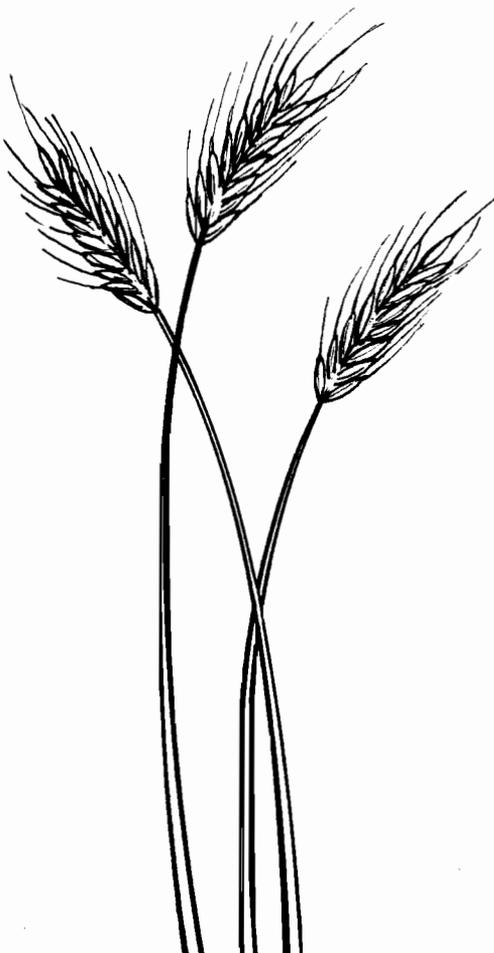


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BULLETIN 507-S



WINTER WHEAT PRODUCTION IN COLORADO

COLORADO STATE UNIVERSITY
EXPERIMENT STATION
FORT COLLINS

Summary

Winter wheat is planted on more acres than any other crop in Colorado, 2,007,000 acres being planted in 1957. Production is almost exclusively of the hard-red type which is used principally in making bread flour.

Fallow is recommended as a land preparation for the crop on non-irrigated land. This method of preparation controls weeds and stores soil moisture to assure a better yield. During the 17-year period, 1941-1957, the use of fallow as a land preparation method at the Akron Station gave yields better than the seven-bushel per acre "break-even" yield.

Planting of winter wheat after September 10 lessens the danger of root rots and of Hessian fly damage, which reduce yields. Seeding of 30 pounds per acre has been found to be an adequate seeding rate.

The use of nitrogen fertilizer on sandy land is recommended. Its use on so-called hard land may give an economical return in wet years but it does not appear that fertilizer application is necessary every year.

Winter wheat should not be

combined until the moisture content is 14 percent or lower. Wheat stored with higher moisture content is liable to heat damage with resultant price dockage.

Of the important wheat diseases, bunt can be controlled by seed treatment, wheat streak mosaic and root rots can be controlled by timely planting, and loose smut can be controlled by the hot water treatment. Rusts cannot be practically controlled by any present chemical means. Early maturing varieties often escape severe rust damage. Dwarf bunt can only be controlled by using resistant varieties such as Wasatch.

Most of the insects that attack wheat can be controlled by timely application of insecticides.

The varieties recommended for the state are Cheyenne and Nebred for the northeastern wheat producing areas, Wichita, Bison and Comanche for the central and southern areas, Pawnee where Hessian fly may be a problem, and Wasatch for the dwarf bunt areas of the western part of the state.

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WINTER WHEAT PRODUCTION IN COLORADO

T. E. Haus, D. W. Robertson, J. F. Brandon,
W. H. Paulson and R. H. Tucker¹

Our Most Important Crop

Winter wheat is the most important crop grown in Colorado. As shown in Figure 1, the acreage planted to the crop increased sharply during and after World War II². Previous to 1941 the acreage planted to winter wheat varied from about one million to one and one-quarter million acres annually. In recent years approximately three million acres have been planted each year with the exception of 1957 when two million acres were seeded. This reduction in acreage in 1957 was a result of lowered acreage allotments and the "soil bank" program.

The harvested acreage varies greatly from year to year as shown in Figure 1. The abandonment of winter wheat acreage is due principally to climatic

conditions. Moisture is the greatest limiting factor of winter wheat production in Colorado.

Production of winter wheat during the 1941-1957 period has averaged 33,381,000 bushels. The yearly production for this period is shown in Figure 1. The average annual value of the winter wheat crop for the 1941-1957 period has been reported to be \$61,021,000.

The ten highest producing counties in order of production for the ten-year period, 1948-1957, were Washington, Logan, Weld, Phillips, Yuma, Kit Carson, Adams, Sedgwick, Baca and Lincoln.

More than 95 percent of the crop is grown on non-irrigated land.

¹ Associate Agronomist, Colorado Agricultural Experiment Station; Chief Agronomist Emeritus, Colorado Agricultural Experiment Station; Agronomist, Agricultural Research Service, USDA; former Assistant Agronomist, San Juan Basin Branch Station, Colorado Agricultural Experiment Station, and Agronomist, Colorado State University Extension Service, respectively.

²Colorado Agricultural Statistics (1941-1957). Issued by the Colorado Department of Agriculture and the Agricultural Marketing Service, United States Department of Agriculture.

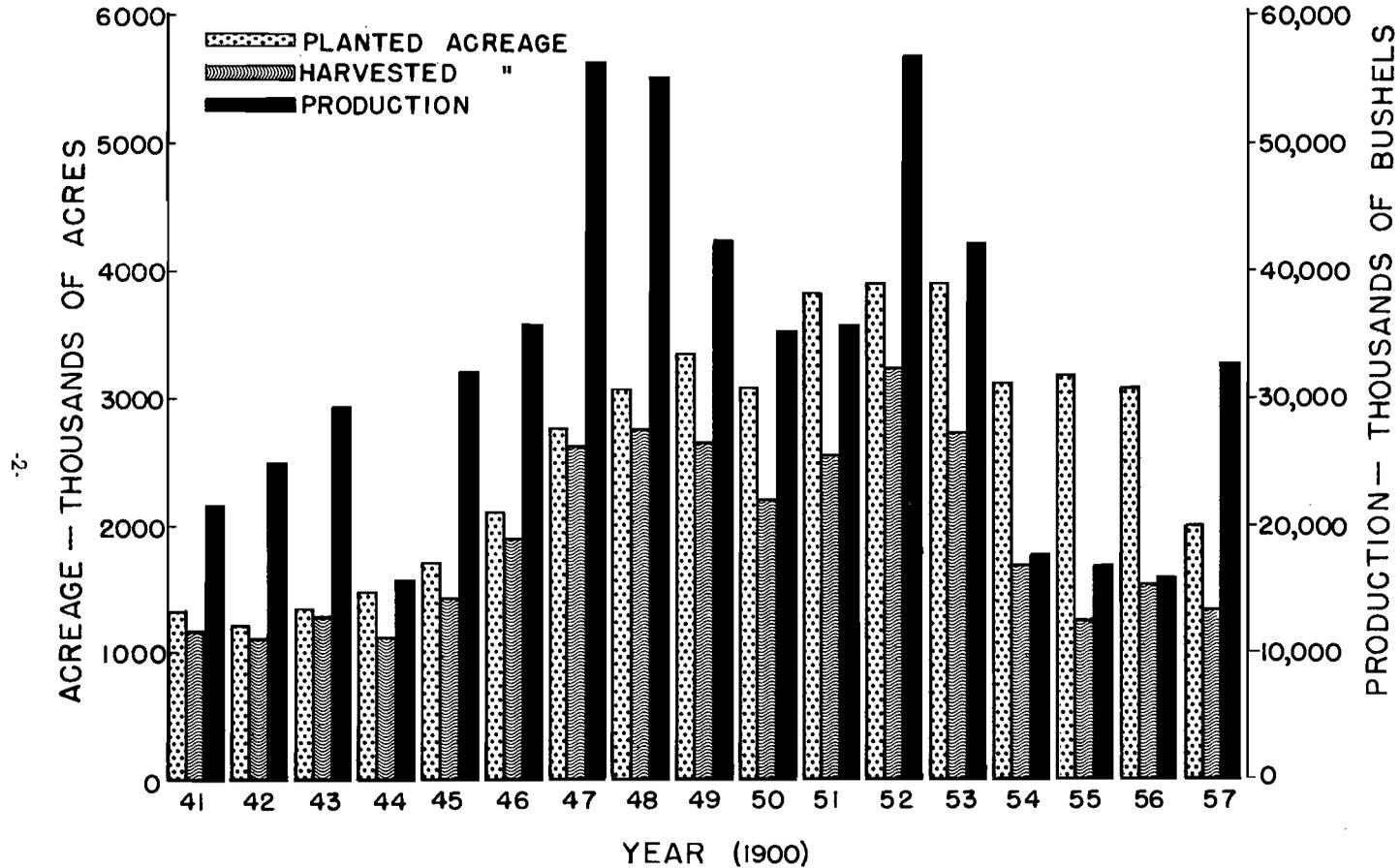


FIGURE 1. Annual winter wheat acreage and production in Colorado (1941 to 1957).

Producing the Crop

Seedbed Preparation

Experiments at the U. S. Central Great Plains Field Station near Akron have shown that summer fallow prior to planting wheat is the most certain tillage practice for producing winter wheat on non-irrigated land in Colorado. As shown in Appendix Tables 1 and 2, the average yield for the two varieties, Wichita and Comanche, grown on fallow has been approximately 22 bushels per acre while the average yield for these two varieties when grown on cornland has been approximately 12 bushels per acre. Considering yields of seven bushels per acre or less as crop failures, there have been five years during the 17-year period when a crop failure resulted when wheat was grown following corn but no crop failures when the wheat crop was grown on fallow.

Summer fallow helps store water and makes it available to subsequent crops in larger quantities than would be available with a continuous cropping system. Another advantage is the lapse of time permitting the decay of residues. Incorporation of stubble in the surface of the soil aids in percolation of water, retards water loss by runoff, and aids in the control of soil blowing, which results in loss of soil moisture.

