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OAT PRODUCTION IN COLORADO 1928-1935

By D. W. Robertson, Dwight Koonce,
J. J. Curtis, and J. F. Brandon

Colorado State College
Colorado Experiment Station
Fort Collins

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SUMMARY

Colorado grows annually about 185,400 acres[1] of oats yielding about 5,438,400 bushels. Of this amount, about 85,500 acres are grown under irrigation and about 99,900 on dryland. The average acre yield of oats for Colorado is about 29.3 bushels. The average acre yield for oats grown under irrigation for the 5-year period is approximately 41.9 bushels and on the dryland for the same period 18.6 bushels. The percentage production of oats grown is 65.9 percent on irrigated land and 34.1 percent on dryland. The acreage percentage is 46.1 percent on irrigated and 53.9 percent on dryland.

In making recommendations for Colorado one is confronted with various conditions such as rainfall, altitude, temperature, and length of frost-free season. Any recommendation should be applied only to conditions similar to those of the district in which the various experimental farms are located. Various local conditions and demands may make it advisable to deviate slightly from the recommendations.

IRRIGATED CONDITIONS

At Fort Collins and Fort Lewis tests have been conducted under irrigation. The difference in elevation is about 2,500 feet between the two stations. Tests carried out at these stations show that the midseason type of oat is the best adapted. Of the midseason types tested, Colorado 37 or Markton are recommended for conditions similar to those of the two stations. At higher altitudes the early oats will more nearly approach the midseason types. At Fort Collins, under irrigation, the earlier types, Kanota and Kherson, are not adapted and cannot be recommended. However, in the southern part of the state, where the climate in the summer is warmer, cooperative tests with the Extension Service have shown that Markton and Kanota are well adapted to irrigated conditions. Similar tests in the San Luis Valley show that Colorado 37 is the best oat tested. Further tests on the adaptability of Markton in this area are necessary.

Colorado 37 is one of the stiffest-strawed oats tested and will stand up under irrigation when Markton will lodge. The kernels are plumper than those of Markton. The latter variety, however, has the advantage of being smut resistant. Colorado 37 should be treated for smut before planting.

Irrigation

Under normal weather conditions in northeastern Colorado a single irrigation at the jointing stage is recommended. On the lighter

[1]Five-year average 1929, 1930, 1931, 1932, 1934; Colorado Year Book, published by State Board of Immigration.

soils several irrigations may be necessary. If two irrigations are applied, one at tillering and one at the late jointing stage are recommended.

Experience has shown that, due to the immature straw found on oats grown under irrigation, long shocks made by placing two sheaves together in a row are better for curing oats than the round shocks often used. Oats shocked in round shocks tend to heat under Colorado conditions. About 10 sheaves to the shock are sufficient.

Rate and Date of Seeding

Under irrigated conditions about 80 pounds of midseason oats are recommended for planting. Oats at the Experiment Station give best yields when planted between the 1st and 20th of April. Midseason oats will mature if sown after this date, but the yield of straw and grain will be reduced.

Good results may be obtained from planting some of the earlier varieties a little later. Oats planted in the latter part of March may suffer from frost damage and are usually retarded in germination, due to the low temperature of the soil at that time.

At Fort Lewis the best date to plant midseason oats was found to be from the middle to the end of April. Earlier plantings showed no advantage, and later plantings reduced the yield. The early oats showed little difference in yield until the planting date was later than the 1st of June.

Place in Rotation

The general practice on irrigated land is to sow oats following a row crop. Under such conditions disking, harrowing, and leveling may be all the preparation necessary for the sowing of oats. Corn stubble should be plowed in order to bury the stalks and roots deep enough to allow for proper leveling. Fall disking is preferable where possible. Oats are not recommended as a nurse crop for alfalfa.

Results of experiments[2] showed that Colorado 37 and Nebraska 21, grown at Fort Collins, germinated immediately after harvest when planted in moist sand. They also sprout badly in the shock under unfavorable weather conditions. Either of these varieties should be reshocked after heavy rains to aid in drying and prevent sprouting of the grain.

Kanota has a long dormancy period after harvest and resists sprouting in the shock.

DRYLAND CONDITIONS

On dryland early oat varieties have produced favorable yields. Midseason varieties failed more often than the early ones and yielded less, even under favorable conditions. In eastern Colorado hot-

[2]Deming, G. W., and Robertson, D. W., Dormancy in Small-Grain Seeds, Colo. Exp. Sta. Tech. Bull. 5.

climate oats *(Avena byzantina)* have outyielded the early oats of the Kherson *(Avena sativa)* type. Brunker and Kanota have given the best yields of the oats tested for an 8-year period, 1928 to 1935, inclusive.

Date to Plant

Only early-maturing oats should be sown. The seeding date should be as early in the spring as is practicable. Very often early varieties of oats sown after the middle of April will be injured by dry weather before maturity.

Rate to Sow

Seeding more than 4 pecks has given larger yields than lighter seeding rates and is advised. In the varietal experiments conducted at Akron the plats were seeded at the rate of 5 pecks per acre.

When to Recommend

Oats cannot be recommended for extensive seeding on dryland, as either corn or barley usually produces a larger yield of grain. Oats may, however, be cut for and fed as hay when drought prevents the crop from properly developing.

Figure 1. Foundation seed of Brunker oats at Colorado Experimental Farm, Fort Collins, Colo.

Oat Production in Colorado
1928-1935

By D. W. ROBERTSON, DWIGHT KOONCE,
J. J. CURTIS, and J. F. BRANDON

Colorado grows annually about 185,400 acres[1] of oats, yielding about 5,438,400 bushels. Of this amount about 85,500 acres are grown under irrigation and about 99,900 on dryland. The average acre yield for Colorado is about 29.3 bushels. The average acre yield for oats grown under irrigation for the 5-year period is approximately 41.9 bushels, and on the dryland for the same period 18.6 bushels. The percentage production of oats grown is 65.9 percent on irrigated land and 34.1 percent on dryland. The acreage percentage is 46.1 percent on irrigated land and 53.9 percent on dryland. The five leading counties in the production of oats for the 5-year period 1928-1933[1] were Weld, Routt, Larimer, Logan, and Rio Grande.

CLIMATIC CONDITIONS

Colorado has a varied climate which influences the kind of crop which may be grown. In sections where the mean summer temperature ranges between 60° and 70° F., varieties of common oats *(Avena sativa)* will give better yields.

Where the summer temperature is well over 70° F. in the southern or eastern part of the state, at the lower altitudes, red oat varieties *(Avena byzantina)* are better adapted. At altitudes below 7,000 feet, with the mean summer temperature below 70° and above 60° F., the midseason or Victory type of common oat is best adapted, provided there is enough water either as rainfall or irrigation. In the drier sections of the area the Kherson type is better adapted and will outyield the later oats in dry years. Above 8,000 feet in elevation, where the growing season is short, the earlier-maturing oats are better adapted for grain production, but the Victory-type oats will give the highest yield of hay.

In some sections good yields of hay are obtained from Bliss side oats (White Tartar). However, this variety is usually later than the midseason types.

