SPRING WHEAT PRODUCTION AND VARIETIES FOR WYOMING

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Wheat ranks high as a farm crop in Wyoming. In annual value it holds third place among crops produced in Wyoming. The average annual value of the hay produced in the state for the twelve-year period, 1924 to 1935, inclusive, has been slightly over $11,000,000.00; of the sugar beet crop has been approximately $2,898,000.00; and of the wheat has been $2,303,200.00. Since the year 1930, the average annual value of the potato crop has exceeded that of wheat. Figure I shows the approximate value of the four most important farm crops (sugar beets, wheat, potatoes, and corn), exclusive of hay, in Wyoming for the twelve-year period, 1924 to 1935, inclusive.

Figure II shows the approximate acreage of wheat and total production in bushels in the United States since 1866. Figure III gives the same information for Wyoming since 1895. In both the United States and in Wyoming there has been a slight general reduction in both acreage and production since 1920. Production has been greatly lowered in the last few years by drought condi-
tions throughout the most of the wheat producing section. This has been especially true in this state.

A study of wheat production in the state during the twelve-year period mentioned above reveals the following interesting facts. The average annual acreage of wheat harvested is 278,250 acres. There is an average production of 3,029,760 bushels per year. Of this the larger part, 87.7 per cent of the acreage and 77.4 per cent of the production, is upon dry land farms. Sixty-five per cent of the acreage and 60.3 per cent of the wheat produced is spring sown. Spring sown wheats gave an average yield of 8.03 bushels per acre under non-irrigated conditions and 20.00 bushels per acre under irrigation. Winter wheat yielded an average of 12.12 bushels per acre upon the dry land and 18.97 bushels under irrigation. It is interesting to note that the average yield of winter wheat is greater upon the dry land than that of spring wheat, but the reverse is true upon the irrigated lands. On irrigated land 91.2 per cent of the acreage is sown to spring wheat. The proportion of winter wheat to spring wheat upon the dry lands has been increasing slightly during the last five years.
Yields are based upon acres harvested. The average annual estimated farm price has been 78 cents.

In total production of wheat the following counties rank in the order named: Goshen, Laramie, Sheridan, Campbell, Platte, Crook, and Weston. These seven counties are all in the dry land section of the state and produce 76 per cent of Wyoming’s wheat crop. The figures used in the foregoing paragraphs are compiled from various official sources and were the best obtainable up to November 1, 1936.

Studies have been conducted at the University of Wyoming Experiment Station at Laramie over a long period of years in order to determine the best methods of culture, and the varieties best adapted to Wyoming’s conditions. The recommendations given are based upon these investigations. Winter wheats have not been studied and tested at this station, and so only spring wheats will be discussed in this bulletin.
CULTURAL METHODS

ROTATION

Wyoming is one of the newer states in point of agricultural development, and has not yet adopted a system of crop rotation which may be expected to give the best yields. In some of the sugar beet areas fairly good systems of rotations are followed, but they are the exception rather than the rule.

Irrigated land in Wyoming needs rotations which will stir the soil and break up the puddled clods which form under irrigation. Wheat grows best following a cultivated crop such as potatoes, sugar beets, beans, or corn, and may serve as a nurse crop with which to seed alfalfa or clover. In the dry-farming sections of the state, spring-seeded wheat upon disked corn or potato ground has yielded profitable returns. Corn is a common crop on many of our dry lands. Tests have shown that on the Great Plains the largest returns of wheat per acre were produced upon summer fallow, but because of the cost of summer tillage and trouble with soil blowing during the winter, the spring wheat crops on disked corn ground were more profitable. Potatoes, where grown, occupy the same place as corn in rotation.

On the irrigated lands of the state wheat has given good returns when seeded following potatoes or sugar beets. Spring plowing is not necessary for most soils when following these crops. Disking puts the ground into condition for wheat. Clover or alfalfa may be seeded in the wheat used as a nurse crop. This rotation gives good returns with the minimum amount of labor.

Any well-planned rotation should include a deep-rooted and shallow-rooted crop and a legume, in the order named.

At this experiment station the following rotation has given very good results and returns: Alfalfa 3 years, potatoes 1 year, small grains (wheat, oats, or barley) 1 year, and a small grain as a nurse crop for alfalfa 1 year. In another rotation used successfully, sweet clover for 2 years was substituted for 3 years of alfalfa in the foregoing. In this latter rotation the second crop of sweet clover in the second year was plowed under about the first of September.
The yields of spring wheat on the Agronomy Farm at Laramie have been greatly increased by the use of a rotation of alfalfa, potatoes, and grain.

SEED BED PREPARATION

Some years ago there was a common impression that spring seeding should always be done on fall plowing. Results of recent investigations do not always support this idea. The experiments of the United States Department of Agriculture at fourteen stations showed that spring plowing for spring wheat gave average results exactly the same as those given by fall plowing. In those sections of Wyoming where soil blowing is not troublesome during the winter, fall plowing may be economical from the standpoint of labor management. Early seeding is very desirable, almost imperative, for spring wheat. Fall plowing, while it may not be a distinct advantage in itself, permits much of the land preparation to be done at a time when farm work is slack. This saves time in the spring and usually permits much earlier seeding than does spring plowing.

When spring wheat follows a cultivated crop, plowing is not necessary. The usual practice is to prepare the ground with a disk, a duck-foot cultivator or a Wheatland plow (one way disk) instead of plowing. At the Archer Field Station in southeastern Wyoming, the highest yields of spring wheat were obtained upon summer fallow, the next highest upon disked corn ground, and the lowest upon land continuously cropped to wheat. Spring wheat on disked corn ground gave the lowest cost of production per unit.

