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BARLEY PRODUCTION IN KANSAS

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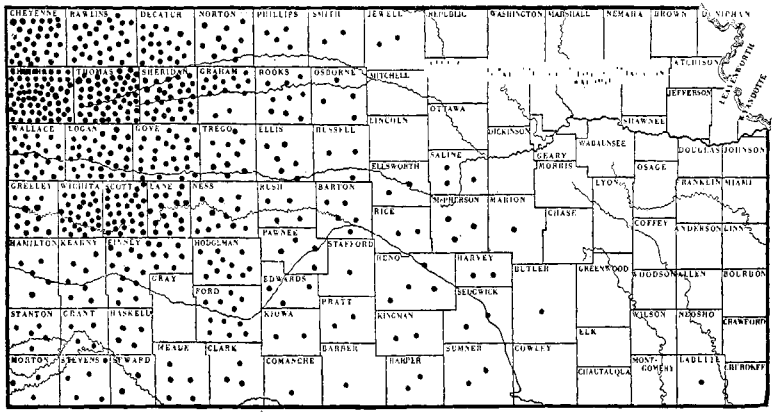
Ten year average acreage of barley, 1925-1934.



Ten year average acreage of oats, 1925-1934.

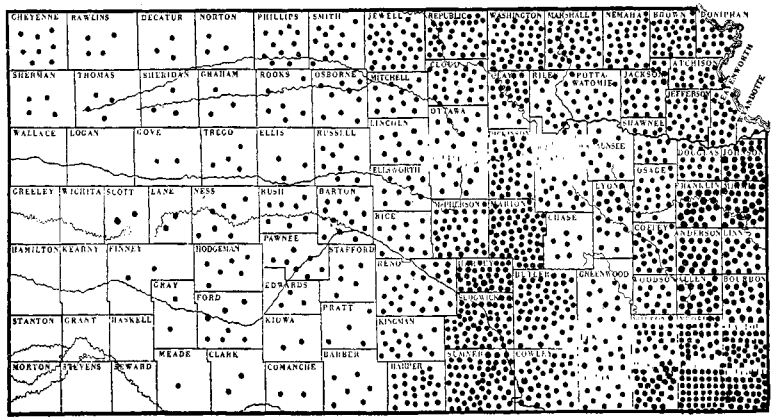


Fig. 1. Comparative acreage of barley and oats in Kansas, ten year average. Each dot represents 1,000 acres.

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, sorghum, alfalfa, and oats. Seventy-five percent of the acreage of barley for the period of 1925 to 1934 was grown in the northwestern part of the state in the rectangle cornered by the counties of Cheyenne, Smith, Barton, and Greeley, inclusive. In south central and central Kansas, where only a limited acreage is grown, winter barley is grown more generally than spring barley since it is used for fall and winter pasture. Very little barley is grown east of a line from Republic to Summer county, the limiting factor being chinch bugs. Oats are grown rather than barley in eastern Kansas. The comparative acreage of barley and oats grown in Kansas is shown in figure 1.

Barley production fluctuates greatly from year to year because most of the crop is grown in the drier sections of the state where soil moisture may not be sufficient in the spring to encourage seeding or to produce a successful crop. When conditions are favorable for wheat, the acreage of barley is greatly reduced in favor of the former. An increased acreage of barley is sown when wheat is abandoned, provided soil moisture is available in late winter or spring after the wheat has been abandoned.

The acreage of barley in Kansas has varied from 137,000 acres to a little over 1,000,000 acres per year since 1900. The annual production for the same period has varied from about 2 million to 20 million bushels. For the 10 years previous 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 much greater acreage of barley in the western half of Kansas is warranted as a source of cheap 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 a better understanding of improved varieties without the objectionable barbed awns, should do much to stimulate increased produetion.

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1. Contribution No. 279 from the Department of Agronomy and No. 25 from the Fort Hays Branch Agricultural Experiment Station, in cooperation with the Division of Cereal Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture.

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

UTILIZATION OF THE CROP

Barley is used chiefly in the feeding of livestock, and in the manufacture of malt and distilled liquors. The many other uses for barley require only a small quantity of grain. In the more humid regions winter barley is important as a source of pasture in fall and winter. In regions where corn cannot be produced regularly, barley grain, when processed and fed intelligently, is highly regarded as feed for swine, dairy and beef herds. Its value has not been fully recognized and appreciated where corn is grown extensively.

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. It is hardier and will grow at higher altitudes than any other cereal crop. It matures more quickly 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 demands a well drained, porous soil but does not thrive in sandy soil. The barley plant is a shallow feeder, because its roots are comparatively weak and do not penetrate the soil so easily as those of wheat.

BARLEY IN ROTATION

Common practice in the northern tier of counties in Kansas is to alternate the major crops, wheat and corn. On the less productive land forage crops are commonly grown. Farther south where corn is not so well adapted, sorghums are extensively grown although wheat is the dominant crop, especially on the hard level lands.

