BULLETIN 329 JANUARY, 1928

COLORADO WHEAT VARIETIES

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COLORADO WHEAT VARIETIES

SUMMARY[1]

In Colorado some 20,000,000[2] bushels of wheat are produced annually. The area sown to wheat each year varies. The average acreage sown to wheat in the last six years is 1,440,333 acres. Over 70 percent of the total wheat produced in Colorado is produced without irrigation.

There are three localities in Colorado where variety tests with grain are being carried. The Fort Collins station is located in the north-central part of the state. At this station variety tests are carried under irrigation. The type of soil, elevation and climatic conditions make it fairly representative of the irrigated sections in northeastern Colorado.

The Fort Lewis farm is located in the southwestern corner of the state in La Plata County. The elevation of the farm is over 7,000 feet. On this farm grains are tested under irrigation. The elevation and climate make this farm a desirable place to test grains for high-altitude conditions.

The U. S. Dry Land Field Station located at Akron, is operated in co-operation with the United States Department of Agriculture. This station is located in the heart of the wheat belt of Colorado. Tests conducted there should give results which can be applied to similar conditions in that region.

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

Such an instance is that regarding summer fallow. In the Akron area, with a precipitation of about 17 inches, summer fallow is not the best practice. It may be a necessary practice to control weeds. Also in some areas corn and cane cannot be grown to advantage. In areas of low rainfall, the moisture stored in the fallow will increase yields to a greater relative extent than where 17 inches or more of moisture fall during the year.

At Fort Collins, under irrigation, Kanred and Turkey Red are two of the highest-yielding wheats. Clark's Blackhull, a new introduction, yields practically as high as Turkey Red in the years it has been tested. It is meeting strong objections from millers and bakers.

[1] This bulletin is the result of experiments carried by the Agronomy section, Colorado Experiment Station at Fort Collins and Fort Lewis and by the Office of Cereal Crops and Diseases, at Akron, co-operating with the Office of Dry Land Agriculture and the Colorado Experiment Station.

[2] Average of a six-year period from 1920 to 1926, inclusive.

Since it has been outyielded by both Kanred and Turkey there seems little reason to grow Blackhull in the regions covered by these experiments. Kanred matures slightly earlier than Blackhull and is more rust resistant than Turkey Red.

In milling and baking tests conducted in 1921, 1922 and 1923 Kanred equalled Turkey in both milling and baking value.

None of the soft or semi-hard winter wheats has yielded as high as the Crimean[1] types and their milling and baking values make them less desirable to most millers than the hard red winter wheats. Local demands may require a certain amount of soft wheats for blending. Their general production in this section is not recommended.

Over a period of years (8 years) Marquis wheat has proved to be one of the best-adapted hard red spring wheats, under irrigation. Several durum wheats have yielded well under irrigation. But they do not outyield Marquis sufficiently to recommend their growth. Besides they sell at a lower price.

Under irrigation no strain or variety has yielded sufficiently high to recommend its growth in place of Marquis. Several promising wheats are under test. They have not been grown long enough to determine their yielding ability under irrigation.

Under irrigation at Fort Collins the Turkey types outyield the highest yielding spring wheats by 15 bushels or more.

At Fort Lewis the Turkey types of wheat gave the highest yields.

Of the spring wheats, Defiance, a soft white wheat, gave the highest yield for a four-year period, 1922 to 1925, inclusive. Preston and Kitchener, two hard red spring wheats, yielded slightly less, but the difference was so small that it could scarcely be considered significant.

Preston is a bearded hard red spring wheat. Both Preston and Kitchener are earlier-maturing wheats than Defiance. Consequently they are more likely to escape rust infection.

At Fort Lewis the difference between the highest-yielding winter wheat and the highest-yielding spring wheat is slightly in favor of the winter variety.

On the dryland field station at Akron, average yields of the better-adapted wheat varieties are fairly satisfactory. But, partial or complete failure may occur. Winter wheats of the Crimean type have produced higher yields than varieties of any other type. Kanred is the highest-yielding variety now being grown. Turkey has produced good yields over a long period of years.

Winter wheat has shown the best results when sown as early in the fall as climatic conditions and soil moisture justify.

[1] Clark, J. A., Martin, J. H., and Ball, C. R., Classification of American Wheat Varieties, USDA, Bul. 1074, page 145, August, 1923.

Of the spring wheats, Peliss durum has outyielded all other varieties. The spread in price between durum and hard red spring wheat often is sufficient to warrant growing the latter. Converse (Red Russian) has been the highest-yielding hard red spring variety.

Spring wheat should be sown as early in the spring as soil conditions permit. The seeding of spring wheat cannot be recommended for the drylands, except possibly as a catch crop where a feed crop is not wanted. Winter wheat when sown as late as the middle of October, usually will outyield spring wheat.

Fallowing for either winter or spring wheat probably is not ordinarily justified in regions similar to the Akron station where there is a rainfall of 17 inches or above. Under such conditions fallow does not usually increase wheat yields over yields obtained on cornland sufficiently to justify the added cost. There are many sections with a lower rainfall than 17 inches where fallowing is regularly justified. At Akron, seeding on cornland usually has hastened maturity, produced shorter straw and smaller yields of both straw and grain than seeding on fallow.

Milling and baking experiments extending over a period of 5 years, which are confirmed by more extensive experiments, indicate that Kanred and Turkey Red are practically equal in milling and baking qualities.

As a result of the varietal experiments with wheat, the following varieties appear to be best adapted, and are recommended for growing in Colorado under conditions similar to those found at the various experimental farms:

Conditions similar to those at Fort Collins (irrigated)

WINTER WHEAT	SPRING WHEAT
Kanred	Marquis
Turkey Red	

Conditions similar to those at Akron (dryland)

WINTER WHEAT	SPRING WHEAT	DURUM
Kanred	Hard Red Spring	Akrona
Turkey	Converse (Red Russian)	Kubanka
		Peliss

Conditions similar to those at Fort Lewis (altitude aver 7,000 feet—irrigated)

WINTER WHEAT	SPRING WHEAT
Kanred	Defiance
	Preston
	Kitchener
	Marquis

WHEAT UNDER IRRIGATION

Spring wheat is grown mostly on irrigated land. On the heavier lands if soil moisture conditions are good the soil should be prepared by fall plowing. If the soil is dry in the fall, plowing had better be put off until spring. If the spring grain follows beets or potatoes, any fall plowing will necessarily be late. Spring plowing should be done as early as possible. The plow should be followed immediately by the disk and harrow. The land should be leveled prior to seeding. The object of leveling is to produce a surface of uniform grade in order to help the easy distribution of water. The usual rate of seeding for spring wheat on irrigated land is 90 pounds per acre.

In the northern Colorado districts, it is very seldom necessary to "irrigate up" small grains. In the Arkansas Valley, often in the San Luis Valley and some western slope localities natural precipitation is so uncertain that it is necessary to "irrigate up." On the tighter soils where it is necessary to irrigate crops up, the land should be irrigated, then disked, leveled, harrowed and planted as soon as cultivation is possible. On light, sandy soils it is better to plant and irrigate after planting because sandy lands dry out at the surface so quickly. If there is moisture enough in the soil to keep the crop growing, there is no need of irrigating until about the time the crop commences to head. The crop should not be allowed to suffer for water, even if it is necessary to irrigate prior to heading. On the tighter lands in northern Colorado one irrigation for small grains is usually amply sufficient. On the sandier land two or more irrigations distributed thruout the growing season may be necessary to produce the same results. In those sections where it is necessary to irrigate crops up, two irrigations on the tighter lands are sufficient and usually three irrigations on the sandier lands. If the crop is growing rather vigorously, showing no need of water, the heaviest seed production can be obtained by irrigating when the grain is heading. Wheat should have sufficient moisture to insure vigorous growth and bring the plant to heading. One good irrigation at heading will insure a crop with the normal rainfall on the tighter lands of northern Colorado. Little or nothing is gained by irrigation after the grain is in the milk and often losses are caused by delayed ripening and lodging.

Winter wheat grown under irrigation should be seeded at about 60 pounds per acre. Winter wheat should be sown in September in order to take advantage of all the fall moisture possible. Spring wheat, ordinarily, should not be sown after the 20th of April. Wheat sown later than this may mature and give a good yield but the danger of rust attack[1] increases with the lateness of ripening.

[1] Durrell, L. W., and Lungren, E. A. Barberry Eradication and Sources of Black Stem Rust in Colorado. Colo. Agr. Exp. Sta. Bul. No. 315.

DRYLAND WHEAT

Over 70 percent of the wheat produced in Colorado is produced without irrigation. Over 80 percent of the dryland wheat is winter wheat.

PREPARATION OF SOIL.—Several methods of preparation may be followed, depending on the rainfall and the type of soil. Where the rainfall is sufficient and the soil comparatively new, a rotation in which wheat follows corn may be used. The wheat can either be sown between the rows of corn with a small drill or the corn cut for forage and the wheat drilled in on corn stubble. Good results by the latter method have been obtained at Akron. Spring wheat can be drilled on cultivated corn stubble in the spring.

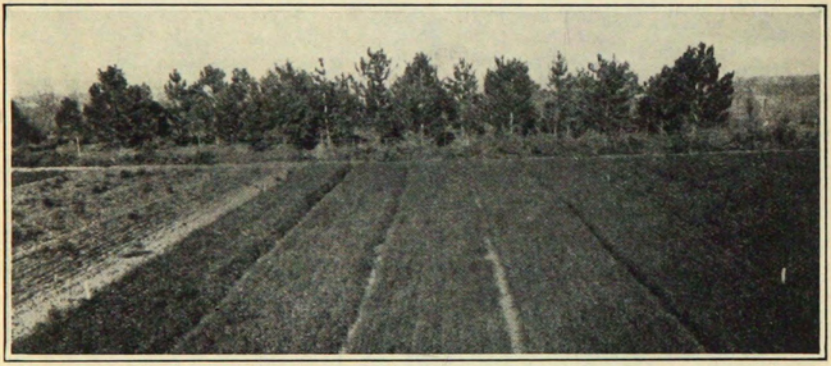
Figure 1—Summer Fallow Showing a Rough Surface. Such a Surface is Desired for Prevention of Blowing.

In many sections summer fallow gives better results especially where the rainfall is light. Of course, extremely sandy lands should never be broken up for non-irrigated farming. The so-called hard lands and the sandy loams can be handled so as to prevent blowing. The essential feature of such handling is to keep a "small cloddy" surface. Superintendent A. L. Nelson of the Archer, Wyoming, station, just north of the Colorado line, has accomplished this by the use of the furrow drill. This drill ridges the soil and plants the seed much deeper than the ordinary drill. These ridges catch more snow and aid in preventing soil drifting. This drill has the added

advantage of planting the wheat close to the moisture supply. The furrow drill seems to give better results the more severe the conditions. From results not reported in this bulletin it appears that the drier the conditions and the colder the winters, the more favorable will be furrow-drill plantings over the use of the common drill.

Sometimes where blowing is severe it is necessary to cultivate or list strips thru the wheat crosswise of the direction of the prevailing winds, but ordinarily the furrow-drill seeding will give ample protection.

Bean land blows worse than almost any other cultivated field because the soil is usually clear of all vegetation and finely pulverized at the top. If there are rains at all after the bean harvest, the surface should be cultivated when slightly moist so as to make a "small cloddy" surface, otherwise bean lands will blow severely. If the weather conditions are dry, it may be necessary to cross list such land



2 pecks. 3 pecks. 4 pecks. 5 pecks. 6 pecks.

Figure 2.—Rate and Date of Seeding on Dryland Fallow at Akron. Seeded August 19, 1926.

to prevent blowing. Where cross listing is done at the right time and in advance of the wind, there will be little damage. Once the soil starts to blow it takes more work and a much rougher surface to prevent damage.

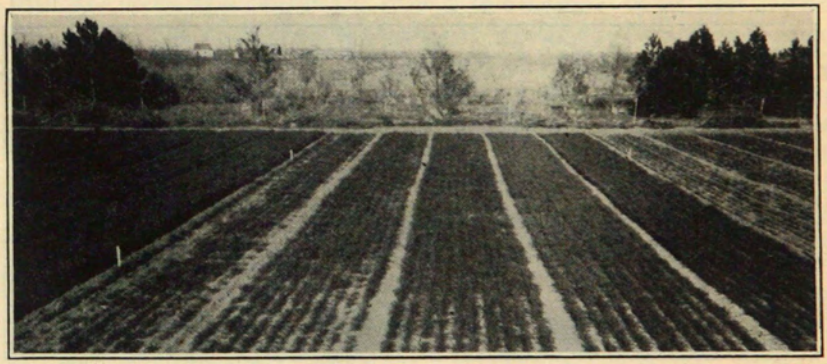
Summer fallow has its disadvantages. Crops grown on summer fallow have to stand the costs of cultivation the first year and taxes for two years. This in many places makes summer fallow very costly. Cheaper means of summer fallowing should be used where possible. In some sections of northeastern Colorado the following method of summer fallowing has been used with success:

The ground is listed in the fall after the crop has been removed or in the early spring. Any method which will prevent weed growth in the fall will aid in conserving moisture. When the weeds com-

mence to come out of the ground in the late spring the lister is used to break out the ridges. The usual outfit for this work consists of a three-row lister. The ridges are then broken down in different ways, depending upon seasonal conditions. Sometimes one harrowing is given to kill small weeds. Sometimes the land is disked, but the disk is used as sparingly as possible because it pulverizes the surface too much. One of the best tools is the so-called duckfoot or field cultivator. This tool leaves the surface of the ground slightly ridged and in a cloddy condition.

Results at the Akron station[1] have shown that the small grains, either fall or spring sown, do not do as well after sorgo as after corn. Where possible, sorgo land should be seeded to some row crop that is planted late in the spring.

Winter wheat is one of the best adapted and generally one of the most profitable grain crops. It is also the most responsive to cultural



2 pecks. 3 pecks. 4 pecks. 5 pecks. 6 pecks.

Figure 3.—Rate and Date of Seeding on Dryland Fallow at Akron. Seeded October 4, 1926.

methods. The yield of winter wheat on fallow has averaged 19.1 bushels, on disked corn ground 13.5 bushels and on land continuously cropped to wheat and deep fall plowed, 10.5 bushels per acre.

RATE AND DATE OF SEEDING.—The earlier winter wheat can be planted in the fall, the better, provided there is sufficient moisture to maintain fall growth, so that the wheat will not be killed by fall drouth. Results at Akron[2] have shown that the highest yields are obtained with wheat sown between September 6 and September 21. Good yields are obtained with plantings as late as October 11. Spring wheat is sown as early in the spring as practicable. Generally, conditions are favorable for seeding in the latter part of March.

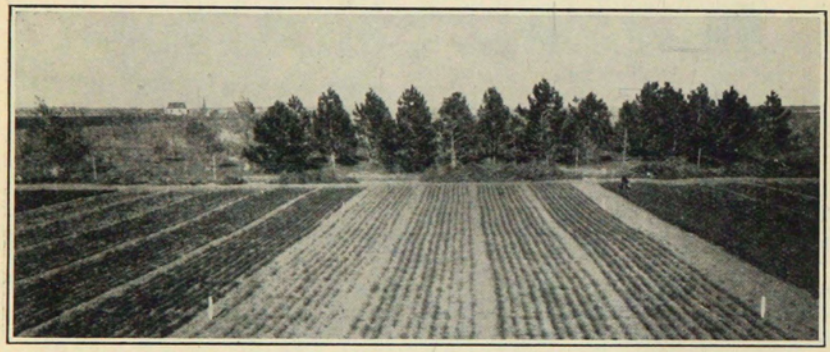
[1] Brandon, J. F., Crop Rotation and Cultural Methods at the Akron (Colorado) Field Station. USDA, Dept. Bul. No. 1304. March, 1925.

[2] Coffman, F. A. Experiments with Cereals at the Akron (Colorado) Field Station in the 15-year period, 1908 to 1922, inc. USDA Bul. No. 1287, March, 1925.

Akron data show little difference between the two and six-peck rates for winter wheat. The yields from the lighter seedings, however, have been the lowest most often. In all years the better yields were from the seedings heavier than two pecks to the acre. The data, however, may not be sufficient to draw definite conclusions. There seems to be enough information to justify the assertion that, the more severe conditions become, the greater the amount of seed must be used. With good conditions results may be obtained with light seedings. Under certain conditions good yields may be obtained from seeding of less than two pecks.

TREATMENT OF SEED

Wheat smut is prevalent in Colorado. Accordingly all seed wheat should be treated before planting. Some varieties are more susceptible to smut attack than others. So far none of the varieties



2 pecks. 3 pecks. 4 pecks. 5 pecks.

Figure 4.—Rate and Date of Seeding on Dryland Fallow at Akron. Seeded November 2, 1926.

recommended are entirely immune to smut. Kota, Bobs and Defiance are more susceptible to smut infection than Marquis.

COPPER CARBONATE.—Colorado Experiment Station Bulletin No. 333 describes the copper carbonate method of treatment[3] which is generally recommended. At least two ounces of 50 percent copper carbonate should be used for each bushel of seed wheat. If "let down" copper carbonate compounds are used, more than 2 ounces should be applied. It may be necessary to use 3 to 4 ounces.

To get the best results wheat, as free from smut as possible, should be used. In no case should wheat having over 5 percent smut be used for seed. This fairly clean seed should be thoroly mixed with the copper carbonate with a mechanical mixer. A mixer which

[3] Durrell, L. W., and Kidder, Waldo. Smuts of Small Grain and Methods of Control. Colo. Agr. Col. Extension Circ. 7.

raises a part of the wheat and carbonate and drops it back into the center of the pile is to be preferred.

FORMALDEHYDE TREATMENT.—If the formaldehyde treatment is used the formula should be about 1 pint of 40 percent formaldehyde to 40 gallons of water. Some recommend using 1 pint of formaldehyde to 30 gallons of water. Treatment by formaldehyde is accomplished by mechanical mixers or by hand mixing. For hand mixing, a clean floor, a wagon box or a canvas upon which to pile the grain, may be used. As good a way of hand treatment as any is to sprinkle a pile of the grain at the rate of about 1 gallon of solution to 1 bushel of wheat.

The pile of grain should be sprinkled and thoroly turned, much as concrete is mixed. Usually alternate sprinkling and turning will soon get all of the wheat dampened by the solution. When all of the wheat is dampened, the treated grain should be covered with wet sacks or a canvas for from 2 to 4 hours. In no case should the covering be more than 6 hours. If left covered for a long time the germination of the grain will be lowered. At the end of 4 to 6 hours the covering should be removed and the grain permitted to air. If the pile is large the treated grain should be spread out. The formaldehyde treatment will only kill the spores on the grain. It will not prevent reinfection. To prevent reinfection, clean, treated bags should be used to take the grain to the field. The drill itself should be disinfected with some of the solution just before starting the seeding operations.

WHEAT PRODUCING AREAS

The climate of Colorado varies greatly. Extremes in both temperature and rainfall are frequent. In some sections less than 10 inches of moisture fall in a year. In other areas the precipitation is 20 inches or more. In the wheat-growing sections the rainfall varies from 10 to 20 inches, and the altitude from below 4,000 to above 7,000 feet. The wheat-growing sections of Colorado can be divided into two general areas, the irrigated and the non-irrigated. The irrigated sections comprise those areas lying along the various water courses. Thus the natural rainfall is supplemented by irrigation. Irrigated farming produces about 30 percent of the wheat grown in the state. The other 70 percent is produced on the non-irrigated farms.

Over 70 percent of the wheat is grown in northeastern Colorado, in Weld, Logan, Sedgwick, Phillips, Morgan, Washington, Yuma, Adams, Arapahoe, Elbert, Lincoln, Kit Carson, and Cheyenne Counties. These same counties also produce over 70 percent of the total number of bushels. In 1925, 82 percent of Colorado's wheat acreage

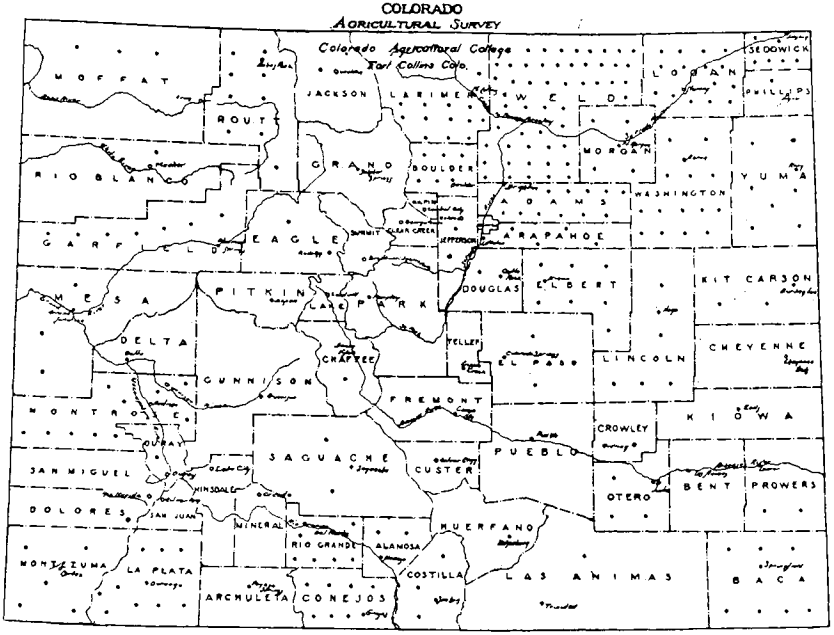


Figure 5—Distribution of Spring Wheat in Colorado in 1925. Each Dot Represents 1,000 Acres.

