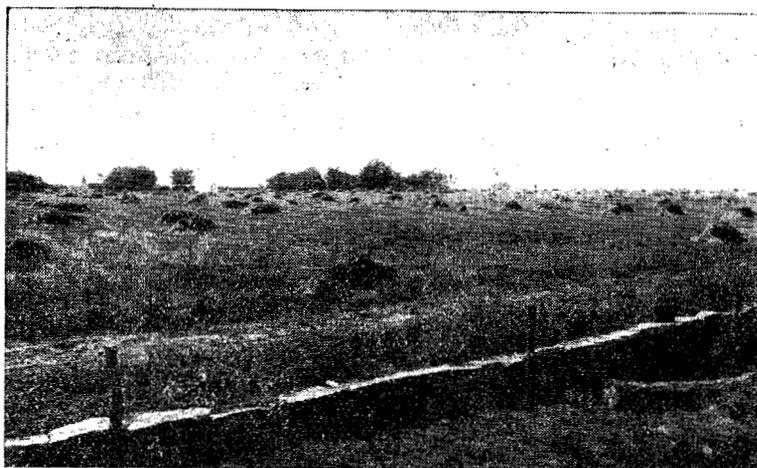


AGRICULTURAL EXPERIMENT STATION

KANSAS STATE AGRICULTURAL COLLEGE
MANHATTAN, KANSAS

DEPARTMENT OF AGRONOMY



KANOTA: AN EARLY OAT FOR KANSAS¹

S. C. SALMON AND JOHN H. PARKER

The Kansas Agricultural Experiment Station has released for distribution a variety of oats, new to Kansas, which promises greatly to improve the oat crop of the state. Its rapid early growth in the spring, early maturity, ability to resist or survive late spring frosts, comparative freedom from smut, and the high average yields secured are such as to support the belief that this variety will prove a valuable addition to the oat-growing sections of Kansas and possibly find a place in other states.

ACKNOWLEDGMENT.—The experiments at Manhattan reported herein were conducted in cooperation with the Office of Cereal Investigations, United States Department of Agriculture.

¹Contribution No. 137 from the Department of Agronomy.

ORIGIN OF KANOTA

This variety has been named Kanota and is a strain of Fulghum oats. Fulghum oats, according to Mr. C. W. Warburton, Agronomist in Charge of Oat Investigations, United States Department of Agriculture, originated on the farm of Mr. J. A. Fulghum, Warrenton, Ga.

Kanota oats were first grown at the Kansas Agricultural Experiment Station in 1916 when four lots of seed from Texas, all called Red Texas or Red Rustproof,¹ were received. These strains were planted in the crop improvement nursery in the spring of 1916. One of them, designated as Kansas No. 5179, was recognized the first season as being especially promising, and was, therefore, increased and included in the farm plot experiments in 1917. Two strains, Kansas Nos. 5180 and 5182, which appeared to be the least promising were discarded after 1918. Kansas Nos. 5179 and 5181 were grown under the name Red Texas for the first two years, though it was recognized from the first that they were a very distinct, early type, differing greatly from the ordinary Red Texas. In 1918 these strains were identified as Fulghum by Mr. Warburton, and Kansas No. 5179 was distributed, for experimental purposes among selected farmers, under the name Kansas Fulghum. It seemed to be distinctly superior to other strains of Fulghum in several important respects.

In order to prevent confusion of this strain with other strains of Fulghum which, as will be shown later, are inferior for Kansas conditions, the name *Kanota* has been assigned to No. 5179. It should be stated in fairness to all concerned that Kanota did not originate at the Kansas station and that the latter is not to be credited for it except in so far as it has been instrumental in discovering and demonstrating its value under Kansas conditions.

DESCRIPTION

Kanota belongs to the red oat group, *Avena sterilis*, having the brownish red color of grain, sucker mouth, and basal hairs characteristic of that group. The color, however, is usually lighter, being sometimes nearly white, and the sucker mouth is not so well nor so consistently developed as in Red Texas oats. The awns or

¹ The names *Red Texas* and *Red Rustproof* are synonymous, referring to the same group of varieties. However, since the name *Red Texas* is more commonly used in Kansas, it is used hereafter in this circular.