Winter wheat is not generally grown on irrigated land since it

is difficult to fit the crop into the usual crop rotation. According to agricultural statistics, a small acreage of irrigated winter wheat is grown in the South Platte River drainage area, the Arkansas River drainage area, and the San Juan Basin area of southwestern Colorado.

In preparing the land for winter wheat under irrigation, a clean, firm seedbed prepared with a minimum of cost is desired. If winter wheat is to follow a row crop, good seedbed preparation may only involve disking and levelling rather than plowing and subsequent seedbed preparation.

Seed and Seed Treatment

Only high quality seed of known purity and germination and of a recommended variety should be planted. Wheat seed should have a germination of at least 90 percent.

All planting seed should be treated with an approved fungicide. Bunt (covered smut) of wheat is a disease that is prevalent in Colorado. This disease can be controlled effectively by treating the seed with one of the several organic mercury compounds available. The seed may be treated either with a dust or with a slurry mixture. In addition to controlling seed-borne bunt the organic mercury compounds inhibit seed-borne and soil-borne organisms that may

cause seed decay or attack young seedlings. Greater seedling vigor and better emergence result in better stands and higher yields.

In treating seed, the manufacturer's recommendations should be followed with respect to rate and method of application and subsequent handling of the seed. Caution should be taken not to breathe the dust or to allow prolonged contact on the skin of most seed treating materials. Treated seed is poisonous and should not be fed to livestock, or sold except for planting.

Rate and Date of Planting

From studies made at Akron between 1920 and 1927 it was found that seeding winter wheat before September 1 or after October 1 reduced crop yields.³ The best date of planting was found to be between September 10 and September 20. Wheat planted before September 1 is frequently damaged by root diseases. Infection by these diseases is favored by high temperatures. Wheat streak mosaic disease is also more severe in early-planted wheat than in late-planted wheat.

In certain areas early-planted wheat may be attacked by Hessian fly, which will reduce yields. Excessive growth from early planting also uses more soil moisture.

Planting wheat later than Oc-

tober 1 makes infection from bunt more of a hazard as infection by this disease is favored by cool temperatures. Late planting also increases the possibility of rust infection the following summer.

In the studies at Akron, it was found that a seeding rate of 30 pounds per acre was an adequate rate of planting. As the season advances an increase of the seeding rate of five pounds per week after September 20 is usually recommended since the later planted wheat does not tiller as well as earlier planted wheat.

Winter wheat grown under irrigation should be seeded at about 60 pounds per acre. It should be planted about mid-September. The disease and insect hazards are the same for irrigated wheat as they are for non-irrigated wheat.

Fertilizers

Experiments conducted by the Agronomy Section of the Colorado State University Experiment Station during the past five years⁴ show that non-irrigated wheat grown on sandy soils will respond to nitrogen fertilizer if soil moisture is adequate for normal growth. The recommended rate of application is 30 pounds of N (available nitrogen) per acre. Wheat grown on hard lands may respond to nitro-

³ Rate and Date of Seeding Winter Wheat in Eastern Colorado. D. W. Robertson, J. F. Brandon, H. Fellows, O. Coleman, and J. J. Curtis. Colorado Agricultural Experiment Station Bulletin 472. 1942.

⁴ Use of Commercial Fertilizers with Dryland Crops in Colorado, 1952-56. K. G. Brengle (in press).

gen fertilizer if soil moisture is high or if large amounts of crop residue have been plowed under. In general, nitrogen applied at lower rates than 30 pounds of N per acre will fail to give an economical return and rates above 30 pounds will not produce a significant increase in yield to pay for the additional fertilizer applied.

Recommendations for fertilizer for wheat grown on irrigated land vary with the fertility of the soil on which the crop is grown.

Application of the fertilizer should be done by disking both nitrogen and phosphorus fertilizers in the top four to six inches of the soil surface just before seeding the crop. On stubble ground 40 to 60 pounds of N and 40 to 80 pounds of P_2O_5 (phosphoric acid) per acre are recommended.

Weed Control

Broadleaf weeds are a serious pest in wheat some years, but can usually be controlled with 2,4-D. Winter wheat can best be sprayed with the least injury to the plant after the crop is fully tillered and before it reaches the boot stage. Damage may occur from 2,4-D if applied during the boot and heading stages. The rate of application for annual weeds is one-fourth to one-half pound acid equivalent per acre. The low rate is increased as weeds increase in size and maturity.

Pre-harvest applications may

be made to kill weeds to permit combining the grain. These applications may be made after the grain is past the milk stage at rates up to one pound per acre.

During the fallow period weeds should be controlled to prevent depletion of soil moisture and to prevent seed formation, which will contaminate the soil of the growing crop.

Harvesting

Practically all the winter wheat grown in Colorado is harvested directly with the combine. Use of the combine necessitates leaving the crop in the field for some time after it has matured. Wheat should not be combined until the moisture content of the grain is 14 percent or lower. Grain containing more than 14 percent moisture cannot be stored safely.

A simple means of determining the 14 percent moisture level of the grain may be used. This consists of rubbing out wheat heads by hand and placing the grain in a dry vial containing a small amount of ammonium chloride. If the grain contains 14 percent moisture or less, the ammonium chloride will remain granular. If the grain contains more than 14 percent moisture the ammonium chloride will become damp and sticky. Ammonium chloride may be purchased in small quantities at any drug store.

Wheat may be windrowed prior to combining. When windrowed, the crop may be cut before the grain is fully mature

and allowed to ripen in the windrow. This method is recommended if the crop is weedy as the weeds will dry and the grain can be combined without adding moisture to the grain from broken bits of the weed plants. Windrowing may also lessen the danger of loss of the crop by hail as the grain will shatter less in the windrow than standing in the field.

The binder is used to some extent, especially when the crop is grown under irrigation or with small acreages. If either the binder or the windrower is used, the grain should be allowed to dry below 14 percent moisture before being threshed.

Storage of Wheat on the Farm

Wheat may be safely stored on the farm. Weathertight bins should be used for this purpose. Bins should be clean and sprayed to kill insects which may attack the stored grain. Spray materials that are satisfactory for treating bins consist of 2.5 percent by weight of DDT, TDE, methoxychlor or chlordane as emulsions of water suspensions. The sprays should be applied at the rate of 2 gallons per 1,000 square feet of surface area. They may be applied with an ordinary garden sprayer.

Wheat should be stored as dry as possible. If the grain contains more than 14 percent moisture, aeration will be necessary by moving or by artificial drying.

Infected grain should be fumigated after storage to prevent

stored grain insects from damaging the grain. Possible fumigants are carbon tetrachloride at 3 gallons per 1,000 bushels in steel bins or a 3-to-1 mixture of ethylene dichloride and carbon tetrachloride at the same rate.

Fumigants must be used cautiously as they may have ill effects on the operator applying them. Manufacturers' recommendations should be followed in using fumigants.

Uses of Wheat

Nearly all of the winter wheat produced in Colorado is used for human food in the form of flour for baked products.

Wheat may be fed on farms, having a nutritive value about equal to corn. Feed wheat requires grinding except for poultry.

Pasturing of Wheat

Winter wheat as pasture is a highly nutritious and palatable feed. Conservative pasturing of rank growing wheat may prevent lodging of the crop with resultant loss in yield. It has been observed in other states that pasturing the crop results in lower yields of grain even with limited grazing. If the grower decides to pasture the crop, the animals should be removed from the crop by May 1. Pasturing may also increase the possibility of wind damage on soils subject to wind erosion.

Varietal Tests

Variety tests of winter wheat are conducted at four locations in Colorado. These tests are conducted under the supervision of the Agronomy Section of the Colorado State University Experiment Station.

United States Central Great Plains Field Station

The United States Central Great Plains Field Station is located at Akron, Colorado, in the principal wheat growing region of the state. Tests at this station are in cooperation with the United States Department of Agriculture.

Precipitation at this station averages approximately 17 inches annually. The nature and distribution of the precipitation are often limiting factors in winter wheat production. Occasional injury from soil blowing, frost, low winter temperatures, low winter precipitation and hail may result in severe losses to the crop. Tests at this station are conducted without irrigation.

The methods of conducting winter wheat experiments at the Akron Field Station are similar to those reported in previous publications. The results in this bulletin cover varietal tests made since 1941. Results previous to this date will be found in Colorado Agricultural Experiment Station Bulletins 329, 404 and 470.

The annual and average results of the winter wheat varieties grown in field plots at Akron since 1941 are given in Appendix Tables 1 and 2. The yields in Table 1 are from field plots grown on fallow. The yields in Table 2 are from field plots grown on cornland.

It has been estimated⁵ that a yield of seven and two-tenths bushels per acre is necessary to cover the costs of producing the crop, including the cost of tilling, seed, planting, harvesting, taxes on land, machine maintenance and depreciation and interest on equipment. It also has been estimated that a yield of at least 11 bushels per acre is necessary to realize a reasonable profit from the crop. The yields of the varieties grown for various years on fallow are shown in Table 1. From the average yield of all varieties grown each year it can be seen that for each of the 17 years wheat was grown on fallow the average yield exceeded the seven and two-tenths bushel "break-even" yield. In only one year, 1953, did the yield fall below the 11 bushel "reasonable profit" yield.

The yields of the varieties grown for various years on cornland are given in Table 2. From the average yield of all varieties grown each year it can be seen that in nine out of the 17 years the yield was equal to or fell below the 11 bushel "reasonable

⁵ Economic Possibilities of Seeding Wheatland to Grass in Eastern Colorado. H. Sitler. ARS 43-64. Agricultural Research Service, United States Department of Agriculture.

profit" figure. In seven of these nine years the yield was below the seven and two-tenths "break-even" figure. The comparison between fallow and cornland indicates that fallow is the preferable method of culture for winter wheat. The value of fallow as a cultural method in the Central Great Plains has been reported by Mathews⁶ and many other workers.