LOCATION OF EXPERIMENTAL FARMS

Experiments with oats were conducted on three station farms in Colorado. The central station is located at Fort Collins, in the north-central part of the state, where all tests are under irrigation. The type of soils, elevation, and climatic conditions make it fairly

[1]Five-year average 1929, 1930, 1931, 1932, 1934; Colorado Year Books, published by State Board of Immigration.

representative of the irrigated sections in the northeastern part of the state.

The Fort Lewis farm is located in the southwestern corner of the state, in LaPlata County. The elevation of the station is over 7,500 feet. At this station the tests are under irrigation. The elevation and climate make this station a desirable place to test grains for high altitudes.

The United States Dryland Field Station, located at Akron, Colo., is operated in cooperation with the Colorado Experiment Station. This station is located in the heart of Colorado's dryland. Tests conducted here apply to crops grown under similar conditions.

TABLE 1.—*Leading types and varieties of oats grown in Colorado.*

Group	Panicle (head) type	Color of grain	Time of maturity	Variety
Covered oats	Spreading	Red	Early	Brunker Kanota
Covered oats	Spreading	White	Midseason	Colorado 37 Markton
Covered oats	Side oats	White	Late	Bliss Side

EXPERIMENTS AT FORT COLLINS

The climate at Fort Collins is adapted to the production of midseason oats. The hot, dry winds found in eastern Colorado are not common in the areas close to the mountains, and the cooler-climate oats can be grown successfully under irrigation. With few exceptions, sufficient rainfall comes in the months of March and April to start an oat crop and keep it healthy and vigorous until irrigation water can be supplied.

Rainfall

Table 2 gives the rainfall records for the years 1928 to 1935, inclusive. The average rainfall for the months of January, March, April, June, July, September, October, and December is below the 41-year average ending in 1927. The amounts below the normal for the 41-year period are as follows: January, 0.19 inch; March, 0.20 inch; April, 0.86 inch; June, 0.39 inch; July, 0.83 inch; September, 0.21 inch; October, 0.59 inch; and December, 0.26 inch. The other months were slightly above normal.

The average rainfall of 13.24 for the 8-year period is short of the 41-year average, 15.06. The rainfall for the season of 1928 = 13.00, 1929 = 13.73, 1931 = 10.26, 1932 = 12.82, and 1934 = 8.15. All these are below the average 15.06 inches for the 41-year period ending in 1927.

TABLE 2.—*Monthly, annual, and seasonal precipitation at Fort Collins Station from 1928 to 1935, inclusive.*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal*
1928	0.26	0.52	1.38	1.02	3.01	2.95	0.79	0.27	0.09	1.50	1.15	0.06	13.00	9.15
1929	0.21	0.70	1.78	2.37	1.08	0.64	0.46	2.35	2.13	0.99	0.93	0.09	13.73	6.33
1930	0.45	0.07	0.70	0.58	3.92	1.50	1.04	5.88	0.16	0.36	0.70	0.14	15.50	7.74
1931	0.00	1.26	0.41	1.07	2.94	1.46	0.05	0.75	0.51	1.00	0.63	0.18	10.26	5.93
1932	0.08	0.48	1.09	0.71	2.65	1.26	2.08	3.29	0.01	0.34	0.34	0.49	12.82	7.79
1933	0.16	0.13	0.60	1.91	4.47	0.01	1.12	5.31	1.97	0.00	0.06	1.06	16.80	8.11
1934	0.01	1.11	0.71	1.42	1.96	0.95	1.13	0.27	0.53	0.00	0.06	T	8.15	6.17
1935	0.07	0.89	0.21	1.35	6.36	0.63	1.14	0.35	3.36	0.62	0.66	0.00	15.64	9.69
Average	0.16	0.64	0.86	1.30	3.30	1.18	0.98	2.31	1.09	0.60	0.57	0.25	13.24	7.61
41-year average up to 1927[1]	0.35	0.60	1.06	2.16	2.81	1.57	1.81	1.24	1.30	1.19	0.46	0.51	15.06	...

*Seasonal—March to July, inclusive.

The rainfall records for the months of January, February, March, October, November and December are obtained from R. E. Trimble. The rainfall records for the other months are obtained from the rain gauge on the Agronomy Farm, about one mile east of the Official U. S. Weather Station located on the main college campus.

[1]R. E. Trimble, The Climate of Colorado, Colo. Exp. Sta. Bul. 340.

Treatment of Plats

The oat-test plats are sown on summer fallow. This is necessary to insure clean land and uniform moisture conditions for the test. While this treatment gives yields slightly higher than those found under average farm conditions, it gives a comparable test.

Irrigation

Average climatic conditions at Fort Collins allow the accumulation of sufficient moisture in the winter and early spring to bring an oat crop to the jointing stage without irrigation. Under normal conditions a single irrigation at this stage will produce a normal crop. If two irrigations are necessary, one should be at the tillering and the other at the jointing stage. In lighter soils more irrigations may be necessary, but care should be taken not to irrigate too late, as this encourages second growth and uneven ripening.

Care of Grain

The threshed grain from the plats is cleaned and weighed. The yield data are determined from the cleaned-grain weights. The standard errors are calculated by the variance method.[2] Ten plats of each variety are grown. These plats are scattered at random in each series so that a random sample of the soil variability is obtained for each variety.

Time and Rate of Seeding

At Fort Collins oats are planted from April 1 to 20. Good results may be obtained from planting some of the earlier varieties a little later. The usual rate of seeding is 80 pounds per acre.

Treatment for Smut[3]

Oat smut cannot be controlled by the copper-carbonate-dust treatment. Smut of hulless oats, however, is an exception.

FORMALDEHYDE SRINKLE METHOD.—The formaldehyde sprinkle treatment is successful in treating oat smut. Clean the seed before treating and pile on a clean floor or on a canvas. The oats are then sprinkled with a solution of formaldehyde, 1 pint to 40 gallons of water. Use about 1 gallon of the solution to each bushel of seed to be treated. While sprinkling, the grain should be thoroughly shoveled until each kernel is wet, after which the pile of grain should be covered with sacks or tarpaulin and allowed to remain for 2 to 4 hours. The seed may then be planted. If it is to be held, however, for any length of time after treating, care must be taken that it be dried out thoroughly and quickly. For hulless oats there is danger of seed injury from formaldehyde. Seed should be stored in clean or treated sacks to prevent recontamination.

[2]Fisher, R. S., Statistical Methods for Research Workers, 4th ed.
[3]Durrell, L. W., Smuts of Colorado Grains, Colo. Agr. Exp. Sta. Bul. 334.

FORMALDEHYDE SPRAY METHOD.[4]—When to Use: The formaldehyde spray or dry treatment should be used for oats only. It is injurious to other grains. It is safe and effective for oats, however; and it has an advantage over the other formaldehyde treatment in that it does not wet the grain.

"Mix 1 pint of commercial formaldehyde with 1 pint of water. Apply this mixture uniformly with a sprayer at the rate of 1 quart of the mixture to 50 bushels of seed as it leaves the grain spout or as it is being shoveled from one pile to another on a clean floor or canvas, or in a tight wagon box. Bin it or pile and cover with canvas, blankets, or disinfected sacks for at least 5 hours, or overnight. Then sow immediately or expose to air before storing for any length of time. If treated grain is stored in an elevator it should be moved and aerated on the following day. This is a convenient method for treating large quantities of seed oats rapidly."