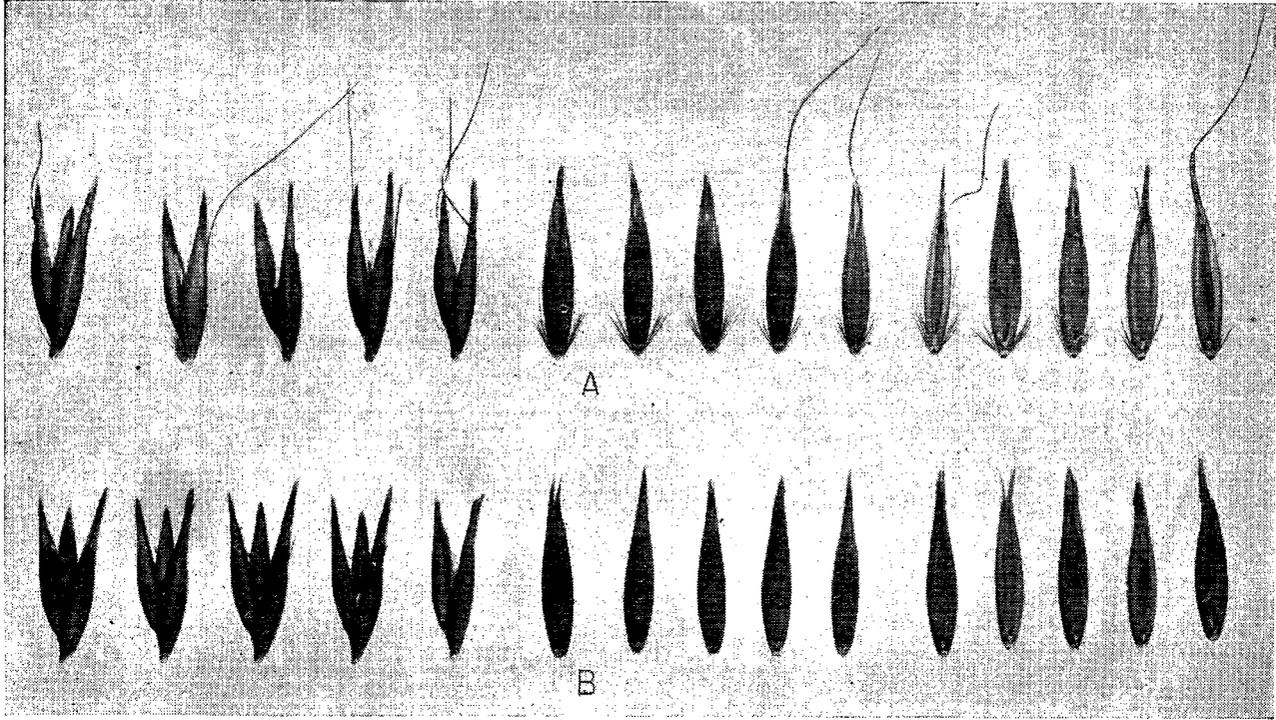


FIG. 1.—Comparison of spikelets and single kernels of Red Texas (A) and Kanota (B) oats. From left to right in each row are five spikelets; five kernels, back view; and five kernels, front view

KANOTA: AN EARLY OAT FOR KANSAS

beards, which are usually rather conspicuous in Red Texas, are seldom present in Kanota, or if present, are poorly developed. Three-grained spikelets are more common than in Red Texas. Some of the differences are illustrated in figure 1.

There is also a marked difference in the growth of the young plants, those of Kanota very early assuming a semi-erect or nearly semierect position, while Red Texas are much more spreading or prostrate, somewhat resembling plants of winter wheat in this respect.

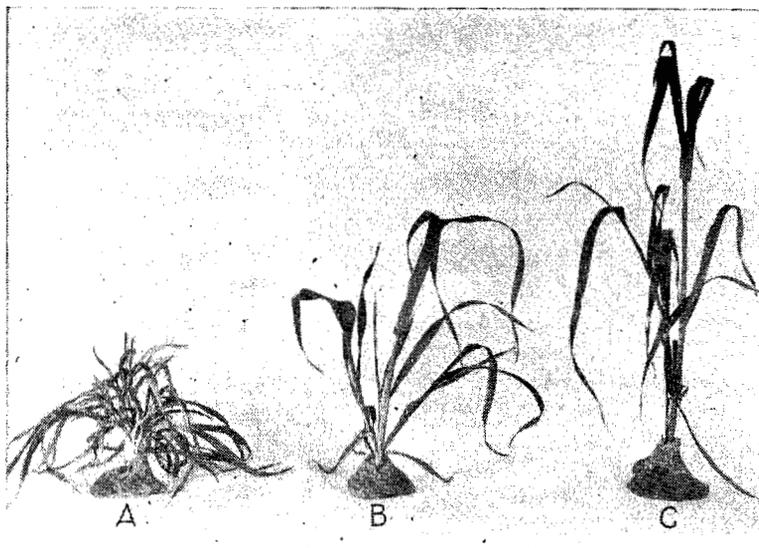


FIG. 2.—Young plants of three varieties of oats: A, Red Texas; B, Kanota; C, Burt

As known at present, Kanota contains a very small percent of off-type plants of unknown origin. These may be mixtures or the result of hybridization which may have occurred earlier in the history of the variety.