The advantages of a firm seed-bed and early seeding resulting from early plowing followed by frequent harrowing cannot be emphasized too much. On loose, poorly packed soil, most of the available moisture will be lost by the simple process of drying, producing unfavorable conditions for germination and early growth. Early and thorough preparation of the seed-bed not only destroys weeds, which are the worst means of dissipating moisture, but also results in a compact seed-bed. There is more available plant food in a compact early worked seed-bed than in one plowed
later and less thoroughly packed. When the time between spring plowing and seeding is short, or if the soil is unusually loose, it is advisable to use a packer. The soil may be packed by the use of a drag or a regular roller soil-packer.

Under irrigation excellent results have been secured at this station upon fall-plowed land by disking lightly in the spring, harrowing, and then following with a drag. This leaves the land level and smooth for irrigating and at the same time produces a firm seed-bed.

Fall plowing for spring wheat is advisable on the irrigated lands of Wyoming where winter soil blowing is not a factor, because it permits a better breaking up of the soil by freezing and thawing. This results in a better physical condition, which is especially desirable on irrigated land.

Summer fallow is generally used when winter wheat is grown, and in some instances summer fallow is used for spring wheat. Due to the extra cost of summer fallow as compared to other methods and the difficulty of preventing the soil from blowing, the advisability of summer fallow for spring sown wheat is questionable. When summer fallow is used the method of preparation is generally to plow deep about the last of May and surface cultivate during the growing season just enough to keep the ground free of weeds.

In many dry farming sections of Wyoming the duck-foot cultivator and Wheatland plow have been substituted for the mould-board plow for preparing ground for wheat. These implements do not turn the soil over, but leave the trash and clods upon the surface. This tends to check wind-blowing and water erosion during the time the land is in fallow. In some instances the lister has been used instead of the cultivators or plows. If listing is done late in the fall and the furrows run at right angles to the prevailing winds, there is a tendency to check the blowing of the soil. The new "basin listers" are now being tried in summer fallow work, but no conclusions as to their value can be made at present.
SEED TREATMENT FOR SPRING WHEAT

Stem rust cannot be controlled by seed treatments. Early seeding will help in rust prevention. The smut diseases of wheat are among the most destructive that attack cereals. They destroy several million bushels each year. Besides the actual grain destroyed there is an additional loss due to dockage. Most of these losses can be prevented by seed treatment.

Smuts are caused by parasitic fungi which infect the plant through the seed. They grow up through the plant and destroy the seed or the whole head. Seed treatment kills the smut spores upon the seed and therefore prevents, to a great degree, infection of the young plants.

Spring wheat seed should be treated regularly for smut. Some newly developed wheat hybrids show resistance to the attacks of this disease. These varieties are not in general use. If a little smut is present in the crop, it is likely to increase until it becomes very destructive unless the seed is treated. Sometimes spores get upon the seed wheat from threshers or infected drills or bags.

The cereal smuts are sufficiently different from each other that no single seed treatment has yet been found which will control all of them. Several seed treatments are in use today. Each one is adapted to control one or a small number of the smuts. The treatment should be varied to correspond to the disease to be controlled.

The spring wheats are subject to attack by only two known smuts which cause very great losses. These need not be distinguished, since the same treatment is used for both. The spikes or heads turn into a black, sooty mass. Formaldehyde is not recommended for wheat because of the danger of reducing or destroying the germination of the seed. Ceresan, a patented dust disinfectant is now being used quite successfully. It contains an ethyl mercury phosphate compound and is poisonous to man or animals.
CERESAN TREATMENT

The seed wheat should be thoroughly cleaned to remove as many smut balls as possible. Use the amount of disinfectant prescribed upon the container of Ceresan. After treatment, store the seed in an uncovered pile or in bags for at least 24 hours. Then plant as soon as possible. The dust may be mixed in the proper amounts in a rotary grain treating machine, or the dust may be added to the grain piled upon a tight floor and mixed with shovels.

The most efficient and convenient method for treating wheat with dust is to use some form of closed container. Some have used a cement mixer and have found it quite suitable. A barrel can very easily be adapted for this work. Several strips should be fastened on the inside to catch the grain and allow it to fall over and thoroughly mix as the container is being rotated. See Figure IV.

PRECAUTIONS IN TREATING WITH DUST

Treating should preferably be done out of doors or in a building with good cross ventilation. Wear a clean, dry cloth or dry filter dust mask over the nose and mouth to prevent inhaling the dust. Undue quantities of dust upon the skin may cause
irritation and should be removed immediately with soap and water. Most dusts for seed treatment contain poisons. In case of poisoning induce vomiting and send for a physician.

SEEDING METHODS UNDER IRRIGATION

All seeding should be done with a drill. On nearly level land, drilling should be done in the same direction as the slope, to aid in directing the water. Spring wheat should be sown at the rate of 90 to 110 pounds per acre. Lighter rates of seeding are advisable where wheat is used as a nurse crop.

The seed should be sown as early in the spring as possible. The last of March or the first of April are favorable dates in most irrigated sections. Early seedings give heavier yields than the later seedings. Where very early seeding is practiced the wheat should be drilled to a depth of 1 1/2 to 2 inches.

SEEDING METHODS ON DRY LAND

After the seed bed has been prepared, seeding upon dry land is very much the same as upon irrigated land. The furrow drill generally gives better results than the common drill. From 50 to 80 pounds per acre are generally used. The heavy rates do not lower the yields materially during drought years, and they do guard against poor stands under adverse conditions. The depth of seeding should be governed by the depth to the moisture supply in the soil. Again, seeding as early as possible is desirable.