Table 1 shows that several varieties have equalled or outyielded the standard variety Kharkof, C.I. 1442. Of the varieties tested for the entire 17-year period, Wichita, Pawnee, Comanche, Cheyenne and Tenmarq have all yielded higher than Kharkof. All five of these varieties are in commercial production in Colorado. Several other varieties have yielded as well or have outyielded Kharkof during the testing period but are not recommended varieties in Colorado because of certain undesirable characteristics.

The agronomic data of the winter wheat varieties grown on fallow at Akron for the 17-year period are given in Appendix Table 3. Six varieties are recommended in the state: Cheyenne, Comanche, Pawnee, Nebred, Wichita and Bison. Of these, Comanche, Pawnee, Nebred, Bison and Wichita are earlier in maturity than the Kharkof standard variety. Cheyenne is a

late-maturing variety as is Kharkof. There is little difference in height among the recommended varieties. Wichita has averaged slightly higher in test weight than the other varieties.

Outstate Tests

In addition to the variety tests conducted at the Akron station, variety tests have been conducted at several locations in the state in cooperation with the Colorado Extension Service.⁷ These tests are summarized in Appendix Table 4. Cheyenne has yielded consistently well in the northeast area. Wichita, a variety recommended for certain parts of this area, has nearly equalled the yield of Cheyenne during the testing period. Chiefkan has outyielded Cheyenne but is not recommended due to its undesirable milling and baking properties. Kiowa has equalled the yield of Cheyenne during the period it was tested but it is not recommended due to questionable baking properties.

In the southeastern area of the state, Cheyenne also has yielded well. Kanred has equalled the yield of Cheyenne but is no longer recommended due to its weak straw and lateness of maturity. Kiowa and Chiefkan have outyielded Cheyenne in limited tests but are not recommended

⁶ Place of Summer Fallow in the Agriculture of the Western States. O. R. Mathews. USDA Circular 886. 1951.

⁷ R. H. Tucker, Extension Agronomist, Colorado State University.

due to undesirable milling and baking properties. Other varieties have all yielded less than Cheyenne.

In a limited number of tests on the western slope of the state, Cheyenne has again been one of the top yielding wheats.

Irrigated Land Experiments

Fort Collins Station

The central Experiment Station is located at Fort Collins in the north central part of the state. At this station varietal tests are conducted under semi-irrigated conditions. Winter wheat is irrigated only if it appears that a crop failure may result without supplemental water.

The average annual precipitation at Fort Collins is approximately 15 inches. Most of this precipitation occurs from April to September. There is usually sufficient soil moisture to establish the crop in the fall. Winter wheat overwinters with little winterkilling at Fort Collins, but in some years damage to the crop may occur in the early spring from dry winds and dry soil conditions.

The methods used in conducting the variety tests of winter wheat at Fort Collins were similar to those used in previous tests.⁸ No yields were obtained in 1952 since the crop was destroyed by hail.

Some 78 varieties have been under test for varying periods of years from 1941 to 1957. Many of these have been dropped from

the test as undesirable for irrigated conditions in northeastern Colorado. (See Appendix Table 5).

The following varieties which are in commercial production and have been dropped from the test are Tenmarq, Kiowa, Turkey, Red Chief, Blue Jacket, Triumph, Chiefkan, Blackhull, Kanred, Early Blackhull, Cheyenne and Nebred.

Of these, only Cheyenne and Nebred are recommended varieties; the others have undesirable milling and baking characteristics or are undesirable from an agronomic standpoint. The yields of commercial varieties currently being tested are given in Table 1.

The variety Wichita is used as a check variety since it has been in the test the entire testing period. The three varieties, Wichita, Comanche and Pawnee, show no differences in yield in comparable periods of testing. The variety, Bison, which was developed by the Kansas Agricultural Experiment Station, has consistently outyielded Wichita during the six-year testing period at Fort Collins. It has not equalled the yield of Wich-

⁸ Wheat Production in Colorado, 1926-1932. Colorado Agricultural Experiment Station Bulletin 404. 1933.

ita and Comanche at Akron, but has been recommended on non-irrigated land in this state. Concho, a variety released by the Oklahoma Agricultural Experiment Station, also has had a high yield record at Fort Collins, but this variety is not winter-hardy enough to be recommended in Colorado.

Several new varieties have had high yields and have stronger straw than most of the present recommended varieties and may be desirable varieties for irrigated land. Information on milling and baking quality is necessary on these varieties before they can be recommended.

The agronomic data of the varieties grown for five or more years are given in Appendix Table 6. It will be noted that the earlier maturing varieties show less lodging than usually occurs in later maturing varieties. Several newer varieties have yielded well and have much stronger straw than varieties now in commercial production. These varieties have not yet been thoroughly tested for milling and baking quality to be recommended on irrigated land.

San Juan Basin Branch Station

The San Juan Basin Branch Station is located in southwest Colorado at an elevation of 7,610 feet. Because of the high altitude the growing season is relatively short. The average annual precipitation at this station is approximately 18 inches. Rainfall during May and June is usually low. Snow usually covers the ground from December until April and, as a result, little winter-killing of the crop occurs. Tests at this station are conducted under irrigated conditions.

Thirty-two varieties and selections have been tested for varying periods of years from 1941 to 1957 at this high altitude station at Fort Lewis in the San Juan Basin. The results of these tests are shown in Appendix Table 7. The variety Tenmarq is used as a check variety.

Cheyenne has equalled the yield of Tenmarq during the testing period. Late maturing varieties show highest yields at Fort Lewis as demonstrated by Cheyenne, Kharkof, Sioux and Tenmarq. Wichita, Comanche and Pawnee, all earlier maturing

TABLE 1. Average Yield of Winter Wheat Varieties for Varying Periods of Years at Fort Collins, Colorado.

Variety	No. Years Tested	Average Bushels per Acre	Percent of Wichita Same Year
Wichita	16	48.2	100.0
Comanche	15	48.1	99.6
Pawnee	15	48.8	100.8
Kharkof	11	48.9	96.7
Ponca	9	52.2	95.1
Bison	6	63.2	116.8
Concho	5	62.0	118.4

TABLE 2. Summary of Yields of Winter Wheat Varieties Grown at the Arkansas Valley Branch Experiment Station for Varying Periods of Years From 1944 to 1957.

Variety	No. Years Tested	Average Bushels Per Acre	Percent of Comanche For Same Years
Comanche	11	56.8	100.0
Pawnee	8	52.7	96.9
Wichita	8	52.0	95.6
Ponca	6	55.4	97.6
Kanred	5	50.5	89.0
Nebred	5	52.9	93.1
Kiowa	4	55.4	97.7
Concho	4	54.6	93.3
Bison	4	58.8	100.6

than Tenmarq, have yielded less than Tenmarq, especially in years when high yields have been obtained such as 1957, 1956 and 1949.

The agronomic data for varieties grown for five or more years are given in Appendix Table 8.

Arkansas Valley Branch Experiment Station

A variety test of promising commercial varieties is grown at the Arkansas Valley Branch Ex-

periment Station, Rocky Ford, Colorado, each year. This station is in the southeastern part of the state in the Arkansas River Valley. Tests at this station are conducted under irrigation. Table 2 gives the summary of the yields of the varieties grown at this station for varying periods of years.

In these tests, Comanche has outyielded all other varieties during the testing period except Bison, which has equalled the yield of Comanche.

Distribution of Varieties

Wheat varieties in Colorado are continually changing in importance and distribution because of the development and release of improved strains. These improved strains usually have more desirable characteristics from the standpoint of the

farmer and of the milling and baking trade.

Varietal surveys are made periodically by the Field Crop Statistics Branch, Agricultural Marketing Service of the United States Department of Agriculture.⁹

⁹ Colorado Agricultural Statistics. 1955.

Table 3 is calculated from those surveys and shows the acres planted and the percentage of the crop of the varieties grown for various years. There has been a marked change in the varieties grown over the 12-year period. The varieties Turkey, Tenmarq, Blackhull and Kanred comprised more than 85 percent of the acreage in the state

in 1944. In 1955, these four varieties were grown on less than ten percent of the acreage. The variety Wichita is widely grown in the state and at the present time comprises more than 50 percent of all winter wheat acreage. Comanche and Cheyenne are each grown on about ten percent of the acreage at the present time.

TABLE 3. Winter Wheat Varieties—Acres and Percent Planted to Each Variety.

Variety	Crop Year							
	1944		1949		1954		1955	
	Percent	Acres Planted	Percent	Acres Planted	Percent	Acres Planted	Percent	Acres Planted
Wichita	.....	.....	14.2	454,660	46.4	1,451,410	55.8	1,775,560
Comanche	.....	.....	21.2	681,990	12.1	378,070	11.3	361,020
Cheyenne	4.9	72,950	9.2	294,820	9.4	294,770	10.8	344,610
Tenmarq	25.2	374,710	15.6	497,280	4.3	134,570	3.4	108,310
Kiowa	.....	.....	.....	.....	3.3	102,530	3.2	101,740
Turkey	29.9	444,310	9.9	319,680	3.4	105,730	3.0	95,180
Red Chief	0.2	3,320	1.9	60,380	2.9	89,710	1.5	49,230
Pawnee	.....	.....	4.5	145,630	1.7	54,470	1.2	39,380
Blue Jacket	.....	.....	.....	.....	3.1	96,120	1.2	39,380
Triumph	.....	.....	2.5	81,700	0.5	16,020	1.0	32,820
Chiefkan	3.5	51,400	1.3	42,620	2.2	70,490	1.0	32,820
Blackhull	19.2	285,180	11.7	376,510	3.6	112,140	0.8	26,260
Wasatch	.....	.....	.....	.....	1.3	41,650	0.5	16,410
Kanred	15.3	227,150	1.7	53,280	1.3	41,650	0.4	13,130
Early Blackhull	0.1	1,660	5.6	181,150	1.3	41,650	0.3	9,850
All Others	1.7	26,320	0.7	20,660	3.2	99,010	4.6	138,300
Total	100.0	1,487,000	100.0	3,210,360	100.0	3,129,990	100.0	3,184,000

Description of Varieties

Wichita (C.I. 11952)¹⁰

Wichita is a black chaff, bearded variety developed by the Kansas Agricultural Experiment Station in cooperation with the Division of Cereal Crops and Diseases, United States Department of Agriculture, from a cross between Early Blackhull and Tenmarq. It is an early maturing wheat, being about a week earlier than Blackhull. Its earliness often enables it to escape rust damage and damage from drouth during the ripening period. It has a high test weight and is of satisfactory breadbaking quality.