It will be noted that in all of the characters mentioned, Kanota occupies a position more or less intermediate between the red oat and white oat groups. This suggests a hybrid origin for Kanota, as well as for other strains of Fulghum, and may explain its geographic adaptation which seems to be between the *Avena sativa* or northern and the *Avena sterilis* or southern oat district.

TABLE I.—COMPARATIVE YIELDS OF KANOTA AND OTHER VARIETIES OF OATS GROWN IN PLOTS ON THE AGRONOMY FARM, 1917 TO 1920

Kansas No.	VARIETY	Yield in bushels per acre				
		1917	1918	1919	1920	Av. 1917 to 1920
5179	Kanota	58.5	30.1	54.3	45.4	47.1
6084	Fulghum	65.2	18.8	37.3	35.5	39.2
5015	Red Texas	57.9	18.1	29.4	28.0	33.4
5085	Red Texas	57.9	24.8	33.2	28.7	36.2
5105	Red Algerian	56.7	18.6	23.7	21.6	30.2
5205	Red Texas	58.5	21.7	31.5	38.7	38.6
6086	Red Texas	59.6	14.3	26.4	29.8	32.5
5020	Burt	61.6	17.2	37.2	36.6	38.2
5009	Kherson	51.5	24.9	47.8	27.4	37.9
5034	Kherson	47.9	17.5	47.0	26.3	34.7
5204	Kherson	50.0	24.9	45.3	27.3	36.9
6021	Kherson	50.6	18.9	47.9	22.0	34.9
5206	Aurora .....	....	36.7	37.1	33.0	....

EXPERIMENTAL RESULTS

So far as appearance of the grain is concerned, Kanota seems to be identical with other strains of Fulghum. There can scarcely be any doubt, however, that there is a difference in certain agronomic characters and in agronomic value. For example, Kansas No. 6084, a variety received from Texas and known there as Red Texas, cannot be distinguished from Kanota or from Fulghum by any readily observable characters of the plant or grain. Yet when grown in experimental plots on the Agronomy Farm for four years Kansas No. 6084 produced as good a yield as Kanota in only one season (Table I) and ripened from two to nine days later—never as early. Its average test weight was three pounds less. Kansas No. 6181, which was introduced with Kanota under the name Red Texas, has been grown in nursery tests only except in 1920 when it was grown in field plots and produced 16.6 bushels per acre less than Kanota. The average dates of heading and of ripening, and the test weight of this strain of Fulghum, of Kanota, and of a number of other varieties grown in the crop improvement nursery from 1916 to 1920 are given in Table II.

It will be seen that Fulghum (Kansas No. 5181) headed and ripened five days later, had a test weight of 2.2 pounds less and an average yield of 10.4 bushels per acre less than Kanota grown under the same conditions. Marked differences in yield were secured in one season only, but the differences in heading and ripening have been consistent throughout the experiment. The figures are for plots consisting of three rod rows each replicated two

TABLE II.—OAT VARIETIES IN NURSERY ROWS, 1916 TO 1920

Kansas No.	C. I. No. (a)	VARIETY	Average date headed	Average date ripe	A. v. length fruiting period	A. v. weight per bushel	A. v. yield per acre
					<i>Days</i>	<i>Lbs.</i>	<i>Bus.</i>
5179	839	Kanota.....	6-4	6-28	24	27.0	70.14
5181	1912	Fulghum.....	6-9	7-3	24	24.8	59.74
5105-2	....	Red Texas.....	6-8	7-2	24	20.9	57.76
5105-13	....	Red Texas.....	6-8	7-1	23	22.5	57.46
5136-B	....	Red Texas.....	6-10	7-1	21	24.3	57.30
5005	1913	Burt.....	6-7	6-29	22	25.3	54.88
5020	293	Burt.....	6-6	6-29	23	25.5	64.84
5220	293	Burt.....	6-7	6-28	21	25.6	51.54
6001	1918	Burt.....	6-6	6-27	21	21.2	51.30
6052	1919	Burt.....	6-7	6-28	21	22.5	52.80
6076	1290	Burt.....	6-6	6-28	22	24.1	49.02
5034	1209	Kherson.....	6-8	6-28	20	23.4	55.48
5148	459	Kherson.....	6-7	6-27	20	23.5	56.08
5168	165	Sixty-Day.....	6-7	6-27	20	23.5	54.02

(a) Cereal Investigations, United States Department of Agriculture.

times for five years. The differences, it will be seen, are as great as those observed between Kanota and other varieties.