IRRIGATION OF WHEAT

The proper use of irrigation water is one of the most important problems of every community and of every farmer in an irrigation district. The irrigation farmer has largely under his control one of the most important factors in determining the yield and quality of his crops, the one over which farmers who depend upon direct rainfall have little or no control, namely the amount of moisture in the soil. However, there is generally less available irrigation water than is needed to give the optimum amount to all the land. Consequently, the proper distribution and use of irrigation water is of the greatest importance to the community.
Early irrigations of spring wheat should be avoided as much as possible. Especially is this true before the wheat comes up. Applications of water after wheat is planted and before it comes up usually decrease the yield. In those sections where the early spring is usually dry, late fall irrigation of the land will generally supply sufficient moisture to bring the crop up. Irrigations do not appear to be very effective until the crop has shaded the ground. Applications of water at jointing and flowering time are desirable in most sections. Usually 2 to 3 applications of water will be sufficient to produce a good crop of spring wheat. Under the conditions existing at the Agronomy Farm at Laramie, two irrigations are usually sufficient, although a third application must be made in certain seasons. Water should not be applied during the maturing of the wheat. Irrigation at this time is likely to lower the quality of the wheat and cause lodging.

Spring wheats are quite tolerant to alkali, but less so than either barley or oats. Lands which contain an accumulation of alkali at the surface should be plowed to a depth of from 8 to 10 inches and seeded immediately, before the alkali has had time to reaccumulate at the surface. This may enable the seeds to germinate and start growth before the excessive accumulation occurs at the surface.

**VARIETIES**

The botanical descriptions which follow are taken from Technical Bulletin No. 459, Classification of Wheat Varieties Grown in the United States, by J. Allen Clark, Senior Agronomist and B. B. Bayles, Associate Agronomist, Division of Cereal Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture.

**MARQUIS**

Early to mid-season in maturity, mid-tall; stem white, mid-strong (seldom lodges); spikes have few short awnlets, dense, erect; glumes glabrous, white to yellowish, short and wide; shoulders usually wide and square; beaks wide, acute, 0.5 mm. long; awnlets few, 1 to 10 mm. long; kernels red, short, hard, ovate,
A=Marquis wheat, B=Red Fife wheat.

with truncate tip; germ mid-sized; crease wide, deep; cheeks angular; brush mid-sized, mid-long. See Figure V.

This is a high yielding variety and one of the best varieties for milling and breadmaking.

Marquis is of hybrid origin, having been originated at the Central Experimental Farm, Ottawa, Canada. The crossing that resulted in Marquis was done under the direction of William Saunders. C. E. Saunders did the selecting, naming, testing, and distributing of the variety. Marquis is one of the descendants of a cross between an early-ripening Indian wheat, Hard Red Cal-
cutta (as female) and Red Fife (as male). The original cross
was made in 1892. It was first selected out of other related sorts
in 1903 and grown in a pure state in 1904. It was introduced
upon farms in Canada in 1907, and by 1911 it had become firmly
established in Canada. Seed was introduced in the United States
by the United States Department of Agriculture in 1912 and 1913.
By 1919, only 7 years after its introduction, it made up about 60
per cent of the total spring-wheat acreage of the United States.

MARQUILLO

Early to mid-season in maturity, short to mid-tall; stem white,
strong; spike has awnlets, mid-dense, erect; glumes glabrous,
white, sometimes showing streaks of brown or black, mid-long,
mid-wide; shoulders mid-wide, round to elevated; beaks broad,
acute, 1 to 1.5 mm. long; awnlets many, 5 to 25 mm. long; kernels
red, mid-long to long, hard, ovate; germ large; crease mid-deep;
cheeks angular; brush mid-large, mid-long, collared.

Marquillo is resistant to stem rust. The grain produces a
yellowish flour and in this respect is undesirable.

Marquillo is the result of a cross between Marquis and
Iumillo durum made in 1914. It was first distributed in 1928. It
is now grown chiefly in Minnesota and South Dakota.

RED FIFE

Mid-season to late maturing, tall; stem white, mid-strong;
spike awnleted, fusiform, mid-dense to lax, erect or inclined;
glumes glabrous, white, mid-long, mid-wide; shoulders mid-wide,
oblique to square; beaks narrow, acute, 0.5 mm. long; kernels red,
short to mid-long, hard, ovate; germ mid-sized; crease wide, deep,
cheeks angular; brush mid-sized, mid-long. See Figure V.

It is only a fair yielding wheat but has excellent milling and
bread making qualities. It is very similar to Marquis, but much
later in maturing.

Red Fife was introduced into the United States from Galicia,
by way of Germany, Scotland, and Canada. Its cultivation in the
United States dates from 1860. Many growers selected and dis-
tributed the Red Fife wheat and usually prefixed their own name to the name Fife.

Red Fife has been grown in the northern Great Plains including Wyoming and Utah. The acreage has been decreasing since 1919. Much Marquis has been grown instead.

RUBY

Early maturing, short to mid-tall; stem purple, mid-strong; spike awnleted, oblong-fusiform, dense, erect; glumes glabrous, yellowish white, short, mid-wide; shoulders wide, oblique to
square; beaks wide, obtuse, 0.5 to 1 mm. long; awnlets several, 3 to 10 mm. long; kernels red, short, hard, ovate; germ mid-sized to large; crease mid-wide to wide; shallow to deep; cheeks angular; brush mid-sized to short. See Figure VI.

Ruby is very similar to Marquis except for the purple straw. It is a wheat of about equal quality, but does not yield as well as Marquis.

Ruby was originated from a double cross using Onega, Gehun, Riga, and Red Fife wheats. It is now grown chiefly in the North Central part of the United States.

**Federation**

Early to mid-season in maturity, short; stem white, strong; spike apically awnleted, oblong, dense, erect; glumes glabrous, brown, short, wide; shoulders wide, oblique to square; beaks narrow, acute, 0.5 mm. long; awnlets few, 1 to 3 mm. long; kernels white, usually short, soft, broadly ovate; germ mid-sized; crease usually narrow, shallow; cheeks rounded; brush mid-sized, mid-long.