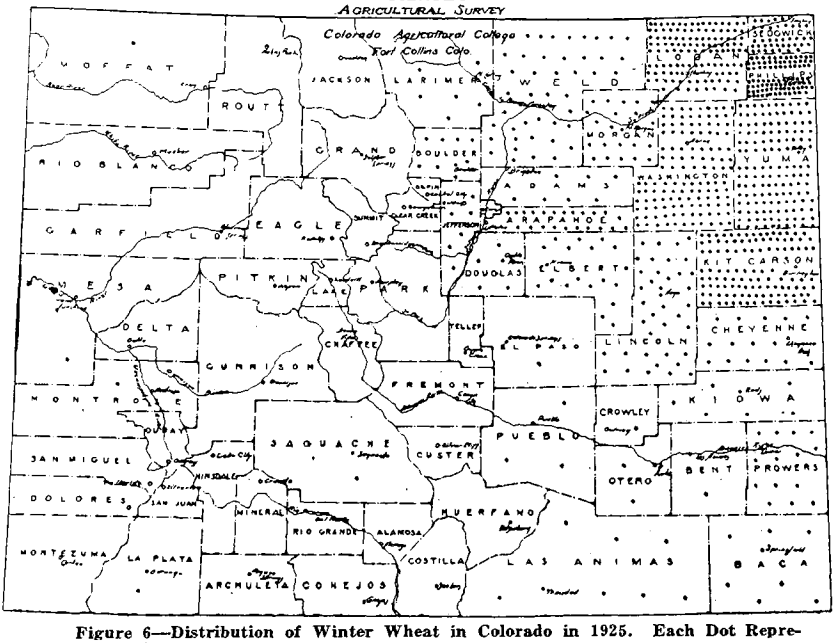


Figure 6—Distribution of Winter Wheat in Colorado in 1925. Each Dot Represents 1,000 Acres.

was grown in this section and 76 percent of the yield was produced in the same area. Winter wheat predominates in this section. The largest area of the spring wheat is produced in this part of the state. Other extensive areas are in the San Luis Valley[1] and the San Juan Basin[1]. Larimer, Boulder, and Montrose Counties also produce a considerable amount of spring wheat. Ninety-five percent of all the winter wheat in Colorado is produced east of the mountains.

HISTORICAL REVIEW

Steinel, in his History of Agriculture[2] in Colorado, briefly discusses the introduction of wheat into Colorado. Wheat migrated north with the Spanish conquerors and evidently was grown in Colorado before the days of the gold rush. One of the first reports of wheat grown in Colorado comes from the Rocky Mountain News of October 27, 1859. Like many other similar incidents, this is the report of a single plant grown from a single kernel of wheat mixed with some corn. In the following years other farmers tried small plats of wheat with more or less success. Several reports of 35 and 40 bushel yields appeared in the newspapers of that period. About that time came reports of the success of winter wheat. The Rocky Mountain News of June 15, 1861, announced that there would be a large demand for winter wheat for sowing the latter part of August.

In the U. S. Department of Agriculture yearbook for 1921, page 91, a map of the wheat production of the United States shows Colorado to have produced 200,000 bushels of wheat in 1869. This has increased to 18,196,000 bushles[3] in 1919.

WHEAT ON THE DRYLAND.—J. E. Payne,[4] in discussing the introduction of wheat into the plains sections, states:

> "Eastern Colorado was settled mainly by people from Kansas and Nebraska. These people had raised wheat as a main crop in their former homes and, as a matter of course, began planting wheat when they came to the new country. The usual successes and failures followed. In 1892 an immense crop was raised, but 1893, 1894 and 1895 were hard years for the wheat growers. The years following were not so bad as 1893 and 1894. Wheat planting began in earnest in 1888. The average of wheat per acre reported by a number of representative farmers now living (1904) near Vernon and Idalia for the eleven years, 1888 to 1899 inclusive, is ten bushels per acre. This includes the years when the crop was an entire failure, on account of drouth, hail or insect enemies."

During the years 1902 and 1903 a spring variety of Macaroni wheat was introduced into the country. About 2,500 bushels of this wheat were grown on the Idalia and Vernon divides in 1903.

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[1] McCann, Roud and Summers, T. H. Colorado's Agriculture. 1925.
[2] Alvin T. Steinel. The History of Agriculture in Colorado, 1927.
[3] U. S. D. A. Yearbook, 1921, page 523.
[4] J. E. Payne. Wheat Raising on the Plains. Colo. Agri. Exp. Sta. Bul. 89 (1904).

FIRST VARIETIES GROWN.—The first varieties grown in Colorado were mixed. The wheats which survived the drouth years were used. Their origin was hard to trace. Many were known as "White Wheat" or "Red Wheat," often having a farmer's name attached as a prefix. Of the irrigated wheat Sonora was possibly the earliest one tried. It was undoubtedly grown by the Spaniards.

EARLY WORK AT THE STATION.—Professor A. E. Blount carried the first variety tests at the Fort Collins station. In some of the earlier reports as high as 344 varieties were tested in single rows.[1] Later tests with a few of the more promising varieties were carried in quarter acre plats. At a later date one-tenth acre plats were used and the number of varieties reduced. Blount in his early work made many crosses, none of which are grown in Colorado at the present time. Of his selections Regenerated Defiance is still grown in some sections of Colorado. Gypsum,[2] another of his productions is still grown in some sections of Idaho. [3]While few of Blount's hybrids were used in this country, they were of sufficient promise to be used by Farrer in Australia as parents of many of the wheats grown in that country.

Prof. W. H. Olin and Mr. A. H. Danielson, while connected with the Fort Collins station, purified and increased one of Prof. A. E. Blount's selections from Defiance. The Colorado Experiment Station had 300 bushels of this selection for distribution in 1908 and it is from this source that our Regenerated Defiance of today was obtained.

PEDIGREE OF BLOUNT'S REGENERATED DEFIANCE WHEAT

"Prof. A. E. Blount, Agriculturist and Plant Breeder of the Colorado Experiment Station from 1879 to 1891, obtained from E. C. Pringle, in 1879, a small sample of Defiance wheat which Mr. Pringle claimed to have originated. From this foundation stock, Prof. Blount obtained a large number of average heads, the largest of which were not quite three inches in length, containing an average of 21 kernels each.

"By following his rule of 'selecting the best to cross on the best to get a better offspring,' Prof. Blount, in 1885, had heads five to six inches long, each containing an average of 43 kernels. From 94 grains in 1886 he produced 3.15 lbs. of superior quality wheat from which foundation stock he increased for distribution to the wheat districts of Colorado, under the irrigation ditch.

"This became the dominant spring wheat of Colorado early in the '90's, millers finding flour made from this wheat had a ready sale as superior biscuit flour all through the south. By 1903, through lack of seed selection, careless methods of threshing, seeding and irrigating, as well as following grain with grain, this Defiance wheat, in many sections of the state, had become seriously mixed.

"Mr. A. H. Danielson, assistant Agriculturist at Colorado Agricultural College, in 1903, found a bottle of the foundation stock of

[1] Report of the Secretary of the State Board of Agriculture, Dec. 9, 1885, to Dec. 9, 1886.
[2] J. A. Clark, J. H. Martin and C. R. Ball, Classification of American Wheat Varieties. U. S. D. A. Bul. 1074, page 67.
[3] Carlton, M. A. (1916). The Small Grains, page 219.

Defiance left by Prof. Blount, when he left the Colorado Station in 1891. This wheat was known to be at least 12 years old but was seeded, hoping to obtain from this seed, plants to renew and regenerate this spring wheat which had given such excellent satisfaction to miller, farmer and baker.

"Three plants grew, one sending up 14 spikes. This superior plant was saved and the other two destroyed. From this foundation plant of the 1903 harvest, the best quality heads and most desirable kernels were saved and each year planted. By 1907 enough wheat was gathered to seed a scant ten-acre field. This field yielded a harvest of 650 bushels of good quality wheat for distribution. By use of a seed grade we separated out the best quality, most desirable wheat kernels for seed purposes and found we had 300 bushels of the Renegerated Blount's Defiance wheat for distribution to Colorado farmers. We sent this wheat out in small lots varying from 25 lbs. to 100 lbs. per farmer in the spring of 1908."—F. Knorr, Associate Agronomist (1908).

LOCATION OF EXPERIMENTAL FARMS

There are three station farms in Colorado where variety tests with grain are being carried. The central station is located at Fort Collins in the north-central part of the state. At this station variety tests are carried under irrigation. The type of soil, elevation and climatic conditions make it fairly 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 La Plata County. The elevation of the station is over 7,000 feet. At this station grains are tested under irrigation. The elevation and climate make this station a desirable place to test grains for high altitude conditions.

The United States Dry Land Field station, located at Akron, Colorado, is operated in co-operation with the United States Department of Agriculture. This station is located in the heart of the Colorado wheat belt. Tests conducted here should apply to crops grown under similar conditions.

RESULTS OF TESTS AT FORT COLLINS[1]

CLIMATE.—The climate at Fort Collins is suitable for the production of small grains. Sufficient rainfall is obtained in average years to start a fall-sown winter wheat crop and carry it thru successfully until spring irrigations can be applied. With few exceptions, sufficient rainfall comes in the months of March and April to start a spring wheat crop. Table 1 gives the rainfall for the years 1918 to 1925, inclusive.

The winter months are mild. Winter wheat over-winters with

[1] The data prior to 1920 were compiled from records kept by various workers in Agronomy at the Colorado Experiment Station. Those prior to 1909 were taken by F. Knorr, W. H. Olin and A. H. Danielson. From 1909 to 1920, records were kept by Alvin Kezer, D. W. Frear and Breeze Boyack. From 1920 to date, D. W. Robertson has taken most of the records.

little winter killing in this section. But some damage is done in the spring by dry winds and dry soil which often reduce the stands of some of the less hardy varieties. The climate is mild enough for the production of the hardier winter wheats. But winter barley almost entirely winter kills under conditions found at Fort Collins.

TABLE 1.—Monthly Rainfall at the Colorado Experiment Station, Fort Collins for the Years 1918 to 1925, Inclusive

	1918	1919	1920	1921	1922	1923	1924	1925
January	0.41	T	0.54	0.96	0.35	0.19	0.51	0.27
February	1.05	0.30	0.64	0.19	0.53	1.39	0.54	0.09
March	0.14	1.65	0.14	0.13	0.32	2.74	1.83	0.58
April	3.72	0.93	3.60	1.63	2.95	2.18	0.93	0.05
May	2.95	0.45	1.95	2.30	0.46	3.60	3.90	0.95
June	1.18	0.19	0.60	4.24	1.03	5.72	0.22	1.99
July	4.83	0.64	0.58	1.34	0.83	5.26	0.16	1.70
August	1.91	0.61	1.72	2.60	0.91	0.69	0.05	1.17
September	3.23	2.61	0.60	0.66	0.00	1.28	0.84	1.79
October	0.71	1.93	0.50	0.53	0.50	3.08	0.79	3.26
November	0.90	1.22	0.24	0.32	1.37	0.10	0.09	0.89
December	0.76	0.39	0.54	0.89	0.31	0.25	0.74	1.50
Totals	21.79	10.92	11.65	15.79	9.56	26.48	10.60	14.24

NOTE:—The monthly rainfall for 1918, 1919 and 1924 was obtained from Mr. R. E. Trimble, assistant irrigation investigator. The records for January, February, March, November and December are also furnished by Mr. Trimble. The records for the other months were obtained on the experiment station farm. They differ slightly from the United States records for Fort Collins. The difference is due to local showers in the summer. The United States weather bureau station is on the college campus, about one mile west from the experimental farm.

RAINFALL.—The rainfall in 1918, 1920, 1921, 1922 and 1923 was adequate early in the season to start the crop and carry it on to the time irrigation water could be applied. In 1919 and 1925, the rainfall early in the season was not sufficient to start the crops evenly. This was particularly true in 1925 when much of the spring wheat had to be "irrigated up" in May. Under the conditions found at the station an abundance of winter and spring moisture is necessary to start the crop and carry it to the middle of May, when irrigation water can be applied. The yields of all varieties were highest in the years in which an abundance of moisture fell in April and May. The lowest yield in 1918 was 35.6 bushels. In that year 6.67 inches of rain fell in the months of April and May. The highest yield in 1919 was 28.3 bushels. The rainfall in April and May was 1.38 inches. There was a good spring rainfall in 1920, 1921, 1922 and 1923 and the results were similar. In 1925 the rainfall was low in April and May. The yield was slightly lower on the average than the yield of the crops grown in the years when the rainfall was high in April and May.

TREATMENT OF PLATS.—All of the plats are replicated. They are irrigated at as near heading[2] as possible. In 1923 sufficient rain

[2] Kezer, A., and Robertson, D. W. The Critical Period of Applying Irrigation water to wheat. Jour. of Am. So. of Agronomy, Vol. 19, No. 2, page 80.

fell in the months of June and July to mature crops without irrigation, and no irrigation water was applied. The plats are sown on summer fallow. While this gives results slightly different from farm conditions, it gives comparative tests. Previous work has shown that in order to control weeds and get comparative yields, summer fallow was necessary. More recent work[3] has shown that when two crops are grown in succession on the same land, that a residual effect from irrigations on the first crop is noticeable in the second crop.

CARE OF GRAIN.—The thrashed grain from the plats is cleaned and weighed. The bushel weights are determined from the cleaned-grain weights. The probable errors are calculated by the deviation from the mean method.[4] Ten plats of each variety are grown. These plats are scattered over the area so that a random sample may be obtained.

TIME AND RATE OF SEEDING.—The winter wheat plats are planted about the 20th of September. Earlier plantings in September are advantageous, as there is a better chance of getting fall moisture. But due to the rush of work at this time of the year, grain is seldom prepared for an earlier planting. Spring wheat is planted from the 20th of March to the 10th of April. An attempt is made to plant it as soon after the 20th as possible. Under farm conditions, spring wheat may be planted any time after the 10th of March, and up to the 20th of April. Later plantings than this do not mature early enough to escape black stem rust infection in normal years. Winter wheat is sown at the rate of 60 pounds per acre. Spring wheat is sown at the rate of 90 pounds per acre.

EXPERIMENTAL RESULTS

VARIETY TESTS, 1907 TO 1912.—The early tests in 1907 were conducted in single plats of one-tenth acre. While these were less reliable than replicated tests, they gave some indication of the yielding ability of the grains tested.

In 1906 and 1907 several varieties of winter wheat were obtained by the station. These were tested in one-tenth acre plats for a period of from 1 to 6 years. The following table gives the names of the varieties and the source from which they were obtained.

DISCUSSION OF YIELDS 1907 TO 1912.—The varieties were grown in single plats of one-tenth acre in 1907, 1909, 1910, 1911, and 1912. The plats in 1908 were one-third of an acre in size. In 1911 the fall was very dry and the stand was very irregular. In the spring

[3] Robertson, D. W., and Kezer, A. Residual Effect of Different Irrigation Treatments on Crops Grown in Succeeding Years. Jour. Am. Soc. Agronomy, Vol. 19, No. 10, October, 1927.

[4] H. K. Hayes, Control of Soil Heterogenity and Use of the Probable Error Concept in Plant Breeding Studies. University of Minnesota, Tech. Bul. No. 30, 1925.

TABLE 2.—Varieties of Winter Wheat Grown at the Colorado Experiment Station (Fort Collins) in Part or in All of the 5 Years from 1908 to 1912, Inclusive

Variety	Colorado Accession No.	Source	Year Received
Banat	33	McPherson, Kansas	1906
Malakof	34	McPherson, Kansas	1906
Oklahoma	35	McPherson, Kansas	1906
Roumanian	36	McPherson, Kansas	1906
Rieti	37	Prof. G. Coboni, Rieti, Italy	1906
Crimea	38	McPherson, Kansas	1906
Poudre	39	Colorado Agricultural College	
Yampah	40	Colorado Agricultural College	
Turkey Red	41	McPherson, Kansas	1906
Kharkof	42	McPherson, Kansas	1906
Winter Durum	43	H. T. Miller, Fort Collins, Colo.	1906
Salzers Prizetaker	55	Salzer Seed Co., La Crosse, Wis.	1907
Salzers Advance	56	Salzer Seed Co., La Crosse, Wis.	1907
Canadian Hybrid	57	Salzer Seed Co., La Crosse, Wis.	1907
Harvest King	58	W. M. Jardine, B. P. I., U.S.D.A.	1907
Fultz Mediterranean	59	W. M. Jardine, B. P. I., U.S.D.A.	1907
Advance	60	McPherson, Kansas	1906
Turkey Red (Canadian)		No Record	
Emmer		No Record	
Mutant		Alvin Kezer, Lincoln, Nebr.	1909
Nebraska No. 3		Alvin Kezer, Lincoln, Nebr.	1909
Nebraska No. 425		Alvin Kezer, Lincoln, Nebr.	1909
Nebraska No. 48		Alvin Kezer, Lincoln, Nebr.	1909
Nebraska No. 287		Alvin Kezer, Lincoln, Nebr.	1909
Nebraska No. 287	(N. Platte)	Alvin Kezer, Lincoln, Nebr.	1909
Turkey Red	(N. Platte)	Alvin Kezer, Lincoln, Nebr.	1909

hard, dry winds whipped and cut the crop seriously. This, together with the poor stand and grasshopper damage, lowered the yield of many of the plats that year.

Table 3 gives the yields in bushels per acre of the different varieties tested at the Colorado Experiment Station (Fort Collins) for the years 1907 to 1912, inclusive. Of the six varieties grown continuously from 1908 to 1912, Turkey Red yielded the highest. The five-year average is shown in column 10 of Table 3. Other varieties were promising for short periods but were not tested sufficiently to determine their value.

PRELIMINARY TEST.—In 1918 a preliminary test was started in small plats. Fifty varieties of winter wheat which had been obtained from various experiment stations were included in this test. (See Table 4.) In 1919 the plats were grown in replications (9 plats). Since that date, single small plats have been grown in the preliminary tests. Table 5 gives the yields of each of the varieties for a period of 7 years, 1919 to 1925 inclusive. Of the first ten varieties six are of the Turkey Red type (Tables 4 and 5). The other four wheats, Niagara, Nigger, Alton and Red Wave, in the ten highest yielders, with the exception of Alton, are soft or semihard wheats. Both Nigger and Red Wave are white wheats.

TABLE 3.—Yield of Winter Wheat at the Colorado Experiment Station (Fort Collins) from 1907 to 1912, Inclusive

Variety	Colorado Accession No.	1907	1908	1909	1910	1911	1912	Years Grown	Average Yield Bu. Per Acre	5 Yr. Av. 1908-1912
Banat	33	57.0	....	....	....	....	....	1	57.0	....
Malakof	34	56.5	....	....	....	....	....	1	56.5	....
Oklahoma	35	62.6	64.3	51.2	42.9	0.0	49.5	6	45.1	41.6
Roumanian	36	64.5	54.2	45.3	33.6	0.0	51.5	6	41.5	36.9
Rieti	37	53.5	....	....	....	....	....	1	53.5	....
Crimea	38	61.3	....	....	....	....	....	1	61.3	....
Poudre	39	56.0	24.9	....	....	....	....	2	40.5	....
Yampah	40	49.8	....	....	....	....	....	1	49.8	....
Turkey Red	41	66.6	61.0	50.0	45.5	25.1	50.2	6	49.7	46.4
Kharkof	42	68.8	56.8	54.2	40.4	....	....	4	55.0	....
Winter Durum	43	53.5	....	....	....	....	....	1	53.5	....
Salzer's Prizetaker	55	....	43.6	50.8	29.2	24.8	47.5	5	39.2	39.2
Salzer's Advance	56	....	39.6	43.8	....	19.5	42.8	4	36.4	....
Canadian Hybrid	57	....	49.8	35.8	33.2	13.3	40.0	5	34.4	34.4
Harvest King	58	....	37.0	48.0	20.9	14.5	43.7	5	32.8	32.8
Fultz Mediterranean	59	....	44.4	45.0	....	19.3	49.2	4	39.5	....
Emmer	..	58.1	....	....	....	27.1	46.9	3	44.0	....
Turkey Red (Canadian)	..	....	....	49.5	38.4	0.0	46.8	4	33.7	....
Mutant	..	....	....	....	....	9.1	60.8	2	34.9	....
Nebraska No. 3	..	....	....	....	....	31.3	67.3	2	49.3	....
Nebraska No. 425	..	....	....	....	....	28.0	70.8	2	49.4	....
Nebraska No. 48	..	....	....	....	....	30.0	69.0	2	49.5	....
Nebraska No. 312	..	....	....	....	....	40.8	73.7	2	57.3	....
Nebraska No. 287	..	....	....	....	....	33.5	74.2	2	53.9	....
Nebraska No. 287 (North Platte)	..	....	....	....	....	38.5	73.6	2	56.0	....
Turkey Red (North Platte)	..	....	....	....	....	47.3	57.5	2	52.4	....
Fultz Mediterranean	..	....	....	....	....	45.0	58.8	2	51.9	....