YIELDS OF KANOTA IN FIELD PLOTS

The early maturity and high yield of Kanota in the 1916 cereal nursery caused it to be singled out and included in the variety test plots in 1917. The yields secured in those plots on the Agronomy Farm in comparison with the leading varieties are indicated in Table I.

The average yield of Kanota for the four years it has been grown in plots is 47.1 bushels per acre, which is 10.9 bushels more than Red Texas (Kansas No. 5085), the variety previously regarded as the best available oat. The yield of Kanota is 8.5 bushels above Red Texas (Kansas No. 5205), which is the highest-yielding strain of Red Texas for the four years considered, and is practically 9 bushels higher than the best Kherson variety (Kansas No. 5009). In three years of the four, Kanota has produced considerably more than any other red oat and in the fourth as much as any of the varieties generally grown.

TABLE III.—COMPARATIVE YIELDS OF KANOTA AND A LOCAL STRAIN OF RED TEXAS IN COOPERATIVE EXPERIMENTS IN 1919

COUNTY	Yields in bushels per acre	
	Kanota	Local Red Texas
Atchison	53.6	25.9
Franklin	68.2	37.8
Cherokee	49.6	44.7
Jewell	38.5	31.5
Dickinson	28.6	20.1
Sedgwick	32.5	19.8
Average	45.2	29.9

YIELDS OF KANOTA IN COOPERATIVE EXPERIMENTS WITH FARMERS

Kanota was first tested by Kansas farmers in 1919, when it was included in oat variety tests in six counties. In that year, as shown in Table III, it outyielded the varieties with which it was compared in every test, the average difference between it and the local variety of red oats being 15.3 bushels. In 1920 it was included in oat variety tests in 24 counties and produced an average yield of 45 bushels per acre as compared with 38.3 bushels for the

local variety grown by the farmer making the test. In nearly all cases this local variety was Red Texas. In 21 tests, as shown in Table IV, it averaged 3.4 bushels per acre more than Burt, and in 16 tests, 6.8 bushels more than Albion (Iowa No. 103). In a number of tests in 1920 Kanota was injured by unseasonably early heat and dry weather at about the heading stage while later-maturing varieties escaped injury.

TABLE IV.—COMPARATIVE YIELDS OF KANOTA AND OTHER VARIETIES OF OATS IN COOPERATIVE EXPERIMENTS IN 1920

VARIETY	Yield in bushels per acre		
	Av. of 16 tests	Av. of 21 tests	Av. of 25 tests
Kanota	44.3	46.1	45.0
Burt (Kansas No. 5219).....	41.0	42.7	....
Albion (Iowa No. 103)	37.5	....	....
Local variety.....	39.1	39.6	38.3

EARLY MATURITY

Perhaps the most outstanding character of Kanota of agronomic interest is its early maturity. Table V gives the dates of heading and ripening of Kanota and other varieties for each year Kanota has been grown in field plot tests on the Agronomy Farm. In these tests Kanota has proved earlier than any other variety, having headed and ripened on the average a week earlier than Red Texas (Kansas No. 5085), two days earlier than Kherson, and one day earlier than Burt, its nearest competitor. Certain strains of Burt and Kherson, however, in nursery tests have averaged as early as Kanota or earlier. Data from cooperative tests with farmers indicate that the average date of ripening for Kanota is ten days earlier than local red oats varieties commonly grown in the state. As is well known, earliness of maturity is a matter of prime importance in a state such as Kansas where hot weather and midsummer drouths are common. Kherson, Sixty-Day, and similar varieties which also mature early are for some reason, perhaps less adaptation to heat, not able to produce as large yields as those varieties belonging to the red oat group, *Avena sterilis*. It therefore seems peculiarly fortunate to have in Kanota a variety which is as early as the earliest and at the same time possesses those qualities of the red oat group which permit satisfactory yields in warm climates.