Federation was produced in New South Wales, Australia, from a cross between Purplestraw and Yandilla wheats and first introduced into the United States in 1914. It is now grown to some extent in the Pacific Northwest.

**Hard Federation**

Early maturing, short; stem white, strong; spike awnless, oblong, dense, erect; glumes glabrous, brown, short, wide; shoulders wide, square; beaks narrow, white, short, hard, ovate, with truncate tip; germ large; crease mid-wide, mid-deep, frequently pitted; cheeks angular to rounded; brush large, mid-long.

Hard Federation differs from Federation in being earlier and shorter and having harder kernels. It was originated by selection from Federation in Australia. It was first introduced into the United States in 1915.

It has proved to be a high-yielding, dry-land wheat in Oregon and California.
BAART

Early to mid-season in maturity, mid-tall to tall; stem white, weak; spike awned, fusiform, mid-dense, inclined; glumes glabrous, white, long, narrow; shoulders narrow, oblique to square; beaks 3 to 5 mm. long; awns 3 to 6 cm. long; kernels white, long, semi-hard to hard, ovate to obpyriform; germ small; crease narrow, shallow; cheeks usually rounded; brush mid-sized, short to mid-long.
Baart was received as Early Baart from Australia by the United States Department of Agriculture in 1900. It was first distributed for commercial production from the Arizona Agricultural Experiment Station. By 1917 its culture had spread to Washington, Oregon, Idaho, and California where it is still quite extensively grown. See Figure VII.

(HAYNES) BLUESTEM

Late in maturing, mid-tall to tall; stem white, glabrous before maturity, mid-strong to strong; spike awnleted, narrowly fusiform, mid-dense to lax, inclined, easily shattered; glumes pubescent, white, short, mid-long, narrow; shoulders mid-wide, oblique to square; beaks mid-wide, obtuse, 0.5 mm. long; awnlets few, 3 to 15 mm. long; kernels red, short to mid-long, hard, ovate; germ mid-sized; crease narrow, mid-deep to deep; cheeks rounded; brush mid-sized, mid-long to long. See Figure VI.

Bluestem is very susceptible to stem rust. It is a fair yielder when rust is not present. It is an excellent milling and bread-making wheat.

Bluestem was first developed through selection by L. H. Haynes, of Fargo, North Dakota, about 1895. Because of the low yields caused by stem rust, the acreage of Bluestem is rapidly decreasing.

KOTA

Mid-season maturing, mid-tall; stem white, weak to mid-strong; spike awned, fusiform, mid-dense, inclined; glumes glabrous, white, mid-long, mid-wide; shoulders mid-wide, square to elevated; beaks 3 to 20 mm. long; awns 3 to 8 cm. long; kernels red, mid-long, hard, ovate to elliptical, slightly humped; germ small; crease wide, usually shallow; cheeks usually angular; brush small, short to mid-long. See Figure VIII.

Kota is resistant to stem rust and to drought. It was obtained in Russia as a separate from Monad durum wheat by H. L. Booley, of the North Dakota Agricultural College, in 1903.

The largest acreage of this wheat has always been in North Dakota. It has been superseded by Ceres in many sections.
Mid-season in maturity, mid-tall; stem white, mid-strong; spike awned, fusiform, mid-dense, erect to inclined; glumes glabrous, white, mid-long, mid-wide; shoulders mid-wide, rounded to elevated; beaks 2 to 10 mm. long; awns 3 to 8 cm. long; kernels red, mid-long, hard, ovate; germ small; crease mid-wide, shallow to mid-deep; cheeks usually angular; brush mid-sized, short.

Ceres is resistant to stem rust and drought and is a high-yielding wheat of good quality for breadmaking. See Figure VIII.

It was developed at the North Dakota Agricultural Experiment Station from a cross between Marquis and Kota. The center of production of this wheat is in and around North Dakota.
RELIANCE

Mid-season to late maturing, mid-tall; stem white, mid-strong to strong; spike awned, fusiform, mid-dense, erect to inclined; glumes glabrous, white, short to mid-long, mid-wide; shoulders wanting to narrow, oblique to elevated; beaks 3 to 15 mm. long; awns 3 to 8 cm. long; kernels red, mid-long, hard, ovate; germ small; crease mid-wide, mid-deep; cheeks rounded; brush mid-sized, short. See Figure VII.

Reliance was originated from a hybrid between Kanred and Marquis made in 1917 at the Sherman County Branch Station, Moro, Oregon. The selection that resulted in Reliance was made by J. A. Clark in 1920 at Chico, California.

This wheat is not yet very widely distributed.

HOPE

Mid-season in maturity, mid-tall; leaves pubescent; stem purple, mid-strong; spike awned, fusiform, white, mid-long, erect to inclined, very resistant to shattering; glumes glabrous, white, mid-long, mid-wide to wide; shoulders mid-wide, rounded to elevated; beaks 2 to 10 mm. long; awns 2 to 6 cm. long; kernels red, mid-long, hard, ovate; germ small; crease wide, mid-deep; cheeks angular; brush large, long.

For spring planting, Hope is very resistant to bunt, stem rust, and leaf rust. It is susceptible to frost and heat injury.

Hope was developed by E. S. McFadden as the result of a cross made in 1915 between Vernal emmer and Marquis wheat. The commercial acreage has probably not increased since 1929.

The wheat H-44 reported in this test is a sister selection of Hope.

DEFIANCE

Mid-season maturing, mid-tall to tall; stem white, weak to mid-strong; spike awnleted, fusiform, mid-dense, erect to inclined; glumes glabrous, white, mid-long, narrow; shoulders narrow, oblique to square; beaks wide, obtuse, somewhat incurved, 1 mm. long; awnlets few, 5 to 20 mm. long; kernels white, mid-
long, soft, ovate; germ usually small; crease wide, mid-deep; cheeks usually angular; brush mid-sized, mid-long.