FORMALDEHYDE DUST TREATMENT.[4]—"There are several brands of formaldehyde dust on the market. They contain from 4 to 8 percent of commercial formaldehyde by weight. These are usually applied at the rate of about 3 ounces per bushel (see directions on container). Use a tight mixing machine or apply by the shovel method. Pile and cover with canvas, blankets, or sacks for at least 1 day. Then sow as soon as possible."

NEW IMPROVED CERESAN DUST METHOD.—Directions for Use: This dust can be applied to cleaned oats at the rate of one-half ounce per bushel. After treatment, store the seed in an uncovered pile or in sacks for at least 24 hours. After that, plant the seed as soon as possible, but not later than 2 or 3 months after treatment. The above directions are those recommended by the manufacturer of the product. The barrel treating machine (Colorado Experiment Station Bulletin 334) can be used for mixing the seed and Ceresan.

Experimental Results

OAT VARIETY TESTS.—The detailed results of the test at Fort Collins are shown in table 1, Appendix. Table 3 shows that Markton is the highest-yielding oat. The difference in yield is significantly

TABLE 3.—*Average yield of the outstanding oats tested for the 8-year period 1928 to 1935, inclusive, at Fort Collins.*

Variety	Years grown	Average yield bus. per acre	Yield in percent of Colorado 37
Markton	8	99.4	103.94
Great Dakota F. C. 1062	8	96.7	101.12
Colorado 37	8	95.6	100.00

Level of significance = 3.2 bushels.

[4]Johnson, A. G., Haskell, R. J., and Leukel, R. W., Treat Seed Grain, U. S. D. A. Misc. Pub. 219.

higher than that of Colorado 37. The Great Dakota selection, however, is not significantly better than Colorado 37. Table 1, Appendix, shows that seven new promising hybrids are under test and that several varieties have been dropped as not suitable for Fort Collins conditions.

MIDSEASON OATS.—Colorado 37, which is a very stiff-strawed oat, is still recommended for irrigated conditions similar to those found at Fort Collins. Markton outyields it slightly but has several

Figure 2. Field of Colorado No. 37 oats at Fort Collins.

undesirable as well as desirable characteristics. It is smut resistant. In this characteristic it is more desirable than Colorado 37. However, it has slightly weaker straw than Colorado 37, which was one of the stiffer-strawed varieties grown in the United States.[5] Markton lacks the plump kernel commonly found in Colorado 37. It has, however, about the same percentage of hull.

EARLY OATS.—The early varieties, Kherson, Alaska, White Cross, and Kanota, are not recommended for Fort Collins conditions.

AGRONOMIC DATA.—Table 2, Appendix, gives a summary of the agronomic data for the various varieties included in the variety test. There is considerable variation in the date of ripening. For the oats tested for more than 5 years we find that the following varieties may be classed as midseason: Markton, Great Dakota, Colorado 37, Gold Rain II, Victory, Star, and Gold Rain. The early oats are as follows: Kherson, Alaska, Kanota, and White Cross. The short-season oats are, as a rule, shorter strawed than the midseason oats.

[5]Davis, L. L., and Stanton, T. R., Studies on the Breaking Strength of Straw of Oat Varieties at Aberdeen, Ida., Jour. of Amer. Soc. of Agron., 24:290-300, 1932.

Table 2 shows that the number of days to mature varies from 99 to 111 days for the oat varieties tested for more than 5 years, the earlier varieties maturing about 10 days earlier than the midseason varieties.

SUMMARY OF VARIETY TESTS AT FORT COLLINS.—The tests for the 8-year period 1928 to 1935 show that Markton and Colorado 37 are the best adapted of the varieties tested at Fort Collins. Since the publication of Bulletin 370, "Oat Varieties in Colorado," the following varieties have been dropped from the test: Abed Silver, Gold Rain, Victory, Alaska, Kanota, Idamine, and Gopher. Two varieties, White Cross and Anthony, have been added and dropped. Several varieties have been added and are still under test. These are Gold Rain II and Star, introductions from Sweden. Swedish Victory, Registration No. 688, received in 1928, and five hybrids from the cooperative tests with the Division of Cereal Crops and Diseases, U. S. D. A., were placed in the variety test in 1935. The hybrids are smut resistant and more or less stiff strawed.

EXPERIMENTS AT FORT LEWIS

By DWIGHT KOONCE[6]

The Fort Lewis farm is located in the San Juan Basin, in the southwestern part of the state. The farm is conducted in cooperation with the Fort Lewis School of the Colorado State College of Agriculture and Mechanic Arts, at Hesperus. The school lands are about 5 miles south of Hesperus. The experimental farm occupies benchland of the La Plata River. The land slopes to the southeast toward the river. The soil is a dark loam underlaid by gravel at a depth of 2 to 15 feet below the surface. The slope of the land is rather steep, which causes some difficulty in irrigation. Small heads of water must be used. The furrow method of irrigation is necessary for both grain and rowed crops.

Climatic Conditions

The season opens late in the spring, due to the high altitude and the fact that a heavy covering of snow usually falls in winter. The normal frost-free period is between 100 and 120 days. Table 4 gives the dates of the last killing frost in the spring, the first killing frost in the fall, and the frost-free period for the years 1923 to 1935, inclusive. The average date of the last killing frost in the spring is June 3. The average date of the first killing frost in the fall is September 21. This gives an average growing season of about 110 days.

The dates of killing frosts were taken when actual frost damage occurred to tender plants, and not on the dates when the thermometer registered 32°. This practice gave a longer frost-free period than would be obtained from the thermometer readings.

TABLE 4.—*Frost-free period at Fort Lewis, 1923-35.*

Year	Date of last killing frost	Date of first killing frost	Frost-free period
1923	June 20	September 19	91
1924	June 19	September 12	85
1925	June 12	September 14	94
1926	May 14	September 29	136
1927	June 5	September 28	117
1928	May 18	September 14	119
1929	May 29	September 9	103
1930	June 1	September 23	114
1931	May 31	September 21	113
1932	June 8	September 10	94
1933	June 7	October 15	130
1934	June 7	September 26	111
1935	June 1	September 29	120
13-year average 1923-35	June 3	September 21	110

[6]Assistant Agronomist, high altitude studies, Fort Lewis.

Precipitation

The average annual precipitation is about 18 inches (tab. 5). The rainfall is usually low in May and June, especially in June. The highest average monthly precipitation occurs in July, August, and September. There is considerable snowfall during the winter which, under normal conditions, provides sufficient moisture in the soil to carry spring crops until the first of June, when the first irrigation is usually applied.

Treatment of Plats

The oats were planted on fall-plowed land following field peas. The average date of planting was April 20. Ten plats of each variety were planted at random in rod-row plats. The yields are the average of the cleaned grain from the 10 plantings. Two or three irrigations are necessary, depending on the season.

Experimental Results

Variety tests with oats have been conducted at the Fort Lewis Station for the 7-year period 1928 to 1935,[7] inclusive. The results of these tests are tabulated in table 3, Appendix. Markton and two Great Dakota selections outyielded Colorado 37 for the period of the test. However, the exceptionally low yield of Colorado 37 in 1928 may account for this. Markton outyielded Colorado 37 in 5

[7]Hail destroyed crop in 1929.