Comanche (C.I. 11673)

Comanche is a white chaff, bearded variety developed by the Kansas Station in cooperation with the Division of Cereal Crops and Diseases from a cross between Oro and Tenmarq.

The superior characteristics of Comanche are high yield, good test weight, stiff straw, excellent milling and baking quality, resistance to some races of bunt or stinking smut, and some resistance to leaf and stem rust. Comanche normally matures three to five days later than Wichita.

Cheyenne (C.I. 8885)

Cheyenne is a late maturing, stiff-strawed variety having short, erect heads. It is a white chaff,

bearded variety selected from Crimean wheat at the Nebraska Agricultural Experiment Station at Lincoln. This variety is very winter hardy, does not shatter easily, maintains its color and bushel weight well, and has excellent milling and baking quality.

Tenmarq (C.I. 6936)

Tenmarq is a white chaff, bearded, medium late maturing wheat of excellent milling and baking quality. It has a fair straw but has a tendency to "yellow berry" and low test weight.

Tenmarq was developed by the Kansas Experiment Station from a cross between Marquis spring wheat and Crimean wheat.

Kiowa (C.I. 12133)

Kiowa is an early maturing, black-chaff, bearded, stiff-strawed variety. It is resistant to some races of bunt but is susceptible to loose smut, leaf rust and Hessian fly. It has questionable milling and baking quality.

Kiowa was developed by the Kansas Experiment Station from a cross between Chiefkan and Oro-Tenmarq.

Bison (C.I. 12518)

Bison is a sister selection of Kiowa, similar in all respects but having more desirable milling and baking quality.

¹⁰ C.I. refers to accession number of the Cereal Crops Section, Field Crops Research Branch, United States Department of Agriculture.

Red Chief (C.I. 12109)

Red Chief is a medium early, stiff-strawed, beardless wheat. It has reddish-brown glumes which adhere tightly to the grain.

This variety resulted from a selection by Earl G. Clark, a farmer wheat breeder of Sedgwick, Kansas. It is an undesirable variety due to its poor bread-baking quality.

Pawnee (C.I. 11669)

Pawnee is a white chaff, bearded, early maturing, stiff-strawed wheat having considerable resistance to Hessian fly and to loose smut. It has a tendency to shatter when ripe. The variety has fair milling and baking quality.

Pawnee was developed in cooperative experiments of the Kansas and Nebraska Experiment Stations and the Division of Cereal Crops and Diseases. It is a selection from a cross between Kawvale and Tenmarq.

Blue Jacket (C.I. 12502)

Blue Jacket is a late, tall, black-glumed, bearded wheat selected from a field of Superhard Blackhull by Earl G. Clark of Sedgwick, Kansas. It has poor baking quality.

Triumph (C.I. 12132)

Triumph is a very early, short-strawed, white chaff, bearded variety. Its quality is only fair as a baker's bread flour, but is satisfactory as a family flour.

Triumph was developed by Joseph Danne of El Reno, Oklahoma. Its parentage is not known.

Wasatch (C.I. 11925)

Wasatch is a white chaff, bearded, midseason, tall variety. It is resistant to dwarf bunt which is prevalent in some areas of the western slope of the state. The variety was developed by the Utah Agricultural Experiment Station from a cross between Relief and Redit, both hard red winter wheats. Due to its questionable milling and baking properties, new varieties are being selected for dwarf bunt resistance that have better quality.

Nebred (C.I. 10094)

Nebred is a bunt resistant wheat of the Turkey type. It is a white chaff, bearded variety, selected from Turkey C.I. 3684 by the Nebraska Station in cooperation with the Division of Cereal Crops and Diseases. It has good milling and baking quality.

Recommended Varieties

Cheyenne and Nebred are recommended for the northeast portion of the state. Wichita, Bison, Comanche and Tenmarq are recommended for the central and southeastern regions. Paw-

nee is recommended where Hessian fly may be a problem. Wasatch is presently recommended in dwarf bunt areas on the west-

ern slope but will probably be replaced by a wheat variety having better milling and baking quality.

Wheat Diseases

The principal diseases of winter wheat in Colorado are smuts, rusts, root rots and wheat streak mosaic.

Smuts

Two types of smut are found in wheat in Colorado. These are fungus diseases which are microscopic, parasitic plants that grow and reproduce at the expense of the wheat plant. They produce tiny, brownish-black spores in the wheat head in place of the wheat kernel.

Common bunt or covered smut is spread by means of spores that mature as the wheat plant matures. The threshing operation breaks the smut balls and the spores adhere to the surface of the healthy grain. When the grain germinates in cool, moist soil, the smut spore germinates and penetrates the young seedling growing within the plant to produce a spore mass or ball in place of the grain in the wheat head.

Wheat that contains smut is unfit for milling and baking without costly washing and processing. Smutty wheat can be detected by the presence of smut balls as well as by the disagreeable odor of the smut spores.

Comanche and Nebred wheats are resistant to some but not all

of the races of smut that occur in Colorado.

Seed treatment with one of the organic mercury compounds such as Ceresan, Agrox and Panogen will control the disease effectively. Seed treatment should be practiced every year.

Information of seed treatment may be obtained from county Extension agents.

Dwarf bunt is also a form of covered smut. This disease is prevalent in some areas of western Colorado. This disease is spread by spores on the grain but is also soil-borne. Treatment with chemicals will control infection from spores carried on the seed but will not give complete control as soil-borne spores may infect the young seedling after the protection from the seed treatment is dissipated. The only present control of this disease is the use of resistant varieties. Wasatch is a resistant variety to this disease and has been recommended in the area that is subject to dwarf smut infection. Wasatch has undesirable milling and baking properties but is preferable to wheat with smut.

Loose smut of wheat appears in the field at flowering time. The smut spores are carried by the wind to healthy flowers where the spore germinates and enters

the ovary of the seed. The fungus remains dormant in the mature seed until germination, then it invades the plant tissues, grows upward as the plant matures and replaces the flower parts with a mass of smut sports.

Loose smut cannot be controlled by surface seed treatment with any chemical compound but can be controlled by a rather complicated hot water treatment in which the seed is subjected to high temperatures which kill the fungus but do not injure the seed.

Instructions for treating seed by the hot water method may be obtained from county Extension agents.

Pawnee wheat is a variety that is highly resistant to loose smut. No other commercial varieties are resistant to all forms of this disease.

Rusts

The rusts, like the smuts, are fungus diseases which infect the plant but do not completely destroy the seed. Symptoms of the rusts are red pustules which appear on leaf and stem surfaces. The effect of the rusts is to reduce yield.

Leaf rust is present in varying amounts every year. Pustules are formed on leaves and leaf sheaths. Fortunately, leaf rust does not appear to cause much reduction in yield and quality of wheat in Colorado.

Stem rust attacks all above-ground parts of the plant, but

especially the stems. It produces red pustules early in the season. The black spore stage of the disease appears later in the season. Only the red spores are capable of reinfecting wheat. The effect of this disease is to reduce yield and cause the grain to shrivel. Stem rust is destructive only occasionally in Colorado.

The only practical control of the rusts is resistant varieties. None of the varieties grown commercially at the present time has adequate resistance to stem rust. Breeding experiments are in progress at nearly all Experiment Stations in the winter wheat area in the attempt to develop varieties resistant to the disease. Early maturing varieties such as Wichita often escape severe rust damage.

Wheat Streak Mosaic

Wheat streak mosaic is not a new disease, although the first serious epidemic of the disease occurred in the winter wheat region in 1949. This disease is caused by a plant virus. The symptoms of the disease are yellow striping or mottling of the leaves. As the plant develops, the older leaves may turn completely yellow and die. Infected plants are also short, often bunched and prostrate.

The disease is spread by a very small mite known as the "wheat curl mite" which is white, cigar shaped, and has only four legs. The disease is not carried by the

seed, soil, stubble, roots, animal grazing, or moving machinery.

Early-seeded fields are more seriously damaged by the disease than late-planted fields. Fields planted about mid-September will show less injury from the disease than fields planted earlier.

There are no commercial varieties that are resistant to the disease.

Root Rot Diseases

There are several root rot diseases that attack wheat; among them are pythium root rot, hel-

minthosporium root rot and fusarium root rot. The symptoms are stunted plants which may show dark-brown streaks in the lower internodes and diseased roots which are light-brown, dry, and relatively short.

The disease may be partially controlled by seed treatment and by planting after mid-September. Infection by the disease is favored by high soil temperatures (above 65° F.), so planting after the soil temperatures are below 65° F. will aid in reducing infection.

Insects that Attack Wheat

Stored Grain Insects

Insects that attack stored wheat cause heating, which results in a high percentage of moisture in the surface grain. This may be followed by molding and crusting of the surface grain. Insect-damaged wheat is unfit for human food.

Before placing threshed grain in storage the bins should be sprayed to destroy insects that may be present. This has been discussed previously.

Insect infestation in stored wheat can be controlled by fumigation, also previously mentioned.

Field Insects

Aphids or greenbugs—Aphids may cause serious injury to win-

ter wheat in the early spring. Severe infestations may actually kill plants.