Defiance is the result of a cross of White Hamburg and Golden Drop, which was made by Cyrus G. Pringle, in the Champlain Valley, near Charlotte, Vermont, in 1871.

Defiance has been a favorite wheat upon the irrigated lands in Colorado, Idaho, New Mexico, and Utah. The acreage seeded to Defiance has been decreasing since about 1919.

**Bunyip**

Early maturing, mid-tall; stem white, strong; spike awnleted, oblong, dense, erect; glumes glabrous, yellowish white (brown striped), mid-long, mid-wide; shoulders mid-wide, oblique to square; beaks narrow to mid-wide, acute, 0.5 mm. long; awnlets few, 2 to 12 mm. long; kernels white, mid-long, soft to semi-hard, ovate; germ mid-sized; crease mid-wide, mid-deep; cheeks angular; brush mid-long, mid-sized to large.

Bunyip is an Australian variety of hybrid origin, originated by William Farrer of New South Wales. It was first introduced into the United States in 1914.

Bunyip has replaced such varieties as Pacific Bluestem and Baart in the Pacific Coast states.

**Dicklow**

A very late maturing wheat, mid-tall to tall; stem glaucous before maturity, white, mid-strong to strong, coarse; leaves broad; spike awnleted, clavate, mid-lax, erect; glumes glabrous, white, mid-long, mid-wide; shoulders mid-wide, oblique to square; beaks wide, obtuse, 1 mm. long; awnlets several, 3 to 15 mm. long; kernels white, short to mid-long soft, oval to ovate; germ small to mid-sized; crease wide, deep; cheeks rounded to angular; brush mid-sized, mid-long.

Dicklow is most widely grown under irrigation in Southern Idaho, Utah, and Wyoming. It is a good yielding soft wheat under irrigation, but because of its late maturity, it is often frosted at Laramie.
James Holly in Utah obtained some California Club wheat. Richard Low obtained some and grew it. He selected the type which suited him best. Good results were secured from this wheat and neighbors began clamoring for Dick Low's wheat. It soon lost its personal connection and became simply Dicklow wheat.

**RED BOBS**

Early maturing, mid-tall; stem white, mid-strong to strong; spike awnless, fusiform, mid-dense, erect; glumes glabrous, white to yellowish, mid-long, mid-wide; shoulders wide, oblique to square; beaks wide, acute, 0.5 mm. long, sometimes nearly wanting; apical awnlets usually wanting; kernels red, usually short, hard, oval to ovate, with truncate tip; germ mid-sized; crease mid-wide to wide, mid-deep to deep; cheeks angular; brush mid-sized, short.

This variety contains several types of plants. It is very susceptible to stem rust.

Red Bobs was originated from a head selection from a field of Bobs wheat in 1910 by Seager Wheeler at Rosthern, Saskatchewan, Canada. It is now grown to a limited extent in Montana, Idaho, Washington, Wyoming, Colorado, and North Dakota.

**GARNET**

Early maturing, short to mid-tall; stem white, slender, weak to mid-strong; spike awnleted, mid-dense to lax, inclined, easily shattered; glumes glabrous, white, long, narrow; shoulders wanting to rounded; beaks narrow, acute, 1 mm. long; awnlets several, 3 to 15 mm. long; kernels red, short to mid-long, hard, elliptical; germ large; crease narrow, mid-wide; cheeks rounded; brush small, mid-long.

Garnet is resistant to bunt, partly because it is early in maturing. It is not a high yielder, and the quality of the grain is not as good as that of Marquis.

Garnet was originated from a cross made at Ottawa, Canada, in 1905. It was introduced into the United States about 1928 and is grown to a limited extent in the Dakotas.
NORKA

Mid-season, mid-tall; stem white, weak to mid-strong; spike awned, fusiform, mid-dense, inclined; glumes glabrous, brown, mid-long, mid-wide; shoulders mid-wide, oblique to elevated; beaks 2 to 25 mm. long; awns 3 to 8 cm. long; kernels red, short to mid-long, hard, ovate, acute; germ small to mid-sized; crease narrow to mid-wide, shallow; cheeks usually angular; brush small, short to mid-long.

Norka originated from a pure-line selection of common wheat separated from a plat of Kubanka durum wheat in 1908 by W. G. Shelley at Akron, Colorado. It has been grown in experiments in Colorado, Wyoming, North Dakota, South Dakota, and Montana. It has not been grown commercially to any extent.

ERIVAN

Early maturing, short; stem white, slender, very weak, often lodges; spike awned, fusiform, mid-dense, nodding; glumes glabrous, white, mid-long, narrow; shoulders mid-wide, usually elevated; beaks 3 to 25 mm. long; awns 2 to 7 cm. long; kernels red, mid-long, soft to mid-hard; elliptical, humped; germ small; crease mid-wide, shallow; cheeks usually angular; brush small, mid-long.

Erivan was introduced in 1903 from the dry mountain district of the Erivan government near the border of Persia. It was grown to a limited extent in Wyoming. Its weak straw prevented it from being of commercial importance.

KUBANKA (DURUM)

Mid-season, tall; stem white, mid-strong; spike awned, broadly oblong, dense, inclined to nodding; glumes glabrous, yellowish, mid-long, wide; shoulders mid-wide, usually rounded; beaks wide, 1 mm. long; awns yellowish, 6 to 15 cm. long; kernels white, large, hard, elliptical; germ mid-sized; crease mid-wide, shallow; cheek angular; brush mid-sized, short.