TABLE 4.—Varieties of Winter Wheat Grown in Single Plats at the Colorado Experiment Station (Fort Collins) for a Seven-Year Period, 1919 to 1925, Inclusive

Variety	Ft. Collins No.	Colo. No.	Source	Year	Correspondent* Variety in Clark's Classification
Crimea	.....	....	Utah Experiment Station.....	1914	.....Crimea
Kharkof	.....	42	See page 18.....	....	.....Kharkof
Niagara	.....	....	Missouri Experiment Station...	1914	.....Valley
Nigger	.....	....	Missouri Experiment Station...	1914	.....
Texas	.....	....	Missouri Experiment Station...	1914	.....Turkey Red
Defiance	.....	....	Missouri Experiment Station...	1914	.....Turkey Red
Alton	.....	....	Utah Experiment Station.....	1914	.....Alton
Turkey Red	.....	....	Nebraska Experiment Station..	1914	.....Turkey Red
Jones Red Wave	.....	....	Missouri Experiment Station...	1914	.....Red Wave
Malakof	311	....	Wyoming Experiment Station..	1912	.....Malakof
Rochester Red	.....	....	Missouri Experiment Station...	1914	.....
Big Frame	.....	....	Nebraska Experiment Station..	1914	.....Big Frame
Lebanon	.....	....	Missouri Experiment Station...	1914	.....Gipsy
Imperial Amber	.....	....	Missouri Experiment Station...	1914	.....Imperial Amber
Ironclad	301	....	Texas Experiment Station.....	1912	.....
Red Wave	.....	....	Missouri Experiment Station...	1914	.....Red Wave
Reliable	.....	....	Missouri Experiment Station...	1914	.....Gipsy
Fulcaster	371	....	Missouri Experiment Station...	1912	.....Fulcaster
Red Cross	.....	....	Missouri Experiment Station...	1914	.....Red May
Sibley New Golden	377	....	Oklahoma Experiment Station..	1912	.....Sibley
Pride of Genesee	.....	....	Missouri Experiment Station...	1912	.....Pride of Genesee
Beechwood Hybrid	.....	....	Missouri Experiment Station...	1914	.....
Mediterranean	302	....	Texas Experiment Station.....	1912	.....Mediterranean
Early Red Clawson	.....	....	Missouri Experiment Station...	1914	.....Red Wave
Dietz	.....	....	Missouri Experiment Station...	1914	.....Fulcaster
Velvet Chaff	.....	....	Missouri Experiment Station...	1914	.....Penquite
Harvest Queen	.....	....	Missouri Experiment Station...	1914	.....Harvest Queen
Treadwell	.....	....	Missouri Experiment Station...	1914	.....Treadwell
Grain O'Gold	.....	....	Missouri Experiment Station...	1914	.....
Fortyfold	402	....	Oregon Experiment Station....	1912	.....Goldcoin
Virginia Hybrid	.....	....	Missouri Experiment Station...	1914	.....Virginia
Goldcoin	.....	....	Missouri Experiment Station...	1914	.....Red Clawson
Harvest King	.....	....	Missouri Experiment Station...	1914	.....Poole
Marvelous	.....	....	S. B. Nuckols, Missouri.....	1914	.....Fulcaster
Prizetaker	.....	55	See page 18.....	....	.....
Little Club	403	....	Oregon Experiment Station....	1914	.....Mixed Club
Rural New Yorker	.....	....	Missouri Experiment Station...	1914	..Rural New Yorker No. 57
Jones Longberry	.....	....	Missouri Experiment Station...	1912	.....Red May

TABLE 4.—Varieties of Winter Wheat Grown in Single Plats at the Colorado Experiment Station (Fort Collins) for a Seven-Year Period, 1919 to 1925, Inclusive

Variety	Ft. Collins No.	Colo. No.	Source	Year	Correspondent* Variety in Clark's Classification
Poole	373	....	Missouri Experiment Station...	1911	.....
Yaroslav	.....	....	No Record, Old Seed.....	1914	.....Yaroslav
Klondike	.....	....	Missouri Experiment Station...	1914	.....Goldcoin
O'Stoner	.....	....	Missouri Experiment Station...	1914	.....Fulcaster
Hickman	.....	....	Missouri Experiment Station...	1912	.....
Fultz	372	....	Missouri Experiment Station...	1912	.....Fulcaster
Red May	303	....	Texas Experiment Station.....	1914	.....
Orange	.....	....	Missouri Experiment Station...	1914	.....Orange
Odessa	.....	....	Utah Experiment Station.....	....	.....Odessa
Fultz Mediterranean	.....	59	See page 18.....	....	.....Fultz Mediterranean
Advance	.....	56	See page 18.....	....	.....Red Wave
Michigan Amber	.....	....	Missouri Experiment Station...	....	.....

* In 1923 and 1925 all varieties were classified according to the classification of American Wheat Varieties. U. S. D. A. Bul. No. 1074.

EXPLANATION OF TABLE

Column 1 gives the Original Variety Name. Column 2 gives the Fort Collins Accession number. Column 3 gives the Colorado Accession number. Column 4 gives the source from which the varieties were obtained. Column 5 gives the year in which the varieties were received. Column 6 gives the Varietal name according to the Classification of American Wheats by Clark, J. A., Martin, J. H., and Ball, C. R., U. S. D. A. Bul. 1074.

TABLE 5.—Winter Wheat Yields in Preliminary Tests at the Colorado Experiment Station (Fort Collins) for the Years 1919 to 1925, Inclusive

Variety	Ft. Collins No.	Colo. No.	Yield in Bushels per Acre							Years Grown	Average Yield in Bu. per Acre
			1919	1920	1921	1922	1923	1924	1925		
Crimea	.....	....	35.0	52.5	48.3	31.8	55.8	95.1	69.8	7	55.5
Kharkof	.....	42	33.6	53.2	44.1	23.5	53.2	93.1	74.9	7	53.7
Niagara	.....	....	30.4	48.7	39.3	31.8	59.2	93.7	66.3	7	52.8
Nigger	.....	....	31.3	55.5	50.4	25.1	49.8	77.6	74.3	7	52.0
Texas	.....	....	32.3	61.1	32.7	22.9	46.5	90.3	77.8	7	51.9
Defiance	.....	....	32.8	43.7	25.0	40.7	57.6	92.6	68.3	7	51.5
Alton	.....	....	31.4	59.0	33.0	31.5	51.1	80.1	69.5	7	50.8
Turkey Red	.....	....	34.6	36.8	28.1	32.4	57.0	91.4	63.9	7	49.2
Jones Red Wave	.....	....	26.5	72.4	28.5	22.8	51.0	82.4	59.4	7	49.0
Malakof	311	....	31.1	52.7	34.7	27.8	46.2	74.1	76.0	7	48.9
Rochester Red	.....	....	26.2	45.4	27.7	33.4	50.0	81.3	69.9	7	47.7
Big Frame	.....	....	28.0	44.8	38.2	25.6	57.5	74.1	64.2	7	47.5
Lebanon	.....	....	35.1	47.1	27.8	26.6	39.3	80.2	72.7	7	47.0
Imperial Amber	.....	....	28.0	49.1	25.6	32.0	55.1	75.3	62.0	7	46.7
Ironclad	301	....	33.0	47.9	35.8	20.6	53.2	86.9	...	6	46.2
Red Wave	.....	....	30.2	61.1	23.0	29.5	43.5	76.2	58.4	7	46.0
Reliable	.....	....	29.4	43.9	29.5	15.6	...	88.2	67.6	6	45.7
Fulcaster	371	....	27.8	60.7	26.3	21.2	40.5	82.6	58.8	7	45.4
Red Cross	.....	....	24.8	52.8	31.1	19.6	50.6	79.3	54.7	7	44.7
Sibley New Golden	377	....	34.3	51.2	28.0	20.4	57.1	77.0	...	6	44.7
Pride of Genesee	.....	....	28.0	47.1	27.1	15.5	54.1	81.6	58.3	7	44.5
Beechwood Hybrid	.....	....	30.6	39.7	25.2	33.9	48.1	87.2	...	6	44.1
Mediterranean	302	....	28.5	53.7	38.8	10.5	43.8	89.0	...	6	44.0
Early Red Clawson	.....	....	25.7	47.2	32.8	28.8	43.6	69.1	60.6	7	44.0
Dietz	.....	....	31.9	48.6	29.3	13.8	51.0	88.2	...	6	43.8
Velvet Chaff	.....	....	23.8	38.1	30.0	22.8	50.9	81.5	59.0	7	43.7
Harvest Queen	.....	....	34.1	45.4	29.0	31.1	35.7	78.9	51.6	7	43.7
Treadwell	.....	....	23.5	39.7	36.9	21.1	46.9	76.5	60.3	7	43.6
Grain O' Gold	.....	....	27.8	51.4	44.0	27.9	40.9	56.5	55.0	7	43.4
Forty Fold	402	....	25.6	54.4	28.0	9.4	43.5	74.8	66.8	7	43.2
Virginia Hybrid	.....	....	28.0	46.7	20.7	14.6	50.4	81.6	55.6	7	42.5
Gold Coin	.....	....	24.4	33.7	23.4	19.1	50.6	84.0	61.7	7	42.4
Harvest King	.....	....	30.4	47.7	11.9	25.8	46.2	91.6	...	6	42.3
Marvelous	.....	....	25.3	35.1	41.5	23.1	50.3	76.1	...	6	41.9
Prizetaker	.....	55	30.0	52.0	16.8	11.9	43.2	69.4	67.7	7	41.6
Little Club	403	....	28.7	61.1	13.9	15.6	32.4	70.3	68.9	7	41.6
Rural New Yorker	.....	....	28.4	36.2	14.9	20.9	47.5	79.4	62.3	7	41.4
Jones Longberry	.....	....	24.4	50.3	31.4	12.5	47.0	76.4	46.3	7	41.2
Poole	.....	....	29.3	33.1	25.9	19.2	53.5	75.9	50.0	7	41.0
Yaroslav	.....	....	25.6	53.7	17.0	39.3	19.7	65.8	64.9	7	40.9

TABLE 5.—Winter Wheat Yields in Preliminary Tests at the Colorado Experiment Station (Fort Collins) for the Years 1919 to 1925, Inclusive

Variety	Ft. Collins No.	Colo. No.	Yield in Bushels per Acre							Years Grown	Average Yield in Bu. per Acre
			1919	1920	1921	1922	1923	1924	1925		
Klondike	.....	....	25.1	52.9	28.2	24.6	40.1	58.1	56.9	7	40.8
O'Stoner	.....	....	27.2	45.4	38.2	18.7	51.8	78.8	25.5	7	40.8
Hickman	.....	....	24.7	47.6	28.9	28.9	...	70.4	41.3	6	40.3
Fultz	372	....	23.0	41.3	23.3	17.3	51.7	82.9	...	6	39.9
Red May	303	....	25.4	40.3	...	23.9	...	64.4	45.6	5	39.9
Orange	.....	....	21.1	42.3	27.7	16.5	33.6	70.9	62.0	7	39.2
Odessa	.....	....	20.4	61.8	28.4	20.0	17.3	62.5	61.9	7	38.9
Fultz Mediterranean	.....	59	28.6	43.2	27.0	15.8	19.0	76.9	61.1	7	38.8
Advance	.....	56	26.5	46.4	25.7	15.2	52.0	71.4	21.1	7	36.9
Michigan Amber	.....	....	21.2	43.0	30.4	15.3	39.3	54.4	53.1	7	36.7

WINTER WHEAT VARIETY TEST.—Table 6 gives the results of the winter wheat variety test at Fort Collins for a seven-year period from 1919 to 1925. In Table 7 the three highest yielding varieties with their yearly and average yields are given. The difference in average yield, however, is so slight that it cannot be considered significant. Hybrid (188) is not winter hardy at Akron and cannot be recommended for that section.

Several other varieties show promise in tests of shorter periods. These will have to be tested further before recommendations can be made. Two of the Mutant selections are showing up well and may prove of value if milling and baking tests show them to be desirable. Clark's Blackhull yields well at Fort Collins, and may be of value where winter killing is not a factor in reducing the yield.

WINTER HARDINESS.—For several years rod row tests have been conducted at the Akron station to determine the winter hardiness of the varieties grown at Fort Collins. All of the beardless hybrids grown at Fort Collins except six, have been eliminated. These are still being tested. Fulcaster and Fultz Mediterranean are much less winter hardy than Kanred and Turkey Red. Clark's Blackhull, while more winter hardy than Fulcaster and Fultz Mediterranean is less winter hardy than Kanred. Iowa 1946, a beardless wheat, is not winter hardy under Akron conditions.

MILLING AND BAKING TESTS.—Very little difference in yield was found between many of the Turkey Red x Fultz Mediterranean, Turkey Red x Harvest King hybrids and the Turkey Red check. The varieties left in the plats in 1921 could not be eliminated further on yield. In 1921, 1922 and 1923, milling and baking tests were made on all varieties in the winter-wheat variety tests. These milling tests were made by the Cereal Chemistry Department of the University of Minnesota, and the baking tests were made in co-operation with the Home Economics Department of the Colorado Agricultural College.

From these tests the most promising wheats were selected and further tested for yield. Of the 23 hybrids which were in the test in 1921, only six now remain. The following data were obtained from the milling test:

Kanred wheat gave a heavier yield of flour than Turkey and was superior in absorptive power. The other qualities measured by the baking test were equal. Of the hybrids, Nos. 190, 189 and 181 were equal to Turkey Red in milling and baking value. Mutant wheat was low in crude protein and flour yield. Alton did not equal Turkey Red in either milling or baking value. These trials indicated that Kanred, Turkey, Hybrids 181, 189 and 190 were good milling wheats.

TABLE 6.—Replicated Plats of Winter Wheat Varieties Grown on the Colorado Experiment Station (Fort Collins) from 1919 to 1925

Variety	Hybrid No.	Colorado Accession No.	Yield in Bushels Per Acre							Comparison with Turkey Red					
			1919	1920	1921	1922	1923	1924	1925	Years Grown	Average Yield in Bu. Per Acre	No. of Years Compared	Average Variety Named	Average Turkey Red	Variety Named in Terms of Turkey Red (Percent)
Mutant Selection	.....	...	.....	.....	.....	.....	.....	87.3±1.83	70.6±1.88	2	79.0±1.63	2	79.0	80.7	97.9
Kansas Selection	P1068-6-18	...	.....	.....	.....	.....	.....	82.5±1.73	72.6±1.93	2	77.5±1.60	2	77.5	80.7	96.0
Fultz Mediterranean Selection	.....	...	.....	.....	.....	.....	.....	79.5±1.67	62.3±1.66	2	70.9±1.46	2	70.9	80.7	87.9
Kansas Selection	P762-4-18	...	.....	.....	.....	.....	.....	72.7±1.53	68.6±1.82	2	70.6±1.46	2	70.6	80.7	87.5
Mutant Selection	.....	...	.....	.....	.....	.....	61.9±1.84	82.1±1.72	61.7±1.64	3	68.6±1.16	3	71.9	69.5	103.5
Kansas Selection	P1066-6-18	...	.....	.....	.....	.....	.....	70.5±1.48	64.6±1.72	2	67.6±1.40	2	67.6	80.7	83.8
Mutant Selection	.....	...	.....	.....	.....	44.0±1.61	48.9±1.45	85.8±1.80	66.4±1.77	4	61.2±0.96	4	61.2	61.7	99.2
Kharkof	.....	332	.....	.....	.....	.....	.....	61.4±1.29	61.4±1.63	2	61.4±1.27	2	61.4	80.7	76.1
Clark's Blackhull	.....	301	.....	.....	.....	33.5±1.23	57.1±1.79	89.2±1.87	60.6±1.61	4	60.1±0.94	4	60.1	61.7	97.4
Turkey Red	.....	...	.....	58.8±1.74	40.8±1.81	38.3±1.40	47.1±1.40	85.8±1.80	75.5±2.01	6	57.7±0.69	6	57.7	57.7	100.0
Kanred	.....	226	.....	54.1±1.60	53.2±2.37	39.2±1.44	49.7±1.48	79.4±1.67	68.5±1.82	6	57.3±0.69	6	57.3	57.7	99.3
Turkey Red x Fultz Mediterranean	24-1-140-34	...	41.6±3.26	60.2±1.78	42.9±1.91	39.3±1.44	46.1±1.37	78.8±1.65	67.8±1.80	7	53.8±0.87	6	55.8	57.7	96.7
Iowa 1946	.....	227	.....	.....	34.7±1.54	40.2±1.47	44.2±1.31	78.1±1.64	64.4±1.71	5	52.3±0.80	5	52.3	57.5	91.0
Turkey Red	.....	...	26.2±0.91	49.3±0.88	37.2±0.58	38.5±1.41	44.4±1.38	74.2±1.56	64.4±1.71	7	52.0±0.56	6	51.6	57.7	89.4
Turkey Red x Fultz Mediterranean	24-1-140-34	...	41.1±3.22	57.8±1.71	36.4±1.62	36.7±1.35	48.6±1.44	72.7±1.53	70.9±1.89	7	52.0±0.84	6	53.8	57.7	93.2
Turkey Red x Harvest King	19-2-87-2	...	44.2±3.46	56.5±1.67	26.7±1.19	34.4±1.26	54.3±1.61	86.5±1.82	59.9±1.59	7	51.8±0.84	6	53.0	57.7	91.9
Turkey Red x Fultz Mediterranean	24-1-140-34	...	40.9±3.20	61.9±1.83	41.6±1.85	36.6±1.34	45.5±1.35	80.5±1.69	.....	6	51.1±1.04	5	53.2	54.2	98.2
Minturki	.....	229	.....	.....	42.4±1.89	39.2±1.44	46.2±1.37	68.3±1.43	59.4±1.58	5	51.1±0.79	5	51.1	57.5	88.9
Turkey Red x Fultz Mediterranean	24-1-140-34	...	38.2±2.99	62.5±1.85	37.2±1.65	35.5±1.30	46.8±1.39	86.1±1.81	.....	6	51.0±1.04	5	53.6	54.2	98.9
Turkey Red x Fultz Mediterranean	24-1-140-34	...	42.2±3.30	58.8±1.74	30.9±1.37	34.1±1.25	48.1±1.43	72.4±1.52	67.4±1.79	7	50.6±0.82	6	52.0	57.7	90.1
Turkey Red x Fultz Mediterranean	24-1-140-34	...	42.3±3.31	62.0±1.83	36.9±1.64	35.1±1.29	48.1±1.43	76.9±1.61	.....	6	50.2±1.02	5	51.8	54.2	95.6
Turkey Red x Fultz Mediterranean	24-1-140-34	...	37.9±2.97	58.1±1.72	35.3±1.57	33.9±1.24	51.4±1.53	80.1±1.70	.....	6	49.4±1.00	5	51.8	54.2	95.6
Alton	.....	...	.....	.....	.....	34.5±1.27	33.3±0.99	62.5±1.31	65.9±1.75	4	49.0±0.77	4	49.0	61.7	79.4
Turkey Red x Harvest King	19-2-87-2	...	42.9±3.36	59.2±1.75	28.9±1.29	34.2±1.25	52.8±1.57	.....	62.6±1.66	6	46.8±0.93	5	47.5	52.1	91.2
Turkey Red x Fultz Mediterranean	24-1-140-34	...	40.0±3.13	57.9±1.71	32.4±1.44	36.8±1.35	42.9±1.27	.....	70.2±1.87	6	46.7±0.93	5	46.0	52.1	88.3
Minhardi	.....	228	.....	.....	35.8±1.59	36.5±1.34	21.6±0.64	59.2±1.24	57.1±1.52	5	42.0±0.72	5	42.0	57.5	73.0

TABLE 7.—The Highest-Yielding Varieties of Winter Wheat at Fort Collins for a Six-year Period—1920 to 1926, Inclusive

	1920	1921	1922	1923	1924	1925	Average
Turkey Red	58.8	40.8	38.3	47.1	85.8	75.5	57.7
Kanred	54.1	53.2	39.2	49.7	79.4	68.5	57.3
Hybrid No. 188	60.2	42.9	39.3	46.1	78.8	67.8	53.8

TABLE 8.—The Results of Milling and Baking Tests Conducted in 1921, 1922, and 1923

Variety	Flour Yield %				Absorption in %				Volume of Loaf in %				Color Score in %				Texture of Loaf in %				Crude Protein in %			
	1921	1922	1923	Av.	1921	1922	1923	Av.	1921	1922	1923	Av.	1921	1922	1923	Av.	1921	1922	1923	Av.	1921	1922	1923	Av.
Mutant	101	97	98	98.7	94	97	98	96.3	100	104	98	100.7	104	104	99	102.3	90	104	96	99.7	89	98	91	92.7
Clark's Blackhull	....	98	101	99.5	....	100	95	97.5	....	101	96	98.5	....	95	101	98.0	....	97	101	99.0	....	104	117	110.5
Turkey Red (192)	101	99	102	100.7	100	99	103	100.7	101	94	107	100.7	102	102	99	101.0	103	101	98	100.7	102	107	104	104.3
Turkey Red (60)	101	101	98	100.0	96	98	101	98.3	95	92	96	94.3	103	98	100	100.3	99	99	101	99.7	103	100	109	104.0
Kanred	108	105	102	105.0	103	98	108	103.0	100	108	108	105.3	99	101	101	100.3	103	101	98	100.7	117	96	108	107.0
No. 188 Hybrid 24-1-140-34	101	100	96	99.0	104	106	100	103.3	98	102	96	98.7	95	97	99	97.0	102	101	101	101.3	101	96	94	97.0
No. 190 Hybrid 24-1-140-34	99	103	98	100.0	103	105	103	103.7	93	99	102	98.0	99	97	100	98.7	101	98	101	100.0	104	100	92	98.7
No. 178 Hybrid 19-2- 87-2	98	95	108	100.3	98	101	94	97.7	122	100	94	105.3	99	102	92	97.7	102	99	100	100.3	92	102	100	98.0
No. 181 Hybrid 24-1-140-34	95	101	102	99.3	106	99	100	101.7	95	102	110	102.3	100	100	100	100.0	96	101	102	99.7	99	98	94	97.0
Alton	....	101	100	100.5	....	99	96	97.5	....	102	98	100.0	....	97	101	99.0	....	97	98	97.5	....	103	100	101.5
No. 180 Hybrid 19-2-87-2	100	95	98	97.7	96	98	98	97.3	96	102	94	97.3	96	103	99	99.3	95	102	101	99.3	93	97	93	94.3
No. 189 Hybrid 24-1-140-34	96	102	97	98.3	101	99	104	101.3	100	94	102	98.7	103	104	99	102.0	99	101	100	100.0	100	97	98	98.3
Actual Averages	71.2	74.4	72.4	....	59.5	51.9	57.0	....	c. c. 1,092	c. c. 709	c. c. 1,762	....	89	91	95	....	85.1	88.5	93.9	....	11.1	12.4	10.8	....