The aphid sucks juices from the plants, destroying the tissues. They are controlled most years by predators such as the lady-beetle and by weather conditions unfavorable for the development of the aphid.

Parathion or malathion has been used effectively in the control of aphids. Malathion used at 1½ pints of 57 percent emulsifiable concentrate per acre or parathion used at 1 pint of 25 percent emulsifiable concentrate per acre has given good control. Use of these materials at temperatures below 50° F. is of little value. Do not pasture wheat treated with parathion within 15 days or wheat treated within seven days of application of mal-

athion. **Parathion and malathion** are extremely poisonous and should be used with caution.

Hessian Fly

Hessian fly has been reported occasionally in eastern Colorado. The larvae of this insect feed on the stems and crowns of wheat plants in the fall and weaken the plants, often causing winter kill. There are two generations a year. Spring feeding of the second generation larvae weakens the stems, causing lodging and breaking of the stems. Adult flies live only three or four days, so control by chemical is impractical. The control for this insect is to plant after the "fly-free date," which in eastern Colorado occurs about September 20-25. Where late planting is not feasible, the grower should use Pawnee wheat, a variety that was developed for its resistance to Hessian fly.

Where growers plant after the "fly-free date" it is necessary to destroy volunteer wheat so that seeded wheat will not be infested by the spring generation of the Hessian fly.

False Wireworm

In dry years, false wireworm may cause considerable damage to germinating seeds and young plants. A combination of 1 pound 75 percent Captan and 5.3 ounces 75 percent Lindane used at the rate of 2½ ounces per 100 pounds of seed has been found to give good control of this insect.

Mites

In recent years, wheat mites have been a serious pest of wheat in some areas of eastern Colorado. These insects feed by sucking juices from the plants, causing stunting and yellowing which result in yield losses. The wheat curl mite has also been found to be the carrier of the wheat streak mosaic disease.

Control of this insect may be obtained by use of parathion or malathion at the same rates as recommended for control of aphid.

APPENDIX TABLE 1. Average yield of winter wheat in bushels per acre grown on fallow at the Central Great Plains Field Station, Akron, Colorado, for varying periods of years from 1941 to 1957, inclusive.

Variety	C.I. or State No.	1957	1956	1955	1954	1953	1952	1951	1950	1949	1948	1947	1946	1945	1944	1943	1942	1941	Ave.	% Kharkof Same Years	
Wichita	11952	17.6	16.9	14.4	17.8	10.4	25.2	21.6	30.8	21.8	25.4	19.8	4.4	47.2	21.6	24.6	39.0	18.8	22.2	106.0	
Pawnee	11669	17.2	17.4	15.8	16.0	9.9	23.2	21.2	27.8	23.8	25.4	31.8	13.0	43.6	17.0	16.0	32.1	17.0	21.7	103.4	
Comanche	11673	17.8	15.9	16.6	18.6	11.6	25.3	21.2	30.0	18.8	27.4	22.4	15.0	46.8	20.2	22.0	32.6	20.5	22.5	107.5	
Tenmarq	6936	17.2	14.2	16.2	15.6	8.8	21.2	24.2	28.2	18.4	32.4	17.8	17.8	39.7	18.4	23.2	30.8	22.5	21.4	102.9	
Cheyenne	8885	22.0	15.4	16.0	15.5	9.9	23.6	24.6	29.2	17.1	34.0	20.6	22.5	44.8	18.1	23.8	17.9	17.8	21.9	104.7	
Kharkof	1442	19.0	15.2	19.8	15.6	8.9	24.2	21.6	29.2	14.0	35.0	23.6	19.8	37.1	16.4	22.5	19.1	15.1	20.9	100.0	
Alton	1438	17.4	12.8	14.0	13.0	7.5	20.8	19.1	25.7	9.6	34.6	8.7	12.0	33.0	15.4	14.5	18.2	8.8	16.8	80.1	
Kiowa	12133	17.8	13.9	16.6	17.6	10.6	26.6	24.2	30.4	20.0	29.8	29.4	-----	-----	-----	-----	-----	-----	-----	21.5	104.8
Ponca	12128	17.8	15.1	16.6	15.4	8.8	23.7	21.2	26.8	22.9	31.1	-----	-----	-----	-----	-----	-----	-----	-----	19.9	98.5
Bison	12518	19.2	17.0	12.3	15.8	*	22.2	21.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	18.1	93.8
Sioux	12142	21.8	13.4	11.0	14.8	4.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	13.2	83.8
Concho	12517	17.4	15.9	15.4	16.6	8.7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.8	94.3
Hyberline	-----	19.2	16.2	8.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.6	81.1
Early Colorado	-----	19.2	16.0	10.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	15.3	84.4
Early Blackhull-Tenmarq x Oro-Mediterranean-Hope	12871	18.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	18.4	96.8
Red Chief	12109	-----	15.3	17.6	17.2	10.2	24.2	20.8	30.1	22.4	31.8	25.4	15.0	38.2	19.4	18.6	31.4	-----	-----	22.5	104.8
Early Blackhull	8856	-----	-----	-----	16.1	9.9	25.6	20.8	27.6	22.4	23.3	25.1	3.0	41.9	19.8	28.6	38.4	18.2	22.9	106.2	
Triumph	12132	-----	-----	-----	18.4	9.6	26.8	18.8	21.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	19.0	95.6
Kanred-Hd. Fed. x Minhardi-Minturki	11970	-----	-----	-----	-----	9.6	20.8	22.6	33.2	18.6	30.4	24.0	13.7	46.3	17.1	23.0	37.8	21.2	24.5	111.1	
Minturki	6155	-----	-----	-----	-----	-----	20.2	20.8	25.7	17.4	34.6	23.0	17.8	35.4	12.2	18.1	26.1	12.1	22.0	94.9	
Cimarron	12120	-----	-----	-----	-----	-----	-----	-----	-----	21.4	29.4	-----	-----	-----	-----	-----	-----	-----	-----	25.4	103.7
Chiefkan x Oro-Tenmarq	12148	-----	-----	-----	-----	-----	-----	-----	-----	-----	26.2	-----	-----	-----	-----	-----	-----	-----	-----	26.2	74.9
Blackhull	6251	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	29.0	20.2	36.6	20.5	26.1	30.0	20.8	26.2	119.3	
Kanred	5146	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	21.4	19.2	38.3	17.1	20.2	22.7	17.2	22.3	101.6	
Cheyenne x Tenmarq	11972	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	33.2	23.2	39.6	19.3	23.6	-----	-----	27.8	116.3	
Apache	12122	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	27.8	15.4	49.1	-----	-----	-----	-----	-----	30.8	114.7
Chiefkan	11754	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	16.4	42.0	19.6	22.0	36.4	18.9	25.9	-----	119.5	
Nebred	10094	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	19.5	43.1	17.2	26.5	29.3	17.5	25.5	-----	117.8
Kharkof	1583	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.6	22.7	22.0	16.4	18.9	-----	103.6
Kanred x Marquis	A44	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	25.6	15.2	20.4	-----	119.3
Ave. Yield All Varieties	-----	18.6	15.4	14.7	16.3	9.3	23.6	21.6	28.3	19.2	30.1	23.9	15.8	41.3	17.9	22.1	28.8	17.4	-----	-----	-----

* Not grown

APPENDIX TABLE 2. Average yield of winter wheat in bushels per acre grown on cornland at the Central Great Plains Field Station, Akron, Colorado, for varying periods of years from 1941 to 1957, inclusive.

Variety	C.I. or State No.	1957	1956	1955	1954	1953	1952	1951	1950	1949	1948	1947	1946	1945	1944	1943	1942	1941	Ave.	% Kharkof Same Years
Wichita	11952	0	0	4.4	7.7	8.6	14.6	16.6	13.3	6.4	9.2	20.0	1.0	24.4	12.6	15.7	34.0	15.8	12.0	103.6
Pawnee	11669	0	0	5.5	6.2	7.2	14.2	20.0	12.6	6.5	8.6	30.2	0.7	20.4	10.4	13.4	32.9	13.4	11.8	102.5
Comanche	11673	0	0	6.1	7.5	9.0	17.0	16.6	13.4	6.0	11.2	20.8	4.4	23.9	10.6	16.2	29.7	16.5	12.3	105.9
Tenmarq	6936	0	0	8.2	4.8	6.4	14.7	19.6	14.7	3.8	13.0	15.4	6.2	25.3	9.9	19.6	32.3	9.4	12.3	103.1
Cheyenne	8885	0	0	5.1	5.0	6.2	16.0	16.6	16.9	4.6	14.4	22.6	8.9	25.6	9.6	21.0	23.0	8.0	12.0	103.2
Kharkof	1442	0	0	8.2	4.1	6.2	13.8	21.8	16.2	4.4	14.2	18.2	10.3	24.6	9.9	17.1	19.4	8.8	11.6	100.0
Alton	1438	0	0	4.1	3.4	4.6	14.4	17.0	11.8	2.4	14.9	7.2	7.5	24.3	12.3	11.2	19.1	6.4	9.4	81.4
Kiowa	12133	0	0	7.5	5.8	7.6	14.4	19.2	15.0	7.2	8.6	26.2	-----	-----	-----	-----	-----	-----	11.0	104.1
Ponca	12128	0	0	4.1	5.2	7.2	13.6	16.3	12.8	8.4	12.4	-----	-----	-----	-----	-----	-----	-----	8.0	90.0
Bison	12518	0	0	5.1	6.0	*	11.6	17.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	6.7	83.7
Sioux	12142	0	0	5.1	4.8	2.7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.5	68.1
Concho	12517	0	0	6.1	5.4	5.3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	3.4	90.8
Hyberline	0	0	0	6.1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.0	74.4
Early Colorado	0	0	0	4.1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.4	50.0
Red Chief	12109	0	0	4.1	6.2	6.5	14.0	17.8	14.8	7.4	12.4	26.0	5.2	24.6	12.0	16.4	33.6	-----	13.4	106.7
Early Blackhull	8856	-----	-----	-----	7.4	7.5	16.0	12.0	13.8	5.6	10.7	23.6	1.0	22.7	12.8	19.0	32.8	14.0	14.2	105.2
Triumph	12132	-----	-----	-----	7.7	8.9	14.9	12.3	13.6	-----	-----	-----	-----	-----	-----	-----	-----	-----	11.5	92.4
Kanred-Hd. Fed. x Minhardi-Minturki	11970	-----	-----	-----	-----	7.2	12.3	18.6	15.4	6.5	10.2	21.4	5.8	23.4	12.6	18.1	35.0	10.8	15.2	106.7
Minturki	6155	-----	-----	-----	-----	-----	13.0	16.6	14.6	4.6	13.2	19.4	8.5	23.8	8.7	13.5	24.4	9.6	14.2	95.1
Cimarron	12120	-----	-----	-----	-----	-----	-----	-----	-----	8.7	10.7	-----	-----	-----	-----	-----	-----	-----	9.7	104.3
Chiefkan x Oro-Tenmarq	12148	-----	-----	-----	-----	-----	-----	-----	-----	-----	7.8	-----	-----	-----	-----	-----	-----	-----	7.8	54.9
Blackhull	6251	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	30.7	7.8	26.6	11.0	22.6	30.8	11.8	20.2	130.5
Kanred	5146	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	20.5	9.2	24.2	10.6	19.0	24.9	9.4	16.8	108.8
Cheyenne x Tenmarq	11972	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	26.5	8.9	24.1	9.9	21.8	-----	-----	18.2	113.9
Apache	12122	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	22.9	4.4	25.8	-----	-----	-----	-----	17.7	100.0
Chiefkan	11754	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	25.1	13.5	18.3	31.1	14.0	17.9	-----	119.3
Nebred	10094	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	7.8	27.2	10.4	22.0	26.6	6.2	16.7	-----	111.2
Kharkof	1583	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	9.9	17.8	27.4	8.8	16.0	-----	115.8
Kanred x Marquis	A44	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	29.2	5.7	17.4	-----	123.8
Ave. Yield All Varieties		0	0	5.6	5.8	6.7	14.3	17.2	14.2	5.9	11.4	22.0	6.1	24.5	11.0	17.8	28.6	10.5		