Figure 3. Field of Colorado 37 oats at Fort Lewis Station, 1932.

TABLE 5.—*Monthly, seasonal and annual precipitation in inches at Fort Lewis from 1928 to 1935, inclusive.*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal*
1928	0.51	1.70	1.53	0.37	1.26	0.02	2.12	1.51	0.63	2.97	2.89	1.14	16.65	5.30
1929	1.24	1.74	0.95	1.21	0.68	0.00	4.13	3.91	3.34	1.19	0.20	0.18	18.77	6.97
1930	2.61	0.74	1.15	1.31	0.89	0.35	2.76	3.08	0.50	0.32	1.91	T	15.62	6.46
1931	0.15	2.45	1.03	1.82	0.50	2.03	3.20	1.14	2.22	2.09	3.64	2.35	22.62	8.58
1932	0.74	3.23	0.98	1.22	0.84	0.83	2.97	4.05	1.30	1.56	T	1.81	19.53	6.84
1933	1.66	1.32	0.60	1.88	0.72	0.66	1.82	1.98	2.51	1.21	0.82	1.40	16.58	5.68
1934	0.19	2.03	0.08	0.81	1.16	0.25	1.63	1.75	1.50	0.31	1.74	1.24	12.69	3.93
1935	2.11	2.31	3.25	1.48	3.49	T	1.16	2.38	2.57	1.69	1.12	0.67	22.23	9.38
Average	1.15	1.94	1.20	1.26	1.19	0.52	2.47	2.48	1.82	1.42	1.54	1.10	18.09	6.64
15-year average 1921-35	0.85	1.51	1.39	1.24	1.07	0.68	2.37	2.49	2.03	1.25	1.18	1.34	17.40	6.68

*Seasonal—March to July, inclusive.

TABLE 6.—*Yields of oats from date of planting; studies at Fort Lewis for the years 1931 to 1935, inclusive.*

Variety	Date planted	Yield in bushels per acre						Average	
		1931	1932	1933	1934	1935	Average	Date ripe	Days to mature
Colorado 37	April 15	104.2	90.8	87.6	77.8	130.0	98.1	8/15	119
	May 1	102.8	96.0	85.8	68.4	131.4	96.9	8/20	111
	May 15	143.8	64.2	67.8	57.2	98.0	86.2	8/29	102
	June 1	154.6	94.4	103.6	45.0	56.2	90.8	9/19	109
	June 15	126.6	94.0	72.0	6.4	45.6	68.9	10/1	108
Nebraska 21	April 15	78.0	81.2	68.2	62.4	99.0	77.8	8/3	107
	May 1	93.2	77.4	60.8	78.0	90.2	79.9	8/9	100
	May 15	90.4	79.4	59.0	67.6	98.0	78.9	8/18	92
	June 1	138.4	50.4	78.6	48.8	79.8	79.2	9/8	94
	June 15	91.2	74.6	72.4	29.0	65.6	66.6	9/18	95
Level of significance		30.0	16.0	16.0	14.0	18.0	8.9	....	...

out of 7 years. The average difference of 7.6 bushels is statistically significant. The crop failure of 1929 was due to hail. Several of the new smut-resistant hybrids show promise. Several of the earlier varieties are adapted to Fort Lewis conditions but yielded less than Colorado 37. These varieties have a shorter straw and mature about 8 or 10 days earlier.

Markton or Colorado 37 oats are well adapted to irrigated conditions at the altitude of Fort Lewis and are recommended over the earlier short-seasoned oats.

DATE OF PLANTING.—Two types of oats, midseason (Colorado 37) and early (Nebraska 21) were grown in triplicate plats for the 5-year period 1931 to 1935. These varieties were planted at 15-day intervals from April 15 to June 15 (tab. 6). There was considerable variability in the yields between plantings and years. As the average date of the last irrigation was July 16, the later plantings were short of moisture some years. However, the results as a whole show that all the plantings, except the June 15 planting, matured and produced good yields. The average date of harvest for the June 1 planting of Colorado 37 was September 19, which is about the average date of the first killing frost. Under irrigation the earlier plantings produced the better yields. It may be advisable to plant Colorado 37 oats on dryland, which has been kept free of weeds, about the first of June in order to get the benefits of the July and August rains.

EXPERIMENTS AT AKRON ON DRYLAND[8]

By J. J. CURTIS, J. F. BRANDON, and D. W. ROBERTSON[9]

Oats do not rank with wheat or corn in importance under dryland conditions in Colorado. In favorable years excellent yields have been secured, but often several years elapse between seasons favorable for oat production. As a result, the yield often is relatively low.

The present publication presents only the result of the varietal and cultural experiments with oats; and has been prepared to bring information up to date and place it in a form comparable with that from similar experiments conducted under irrigated conditions, making the data from both conditions more readily available to farmers and others of the state.

The Akron Field Station is located about 4½ miles from Akron, the county seat of Washington County. The station, containing some

[8]United States Dry Land Field Station, Akron, Colo., is operated by the Division of Dry Land Agriculture Investigations of the United States Department of Agriculture, with Colorado Experiment Station cooperating. The Cereal experiments were conducted by Division of Cereal Crops and Diseases, in cooperation with division named, from 1907 to 1924.

[9]J. F. Brandon, Superintendent of United States Dry Land Station, and D. W. Robertson, Associate Agronomist at Colorado Experiment Station, carried the work from 1924 to September, 1930. J. J. Curtis, Junior Agronomist, Division of Cereal Crops and Diseases, has been in charge of work since September, 1930.

382 acres, is located 112 miles northeast of Denver on the main line of the Chicago, Burlington, and Quincy Railroad. The topography of the station is slightly rolling. The soil is a naturally fertile, sandy loam, known locally as "hard land." The soil of this section is variable in texture but comparatively free from coarse gravel.

Climate and Precipitation

The climatic conditions at Akron are similar to those of the rest of the northeastern part of Colorado. The amount and distribution of precipitation usually is the limiting factor in crop production, although injury from low temperatures and by hail sometimes causes crop losses. Table 5, Appendix, gives the precipitation data for the Akron Field Station for the 8-year period from 1928 to 1935, inclusive. This table shows that the average annual precipitation for the 8-year period was below the average for the previous 20-year period. The precipitation was above the average for the years 1929, 1930, 1933, and 1935, and below the average for the years 1928, 1931, 1932, and 1934. The precipitation was low during the growing season, April to September, in 1931 and 1934.

Table 7 presents the climatic data for the 8-year period 1928 to 1935, inclusive. The evaporation records kept each year from April 1 to September 30 for the years 1928, 1932, 1933, 1934, and 1935 show an increase of 2.709 inches over the average for the 20-year period 1908 to 1927, inclusive. Freezing over of the evaporation tank makes it impossible to secure complete evaporation records for April.

The records show the average annual wind velocity to be between 6 and 7 miles an hour. The highest monthly velocities usually occur in March, April, and May. During July and August the atmosphere is usually comparatively quiet. Hot winds are almost unknown at Akron. The nights are cool the year round. The summer temperatures at Akron usually are mild, due to the elevation—about 4,500 feet above sea level. The average frost-free period has been about 142 days.

