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BARLEY PRODUCTION IN KANSAS

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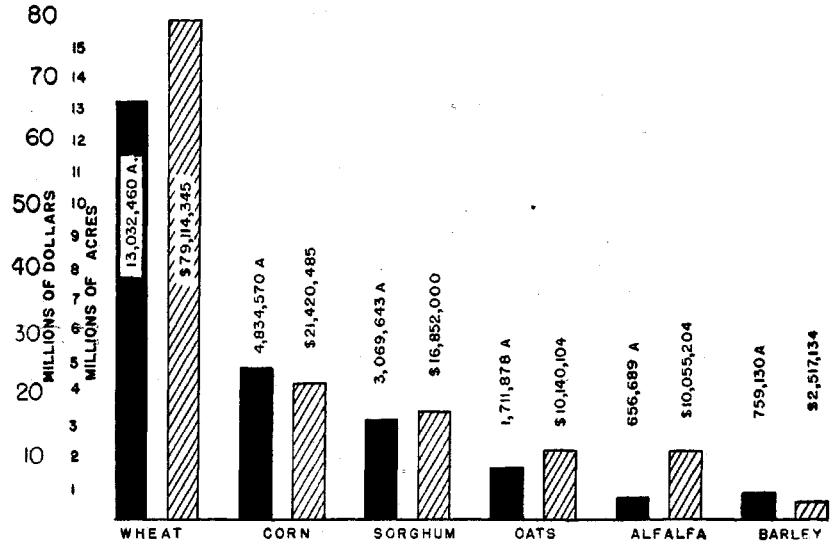

FIG. 1.—Comparative acreages and values of some Kansas farm crops. (Source: Latest available reports of the Secretary of the State Board of Agriculture.)

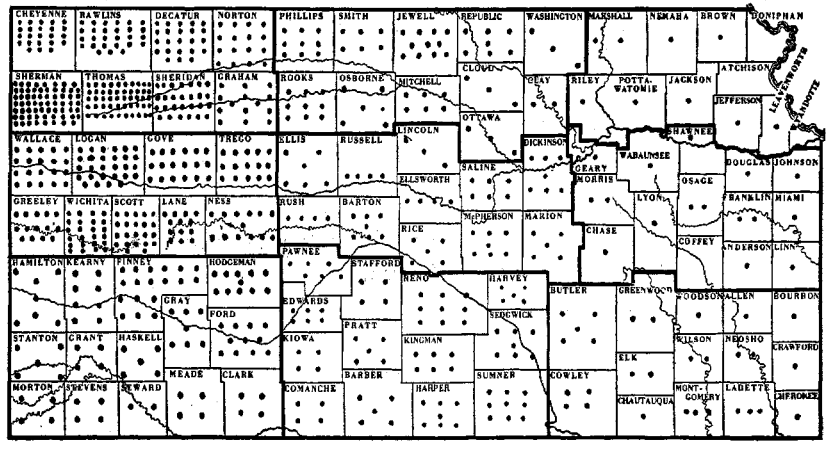

FIG. 2.—Acreage and distribution of barley in Kansas, 1931-1940. Each dot represents 1,000 acres.

BARLEY PRODUCTION IN KANSAS [1]

A. F. SWANSON AND H. H. LAUDE [2]

IMPORTANCE OF BARLEY IN KANSAS

Kansas ranks tenth among the states in the production of barley. Barley is sixth in economic importance among the crops in the state, being exceeded by wheat, corn, sorghums, oats and alfalfa. (Fig. 1.) Fifty-five percent of the acreage of barley in Kansas for the period 1931 to 1940 was grown in the northwestern part of the state in the rectangle cornered by the counties of Cheyenne, Norton, Ness and Greeley as shown in Figure 2. In southern and eastern Kansas where only a limited acreage is grown, winter barley is more common than spring barley and is often used for fall and winter pasture. Very little spring barley is grown east of a line from Republic to Sumner county, the limiting factor being chinch bugs. Oats are grown rather than barley in eastern Kansas.

Barley production fluctuates greatly from year to year because most of the crop is grown in the more arid section of the state where soil moisture may not be sufficient in the spring to encourage seeding or to produce a crop. When conditions are favorable for wheat, relatively more of that crop is planted than of barley. An increased acreage of barley is sown when wheat is abandoned, provided soil moisture is available in late winter or spring.

The acreage of barley in Kansas has varied from 137,000 acres to slightly over 1,300,000 acres per year since 1900. The annual production for the same period has varied from about 2 million to 25 million bushels. For the 10 years prior to 1898 Kansas averaged less than 25,000 acres of barley a year. The extension of agriculture into the northwestern corner of the state greatly stimulated the production of spring barley in that area after 1900.

A larger acreage of barley in the western half of Kansas is warranted as a source of feed, and to some degree for malting purposes. The tendency in Kansas has been to sow barley as an emergency crop rather than as a stabilized crop. A better understanding of the efficient use of barley as a feed and knowledge of improved varieties and disease control should do much to stimulate increased production.

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1. Contribution No. 356 from the Department of Agronomy and No. 39 from the Fort Hays Branch Agricultural Experiment Station, in coöperation with the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture.

2. Associate Agronomist, Division of Cereal Crops and Diseases and Agronomist, Kansas Agricultural Experiment Station, respectively.

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HISTORY OF BARLEY IN KANSAS

Barley is one of the oldest of the cultivated cereals. For centuries wild and cultivated forms have been grown in the Old World. Varieties from Africa, Europe and Asia differing in type and adaptation have had a great influence on barley production in Kansas either as introductions or as parents of new hybrids of economic importance to the state. Much of the basic improvement work has been due to H. V. Harlan, a former Kansan, who for many years has had charge of the investigational work with barley for the Bureau of Plant Industry, Soils, and Agricultural Engineering in cooperation with the Kansas Agricultural Experiment Station.

The early history of barley production in Kansas is very vague. The immigrants from the East no doubt brought their seed with them. The earliest records from the Kansas State Board of Agriculture show that 12,000 acres of barley were grown in Kansas in 1872. Nothing is known of the varieties grown in the early years in eastern Kansas. Stavropol is the first definitely-known spring variety to have been grown in the central and western part of the state before 1900. It is quite certain that Coast from the western states had been introduced into Kansas prior to 1900, since types of this variety were the first to reach America.

There are no records to show that any experimental work was carried on with barley until 1902 when the first experimental plot was grown at the Fort Hays Branch Agricultural Experiment Station. Fairly extensive varietal tests followed at Hays in 1903 and 1904 but were later discontinued. Extensive nursery plantings were made from 1906 to 1909 by the United States Department of Agriculture at its temporary experiment station at McPherson, Kansas, under the direction of L. A. Fitz in coöperation with the Kansas Agricultural Experiment Station,

Large nursery plantings including hundreds of selections from all parts of the country and from over the world were begun in 1924 under the direction of John H. Parker of the Manhattan station and assisted by A. F. Swanson of the Hays station, B. F. Barnes and E. H. Coles of the Colby station. The best introductions and hybrids so tested have from time to time been recommended for farm production.

Barley was not greatly appreciated and often only tolerated in the pioneer days of Kansas, due to the fact that it was grown in the eastern part of the state where it was then, as today, not well adapted because of high susceptibility to chinch bugs. Barley has always been a favorite host for chinch bugs which would leave the crop as it ripened to invade adjacent fields of corn. Farmers after such an experience often would have little to do with barley. Then, too, there was some prejudice against growing barley as a cash crop because of its use in the making of beer. Its feeding value was not fully appreciated in a section where corn could be grown, although in Europe it has long been the principal source of a concentrate in

livestock production. It was not until western Kansas became settled that it found a place of value as a staple crop in that region where corn is less certain and barley more dependable.

UTILIZATION OF BARLEY

In Kansas, barley is used chiefly for livestock feeding and most of the grain is consumed on the farms and as a substitute for corn, and in conjunction with the grain from sorghums. As a national crop large quantities are used in the manufacture of malt and beverages. Not much of the Kansas crop is used for malting purposes, but certain types are available in the state that could meet this demand if care in harvesting and marketing were used.

Not all malting barley is used for beverage. Numerous additional outlets include coffee substitutes, malt flour, yeast, malted milk beverages, malt syrup and infant foods. Forms of malted barley are used in candies, cakes and cookies, breakfast food and for medicinal purposes. When malted barley is used to make beer, the by-products in the form of dry brewers grain or wet brewers grain, are valuable for livestock. Pearled barley is used in soups.

Success in feeding barley to livestock depends in part on how it is fed. Barley grain is so hard that if it is fed whole much of it remains undigested. Best results are usually secured when it is rolled or ground to a medium degree of fineness and fed dry. Investigations [3] have shown that barley makes an excellent substitute for corn in fattening cattle provided it is grown on the farm or can be purchased at a lower price per pound than corn and if the test weight is not too low. When used to fatten cattle it sometimes causes trouble from bloat. This danger can be lessened apparently by mixing oats with barley while the cattle are being brought to full feed, and by the addition of protein supplement to a ration of barley and alfalfa hay.

In the more humid regions winter barley is important as a source of pasture during the fall and winter. Fall-sown barley grows rapidly under favorable weather conditions and is highly palatable. It is generally considered superior to wheat and rye for fall and early winter pasture, but wheat and rye furnish more grazing than barley in late winter and spring. The need for winter barley as pasture is not so great in the western part of the state where winter wheat is the principal crop and where much of it is grown on fallowed land, since the latter crop is also excellent for pasture.

ADAPTATION OF BARLEY

Barley has a wide range of climatic adaptation. The crop is found in regions of high temperature and also as far north as the Arctic circle, although it does not do well in a hot, humid climate. Barley is hardier than most cereal crops and will grow at higher altitudes.

3. Weber, A. D. Cattle Feeding Experiments, 1935-'36. Mimeo. Cir. 36A Kansas Agricultural Experiment Station, and "Barley as a Feed for Beef Cattle," American Society Animal Production, Nov. 27, 1936.

