

UNIVERSITY OF MISSOURI

COLLEGE OF AGRICULTURE

Agricultural Experiment Station

COLUMBIA, MISSOURI, OCTOBER, 1910

CIRCULAR NO. 46

FACTORS INFLUENCING THE YIELD OF OATS

F. H. DEMAREE, Acting Agronomist.

The factors which determine the profitable growing of oats in Missouri are, the use of the best adapted varieties, thorough fanning of seed to prevent running out, better preparation of the ground, drilling instead of broadcasting, early seeding, and the prevention of the smut by the formalin treatment.

Place in Rotation. These factors are so often disregarded by farmers that oat growing is unprofitable in this state. It is the opinion of this Experiment Station that the importance of the oat crop in a rotation still justifies its production.

Oats are one of the most efficient feeds known for horses and young stock. They also fit into our most practical rotations in a way no other crop will do. One of the best rotations for the state as a whole is corn, oats, wheat, and clover or cowpeas. In this rotation the ground is plowed only two years out of the four and there is no reason to drop out one of the crops at any time, thus upsetting the whole scheme of cropping. On the other hand where a three-course rotation of corn, wheat, and clover or cowpeas is adopted, the corn often blows down, which prevents sowing wheat between the rows, and the whole crop must be cut up if the land is put in wheat. This is often objectionable or impossible, so the rotation degenerates into corn two or three years and wheat when it can be sown. This

very condition of affairs is largely responsible for our increase in acreage of corn and its decreased yield per acre. Of course, where the general practice is to cut up all corn each year the three-course rotation is a good practical one.

Present Status. In past years oats have been of minor importance in the agriculture of this state. For the last seven years the average acreage has been 709,589 acres. The average acreage for corn has been about 6,500,000 acres for the same time. The average yield per acre of oats in the seven years has been 22.6 bushels, valued at 35 cents per bushel. This places the average value of an acre of oats at \$7.91.

The Illinois Experiment Station (Bulletin 136) estimates that it costs not less than \$4.45 to produce an acre of oats, not including interest on money invested in the land, and taxes. The Minnesota Experiment Station (Bulletin 97) has perhaps the most exact data on the cost of producing farm crops. The average cost for producing an acre of oats, taking all conditions into account, with them is \$7.97. In the annual report of the Missouri State Board of Agriculture for 1909 is given an estimate for producing an acre of oats in Missouri. This has been worked out by a careful farmer, and in light of estimates from other stations, can be taken as fairly accurate. The cost given here, not including fertility removed from the soil, amounts to \$7.56 per acre.

Taking this last estimate as typical of Missouri conditions and comparing the cost of production with the value of an acre of oats it is seen that the oat growers have been raising about enough only to pay for the cost of producing the crop. It is no wonder, with such a condition of affairs, that many farmers are dropping out the crop or are giving it so little attention as to make its growth extremely unprofitable.

TABLE NUMBER I.

YIELD OF OAT VARIETIES—MISSOURI EXPERIMENT STATION.

FIVE YEARS' TEST. 1905-1910.

Variety	1905	1906	1907	1908	1909	1910	Gen. Av.	Average 1909-10
Jeanette.....	46.47	34.10			40.88	35.97	39.3	38.42
Wide Awake.....	55.38	25.87			*39.66	*36.57	39.37	37.47
Martinsburg.....	44.82	23.81			43.0	47.68	39.83	45.34
Siberian.....	44.37	34.43			52.81	29.12	40.18	40.96
White Russian.....	21.41	22.47			36.17	38.59	29.66	37.88
Red Rust Proof.....	14.47	29.43		27.29	51.49	40.6	32.71	46.05
Silvermine.....	25.95	46.70			*39.36	*40.22	38.06	39.29
Great Dakota.....	25.25	55.05			39.69	25.08	36.18	32.38
Kherson.....	13.23	40.20			40.51	35.98	32.48	38.25
American Banner.....	19.69	47.32			42.12	34.5	35.9	38.31
Lincoln.....	12.12	31.54			41.47	39.42	31.26	40.69
Swedish Select.. (Regenerated)					37.23	26.85		32.04
Senator.....					51.74	20.73		36.23
Victor.....					43.54	37.53		40.53
Nichols' Black Comet....					53.8	39.85		46.82
White Tartar (North) ...						46.67		46.67

*Yields taken from small blocks.