The latest spring frost at Akron was on June 4, 1919, while for the period of the test, 1928 to 1935, the latest killing frost was on May 22, 1930. The earliest killing frost in the fall was somewhat earlier during this period, the earliest one on record occurring on September 8, 1929. In two years, 1929 and 1930, the season was very short. The lowest precipitation on record was also recorded in this period, 7.45 inches between April and September, inclusive, in 1931. In this year the precipitation was low in April, May, July, August, and September. The year 1934 also showed a low precipitation in the growing season. The precipitation in June was high, but that of April, May, and July was low. That of July was exceedingly low. The evaporation from a free-water surface was considerably above

average and, combined with low rainfall, evidently played an important part in the crop failure of 1934.

TABLE 7.—*Seasonal and average seasonal precipitation, evaporation, date of last spring and first fall frosts, and length of the frost-free period at U. S. Experiment Station, Akron, Colo., from 1928 to 1935, inclusive.*

Year	Seasonal —Apr.-Sept., incl.— Precipitation	Seasonal —Apr.-Sept., incl.— Evaporation	May-Sept. Evaporation	Frost dates — Last spring	Frost dates — First fall	Frost-free period (days)
1928.....	12.51	43.161	37.930	April 26	Sept. 20	147
1929.....	15.54	.....	36.501	May 5	Sept. 8	126
1930.....	16.82	.....	35.348	May 22	Sept. 25	126
1931.....	7.45	.....	42.505	May 21	Oct. 13	145
1932.....	13.13	49.147	43.398	April 29	Oct. 3	157
1933.....	17.33	44.831	39.281	May 10	Oct. 7	150
1934.....	10.82	52.619	46.948	April 26	Sept. 14	141
1935.....	17.12	40.563	36.315	May 5	Sept. 27	145
Average...	13.84	46.064	39.778	May 7	Sept. 26	142
Average 1908–27..	13.63	43.355	38.412	May 11	Sept. 29	141

Experimental Methods

SOIL PREPARATION.—The earlier oat experiments at Akron were conducted almost entirely on summer fallow. Beginning with the 1917 crop, the varietal experiments with oats were sown in quadruplicate plots, two on fallow and two on corn land. Data on each variety thus were obtained on two soil preparations each season. Generally the stubble of the previous season's crop remained undisturbed over winter. In the spring the soil usually was plowed to a depth of 5 to 7 inches. In a few seasons the plowing was omitted and the soil double disked. The fallow, however, was always kept free from weeds by the use of a spring-tooth harrow or a duckfoot cultivator. The usual system practiced in preparing the fallow for seeding oats was to plow in the spring and keep free from weeds. The last cultivation in the fall was done with the duckfoot cultivator to leave the ground rough and lessen the chance of soil blowing. The spring-tooth harrow was used in the spring to level the ground or to break up any crust that had formed during the winter.

Preparation of corn land for oats varied slightly in different years. The usual procedure was to allow the small-grain stubble of the previous season to remain undisturbed until the following spring, when the ground was double disked. About the middle of May, corn was listed on the entire area, the rows running across the plats later to be sown to oats. During the summer the corn was cultivated several times to keep down weed growth. The corn was

husked and the stalks allowed to stand until early spring, when they were disked into the ground.

SIZE AND REPLICATION OF PLATS.—Starting in 1917, four systematically-distributed plats were sown to each variety of oats included in the regular plat experiments. The plats used were 8 rods long and 6 feet wide, separated by alleys 16 inches in width. Plats of these dimensions contain 1/55 of an acre. But, as the plants in them draw considerably on the moisture and plant-food in the alleys, it seems fair to consider them as 1/50-acre plats in computing yields, although their actual area is slightly less. The sowing of four plats at some distance from each other tends to reduce experimental error resulting from soil variation. With less important varieties, sometimes two plats only were sown, one on each soil preparation.

RATES AND DATES OF SEEDING.—From rate-of-seeding experiments conducted at Akron it appears that the best rate of seeding for oats is more than 4 pecks per acre. During the past few years the oat varieties were seeded at the rate of 5 pecks per acre.

Conditions in eastern Colorado generally are favorable for oat seeding about the latter part of March. The climatic records at Akron Field Station show that any delay in the seeding of the crop after early April is not advisable. Late seedings mature late in July; and warm, dry weather usually causes them to ripen prematurely, and thus the yields are low.

Experimental Results

The yields of oats at Akron usually have been less in pounds per acre than the yields of barley. Drought sometimes prevents heading of oats, in which case the crop may be cut for hay. The annual and average yields of varieties grown at Akron are presented in table 6, Appendix.

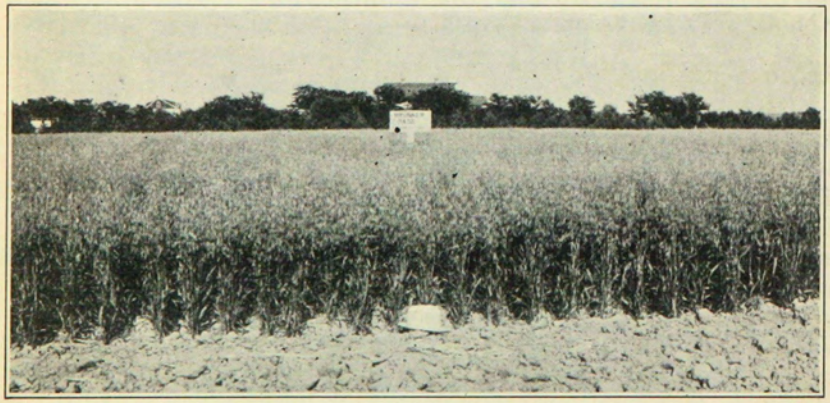

Figure 4. Field of Brunker oats at Akron Field Station.

Most of the varieties showing promise at Akron are of the early-yielding sorts. Brunker, a light-colored red oat, has outyielded all the other varieties under test. Kanota, a red oat of the Fulghum type, however, is a close second. Good yields have been obtained with adapted oats at the Akron Station for the period of the test. An exceedingly low yield was obtained in 1934, due to the exceedingly dry season. Kherson, the old standard for dryland conditions, yielded about 76 percent of Brunker. The yields in table 6, Appendix, indicate that the red or hot-climate oats are well adapted to eastern Colorado dryland conditions. The midseason oats, Colorado 37, Victory and Markton, did not yield well.

OATS ON FALLOW AND CORN LAND.—Table 8 presents the yields of five oat varieties grown on fallow and on corn land during the 8-year period 1928 to 1935, inclusive. The fallow yields are much higher for all varieties than those on corn land. The midseason oats failed to mature (dried up) 3 years out of 8 on corn land, and 1 year out of 8 on fallow. Fallow insures a crop each year, but even with the adapted varieties, Brunker and Fulghum, the difference in yield may not be sufficient to make up for the loss in crop during the fallow year. Adapted varieties of oats yield well on corn land, only one complete failure occurring in the last 8 years. However, low yields were obtained in 2 of the other years when 24 bushels was the yield on fallow. Fallow has insured a crop each year in the past 8 years.

