely, that the average farmer is apt to underrate the amount of injury done by smut, failing to notice many of the diseased stems, which remain dwarfed and inconspicuous, or to allow for grain which, though apparently sound, is light, as the result of smut. As estimated above, the loss in Alabama oat fields due to smut is generally greater than that noted in this experiment, where comparatively clean seed was used.

By treating all the seeds for a few years in succession, and sowing grain only on fields where smut has not recently developed, the seed grown on the farm will become so free from smut spores that scalding will in time become unnecessary. The value of the treatment given above has been conclusively proven in many experiments in a number of states. The treatment is rendered easier by the following arrangement for heating the grain:

Have a vessel for heating water and three tubs or barrels. In tub No. 1 maintain the water at a temperature of 110 to 120 degrees Fahrenheit, in No. 2 keep the water at 130 to 135 degrees, adding cold or hot water as required, and in No. 3 keep cold water. Dip the sacks of oats for a few minutes in tub No. 1, the sole purpose of which is to prevent the cold oats from going immediately into tub No. 2, and thereby reducing the temperature too low.

From tub No. 1 carry the sacks of warm oats to tub No. 2, keeping the oats submerged there and occasionaly stirred for ten or fifteen minutes. Then dip the hot oats into cold water or immediately spread them to cool. Only the one vessel having water kept continuously at 130 to 135 degrees is absolutely necessary. The other two are simply conveniences to hasten the work. An accurate thermometer is absolutely necessary. No guess work is admissible. A good "floating dairy thermometer" can be obtained from large drug stores or from dealers in dairy goods at a cost not exceeding 50 cents.

This cheap thermometer should be compared with a more expensive one to see that it is accurate. If the floating thermometer varies by a degree or two from the standard, due allowance can be made for this when using the former.

Two men in an hour can treat several bushels, usually 3 to 4 bushels where grain is handled in one bushel sacks, or larger quantities in proportion as the sacks and hot water vessels are larger. The cost for labor should not, at current rates, exceed three cents per bushel or not over five cents per acre. In return a gain of from 1 to 8 bushels of oats per acre may be expected. The scalded oats may be sown as soon as cooled or they may be dried for later sowing, by being spread out in a thin layer and stirred, or by adding any drying material, as sand, dust, etc.