The average of each year was taken as 100 percent and the percentage data were obtained for each variety in each year.

TABLE 9.—Average of Agronomic Data Recorded for Six Varieties or Strains of Winter Wheat Grown on the Experiment Station Farm, Fort Collins, in the Five-year Period from 1921 to 1925, Inclusive

Variety	Dates Heading	Date Maturity	Height of Straw in Inches	Strength of Straw	Stem Rust Infection %	Acre Yield Bushels
Clark's Blackhull....	6/9	7/28	44.5	L	5	60.1[1]
Turkey Red.....	6/14	7/24	45.0	L	7	57.5
Kanred.....	6/14	7/24	45.0	L	4	58.0
Hybrid 188.....	6/14	7/23	44.7	S	11	54.9
Iowa 1946.....	6/14	7/27	48.2	M	8	52.3
Hybrid 190.....	6/14	7/23	44.0	S	14	51.7

[1] Four-year average.
L—Lodged.
M—Slightly lodged.
S—Stiff straw.

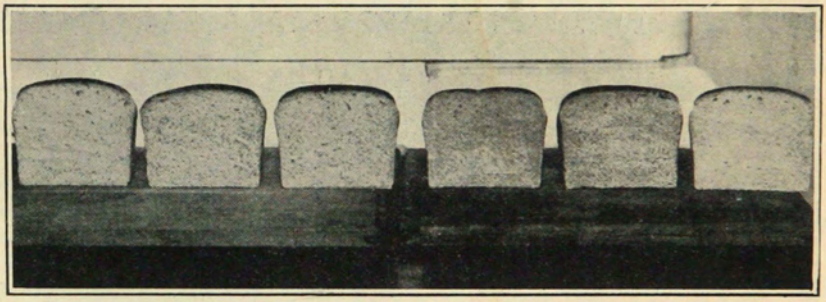

Figure 7.—(Left to right)—Standard Grade of Flour—Turkey—Kanred—188—187—Standard Grade. Shows Cross Section of Loaves, Giving Some Idea of Texture and Color. The Loaves on Each End of the Picture Were Baked from a Standard Grade of Flour. Numbers Refer to Hybrids. Baking Tests Were Made in 1922.

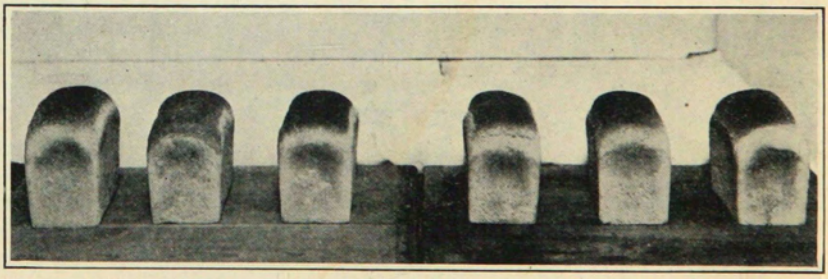

Figure 8.—(Left to right)—Standard Grade—Turkey—Kanred—188—187—Standard Grade. Shows End View of Loaves, Giving Some Idea of Texture and Color. The Loaves on Each End of the Picture Were Baked from a Standard Grade Flour. Numbers Refer to Hybrids. Baking Tests Were Made in 1922.

Clark's Blackhull, Turkey Red and Kanred have a rather weak straw which lodges under irrigation. Clark's Blackhull matures several days later than Kanred or Turkey Red. Turkey Red is slightly more susceptible to rust than Kanred, and Hybrid 188 and Hybrid

190 are more susceptible to stem rust than Kanred, but are several days earlier in maturing.

CONCLUSIONS AT FORT COLLINS.—At Fort Collins, Kanred and Turkey Red are two of the highest yielding wheats. Blackhull, a new introduction, yields practically as high as Turkey Red in the years it has been tested. Kanred is slightly earlier in maturing than Blackhull and is more rust resistant than Turkey Red. In milling and baking tests conducted in 1921, 1922 and 1923, Kanred has equalled Turkey Red in both milling and baking value.

None of the soft or semihard winter wheats have yielded as high as the Turkey types of wheat and their milling and baking value make them less desirable to most millers than the hard red winter wheats. Local demand may require a certain amount of soft wheats for blending. But their universal growth in this section is not recommended.

SPRING WHEAT

Spring wheat tests have been conducted at the experiment station at Fort Collins from the year 1906 to 1908 and from 1918 to 1925. The following results were obtained from the tests conducted from 1906 to 1908, inclusive. (The plats were single one-tenth acre plats.)

TABLE 10.—Spring Wheat Variety Tests at the Colorado Experiment Station, Fort Collins, from 1906 to 1908, Inclusive

Variety	Accession No.	Yield in Bushels per Acre			
		1906	1907	1908	Average
Colorado No. 50	50	53.3	34.1	40.7	42.7
Blount No. 16	29	48.9	...	26.1	37.5
Sonora	4	44.2	35.5	31.8	37.2
Defiance	1	57.3	41.4	26.3	41.7
Kubanka 5639	2	35.1	23.0	34.7	30.9
Black Don 5645	10	37.0	26.9	...	31.9
New Zealand	24	50.8	37.5	36.7	41.7
Minn. No. 169	8	46.1	37.0	33.5	35.5
Red Fife	54	...	...	39.3	39.3
White Russian	63	...	...	40.7	40.7

TABLE 11.—Source of Varieties Grown in the Spring Wheat Variety Test at the Colorado Experiment Station (Fort Collins) from 1906 to 1908, Inclusive

Variety	Colorado Accession No.	Source	Date Received
Defiance	1	Own production	.....
Kubanka 5639	2	J. B. Biedesell, Idalia, Kans.	.....
Sonora	4	No record	.....
Minn. 169	8	Minnesota Station	.....
Black Don 5645	10	U. S. D. A.	.....
New Zealand	24	Utah Exp. Station	3/29/06
Blount No. 16	29	Barteldes Seed Co.	3/20/06
Colorado No. 50	50	Selection, Colorado Exp. Sta.	.....
Red Fife	54	Garton Bros., England	8/10/06
White Russian	63	No record	.....

It would seem from the results obtained in the three-year test from 1906 to 1908 that Colorado No. 50, a selection from Defiance

TABLE 13.—Yield of Spring Wheat Grown at the Colorado Agricultural Experiment Station, Fort Collins, in Part or in All of the Eight-year Period from 1918 to 1925, Inclusive

Variety	Colo. No.	Other Numbers	Yield Bushels Per Acre								Years Grown	Average Yield Bus. Per Acre	Comparison with Marquis			
			1918	1919	1920	1921	1922	1923	1924	1925			Average Yields		Variety Named in Terms of Marquis (Percent)	Number of Years in which Compared
													Variety Named	Marquis		
Mindum	304	C. I. 470	.....	.....	.....	.....	44.6±0.99	59.2±1.33	29.9±0.80	33.0±1.15	4	41.7±0.56	41.7	36.4	114.6	4
Kota	329	.....	.....	.....	.....	.....	.....	.....	35.5±0.95	46.5±1.62	2	41.0±0.90	41.0	34.1	120.2	2
Marquis	...	.....	46.2±1.50	24.2±1.03	45.6±0.92	36.0±1.04	44.2±0.98	43.3±0.97	.....	.....	6	39.3±0.46	39.3	40.2	97.8	6
Kubanka	...	.....	48.7±1.58	23.7±1.01	45.1±0.91	35.3±1.02	37.8±0.84	50.2±1.12	35.5±0.95	38.3±1.34	8	39.3±0.41	39.3	38.6	101.8	8
Marquis	...	.....	44.8±1.46	22.9±1.04	46.5±0.94	37.5±1.08	42.0±0.93	41.9±0.94	.....	.....	6	39.3±0.46	39.3	40.2	97.8	6
White Bobs	...	.....	46.5±1.59	25.4±1.08	46.2±0.93	37.4±1.08	.....	.....	.....	.....	4	38.9±0.62	38.9	38.6	100.8	4
Ghirka	...	.....	45.9±1.49	27.9±1.19	49.0±0.99	32.5±0.94	46.6±1.03	41.0±0.92	29.6±0.79	38.8±1.35	8	38.9±0.40	38.9	38.6	100.8	8
Marquis	...	.....	47.5±1.55	25.3±1.08	45.9±0.92	35.8±1.03	41.3±0.91	45.3±1.02	31.8±0.85	36.3±1.27	8	38.6±0.40	38.6	38.6	100.0	8
Federation	...	.....	63.9±2.08	24.4±1.04	41.8±0.84	28.0±0.81	47.6±1.05	38.8±0.87	26.6±0.71	37.9±1.32	8	38.6±0.40	38.6	38.6	100.0	8
Marquis	...	.....	46.4±1.51	23.5±1.07	46.8±0.94	36.0±1.04	41.2±0.91	44.3±1.00	33.8±0.90	36.1±1.26	8	38.5±0.40	38.5	38.6	99.7	8
Preston	...	.....	46.3±1.51	22.9±0.98	48.1±0.97	27.5±0.79	40.6±0.90	44.7±1.00	.....	.....	6	38.3±0.45	38.3	40.2	95.3	6
Warner	223	.....	.....	.....	41.1±1.31	31.3±0.90	42.4±0.94	43.2±0.97	35.1±0.94	36.7±1.28	6	38.3±0.44	38.3	40.2	95.3	6
Red Bobs	239	.....	.....	.....	.....	31.8±0.91	38.8±0.86	45.3±1.02	.....	37.3±1.30	4	38.3±0.53	38.3	39.7	96.5	4
Red Saskatchewan	...	F. C. 1059	.....	.....	.....	.....	.....	.....	.....	38.3±1.34	1	38.3±1.34	38.3	36.3	105.5	1
J. C. No. 157	216	.....	.....	.....	40.8±0.82	37.0±1.06	41.7±0.92	44.3±1.00	27.7±0.74	37.9±1.32	6	38.2±0.41	38.2	40.2	95.0	6
Red Russian	...	.....	44.7±1.45	27.8±1.27	46.2±0.93	32.0±0.92	44.5±0.98	36.1±0.81	32.0±0.85	41.4±1.44	8	38.1±0.39	38.1	38.6	98.7	8
Red Russian	...	.....	44.0±1.43	28.3±1.29	46.8±0.94	30.0±0.86	42.0±0.93	37.4±0.84	.....	.....	6	38.1±0.44	38.1	40.2	94.8	6
Yandilla	221	.....	.....	.....	39.3±0.79	30.3±0.87	42.8±0.95	45.8±1.03	33.7±0.90	34.9±1.22	6	37.8±0.41	37.8	40.2	94.0	6
Kitchener	254	.....	.....	.....	.....	37.0±1.06	40.7±0.90	43.3±0.97	30.7±0.82	37.3±1.30	5	37.8±0.46	38.0	38.1	99.7	5
Preston	...	F. C. 497	48.0±1.56	23.0±0.98	48.4±0.98	29.3±0.84	40.6±0.90	45.5±1.02	29.0±0.82	37.7±1.31	8	37.7±0.39	37.7	38.6	97.7	8
Comeback	215	.....	.....	.....	39.0±1.44	29.0±0.83	44.1±0.97	45.5±1.02	31.1±0.83	37.8±1.32	6	37.7±0.45	37.7	40.2	93.8	6
Red Russian	...	.....	41.7±1.36	26.7±1.22	46.2±0.93	29.3±0.84	42.8±0.95	39.3±0.88	.....	.....	6	37.7±0.44	37.7	40.2	93.8	6
John Brown No. 13	218	.....	.....	.....	39.3±1.25	31.5±0.91	45.8±1.01	44.8±1.01	29.6±0.79	34.6±1.21	6	37.6±0.43	37.6	40.2	93.5	6
Hudsons E. P. S.	224	.....	.....	.....	35.3±1.12	33.5±0.96	51.2±1.13	40.4±0.91	29.4±0.78	35.1±1.22	6	37.5±0.43	37.5	40.2	93.3	6
Sevier	...	.....	.....	.....	.....	.....	.....	.....	.....	37.3±1.30	1	37.3±1.30	37.3	36.3	102.7	1
Arnautka	303	C. I. 1493	.....	.....	.....	.....	32.8±0.72	53.1±1.19	30.3±0.81	32.6±1.14	4	37.2±0.50	37.2	38.7	96.1	4
Comenut	217	.....	.....	.....	33.7±0.68	30.5±0.88	44.6±0.99	42.3±0.95	31.4±0.84	39.7±1.39	6	37.0±0.40	37.0	40.2	92.0	6
M. A. C. No. 10	247	.....	.....	.....	.....	24.0±0.69	44.6±0.99	48.2±1.08	31.3±0.84	33.7±1.18	5	36.4±0.45	36.4	38.1	95.5	5
Onas	...	F. C. 1026	.....	.....	.....	.....	.....	.....	33.2±0.89	37.8±1.32	2	35.5±0.78	35.5	34.1	104.1	2
Cedar	219	.....	.....	.....	29.3±0.71	32.5±0.94	42.3±0.93	41.9±0.94	30.7±0.82	33.7±1.18	6	35.1±0.38	35.1	40.2	87.3	6
Wallace	220	.....	.....	.....	27.0±1.22	30.5±0.88	53.2±1.18	33.5±0.75	28.0±0.75	37.4±1.30	6	34.9±0.44	34.9	40.2	86.8	6
Quality	...	F. C. 1055	.....	.....	.....	.....	.....	.....	.....	34.5±1.20	1	34.5±1.20	34.5	36.3	95.0	1
Kitchener	255	.....	.....	.....	.....	24.5±0.71	39.0±0.86	44.1±0.99	27.8±0.74	37.0±1.29	5	34.5±0.42	34.5	38.1	90.5	5
Bunyip	222	.....	.....	.....	25.0±0.71	28.3±0.81	49.0±1.08	40.3±0.91	28.1±0.75	30.8±1.07	6	33.6±0.38	33.6	40.2	83.6	6
Ruby	249	.....	.....	.....	.....	25.5±0.73	37.8±0.84	41.9±0.94	*29.0±0.82	32.9±1.15	5	33.4±0.40	33.4	38.1	87.7	5
Prelude	248	.....	.....	.....	.....	25.5±0.73	31.3±0.69	47.9±1.08	27.9±0.74	31.9±1.11	5	32.9±0.40	32.9	38.1	86.3	5
Black Don	...	.....	.....	.....	30.3±0.61	28.8±0.83	30.4±0.67	47.8±1.08	24.4±0.65	.....	5	32.3±0.35	32.3	40.0	80.7	5
Red Fife	...	.....	43.0±1.40	24.0±0.96	42.5±0.86	23.3±0.67	31.1±0.69	30.3±0.68	.....	.....	6	32.4±0.38	32.4	40.2	80.6	6
Dicklow	...	F. C. 1053	.....	.....	.....	.....	.....	.....	.....	32.3±1.13	1	32.3±1.13	32.3	36.3	89.0	1
Garnet	...	F. C. 1052	.....	.....	.....	.....	.....	.....	.....	31.4±1.09	1	31.4±1.09	31.4	36.3	86.5	1
Red Fife	...	.....	*41.2±1.41	24.1±0.97	40.9±0.82	24.0±0.69	29.4±0.65	30.9±0.69	28.0±0.75	28.2±0.98	8	30.8±0.32	30.8	38.6	79.8	8
Hard Federation	328	.....	.....	.....	.....	.....	.....	.....	23.6±0.63	36.2±1.26	2	29.9±0.66	29.9	34.1	87.7	2
Polish	...	.....	50.3±1.64	21.1±0.90	32.5±0.66	14.0±0.40	.....	.....	.....	.....	4	29.5±0.46	29.5	38.6	76.4	4
Khogot	...	F. C. 653	*37.9±1.30	18.9±0.80	35.4±0.71	27.3±0.79	33.1±0.73	32.4±0.73	22.6±0.60	27.5±0.96	8	29.4±0.31	29.4	38.6	76.2	8
Red Fife	...	.....	.....	.....	33.9±0.68	20.0±0.58	33.3±0.74	29.8±0.67	.....	.....	4	29.2±0.34	29.2	42.1	69.3	4
Defiance	50	.....	35.6±1.16	26.6±1.13	38.5±0.78	17.0±0.49	30.9±0.68	21.0±0.47	27.5±0.73	33.1±1.16	8	28.8±0.30	28.8	38.6	74.6	8

* Average of nine plats.

Variety	Colorado Accession No.	Other Numbers	Date Received	Source
Mindum	304	C. I. 470	Feb. 1922	Akron Field Station, Akron, Colorado.
Kota	329	.....	Mar. 1924	University Farm, St. Paul, Minnesota.
Marquis	...	.....	Mar. 1911	Central Experimental Farm, Ottawa, Canada.
Kubanka	...	.....	 1914	Dr. Headden, from 1913 plats.
Marquis	...	.....	.....	Centgener plats.
White Bobs	...	.....	.....	Old Stock. No Record.
Ghirka	...	C. I. 1517	.....	B. P. I., U. S. D. A.
Marquis	...	.....	.....	Centgener plats.
Federation	...	.....	.....	Old Stock.
Marquis	...	.....	.....	Centgener plats.
Preston	...	.....	.....	Minnesota.
Warner	223	.....	.....	Dry Farming Congress, Spokane, Washington.
Red Bobs	239	.....	Jan. 1921	University of Saskatchewan, Saskatoon, Saskatchewan.
Red Saskatchewan	...	F. C. 1059	Feb. 1925	Central Experimental Farm, Ottawa, Canada.
J. C. No. 157	216	.....	.....	Dry Farming Congress, Spokane, Washington.
Red Russian	...	.....	.....	Chas. Green, Leroy, Colorado.
Red Russian	...	.....	.....	Chas. Green, Leroy, Colorado.
Yandilla	221	.....	.....	Dry Farming Congress, Spokane, Washington.
Kitchener	254	.....	.....	Seger Wheeler, Rosthern, Saskatchewan.
Preston	...	F. C. 497	Mar. 1911	Central Experimental Farm, Ottawa, Canada.
Comeback	215	.....	.....	Dry Farming Congress, Spokane, Washington.
Red Russian	...	.....	.....	Old Stock.
John Brown No. 13	218	.....	.....	Dry Farming Congress, Spokane, Washington.
Hudsons E. P. S	224	.....	.....	Dry Farming Congress, Spokane, Washington.
Sevier	...	F. C. 1054	.....	Utah Agricultural College, Logan, Utah.
Arnautka	303	C. I. 1493	Feb. 1922	Akron Field Station, Akron, Colorado.
Comenut	217	.....	.....	Dry Farming Congress, Spokane, Washington.
M. A. C. No. 10	247	.....	April 1921	Manitoba Agricultural College, Winnipeg, Manitoba.
Onas	...	F. C. 1026	Dec. 1923	University Farm, Davis, California.
Cedar	219	.....	.....	Dry Farming Congress, Spokane, Washington.
Wallace	220	.....	.....	Dry Farming Congress, Spokane, Washington.
Quality	...	F. C. 1055	Mar. 1925	Mrs. E. J. Martin, Gardner, California.
Kitchener	255	.....	April 1921	Manitoba Agricultural College, Winnipeg, Manitoba.
Bunyip	222	.....	.....	Dry Farming Congress, Spokane, Washington.
Ruby	249	.....	April 1921	Manitoba Agricultural College, Winnipeg, Manitoba.
Prelude	248	.....	April 1921	Manitoba Agricultural College, Winnipeg, Manitoba.
Black Don	...	.....	.....	Dry Farming Congress, Spokane, Washington.
Red Fife	...	.....	.....	Old Stock. No Record.
Dicklow	...	F. C. 1053	Feb. 1925	Utah Agricultural College, Logan, Utah.
Garnet	...	F. C. 1052	Feb. 1925	Dominion Experimental Farm, Rosthern, Saskatchewan.
Red Fife	...	.....	.....	Old Stock.
Hard Federation	328	.....	April 1923	University Farm, Davis, California.
Polish	...	.....	.....	Old Stock.
(Khogot) Siberian No. 1	...	F. C. 653	April 1911	Rampart Experimental Station, Alaska.
Red Fife	...	.....	.....	Dry Farming Congress, Spokane, Washington.
Defiance	50	.....	.....	Old Stock.

gave the most consistent yields. New Zealand,[1] a wheat of unknown origin also yielded well. Kubanka, then a new wheat, did not show up as a promising variety. The tests were carried on single one-tenth acre plats.