* Not grown

-05-

APPENDIX TABLE 3. Agronomic data of winter wheat varieties grown on fallow at Akron, Colorado, from 1941 to 1956, inclusive, showing averages for this period.

Variety	C.I. or State No.	Date Headed	Date Ripe	Height	Percent Lodged*	Test Weight	Years Grown
Early Blackhull	8856	5-28	7-7	33	5	59.0	14
Wichita	11952	5-29	7-6	30	2	59.3	16
Pawnee	11669	5-31	7-6	30	2	57.8	16
Comanche	11673	5-31	7-6	30	T	58.6	16
Tenmarq	6936	6-3	7-11	31	1	56.9	16
Cheyenne	8885	6-6	7-11	30	1	58.2	16
Kharkof	1442	6-7	7-9	31	2	57.7	16
Alton	1438	6-9	7-10	32	1	57.7	16
Red Chief	12109	6-2	7-7	33	1	60.5	15
Minturki	6155	6-8	7-12	35	2	57.1	13
Kanred-Hd. Fed. x Minhardi-Minturki	11970	6-1	7-9	34	2	57.7	13
Kiowa	12133	6-1	7-3	27	0	58.4	10
Ponca	12128	6-2	7-3	27	2	57.6	9
Bison	12518	6-1	7-3	30	-	58.2	5
Sioux	12142	6-4	6-21	24	-	56.0	4
Chiefkan	11754	6-1	7-11	36	T	58.7	6
Blackhull	6251	6-1	7-11	34	2	57.6	7
Nebred	10094	6-5	7-12	31	0	57.9	6
Kanred	5146	6-7	7-13	33	1	56.9	7
Cheyenne x Tenmarq	11972	6-5	7-12	35	0	57.9	5
Kanred x Marquis	A 44	5-31	7-12	27	0	58.2	2
Concho	12517	6-1	6-20	23	-	56.9	4
Kharkof	1583	6-8	7-15	30	0	57.6	4
Apache	12122	5-30	7-10	34	1	59.3	3
Triumph	12132	6-1	7-2	36	0	59.2	5
Cimmarron	12120	5-25	7-9	24	2	59.5	2
Hyberline	-----	5-22	6-19	22	-	58.2	2
Early Colorado	-----	5-27	6-18	21	-	57.9	2
Chiefkan x Oro-Tenmarq	12148	5-19	6-29	18	-	58.0	1

*Percent lodging calculated only for years in which some lodging occurred.

APPENDIX TABLE 4. Summary of yields of winter wheat varieties grown in various regions of the state as determined by the outstate testing program, 1941-1957. (Yields for varieties grown in three or more tests.)

Variety	Northeast ¹			Southeast ²			Western Slope ³		
	Yield	No. Tests	% Cheyenne Same Years	Yield	No. Tests	% Cheyenne Same Years	Yield	No. Tests	% Cheyenne Same Years
Cheyenne	27.7	26	100.0	30.4	9	100.0	41.9	8	100.0
Tenmarq	27.0	24	96.2	28.8	9	94.8	37.9	5	91.4
Pawnee	26.0	23	93.3	27.8	9	91.6	32.7	5	81.7
Wichita	26.7	23	97.8	27.2	9	89.6	34.9	5	87.4
Comanche	25.5	22	90.4	27.9	9	91.9	39.8	6	94.5
Nebred	25.8	22	89.9	27.0	5	92.0	40.8	5	103.9
Blackhull	29.0	20	97.2	27.5	9	90.7	33.1	5	82.7
Early Blackhull	24.7	19	91.1	24.7	9	81.5	34.0	4	85.4
Kanred	27.1	18	87.6	28.0	7	100.2	34.2	5	85.6
Red Chief	24.3	17	91.3	26.6	9	87.6	-----	---	-----
Turkey	27.9	14	91.5	30.9	7	96.4	-----	---	-----
Triumph	22.5	11	95.1	28.8	7	87.6	-----	---	-----
Kiowa	19.7	8	99.6	31.3	3	107.1	-----	---	-----
Chiefkan	30.1	8	104.5	23.8	3	112.3	-----	---	-----
Ponca	14.4	7	87.5	-----	---	-----	-----	---	-----
Concho	18.2	3	91.8	-----	---	-----	-----	---	-----
Cache	-----	---	-----	-----	---	-----	56.6	3	125.5
Relief	-----	---	-----	-----	---	-----	50.6	3	112.4
Wasatch	-----	---	-----	-----	---	-----	55.2	3	122.4

¹ Northeast includes tests in Boulder, Larimer, Adams, Arapahoe, Lincoln, Weld, Sedgwick, Logan, Phillips and Yuma Counties.

² Southeast includes tests in Kit Carson, Baca and Cheyenne Counties.

³ Western Slope includes tests in Mesa, Moffat and Routt Counties.

APPENDIX TABLE 5. Winter wheat nursery varietal test, Fort Collins, Colorado; average yields in bushels per acre from 1941 to 1957.