It matures earlier as a rule than wheat, rye, or oats. Where rainfall is ample, it can be grown in a short season. The adaptability of barley to many environments is due partly to the wide range of varieties and also to types within the crop.

On the other hand, barley is very sensitive to soil variation. It requires a well-drained, porous soil but does not thrive in sandy soil. The barley plant is a shallow feeder and usually exhausts the moisture and nutrients in the surface soil more completely than do the fall-sown, cereal crops. This residual effect is sometimes a detriment to the crop that follows.

SPRING AND WINTER BARLEY IN KANSAS

There are two barley-growing regions in Kansas which overlap each other, depending on whether spring or winter types are grown. Spring barley is best adapted in the northwestern section of Kansas where it is damaged less by drought and high temperatures during the ripening period. The danger from chinch bug injury is much less in northwestern Kansas than elsewhere in the state. Winter temperatures are often too low for winter barley to survive well in northwestern Kansas. Winter barley is adapted in southern and central Kansas, as far north as Salina, although it is subject to winterkilling in all parts of the state. Winter barley, being earlier than spring barley, usually is injured less by chinch bugs and often escapes high temperatures in June, resulting in the production of plumper grain. Fall-sown barley that survives the winter with a full stand will usually yield more than spring barley.

Winter barley and spring barley are distinctly different types. Winter barley, if sown in the spring, will usually produce a heavy growth of leaves but very few heads will develop. Spring barley if sown in the fall will soon be killed by cold weather.

CLASSES OF BARLEY

For classification and description, six classes of barley are recognized, but in this bulletin and for agronomic purposes, it is necessary to consider only the six-rowed and two-rowed types. A typical barley produces three single-flowered spikelets at each node of the rachis. In the six-rowed varieties all of the spikelets in the mesh produce seed. In the two-rowed types only the central of the three spikelets is fertile. The three kernels in a mesh of six-rowed barley are crowded together, causing the two outer kernels to be more or less twisted or bent by the middle kernel. The middle kernel tends to be plump in comparison with the two lateral kernels. In a normally-developed crop of two-rowed barley the individual kernels are broad, plump and full. In the threshed grain a six-rowed variety will show many twisted kernels while the kernels of a two-rowed type will be much more uniform and broad through the width of the kernel.

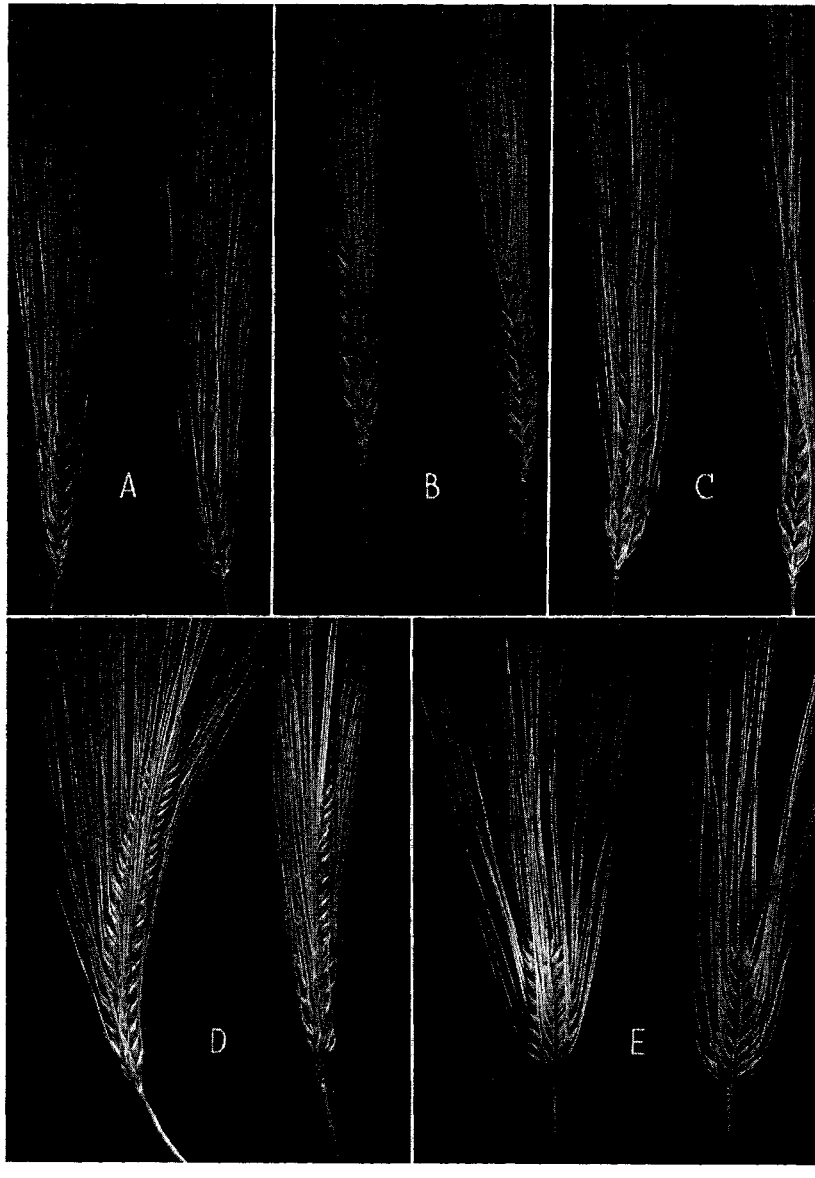

FIG. 3.—Typical side and front views of heads of barley: (a) Stavropol, (b) Coast, (c) Flynn, (d) Franklin Malt Manchurian type, (e) Club Mariout. Illustrations supplied through the courtesy of Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering.

Varieties of barley may be awned, awnless or hooded. The hull remains attached to the threshed grain of most varieties, but a few varieties are hull-less. The awns of barley may have sharp barbs which point away from the base of the head. (Fig. 4.) These barbs are larger and more severe at the base of the awn and gradually become less prominent toward the tip. In some varieties the entire length of the awns is so nearly without barbs as to be considered smooth. Barbs on the awns of barley can be felt by stroking the awn downward between the thumb and forefinger. Barley with

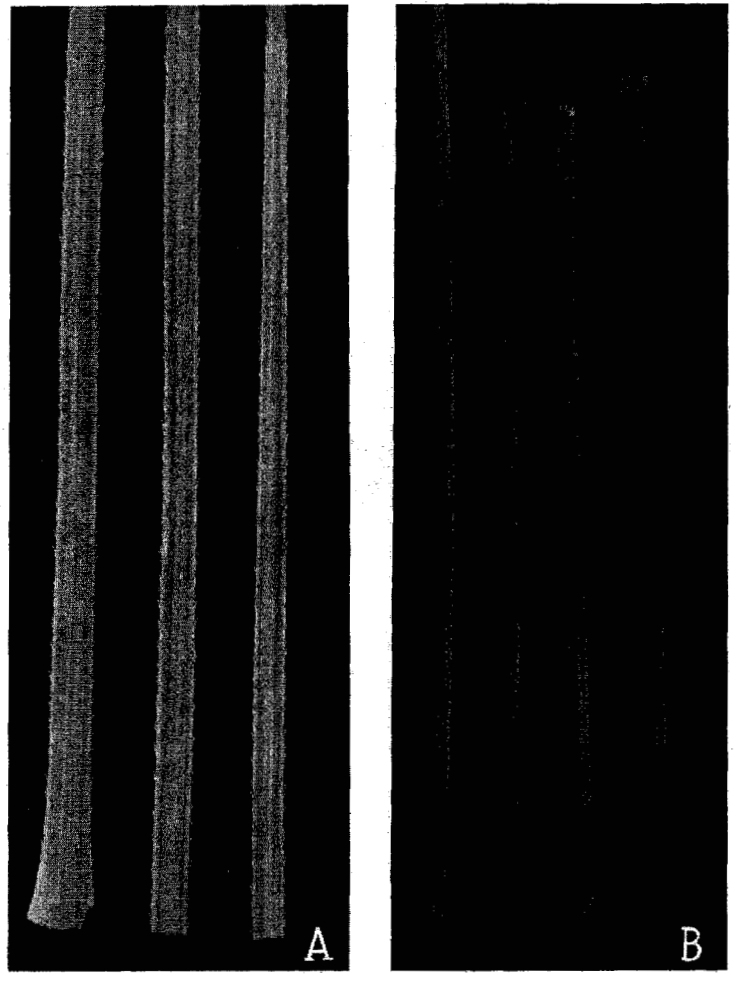

FIG. 4.—(A) View showing awns with sharp barbs, found on such varieties as Stavropol; (B) view showing awns without barbs as found on Flynn barley. Photographs supplied through the courtesy of the Colorado Agricultural Experiment Station.

a strong barbed awn is objectionable when the grain or straw is fed to livestock, as broken pieces may cause festering sores in the mouths and digestive tracts of the animals. Barley with barbed awns has been the type most frequently grown in Kansas. Recently, high-yielding, smooth-awn varieties such as Flynn have been developed, and such types are rapidly replacing the varieties with rough awns.

In hooded varieties, three short-lobed appendages take the place of the awns at the upper end of the kernel. Most varieties of this type when threshed retain the hull; a few are hull-less. No varieties of hooded or hull-less barley have produced so good yields of grain in Kansas as adapted varieties of the awned types.

FEED AND MALTING BARLEY

On the basis of use, barley is further classified as "feed" or "malting" varieties. Most of the barley grown in Kansas and throughout the country is used as feed and never leaves the farms on which it was grown. When used as feed, less care is required in the harvesting and threshing of the crop than if the grain is to be malted. High yield is of prime importance. Low test weight is undesirable as the percentage of hulls will be greater in proportion to the amount of starch contained in the grain and this lowers the feeding value. Smooth awns are, of course, more desirable in a feed barley than are rough awns. Much barley that is planted with the intention of selling it for malting purposes may end up as feed type on the market because of some character that makes the lot objectionable for malting. In Kansas the term "hog" barley sometimes has reference to types of feed barley which have strong-barbed awns that do not break close to the grain when it is threshed.