From 1909 to 1917, inclusive, extensive experiments were carried on in selection by the centgener method. Several high-yielding strains were obtained by this method. They are included in the spring wheat variety test. The same technique is used in the spring wheat test as is used in the winter wheat test. The varieties are shown in Table 12. Table 13 gives the yield of all varieties which have been tested for a part or all of the eight-year period from 1918 to 1925, inclusive. Of the varieties tested for 4 years or more, Mindum, Marquis and Kubanka have given the highest yields. The differences are so slight in the first ten varieties that they cannot be considered of great significance. Of the varieties tested for an eight-year period, 1918 to 1925, inclusive, Kubanka, Marquis, Ghirka and Soft Federation have given good yields. Marquis, the only hard red spring wheat tested, yields as high as the other three varieties and is of better milling quality. Kubanka is a durum. The quality of Ghirka is poorer than Marquis. It is classified as a semihard red wheat by J. A. Clark, J. H. Martin, and C. R. Ball. Federation is a soft white wheat and like Ghirka is susceptible to stem rust. Marquis under Colorado conditions is slightly less susceptible to stem rust.

TABLE 14.—Average of Agronomic Data Recorded for Seven Varieties or Strains of Spring Wheat Grown on the Experimental Station at Fort Collins in the Five-year Period from 1921 to 1925, Inclusive

Variety	Date Heading	Maturity	Height Straw in Inches	Strength of Straw	Stem Rust Infection	Acre Yield Bushels Per Acre
Mindum.....	6/21	8/10	48.1	M *	2	41.7
Kubanka.....	6/24	8/7	48.7	M	2	40.4
Ghirka.....	6/24	8/6	44.4	M	10	39.0
Marquis.....	6/21	8/2	42.4	S	7	38.7
Federation...	6/21	8/3	37.3	S	14	37.7
Marquis.....	6/21	8/2	43.1	S	9	38.8
Warner.....	6/14	7/30	39.1	M—	14	39.3

* Strength of straw. M=Medium, S=Stiff.

The yields of several new varieties are given in Table 13 for periods of from 1 to 4 years. While some of these look promising they have not been in the test long enough to indicate what they will do under Colorado conditions. Care should be taken in adopting such varieties before a thoro test has been made over a period of years.

[1] Clark, J. A., Martin, J. H., and Ball, C. R. Classification of American Wheat Varieties, U. S. D. A. Bul. 1074, page 72.

RECOMMENDATIONS FOR SPRING WHEAT VARIETIES UNDER CONDITIONS SIMILAR TO THOSE AT FORT COLLINS

Over a long period of years (8 years) Marquis wheat has proved to be one of the best adapted hard red spring wheats under irrigation.

Several durum wheats have yielded well, but they do not outyield Marquis by a large enough margin to recommend their growth. The durum wheats have a limited market.

Ghirka slightly outyields Marquis, but not enough to recommend its growth under irrigation. It is weak strawed and lodges badly. It is also more susceptible to stem rust than Marquis.

Under irrigation, no strain or variety has yielded sufficiently high to displace Marquis. Several promising wheats are under test, but, have not been tested long enough to determine their yielding ability under irrigation.

RESULTS AT FORT LEWIS

BY DWIGHT KOONCE[1]

The Fort Lewis farm is in the San Juan Basin in the southwestern part of the state. The farm is conducted in co-operation with the Fort Lewis School of Agriculture at Hesperus. The school lands are about 5 miles south of Hesperus. The experimental farm occupies some benchland in the old bottom 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 from 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 have to be used. The furrow type of irrigation is necessary for both grain and rowed crops.

CLIMATIC CONDITIONS.—The season is late in the spring due to the higher altitude and the fact that a heavy covering of snow usually falls in the winter. The normal frost-free period is about 90 days. Table 15 gives the dates of the last killing frost in the spring, the first killing frost in the fall and the frost-free periods for the years 1923 to 1926, inclusive.

TABLE 15.—Frost-Free Periods, 1923-1926, Inclusive

Year	Last Killing Frost	First Killing Frost	Frost-Free Period Days
1923	6/20	9/19	91
1924	6/19	9/12	85
1925	6/12	9/14	94
1926	5/14	9/29	136
Average	....	....	102.5

[1] The tests at Fort Lewis were made by L. R. Quinlan in 1921, Harrison D. Horton in 1922 and 1923 and by Dwight Koonce in 1924, 1925 and 1926.

TABLE 16.—Precipitation at Fort Lewis from 1921 to 1925, Inclusive

Month	1921	1922	1923	1924	1925	
January	.11	1.07	1.32	.34	.14	
February	.13	1.31	.65	.43	T	
March	1.36	1.38	.79	4.77	1.13	
April	.60	.52	.85	2.00	.41	
May	.64	.89	.63	.15	.76	
June	.45	.30	.14	.00	2.05	
July	3.07	.88	2.09	1.85	3.87	
August	3.38	.92	5.44	.52	3.22	
September	.28	.54	1.85	1.38	3.44	
October	1.08	.21	.38	1.13	2.95	
November	.27	2.65	.38	.05	.32	
December	1.74	1.68	1.85	1.79	1.03	
Total	13.11	12.35	16.37	14.41	19.32	Ave. 15.11
April-July, Inc.	4.76	2.59	3.71	4.00	7.09	4.43

The rainfall during the last 4 years, 1922 to 1925, is well distributed. The precipitation is much higher from October to March than it is at Fort Collins. This is due to a heavier covering of snow. The moisture in the soil is sufficient with the precipitation to carry spring and winter planted wheat to the time irrigation water is available.

IRRIGATION.—The furrow method of irrigation is used. This is necessary because of the slope of the land. The soil being shallow, it is necessary to irrigate at least twice and sometimes oftener. The number of irrigations is governed by the rainfall.

METHOD OF CONDUCTING EXPERIMENTS—The plats are replicated. The grain is cut and dried under cover for about three weeks and thrashed.

DATE OF SEEDING.—The spring wheat is sown as soon as the land can be prepared. The average date is about April 25. Winter wheat is sown as near the 15th of September as possible.

EXPERIMENTAL DATA

Six varieties of winter wheat have been tested at Fort Lewis for the four-year period, 1922 to 1925. Turkey Red, Iowa 1946 and Kanred have given the best yields. The difference between any two of these varieties is not great enough to be considered significant.

TABLE 17.—The Yield of Winter Wheat at Fort Lewis for a 4-year Period, 1922 to 1925, Inclusive

Variety	1922	1923	1924	1925	4-year Average
1. Iowa 1946	53.4±1.32*	39.5±2.55	64.9±2.41	53.6±1.90	52.9±1.14
2. Turkey Red	50.7±1.25	38.5±2.62†	71.4±2.66	48.4±1.72	52.3±1.16
3. Kanred	48.5±1.20	35.8±2.31	62.8±2.34	55.5±1.97	50.7±1.09
4. Beardless Turkey	48.5±1.20	37.1±2.40	72.1±2.68	39.5±1.40	49.3±1.06
5. Minturki	47.2±1.17	30.7±1.98	62.2±2.31	50.3±1.79	47.6±1.02
6. Minhardi	47.4±1.17	32.6±2.11	60.8±2.26	41.9±1.49	45.7±0.98

* Probable errors are worked by the deviation from the mean method. The winter wheat is sown at the rate of 60 pounds per acre. The spring wheat is sown at the rate of 90 pounds per acre.

† 9 replications.

Nine spring wheat varieties have been tested at Fort Lewis for the four-year period, 1922 to 1925, inclusive. Defiance is one of the best yielding wheats at Fort Lewis. Both Preston and Kitchener have yielded slightly less than Defiance and have both outyielded Marquis by over 2 bushels. Preston is a bearded, hard, red spring wheat. It has long straw which often lodges under irrigation. Kitchener is a hard, red spring wheat resembling Marquis from which it was selected by Seger Wheeler, of Rosthern, Saskatchewan. It differs from Marquis in having a rather compacted tip to the head.

TABLE 18.—The Yield of Spring Wheat at Fort Lewis for a 4-year Period, 1922 to 1925, Inclusive

Variety	1922	1923	1924	1925	4-year Average
1. Defiance	49.0±1.36	52.5±1.84	28.6±0.95	63.8±2.66	48.5±0.86
2. Preston	45.5±1.26	45.9±1.70	34.7±1.16	61.2±2.55	46.8±0.83
3. Kitchener	45.8±1.27	46.5±1.72	34.2±1.14	57.9±2.41	46.1±0.82
4. Ghirka	48.0±1.35	36.9±1.36	38.5±1.28	57.3±2.52*	25.2±0.80
5. Kubanka	41.1±1.14	42.6±1.58	39.3±1.31	55.6±2.32	44.7±0.79
6. Marquis	44.8±1.25	38.1±1.41	40.4±1.35	52.4±2.18	43.9±0.78
7. Bobs	42.3±1.86†	41.1±1.52	35.5±1.18	55.6±2.32	43.6±0.85
8. J. C. 157	42.4±1.52‡	41.0±1.52	29.7±0.99	50.2±2.09	40.8±0.76
9. Khogot	37.3±1.04	20.5±0.76	36.7±1.22	46.6±2.05*	35.3±0.64

* M=9. † M=6. ‡ M=4. M gives the number of replications when less than 10.

TABLE 18a.—Average of Agronomic Data Recorded for the Three Highest Yielding Varieties of Winter Wheat Grown at Fort Lewis for the Years 1922 to 1925, Inclusive

Variety	Date of Heading	Maturity	Height of Straw in Inches	Strength of Straw	Acre Yield Bushels
Iowa 1946	6/20	8/7	41.7	L+	52.9
Turkey Red	6/21	8/3	39.7	L+	52.3
Kanred	6/21	8/6	41.1	M	50.7
Defiance	7/17	9/4	47.1	S—	48.5
Preston	7/10	8/17	37.7	S—	46.8
Kitchener	7/13	8/28	40.7	S—	46.1

S=Stiff Straw.
M=Medium Stiff Straw.
L=Lodged.
Heading and strength of straw data from 1925 only.
Maturity data from the years 1923, 1924 and 1925.

CONCLUSIONS AT FORT LEWIS

Wheats of the Turkey Red type yielded well at Fort Lewis for the period 1922-1925.

Defiance spring wheat, a soft wheat, gave the highest average yield for the period, 1922-1925, inclusive. In 1924 the yield of this wheat was low. In years when the season was normal and no rust occurred, it outyielded all other spring varieties tested. Preston and Kitchener, two hard red spring wheats, yielded well under Fort Lewis conditions. (Preston is a bearded spring wheat with a rather weak straw.)

VARIETAL EXPERIMENTS WITH WHEAT ON DRYLAND

BY F. A. COFFMAN[1]

Investigations with cereals have been conducted by the Office of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture,[2] at the U. S. Dry Land Field Station, Akron, Colorado, during the past 18 years.

The experiments consisted chiefly of varietal studies, dates, rates and methods of seeding and the improvement of wheat, chiefly by selection. The object of the experiments was (1) to determine the best varieties and strains of wheat and other cereals, not only for eastern Colorado, but for the entire section of which Akron is a type locality; (2) to improve cereal varieties by breeding, and (3) to determine the best practices for cereal production under dry-farm conditions with wheat the most important crop.

The data presented in this bulletin give only results from the varietal experiments, and are based on the data secured during the 18 years, 1908 to 1925, inclusive. They have been prepared in order to bring the information up to date and to place results obtained under dryfarming in a form where they can be compared with the results obtained under irrigation. The data indicate the relative values of the different wheat varieties and show which are probably the best for the dryland sections of Colorado, as well as for adjacent portions of adjoining states.

These experiments have been conducted on what are known in eastern Colorado as the "hard lands." The sand-hill sections present somewhat different conditions under which the results here reported may not entirely apply. In general, the yields obtained from the different cereals and varieties at Akron compare very favorably with those obtained under dryland conditions in other parts of the United States.

DESCRIPTION OF THE AKRON FIELD STATION

The U. S. Dry Land Field Station is about 4½ miles east of Akron, the county seat of Washington County. The town of Akron is located 112 miles northeast of Denver on the main line of the

[1] Associate agronomist, formerly in charge of experiments of the Office of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture at Dry Land Field Station, Akron, Colorado.

[2] The Dry Land Field Station, Akron, Colorado, is operated by the office of Dry Land Agriculture Investigations. The cereal experiments were conducted by the Office of Cereal Crops and Diseases in co-operation with the office named. These experiments were begun in 1907. Wilson G. Shelley was in charge from March 1, 1908, until February 28, 1911; Clyde McKee from March 1, 1911, until February 15, 1913; Charles H. Clark from about March 1, 1913, until July 1, 1913; George A. McMurdo from July 1, 1913, until February, 1917, and the writer of this portion of this bulletin, from July, 1917, until the work of the Office of Cereal Investigations was discontinued in August, 1924. J. F. Brandon, superintendent of the U. S. Dry Land Field Station and D. W. Robertson, associate agronomist at the Colorado Experiment Station, have carried on the work since August, 1924.

TABLE 19.—Monthly, Annual, Average Monthly, and Average Annual Precipitation at U. S. Dry Land Field Station During the 18-year Period, 1908 to 1925, Inclusive

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1908	...	.34	T	1.70	3.30	2.37	2.42	1.47	.05	3.20	2.00	T	16.85
1909	T	1.38	3.06	.40	1.87	3.32	4.61	3.77	2.16	.86	.48	.55	22.46
1910	.05	.16	.26	3.96	2.06	1.38	1.47	3.72	3.81	.05	.12	.32	17.36
1911	.60	.44	.06	2.63	1.15	1.48	1.34	1.30	2.40	1.47	.28	1.36	14.51
1912	.28	1.43	.78	2.49	2.86	3.39	3.58	1.58	1.88	1.99	.18	.29	20.73
1913	.22	.40	1.57	2.19	1.44	1.35	1.85	1.14	2.08	.34	.70	3.27	16.55
1914	.03	.32	.20	4.01	1.46	3.54	1.66	1.05	.23	2.08	.10	.90	15.58
1915	1.10	1.68	1.50	5.19	4.13	3.75	1.10	3.51	1.76	.48	.15	.65	25.00
1916	.50	T	.09	1.59	2.24	2.09	1.77	2.82	.26	1.02	.75	.61	13.74
1917	.28	.63	.72	.96	7.79	.56	1.52	1.78	2.19	.57	T	.50	17.50
1918	.70	.80	.60	1.20	1.76	.96	3.10	7.36	2.43	1.07	.75	1.55	22.28
1919	.07	.50	.65	1.96	1.59	2.27	1.79	.44	2.62	1.64	1.29	.70	15.52
1920	T	.02	.90	3.28	2.90	3.97	4.72	1.45	1.80	.44	.47	.90	20.85
1921	1.22	T	1.25	2.77	.47	1.32	2.88	.92	.79	.97	.20	.65	13.44
1922	.65	.25	.15	3.96	3.63	1.43	3.24	1.24	.06	.05	1.90	.10	16.66
1923	T	.18	.95	1.65	4.94	2.17	3.62	.75	.82	1.91	.47	.70	18.16
1924	.50	.59	1.25	.31	3.26	.35	1.71	.77	4.04	.40	.13	.77	14.08
1925	.05	T	.39	2.24	1.19	2.90	1.08	1.01	.50	1.46	.47	.53	11.82
Mean	.35	.51	.80	2.36	2.67	2.14	2.41	2.00	1.66	1.11	.58	.80	17.39

T=Trace.

Chicago, Burlington & Quincy Railroad. The experiment station farm contains some 382 acres, of which 315 acres are owned by the Colorado Agricultural Experiment Station. The remaining 67 acres are controlled by the Office of Dry Land Agriculture Investigations of the Bureau of Plant Industry.

The soil of the experiment station farm is rolling in character, is naturally fertile, and is classed as sandy loam. The soils of this part of Colorado are somewhat variable in texture but all are comparatively free from coarse gravel. The soil of the type found on the station is locally called "hard land" and is not as subject to soil blowing as the "soft" or more sandy soil to the north and east of the station.

PRECIPITATION.—The precipitation at Akron is similar to that of most of eastern Colorado, altho the precipitation generally decreases toward the foothills of the Rocky Mountains and probably is greater along the high divide between the Arkansas and Platte Rivers. The river valleys also receive some additional precipitation in the form of local showers.

The limiting factors in crop production at Akron usually are the amount and distribution of the moisture supply. Injury by low temperatures may occur, and hail sometimes causes severe crop losses. The annual average precipitation at Akron is slightly less than 18 inches and has varied from 11.82 inches in 1925 to 25.0 inches in

TABLE 20.—Annual and Average Growing Season, Precipitation, Evaporation, Ratio of Precipitation to Evaporation, the Dates of the Last Spring and First Autumn Frost, and the Frost-free Period in Days for the 18 Years, 1908 to 1925, Inclusive

Year	Seasonal		Ratio	Frost Dates		Frost-free Period—Days
	Precipitation Inches	Evaporation Inches	Precip. to Evapora.	Last Spring	First Autumn	
1908....	11.31	44.936	1:3.97	May 7	September 25	141
1909....	16.13	42.353	1:2.63	May 16	October 3a	140
1910....	16.40	43.621	1:2.66	May 16b	September 25	132
1911....	10.30	48.818	1:4.74	May 10	October 7a	150
1912....	15.78	37.696	1:2.39	May 13	September 20	130
1913....	10.05	42.960	1:4.27	May 3	September 19	139
1914....	11.95	41.863	1:3.50	May 12	September 13	124
1915....	19.44	33.550	1:1.73	May 20	October 4	137
1916....	10.77	47.166	1:4.38	May 16	September 14	121
1917....	14.80	42.709	1:2.89	May 11	October 8	150
1918....	16.81	41.422	1:2.46	May 11	October 23	165
1919....	10.67	47.232	1:4.43	June 4	October 4	122
1920....	18.12	40.912	1:2.26	May 15	September 29	137
1921....	9.15	45.903	1:5.02	May 7	October 1	147
1922....	13.55	44.579	1:3.29	April 28	October 7	162
1923....	13.95	41.429	1:2.97	May 15	September 28	136
1924....	10.44	42.985c	1:4.12	May 14	September 21	130
1925....	8.92	47.290	1:5.30	April 30	October 7	160
Mean...	13.25	43.190	1:3.50	May 12	September 30	140

a First frost occurred after this date when record ended.
b Temperature of 32° F. recorded June 9, but probably no frost.
c Evaporation from May 1 to September 30.

1915. Table 19 presents monthly and annual precipitation data. Table 20 presents other climatic data obtained at the U. S. Dry Land Field Station at Akron during the 18-year period.

EVAPORATION.—Evaporation records have been kept for the six months of the growing season, April to September, each year since the station was established. The average annual evaporation for these 6 months has been close to 43 inches, varying from 33.55 in 1915 to 48.818 inches in 1911. The evaporation usually is inversely proportional to the precipitation, the average ratio being approximately 3 to 1.

WIND VELOCITY.—The average annual wind velocity usually is between 6 and 7 miles an hour. The highest monthly velocities generally occur in the spring months of March, April and May. In some years serious damage results from soil blowing in these months. Hot winds, such as are experienced farther south and east, are almost unknown. June, July and August are generally months of comparative quiet as far as atmospheric conditions are concerned. In some years high wind velocities in September and October may cause serious soil blowing, but this is unusual.

TEMPERATURE.—Temperatures are not usually a limiting factor in wheat production in eastern Colorado. Winter temperatures, while low, are not as low, nor are summer temperatures as high, as in most parts of the central and northern Great Plains. The minimum temperature so far recorded at Akron is 28° F., and the maximum 103° F. The latest spring frost recorded was on June 4, 1919, while the earliest autumn frost was on September 13, 1914. The usual frost-free period is about 140 days, or from about May 10 or 15 to about the last of September or the first of October.

EXPERIMENTAL METHODS

SOIL PREPARATION.—Practically all of the earlier cereal experiments at the U. S. Dry Land Field Station were conducted on summer fallow. Beginning with the crop of 1917, most of the plat experiments have been seeded on both fallow and corn land. Data have thus been obtained on two soil preparations in each season. No definite system of preparing and maintaining the fallow has been followed. Usually, the stubble of the previous crop remained undisturbed over winter. In the spring the land to be fallowed usually was plowed to a depth of 5 to 7 inches. In a few seasons the plowing was omitted and the land simply double disked. During the summer the fallow was kept free from weeds by the use of the disk and the spring-tooth harrow, or duck-foot cultivator. The duck-foot cultivator levels the soil sufficiently for seeding without further preparation for either fall or spring wheat.

The cornland, on the other hand, was not handled exactly the same for fall-sown as for spring-sown crops. The corn always was cut from the plats to be sown to fall grains. On the land sown to spring grain the corn was husked from the stalks which then remained standing until spring, when they were disked into the ground. The chief difference in the results from the two methods of preparing the land, for fall and for spring grain, probably was in the effect of the standing stalks in catching and holding snow. The standing stalks caught and held more snow than did the corn stubble. As a rule, in this part of Colorado, very little is left of a stalk field after the wind storms of winter and early spring, and disking in the corn stalks probably did not influence the results to any extent.

In preparing the ground for corn following a grain crop the grain stubble of the previous season usually remained undisturbed until the following spring, when the land was double disked. About the middle of May corn was listed on the entire area, the rows running across cereal plats of the previous seasons. During the summer the soil was cultivated between the corn rows to keep down weed growth, to fill the furrows, and to prevent baking.