Varieties. Table Number 1 gives the yearly yields together with the general average and average of the last two years of all varieties grown at the Station in large blocks. Our variety tests of oats have been made in duplicate, one series running a large number of varieties in very small blocks ranging from two rows across the plot to a drill width. Those varieties showing up best in the small plots have been put in the larger blocks, which are more typical of practical field tests. Results of the tests in larger blocks only are given here. From the table it can be seen that a few varieties hold up in yield much better than others, although as compared with the better oat producing states, our yields are only fair. This is largely true because this far south oats have a tendency to run out.

Running out is shown in several ways. The oat hulls may remain full, yet upon pinching them it is seen that there is very little grain inside. The weight per bushel is then considerably reduced. This season the Senator oat showed this kind of running out to a marked degree. Other varieties do not retain their size but become pointed and sharp, thus causing a reduction in size of both grain and hull. The weight of such oats remained comparatively heavy but the yield per acre is always reduced. Still another sign of running out is the change in color of the grain. Our black oats do not retain the coal black seen in the heavy, plump, black oats in the north, but gradually change to a reddish brown, some of them even becoming nearly white. White oats do not retain the white glistening color of good plump northern oats. They gradually assume a gray color which is prevalent among southern varieties.

Those varieties of white oats which have held up best are Siberian, Silvermine, Wide Awake and Great Dakota. The best adapted black oats are Jeanette, Martinsburg, Nichols' Black Comet and Victor. The Kherson is the only yellow oat we have had under rest, and it has made a good average yield. The kernels of this oat appear very small when compared with other varieties so do not prepossess a farmer in their favor; however, the Kherson is one of our earliest maturing and most dependable varieties of oats. It makes a good average yield under almost all circumstances.

The Red Rust Proof, although not showing as high an average yield as other varieties, is perhaps the best variety of oats to grow in this state on account of its rust-resisting power. This was strikingly brought out in the season of 1908. When the yields of other varieties were not worth taking, the Red Rust Proof averaged twenty-seven bushels to the acre. The main objection to this variety is the fact that the kernels have long beards, which cause the grain to must rather easily in the shock, to become dusty and bin-burned when stored. As far as yield is concerned, however, it is a most dependable variety and runs out least of any that can be grown in Missouri.

TABLE NUMBER II.

CHARACTERISTICS OF OAT VARIETIES GROWN AT COLUMBIA.

Variety.	Ave. Ht. (inches)	Days to Mature.	Color of Grain.	Panicle or side.	Size Straw.	Wt. per bushel (lbs.)
Jeanette	40	114	Black	Panicle	medium	31
Wide Awake	38	118	White	Panicle	fine	27
Martinsburg	45	109	Red Bl'k	Panicle	fine	34.5
Siberian	36	119	White	Panicle	medium	27
White Russian	38	119	White	Side	fine	32
Red Rust Proof	36	119	Red	Panicle	fine	31
Silvermine	48	112	White	Panicle	medium	27
Great Dakota	46	114	White	Panicle	M. coarse	30
Kherson	40	106	Yellow	Panicle	fine	31
American Banner	42	119	White	Side	medium	31.5
Lincoln	42	119	White	Side	M. coarse	32.5
Swedish Select (Regenerated)	42	119	White	Panicle	medium	28.5
Senator	44	119	White	Side	V. coarse	16
Victor	48	114	Black	Panicle	coarse	28
Nichols' Black Comet	40	114	Black	Panicle	medium	31
White Tartar (north)	45	111	White	Side	coarse	31.5

The Table on Characteristics (Table No. II) gives general markings together with the length of time required to mature and the weight per measured bushel. This data was taken on the 1910 crop. One noticeable fact is that the average yield of the earlier maturing varieties for the season of 1910 was 46.64 bushels per acre. The average yield of late maturing sorts was 33.36, a difference of 13.28 bushels per acre. Bringing the crop to maturity then, before the extremely dry, hot weather of middle summer sets in is a very desirable thing.