Barley suitable for malting purposes commands a premium over prices paid for feed barley because of extra care which must be taken in its production in order to get high quality of grain. The requirements for a high-grade, malting barley are that the grain be plump, mellow and starchy with no hard, flinty or green kernels. The grain must be well-matured, uniform in size, a bright, creamy, rich color and comparatively free of diseased kernels. The grain should also be free from skinned and broken kernels.

Weather conditions in the barley belt in northwestern Kansas are not always suitable for the production of good malting barley and are less so in the central part of the state, since high temperatures often prevail when the crop is ripening, causing the grain to become flinty and low in starch content.

Mixtures of other varieties of barley, or of wheat or oats which are difficult to remove, cause barley to be discounted at the malting markets. Successful malting depends upon sure, quick and even germination. The average time for barley to germinate on the malting floor is four and one-half to five days. Slow germination is unsatisfactory because of the extra time required on the malting floor.

Unripened barley tends to germinate poorly and unevenly. Broken grain and skinned kernels are likely to mold. Skinned kernels result from high cylinder speed or concave teeth set too close to the cylinder in threshing. Other causes are unequal adjustment between concave and cylinder teeth and end play in the cylinder. The latter allows the cylinder teeth to rub the kernels too closely occasionally as the cylinder swings slightly from side to side. Smooth-awned barleys tend to have loose hulls which fray and skin more easily than the more firmly attached hulls of the rough-awned varieties. While the smooth-awned barleys are best suited for feed purposes, they are less desirable from the standpoint of a malting barley which becomes a factor in considering which type the grower ought to produce.

Franklin Malt, which previously was extensively grown in the Colby-Goodland territory, and Reno winter barley, now grown in central Kansas, have been tested by malting laboratories and found to be high in diastatic power and of value to maltsters and distillers. Franklin Malt is much lower in yield than Flynn barley but the latter variety tends often to produce flinty or steely kernels due to rapid ripening in high temperatures and for this reason is not a desirable malting type. Reno winter barley ripens much earlier than Flynn and so escapes the high temperatures and produces a plumper and more starchy grain, which is more acceptable to the maltsters. The difficulties in developing a market for malting barley in Kansas have been due to scattered sources of grain and the irregularity of the supply, along with the lack of a premium to encourage production of the suitable types available. Little attention has been given to keeping malting types separated from feed types on farms and elevators in sufficient quantities for carload shipment to consuming centers.

CULTURE OF BARLEY IN KANSAS

Successful production of barley is dependent on many factors such as type of seedbed, seedbed preparation, date and rate of seeding, method of seeding, harvesting and threshing. The treatment of the crop will be somewhat altered depending on whether it is to be used primarily for feed, malt or fall and winter pasture. The various methods of preparing a seedbed depend upon available equipment, cost, type of soil, the previous crop and climatic conditions.

METHOD OF SEEDBED PREPARATION

An ideal seedbed for barley is one that is firm beneath the surface but not too hard for easy penetration of water and roots. Spring barley does not root so deeply as a fall-sown crop of winter barley or winter wheat and, therefore, cannot use deep soil moisture so efficiently. It needs an abundance of stored moisture within easy reach. The surface of the seedbed should be level with 2 or 3 inches of loose soil so that the seed can be covered thoroughly for uniform germination.

Probably the best seedbed for spring barley can be prepared in corn or sorghum land where soil moisture is available to a depth of several feet. If such a seedbed is given a light cultivation with a disc or one-way plow to level the soil, followed by a subsurface packer, conditions should be ideal for quick emergence of barley. Land which has been well prepared for wheat but is held over until spring will also make a good seedbed.

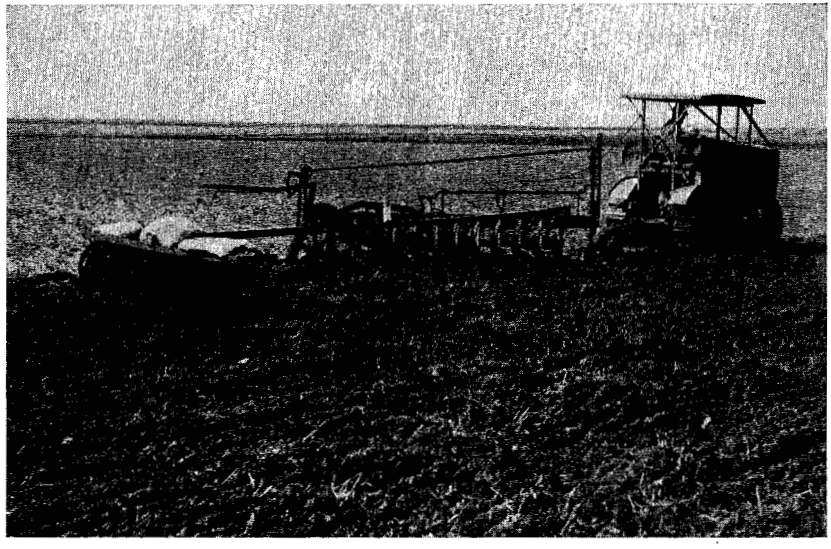

FIG. 5.—A light cultivation in the spring with a one-way plow followed with a subsurface packer often makes a favorable seedbed for barley.

Land plowed in the spring is often too loose and cloddy for a good seedbed for barley in which case yields are likely to be lower than on fall-plowed or fall-listed land.

At the Hays station, the yield of barley has been 40 percent higher when grown on fallowed land than on fall-plowed land. At Colby the yield on fallowed land has been 80 percent higher than on fall-plowed land. Wheat yields on fallow compared to continuous cropping are increased somewhat more than barley. Fallowed land left over winter for spring barley is subject to soil blowing if not carefully handled. Yields of barley for different methods of seedbed preparation are shown in Table 1 for the Colby and Hays stations as determined by J. B. Kuska and A. L. Hallsted, Division of Dry Land Agriculture.

At Colby as good yields of barley have been obtained by planting on spring-plowed as on fall-plowed barley stubble land and somewhat better yields than on disked corn or milo stubble. At Hays, yields of barley on spring-disked corn and kafir land and fall-plowed barley stubble have been about equal and have been somewhat better than on fall-listed and spring-plowed barley land.

TABLE 1.—*Yields of spring barley for different methods of seedbed preparation at the Colby and Fort Hays Branch Experiment Stations*

PREPARATION OF LAND	Bushels per acre	
	Colby	Hays
	23-year av. 1920-1942	25-year av. 1918-1942
Corn stubble disked in spring	12.3	21.9
Kafir or milo stubble disked in spring[1]	12.2	21.5
Barley land plowed in spring	14.7	17.5
Barley land plowed in fall	14.6	21.4
Barley land listed in fall	.....	19.0
Summer fallow	26.6	30.5

1. Kafir at Hays, Milo at Colby.

It is not profitable to seed spring barley on land in which there is not stored moisture and little or no surface moisture, a condition that often prevails in abandoned wheat land. The emergence of barley in such cases is usually so delayed that even if there is a good supply of rainfall in May and June the crop is likely to be injured by drought before it has matured properly. This results in shriveled grain and low yields.

Where wheat fails to survive the winter because of low temperatures, spring barley can ordinarily be planted successfully if subsoil moisture is available. The moisture supply should be determined before abandoned wheat land is seeded to barley. Late spring and summer rainfall is rarely sufficient to produce a profitable crop of spring barley, unless supplemented by stored moisture from the previous fall and winter.

DATE OF SEEDING

The maximum returns from spring barley are obtained when the crop is seeded early. Since the principal barley-producing section is in northwestern Kansas, a study of the climate of that region in relation to date of seeding is of considerable importance. One of the chief handicaps to barley production in this region is the occasional shortage of surface moisture to give the crop a quick start at seeding time. Barley should be seeded as early as is possible without injury from low temperature after emergence. Latest periods of cold weather likely to cause serious injury to barley are apt to occur during the last 10 days in March. Seeding-date experiments with Club Mariout barley at the Hays station for the five-year period, 1924-1928, as shown in Table 2, indicated that March 15 was the most favorable time for sowing. Since barley requires two or more weeks for emergence at this season, the crop will escape much of the danger from low temperatures. Sprouted barley and the very young

seedlings at Hays have been observed to survive temperatures at 10 degrees F. for short durations of time without loss of stand.

TABLE 2.—*Barley yields from different dates of seeding. Fort Hays Branch Experiment Station, Hays, Kansas*

Date of seeding	Bushels per acre						6-year average 1922-1928[2]	5-year average 1924-1928	4-year average 1925-1928
	1922	1924	1925	1926	1927	1928			
Feb. 15	49.2	40.6	6.0	24.5	23.7	35.9	30.0	26.1	22.5
Mar. 1	.....	38.5	4.7	24.5	24.5	38.5	.....	26.1	23.1
Mar. 15	.....	38.5	4.5	29.2	28.4	47.9	.....	29.7	27.5
Apr. 1	52.3	29.7	1.1	24.2	15.4	39.9	27.1	22.1	20.2
Apr. 15	37.7	25.5	0.0	18.0	20.3	33.3	22.5	19.4	17.9

1. March 1 yield substituted as storm prevented seeding on March 15.
2. 1923 crop destroyed by hail.

In the Hays region, seeding should be completed by April 1. Yields of barley are nearly always reduced by seeding as late as April 15 because the crop then ripens about the last of June when high temperatures generally prevail. Barley has been seeded at Hays on February 15 with better success than when seeded April 15. However, when seeded at this early date, there is always some danger that the crop may be injured by a late freeze. In the vicinity of Colby in northwestern Kansas where the altitude is higher the best seeding date is about March 25. Limited data indicate that in southcentral Kansas, spring barley should be seeded early in March.

RATE OF SEEDING

The best rate of seeding spring barley varies with the season and the locality. If the rate is too thin, the individual plants tend to produce many tillers and to mature late. The rate of seeding should be heavy enough to insure enough plants for a good yield on the thin spots of the field. Experience has shown that usually the best rate of seeding, in the more humid regions is 8 to 10 pecks per acre; in the vicinity of Hays, about 7 pecks; and in the extreme western portion of the state 5 to 6 pecks.