SIZE AND REPLICATION OF PLATS.—Previous to 1917, the cereal plats at the Akron Field Station were not of standard size. When the station was first established varieties were grown on single tenth-acre plats 8 rods long by 2 rods wide, separated by alleys 4 to 5 feet in width. Later the need of replication was recognized and, more plats being necessary, these tenth-acre plats were subdivided into smaller ones. During later years the varieties were grown on four plats systematically replicated, each plat 8 rods long and 6 feet wide, separated by alleys 16 inches in width. Such plats contain slightly less than one fifty-fifth of an acre, but as the plants in them also draw on the moisture and plant food in the alleys it seems fair to consider them as fiftieth-acre plats in computing yields, altho the actual area is slightly less. During the earlier years when the experiments were conducted very largely on tenth-acre plats, it was not possible to sow more than one plat of each variety, and check plats were generally included at regular intervals. Since replication has been introduced check plats have been eliminated as the sowing of four plats at some distance from each other tends to reduce experimental error resulting from soil variations. Less important varieties have sometimes been sown on only two plats, one on each kind of seedbed preparation.

DATES AND RATES OF SEEDING.—Fall wheat in the varietal experiments has been sown at the rate of 3 pecks to the acre. Spring wheat has been sown at the 4-peck rate.

Fall-sown wheat generally has been sown during the month of

TABLE 21.—Annual and Average Yields of 29 Winter Wheat Varieties and Strains Grown at the U. S. Dry Land Field Station, Akron, Colo., for Varying Periods During the 18-year Period, 1908 to 1925, Inclusive, and the Average Yields as Percentage of Kharkof, C. I. No. 1583, for Comparable Years

Group and Variety	C.I.No. a	Yield Per Acre (Bushels)																	Average			Comparison with Kharkof C. I. 1583			
		1908	1909b	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919c	1920	1921	1922	1923	1924	1925	1908d 1925	1917d 1925	1920 1925	No. of Years in which Compared	Average Yields: Variety Named	Average Yields: Kharkof C.I. 1583	Variety Named in Terms of Kharkof	
																								Bu.	Bu.	Percent	
Crimean:																											
Alberta Red	2979	21.0	0	...	...	...	...	...	31.3	25.0	9.7	13.1	...	...	...	...	...	...	...	...	...	...	6	16.7	17.3	96.5	
Altara	5797	...	...	...	...	...	...	...	...	...	...	...	...	13.4	7.8	...	...	...	...	...	...	...	2	10.6	14.5	72.6	
Armavir	1355-2-2	...	...	...	...	...	...	...	...	...	...	18.0	...	17.2	...	...	...	...	...	...	...	...	2	17.6	14.2	123.9	
Beloglina	1543	...	0	23.6	...	...	...	...	18.4	21.3	9.0	12.2	...	...	...	...	...	...	...	...	...	...	6	14.1	19.1	73.8	
Blackhull	6251	...	...	...	...	...	...	...	...	...	...	...	...	11.8	18.0	8.9	9.6	3.9	5.1	...	...	9.6	6	9.6	10.2	94.1	
Crimean	1432	19.2	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	9.6	9.7	99.0	
Crimean	1435	15.3	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	7.7	9.7	79.4	
Crimean	1436	19.1	0	38.3	17.9	33.1	12.6	28.3	26.6	20.5	7.0	16.4	...	19.2	16.7	10.6	6.7	f	5.8	17.4	11.8	10.6	16	17.4	17.7	98.3	
Crimean	1437	14.6	0	34.8	13.3	32.5	...	...	26.6	...	...	...	...	...	...	...	...	...	...	...	...	...	6	20.3	21.7	93.5	
Crimean	1559	...	0	36.9	11.5	32.7	17.0	39.6	29.0	21.7	7.1	15.6	...	...	...	...	...	...	...	...	...	...	10	21.1	20.9	101.0	
Hussar	4843	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6.8	3.9	4.6	...	...	...	3	5.1	6.0	85.0	
Kanred	5146	...	...	...	...	...	...	...	...	...	17.6	20.0	21.3	30.1	14.3	14.5	11.5	5.3	2.3	...	14.5	13.0	9	12.8	12.0	106.7	
Kharkof	1442	20.6	0	27.9	10.0	34.3	16.1	26.6	27.5	19.2	12.9	12.8	...	15.6	15.0	15.2	7.5	4.3	...	15.6	11.9	11.5	16	15.6	17.7	88.1	
Kharkof	1583	19.3	0	29.8	14.2	37.5	16.6	26.0	29.2	26.2	16.9	12.3	17.6	16.1	13.0	14.3	7.6	5.8	4.7	17.0	11.3	10.2	17	17.0	17.0	100.0	Check
Kharkof (6P4)	4207	...	...	...	10.3	33.2	18.5	26.1	28.3	29.0	13.5	12.8	...	17.9	10.0	13.1	6.2	...	...	...	...	...	12	18.2	19.2	94.8	
Kharkof (Mont. No. 36)	5549	...	...	...	...	...	...	...	...	...	...	...	...	18.7	10.0	14.6	8.1	f	6.0	...	...	11.5	5	11.5	11.1	103.6	
Kharkof (Hays. No. 2)	6686	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15.3	6.5	4.6	7.0	...	...	...	4	8.4	8.1	103.7	
Kharmont	6700	...	...	...	...	...	...	...	...	...	...	...	...	...	11.1	12.9	6.1	4.7	6.4	...	...	...	5	8.2	9.1	90.1	
Malakof	2908	...	0	26.7	17.3	35.4	...	...	30.5	18.3	9.0	12.2	...	...	...	...	...	...	...	...	...	...	8	18.8	20.8	90.4	
Minturki	6155	...	...	...	...	...	...	...	...	...	...	...	...	18.1	7.0	9.1	4.1	2.9	4.3	...	...	7.6	6	7.6	10.3	75.6	
Torgora	1539	...	...	20.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	20.6	29.8	69.1	
Turkey	1558	15.7	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	7.9	9.7	81.4	
Turkey	1571	19.8	0	29.5	11.7	43.1	7.3e	25.1	28.1	31.7	8.5	18.4	...	21.7	15.3	12.7	6.8	5.0	7.0	17.2	11.9	11.4	17	17.2	17.0	101.1	
Turkey	2998	...	...	...	...	...	...	...	23.3	30.8	6.1	10.3	...	...	...	...	...	...	...	...	...	...	4	17.6	21.2	83.0	
Red Winter	6213	...	...	...	...	...	...	...	...	...	...	...	...	10.7	...	...	...	...	...	...	...	...	1	10.7	16.1	66.5	
Sherman	4430	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6.5	4.3	4.9	...	...	...	3	6.5	7.6	85.5	
Miscellaneous:																											
Alton (Ghirka Winter)	1438	15.6	0	38.5	15.8	38.3	...	...	22.8	21.0	6.6	14.3	...	14.4	15.4	11.3	6.1	5.6	3.9	...	11.1	11.3	15	15.3	16.4	93.3	
Buffum No. 17	3330	...	...	...	...	17.5	6.5	13.8	...	...	...	...	...	...	9.6	7.9	2.7	...	...	...	...	...	6	9.7	19.2	50.5	
Nebraska No. 28	5147	...	...	...	...	...	...	...	...	...	8.9	15.8	...	8.6	...	...	...	...	...	...	...	...	3	11.1	15.1	73.5	
Pesterboden Sel.	2-11	1564	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5.2	...	...	...	...	1	5.2	5.8	89.6	
Iobred	6934	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4.6	...	...	...	...	1	4.6	5.8	79.3	
Kanred Sel.	1499Kd.	7369	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3.9	2.7	...	...	...	2	3.3	5.3	62.3	
Alton Sel.	7198G	1438	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2.9	...	...	...	...	1	2.9	5.8	50.0	

a Accession number of the Office of Cereal Investigations.
b All varieties of wheat failed to survive the winter of 1908-1909.
c Winter wheat was not sown in plats in the fall of 1918. The yields of Kanred and Kharkof reported are from increase fields.
d Not including 1919.
e Yield of a selection from Turkey, C. I. No. 1571, the original variety not being grown.
f Not grown in 1924.

September. During the past five years the seeding date has not varied more than a day or two from September 15. Spring wheat has been sown as early in the spring as practicable. Generally, conditions are favorable for seeding in the latter part of March. The climatic records at the Akron Field Station show that any delay in the seeding of spring grain after the first part of April is to be avoided if possible, because the chances against favorable weather for seeding spring grain increase as the month of April advances.

EXPERIMENTAL RESULTS

Winter wheat is the most important crop in the dryland sections of Colorado. From 80 to 85 percent of the total winter wheat crop of the state is produced on drylands. The crop is especially important in the northeastern part of the state where the U. S. Dry Land Field Station is located. For that reason the experiments with winter wheat have been far more extensive than those with all other crops, altho both winter and spring varieties have been included in the experiments at Akron. The experiments with spring wheat have usually ranked second in importance.

WINTER WHEAT.—The winter wheat varietal experiments were begun at Akron in the fall of 1907. No yields were obtained in 1909 as the crop was completely winter killed. In 1918 no winter wheat was grown in the plat experiments, the yields included for 1918 being from increase fields grown on the Station farm that year. Good yields were obtained in 1910, 1912, 1914 and 1915. Some good yields were obtained in 1908, 1916, 1920 and 1922 but the average yields for these years were not high. The yields in 1911, 1913, 1917, 1918, 1921, 1923, 1924 and 1925 were reduced by drouth. The seasons of 1911, 1921, 1924 and 1925 were unusually dry. The yields in 1923 were very low as winter wheat did not emerge until spring, ripened late in July, and was severely injured by stem rust. The crops of 1915, 1917, 1920 and 1922 were injured by winter killing and soil blowing. The seasons of 1915 and 1920 were unusually favorable and the crops of those years would doubtless have been the best recorded had stands been normal. Half of the plats sown in the fall of 1916 were abandoned in 1917, due to winter killing. In 1925 considerable damage was done to some of the plats by army worms. Since 1917, as previously mentioned, the varieties were grown both on fallow and on cornland, which resulted in some reduction in average yields.

The yields of all of the winter wheat varieties grown in the varietal experiments at Akron are presented in Table 21. Table 21 shows the annual and average yields of the varieties grown during the period 1908 to 1925, inclusive. Table 22 shows the average dates of heading and maturity, weight per bushel, percentage of stem-rust

infection, and yield of grain and straw recorded on four wheat varieties of the Crimean group grown on the Akron Field Station from 1908 to 1925, inclusive.

The results obtained from both the field and nursery experiments during the 18 years, 1908 to 1925, inclusive, show that of all varieties so far grown, the hard red winter wheats of the Turkey or Crimean group are best adapted to the dryland sections of the state. Most of the varieties on which data from Akron are reported in this bulletin, are of this group, altho others have been grown. The exceptions are Alton (Ghirka winter), an awnless hard red winter variety; Buffum No. 17, an awnless soft red winter wheat; and Nebraska No. 28, an awned soft red winter variety.

The average yields of the four Crimean strains which have been grown each year, Crimean (C. I. No. 1436), Kharkof (C. I. No. 1442 and 1583) and Turkey (C. I. No. 1571), show an extreme variation of only 0.9 bushels. This difference is within the limits of the probable error. This fact and the data presented in Tables 21 to 24 indicate that these bulk, unselected varieties probably are identical for all characters.

TABLE 22.—Average Agronomic Data Recorded for Seven Varieties and Strains of Winter Wheat Grown on Fallow and on Cornland at the U. S. Dry Land Field Station in the 7 Years from 1917 to 1923, Excluding 1919.

Group and Variety	C.I. No.	Date of Heading	Date of Maturity	Height Inches	Stem-rust Infection (Percent)	Bushel Weight Pounds	Acre Yield Grain (Bushels)	Acre Yield Straw (Pounds)
ON FALLOW								
Crimean								
Kanred	5146	June 23	July 19	32	3.7	56.7	19.4	2,897
Turkey	1571	June 23	July 20	32	8.7	56.7	17.0	2,449
Kharkof	1583	June 24	July 22	33	9.2	57.5	16.3	2,375
Kharkof	1442	June 25	July 22	33	8.3	57.2	16.3	2,189
Crimean	1436	June 23	July 23	32	9.0	56.4	15.6	2,463
Kharkof	4207	June 24	July 23	32	10.4	57.5	15.7	2,257
Miscellaneous								
Alton (Ghirka Winter)	1438	June 25	July 21	34	8.7	55.9	14.4	1,925
ON CORNLAND								
Crimean								
Kanred	5146	June 21	July 20	31	2.1	56.9	16.6	1,862
Turkey	1571	June 20	July 21	27	4.0	57.0	10.9	1,380
Kharkof	1583	June 22	July 22	27	4.0	57.7	10.5	1,437
Kharkof	1442	June 20	July 22	27	3.4	57.6	10.1	1,379
Crimean	1436	June 21	July 20	27	4.3	57.5	9.9	1,318
Kharkof	4207	June 20	July 23	26	3.3	57.0	8.8	1,270
Miscellaneous								
Alton (Ghirka Winter)	1438	June 21	July 22	29	4.6	57.0	8.2	1,006

During the 9 years from 1917 to 1925, inclusive, Kanred has exceeded the highest yielding of the unselected Crimean winter wheat varieties in average acre yield by about 3 bushels.

Figure 9 is a view of an increase field of Kanred wheat in shock at the Akron Station in 1919. Kharkof (C. I. No. 4207), a selection made at Akron, is no better than the unselected Kharkof, and as it matures slightly later it escapes neither drouth nor injury from stem-rust infection. Montana No. 36 (C. I. No. 5549), another Kharkof selection, also has given results which indicate that for Akron condi-

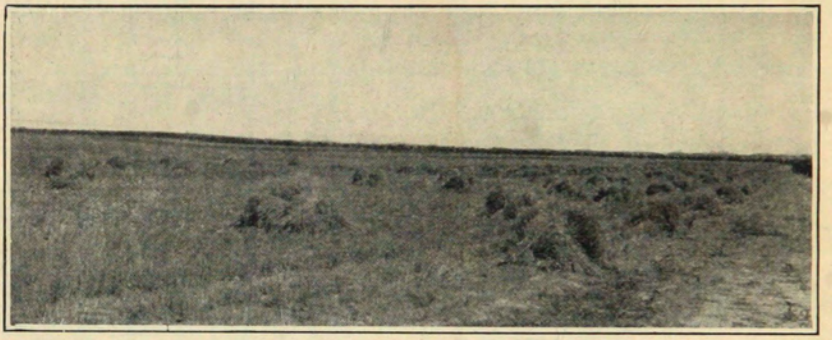

Figure 9—Field of Kanred Wheat, C. I. 5146, Which Yielded 34.5 Bushels Per Acre on Land Fallowed the Previous Season. U. S. Dry Land Station, Akron, Colo., 1919.

tions it is no better than the unselected strains. Minturki, while winter hardy, is too late in maturing to compete successfully with the earlier maturing Crimean wheat varieties of better milling quality. Blackhull appears to lack hardiness under Akron conditions and, while it is desirably early, it is meeting with objection from the millers and bakers and cannot be recommended for general seeding in north-eastern Colorado. Alton (Ghirka winter), an awnless variety, has yielded little more than the poorest of the awned varieties and, except that it is awnless, has nothing to recommend it.

Kanred is not only the high-yielding variety of these experiments, but it also is recognized as the highest-yielding variety grown commercially in the section in which the U. S. Dry Land Field Station is located.

Table 23 presents the yields of the more important varieties grown on fallow and on cornland during the period from 1917 to 1923. Table 25 presents the agronomic data on the varieties in these plats.

The winter wheat usually headed about three days earlier on cornland than on fallow, but ripened at about the same time on both soil preparations. The height of straw averaged several inches taller on fallow than on cornland. Stem-rust infection was more severe on

TABLE 23.—Annual and Average Acre Yields of the Leading Varieties of Winter Wheat Grown on Fallow and on Cornland at the U. S. Dry Land Field Station from 1917 to 1925, Inclusive

Group and Variety C.I. No.	Fallow								Average		Cornland								Average	
	1917	1918a	1920	1921	1922	1923	1924	1925	1917 1925	1920 1925	1917	1918	1920	1921	1922	1923	1924	1925	1917 1925	1920 1925
Crimean																				
Kanred 5146	14.8	22.6	27.9	18.6	19.5	13.1	7.7	2.4	15.8	14.9	20.4	17.5	32.3b	9.9	9.6	9.9	2.9	2.2	13.1	11.1
Turkey 1571	7.7	20.1	24.5	23.9	17.2	8.4	7.5	6.7	14.5	14.7	9.4	16.8	18.9	6.6	8.3	5.2	2.5	7.3	9.4	8.1
Kharkof ...1583	15.6	12.8	19.1	20.8	20.0	9.2	8.6	5.0	13.9	13.8	18.1	11.8	13.2	5.2	8.5	6.0	3.0	4.3	8.8	6.7
Blackhull ..6251	...	...	12.2	24.1	9.7	12.5	4.6	6.3	...	11.6	...	...	11.5	11.9	8.1	6.7	3.1	3.9	...	7.5
Minturki ..6155	...	..	20.4	10.5	10.4	7.1	3.1	4.8	...	9.4	...	...	15.8	3.5	7.9	1.2	2.7	3.7	...	5.8
Miscellaneous																				
Alton (Ghirka Winter)..1438	6.5	15.2	17.1	22.5	16.1	9.2	6.5	4.2	12.2	12.6	6.7	13.3	11.7	8.2	6.6	2.9	4.6	3.6	7.2	6.3

a No varietal plats of winter wheat were grown at Akron in 1919.
b Plats located in favorable position to receive run-off.

TABLE 24.—Annual and Average Yields of Winter Wheat Varieties Grown at the U. S. Dry Land Field Station in All Years Experiments Have been Conducted During the 18-year Period, 1908 to 1925, Inclusive

Variety C.I. No.	1908	1909*	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919†	1920	1921	1922	1923	1924§	1925£	17-year Average Excluding 1909
Turkey ...1571	19.8	...	29.5	11.7	43.1	7.3‡	25.1	28.1	31.7	8.5	18.4	...	21.7	15.3	12.7	6.8	5.0	7.0	18.2
Kharkof ..1583	19.3	...	29.8	14.2	37.5	16.6	26.0	29.2	26.2	16.9	12.3	17.6	16.1	13.0	14.2	7.6	5.8	4.7	18.1
Kharkof ..1442	20.6	..	27.9	10.0	34.3	16.1	26.6	27.5	19.2	12.9	12.8	...	15.6	15.0	15.2	7.5	4.3	...	17.7
Crimean ..1436	19.1	...	38.3	17.9	33.1	12.6	28.3	26.6	20.5	7.0	16.4	...	19.2	16.7	10.6	6.6	...	5.8	18.6

* Winter wheat failed completely in 1909.
† No experimental plats of winter wheat were grown in 1919. The yield here included was from an increase field. The yield in 1919 is not included in computing the average.
‡ No plats of Turkey, C. I. No. 1571, were grown; this yield was from a plat of a selection of that variety.
§ Crimean C. I. No. 1436 not included in the 1924 test; this yield was not included in computing the average.
£ Kharkof C. I. No. 1442 not included in the 1925 test; this yield was not included in computing the average.

fallow than cornland. The bushel weight of the crop grown on the two soil preparations varied only slightly, but the average usually was slightly higher for wheat grown on cornland than for wheat grown on fallow. Straw yields were about 75 percent more on fallow than on cornland.

Yields of all varieties were less from cornland than when grown on fallow. Yields from winter wheat plats on fallow usually have been one-third to one-half more than those on cornland. In fallowing, every other crop is lost, and, for fallow to prove profitable, it is necessary for yields on fallow to be at least twice those on cropped land. The data presented prove fallowing unprofitable at Akron, but probably this does not hold true in all dryland sections of the state, especially where the annual precipitation is lower or not as favorably distributed for winter wheat.

TABLE 25.—Averages of Agronomic Data Recorded for Four Varieties or Strains of Winter Wheat Grown on the U. S. Dry Land Station at Akron in the 16 Years from 1908 to 1923, Inclusive

Variety	C.I. No.	Dates of		Height Inches	Stem Rust Infection %	Bu. Wt. Lbs.	Acre Yield	
		Heading	Maturity				Grain Bus.	Straw Lbs.
Turkey..	1571	6/19	7/17	33	3	57.8	18.6	2316
Kharkof.	1583	6/20	7/17	32	3	58.1	18.6	2304
Kharkof.	1442	6/20	7/18	32	3	58.0	17.4	2090
Crimean.	1436	6/19	7/17	32	3	57.8	18.2	2171

SPRING WHEAT.—As a rule only early-maturing spring wheat varieties yield well at Akron. Spring wheat seldom has been injured seriously by rust in the dryland section surrounding the Akron Field Station.

In all, 66 varieties and strains of spring wheat were grown in plats at the Akron Station during the 18-year period from 1908 to 1925, inclusive. Several strains under the same name, but from different sources, and several selections of the same variety, have been grown in some cases. Most of the spring wheat varieties grown in plat experiments belong to the two main classes, durum and hard red spring. Experiments conducted early in the Akron Station's history proved many white spring wheats to be poorly adapted. Some 17 varieties tried in the earlier years were soon discontinued because of low yields or other undesirable characters. The records of these varieties have been presented[1] elsewhere and are not repeated.

The annual yields of the remaining 49 varieties and strains, with average yields for each of the periods 1908 to 1925, 1917 to 1925 and 1920 to 1925, inclusive, are presented in Table 26. These data

[1] McMurdo, Geo. A. Cereal Experiments at the Akron Field Station, Akron, Colo. U. S. D. A., Bul. 402, 34 pages, 11 figs., 1916.

show excellent yields were produced in 1908, 1910, 1912, 1914 and 1915; fair yields were recorded for 1909, 1920 and 1923 and poor yields or almost complete failures resulted in 1911, 1913, 1916, 1917, 1918, 1919, 1921, 1922, 1924 and 1925. Poorly distributed seasonal precipitation in 1911, 1913, 1916, 1917, 1918, 1919, 1921, 1922, 1923, 1924 and 1925, reduced yields thru lack of moisture at critical periods in the plant's development.