Variety	C.I. or State No.	1957	1956	1955	1954	1953 ¹	1951	1950	1949	1948	1947	1946	1945	1944	1943	1942	1941	Average	Ave. Wichita Same Years	Pct. Wichita
Wichita	11952	54.7	49.8	48.4	51.7	57.3	62.4	50.6	50.1	68.8	20.4	42.2	33.3	24.5	44.9	66.3	45.7	48.2	48.2	100.0
Comanche	11673	51.1	53.8	63.4	59.2	55.2	60.5	45.9	46.7	62.5	22.0	51.1	32.2	18.6	45.6	54.4	---	48.1	48.4	99.6
Pawnee	11669	53.4	52.7	64.3	56.9	54.6	59.3	44.4	44.7	63.6	31.6	49.7	37.8	18.9	46.1	53.3	---	48.8	48.4	100.8
Red Chief	12109	---	48.7	61.1	55.6	36.5	63.6	---	---	43.7	54.0	30.2	50.5	29.2	---	---	---	47.3	48.4	97.7
Kharkof	1442	47.6	40.0	58.1	57.3	49.5	58.3	54.9	31.2	62.3	27.5	51.5	---	---	---	---	---	48.9	50.6	96.7
Ponca	12128	57.2	51.3	51.8	57.1	59.7	55.8	48.3	31.0	57.5	---	---	---	---	---	---	---	52.2	54.9	95.1
Triumph	12123	---	51.4	54.4	46.6	39.2	51.0	36.8	---	---	---	---	---	---	---	---	---	46.6	53.4	87.3
Bison	12518	56.4	63.4	64.6	66.6	65.3	62.6	---	---	---	---	---	---	---	---	---	---	63.2	54.0	116.8
Concho	12517	63.8	58.5	68.5	62.3	56.9	---	---	---	---	---	---	---	---	---	---	---	62.0	52.4	118.4
Sioux	12142	---	45.0	65.3	57.5	---	---	---	---	---	---	---	---	---	---	---	---	55.9	50.0	111.9
Medit.-Hope x Pawnee ²	12873	51.8	53.4	63.9	53.7	---	---	---	---	---	---	---	---	---	---	---	---	55.7	51.2	108.9
(Mqo.-Oro x Oro-Tq.) x Med.-Hope x Pawnee	FC 1262	67.7	74.9	61.7	---	---	---	---	---	---	---	---	---	---	---	---	---	68.1	51.0	133.6
(Mqo.-Oro x Oro-Tq.) x Med.-Hope x Pawnee	FC 1263	55.4	45.4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	50.4	50.9	96.5
(Mqo.-Oro x Oro-Tq.) x Med.-Hope x Pawnee	FC 1264	63.2	53.4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	58.3	50.9	111.6
FC 1262 x Comanche	FC 1265	54.4	49.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	51.8	50.9	99.2
E. Bl.-Tenq. x Oro-Med.-Hope	12871	59.0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	59.0	54.7	107.9
Cheyenne	8885	---	---	74.9	65.6	62.9	67.5	54.8	28.6	59.1	43.8	53.6	24.6	10.2	52.8	48.4	42.0	49.2	47.6	103.3
Tenmarq	6936	---	---	57.5	63.5	50.2	63.7	44.5	30.1	60.7	30.1	56.8	22.9	13.3	38.6	58.8	40.3	45.1	47.6	94.7
Kiowa	12133	---	---	61.8	66.8	47.3	62.0	46.2	48.9	65.7	31.8	---	---	---	---	---	---	53.8	51.2	105.1
Cheyenne x Tenmarq	11972	---	---	---	---	54.9	65.3	56.4	48.1	60.2	36.5	58.9	30.3	14.6	14.6	---	---	44.0	45.4	96.8
E. Bl.-Marmin x Hope-Med.-25	FC 1270	---	---	---	---	60.7	61.4	53.5	38.2	56.1	16.5	54.3	---	---	---	---	---	48.7	50.3	96.8
E. Bl.-Marmin x Hope-Med.-73	FC 1271	---	---	---	---	51.4	52.5	48.6	37.7	56.6	27.1	53.7	---	---	---	---	---	46.8	50.3	93.1
E. Bl.-Marmin x Hope-Med.-76	FC 1272	---	---	---	---	57.5	51.2	46.5	38.1	57.1	33.3	50.1	---	---	---	---	---	47.7	50.3	94.9
Mutant 348	A 910	---	---	---	---	---	---	---	37.2	62.1	28.1	55.5	22.3	16.7	42.5	65.5	44.4	41.6	44.0	94.5
Hd. Fed.-Marquis x Kanred	A 340	---	---	---	---	---	---	---	34.9	65.5	23.0	44.0	29.5	12.0	42.7	57.3	52.4	40.1	44.0	91.2
Eureka-Minhardi x Kanred-Hd. Fed.	A 149	---	---	---	---	---	---	---	31.1	72.0	35.9	73.2	21.3	13.8	54.5	64.8	---	45.8	43.8	104.6
Apache	12122	---	---	---	---	---	---	---	44.0	64.8	21.0	55.4	---	---	---	---	---	46.3	45.4	102.0
E. Bl.-Marmin x Hope-Med.- 5	FC 1267	---	---	---	---	---	---	---	31.7	44.3	12.9	54.6	---	---	---	---	---	35.9	45.4	79.1
E. Bl.-Marmin x Hope-Med.-10	FC 1268	---	---	---	---	---	---	---	30.2	52.3	29.3	50.3	---	---	---	---	---	40.5	45.4	89.3
E. Bl.-Marmin x Hope-Med.-15	FC 1269	---	---	---	---	---	---	---	35.6	50.5	10.5	48.8	---	---	---	---	---	36.4	45.4	80.1
Cimarron	12120	---	---	---	---	---	---	---	60.4	60.7	---	---	---	---	---	---	---	60.6	59.4	101.9
Colorado Early	FC 1273	---	---	---	---	---	---	---	42.3	---	---	---	---	---	---	---	---	42.3	50.1	84.4
Kanred	5146	---	---	---	---	---	---	---	---	52.0	27.5	51.5	26.5	11.3	40.6	43.3	34.3	35.9	43.3	82.9
Kanred x Hope-Hd. Fed.	12135	---	---	---	---	---	---	---	63.8	22.4	47.2	29.5	26.4	39.8	38.9	42.2	---	38.8	43.3	89.6
Chiefkan x Oro-Tenmarq	12148	---	---	---	---	---	---	---	---	64.3	---	---	---	---	---	---	---	64.3	68.8	93.5
Blackhull	6251	---	---	---	---	---	---	---	---	---	17.7	47.3	28.8	24.0	37.6	44.8	---	33.4	38.6	86.4
Early Blackhull	8856	---	---	---	---	---	---	---	---	---	9.6	35.7	37.9	---	---	---	---	27.7	32.0	86.8

(Continued)

APPENDIX TABLE 5.—Continued

Variety	C.I. or State No.	1957	1956	1955	1954	1953 ¹	1951	1950	1949	1948	1947	1946	1945	1944	1943	1942	1941	Average	Ave. Wichita Same Years	Pct. Wichita
Cheyenne x E. Blackhull	12124	---	---	---	---	---	---	---	---	---	13.7	51.7	29.3	---	---	---	---	31.6	32.0	98.7
Chiefkan	11754	---	---	---	---	---	---	---	---	---	---	48.7	32.3	19.2	35.3	51.5	38.3	37.6	42.8	87.7
Nebred	10094	---	---	---	---	---	---	---	---	---	---	53.3	31.8	18.6	45.3	54.4	38.5	40.3	42.8	94.2
Hd. Fed.-Marquis x Marquis-Kanred	A 276	---	---	---	---	---	---	---	---	---	---	48.3	31.3	21.3	48.9	53.9	---	40.7	42.2	96.4
Marmmin	11502	---	---	---	---	---	---	---	---	---	---	50.8	26.1	10.4	---	---	---	29.1	33.3	87.3
Kanred x Marquis	A 31	---	---	---	---	---	---	---	---	---	---	---	24.7	16.8	48.5	61.2	---	37.8	42.2	89.5
Kanred-F ₁ Spring x Kanred-Hope	A 900	---	---	---	---	---	---	---	---	---	---	---	28.7	---	---	---	---	28.7	33.3	86.2
Mutant 1143	11971	---	---	---	---	---	---	---	---	---	---	---	---	15.6	42.1	63.1	41.6	40.6	45.4	89.5
(Hd. Fed.-Marquis x Prelude) x Kanred	A 350	---	---	---	---	---	---	---	---	---	---	---	---	15.2	48.2	47.1	36.8	36.8	45.4	81.2
Kanred x Hope	A 858	---	---	---	---	---	---	---	---	---	---	---	---	7.9	38.2	55.3	---	33.8	45.2	74.7
Kanred x (Hd. Fed.-Marquis x Prelude)	A 833	---	---	---	---	---	---	---	---	---	---	---	---	14.1	40.1	47.2	---	33.8	45.2	74.7
Kanred x (Hd. Fed.-Marquis x Prelude)	A 834	---	---	---	---	---	---	---	---	---	---	---	---	12.5	38.6	55.9	---	35.7	45.2	78.9
Kanred x (Hd. Fed.-Marquis x Prelude)	A 843	---	---	---	---	---	---	---	---	---	---	---	---	9.3	31.4	68.6	---	36.4	45.2	80.5
Kanred x (Hd. Fed.-Marquis x Prelude)	A 844	---	---	---	---	---	---	---	---	---	---	---	---	11.2	38.4	57.2	---	35.6	45.2	78.7
Tenmarq x Minturki	A 169	---	---	---	---	---	---	---	---	---	---	---	---	13.2	46.3	44.8	---	34.8	45.2	76.9
Kanred-Hd. Fed. x Kanred-Buffum	A 214	---	---	---	---	---	---	---	---	---	---	---	---	7.2	42.1	48.3	---	32.5	45.2	71.9
Turkey-Minessa x Kanred-Hd. Fed.	A 257	---	---	---	---	---	---	---	---	---	---	---	---	14.3	45.6	59.1	---	39.7	45.2	87.7
(Hd. Fed.-Marquis x Prelude) x Kanred	A 819	---	---	---	---	---	---	---	---	---	---	---	---	15.4	41.6	46.7	---	34.6	45.2	76.4
Odessa-Marquis x Turkey	A 397	---	---	---	---	---	---	---	---	---	---	---	---	13.1	40.6	56.0	---	36.6	45.2	80.8
F ₂ Winter x Kanred-Hope	A 915	---	---	---	---	---	---	---	---	---	---	---	---	16.6	38.6	58.5	---	37.9	45.2	83.8
Ridit x Kanred-Hope	A 602	---	---	---	---	---	---	---	---	---	---	---	---	---	42.8	51.1	37.7	43.9	52.3	83.9
Kanred x Komar 1656	A 645	---	---	---	---	---	---	---	---	---	---	---	---	---	45.2	45.2	---	45.2	55.6	81.3
Kanred x Hope	11976	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	49.0	56.0	87.4
Kanred x Hope-Hd. Fed.	11975	---	---	---	---	---	---	---	---	---	---	---	---	---	---	40.0	42.5	41.2	56.0	73.7
1656-84 x Kanred	A 914	---	---	---	---	---	---	---	---	---	---	---	---	---	---	47.3	---	47.3	66.3	71.3
F ₂ Winter x Kanred	A 925	---	---	---	---	---	---	---	---	---	---	---	---	---	---	57.4	---	57.4	66.3	86.6
Mutant 95	A 95	---	---	---	---	---	---	---	---	---	---	---	---	---	---	57.7	---	57.7	66.3	87.0
Kanred x (Hd. Fed.-Marquis x Prelude)	A 839	---	---	---	---	---	---	---	---	---	---	---	---	---	---	48.0	---	48.0	66.3	72.4
Kanred x (Hd. Fed.-Marquis x Prelude)	A 842	---	---	---	---	---	---	---	---	---	---	---	---	---	---	50.7	---	50.7	66.3	76.5
Tenmarq x Minturki	A 164	---	---	---	---	---	---	---	---	---	---	---	---	---	---	55.0	---	55.0	66.3	83.0
Kanred-F ₁ Spring x Kanred-Hope	A 905	---	---	---	---	---	---	---	---	---	---	---	---	---	---	58.8	---	58.8	66.3	88.7
Kanred x Hope	A 857	---	---	---	---	---	---	---	---	---	---	---	---	---	---	50.4	---	50.4	66.3	76.0
Kanred x 28-32-32	A 862	---	---	---	---	---	---	---	---	---	---	---	---	---	---	54.0	---	54.0	66.3	81.4
Kanred x 28-32-32	12119	---	---	---	---	---	---	---	---	---	---	---	---	---	---	58.9	---	58.9	66.3	88.8
Kanred x Hope-Hd. Fed.	A 868	---	---	---	---	---	---	---	---	---	---	---	---	---	---	59.0	---	59.0	66.3	89.0
Kanred x Hope-Hd. Fed.	A 859	---	---	---	---	---	---	---	---	---	---	---	---	---	---	47.7	---	47.7	66.3	71.9
Kanred-Hd. Fed. x Minhardi-Minturki	12117	---	---	---	---	---	---	---	---	---	---	---	---	---	---	55.5	---	55.5	66.3	83.7
Kanred-Hd. Fed. x Minhardi-Minturki	A 191	---	---	---	---	---	---	---	---	---	---	---	---	---	---	54.2	---	54.2	66.3	81.7
Kanred-Hd. Fed. x Minhardi-Minturki	12118	---	---	---	---	---	---	---	---	---	---	---	---	---	---	52.6	---	52.6	66.3	79.3
Kanred x Hope-Hd. Fed.	A 528	---	---	---	---	---	---	---	---	---	---	---	---	---	---	48.2	---	48.2	66.3	72.7
Kanred x Hope-Hd. Fed.	A 540	---	---	---	---	---	---	---	---	---	---	---	---	---	---	49.0	---	49.0	66.3	73.9

¹ Not grown in 1950 and test destroyed by hail in 1952.