METHOD OF SEEDING

Drilling with a grain drill is the best method of seeding barley. A drill will distribute the seed uniformly if the ground is leveled properly by tillage machinery. The seed should be covered from 2 to 3 inches deep. The use of press wheels on the drill will aid germination and cause quicker and more uniform emergence. An uneven seedbed will prevent the drill from properly covering all of the seed, resulting in delayed emergence and uneven development of a part of the stand. When the late plants are harvested before the seed is

fully matured, shriveled grain may result. Such grain cannot be used to advantage for malting purposes, or for seed.

Slow and irregular germination will usually be reflected in reduced yields because the late part of the crop is more likely to be injured by high temperatures before it is fully ripened.

HARVESTING AND THRESHING

Five methods of harvesting barley in Kansas are followed. Each method has its advantages and disadvantages.

Much of the barley in Kansas probably is harvested with the combine harvester-thresher. Although this is one of the cheapest

FIG. 6.—Harvesting Flynn barley with the combine harvester-thresher. Fort Hays Branch Experiment Station.

methods, it has the disadvantage that the crop must stand erect until it is thoroughly ripe and dry. By that time, considerable loss from shattering or broken heads may have occurred. The so-called "malt" type of barley shatters very quickly after ripening. With the "hog" type of barley losses are more likely to occur from broken heads. Rain will delay harvesting with the combine, and, if rainy weather is of long duration, it will discolor the grain and decrease its malting value.

A second and somewhat more expensive method of harvesting is commonly known as the swather-pickup method. When the heads have turned a golden color, and while the straw is still slightly green, the standing barley is cut and dropped in swaths from the end of the harvester platform. A few days of dry weather will

remove most of the natural moisture from the crop. Under favorable conditions by using the pickup attachment on the combine, the crop can be threshed three or four days after swathing. The result is a high quality grain, particularly if the weather has been warm and dry while the grain was in the swath. A light shower during that time probably will not discolor it, but a heavy rain or wind may result in considerable damage and loss.

The older and more expensive method of harvesting the crop with a binder, and shocking the bundles, is the most satisfactory for the highest quality of grain. Barley can be cut as soon as the grain has turned to a golden color, although the straw is still slightly

FIG. 7.—Harvesting barley with the swather. Later the combine with pick-up attachment will thresh the barley from the windrow.

green. When shocked properly there is little loss either from shattering or broken heads.

A fourth method is to harvest the crop with a header, stack the heads, and thresh them later. The greatest danger with this method is possible spoilage from heating, especially if the season is rainy. Headed barley will not keep as well in stacks as will headed wheat. However, the danger is not great if the crop is ripe and dry when headed and is piled in long, narrow ricks rather than wide stacks. Subsequent losses may result if heavy rains occur before the crop is threshed.

The fifth method of harvesting sometimes used on small acreages is to mow and rake the crop. It is then stacked in long, narrow ricks. By the time the various operations have been completed there is usually a heavy loss from shattering, as well as loss of heads left on the ground.

Maturity of barley is indicated when a dent in the kernel made by the pressure of the thumb nail remains visible for some time. At this stage, translocation of carbohydrates and other nutrients to the kernel will have been about completed and the hulls will have begun to wrinkle due to shrinkage from loss of water. The ripening process after this time is due principally to loss of moisture. At this stage the yield will not be greatly affected by harvesting practices. The problem remains of harvesting the crop in a manner to avoid losses from lodging, shattering and heating.

VARIETIES OF SPRING BARLEY

Since 1924, many hundred selections of spring barley from various parts of the United States and other countries of the world have been tested in the nurseries or in plots at Hays, Colby and Manhattan. Varieties also have been grown in plots at the experiment stations at Garden City and Tribune, at the various experiment fields and in cooperative tests on farms in Kansas.

The agronomic data as to heading, height of plants, susceptibility to loose and covered smut and percentage of lodging are shown in Table 3. A brief description and statement of origin are given for several varieties of spring barley which are now or have been extensively grown in Kansas or which appear to be of promise.

TABLE 3.—*Agronomic data for seven well-known spring barley varieties grown at Hays, Kansas, 1936-1942*

VARIETY	Date headed. Average 1937-1942	Height plant. Average 1936-1942	Number loose smut heads per 15-foot row. Average 1936-1942	Number covered smut heads per 15-foot row. Average 1938-1942	Percent lodging. Average 1936-1942
Flynn	5-23	25	4	19	20
Beecher	5-20	24	11	1	4
Stavropol	5-26	26	7	6	30
Club Mariout	5-23	24	4	7	33
Franklin Malt	5-29	26	4	9	23
Vaughn	5-22	23	9	10	8
Spartan	5-26	28	4	8	10

COAST

Probably the first barley to be introduced into Kansas was Coast, brought to America when the Spaniards conquered Mexico. The original stock of Coast is believed to have come from North Africa and through hundreds of years of selection became adapted to the semiarid region of Spain. It was introduced from Mexico through mission settlements in California, New Mexico and Arizona. It is not known when Coast reached Kansas. Coast is similar to Stav-

ropol in general type and for many years has been an important variety in the semiarid region of the western half of the United States where it is also known as Bay Brewing and California Feed. It is different from Stavropol in that the plants have a bluish-green tinge. It has a stiffer and more pronounced barbed awn than Stavropol. Coast was almost entirely replaced by superior varieties in Kansas by 1920. It is no longer grown commercially in the state.

STAVROPOL

Stavropol is one of the first varieties to have become well established in Kansas. It has also been listed under the name of Ellis and is often referred to as "Kansas Common Six-rowed." Farmers

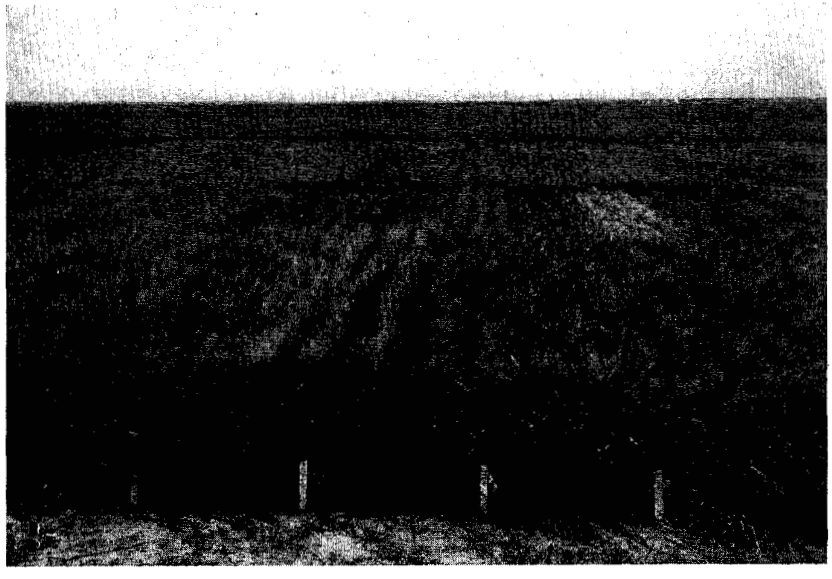

FIG. 8.—Barley testing nursery. Fort Hays Branch Experiment Station.

frequently refer to Stavropol as "hog" or "feed" barley because of its long, stiff-barbed awns. The variety was introduced into Ellis county from Russia by the German-Russian immigrants between 1872 and 1880. Its more remote origin is believed to be North Africa. Stavropol was for more than 50 years the most important variety grown in western Kansas and is among the high yielding varieties at the Hays station. Its average height is about 26 inches with a range of from 17 to 39 inches, depending on the season. It has required an average growing season of 84 days. The stiff-barbed awns do not break close to the kernel in threshing and so prevent the threshed grain from packing. This characteristic has often lowered its test weight considerably. Stavropol is susceptible to loose smut, and lodges rather freely in wet years when the straw growth is tall.

It ripens somewhat late and so may be injured by drought in June, although, over a period of years its yield has been satisfactory. Recently the acreage of Stavropol has declined greatly in favor of the smooth-awned, higher-yielding Flynn.

FRANKLIN MALT

Franklin Malt is a farmer's introduction which became established in the Colby-Goodland region about 1920 and by 1932 had gained dominance over Stavropol, only to disappear almost entirely from the Kansas farms after the long drought period from 1933 to 1940. Franklin Malt probably had its origin in Manchuria for it resembles the Oderbrucker-Odessa-Manchuria group of varieties which for many years has been grown in the upper Mississippi valley from introductions that came from Manchuria through either Germany or Russia.

The lateness of Franklin Malt has frequently caused it to ripen in late June when high temperatures prevail as a rule. Injury from drought has often reduced its yields 7 to 10 bushels under Flynn.

The average height of Franklin Malt is about 26 inches with a range from 18 to 33 inches. The heads are long with awns that break very readily close to the kernel thus giving the variety a heavy test weight. This variety shatters badly immediately on ripening. The popularity of the variety was due to its plump, bright grain and freedom from the troublesome awns but the relatively low yield during the years of drought was responsible for its greatly reduced acreage.

CLUB MARIOUT

Club Mariout was received in 1903 by the United States Department of Agriculture from the Mariout lake region along the Sahara desert south of Alexandria, Egypt, as a six-rowed, compact, short-headed variety. The variety was widely tested in the drier regions of the western half of the United States and was first tested in Kansas the year it was received into this country. A new source of purer seed was re-introduced into the state in 1921. The variety is now grown in eastern Colorado and on isolated farms in western Kansas.

The average height of the variety at Hays has been 24 inches. Club Mariout requires about the same number of days to mature as Stavropol, and over a long period of years has given slightly higher yield. Unfortunately when Club Mariout produces a heavy crop the heads are inclined to break off just below the base with considerable loss of yield. The recurved heads are sometimes severed by grasshoppers to a greater extent than other varieties. Club Mariout appears to be more susceptible to stripe disease than most other varieties, which may be the cause of the low palatability of the straw, sometimes reported by farmers in western Kansas.