TABLE V.—DATES OF HEADING AND RIPENING OF KANOTA AND OTHER VARIETIES OF OATS IN FIELD PLOTS ON THE AGRONOMY FARM

Kansas No.	VARIETY	1917		1918		1919		1920		Av., 1917 to 1920	
		Headed	Ripe	Headed	Ripe	Headed	Ripe	Headed	Ripe	Headed	Ripe
5179	Kanota	6-8	7-2	5-24	6-21	6-1	7-5	6-6	6-24	6-2	6-28
6084	Fulghum	6-15	7-9	5-25	6-28	6-4	7-7	6-6	6-28	6-5	7-3
5015	Red Texas	6-15	7-9	5-29	6-28	6-11	7-9	6-11	7-3	6-9	7-5
5085	Red Texas	6-17	7-9	5-30	6-28	6-11	7-8	6-11	7-3	6-10	7-4
5105	Red Algerian	6-17	7-10	5-30	6-28	6-11	7-8	6-11	7-2	6-12	7-5
5205	Red Texas	6-18	7-10	5-30	6-28	6-11	7-9	6-10	7-3	6-10	7-5
6086	Red Texas	6-14	7-7	5-29	6-29	6-12	7-9	6-11	7-2	6-9	7-4
5020	Burt	6-7	7-3	5-24	6-20	6-3	7-5	6-7	6-27	6-3	6-29
5009	Kherson	6-12	7-6	5-27	6-21	6-4	7-7	6-9	6-29	6-5	7-1
5034	Kherson	6-11	7-7	5-28	6-21	6-10	7-5	6-10	6-29	6-8	7-1
5204	Kherson	6-12	7-6	5-28	6-24	6-4	7-5	6-10	6-29	6-7	7-1
6021	Kherson	6-11	7-6	5-28	6-20	6-4	7-4	6-9	6-28	6-7	6-30
5206	Aurora .....	....	....	5-28	6-22	6-6	7-5	6-7	6-24	....	....

KANOTA: AN EARLY OAT FOR KANSAS

EARLY SPRING GROWTH

Red Texas oats are not extensively grown north of Kansas. Their inability to make satisfactory yields in the area to the north, so far as the writers are aware, has never been satisfactorily explained. For one thing, it appears they are likely to make slow progress where early spring temperatures are low. They have a tendency under such conditions to assume a somewhat prostrate or spreading habit of growth similar to the true winter cereals. This in turn seems to be associated with a semi-dormant period in which there is very little growth, and as a result they may be rather slow in jointing and heading. This also gives any weeds that may be present an unusual opportunity. At least these observations hold true for certain seasons in Kansas when cool weather prevails longer than usual in the spring. On the other hand, Kherson, Sixty-Day, Swedish Select, and similar varieties of the northern or white oat group seem to flourish in such seasons and localities. They would probably produce better yields were they as well able as the Red Texas oats to withstand the high temperatures which often prevail during the fruiting period.

In early spring growth, Kanota resembles the white oat or *Avena sativa* group more closely than it does the varieties of Red Texas. In 1919 when this factor seemed to be a determining one with respect to production, Kanota made as rapid a growth as any other variety, tillered abundantly, and was not seriously hindered in its growth by weeds. All strains of Red Texas on the other hand made a very slow vegetative growth, were badly crowded by weeds, especially smart weed, and produced very low yields. Reference to Table I will show that in that season Kanota produced 54.3 bushels per acre while the highest yield secured from any strain of Red Texas was 33.2 bushels. All strains of the latter were far outyielded by Kherson although normally Red Texas may be expected to yield more than Kherson at Manhattan.

WEIGHT PER BUSHEL

In field plot tests Kanota has produced grain of better quality than other varieties so far as quality is indicated by test weight. Thus, as shown in Table VI, the average test weight of this variety is 5 pounds higher than Red Texas (Kansas No. 5085), 3 pounds higher than Burt, and 8.1 pounds higher than the most productive Kherson (Kansas No. 5209).