Spring barley is well adapted to a rotation of wheat, sorghum or corn, and barley. Spring barley may well replace some of the corn on the more rolling lands in north central and northwestern Kansas as a means of reducing soil erosion losses. Frequently after sorghum the surface soil is too dry in the fall to make a good seedbed for wheat. In such fields moisture in the surface soil is sometimes supplied by winter and spring precipitation which makes it possible to plant spring barley. After the barley crop has been harvested, the land can be properly prepared for wheat. Another practical rotation in the spring barley belt of Kansas is sorghum, barley, fallow and wheat.

GROWING BARLEY IN KANSAS

An ideal seedbed for barley is one that is firm but not too hard for easy penetration of water and roots. Spring barley

does not root so deeply as a fall sown crop such as winter wheat and therefore cannot use deep soil moisture so efficiently. However, it needs an abundance of stored moisture within easy reach.

The surface of the seedbed should be level with two or three inches of loose soil so that the seed can be covered thoroughly. The use of press wheels on the drill will usually 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. The late plants may be harvested before the seed is fully matured, resulting in shrivelled grain. Such grain cannot be used to advantage for malting purposes or for seed. Also, slow and irregular germination usually will 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. 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

Probably the best seedbed for spring barley can be prepared in corn or sorghum land where soil moisture is available to a

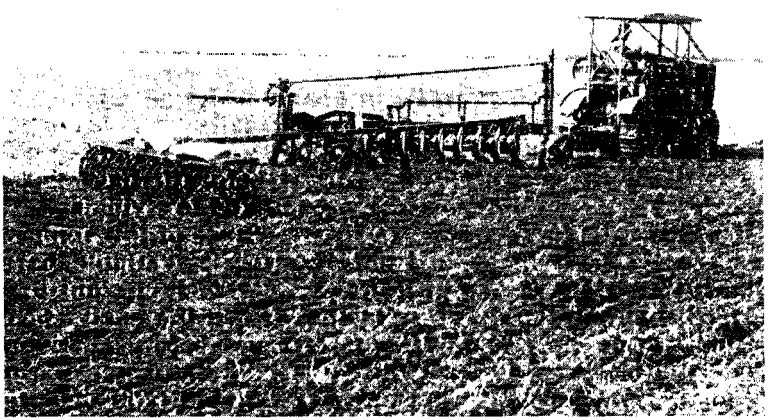

Fig. 2. A light cultivation in the spring with a one-way plow followed with a packer often makes a good seedbed for barley.

depth of several feet. If such a seedbed is given a light cultivation with a one-way plow to level the ground, followed by a packer, conditions should be ideal for quick emergence of bar-

ley. Land which has been well prepared for wheat but is held over until spring will also make a good seedbed.

Yields are usually lower on spring-plowed land than on land plowed or listed in the fall. Land plowed in the spring is generally too loose for a good seedbed for barley.

At the Hays station, the yield of barley has been 30 percent higher when grown on fallowed land than on fall-plowed land. Even so, it is probably not advisable to summer-fallow land for barley because wheat makes better use of the moisture stored after fallow. Fallowed land left over winter for spring barley would also be subject to soil blowing. Yields of barley for different methods of seedbed preparation are shown in Table 1 as determined by A. L. Hallsted, Division of Dry Land Agriculture, Hays, Kansas.

TABLE I.—YIELDS OF SPRING BARLEY FOLLOWING DIFFERENT METHODS OF SEEDBED PREPARATION, 1908-1937. FORT HAYS EXPERIMENT STATION.

Preparation of land	Average acre yield, bushels
Plowed in spring	14.2
Plowed in fall	18.5
Plowed in fall and subsoiled	18.5
Listed in fall	15.6
Summer fallowed	26.8

It is not profitable to seed spring barley on land in which there is no 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 shrivelled grain and low yields.

If wheat fails to survive the winter because of low temperatures or soil blowing when subsoil moisture is available, barley ordinarily can be grown successfully under such circumstances, provided that surface moisture is supplied in the early spring. 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.

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 im-

portance. 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 of 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 of 10 degrees F. for short durations of time without loss of stand.

TABLE II.—BARLEY YIELDS FROM DIFFERENT DATES OF SEEDING. FORT HAYS EXPERIMENT STATION.

Date of seeding	1922	1924	1925	1926	1927	1928	6 yr. ave. 1922-1928*b*	5 yr. ave. 1924-1928	4 yr. ave. 1925-1928
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*a*	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

a March 1 yield substituted as storm prevented seeding on March 15.
b 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 after April 15 because the crop then ripens about the last of June when high temperatures generally prevail. Barley has been seeded at Hays February 15 with better success than when seeded April 15. However, there is always some danger when seeded at this early date that the crop may be injured by a late March freeze. In the vicinity of Colby in northwestern Kansas the best seeding date is about April 1. This is because of the higher altitude in that section.