Value of Heavy Seed. Much can be done to prevent any of these oat varieties from running out. By sowing only plump seed, definite increases in yield may be expected. At the Ontario Station (Annual Report 1908) an experiment was conducted to determine

the differences in yield to be secured by sowing the heavy and light seed of a given variety. For the first three years of the experiment the difference was 10.4 bushels in favor of the heavy seed and the last three years the difference was 22.4 bushels per acre in favor of the heavy seed. Furthermore, the difference in weight per bushel increased from 3.2 pounds the first three years to 9.5 pounds the last three years of the experiment. Heavy seed can be obtained from our home grown varieties by fanning them heavily, saving only the large plump grains for seed. This is not the general practice. Most farmers put it off until spring, then simply go to the bin and shovel out the oats as they come, sowing good and bad alike.

Northern Grown Seed. Owing to the fact that our native grown oats have a decided tendency to run out, importing northern grown seed every two or three years is often advisable. The White Tartar (Table I) was brought from Minnesota and grown on the Station Field during the season of 1910. Its yield stood second and the quality of grain was excellent.

It is not yet known how long it will take northern seed to run down to the standard of our home grown oats. However, in those communities where oats rapidly run out it will pay to import good, heavy northern seed every other year.

Preparation of the Soil. The preparation of the ground has much to do with the yield of oats. In most cases it has not been found practical to plow the land for this crop although some stations have secured better yields by this method. Oats generally follow corn, and that being the case, a good double disking of the land should suffice, especially if the seed is then put in with the disk drill instead of broadcasting and harrowing it in. The general practice is, however, to broadcast with an end-gate seeder on top of unprepared land, then disk or cultivate with the corn cultivator and smooth down with a spike tooth harrow, thus allowing the cultivation to cover the oats. This is not as good practice as drilling, as shown in the light of recent experiments at various stations.

Drilling vs. Broadcasting. In experiments conducted at various experiment stations to determine the effect of drilling compared with broadcasting on the yield of oats it has been found that a definite increase in yield can be secured by drilling in the oats instead of broadcasting them. The Illinois Station (Bulletin 136) found as a general average on three separate fields for three years, an increase of 3.9 bushels per acre in favor of drilling over broadcasting. Kan-

sas (Bulletin 74) reports one of the longest continued experiments on this method of seeding oats. The station at Manhattan found a yearly increase of 5.3 as an average for seven years in favor of drilling over broadcasting. At the Ontario Agricultural College (Annual Report for 1898) the yields of six plots each for three years for the two methods of seeding showed four bushels per acre increase in favor of drilling.

These results are quite conclusive and definite increases should be secured by a more thorough preparation of the soil and putting in the oats with a drill. A disk drill is preferable because it acts as a cultivator and will cover better when running through corn stalks. These increases in yield are probably due to a better germination and stronger plants, which were produced by getting the seed down to moist fine dirt and a place where the root system could become more thoroughly established.

Rate of Seeding. The yield of oats varies somewhat with the rate of seeding. There is no definite rule which can be laid down as to how many pecks to sow per acre, consequently the rate of seeding varies with the idea of the farmer. At this Station an experiment was conducted last season to determine the influence of the rate of seeding on the yield of the crop. Kherson oats were used and were sown in series of seven blocks, three plots to the block. The rate on the first plot was eight pecks; on the second plot, ten pecks, and on the third, twelve pecks. Table No. III shows the results secured.

TABLE NUMBER III.

THE EFFECT OF RATE OF SEEDING ON YIELD AND WEIGHT PER BUSHEL.

Rate pecks.	Average yield straw, pounds.	Weight per bushel. (pounds)	Yield grain bushels
8	2826.3	29.6	48.17
10	2882.8	30.7	49.66
12	2904	30.9	47.93

The differences in yield of grain are not very large, being greatest with ten pecks of seed used to the acre and least with twelve. The weight per bushel and the yield of straw increases with the rate of seeding. On the whole, ten pecks seems to be the best amount to sow and would make a good seeding over the average land of the state. The Ohio Experiment Station (Circular 88) has carried on

a very comprehensive experiment on this subject. Results for four varieties seeded at rates varying from four to eleven pecks, and extending over eleven years' time, have shown that eleven pecks of seed per acre give the highest average yield. The weight per bushel increased with the increase in rate of seeding up to ten pecks per acre. These results correspond closely with our own.

In general, as stated above, oats seeded at the rate of ten pecks per acre, is about right. However, this can vary somewhat with the soil—a lighter seeding on rich soil and a heavier seeding on the poorer soil. A heavy seeding is needed on poorer soils because the plants do not stool well and more seed is required to get a good stand.