The agronomic data are given for five varieties grown for the 8-year period 1928 to 1935. The average height of the two leading varieties has been about 21 inches, giving a yield of 1,128 pounds of straw per acre for Brunker and 1,098 pounds of straw per acre for Kanota. Taking the yield of straw and grain into consideration, there is no advantage from growing the midseason oats for hay, since the total yield is considerably higher for the Brunker and Kanota when compared with Colorado 37 and Victory.

Recommendations for Dryland Conditions

Brunker and Kanota are recommended for dryland conditions in eastern Colorado where an adapted oat variety is desired. Table 10 gives the average and annual yield of three varieties of oats grown at Akron for a 13-year period from 1923 to 1935, inclusive. Over the period of years Brunker has outyielded the other two varieties 8 years out of 13, Kanota has outyielded the other varieties 2 years out of 13, and Kherson has outyielded the other varieties 2 years out of 13. On the average Brunker has outyielded the other varieties about 2 to 6 bushels per year. Kherson is not well adapted to the hot seasons found in the eastern part of Colorado.

TABLE 8.—*Annual and average yields of five oat varieties grown on fallow and corn land during 8-year period, 1928 to 1935, inclusive, at Akron, Colo.*

Variety	C. I. No.	Yield in bushels per acre 1928	1929	1930	1931	1932	1933	1934	1935	Average
GROWN ON FALLOW										
Brunker	2054	66.3	23.3	23.5	30.5	34.3	24.1	9.2	53.9	33.1
Kanota	839	64.0	34.4	21.9	29.7	34.8	23.2	9.4	49.9	33.4
Kherson	459	47.5	22.4	18.0	19.6	34.6	15.1	5.4	36.4	24.9
Colorado 37..	1640	38.3	8.6	8.6	0	14.5	3.0	2.6	22.9	12.3
Swedish Select	134	25.6	12.5	5.5	0	17.1	3.9	4.6	19.4	11.1
GROWN ON CORN LAND										
Brunker	2054	47.0	5.4	27.4	15.7	10.2	9.4	0	39.5	19.3
Kanota	839	45.2	9.3	20.8	12.8	10.8	6.1	0	40.5	18.2
Kherson	459	41.9	6.8	18.0	8.3	14.6	3.1	0	26.4	14.9
Colorado 37..	1640	34.4	3.3	8.6	0	9.4	0	0	12.5	8.5
Swedish Select	134	24.3	3.6	6.3	0	13.3	0	0	11.6	7.4

TABLE 9.—*Agronomic data on five varieties of oats grown on fallow and corn land at the U. S. Experiment Station, Akron, Colo., 1928 to 1931, inclusive.*

Variety	C. I. No.	Dates: First heading	Fully ripe	Plant height, inches	Wt. per bu., lbs.*	Acre yield: Grain bu.	Straw lbs.
Brunker	2054	6-9	7-10	22	31.8	26.2	1128
Kanota	839	6-11	7-11	21	33.1	25.8	1098
Kherson	459	6-16	7-15	21	29.1	19.9	1159
Colorado No. 37	1640	6-28	7-23	21	28.0	10.4	1195
Swedish Select.	134	6-27	7-23	21	28.9	9.3	1084

*Weight per bushel is 5-year average from 1931 to 1935, inclusive.

TABLE 10.—*Average and annual yield of three varieties of oats grown at Akron for the 13-year period, 1923-1935, inclusive.*

Variety	C. I. No.	Yield in bushels per acre 1923	1924	1925	1926	1927	1928	1929
Kherson ...	459	34.8	6.6	11.4	5.5	46.8	44.7	14.6
Kanota	839	40.5	8.6	15.7	2.7	48.7	54.6	21.8
Brunker	2054	45.0	13.1	15.7	3.2	51.6	56.7	14.3

Variety	C. I. No.	Yield in bushels per acre 1930	1931	1932	1933	1934	1935	Av.
Kherson ...	459	18.0	13.9	24.6	9.1	2.7	31.4	20.3
Kanota	839	21.4	21.3	22.8	14.6	4.7	45.2	24.8
Brunker	2054	25.4	23.1	22.2	16.7	4.6	46.7	26.0

HISTORY AND DESCRIPTION

OAT VARIETIES ADAPTED TO COLORADO

Colorado No. 37, Reg. No. 53[10]

Colorado No. 37 (C. I. No. 1640) was selected in 1900 from a field of commercial oats on the farm of P. A. Amiss at La Gratin, in the San Luis Valley, by A. H. Danielson of the Agronomy Section, Colorado State College. Colorado No. 37 is a midseason white common oat similar to Swedish Select, except that it has decidedly fewer awns and a little shorter culm. The superior characteristics are high yield, stiff straw, and awnless kernels.

Brunker, Reg. No. 73[11]

Brunker (C. I. No. 2054) was originated as a pure line from Burt at the Akron Field Station, Akron, Colo., in 1919. The original plant row was isolated by F. A. Coffman, under whose direction the variety also was subsequently developed. Brunker was grown in head row number 16 in 1919, and thereafter it was known as Burt

Figure 5. Oat nursery at Akron Field Station.

No. 916. The collection of panicles used for sowing this series of head rows was made by T. R. Stanton from fields of Burt in the southeastern states during a field trip in the spring of 1918.

"Brunker is a very early variety of the red oat *(Avena byzantina)* group, maturing even earlier than Fulghum. The straw is rather short and slender, with a typical reddish tinge. The panicles

[10]Stanton, T. R., Griffee, Fred, and Etheridge, W. C., Registration of Varieties and Strains of Oats, Jour. Amer. Soc. of Agron., 18:942, no. 10, 1926.

[11]Stanton, T. R., Gaines, E. F., and Love, H. H., Registration of Varieties and Strains of Oats IV, Jour. Amer. Soc. of Agron., 21:1175, no. 12, 1929.

are small and equilateral, with short, spreading branches. Spikelets usually are two-flowered, sometimes three-flowered; lemmas reddish, with an occasional slender awn on the lower floret of the spikelet; basal hairs usually present, nerves somewhat prominent. Under favorable conditions the variety produces plump kernels of good bushel weight. It has shown considerable resistance to some physiologic strains of *Ustilago avenae* which infect other red oats, such as Fulghum.

"Results of recent tests indicate that Brunker is resistant to practically all known physiologic races of the oat smuts."[12]

Markton, Reg. No. 52[13]

Markton (C. I. No. 2053) originated as a pure line from an unnamed oat (C. I. No. 357) obtained by the late M. A. Carlton from the exhibit of Louis Dreyfus and Company at the Louisiana Purchase Exposition. The original head was selected in 1911 by H. J. C. Umberger at the Sherman County Branch Station, Moro, Oreg. The variety was subsequently developed and distributed by this station under the supervision of D. E. Stephens, in cereal experiments conducted cooperatively by the Oregon Agricultural Experiment Station and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture. Its immunity from covered smut was discovered by E. F. Gaines, Agricultural Experiment Station, Pullman, Wash.

"Markton is a midseason, midtall common oat with culms, hairy near the nodes, large drooping panicles, and rather long, slender-to-midplump, yellowish-white kernels. The lower floret of the spikelet usually is awned."