APPENDIX TABLE 6. Agronomic data of winter wheat varieties grown for five years or more at Fort Collins from 1941 to 1957, inclusive.

Variety	C.I. or State No.	Date Headed	Date Ripe	Percent Lodged ¹	Height	Test Weight	Years Grown
Wichita	11952	6-2	7-19	25	41	62.8	16
Comanche	11673	6-5	7-21	34	40	62.0	15
Pawnee	11669	6-4	7-20	31	39	61.6	15
Kharkof	1442	6-7	7-23	73	42	61.3	10
Ponca	12128	6-2	7-18	55	38	62.1	9
Bison	12518	6-2	7-17	43	40	62.0	5
Concho	12517	6-1	7-17	40	40	62.7	5
Cheyenne	8885	6-5	7-20	28	42	61.3	14
Tenmarq	6936	6-11	7-25	29	39	61.2	14
Red Chief	12109	6-2	7-21	30	44	63.2	10
Triumph	12123	5-31	7-16	16	36	61.6	6
Kiowa	12133	6-2	7-22	29	38	62.3	8
Cheyenne x Tenmarq	11972	6-12	7-25	39	39	60.6	10
E. B1.-Marmin x Hope-Med.	FC 1270	6-4	7-22	58	42	62.0	7
E. B1.-Marmin x Hope-Med.	FC 1271	6-6	7-22	58	42	60.3	7
E. B1.-Marmin x Hope-Med.	FC 1272	6-6	7-22	52	41	61.2	7
Mutant 348	A 910	6-7	7-24	32	44	60.6	8
H. Fed.-Marquis x Kanred	A 340	6-6	7-22	27	41	61.2	9
Eureka-Minhardi x Kanred-H. Fed.	A 149	6-8	7-24	36	43	61.0	8
Kanred	5146	6-10	7-25	38	43	61.2	8
Kanred x Hope-H. Fed.	12135	6-7	7-24	18	42	60.8	8
Blackhull	6251	6-10	7-25	27	44	61.9	6
Chiefkan	11754	6-9	7-25	18	46	61.1	6
Nebred	10094	6-11	7-25	20	42	61.2	6
H. Fed.-Marquis x Marquis-Kanred	A 276	6-8	7-15	11	40	59.8	5

¹ Lodging percent calculated only in years in which some lodging occurred.

APPENDIX TABLE 7. Summary of winter wheat varieties grown at the San Juan Basin Branch Station for the years 1941-1957, inclusive (yields in bushels per acre).

Variety	C.I. Number	1957	1956	1955	1954	1953	1952	1951	1950 ¹	1949	1948	1947	1946	1945 ²	1944	1943	1942	1941	Average Yield	Percent Tenmarq ³
Cheyenne	8885	86.8	100.6	34.7	53.3	39.9	32.4	45.2	25.7	86.7	43.5	21.7	40.0	0.0	44.3	61.3	53.0	65.2	49.1	101.8
Tenmarq	6936	82.5	97.8	36.1	51.0	32.0	29.5	50.1	26.7	80.2	40.0	25.7	42.0	0.0	40.6	56.7	58.3	70.3	48.2	100.0
Wichita	11952	74.8	83.3	46.4	48.5	33.6	28.3	40.4	12.4	67.9	40.0	11.1	47.6	0.0	41.4	49.9	51.1	50.5	42.8	88.7
Comanche	11673	80.5	93.8	44.5	51.1	31.3	28.6	45.7	21.9	77.8	40.4	14.5	39.1	0.0	42.3	.....	.....	.....	43.7	96.4
Pawnee	11669	74.5	75.1	37.8	44.4	34.8	16.4	43.2	10.8	65.5	38.5	14.5	38.5	0.0	37.9	.....	.....	.....	38.0	83.8
Kharkof	1442	80.1	93.1	44.6	50.5	39.9	26.5	53.1	27.6	71.6	31.1	20.0	.....	.....	.....	.....	.....	.....	48.9	97.6
Ponca	12128	73.9	102.6	39.2	39.0	38.7	26.9	38.0	19.2	67.2	41.0	.....	.....	.....	.....	.....	.....	.....	49.2	93.5
Triumph	12120	66.7	97.2	46.5	31.5	26.8	20.3	31.9	13.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	41.7	82.2
Bison	12518	76.3	96.2	41.4	40.3	37.1	32.7	45.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	52.8	97.5
Sioux	12142	81.7	95.5	39.6	55.9	39.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	62.2	104.0
Kiowa	12133	76.6	97.9	47.1	41.2	38.3	24.5	42.6	22.0	72.5	39.6	13.9	.....	.....	.....	.....	.....	.....	46.9	93.6
Ea. Bkhl.-Marq. x Hope-Med.	25	73.4	90.0	36.8	47.0	34.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	56.4	94.3
Ea. Bkhl.-Marq. x Hope-Med.	73	75.8	82.4	43.1	48.5	34.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	56.9	95.1
Ea. Bkhl.-Marq. x Hope-Med.	76	69.6	77.7	36.1	47.1	33.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	52.7	88.1
Cheyenne x Tenmarq	11972	74.4	102.5	42.6	57.5	33.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	62.1	103.8
Wasatch	11925	72.5	81.1	41.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	64.9	90.0
Kanred	5146	.....	.....	.....	.....	.....	31.1	44.7	25.4	71.6	39.3	24.2	41.4	0.0	40.7	55.1	57.7	56.1	40.7	94.0
Red Chief	12109	.....	.....	.....	.....	.....	20.6	42.5	26.1	64.8	35.7	23.6	53.9	.....	.....	.....	.....	.....	38.2	90.8
Early Blackhull	8856	.....	.....	.....	.....	.....	19.7	41.4	12.1	55.7	43.6	.....	.....	.....	.....	.....	.....	.....	34.5	76.2
Chiefkan-Oro x Tenmarq	12148	.....	.....	.....	.....	.....	.....	.....	13.5	71.0	35.3	.....	.....	.....	.....	.....	.....	.....	39.9	81.6
Cimarron	12120	.....	.....	.....	.....	.....	.....	.....	.....	65.7	.....	.....	.....	.....	.....	.....	.....	.....	65.7	81.9
Mutant 348	A 910	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	49.2	0.0	44.0	60.6	53.8	70.2	46.8	104.8
Chiefkan	11759	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	49.5	0.0	50.6	56.4	51.5	62.3	45.0	100.9
Cheyenne x Tenmarq	11972	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	46.5	0.0	48.7	.....	.....	.....	31.7	115.0
Mutant	11971	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0	43.1	53.3	52.6	67.2	43.2	95.7
Hd.-Fed. x Mar.-Pre.-Kan.	A 538	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0	42.3	57.0	55.0	58.9	42.6	94.4
Ft. Lewis Marquis	A 27	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.0	40.1	61.9	50.8	53.2	41.6	91.2
Relief	10082	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	62.4	56.2	55.0	57.9	93.7
Ridit x Kan.-Hope	A 602	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	52.2	48.0	52.4	50.9	82.4
Hope-Kan. x Hd. Fed.	A 563	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	48.8	48.3	53.8	50.3	81.4
Kan. x Hope-Hd. Fed.	11975	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50.1	52.1	51.5
Nebred	10094	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	52.7	62.3	57.5	89.4

¹ Hail damage accounted for the low yields in 1950.

² Failure in 1945 was apparently due to smothering.

³ Same years.

APPENDIX TABLE 8. Agronomic data of winter wheat varieties grown for five or more years at the San Juan Basin Branch Station, Fort Lewis.

Variety	C.I. or State No.	Headed	Ripe	Height	Percent Lodged ¹	Test Weight	Number Years Grown
Bison	12518	6-21	7-28	37	10	61.7	10
Cheyenne	8885	6-20	7-29	38	8	62.3	16
Cheyenne x Tenmarq	11952	6-18	7-30	36	10	62.3	5
Comanche	11673	6-16	7-27	38	9	62.2	13
Kharkof	1442	6-19	7-30	38	18	62.4	11
Kiowa	12133	6-14	7-26	37	4	61.8	11
Pawnee	1169	6-15	7-23	37	5	60.7	13
Ponca	12128	6-15	7-27	36	8	61.6	10
Sioux	12142	6-19	7-31	34	7	61.3	5
Tenmarq	6936	6-19	7-30	39	10	61.8	16
Triumph	12132	6-12	7-24	34	3	61.5	8
Wichita	11952	6-12	7-24	38	8	62.2	12

¹ Lodging percent calculated only in years in which some lodging occurred.