TABLE VI.—TEST WEIGHT OF KANOTA AND OTHER VARIETIES OF OATS GROWN IN FIELD PLOTS AT MANHATTAN, 1917 TO 1920

Kansas No.	VARIETY	Pounds per bushel				
		1917	1918	1919	1920	Av., 1917 to 1920
5179	Kanota	37.7	32.0	34.5	30.7	33.7
6084	Fulghum	34.8	28.3	33.3	26.5	30.7
5015	Red Texas	34.5	27.5	28.0	21.0	27.8
5085	Red Texas	35.3	26.0	31.5	21.8	28.7
5105	Red Algerian	32.8	28.5	33.5	24.5	29.8
5205	Red Texas	32.7	26.0	33.5	21.1	28.3
6086	Red Texas	35.7	28.5	35.8	25.0	30.8
5020	Burt	35.3	30.0	29.8	27.7	30.7
5009	Kherson	32.0	22.5	25.3	22.6	25.6
5034	Kherson	33.0	26.0	25.2	24.5	27.2
5204	Kherson	30.7	27.0	26.0	23.7	26.9
6021	Kherson	25.7	27.3	26.5	25.8	26.3
5206	Aurora .....	....	30.3	33.0	31.2	31.5

HEIGHT OF PLANT

In nursery and field plot tests Kanota has been slightly shorter than most strains of Red Texas oats but there seems to be no reason to fear that the straw will be too short to bind where other varieties grow successfully. In fact, a slightly shorter straw may be an advantage where lodging is likely to occur.

RESISTANCE TO LATE SPRING FREEZES

Observations in the springs of 1920 and 1921, both at Manhattan and Hays, indicate that Kanota is somewhat more resistant to late spring freezes than Kherson oats and fully equal, if not superior, to Red Texas in this respect. At Manhattan in 1920, a severe storm followed by freezing temperatures occurred about April 1. The varieties had been sown about three weeks earlier and were well up when the storm occurred. All Kherson oats were badly damaged and several strains of Red Texas showed slight injury. Kanota and Fulghum (Kansas No. 5181) were injured the least of all. Since this condition prevailed in each of two series of plots there can be little question as to the accuracy of the observations for the conditions of the test.

On May 4, about one month after the freeze, the following significant observations were recorded. "Kanota (Kansas No. 5179) and Fulghum (Kansas No. 5181) are noticeably better than other varieties at this date. All Kherson and Sixty-Day oats have been slow to recover from the effects of the freeze. Red oats in general were injured very little." Reference to Table I will show that

in 1920 Kanota was an outstanding variety with respect to yield and that the various strains of Kherson made very low yields.

Severe freezes occurred in most sections of Kansas in April, 1921, and many of the cooperating farmers reported that Kanota withstood the freezes better and made a quicker and more complete recovery than Red Texas. In one case observed by the writers, a field of Red Texas had been sown at the rate of 2.5 bushels per acre and an adjacent field of Kanota at the rate of 1.5 bushels per acre. The freeze thinned the stand of Red Texas to such an extent that it was much poorer than Kanota although the latter variety was sown at less than the normal rate of seeding.

Whether resistance to spring freezes may be considered a major factor in oat production in Kansas cannot be stated at the present time nor are the data sufficient to justify the claim that Kanota is generally better than other varieties in this respect. However, the point is of sufficient importance to justify more extended observations.

RUST RESISTANCE

Although Kanota belongs to the so-called Red Rust-proof group, *Avena sterilis*, it is not resistant to the crown or leaf rust, *Puccinia coronata*, as it occurs in Kansas, and like all varieties of the red oat group, as far as known, it is susceptible to black stem rust, *Puccinia graminis avenae*. The yield of some fields of Kanota was reduced in 1921 as a result of the attack of these rusts.

SMUT RESISTANCE

In comparison with most varieties of the white oat group, Kanota has shown a high degree of smut resistance in experiments conducted at Manhattan, agreeing with other experiments with strains of Fulghum oats in this respect. It cannot be said, however, that Kanota is immune from smut.

SOURCES OF PURE SEED

About 600 bushels of Kanota were distributed by the Agronomy Department of the Kansas Agricultural Experiment Station in the spring of 1921. These were sold to members of the Kansas Crop Improvement Association

¹ G. M. Reed. Varietal resistance and susceptibility of oats to powdery mildew crown rust, and smuts. Mo. Agr. Expt. Sta. Research Bul. 37: 3-41. Pls. 4. 1920.

who agreed to grow them for seed and keep them as pure as possible. It is estimated that about 8,000 bushels will be available for seeding in the spring of 1922. It is proposed to inspect the crop and publish a seed list each year so that a supply of reasonably pure seed will be available at all times.

As previously noted Kanota is not absolutely pure, in the sense that all the plants belong to the same pure line. The percent of mixtures, however, is so small that they need not be seriously considered so far as their effect on yield is concerned.