Kanota, Reg. No. 66[14]

Kanota (C. I. No. 839) was introduced into Kansas and was tested and distributed by the Kansas Agricultural Experiment Station. The stock of seed was obtained in 1916 by the Kansas Station from the Robert Nicholson Seed Company, Dallas, Tex. The preliminary tests were made under the direction of S. C. Salmon at Manhattan, Kans. It was first distributed to farmers of Kansas in 1919 under the name of Kansas Fulghum, but later was named Kanota.

"Kanota is an early red oat of the Fulghum type. The superior characteristics of Kanota are high yield, high test weight, and earliness."

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[12]Letter from Stanton, T. R.

[13]Stanton, T. R., Griffee, Fred, and Etheridge, W. C., Registration of Varieties and Strains of Oats, Jour. Amer. Soc. of Agron., 18:942, no. 10, 1926.

[14]Stanton, T. R., Love, H. H., and Down, E. E., Registration of Varieties and Strains of Oats II, Jour. Amer. Soc. of Agron., 19:1031-1037.

APPENDIX

TABLE 1.—*Oat yields at Fort Collins for varying periods of years from 1928 to 1935, inclusive.*

Variety	C. I. No.	Yield in bushels per acre								Average	Yield in pct. of Colo. 37
		1928	1929	1930	1931	1932	1933	1934	1935		
Markton	2053	118.8	103.5	104.3	80.4	99.2	80.6	88.6	119.4	99.4	103.94
Great Dakota	F.C. 1062	124.5	101.4	92.4	80.0	88.8	77.2	86.5	122.5	96.7	101.12
Colorado 37	1640	117.3	106.2	97.1	74.5	94.0	70.2	83.9	121.5	95.6	100.00
Great Dakota	F.C. 1063	114.0	103.7	91.0	81.3	92.2	71.6	84.2	116.8	94.4	98.71
Great Dakota	Col. 74	117.1	103.2	98.9	71.9	91.6	72.8	83.2	115.0	94.2	98.56
Gold Rain II	F.C. 1102	...	...	94.6	81.4	96.0	70.6	84.0	108.9	89.3	98.95
Kherson (Akron)	...	103.7	87.8	88.0	72.0	83.8	66.0	83.7	121.4	88.3	92.38
Victory	F.C. 1090	...	112.5	91.2	64.4	89.6	66.4	81.1	112.9	88.3	95.47
Star	F.C. 1103	...	...	94.1	77.6	92.2	66.8	84.1	110.2	87.5	97.01
Markton x Swedish Select	2662	...	...	...	...	...	...	...	122.3	...	100.66
Markton x Victory	2598	...	...	...	...	...	...	...	120.0	...	98.77
Markton x Victory	2592	...	..	...	...	...	...	...	119.7	...	98.52
Markton x Victory	2594	...	...	...	...	...	...	...	118.7	...	97.70
Markton x Idamine	2574	...	...	...	...	...	...	...	117.2	...	96.46
Abed Silver	F.C. 1027	121.8	108.9	92.1	69.0	89.2	72.4	69.9	...	89.0	96.91
Gold Rain	Col. 240	110.8	105.2	97.5	71.8	89.6	67.2	81.0	...	89.0	96.87
Victory	F.C. 679	119.8	105.1	82.3	74.0	87.8	66.4	76.1	...	87.4	95.07
Alaska	F.C. 1056	114.5	89.4	96.1	67.3	69.8	60.4	85.3	...	83.3	90.61
Kanota	839	101.4	78.9	82.6	64.9	66.8	52.6	76.4	...	74.8	81.41
White Cross	2026	...	...	87.2	62.9	74.0	59.4	74.0	...	71.5	85.18
Idamine	1834	113.6	104.3	89.7	77.0	...	...	...	...	96.1	97.34
Gopher	2027	111.4	91.0	96.6	65.5	...	...	...	...	91.1	92.26
Anthony	Col. 347	...	99.5	92.0	66.8	...	...	...	...	86.1	92.98
*Level of significance	...	11.0	7.0	8.0	8.0	8.0	7.0	9.0	13.0	3.2†	....

*Based on S.E. of Colorado 37 in bushels = twice the S.E. of a difference.
†Based on 8-year average.

TABLE 2.—*Agronomic data on oats at Fort Collins Station from 1928 to 1935, inclusive.*

Variety	C.I. No.	Years grown	Date ripe	Days to mature	Straw length	Straw strength
Markton	2053	8	7/29	110	46	S*
Great Dakota	F.C. 1062	8	7/27	108	47	S
Colorado 37	1640	8	7/28	109	46	S
Great Dakota	F.C. 1063	8	7/27	108	47	S
Great Dakota	Col. 74	8	7/27	108	47	S
Gold Rain II	F.C. 1102	6	7/27	109	48	S
Kherson (Akron)	....	8	7/24	105	42	S
Victory	F.C. 1090	7	7/28	109	45	S
Star	F.C. 1103	6	7/27	109	47	S
Markton x Swedish Sel.	2662	1	8/7	124	52	S
Markton x Victory	2598	1	8/7	124	55	S
Markton x Victory	2592	1	8/6	122	47	S
Markton x Victory	2594	1	8/7	123	51	M†
Markton x Idamine	2574	1	8/7	124	53	S
Abed Silver	F.C. 1027	7	8/1	111	46	S
Gold Rain	Col. 240	7	7/28	107	47	S
Victory	F.C. 679	7	7/29	109	46	S
Alaska	F.C. 1056	7	7/19	99	44	S
Kanota	839	7	7/20	100	38	S
White Cross	2026	5	7/16	99	43	S
Idamine	1834	4	7/29	110	49	S
Gopher	2027	4	7/24	104	42	S
Anthony	Col. 347	3	7/29	111	45	S

* = stiff.
† = medium.

TABLE 3.—*Yield of oats at Fort Lewis for varying periods of years from 1928 to 1935, inclusive.*

Variety	C.I. No.	Yield in bushels per acre							Average	Yield in pct. of Colo. 37
		1928	1930	1931	1932	1933	1934	1935		
Markton	2053	58.3	70.3	134.0	105.3	107.5	114.2	105.5	99.3	108.25
Great Dakota	F.C. 1063	49.0	81.0	126.3	105.3	98.5	128.2	106.4	99.2	108.19
Great Dakota	Col. 74	52.4	76.4	127.9	102.0	103.2	122.2	105.3	98.5	107.37
Colorado 37	1640	39.4	60.1	117.0	90.5	106.6	120.2	108.3	91.7	100.00
Swedish Select	Col. 253	52.4	64.3	113.0	93.8	93.6	111.6	98.9	89.7	97.74
Kherson 317	...	54.8	65.4	120.5	105.2	87.6	93.9	92.3	88.5	96.51
Gopher	2027	50.8	61.7	121.7	101.1	85.9	93.0	84.2	85.5	93.19
Nebraska 21	Col. 257	49.9	57.7	117.8	103.8	75.2	90.6	80.9	82.3	89.69
Great Dakota	F.C. 1062	...	...	...	105.9	106.9	135.1	96.6	111.1	104.44
Gold Rain II	F.C. 1102	...	...	...	105.0	107.0	123.4	104.2	109.9	103.29
Brunker	2054	...	43.5	72.1	90.7	65.9	49.2	72.1	65.6	65.29
Markton x Victory	2598	...	...	...	...	...	...	116.9	...	107.94
Markton x Swedish Sel.	2662	...	...	...	...	...	...	113.0	...	104.34
Markton x Idamine	2574	...	...	...	...	...	...	107.1	...	98.89
Markton x Victory	2592	...	...	...	...	...	...	107.1	...	98.89
Markton x Victory	2594	...	...	...	...	...	...	104.9	...	96.86
Abundance	...	46.4	66.4	118.4	...	...	...	...	77.1	106.79
Gold Rain	Col. 240	38.3	55.9	112.7	...	...	...	...	69.0	95.57
Kanota	839	51.5	57.3	78.7	...	...	...	...	62.5	86.61
Level of significance	...	10.0	16.0	16.0	14.0	13.0	11.0	11.0	5.0	....