FLYNN

Flynn is a six-rowed, smooth-awned, hybrid barley developed in the coöperative breeding experiments of the United States Department of Agriculture and the Minnesota Agricultural Experiment Station. The selection is a cross between Club Mariout and Lion which showed up well in experiments on the western stations. Flynn was introduced into Kansas in 1922 when it was tested at the Hays and Colby experiment stations. The initial introduction was not as pure for smooth awns as was desired.

In 1931, a new supply of Flynn seed known as Selection No. 1 was received from the Sherman Branch Experiment Station, Moro, Oregon. After careful study the new strain was found not to differ from the original seed, except for purity for smooth awns. The first certification and distribution of this variety was from the Hays station in 1933. The dry years which followed prevented rapid distribution of the seed, but by 1942 Flynn had become the leading spring barley in Kansas.

Flynn ripens from two to three days earlier than Stavropol and is greatly favored over the latter variety because of its smooth awns when the grain and straw are to be fed to livestock. The average height of the plants is 25 inches, with a range of 18 to 33 inches depending on the season. Flynn has averaged 4.4 bushels higher than Stavropol at Hays over a period of 20 years. Flynn has been tested with hundreds of selections in the nurseries at Hays but is only occasionally excelled in yield. It is somewhat susceptible to lodging but in many respects is an outstanding variety. Several new selections of Flynn more pure for smooth awns and with stiffer straw are under observation at the Hays station and may in time be substituted for the strain now on farms.

BEECHER

Beecher barley is a cross between Atlas and Vaughn received in Kansas in 1934 from Aberdeen, Idaho. Atlas is a selection from the California Coast, and Vaughn is a sister strain of Flynn which had earliness and stiffness of straw. Many selections of the above cross were grown at Akron, Colorado; North Platte, Nebraska; Colby and Hays, Kansas. The earliest selection of the group was named Beecher and was released from the Akron station and distributed in Colorado in 1940. It was recommended for distribution in Kansas from the Colby station in 1943.

Beecher is about three days earlier in maturity than Flynn and has a stiffer straw and is about one pound higher in test weight. Both varieties have about the same yielding ability. The superiority of Beecher over Flynn is its earlier maturity and stiffer straw and it should, therefore, be better adapted to combine methods of harvesting.

SPARTAN

Spartan is a two-rowed, smooth-awned barley from Michigan. It has found favor in Nebraska and along the northern tier of counties in Kansas because of its very high test weight and plump grain with freedom from awns when threshed. The straw is tall, stiff and erect. The yield of Spartan barley has been from 3 to 5 bushels lower than for Flynn.

VAUGHN

Vaughn like Flynn has Club Mariout and Lion as parents but is derived from another cross of these varieties. Vaughn differs from Flynn in being slightly earlier with a shorter and stiffer straw and in having slightly barbed awns. Vaughn was at one time considered for distribution as a suitable type to be harvested with a combine. Later testing showed that Beecher has a stiffer straw and had made somewhat higher yields. Beecher was, therefore, recommended over Vaughn for distribution on Kansas farms in 1943.

OTHER VARIETIES

Trebi, White Smyrna and strains of hull-less, hooded or awnless types of spring barley have either yielded less than the varieties that have been described above or have other objectionable characteristics which make them undesirable. Late-maturing varieties from the northern states have nearly always been too low in yield to be grown profitably in Kansas.

YIELDS OF SPRING BARLEY IN KANSAS

The yields of the more important varieties of spring barley grown on the experiment stations and fields and in cooperative tests in Kansas are shown in several tables which follow.

In Table 4 are presented the yields covering a period of from 5 to 20 years for a number of the better-known varieties of barley that have been or are currently grown at the Hays station. Flynn was the highest-yielding variety grown at Hays regardless of the years compared. Flynn has also been compared with many selections in the nursery and is rarely excelled by any in the yield,

The varieties shown in the insert in Table 4 were among the best known in the early years of the work at the Hays station. Coast and Stavropol yielded 30.4 and 29 bushels, respectively, for the 7-year period. This increase in yield is a good example of what can be accomplished by the introduction or development of new varieties. Meloy, a hooded barley, and Odessa or Hannchen, representing late-maturing, malting types, have yielded about 10 bushels below Flynn for the same years. The lateness of Franklin Malt and the fact that its yield has been 7.3 bushels below the earlier-maturing Flynn is another example of the need for earliness in the spring barley belt in Kansas.

The yields for the Colby, Garden City, and Tribune stations are shown in Table 5. Flynn is the highest-yielding variety at these stations in the long-time averages. For shorter periods of years Beecher yielded 5.1 bushels higher at Colby and averaged about the same as Flynn at the Tribune station.

The yields for the experiment fields located in southcentral and southwestern Kansas are shown in Table 6 for Stavropol, Flynn, Vaughn and Beecher. Flynn has outyielded Stavropol in nearly all comparisons, while Beecher in the experiments, for only one year compared favorably with Flynn in yield on the southcentral Kansas fields.

The yields in coöperative tests conducted on Kansas farms from 1929 to1942 are shown in Table 7. In 70 tests in the northern part of the barley region of Kansas from 1929 to 1941, and in 63 tests in the southern part of the region from 1930 to 1941, Flynn outyielded Stavropol 2.9 and 1.9 bushels, respectively. Beecher averaged from 1.6 to 1.2 bushels higher than Flynn in 19 and 10 tests, respectively, in the northern and southern sections of the state from 1941 to 1942, and well above Stavropol and Spartan.

TABLE 4.—*Grain yields of spring barley varieties, Hays, Kansas, Branch Agricultural Experiment Station, 1921-1942* [1]

VARIETY	C. I. No.	1930	1931	1932	1933	1934	1936	1937	1938	1939	1940	1941	1942	7-yr. av. 1921-1928	5-yr. av. 1938-1942	12-yr. av. 1930-1942	20-yr. av. 1921-1942
Flynn[2]	5911	30.6	24.1	30.7	7.3	1.6	33.9	23.4	50.3	15.9	28.5	57.4	25.3	34.0	35.5	27.4	30.8
Club Mariout	261	28.8	23.8	35.9	8.3	1.0	28.9	19.3	24.0	9.4	25.0	42.3	28.6	32.7	25.9	22.9	27.7
White Smyrna	195	35.0	26.9	39.0	6.2	1.0	28.4	30.2	32.6	11.2	23.2	44.3	18.4	32.8	25.9	24.7	28.9
Stavropol H. C. 249	5913	28.8	13.7	39.0	5.7	1.0	23.2	18.7	35.9	7.3	29.8	48.5	25.6	29.0	29.4	23.1	26.4
Vaughn	1367	29.2	24.1	31.3	5.7	1.6	33.6	20.3	49.5	15.1	24.7	51.3	29.8	.....	34.1	26.4	.....
Franklin Malt	5915	29.8	13.4	37.5	1.6	1.0	14.4	24.7	29.9	2.6	27.1	45.0	14.1	.....	23.7	20.1	.....
Spartan	5027	.....	.....	.....	.....	.....	27.4	21.1	38.0	5.0	25.0	45.8	11.9	.....	25.1	.....	.....
Beecher	6566	.....	.....	.....	.....	.....	.....	.....	45.3	20.3	21.1	47.8	27.2	.....	32.3	.....	.....

Yields of varieties grown from 1921-1929

						1921	1922	1924	1925	1926	1927	1928	1929				
Flynn	1311	.....	.....	.....	.....	49.0	42.8	36.7	8.1	31.8	21.9	47.5	49.0	34.0	.....	.....	.....
Club Mariout	261	.....	.....	.....	.....	45.2	42.6	38.3	6.3	35.1	19.0	42.5	50.0	32.7	.....	.....	.....
White Smyrna	195	.....	.....	.....	.....	36.2	45.6	36.4	7.3	32.8	18.5	53.1	52.1	32.8	.....	.....	.....
Stavropol (Ellis)[3]	2107	.....	.....	.....	.....	37.5	36.7	30.7	7.3	27.1	10.4	53.1	47.2	29.0	.....	.....	.....
Coast	690	.....	.....	.....	.....	46.8	40.6	34.1	4.4	30.5	15.4	40.8	.....	30.4	.....	.....	.....
Meloy	1176	.....	.....	.....	.....	27.3	36.0	28.1	5.8	27.9	13.3	30.5	.....	24.1	.....	.....	.....
Himalaya	620	.....	.....	.....	.....	23.0	35.4	28.4	2.1	22.7	10.5	22.2	.....	20.6	.....	.....	.....
Beldi Dwarf	190	.....	.....	.....	.....	33.8	41.8	34.4	6.5	26.6	7.6	49.4	.....	28.6	.....	.....	.....
Gatami	575	.....	.....	.....	.....	32.0	35.2	33.1	3.6	27.1	9.9	30.9	.....	24.5	.....	.....	.....
Odessa	182	.....	.....	.....	.....	28.5	34.9	25.0	2.4	25.5	14.6	41.8	.....	24.7	.....	.....	.....
Blackhull	878	.....	.....	.....	.....	43.7	44.0	32.1	8.9	29.7	22.1	34.9	.....	30.8	.....	.....	.....
Hannchen	531	.....	.....	.....	.....	32.4	34.9	19.0	4.7	29.1	13.3	34.0	.....	23.9	.....	.....	.....

1. Yields omitted for 1923 because of hail. No planting was made in 1935 because of spring drouth.
2. Flynn C. I. 5911 substituted for Flynn 1311 since 1932.
3. Stavropol C. I. 5913 was used in 1929.