Kubanka is a high yielding variety and is very resistant to stem rust. It is a very good milling wheat. See Figure IX.
Kubanka is of Russian origin. The principle introduction was made in 1900 by M. A. Carleton. It is now considered the most widely adapted of the durum varieties to the varying conditions in the northern spring wheat section of the United States.

**ACME (DURUM)**

Mid-season, mid-tall; stem white, weak to mid-strong; spike awned, fusiform, mid-dense, inclined to nodding; glumes glabrous, yellowish, mid-long, mid-wide; shoulders mid-wide, usually obli-
October, 1937  Wyoming Spring Wheat Production  25
que; beaks broad, incurved, 1 mm. long; awns yellowish, 5 to 15 cm. long; kernels white, mid-long to long, hard, elliptical to ovate; germ mid-sized; crease mid-wide, shallow; cheeks angular; brush mid-sized, short.

Acme differs from Kubanka in being shorter, in having a weaker straw and a longer, laxer, and narrower spike. It is very resistant to stem rust and a fair yielding variety.

Acme originated as a plant selection from Kubanka. It was grown commercially in 1916. Now being grown in North Dakota, South Dakota, Minnesota, Nebraska, and Wyoming.

EXPERIMENTAL METHODS

CLIMATE

As weather and climatic conditions are influenced to a great extent by topography, a brief description of the location and the surroundings of the Agronomy Farm of the Experiment Station will be given.

The Agronomy Farm is situated about two and one-half miles west of the city of Laramie. Laramie, the seat of the University and Experiment Station, is situated at the eastern edge of a large, nearly level plateau known as the Laramie Plains. These plains constitute the drainage basin of the Laramie River and its tributaries which have their sources in the mountains to the south and west. Laramie has an elevation of 7150 feet above sea level.

To the eastward the land rises rapidly to the crest of the Laramie mountains, about eight miles distant, where it reaches an elevation of nearly 9000 feet, or about 1800 feet above the valley. This range has a general north and south direction and connects with a spur of the Medicine Bow range near the Wyoming-Colorado state line, about twenty miles to the south.

To the westward some thirty miles lies the Medicine Bow range. This range has an elevation well above 9,000 feet and culminates in Medicine Bow Peak, which rises to an altitude of 12,005 feet above sea level. The Laramie Plains slope toward the north and northeast.

Laramie is thus surrounded on three sides by high elevations. These elevations exert a very noticeable effect upon the climate.
They cool the air as it passes over their crests, and in doing so the moisture therein is condensed and precipitated before reaching the plains. Thus, the tendency is to produce a cool, dry climate.

Only five times in forty years has the maximum temperature reached 90° F. The sky is nearly always clear and the humidity is low; hence, though the days may be warm, the nights are always cool. The daily range of temperature is great. There is a great difference in the temperature between sunshine and shade. The winters, while cold, are not excessively so, and owing to the low humidity, the temperature seldom becomes disagreeable.

The monthly mean temperatures for a forty-year period 1891-1930 were as follows: January 22.0, February 23.1, March 29.5, April 37.9, May 49.9, June 56.7, July 63.0, August 61.8, September 53.6, October 42.3, November 31.6, and December 22.0. The average mean temperature for the year during the same period was 40.8° F.

The average yearly precipitation at Laramie for this period was 11.09 inches. More than sixty per cent of the precipitation falls during the growing season, April first to September first. The average annual snowfall is comparatively small, being only 45.2 inches. Much of this snow melts shortly after it falls.

The Agronomy Farm is located on a comparatively level plain, with very few obstructions to the free movement of air currents, and so it naturally has a greater wind velocity than is found in more sheltered regions. However, the average is not as great as might be expected and does very little damage to crops. The winds occur chiefly in the early spring and late fall.

SOIL

The fields of the Agronomy Farm slope to the southeast. The soil varies from a rather light brown, fine, sandy loam to true loam. It is of a medium depth and underlaid with shale strata. These shale layers are at varying depths and have a downward pitch in a direction opposite the direction of the slope of the land surface. In some places, where these shale layers rise to the surface, the water table is also brought near the surface.
October, 1937: Wyoming Spring Wheat Production

The soil contains considerable clay and becomes rather difficult to handle unless it is well supplied with humus. The alkali content is comparatively high, but causes no material damage to cereal crops. The nitrogen content of the soil is low and all crops respond to the application of organic matter. The legume crops in the rotation also produce very favorable results upon the succeeding crops.

TREATMENT OF PLATS

The Agronomy Farm is divided into fields and a crop rotation system is maintained. An attempt is made to secure as nearly uniform soil in each field as possible. The plats are arranged within a field to obtain the greatest degree of uniformity in soil conditions. A thirty-two inch alley is left between plats. Figure X shows some of these plats.

The plats are adjusted in size to fit the field used. They range from one-tenth to one-twentieth of an acre. The drill used sows a strip seventy-two inches wide and one (sometimes two)
width of the drill constitutes a plat. This width of the plats with the 32-inch alleys between plats is very convenient for roguing accidental mixtures and preventing mixtures in harvesting. This size of plat is also easily cut with a binder.

In variety plats some means of comparing the performance of one variety with another is necessary when the two are some distance apart, because there may be a difference in yield due to the soil conditions. To supply a means for such a comparison, check plats were used. Every fourth plat 1, 5, 9, etc., was planted as a check plat. The variety used in seeding the checks is a variety which has been grown in the locality and has been sufficiently well graded to insure uniformity in its producing power, so that the yields of the check plats vary directly with the soil conditions. In the tests here reported, Marquis has been used as the check variety.