Previous to 1917, most of the experiments with spring wheat were grown on summer fallow. Beginning with the crop of 1917, they were grown both on fallow and on cornland. This partially accounts for the lower yields recorded during the past 6 years. Had the 1920 crop been grown on fallow only, the yields probably would have been equal to those of 1908 or 1915.

Table 27 presents the yields of one hard red spring and two durum varieties grown for the 18-year period, 1908 to 1925, inclusive. Converse (Red Russian) was not grown in 1908, and the average of the yields of two similar varieties, Erivan and Fretes, have been included for that year. The average dates of heading and ripening, height of straw, percentage of stem-rust infection, and average yields of grain and straw of these three varieties are presented in Table 28. These data indicate the average development of the durum and hard red spring wheat crop on dryland in eastern Colorado.

Several durum varieties have been grown for nearly the entire 18-year period, but most common wheat varieties which yielded well the first 5 or 10 years were dropped because of objectionable characters, such as poor milling quality, excessive shattering, or weak straw.

The best durum varieties have produced yields during the 18-year period averaging a little better than those of the best hard red spring wheats. This advantage has not been consistent. In some seasons the durum varieties have outyielded the common varieties, while in many others the reverse has been true. The difference in average yield in favor of the durums is insufficient to warrant recommending the sowing of durum varieties exclusively in preference to those of hard red spring wheat, due to the usual spread in price favoring hard red spring wheat.

Of the varieties of durum wheat grown for 8 years or longer, Peliss produced the best yields. Kubanka (C. I. No. 1440) was inferior to Peliss, and Arnautka (C. I. No. 1493) was but little better than Kubanka. The rust-resistant strains, Pentad (D-5) and Monad (D-1), have not yielded well. Among the varieties grown for 4 years or longer Akrona (C. I. No. 6881), an early maturing selection from Arnautka (C. I. No. 1493), made at the Akron station in 1912, has given best results. This selection has shown unusual promise at

TABLE 26.—Annual and Average Yields of 49 Varieties and Strains of Spring Wheat Grown at the U. S. Dry Land Field Station, Akron, Colorado, for Varying Periods During the 18 Years from 1908 to 1925, Inclusive, and the Average Yields as Percentage of Peliss, C. I. No. 1584, for Comparable Years

Group and Variety	C. I. No.	Yield Per Acre (Bushels)														Average							Comparison with Peliss C. I. No. 1584			
		1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924†	1925	1908 1925	1917 1925	1920 1925	No. Years in which Compared	Variety Named	Peliss	Variety Named in Terms of Peliss (Percent)
Durum:																										
Acme	5284	...	...	...	...	...	...	...	...	...	...	...	...	14.6	7.7	8.8	...	...	...	...	...	...	3	10.4	11.3	92.0
Arnautka	1493	26.9	20.7	16.4	10.6	27.5	10.6	25.6	27.9	10.7	7.0	7.1	8.6	15.2	7.8	9.2	...	...	...	...	...	...	15	15.5	16.5	93.9
Arnautka (6P1)	4064	...	...	19.5	15.7	37.0	10.6	25.0	27.6	11.4	6.5	6.4	5.4	13.8	7.2	7.4	...	...	...	...	...	...	13	14.9	15.3	97.4
Akrona	6881	...	...	...	...	...	...	...	...	...	...	6.7*	8.6	20.4*	10.2	10.2	17.2	0	5.3	...	...	10.6	8	9.8	8.8	111.4
Beloturka	1520	31.1	19.4	19.9	8.0	21.1	10.6	19.5	26.7	11.4	5.5	3.1	8.3	20.2*	8.5	9.6	...	...	...	...	...	...	15	14.9	16.5	90.3
Ble dur	1471	15.5	16.8	17.7	10.6	33.0	8.3	26.3	33.6	...	...	...	...	...	...	...	...	...	...	...	...	...	8	20.2	22.4	90.2
Gharnovka	1447	29.1	20.9	25.0	9.2	36.5	3.3	23.6	22.2	...	...	...	...	...	...	...	...	...	...	...	...	...	8	21.2	22.4	94.7
Golden Ball	6227	...	...	...	...	...	...	...	...	...	...	...	8.8	15.8	8.2	...	...	...	...	...	...	...	3	10.9	11.6	94.0
Kahla	5549	...	...	...	...	...	...	...	...	...	...	...	...	11.9*	6.1	7.1	...	...	...	...	...	...	3	8.4	11.3	74.3
Kubanka	1354	27.2	18.0	21.3	11.7	19.8	13.6	22.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	19.2	21.1	91.0
Kubanka	1440	26.8	9.3	17.1	9.0	25.1	5.1	20.6	27.6	12.9	7.5	3.0	6.0	14.8	8.6	9.6	15.0	0	8.8	12.6	8.1	9.5	18	12.6	15.1	83.4
Kubanka	1516	...	...	32.3	9.1	30.0	6.0	26.4	31.3	...	...	...	...	...	...	...	...	...	...	...	...	...	6	22.5	21.8	103.2
Kubanka (No. 8)	4063	...	...	...	...	...	...	...	...	4.7	7.0	...	...	...	...	...	...	...	...	...	...	...	2	5.9	11.1	53.1
Marouani	1593	22.9	14.2	19.2	10.6	18.9	14.1	23.9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	17.7	21.1	83.9
Mindum	5296	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8.2	15.8	0	8.6	...	...	...	4	8.2	8.0	102.4
Monad (D-1)	3320	...	...	...	...	...	...	...	...	...	6.5	2.0	8.7	14.9	7.2	9.6	16.6	...	...	...	...	...	7	9.4	10.1	93.9
Nodak (K98)	6519	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12.8	0	10.0	...	...	...	3	7.6	8.0	95.0
Peliss (check)	1584	24.7	23.6	15.8	10.6	35.6	10.5	26.6	31.6	14.4	7.8	3.7	8.8	16.9	9.1	7.9	16.7	0	7.4	15.1	8.7	9.7	18	15.1	15.1	100.0
Pentad (D-5)	3322	...	...	...	...	...	...	...	...	...	7.8	2.5	6.5	15.7	8.4	8.7	...	...	...	...	...	...	6	8.3	9.0	92.2
Pererodka	1350	21.9	15.9	11.5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	16.4	21.4	76.6
Purple	3024	24.7	20.7	15.3	7.9	33.0	10.0	21.1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	19.0	21.1	90.0
Togaurog	1570	20.0	...	...	...	...	...	...	...	...	...	...	4.2	23.5*	...	...	...	...	...	...	...	...	3	15.9	16.8	94.6
Velvet Don	1445	33.3	21.1	13.5	10.0	33.3	7.3	25.3	28.1	...	...	...	...	...	...	...	...	...	...	...	...	...	8	21.5	22.4	95.9
Yellow Gharnovka	1444	32.8	25.5	15.0	10.8	34.2	5.3	22.5	31.2	...	...	...	...	...	...	...	...	...	...	...	...	...	8	22.2	22.4	99.8
.....	3143	...	...	...	...	...	...	...	...	...	...	...	...	...	...	12.7	...	...	...	...	...	...	1	12.7	7.9	160.8
Hard Red Spring:																										
Cole Hybrid	4062	11.8	27.9	21.5	12.3	18.2	8.0	21.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	17.2	21.1	81.5
Converse (Red Russian)	4141	...	15.2	15.6	12.1	23.2	8.3	23.0	23.9	7.7	7.0	7.5	11.1	16.8	6.7	10.8	14.4	0	7.3	...	9.1	9.3	17	12.4	14.5	85.5
Erivan	2397	19.3	26.3	15.1	11.9	20.7	12.0	19.3	19.5	7.8	9.2	10.5	12.9	22.9*	...	...	...	...	...	...	...	...	13	14.4	17.7	81.3
Ghirka	1517	20.6	23.8	18.7	8.5	23.3	11.6	19.3	22.6	7.5	8.2	4.1	7.5	17.9*	...	...	...	...	...	...	...	...	13	14.9	17.7	84.2
Glyndon	2873	...	...	...	9.4	17.3	8.0	16.6	16.2	7.2	6.6	2.5	4.3	14.2	4.0	...	...	...	...	...	...	...	11	9.7	16.0	60.6
Haynes Bluestem	2874	...	...	...	...	...	...	...	16.4	0.8	4.9	1.0	2.7	12.5*	1.8	...	...	...	...	...	...	...	7	5.7	13.2	43.1
Haynes Bluestem	3020	25.2	15.3	19.8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	20.1	21.4	93.9
Kitchener	4800	...	...	...	...	...	...	...	...	...	...	...	...	15.9	5.7	7.3	...	...	...	...	...	...	3	9.6	11.3	85.0
Kota	6248	...	...	...	...	...	...	...	...	...	...	...	...	18.8	5.7	11.3	13.1	0	5.2	...	...	9.0	6	9.0	9.7	92.8
Laramie	6235	...	...	...	...	...	...	...	...	...	...	...	5.6	13.5*	...	...	...	...	...	...	...	...	2	9.6	12.9	74.4
Manchuria	2492	18.2	23.2	25.0	...	...	...	...	21.2	...	...	...	...	...	...	...	...	...	...	...	...	...	4	21.9	23.9	91.6
Marquis	3641	...	...	...	...	...	7.5	19.6	26.5	11.8	7.3	3.7	8.5	14.5	7.4	6.0	10.5	0	6.5	...	7.5	8.0	13	10.2	12.4	82.2
Norka	4377	...	...	...	...	...	8.6	16.3	...	...	...	...	...	...	4.4	...	...	...	...	...	...	...	3	9.8	15.4	63.6
Pioneer	4324	...	...	...	...	...	...	...	28.7	6.9	8.0	9.1	13.9	15.5	7.6	9.4	...	...	...	...	...	...	8	12.4	12.5	99.2
Power	3697	...	...	...	...	...	...	...	...	1.6	...	1.2	4.7	15.4*	6.4*	...	...	...	...	...	...	...	5	5.9	10.6	55.7
Prelude	4323	...	...	...	...	...	...	...	29.5	8.3	6.0	9.8	17.5	11.6	4.2	9.0	16.2	4.9	3.8	...	9.2	8.3	11	11.0	11.3	97.3
Preston	3081	...	...	...	...	...	9.6	18.3	26.2	7.2	6.9	2.3	5.9	18.3*	3.0*	...	...	...	...	...	...	...	9	10.9	14.4	75.7
Red Bobs	6255	...	...	...	...	...	...	...	...	...	...	...	...	12.5*	6.3	11.1	14.8	...	...	...	...	...	4	11.2	12.7	88.2
Redsask	6794	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15.3	5.2	6.1	...	...	...	3	8.9	8.0	111.2
Ruby	6047	...	...	...	...	...	...	...	...	...	...	...	...	16.5*	7.6	10.5	14.0	...	...	...	...	...	4	12.2	12.7	96.1
Common White:																										
Early Baart	1697	...	...	...	...	...	...	...	...	...	...	...	...	...	6.0*	12.7	17.3	0	7.6	...	...	...	5	8.7	8.2	106.1
Galgalos	2398	21.8	19.8	20.5	19.6	20.5	14.1	21.6	24.4	10.5	9.2	10.7	5.8	18.3	...	...	...	...	...	...	...	...	13	16.7	17.7	94.4
Hard Federation	4733	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11.4	15.6	5.9	5.5	...	...	...	4	9.6	8.0	120.0
Quality	6607	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	19.2	4.8	3.6	...	...	...	3	9.2	8.0	115.0

* Grown on fallow only.
† Most spring wheat varieties failed, due to very dry season.

TABLE 27.—Annual and Average Yields of the Leading Spring Wheat Varieties Grown on the U. S. Dry Land Field Station for the 18 Years from 1908 to 1925, Inclusive

Variety	C.I. No.	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924†	1925	Av.
Durum:																				
Peliss ..	1584	24.7	23.6	15.8	10.6	35.6	10.5	26.6	31.6	14.4	7.8	3.7	8.8	16.9	9.1	7.9	16.7	0	7.4	15.1
Kubanka	1440	26.8	9.3	17.1	9.0	25.1	5.1	20.6	27.6	12.9	7.5	3.0	6.0	14.8	8.6	9.6	14.9	0	8.8	12.6
Hard Red Spring:																				
Converse (Red Russian)	4141	14.8*	15.2	15.6	12.1	23.2	8.3	23.0	23.9	7.7	7.0	7.5	11.1	16.8	6.7	10.8	14.3	0	7.3	12.8

* Not grown in 1908. The yield shown is the average of yields by Erivan and Fretes, two similar varieties.
† Most spring wheat varieties failed, due to very dry season.

TABLE 28.—Average of Agronomic Data Recorded for Three Spring Wheat Varieties Grown on the U. S. Dry Land Field Station in the 16 Years from 1908 to 1923, Inclusive

Group and Variety	C.I. No.	Dates of		Height (Inches)	Stem-Rust Infection (Per cent)	Bushel Weight (Pounds)	Acre Yield	
		Heading	Maturity				Grain (Bushels)	Straw (Pounds)
Durum:								
Peliss	1584	June 28	July 29	32	1	59.0	16.5	2,043
Kubanka	1440	June 28	July 28	31	1	59.5	13.6	2,020
Hard Red Spring:								
Converse (Red Russian)	*4141	June 29	July 24	29	3	56.0	13.6	1,908

* Not grown in 1908, average for 15-year period, 1909 to 1923, Inclusive.

several other stations in the Great Plains as well as at Akron. For the past several years this selection has outyielded all other durums at Akron. The information available at this time indicates that this selection may prove of excellent quality for the manufacture of macaroni. Acme and Kahla have proved inferior in yield, while Nodak and Mindum have been grown for periods too short for results to be conclusive.

No hard red spring wheat varieties have been grown during the entire period, 1908 to 1925, but those grown for the longest periods have produced yield averages slightly below those of the best durum varieties. During the 9-year period, 1917 to 1925, inclusive, several varieties of hard red spring wheat outyielded the durums. Converse (Red Russian) and Prelude were the highest yielding of these hard red spring varieties. As they mature early they have more nearly escaped the effects of drouth than Marquis or Kota.

The 6-year average yields of Kota indicate that this variety is about equal to Marquis, but both apparently mature later than is desirable for growing on dryland in eastern Colorado.

During the seasons of 1922 and 1923 very favorable yields were obtained from early-maturing varieties of white spring wheat. These varieties have as yet been grown for too short a period to justify recommending them for general seeding. Moreover, white wheats are little grown on dryland in eastern Colorado and their commercial extension does not seem advisable at the present time. The indications are, however, that early maturity is essential in a spring wheat variety for the section in which the Akron Station is located. As several of the white wheats possess this character they may prove of value in the production of adapted early red wheats by hybridization.

During the 9-year period, 1917 to 1925, inclusive, the spring wheat varieties were grown on both fallow and on cornland. The annual and average yields of the eight leading varieties are presented in Table 29. Table 30 presents the average dates of heading and ripening, height of plants in inches, percentage of stem rust infection, weight per bushel and yield of straw in pounds, and acre yield in bushels, of these varieties when grown on fallow and cornland for the period 1917 to 1923.

In comparing the effect of the two methods of seedbed preparation, the varieties have headed slightly earlier on cornland than on fallow, but have reached maturity at about the same time on the two soil preparations. Most varieties have grown from 3 to 6 inches taller on fallow. Stem-rust infection has been slight in all cases, and has been about equal on both soil treatments. Variation in bushel weight has been slight, except in a few varieties which showed a materially higher bushel weight when grown on fallow.

TABLE 29.—Annual and Average Yields of Leading Spring Wheat Varieties Grown on Fallow and on Cornland at the U. S. Dry Land Field Station During the Years from 1917 to 1925, Inclusive

Group and Variety	C.I. No.	Fallow									Average		Cornland								Average	
		1917	1918	1919	1920	1921	1922	1923	1924*	1925	1917 1925	1920 1925	1917	1918	1919	1920	1921	1922	1923	1924*	1925	1917 1925	1920 1925
Durum																							
Peliss	1584	12.1	4.2	9.8	20.6	10.1	9.7	16.1	0	8.8	10.2	10.9	3.5	3.2	7.6	13.2	8.0	6.0	17.2	0	5.9	7.2	8.4
Kubanka	1440	12.1	2.9	6.0	17.1	10.3	11.1	13.4	0	11.3	9.4	10.5	3.0	3.2	5.8	12.7	6.8	8.0	16.5	0	6.3	6.9	8.4
Akrona (Sel. 7-12)	6881	---	---	---	20.4	12.5	12.9	17.2	0	6.3	---	11.6	---	---	---	---	7.8	7.5	17.1	0	4.2	---	---
Hard Red Spring																							
Converse	4141	10.3	8.0	13.5	18.5	8.3	11.8	13.1	0	9.2	10.3	10.2	3.8	7.1	8.7	15.2	5.1	9.7	15.6	0	5.4	7.8	8.5
Prelude	4323	8.5	8.4	16.9	14.5	5.6	10.7	14.3	4.9	4.2	9.8	9.0	3.5	11.3	18.1	8.6	2.7	7.3	18.1	4.9	3.4	8.7	7.5
Marquis	3641	11.3	4.1	12.7	15.8	9.4	7.4	12.1	0	8.3	9.0	8.8	3.0	3.4	4.3	13.1	5.4	4.6	14.8	0	4.6	5.9	7.1
Kota	6248	---	---	---	20.4	7.2	13.1	11.8	0	7.5	---	10.0	---	---	---	17.2	4.1	9.6	14.4	0	2.9	---	8.0

* Most of the spring wheat varieties failed, due to a very dry season.

TABLE 30.—Average Agronomic Data Recorded for Six Spring Wheat Varieties Grown on Fallow and on Cornland at the U. S. Dry Land Field Station in the Seventeen Years from 1907 to 1923, Inclusive

Group and Variety	C. I. No.	Dates of Maturity	Dates of Heading	Height (Inches)	Stem-Rust Infection (Per cent)	Bushel Weight (Pounds)	Acre Yield	
							Grain (Bushels)	Straw (Pounds)
ON FALLOW								
Durum:								
Peliss	1584	June 29	July 26	32	2	59.3	11.8	1,987
Kubanka	1440	June 28	July 25	31	2	58.3	10.4	1,789
Monad	3320	June 28	July 25	30	2	57.9	10.1	1,844
Hard Red Spring:								
Converse (Red Russian)	4141	June 28	July 22	30	5	55.2	11.9	2,043
Prelude	4323	June 19	July 15	29	6	55.2	11.3	1,429
Marquis	3641	June 29	July 26	29	3	55.0	10.4	1,462
ON CORNLAND								
Durum:								
Peliss	1584	June 25	July 26	27	2	57.0	8.4	1,205
Kubanka	1440	June 25	July 25	26	2	57.7	8.0	1,274
Monad	3320	June 25	July 25	28	1	58.4	8.6	1,438
Hard Red Spring:								
Converse (Red Russian)	4141	June 25	July 21	26	6	55.1	9.3	1,407
Prelude	4323	June 18	July 13	26	3	54.7	9.9	1,077
Marquis	3641	June 26	July 25	25	3	54.8	6.9	1,152

Yields from all varieties, both of grain and straw, have averaged higher on fallow than on cornland.

The average yields of spring wheat, both on fallow and on cornland, are too low to merit very serious consideration for this crop. In an occasional season good yields may be obtained, but, as an average, the crop is grown at a loss. The yield difference of fallow over cornland often is insufficient to warrant growing spring wheat even after fallow in northeastern Colorado. The only justification for sowing spring wheat in dryland sections of eastern Colorado apparently is as a catch crop, where winter wheat has failed to survive the winter and a feed crop is not desired.

COMPARISON OF WINTER AND SPRING WHEAT.—Table 31 presents the annual and average yields for the 18-year period from 1908 to 1925, inclusive, of Turkey and Kharkof winter wheat, Peliss and Kubanka durum wheat, and Converse (Red Russian) hard red spring wheat. Winter wheat failed in 1909, and none was sown in experimental plats in the fall of 1918. Converse was not grown in 1908, but the average of the yields of two similar varieties, Erivan and Fretes, is included in the table for that year.

From the results obtained over a period of 18 years, it is evident that winter wheat yields higher than spring wheat almost every year. The winter wheat crop may be reduced by soil blowing and by winter killing, but with a fair stand only winter wheat still will outyield spring wheat in an average season under conditions such as prevail at the Akron Station.

A complete failure of winter wheat resulted in 1909 from a combination of winter killing, soil blowing and treating the seed too severely for smut. No winter-wheat plats were grown at Akron in 1919.[1] As no winter-wheat plats were grown in 1919, that year is not included in comparing the average yields of spring with winter varieties.

The average yields of both Turkey and Kharkof have been 18.2 and 18.1 bushels per acre, respectively. The yields of these varieties exceeded those of the durum varieties in 12 of the 16 years where comparison was possible. The two durum varieties yielded more than the two winter wheats in 1908, 1915, 1923 and 1925. The average advantage in yield per acre of the two winter varieties over the highest-yielding spring wheat, Peliss durum, was 2.7 bushels and 2.6 bushels for the 18-year period, 1908 to 1925, inclusive. Kubanka, the other durum variety grown for the entire period, produced an average yield of 13.0 bushels, while Converse, a hard red spring

[1] In computing the average winter wheat yields of the 18-year period, 1908 to 1925, inclusive, the yields for 1909 are included as zero. Had the soil been cropped to spring wheat a crop could have been produced on it. This would have given a still greater advantage in yields of winter over spring wheat. There are arguments both for and against either method of computing yields.