TABLE 5.—*Grain yields of spring barley varieties at the Colby, Garden City, and Tribune Branch Agricultural Experiment Stations, 1932 to 1942*

VARIETY	C. I. No.	1932	1933	1934	1936	1937	1938	1939	1940	1941	1942	10-yr. av. 1932-1942[1]	7-yr. av. 1936-1942	3-yr. av. 1940-1942
Colby														
Flynn	5911	30.7	2.7	0.0	7.3	10.5	13.2	18.4	26.5	51.5	29.0	19.0	22.3	35.7
Vaughn	1367	23.9	2.3	0.0	13.3	8.6	10.9	16.4	19.4	51.2	32.5	17.9	21.8	34.4
Stavropol[2]	5913	21.5	0.0	0.0	2.9	8.5	18.0	11.5	13.0	50.7	31.2	15.7	19.4	31.6
Club Mariout	261	21.7	1.2	0.0	3.6	6.7	9.7	12.8	19.9	51.1	16.5	14.3	17.2	29.2
Franklin Malt	5915	24.1	0.0	0.0	0.0	.7	11.8	8.9	7.3	42.9	22.5	11.8	13.4	24.2
Spartan	5027	.....	.....	.....	4.3	6.9	8.0	15.4	13.7	50.3	29.4	.....	18.3	31.1
Beecher	6566	.....	.....	.....	.....	.....	.....	.....	23.6	66.6	32.2	.....	.....	40.8
												10-yr. av. 1932-1942	6-yr. av. 1937-1942	3-yr. av. 1940-1942
Garden City														
Flynn	5911	22.4	7.8	0.0	0.0	13.5	5.5	1.7	41.3	49.4	16.3	15.8	21.3	35.7
Vaughn	1367	17.1	8.3	0.0	0.0	14.9	5.9	1.8	37.9	48.1	11.4	14.5	20.0	32.5
Stavropol[2]	5913	22.6	4.8	0.0	0.0	14.2	1.0	1.2	38.0	57.5	9.4	14.9	20.2	35.0
Franklin Malt	5915	25.7	5.0	0.0	0.0	11.3	2.1	0.8	26.3	34.0	8.5	11.4	13.8	22.9
Club Mariout	261	20.9	.....	.....	.....	12.8	6.0	0.9	29.9	37.8	5.0	.....	15.4	24.2
Beecher	6566	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.8	.....	.....	.....
												9-yr. av. 1933-1942	2-yr. av. 1941-1942	
Tribune														
Flynn	5911	.....	0.0	14.5	0.0	0.0	17.1	4.3	3.8	58.9	28.5	14.1	43.7	.....
Vaughn	1367	.....	0.0	11.1	0.0	0.0	16.3	4.9	3.6	50.2	19.9	11.8	35.1	.....
Stavropol[2]	5913	.....	0.0	8.9	0.0	0.0	23.0	4.1	2.5	49.8	27.2	12.8	38.5	.....
Beecher	6566	.....	.....	.....	.....	.....	.....	.....	.....	67.1	22.4	.....	44.8	.....
Spartan	5027	.....	.....	.....	.....	.....	.....	.....	.....	38.6	17.3	.....	28.0	.....

1. Yields for 1935 omitted as crop was not planted at Colby and complete failure at other stations.
2. Different selections or sources of Stavropol were grown at the several stations.

TABLE 6.—*Grain yields of spring barley varieties on experiment fields in southcentral and southwestern Kansas, 1932-1942*

VARIETY	C. I. No.	1932	1934	1935	1936	1937	1938	1939	1940	1941	1942	4-yr. av. 1939-1942	Comparative yields for years grown		
													No. years	Variety named	Stavropol, same years
Southcentral Experiment Fields															
Kingman															
Stavropol[1]	5913	23.8	14.3	50.1	36.4	22.2	39.0	12.1	22.1	31.8	26.4	23.1	10	27.8	.....
Flynn	5911	.....	.....	.....	.....	22.3	28.3	13.2	26.0	28.9	29.3	24.4	6	24.7	25.6
Franklin Malt	5915	.....	15.1	52.5	36.5	23.6	40.8	9.8	27.7	.....	.....	.....	7	29.4	28.0
Beecher	6566	.....	.....	.....	.....	.....	.....	.....	.....	.....	29.6	.....	1	29.6	26.4
Wichita															
Stavropol	5913	15.7	28.2	30.7	33.1	25.4	39.5	11.4	50.8	40.8	40.4	35.9	10	31.6	.....
Flynn	5911	.....	.....	.....	.....	31.4	37.1	11.4	61.6	47.6	47.0	41.9	6	39.4	34.7
Franklin Malt	5915	.....	24.1	33.3	42.3	31.0	31.0	8.3	53.9	.....	.....	.....	7	32.0	31.3
Beecher	6566	.....	.....	.....	.....	.....	.....	.....	.....	.....	54.9	.....	1	54.9	40.4
Hutchinson															
Stavropol	5913	.....	.....	.....	.....	.....	.....	10.5	40.0	22.5	31.9	26.2	4	26.2	.....
Flynn	5911	.....	.....	.....	.....	.....	.....	14.7	57.8	30.5	33.0	34.0	4	34.0	26.2
Franklin Malt	5915	.....	.....	.....	.....	.....	.....	13.4	52.4	.....	.....	.....	2	32.9	25.3
Beecher	6566	.....	.....	.....	.....	.....	.....	.....	.....	.....	36.3	.....	1	36.3	31.9
Southwestern Experiment Fields															
Meade															
Stavropol	5913	.....	.....	.....	.....	.....	16.8	4.7	22.1	43.1	11.4	20.3	5	19.6	.....
Flynn	5911	.....	.....	.....	.....	.....	18.9	7.9	24.9	56.4	16.3	26.4	5	24.9	19.6
Vaughn	1367	.....	.....	.....	.....	.....	17.6	7.6	26.6	58.8	14.1	26.8	5	24.9	19.6
Dodge															
Stavropol	5913	.....	.....	.....	.....	.....	.....	11.3	40.2	48.0	23.1	30.7	4	30.7	.....
Flynn	5911	.....	.....	.....	.....	.....	.....	13.8	45.9	47.5	34.8	35.5	4	35.5	30.7
Vaughn	1367	.....	.....	.....	.....	.....	.....	12.8	49.2	45.7	29.4	34.3	4	34.3	30.7

1. Common 6-row.

TABLE 7.—*Yields and test weight of spring barley grown in coöperative tests in two sections of Kansas*

VARIETY	Northern Kansas[1]			Southern Kansas[1]		
	Bushels per acre		Test wt.	Bushels per acre		Test wt.
	70 tests 1929-'41	19 tests 1941-'42	19 tests 1941-'42	63 tests 1940-'41	10 tests 1942	10 tests 1942
Flynn	25.4	36.8	27.0	26.0	27.3	41.6
Beecher	.....	38.4	37.2	.....	28.5	42.1
Vaughn	24.5	.....	.....	25.0	.....	.....
Stavropol	22.5	32.9	35.8	24.1	22.7	42.1
Spartan	.....	31.5	41.8	.....	.....	.....

1. The areas north and south of the Smoky Hill River, respectively.

PRODUCTION OF WINTER BARLEY IN KANSAS

Winter barley is valuable for fall and early-winter pasture but in general is not a dependable grain crop in Kansas. The greatest handicap of fall-sown barley is the danger of winterkilling. Even the more hardy varieties of winter barley are more likely to winterkill than any of the varieties of winter wheat ordinarily grown in this state. Fall-sown barley does not often fully survive the winter in northcentral and northwestern Kansas. The chances are considerably better that it will survive in the southcentral and southeastern parts of the state, although losses from winterkilling frequently occur even in these sections.

The best results with winter barley may ordinarily be secured in eastern and central Kansas by sowing the crop between September 15 and 25, or even later at the rate of about 2 bushels to the acre. When there is a shortage of feed, it may be advisable to sow winter barley in late August or early September to obtain pasture as soon as possible. However, early seeding increases the danger of winterkilling. Observations indicate that winterkilling is less likely to occur if the seeding is delayed into October but less pasturage can be expected. If barley winterkills the land can be put in condition for a spring crop at little expense. The seedbed for winter barley should be prepared in the same manner as for winter wheat.

VARIETIES OF WINTER BARLEY IN KANSAS

Most of the winter barley in Kansas appears to be of the Tennessee winter type. The origin of Tennessee winter is uncertain but it probably came into Kansas from the southeastern states, having first arrived in the United States by way of Switzerland or the Balkan countries.

RENO

Reno is the principal variety of winter barley grown in Kansas. It is not a pedigreed strain, but comes from selected heads from the adapted strain known as "Southcentral" from the farm of J. A. Johnson of Hutchinson, Kansas. The selected heads were increased by Walter C. Peirce of Hutchinson, in cooperation with the experiment station. The first farm supply of seed was distributed by Mr. Peirce after approval for certification in 1939. Reno is a six-rowed, lax-headed, strong-awned variety, and is most winter hardy and the highest in yield of the winter types tested in Kansas. The plants tiller freely and lodge rather easily.

MISSOURI EARLY BEARDLESS

Missouri Early Beardless is an early-hooded, six-rowed winter barley distributed by the Missouri Agricultural Experiment Station in 1933 from an unnamed variety. It is earlier than Reno and the heads are more inclined to break. It is not as winter hardy as Reno and has yielded less in Kansas. Missouri Early Beardless is grown in the eastern part of Kansas and a few fields have been observed recently in southwestern Kansas.

OTHER VARIETIES

Kentucky No. 2 had its origin in Kentucky where it was well adapted and quite winter hardy. The selection has been low in yield in Kansas. A number of strains of Tennessee winter have been grown in Kansas for many years but more recently under the names of Southcentral, Eastcentral, Admire, Ward and others. In general, Reno which was first grown as Southcentral has been the highest yielding strain.

YIELDS OF WINTER BARLEY

Yields of winter barley have been obtained at the Manhattan, Hays, and Garden City stations, on the experiment fields and in cooperative tests over the state.

The experiment station yields are shown in Table 8 for Reno, Missouri Early Beardless and other winter varieties and are compared with Flynn spring barley, since these two types are grown in overlapping territory. At the three experiment stations, Reno has outyielded all other winter varieties, but in all instances Flynn spring barley has made a higher yield than Reno barley. This may be due partly to the fact that the three stations are in the border-line area where winter barley is more subject to winterkilling and where the crop does not have its best adaptation.