TABLE 4.—*Agronomic data on oats at the Fort Lewis Substation from 1928 to 1935, inclusive.*

Variety	C.I. No.	Years grown	Date ripe	Days to mature	Straw length	Straw strength
Markton	....	7	8/14	113	42	S
Great Dakota	F.C. 1063	7	8/15	114	42	S
Great Dakota 74	....	7	8/15	114	47	S
Colorado 37	....	7	8/15	115	46	S
Swedish Select	....	7	8/15	115	44	S
Kherson 317	....	7	8/4	104	36	S
Gopher	....	7	8/7	107	38	S
Nebraska 21	....	7	8/5	104	37	S
Great Dakota	F.C. 1062	4	8/18	114	44	S
Gold Rain II	....	4	8/18	114	43	S
Brunker	2054	6	8/1	99	35	S
Markton x Victory	2598	1	8/23	118	44	S
Markton x Swedish Sel.	2662	1	8/23	118	44	S
Markton x Idamine	2574	1	8/23	118	44	S
Markton x Victory	2592	1	8/23	118	44	S
Markton x Victory	2594	1	8/20	115	44	S
Abundance	....	3	8/13	117	45	M
Gold Rain 240	....	3	8/13	117	45	M
Kanota	....	3	8/3	107	34	M

TABLE 5.—*Monthly, annual, seasonal, average monthly, average annual, and average seasonal precipitation at the U. S. Experiment Station, Akron, Colo., during the period 1928 to 1935, inclusive.*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Seasonal Apr.-Sept.	Annual
1928	.13	.17	.32	.17	3.52	5.39	3.14	.25	.04	1.75	.49	T	12.51	15.37
1929	.07	.34	.32	3.43	1.19	1.15	4.44	2.66	2.67	2.76	.49	.09	15.54	19.61
1930	.07	T	.17	2.28	5.52	1.61	3.54	3.48	.39	.83	1.05	.09	16.82	19.03
1931	.01	.71	.95	.84	1.38	2.20	1.49	1.04	.50	.61	.11	.90	7.45	10.74
1932	.27	.25	.60	1.93	2.91	2.80	4.17	1.27	.05	.49	.19	.21	13.13	15.14
1933	T	.04	.74	4.58	4.15	.92	2.01	4.54	1.13	T	.04	.75	17.33	18.90
1934	.02	.91	.36	.64	1.42	4.14	.31	3.56	.75	.04	.37	.09	10.82	12.61
1935	.01	.23	1.22	3.25	7.35	3.08	.37	.83	2.24	.21	.26	.04	17.12	19.09
Average	.07	.33	.59	2.14	3.43	2.66	2.43	2.20	.97	.84	.38	.27	13.84	16.31
20-year average, 1908-27	.34	.47	.86	2.25	2.66	2.26	2.65	2.24	1.58	1.06	.57	.74	13.63	17.68

TABLE 6.—*Annual and average yields of oat varieties grown at the U. S. Experiment Station, Akron, Colo., 1928 to 1935, inclusive; and average yield as compared with Brunker.*

C. I. No.	Variety	1928	1929	1930	1931	1932	1933	1934	1935	No. years grown	Variety average	Brunker average	Yield in pct. of Brunker
2054	Brunker	56.7	14.3	25.4	23.1	22.2	16.7	4.6	46.7	8	26.2	...	...
787	Richland	56.3	11.6	21.5	13.2	28.5	8.8	3.5	33.4	8	22.1	26.2	84.4
839	Kanota	54.6	21.8	21.4	21.3	22.8	14.6	4.7	45.2	8	25.8	26.2	98.5
459	Kherson	44.7	14.6	18.0	13.9	24.6	9.1	2.7	31.4	8	19.9	26.2	76.0
1640	Colorado 37	36.4	6.0	8.6	0	12.0	1.5	1.3	17.7	8	10.4	26.2	39.7
134	Swedish Select	25.0	8.1	5.9	0	15.2	2.0	2.3	15.5	8	9.3	26.2	35.5
708	Fulghum	52.8	22.9	19.5	20.7	23.4	13.7	...	...	6	25.5	26.4	96.6
2491	Trojan	...	17.3	27.4	21.5	23.1	14.7	5.5	40.1	7	21.4	21.9	97.7
2823	Early Rustproof	...	...	...	21.7	19.3	17.2	4.2	45.0	5	21.5	22.7	94.7
2892	Franklin	...	...	...	14.7	27.7	8.8	3.5	30.7	5	17.1	22.7	75.3
2820	Columbia	...	...	...	...	25.9	12.8	4.0	40.9	4	20.9	22.6	92.5
727	Burt x Sixty-Day	55.0	14.2	23.5	18.8	...	...	...	...	4	27.9	29.9	93.3
2329	Iogold	48.1	10.9	16.8	12.4	...	...	...	...	4	22.1	29.9	73.9
841	Nebraska No. 21	48.0	5.0	18.0	14.0	...	...	...	...	4	21.3	29.9	71.2
2053	Markton	44.1	9.5	23.5	13.0	...	...	...	...	4	22.5	29.9	75.3
3330	Edkin	...	...	13.7	11.6	23.2	6.5	...	...	4	13.8	21.9	63.0
3008	Richland Sel. 52	...	...	...	...	...	8.7	3.0	28.4	3	13.4	22.7	59.0
729	Albion	47.8	9.7	18.8	...	...	...	...	...	3	25.4	32.1	79.1
2019	Colburt	40.3	12.6	9.0	...	...	...	...	...	3	20.6	32.1	64.2
....	Burt Sel. 6076-16	...	18.5	23.8	20.1	...	...	...	...	3	20.8	20.9	99.5
....	Ligowa	32.3	4.0	...	...	...	...	...	...	2	18.2	35.5	51.3
....	Golden Rain	...	7.5	...	...	...	...	...	...	1	7.5	14.3	52.4
3227	Fulghum H.C. 726	...	...	...	...	...	...	5.9	40.7	2	23.3	25.7	90.7
3228	Fulghum H.C. 713	...	...	...	...	...	...	5.4	44.1	2	24.8	25.7	96.5
2330	Kherson 459-14-3	...	9.7	...	...	...	...	...	...	1	9.7	14.3	67.8