TABLE 31.—Annual and Average Yields of Two Varieties of Winter Wheat, Two of Durum Wheat and one of Hard Red Spring Wheat, Grown at U. S. Dry Land Field Station from 1908 to 1925, Inclusive

Group and Variety	C.I. No.	Acre Yield (Bushels)																		Average	
		1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1908 1925	1908 1925*
Hard Red Winter:																					
Turkey	1571	19.8	†0	29.5	11.7	43.1	‡7.3	25.1	28.1	31.7	8.5	18.4	---	21.7	15.3	12.7	6.8	5.0	7.0	---	18.2
Kharkof	1583	19.3	†0	29.8	14.2	37.5	16.6	26.0	29.2	26.2	16.9	§12.3	17.6	16.1	13.0	14.2	7.6	5.8	4.7	18.1	18.1
Durum:																					
Peliss	1584	24.7	23.6	15.8	10.6	35.6	10.5	26.6	31.6	14.4	7.8	3.7	8.8	16.9	9.1	7.9	16.7	0	7.4	15.1	15.5
Kubanka	1440	26.8	9.3	17.1	9.0	25.1	5.1	20.6	27.6	12.9	7.5	3.0	6.0	14.8	8.6	9.6	15.0	0	8.8	12.6	13.0
Hard Red Spring:																					
Converse (Red Russian)	4141	£14.8	15.2	15.6	12.1	23.2	8.3	23.0	23.9	7.7	7.0	7.5	11.1	16.8	6.7	10.8	14.4	0	7.3	12.8	12.6

* Not including 1919 crop.
† All winter varieties destroyed by winter killing.
‡ Yield from a selection of Turkey, C. I. No. 1571; original variety not grown.
§ No winter wheat plats were sown in fall of 1918; yield included in the average of 2 increase fields.
£ Converse was not grown in 1908, but average of 2 similar varieties included.

wheat, averaged but 12.6 bushels per acre for the same years. Converse outyielded the average of the two winter wheat varieties in 2 of the 14 years. This was in 1923 and 1925. It outyielded the average yield of the two durum varieties in 7 of the 17 years Converse was grown. As previously stated, Converse was not grown in 1908, but the average yields of similar varieties, Erivan and Fretes, were included for that year. Converse outyielded Peliss, the best durum variety, four times, and practically equalled the yield of Peliss thrice in the entire period. The average advantage of the winter-wheat varieties over Converse is nearly 5.5 bushels.

In summing up and considering the available data, it is shown that spring wheat has little place in the dryland section of eastern Colorado except as a catch crop to reseed ground on which winter wheat has failed to survive the winter. Winter wheat sown even as late as October 15 in an average season will outyield spring wheat.

COMPARISON OF FALLOW AND CORNLAND.—As previously stated, since 1917 the wheat varieties have been grown in duplicate plats on fallow and on cornland. The data presented in Table 32 shows that winter wheat outyielded spring wheat on both soil preparations. Most varieties of both winter and spring wheat yielded about one-fourth to one-half more on fallow than on cornland. The yields of Kanred are the only variation from this rule. The plats of Kanred on cornland in 1920 were located favorably. As a result, these plats produced exceptional yields. In a period so short this advantage has not been equalized. In comparing the yields of winter and spring wheat it seems advisable to omit from consideration the yields presented in Table 32 for 1919. These data are from increase fields of Kanred and Kharkof grown on fallow and cornland, and, while included in the table for comparison, are probably not comparable with the other data.

Summarizing the data presented in Table 32 and excluding that for 1919, the 8-year average yields for the varieties of winter wheat, durum spring wheat and hard red spring wheat, were as follows: Winter wheat varieties 14.7 bushels on fallow, 10.4 bushels on cornland; durum varieties 9.8 bushels on fallow, 7.1 on cornland; and hard red spring varieties 8.8 bushels on fallow and 7.1 on cornland. Assuming the average yield of each group of varieties on cornland to be 100 percent, then the average yield on fallow of winter wheat was 141.3 percent; durum spring wheat 138.0 percent, and hard red spring wheat 123.9 percent. These data indicate that winter wheat is able to utilize to a greater net advantage the cumulative effects of the fallow than do either the durums or the hard red spring wheats. The hard red spring varieties are the least efficient of all, the durums being intermediate in that respect. The data emphasize

TABLE 32.—Annual and Average Yields of Three Varieties of Winter Wheat, Two of Durum and Three of Red Hard Spring, Grown on Fallow and Cornland at the U. S. Dry Land Field Station, from 1917 to 1925, Inclusive

Group and Variety	C.I. No.	Acre Yield (Bushels)																				
		Fallow									Average		Cornland								Average	
		1917	1918	1919	1920	1921	1922	1923	‡ 1924	1925	1917 1925	1917† 1925	1917	1918	1919	1920	1921	1922	1923	‡ 1924	1925	1917 1925	1917† 1925
Hard Red Winter:																						
Kanred	5146	14.8	22.6	*34.5	27.9	18.6	19.5	13.1	7.7	2.4	17.9	15.8	20.4	17.5	*8.0	32.3	9.9	9.6	9.9	2.9	2.2	12.5	13.1
Turkey	1571	7.7	20.1	---	24.5	23.9	17.2	8.4	7.5	6.7	---	14.5	9.4	16.8	---	18.9	6.6	8.3	5.2	2.5	7.3	---	9.4
Kharkof	1583	15.6	12.8	27.2	19.1	20.8	20.0	9.2	8.6	5.0	15.4	13.9	18.1	11.8	8.0	13.2	5.2	8.5	6.0	3.0	4.3	8.7	8.8
Durum:																						
Peliss	1584	12.1	4.2	9.8	20.6	10.1	9.7	16.1	0	8.8	10.2	10.2	3.5	3.2	7.6	13.2	8.0	6.0	17.3	0	5.9	7.2	7.1
Kubanka	1440	12.1	2.9	6.0	17.1	10.3	11.1	13.4	0	11.3	9.4	9.8	3.0	3.2	5.8	12.7	6.8	8.0	16.5	0	6.3	6.9	7.1
Hard Red Spring:																						
Converse (Red Russian)	4141	10.3	8.0	13.5	18.5	8.3	11.8	13.1	0	9.2	10.3	9.9	3.8	7.1	8.7	15.2	5.1	9.7	15.6	0	5.4	7.8	7.7
Prelude	4323	8.5	8.4	16.9	14.5	5.6	10.7	14.3	4.9	4.2	9.8	7.9	3.5	11.3	18.1	8.6	2.7	7.3	18.1	4.9	3.4	8.7	7.5
Marquis	3641	11.3	4.1	12.7	15.8	9.4	7.4	12.1	0	8.3	9.0	8.6	3.0	3.4	4.3	13.1	5.4	4.6	14.8	0	4.6	5.9	6.1

* No winter wheat plats were grown at Akron in 1919. The yields of winter wheat included are from increase fields grown in 1919.
† Average excluding the yields in 1919.
‡ Most spring wheat varieties failed, due to a very dry season.

the fact that for the environment typified by Akron the hard red spring wheats are poorly adapted, and this range of adaptability is not increased by fallowing.

Comparing the two methods of cropping wheat after fallow and wheat after corn, the available data show that fallowing is not profitable for conditions such as prevailed at Akron during these experiments. Where the fallow system is used each wheat crop must bear almost the entire expense of soil preparation, interest on land, and the interest and depreciation on equipment for 2 years, and the cost of seeding and harvest for 1 year. Where wheat is grown after corn the wheat crop carries a lower charge for soil preparation, an equal charge for seeding, at least no greater charge for harvesting, and interest and depreciation for 1 year only. The data show an average yield of 3.0 bushels greater for winter wheat grown on fallow than on cornland which at average prices will not cover the greater cost of preparing and maintaining the fallow and the added interest and depreciation charge. In addition, a crop of corn in eastern Colorado often is nearly as valuable as a crop of fallow wheat. When this profit is added to that from the wheat grown on the cornland the disadvantage of the fallow system for conditions such as prevail at Akron is evident.

MILLING AND BAKING EXPERIMENTS

Milling and baking experiments were made on samples of the grain from the varietal experiments to assist in determining the value of new varieties. This was done thru the co-operation of the Office of Cereal Crops and Diseases and the Milling Investigations Section, Grain Division of the Bureau of Agricultural Economics, United States Department of Agriculture. This work was begun in 1917. The 1917 experiments were conducted at Fargo, N. Dak., in co-operation with the North Dakota Agricultural Experiment Station. After 1918, the experiments were conducted in the milling and baking laboratory of the Bureau of Agricultural Economics at Washington, D. C.

Annual yields and data on the most important factor in milling and baking of two varieties of winter wheat and one variety of spring wheat are shown in Table 33. Data are included for each of the five years, 1918 to 1922, inclusive. A five-year summary of data on two varieties and a four-year summary of data on three varieties are presented.

During the past few years there has been considerable controversy over the relative value of Kanred and Turkey for milling and baking purposes. Some elevators in northeastern Colorado have discriminated against Kanred wheat, stating that it is inferior in milling

TABLE 33.—Average Yield, Milling and Baking Data of Three Wheat Varieties Grown at the U. S. Dry Land Field Station, Akron, Colorado, During the Five-year Period from 1918 to 1922, Inclusive

Variety, C. I. No. and Season	Grain		Milling Tests					Baking Tests				
	Yield Bu. Per Acre	Grade	Bushel Weight	Percent Protein	Flour Percent	Shorts Percent	Bran Percent	Water Absorption Percent	Volume c.c.	Weight Loaf Gms.	Texture Percent	Color Percent
Kanred C. I. No. 5146												
1918	20.0	2 H.W.	58.1	14.8†	70.6	16.1	15.9	60.0	1900	496	88.5	88.0
1919*	21.3	2 D.H.W.	58.1	13.7	69.9	16.0	16.7	62.1	2150	506	91.0	91.0
1920	30.1	1 D.H.W.	60.1	13.9	76.0	11.7	12.3	66.2	2160	520	90.0	93.3
1921	14.3	3 D.H.W.	56.4	18.3	73.1	14.2	14.7	65.0	1960	513	91.3	89.5
1922	14.5	3 D.H.W.	57.7	16.3	77.1	12.0	12.5	71.2	1860	540	83.0	84.0
Average (1918, 1920, 1921, 1922)	...	.....	58.1	15.8	74.2	13.5	13.9	65.6	1970	517	88.2	88.7
(1918-1922, Inclusive)	...	.....	58.1	15.4	73.3	14.0	14.4	64.9	2006	515	88.8	89.2
Turkey C. I. No. 1571												
1918‡	12.8	2 D.H.W.	58.6	17.8	74.3	11.8	16.5	58.8	1930	492	86.5	88.0
1919*	...	.....	...	...	...	...	...	...	...	...	...	...
1920	21.7	3 D.H.W.	56.9	14.5	71.2	13.5	15.0	66.8	2170	522	94.0	94.0
1921	15.3	3 D.H.W.	57.4	16.0	74.1	12.6	14.9	64.7	1840	515	91.3	92.0
1922	12.7	3 D.H.W.	56.6	16.4	75.3	11.5	13.5	73.5	1850	543	87.5	86.5
Average (1918, 1920, 1921, 1922)	...	.....	57.4	16.2	73.7	12.4	15.0	66.0	1948	518	89.8	90.1
Marquis C. I. No. 3641												
1918	3.7	Sp. D.N.S.	54.6	17.4	70.3	18.1	12.5	59.4	2450	502	88.0	89.0
1919	8.5	4 D.N.S.	54.8	15.9	66.8	19.0	16.0	60.6	2180	499	91.0	95.5
1920	14.5	5 D.N.S.	53.2	17.5	69.2	16.3	16.2	58.8	2420	500	83.0	93.0
1921	7.4	4 D.N.S.	54.2	17.5	70.3	15.7	17.3	61.2	2260	497	91.3	92.0
1922	6.0	3 D.N.S.	56.5	17.5	73.5	17.8	11.9	66.2	2230	519	88.0	90.5
Average (1918, 1920, 1921, 1922)	...	.....	54.6	17.5	70.8	17.0	14.5	61.4	2340	505	87.6	91.1
(1918 to 1922, Inclusive)	...	.....	54.7	17.2	70.0	17.4	14.8	61.2	2308	503	88.3	92.0
Summary:												
Aver. (1918, 1920, 1921, 1922)	...	.....	...	...	...	...	...	...	...	...	...	...
Kanred	...	.....	58.1	15.8	74.2	13.5	13.9	65.6	1970	517	88.2	88.7
Turkey	...	.....	57.4	16.2	73.7	12.4	15.0	66.0	1948	518	89.8	90.1
Marquis	...	.....	54.6	17.5	70.8	17.0	14.5	61.4	2340	505	87.6	91.1
Average (1918 and 1922, Inc.)	...	.....	...	...	...	...	...	...	...	...	...	...
Kanred	...	.....	58.1	15.4	73.3	14.0	14.4	64.9	2006	515	88.8	89.0
Marquis	...	.....	54.7	17.2	70.0	17.4	14.8	61.2	2308	503	88.3	92.0

* No winter wheat plats were grown in 1919. Data on Kanred from increase fields of that variety.
† Percent crude protein in flour not recorded in wheat, but would have been higher than 14.8.
‡ Data on Kharkof, C. I. No. 1440, a strain almost identical, included; Turkey not included.

quality to the common Turkey. It has been reported that in some cases the price paid for Kanred has been reduced below that paid for Turkey.

In comparing the milling and baking quality of different wheats the important points to be considered are: The percentage of crude protein in the grain, the yield of flour and shorts, the percentage of water absorption, and the volume, texture and color of the loaf. The data presented in Table 33 show that few differences have been found in the four-year averages of Kanred and Turkey. Kanred wheat produced slightly more flour and slightly more shorts, while Turkey produced about 1 percent more bran. Turkey was very slightly superior in water absorption.

The baking results show that very little difference exists between Turkey and Kanred. Kanred wheat produced a slightly larger loaf of about equal weight to that of Turkey. In texture and color of the loaf, Turkey was slightly the better. However, in either case, the differences were slight and would probably tend to be equalized over a longer period. That such an assumption is correct is indicated by seasonal fluctuations between the two varieties, one variety leading one season, the other the next.

Based on the results from these experiments, which merely confirm more extensive experiments,[1] it would appear that Kanred and Turkey are about equal in value for milling and baking purposes.

The data obtained from the milling and baking of Marquis, a wheat considered of the very highest quality for milling and baking purposes, have been included for the sake of comparison. Marquis is a hard red spring wheat, often used as a standard of comparison in milling and baking experiments. Altho climatic conditions at Akron usually are unfavorable for the growing of Marquis of good quality, the results obtained from the milling and baking of Marquis as compared with Kanred or Turkey, are favorable to Marquis. The comparison is unfair to Marquis to an extent, as Akron is outside of the area to which the variety is best adapted, while Turkey and Kanred are especially adapted to this environment.

SUMMARY OF RESULTS AT AKRON

The U. S. Dry Land Field Station at Akron, Colorado, is located in northeastern Colorado, about 60 miles from the Nebraska line on the east and on the north. Experiments with cereals here reported were conducted by the Office of Cereal Crops and Diseases, U. S. Department of Agriculture and the Colorado Experiment Station, co-operating at the Akron Station during the 18 years from 1908 to

[1] Shollenberger, J. H., and J. Allen Clark. Milling and Baking Experiments with American Wheat Varieties. U. S. D. A., Bul. 1183, 92 pp. 23 figs., 1924.

1925, inclusive. The experiments were conducted on dryland and the results obtained were generally applicable to eastern Colorado, northwestern Kansas, western Nebraska and southeastern Wyoming.

The results are believed to be especially applicable to practically all dryland wheat-growing sections of Colorado. This is primarily a grain-growing section and winter wheat is the crop of most importance.

The soil on which the experiments were conducted is a sandy loam, termed locally "hard land." The average annual precipitation for 18 years is about 17.5 inches, of which an average of about 13 inches fell during the growing season, April 1 to September 30, inclusive. The seasonal precipitation is a very important factor and influences grain yields very greatly.

Average yields of the better-adapted wheat varieties are fairly satisfactory, but partial or complete failure may occur. Winter wheats of the Crimean type have produced higher yields than varieties of any other type. Kanred is the highest yielding variety now being grown, altho Turkey has produced good yields over a long period of years.

Selections from these winter wheat varieties which appear exceptionally promising also have been made at Akron. Winter wheat has shown the best results when sown as early in the fall as climatic conditions and soil moisture justify.

Of the spring wheats, Peliss durum has outyielded all other varieties. The spread in price between durum and hard red spring wheat often is sufficient, however, to warrant growing the latter. Converse (Red Russian) has been the highest yielding hard red spring variety. Spring wheat should be sown as early in the spring as soil conditions permit. The seeding of spring wheat cannot be generally recommended, however, except possibly as a catch crop where a feed crop is not desired. Winter wheat when sown as late as the middle of October, usually will outyield spring wheat.

Fallowing for either winter or spring wheat probably is not justified, as the average yields on fallow for all types of wheat usually are not sufficiently increased over those on land cropped previously to corn to justify the additional expense. Seeding on cornland usually has hastened maturity, produced shorter straw, and smaller yields of both straw and grain than seeding on fallow.

Milling and baking experiments with wheat grown at Akron extending over a period of 5 years which are confirmed by more extensive experiments, indicate that Kanred and Turkey are practically equal in milling and baking quality.

As a result of the varietal experiments with wheat, the following varieties appear best adapted, and are recommended for growing on dryland in Colorado:

WINTER WHEAT	SPRING WHEAT	DURUM
Kanred	Converse (Red Russian)	Akrona
Turkey	Hard Red Spring	Kubanka
		Peliss

DESCRIPTION OF BETTER VARIETIES

KANRED.—Kanred is a winter wheat with a smooth, awned head. The glumes and awns are white. The straw is rather weak and is white in color. The kernels are dark, medium long and hard. This wheat can be distinguished from Turkey Red when in the head. The beaks of the outer glumes are from 3 to 25 mm. long while those of Turkey Red are from 3 to 8 mm. long. Clark, Martin and Ball[1] make the following statement regarding Kanred:

"Kanred is very similar to Turkey, but is slightly more winter hardy and slightly earlier and can be distinguished from that variety by its longer beaks on the outer glumes and by its resistance to some forms of both leaf and stem rust."

TURKEY RED.—Similar to Kanred, distinguished from it by having shorter beaks in the outer glume.

MARQUIS.—Marquis is a hard red, beardless spring wheat of hybrid origin. It matures fairly early and has a stiff white straw. The glumes are white in color and have short beaks. The kernels are short and deeply creased and dark red in color. The cheeks are angular and the brush is rather heavy. When planted late this variety often becomes badly infected with stem rust. It is also very susceptible to wheat scab.

CONVERSE.—Converse is a bearded spring wheat sometimes called Red Russian. It has a weak, white straw and bearded white glumes. The kernels are rather long and pale red in color. They are classified as soft or semi-hard by Clark, Martin and Ball. Under irrigation this wheat is not recommended but it has yielded well at Akron under dryland conditions.

DEFIANCE.—Defiance is a soft white spring wheat. The head is awnless, having short beaks on the glumes. The straw and glumes are white and the head is open, the spikelets being set far apart on the rachis. This wheat makes a much ranker growth under favorable conditions than Marquis. It rusts badly, being from 10 days to 2 weeks later than Marquis in maturing. It is also susceptible to smut

[1] For detailed descriptions see reference, Classification of American Wheat Varieties, J. Allen Clark, John H. Martin and C. R. Ball, U. S. D. A. Bul. No. 1074.

and should always be treated before planting. The kernels are shaped similar to those of Marquis but are white in color.

KITCHENER.—Kitchener can be distinguished from Marquis by its purple stem and the rather compact broad tip to the head or spike. It is a little later in maturing than Marquis. The kernels are described by Clark, Martin and Ball as being slightly longer and more rectangular than Marquis. The thrashed grain is hard to distinguish from Marquis.

PRESTON.—Preston is a hard, red bearded spring wheat. The straw is rather weak and is white in color. Sometimes it may be slightly colored at the lower nodes. The awns are from 2 to 7 mm. long. The kernels are red in color and are rather tapering, being broader at the germ end than at the tip. Clark, Martin and Ball state that "the kernels of Preston are distinguished from other hard red wheats by the dull seed coat and rather narrow triangular crease."

KUBANKA.—Kubanka is awned spring durum or macaroni wheat. The straw is long and is white in color. The heads are inclined to be nodding. The glumes are smooth and yellowish in color and are strongly keeled. The awns are long and are yellowish in color. The grain is amber in color and is hard. The grains are longer than those of Kanred. The brush is slight.

PELISS (Pelissier).—Peliss is a spring durum. The stem is white and the head has long black awns. The kernels are amber and hard with a short brush. The glumes are white. Peliss is distinct from Kubanka in having white, rather than yellowish glumes, black awns and very long kernels which are somewhat curved. (Clark, Martin and Ball.)

AKRONA.—Akrona (C. I. No. 6881) Reg. No. 246[1], is a spring durum. It was developed by the Office of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture at the U. S. Dry Land Station, Akron, Colorado. It is an early selection from Arnautka.

[1] Report of Committee on Registrations of Improved Wheat Varieties. Jour. of American Soc. of Agronomy, Vol. 18, No. 10, page 931.