The yields as shown in Table 9 for the several locations on the southcentral and southeastern experiment fields are more indicative of the region where winter barley has better adaptation. At all points Reno or Ward winter barley was the best of this group. In

the three-year average Flynn barley was 4 and 12.3 ushels higher in yield than Reno winter barley at Kingman and Hutchinson.

At the Wichita experiment field the 6-year average yield of Reno barley is 5.1 bushels higher than that of Flynn spring barley. No spring barley was grown at the southeastern experiment fields, chinch bugs being one of the limiting factors. At these fields, Reno was the highest-yielding variety of the winter group.

In 24 cooperative, winter-barley tests on farms from 1940 to 1942, Reno gave an average yield of 43.7 bushels and Missouri Early Beardless 31.3. bushels. The test weight was 45.6 pounds for Reno and 42.9 pounds for Missouri Early Beardless.

TABLE 8.—*Comparative grain yields of winter barley with Flynn spring barley at Hays, Garden City, and Manhattan, Kansas, 1936-1942*

VARIETY	Annual acre yields							3-yr. av. 1940-1942	Comparative acre yields for years grown		
	1936	1937	1938	1939	1940	1941	1942		No. years	Variety named	Reno winter, same years
Hays											
Flynn spring barley	33.9	23.4	50.3	15.9	28.5	57.4	25.3	37.1	7	33.5	27.6
Reno winter barley[2]	33.8	8.3	31.2	7.3	19.3	47.9	45.3	37.5	7	27.6	.....
Walcher's winter barley	.....	.....	.....	.....	17.7	41.1	43.7	34.2	3	34.2	37.5
Hyatter winter barley	.....	.....	.....	.....	17.7	38.5	40.6	32.3	3	32.3	37.5
Michigan winter barley	.....	.....	.....	.....	20.3	45.8	34.1	33.4	3	33.4	37.5
Manhattan											
Flynn spring barley[1]	21.3	35.9	46.6	2.1	21.8	29.3	21.2	24.1	7	25.5	20.2
Reno winter barley[2]	48.4	21.1	00.0	5.4	29.3	24.3	13.0	22.0	7	20.2	20.2
Missouri Early Beardless	32.6	15.4	00.0	2.3	20.1	19.4	9.0	16.2	7	14.1	20.2
Garden City											
Flynn spring barley	.....	.....	.....	1.7	41.3	49.4	16.3	35.7	4	27.2	13.4
Reno winter barley[2]	.....	.....	.....	2.2	17.0	30.0	4.3	17.1	4	13.4	.....

1. Flynn grown from 1936 to 1939. Stavropol for rest of period.
2. Southcentral strain was grown from 1936 to 1939 and renamed Reno in 1940.

TABLE 9.—*Comparative grain yields of winter and spring barley from southcentral and southeastern experiment fields, 1935-1942*

VARIETY	Annual acre yields								3-yr. av. 1940-1942	Comparative yields for years grown		
	1935	1936	1937	1938	1939	1940	1941	1942		No. years	Variety named	Reno Winter, same years
Southcentral Experimental Fields												
Wichita Field												
Reno winter barley[1]	20.7	15.3	34.5	38.8	42.5	80.9	40.4	30.1	50.5	8	37.9	.....
Missouri Early Beardless winter	.....	14.7	.....	37.5	15.5	73.3	34.8	23.5	43.9	6	33.2	41.3
Ward winter barley	.....	.....	.....	.....	.....	84.6	46.2	24.7	51.8	3	51.8	50.5
Flynn spring barley	.....	.....	31.4	37.1	11.4	61.6	47.6	47.0	52.1	6	39.4	44.5
Kingman Field												
Reno winter barley[1]	19.4	23.3	19.1	47.0	0	17.3	42.1	12.8	24.1	8	22.6	.....
Missouri Early Beardless winter	.....	14.3	12.1	42.0	0	16.5	30.1	6.2	17.6	7	17.3	23.1
Ward winter barley	.....	.....	.....	.....	.....	23.1	43.4	10.7	25.7	3	25.7	24.1
Flynn spring barley	.....	.....	22.3	28.3	13.2	26.0	28.9	29.3	28.1	6	24.7	23.1
Hutchinson Field												
Reno winter barley[1]	.....	.....	.....	.....	.....	41.3	27.2	15.7	28.1	3	28.1	.....
Missouri Early Beardless winter	.....	.....	.....	.....	.....	28.9	.....	14.4	.....	2	21.7	34.7
Flynn spring barley	.....	.....	.....	.....	.....	57.8	30.5	33.0	40.4	3	40.4	28.1
Southeastern Experimental Fields												
Columbus Field												
Reno winter barley[1]	.....	20.5	38.1	64.4	34.8	32.2	38.5	15.0	28.6	7	34.0	.....
Missouri Early Beardless winter	.....	15.1	30.7	30.7	18.9	14.3	21.3	17.3	17.6	7	21.2	34.8
Southeastern Kansas winter barley	.....	15.4	43.7	61.4	31.7	32.0	.....	.....	.....	5	36.8	38.0
Kentucky No. 2 winter barley	.....	18.2	39.8	57.5	28.1	.....	.....	.....	.....	4	35.9	39.5
Ward winter barley	.....	.....	.....	.....	.....	32.9	33.7	15.6	27.4	.....	.....	.....
Thayer Field												
Reno winter barley	.....	.....	.....	.....	21.6	22.2	44.1	15.0	27.1	4	25.7	.....
Missouri Early Beardless winter	.....	.....	.....	.....	20.7	14.1	27.0	13.0	18.0	4	18.7	25.7
Ward winter barley	.....	.....	.....	.....	.....	10.4	41.4	15.5	22.4	3	22.4	27.1

1. Reno barley up to 1939 was grown under the name of Kansas Southcentral strain. It was certified for distribution in 1940.

COMPARATIVE YIELDS OF SPRING BARLEY AND OTHER SMALL GRAINS

In years when conditions are unfavorable in Kansas, there is an increased interest in planting other small grains to supplement an impending short crop of winter wheat. The question is also often raised as to comparative yields of oats and barley in the region where barley is adapted in Kansas. The acre yields in pounds are shown for winter and spring wheat, oats and spring barley in Table 10.

TABLE 10.—*Comparative yields in pounds of grain per acre of winter wheat, spring wheat, spring oats and spring barley*

LOCATION	Years compared	Pounds of grain per acre			
		Winter wheat	Spring wheat	Spring oats	Spring barley
Manhattan	20	1,962	450	1,581	1,070
Hays	18	1,434	528	1,174	1,426
Colby, After crop	23	528	336	518	830
Colby, After fallow	23	1,002	534	851	1,411
Garden City, After crop	11	366	228	349	365
Garden City, After fallow	11	420	372	547	638
Tribune, After crop	14	414	222	339	370
Tribune, After fallow	7	1,104	552	1,123	1,142
Tribune, After crop	7	588	269	470	430

At Manhattan the yield of oats has been about one-third more than for spring barley and one-fifth less at Hays. The yield of barley has been equal to that of winter wheat at Hays, but at Manhattan the ratio of wheat to spring barley is almost 2 to 1.

At Colby where spring barley is well adapted, it has produced about 45 percent more pounds per acre than winter wheat and 60 percent more than oats.

At Garden City barley has yielded more than oats or winter wheat on fallowed land. The yields of the three crops have been about equal on cropped land.

Barley, oats and winter wheat have yielded about the same at the Tribune station, but in most of the experiments winter wheat had an advantage over the other two.

Spring wheat has been decidedly lower in all regions in Kansas compared with winter wheat, oats or barley.

RECOMMENDED BARLEY VARIETIES FOR KANSAS

Flynn and Beecher are the recommended varieties for the spring, barley-producing belt of northwestern Kansas. Flynn barley has good adaptation in central and southcentral Kansas, if chinch bugs are not a factor. Flynn will probably make somewhat higher

yields over a period of years, but Beecher is about three days earlier, has a stiffer straw and, therefore, is somewhat better adapted to combine harvesting. Spartan is grown to a limited extent in the northern tier of counties in Kansas because of its high test weight and freedom from awns when threshed, although the yield per acre is considerably lower than that of either Flynn or Beecher.

Reno winter barley is recommended in central, southcentral and southeastern Kansas.

INSECT ENEMIES OF BARLEY

The chinch bug is the most important insect pest of barley, and often the crop fails in eastern Kansas because of the prevalence of this insect. Barley is much more susceptible to drought injury when infested with chinch bugs. Therefore, the combined effect of chinch bugs with only moderate drought frequently results in low yields of barley or a total failure of the crop. Chinch bug infestations are much higher on barley than on other small grains. Infestation of corn or sorghum is more likely to occur if adjacent to barley, than near oats or wheat.

Grasshoppers may cause considerable trouble in the northwestern part of the state by cutting off the heads of barley. Varieties with drooping heads are more likely to be injured than erect-headed varieties.

DISEASES OF BARLEY [5]

The major diseases of barley in Kansas are loose smut, covered smut, stripe, and mildew. Minor diseases of this crop in the state are black loose smut, scab, ergot, stem rust, leaf rust, spot blotch, bacterial blight, different root rots and seedling blights. Only the major diseases will be discussed.

BROWN LOOSE SMUT

Brown loose smut is an important disease of barley in Kansas. Many fields have from 1 to 4 percent, and occasionally fields are found that contain 10 to 50 percent of smutted heads. Very high percentages of loose smut are especially common in winter barley in southcentral Kansas.

Loose smut is first apparent as the heads emerge from the "boot." Instead of normal heads, usually all the glumes (chaff), as well as the kernels, are transformed by the smut fungus into a loose, dusty, brownish-black mass of spores. Within a few days these masses are either blown or washed away by the rain, leaving only the naked central stems of the heads.