The land is prepared for all plats as uniformly as possible, and the seed bed is made as perfect as the soil conditions will permit. The land is fall-plowed, as this fits in with the labor distribution, and makes possible earlier spring seeding than does spring plowing. In the spring the land is harrowed and leveled with a float as early as the ground may be worked. The plats are seeded with a drill usually during the last days in March or the first ten days in April. Great care is used to clean the drill thoroughly between the drilling of the plats. Beginning on one side of the field, plat number 1, a check, is sown, a thirty-two-inch alley is left and plat number 2, a variety plat, is sown, then another alley is left. Thus all varieties are planted in their turn. As the plats are sown a marking sign is placed in the center of the end of the plat, thus identifying it. Heavy rates of seeding are always used. A rate equal to 100 to 120 pounds of seed per acre is used. The drill is set so as to give approximately the same number of seeds per acre, regardless of the size of the kernels. The seed is sown with a single disk, chain drag drill, and drilled to a depth of from one and one-half to two inches.

The flooding method of irrigation is used for all plats. Small ditches are made in the alleys between the plats just preceding each irrigation. This permits the application of uniform amounts
of water to all plats. These ditches are filled in again in cultivating out the weeds in the alleys. From two to four irrigations per season are used, the number depending upon the season and the amount of rainfall. Plenty of irrigation water has been available except during the seasons of 1932 to 1935, inclusive.

The fall-plowed ground usually has sufficient moisture in the spring to germinate the seed. Ordinarily there is enough rainfall during the months of May and June to maintain the growth of the crop. Hence, irrigation is generally not necessary until the wheat is at least jointing. This is the beginning of the dry season and irrigation at this time is necessary. One or more irrigations are necessary to mature the grain. Late irrigations are not made, as they tend to cause lodging, delay ripening, and impair the quality of the wheat.

**CARE OF THE WHEAT PLATS**

As soon as the wheat is sufficiently headed to enable varietal characteristics to be distinguished, the plats are thoroughly hand-rogued. This is accomplished by three trained men working together. One walks in the alley on each side of the plat and the third man walks in the center of the plat. Each head or stool of wheat showing any characteristics not in conformity with the variety in the plat is pulled and laid in the alley to be gathered up later.

A self-binder is used in harvesting. Great care is taken to remove all straw and heads of wheat from all parts of the machine after one plat is cut and before another is entered. The sheaves are carefully shocked upon the same plat from which they are cut. They remain thus until threshing time.

The threshing of the plats is done with a small, standard threshing machine of the ordinary type. The machine has been reconstructed slightly so as to permit cleaning. The cases under worm conveyors, the sides and top of the machine, have been hinged and made to open easily. An air compressor and a pressure tank are mounted upon the top of the separator. The compressor is belted to a side shaft of the separator. A long rubber hose with an air nozzle attached is connected to the air pressure tank. Thus all parts of the separator are thoroughly cleaned by
means of air pressure after each plat is threshed and before another is begun. To further prevent mechanical mixing of varieties, the first grain threshed from each variety is not saved for seed purposes. The grain is placed in clean sacks, weighed and labeled, the weights are recorded, and the grain is taken to the granary, where it is later cleaned with a Clipper fanning mill and stored.

A limited supply of clean unmixed seed of each variety grown is available each spring for distribution in small lots. This distribution is made largely through county extension agents, to cooperating farmers who agree to test the varieties and save the wheat for seed to insure an increase of the available supply of the varieties which are satisfactory.

**WHEAT NURSERY**

Since 1930 a wheat nursery has been conducted upon the Agronomy Farm. This nursery permits the testing and investigating of a much larger number of varieties and strains than can be handled in the variety test plats. The plan being followed at the present time is to secure and test a large number of varieties each year and then to complete the test of most promising wheats in the variety test plats.

The field used for nursery work is laid out in blocks of rows each of which is eighteen feet long. Three-foot alleys are left between the row blocks. These alleys permit the working of the field and are a great aid in the irrigation of the nursery. Just before harvest, one foot is removed from each end of each row. This leaves a rod row to be harvested. The planting of an eighteen-foot row and then cutting it back to sixteen feet tends to make rows more uniform for comparison. Irregularities in planting caused by stopping and starting the seeder are thus removed. Each row is numbered for the purpose of identification and record keeping. The rows are one foot apart. This permits working between rows, allows roguing and tends toward ease in harvesting.

The seed is planted by a seeder constructed by the author. All gears and feeding mechanism were removed from a garden vegetable planter. The wheel, frame, furrow opener, and the cov-
erating device were retained. A large funnel is placed at a convenient height. A straight tube leads from the funnel to the furrow opening shoe. By sifting the seed into the funnel with the fingers as the planter is moved along, the seed is dropped into the furrow as it is opened and then covered, all in one operation. Since there is no place for a kernel of wheat to lodge, the seeder never needs cleaning and a great deal of time is saved. See Figure XI.
Weeds are kept from between the rows by using a small garden tractor-cultivator. The entire nursery is treated uniformly in preparation, seeding, cultivating, irrigating, and harvesting. Weeds in the grain row are pulled by hand. All mechanical mixtures are hand rogued.

At harvest each row is cut individually with a small hand sickle, tied into a single bundle and tagged with the proper label. Each bundle is left upon the row from which it was cut until sufficiently cured. It is then either carefully wrapped or placed in a large paper bag, to prevent shattering and mixing in handling, and is threshed separately with a nursery thresher—the grain is placed in a paper bag, and the label is transferred from the bundle to the bag.

The nursery thresher does not have an efficient grain cleaning attachment. Before the grain is weighed, it is recleaned in a Clipper nursery or sample fanning mill which is driven by variable speed electric motor. The grain is then weighed and the weights recorded. These row weights are later converted into yields expressed in bushels per acre and the varieties compared.

In the nursery three-row plats are used for each variety or strain grown. The center row only is harvested for securing data. These plats are duplicated three times for each variety. The use of the three-row plats eliminates the competition for food and moisture between different varieties and greatly helps in preventing mechanical mixing. Since wheats are self pollinated natural crosses seldom occur.