Time of Seeding. The time of seeding varies considerably with the season. In general, farmers in the extreme southern part of the state attempt to get in their oats the latter part of February and the first of March. The time becomes later as you go to the north and the average time of seeding oats in northern Missouri will be the latter part of March and the first two weeks of April. The earlier oats can be seeded, the better, because the oat plant makes its best growth and stools best during cool, moist weather. They do not do well when the weather becomes very warm. For this reason, early seeding and the use of early maturing varieties is recommended.

Rust. One of the worst enemies of oats in this state is red rust. It is prevalent almost any season but does its greatest damage in a very warm, wet spring. The season of 1908 was one in which the oat crop was nearly ruined by the rust. There are no known preventatives of rust, the only means for checking it being the use of a rust-resisting variety. The Texas Red Rust Proof is the only variety which has given satisfactory evidence of being rust resistant.

Smut. Aside from the rust, the oat smut is the greatest enemy of the plant. Smut affects the head, reducing grain and all to a black mass. It sometimes attacks the head while still in the boot. In that case the head never appears and the disease is not detected. Loss from smut often amounts to as much as 25 per cent of the total crop. The disease can easily be controlled by the formalin treatment, which will reduce the number of smutted heads to negligible quantities, in most cases being less than 1 per cent. An experiment conducted at this Station comparing oats treated for smut with untreated oats of the same variety showed large differences in the number of smutted heads to be found, and also in yield. Table Number IV shows these results:

TABLE NUMBER IV.

THE EFFECT OF SMUT ON YIELD.

Treatment	Number smutted heads per 100	Yield, bushels.	Favor Treatment. + or -
10 minutes	1-2	39.48	+10.08
2 hours.....	1-2	37.41	+ 8.05
none	7-10	29.36	

Treatment of Oats for Smut. Prepare a solution as follows: Mix 1 pound of commercial formalin, 40 per cent strong, with 40 or 50 gallons of water in barrels. This formalin can be secured at practically any drug store. After the seed oats have been thoroughly fanned, spread them out on a clean floor and sprinkle them with the solution until damp enough to pack in the hand. Turn them with a shovel until all have been well dampened. Then shovel them into a pile and cover with some old sacks or carpets for two or three hours. The oats should then be scattered and turned from time to time until dry. As soon as dry the oats are ready for seeding at once or may be left for weeks until they can be used.

This solution is poisonous in considerable quantities but as recommended, is very weak. It will not injure the hands and is perfectly safe to handle.

Breeding. Most of the work done on oats at this Station has been along the line of variety testing. An attempt has been made to find some good variety which will not run out, will resist the rust and maintain its yield. It seems, however, that only fair results can be secured with varieties so far known and attempts are now being made to breed varieties of oats which will answer our conditions. Some good strains of Red Rust Proof and Jeanette have been isolated but results along this line are not yet available for publication.

Winter Oats. For the southern part of Missouri, growth of winter oats seems advisable if varieties can be adapted which will survive the severer winters. Work is in progress at the Station to adapt a variety of winter oats to our conditions and there is promise of good success along this line. A strain of Culberson and one of Winter Turf have been grown at the Station for the past two years and give promise of becoming valuable in the southern part of the state.

Conclusions:

(1) Up to the present time, the oat crop has been regarded as one of minor importance by farmers of the state. The average yield has been so low that it has just about paid for the cost of production.

(2) The oat crop, however, has a place in Missouri rotations and should not be discarded, as better methods applied to its production will place it on a paying basis, although Missouri can never expect to become a banner oat producing state on account of climate.

(3) The best varieties are: White—Siberian, Wide Awake, Silvermine, Great Dakota; Black—Jeanette, Martinsburg, Nichols' Black Comet, Victor; Red—Texas Red Rust Proof; Yellow—Kher-son.

(4) Drilling is preferable to broadcasting and definite increases in yields can be expected if the practice is followed.

(5) Rate of seeding varies with the soil and the size of the seed but under average conditions, ten pecks per acre is recommended.

(6) Rust can only be controlled by the use of rust-resistant varieties. The Texas Red Rust Proof is the only sort which can be depended upon to resist the rust.

(7) Smut in oats can easily be controlled by the formalin treatment and definite increases in yield can be expected by so treating seed oats.

(8) General recognition of these factors influencing the yield of oats will aid in placing the production of oats in this state on a paying basis.