Some of the spores are carried to neighboring healthy plants which are in bloom at this time. If the spores alight within a blossom they germinate, penetrate the ovary, and infect the developing seed. The fungus then gradually goes into a resting stage and remains

5. This section prepared by L. E. Melchers, Plant Pathologist, and E. D. Hansing, Assistant Plant Pathologist, Department of Botany, Kansas Agricultural Experiment Station.

dormant inside the seed. Although the developing seed is infected internally with the fungus, it continues to grow into an apparently-normal kernel. If this seed is later planted without special treatment, the fungus will become active again and grow internally from the embryo of the seed into the developing seedling. As the seedling develops into a plant, the fungus infects the young head, transforming the tissues into a mass of smut spores. It is this stage which is seen in a barley field when plants begin to head.

This smut cannot be controlled by external application of chemicals to the seed. It may be effectively controlled by the modified hot-water seed treatment. This treatment, however, is complicated and is not recommended as a general practice because of this fact and the danger of reducing the germination and vitality of the seed. For detailed information on the modified hot-water, seed treatment and the use of a clean seed plot see Kansas Agricultural Experiment Station Bulletin 279, "Smuts of Cereal and Forage Crops in Kansas and Their Control."

The most practical way of avoiding excessive loss from loose smut is to purchase certified seed. A field is not certified if it has over 1 percent of loose smut. New seed should be purchased as often as seems necessary, depending on how fast the loose smut increases on a particular farm.

COVERED SMUT OF BARLEY

Covered smut of barley is common in Kansas. From 1 to 5 percent infection frequently occurs in spring barley. This disease is especially prevalent and destructive in winter barley in southcentral Kansas.

It is first apparent when the heads emerge from the "boots." Sometimes smutted heads do not fully emerge and therefore the diseased plants are not as tall as normal plants. Covered smut differs in appearance from loose smut in that a grayish membrane covers the smut mass of the former. (Fig. 9, left.) This is rather thin and transparent and the greenish-black spore mass may be seen within. Unless this membrane is broken, the spores are not scattered about by the wind or rain. Their dissemination usually does not occur until threshing, when the masses break up and the spores adhere to the external portion of the seed. (Fig. 9, right.) The smut spores also may be disseminated by contaminated machinery, sacks, or bins.

The life cycle of this smut differs from loose smut of barley. If smutted seed is planted, the adhering smut spores germinate simultaneously with the sprouting seed. The fungus penetrates the tissues of the seedling and then keeps pace with its growth until heading time, producing masses of hard smut in place of kernels.

Covered smut may be easily controlled by treating the seed with New Improved Ceresan at the rate of one-half ounce of the chemical dust for each bushel of seed. A dust-treating machine should be used in order to mix thoroughly the seed with the chemical. If a

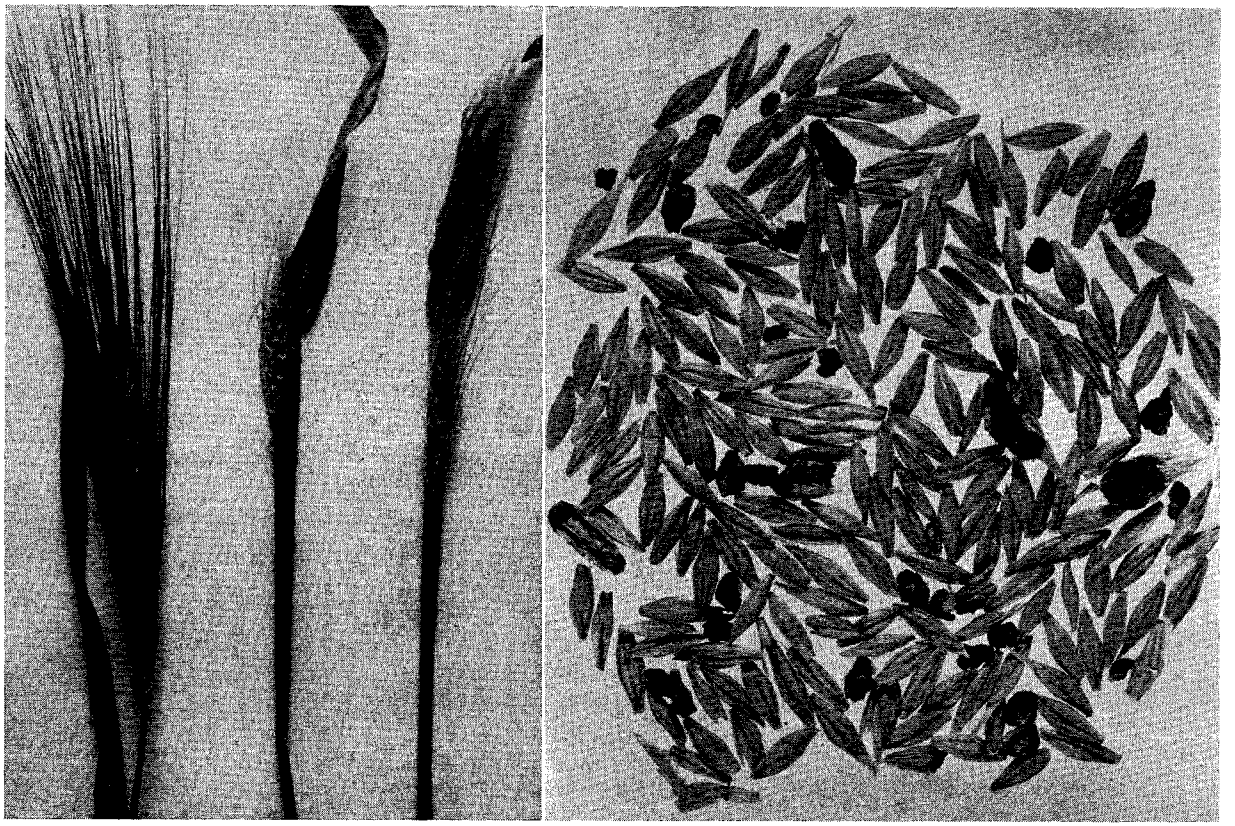

FIG. 9.—Covered smut of barley. (Heads) Left, normal head. Right, two smutted heads. The beards are not destroyed and the smut masses are held together by a membrane. (Threshed grain) A sample of smutted barley. Covered smut of barley breaks up in lumps.

treating machine is not available the dust may be applied to the seed fairly well by means of the shovel method. A bushel of seed is spread upon a clean grain-tight floor, and *one-half ounce of the dust* is scattered over it. As additional bushels of seed are added to the pile, each has scattered over it one-half ounce of the dust. The pile is then shoveled and reshoveled several times until the chemical dust in the grain is evenly distributed. The grain is then left either in an uncovered pile or, preferably, in sacks for at least 24 hours before being sown. Excessive applications may injure the seed. Because of its nauseating effect, care should be taken that the operator does not inhale the dust. It is best to use a dust mask or place a dry cloth (never wet) over the mouth and nose. Wash hands and face with soap and water after treating seed. Treated seed should not be fed to poultry or livestock because of poisonous qualities.

STRIPE

Stripe is another destructive, seed-borne disease of barley. When the plants are approximately 6 inches tall, elongate yellowish stripes occur on the leaves and stems. Later these enlarge, often run together and then turn brown. The heads may or may not emerge from the "boot." Those which do are often discolored and shrunken. By harvest time severely-infected plants usually have collapsed entirely and it is often difficult to find them.

Fungus spores develop on the surface of the plants where the stripes occur and are disseminated by the wind and infect healthy heads.

Stripe disease may be controlled by treating the seed with New Improved Ceresan following the same methods and precautions described for covered smut.

POWDERY MILDEW

In Kansas powdery mildew is the most serious disease of barley which is not seed-transmitted. It is especially common and destructive to barley in seasons when excess rain occurs in May and June. This was especially true in 1942 when there was above-normal rainfall in May and very heavy rainfall in June. In that year the disease caused considerable injury to barley in all parts of the state, but especially in the eastern section.

The first symptom of the disease is the appearance of small grayish or white, feltlike patches on the leaves and leaf sheaths. These rapidly enlarge, coalesce, and may cover the entire leaf and leaf sheath with a powdery coat.

There is nothing practical that can be recommended to control powdery mildew of barley. Some day a resistant variety may be developed that will be suitable for Kansas.

SUMMARY

Kansas ranks tenth among the states in the production of barley. Barley is sixth in importance among the crops of the state. Fifty-five percent of the acreage of barley in Kansas for the period 1931 to 1940 was grown in the northwestern part of the state in the rectangle cornered by the counties of Cheyenne, Norton, Ness and Greeley. Barley is an excellent grain feed for all classes of livestock when crushed or coarsely ground, and is well suited for mixing with other concentrates. In the more humid regions of Kansas winter barley is an important source of fall and winter pasture.

Barley requires a firm seedbed with an abundance of available moisture in the upper subsoil. Barley is not well adapted to sandy soil, nor to land where the drainage is poor. Good rotations in which spring barley is included are sorghum, barley and wheat, or sorghum, barley, fallow and wheat.

The best rate of seeding spring barley is from 5 to 7 pecks per acre, depending upon the locality. The best time to seed spring barley is usually between March 15 and April 1, depending again on locality.

Flynn and Beecher are the recommended varieties of spring barley for Kansas. Spartan is acceptable in the northern tiers of counties but is low in yield. Reno is the best variety in the winter-barley belt of Kansas.

The cheapest way to harvest barley is with the combine. The quality is generally somewhat better when the grain is harvested with the swather-pickup although this method is a little more expensive than the former. Harvesting with a binder, followed by careful shocking and early threshing, should produce the highest quality grain. Harvesting the crop with a header may result in considerable spoilage. Barley that is suitable for malting is produced only with extra care in harvesting and threshing to keep the grain free of mechanical injury and discoloration. The climate of Kansas is not well suited for the production of the highest quality of malting barley. Most of the Kansas barley crop can best be used as feed on the farms where grown or sold for feed.

Diseases most prevalent in barley in Kansas are loose smut, covered smut, and stripe disease. Control methods are described in this publication. Additional information on the control of these diseases can be obtained from the county agricultural agent.