Small plats are planted in the nursery to increase the volume of seed of those varieties which are to to be introduced in the variety test plats.

Every precaution is used throughout this work to prevent mechanical mixing of the varieties. Both the nursery thresher and the fanning mill are thoroughly cleaned by using compressed air immediately after each variety is threshed and before another variety is introduced into the machine.
EXPERIMENTAL RESULTS

Two varieties of wheat have been in the variety test plats every year since 1920. Others have been added since that time and several varieties which did not prove to be adapted have been discarded from year to year. A total of twenty-one varieties have been tested during this seventeen-year period. Two tables are presented to give the results of the entire test. Table number I shows the yield by years, the average yield, and the corrected average yield of all varieties which were introduced into the test prior to the season of 1932. Table II presents the same information for those varieties which were introduced in 1932 and later.

<table>
<thead>
<tr>
<th>TABLE NO. I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table Showing Spring Wheat Varieties Grown in Variety Test Plats Since 1920. (Yields are expressed in bushels per acre)</td>
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<table>
<thead>
<tr>
<th>Variety</th>
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<td>42.01</td>
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The explanation of the corrected average yield and the need for it is as follows:
Marquis wheat was used throughout the entire test as the check variety. As indicated by the variation in yields of Marquis, yields varied greatly from year to year. Unless a variety was grown for the full period, its average yield cannot be compared directly with the average yield of Marquis, or any other variety. Since Kubanka was the only other variety grown in all seventeen years, a correction must be applied to the average yield of the different varieties before comparisons are made. The last column in each table gives the corrected yields for each variety. This correction was determined by comparing the yield of each variety to the average yield of Marquis for the entire period and the average of Marquis for the same period during which each variety was grown. The corrected average yield was calculated by multiplying the average yield of Marquis for the full period by the yield of the variety in question, and dividing this product by the average yield of Marquis for the same period in which the variety was grown.

Table I shows the yields of fifteen wheats which have been grown since 1920. The column of corrected average yields shows that Marquis holds first place with an average yield of 41.96 bushels per acre. Baart is in second place with a yield of 41.75 bushels per acre. Kubanka, ranked third, yielded only 0.29 of a bushel per acre less than Marquis. Kota ranked fourth with a yield of 39.85 bushels per acre.

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The five year average yield of Marquis in table number II was 33.67 bushels per acre. Here Hope holds first place with an
average yield of 37.86 bushels. Second place is held by H-44, a sister selection with Hope. Marquis hold third place. Marquillo was grown in the variety test plats in the year 1936 only. The yield of Marquillo that year was 37.81 bushels per acre as compared to 29.59 bushels for Marquis. It would seem that these hybrid wheats, in which Marquis is one of the parents, may have some advantages over Marquis.

The average yield of all wheats for the period of test was 37.34 bushels per acre. The highest single yield was 74.33 bushels produced by the variety Norka in 1927. The lowest yielding variety was Garnet.

In 1930 the varieties Bluestem, Red Fife, Defiance, Erivan, Federation, Red Bobs, and Ruby were dropped from the tests. These wheats all fell below Marquis in yielding ability and the quality of their grains was not as good as the quality of Marquis. Bluestem was again added to the test in 1933, but it has not shown any special merit and was very susceptible to the stem rust in 1935. Erivan was dropped because of its tendency to lodge. Norka was dropped in 1933 because of its weak straw. The yields of Dicklow were reduced by frost in the years 1923 and 1929. In other irrigated sections of Wyoming it is not so likely to be frosted. In 1936 this wheat was almost completely destroyed by stem rust and smut.

The very low yields secured in the seasons of 1933, 1934, and 1935 are due chiefly to a shortage of irrigation water. In 1936 there was an epidemic of stem rust which lowered the yields of all susceptible varieties.

ADDITIONAL NOTES ON GENERAL CULTURE

No commercial fertilizers have been used in wheat tests upon the Agronomy Farm. A dressing of barnyard manure is given to the legume crop the year previous to plowing for potatoes. This permits the organic matter to be broken down into available form by the time that the potatoes need it. The best results are secured when potatoes follow fall crowned alfalfa and are in turn followed by wheat. This is the system now being used. A yield of thirty to forty bushels of wheat per acre is well within the reach of good practical farm management on irrigated lands.
The time of seeding is influenced to some extent by the climatic condition. The best results have been secured from the earliest possible seedings of spring wheat.

Wheat should be irrigated when the condition of the plants shows that they need water. Most of our soils have sufficient spring moisture to give the wheat a good start. If possible, irrigation of the land should be avoided before the spring wheat comes up. Two irrigations of six inches each should be sufficient in most cases where the rainfall is ten inches or more. Late irrigations should be avoided whenever possible.

**SUMMARY**

The production of wheat is perhaps decreasing slightly. Winter wheats yielded more per acre under dry land conditions than did spring wheats. The reverse was true under irrigated conditions.

Fall plowing for spring wheat should be practiced on our irrigated lands in order to permit early seeding. If spring wheat follows a cultivated crop, disking and floating are sufficient.

Wheat should be seeded early so as to take advantage of early spring moisture.

Marquis, a hard red spring wheat, with an average of 41.96 bushels per acre, gave the highest yield over the entire seventeen-year period.

Baart, a semi-hard white wheat was second with an average of 41.81 bushels, and Kubanka, a spring durum, was third with 41.67 bushels per acre.

The new hybrid wheat, Hope, shows promise of being slightly better in yielding ability than Marquis.

**ACKNOWLEDGMENTS**

The author wishes to express his thanks and indebtedness to J. L. Robinson and J. C. Overpeck for their work during the first years of the tests, and to D. Rankin McIntyre and Chauncy Norris, station foremen, for their continued assistance in carrying on the field studies.