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 of the state, 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 and if equipped with press wheels will press the soil closely around the seed, making conditions favorable for quick, uniform germination. The seed should be covered from two to three inches.

HARVESTING AND THRESHING

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

Most of the barley in Kansas probably is harvested with the combine harvester-thresher. Although this is likely the cheapest method, it has the disadvantage that the crop must stand 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.

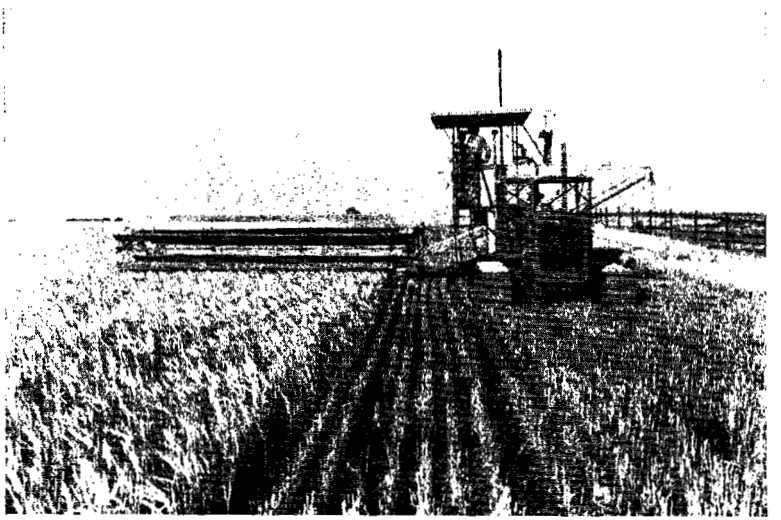

Fig. 3. Harvesting Flynn barley with the combine harvester-thresher. Fort Hays Experiment Station.

A second and somewhat more expensive method of harvesting is with the swather-pickup attachment on the combine. 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 combine platform. A few days of dry weather will remove most of the natural moisture from the crop. Under favorable conditions the pickup and combine are used three or four days after swathing. The result is a high quality grain, particularly if the weather has been hot and dry during that time. A light shower while the grain is in the swath probably will not discolor it, but a heavy rain or wind may result in considerable damage and loss.

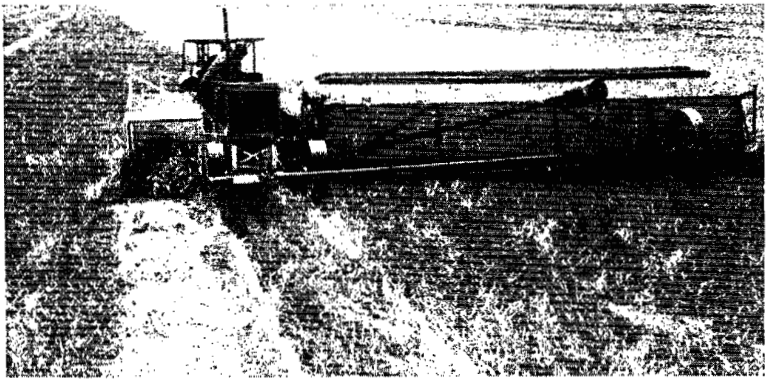

Fig. 4. Harvesting barley with swather-pickup attachment on combine. Fort Hays Experiment Station.

The older and more expensive method of harvesting the crop with a binder, and shocking it, 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 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. With this method the greatest danger is possible spoilage from heating, especially if the season is rainy. Headed barley will not keep as well in stacks as will 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 remains visible for some time. At this stage the milky juices

have disappeared from the kernel and the hulls will have begun to wrinkle due to shrinkage of the kernel underneath. The ripening process after this time is principally loss of moisture. At this stage the yield will not be greatly affected by harvesting practice. The problem remains of harvesting the crop in a manner to avoid losses from lodging, shattering and heating.

PRODUCTION OF MALTING BARLEY

Barley suitable for malting purposes commands a premium over prices paid for feed barley. The production of good malting barley requires favorable weather and extra care in harvesting and threshing the crop. Weather conditions in the barley belt in northwestern Kansas are not always suitable for the production of good malting barley.

The maltsters' requirements for a high grade malting barley are that it 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, particularly scab.

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. Broken grain and skinned kernels are likely to mould. Skinned kernels are the result of too high cylinder speed while threshing or concave teeth set up too close to the cylinder. 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.

Considering the high requirements of malting barley, it is apparent that not all of the Kansas crop can qualify for that market. The greatest outlet for Kansas barley will be for feed either to be used on the farm, or to be sold on the market.

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. By carefully observing the above characteristics the two types of kernels can be distinguished as threshed grain.

Classes of barley may be awned, awnless or hooded. The

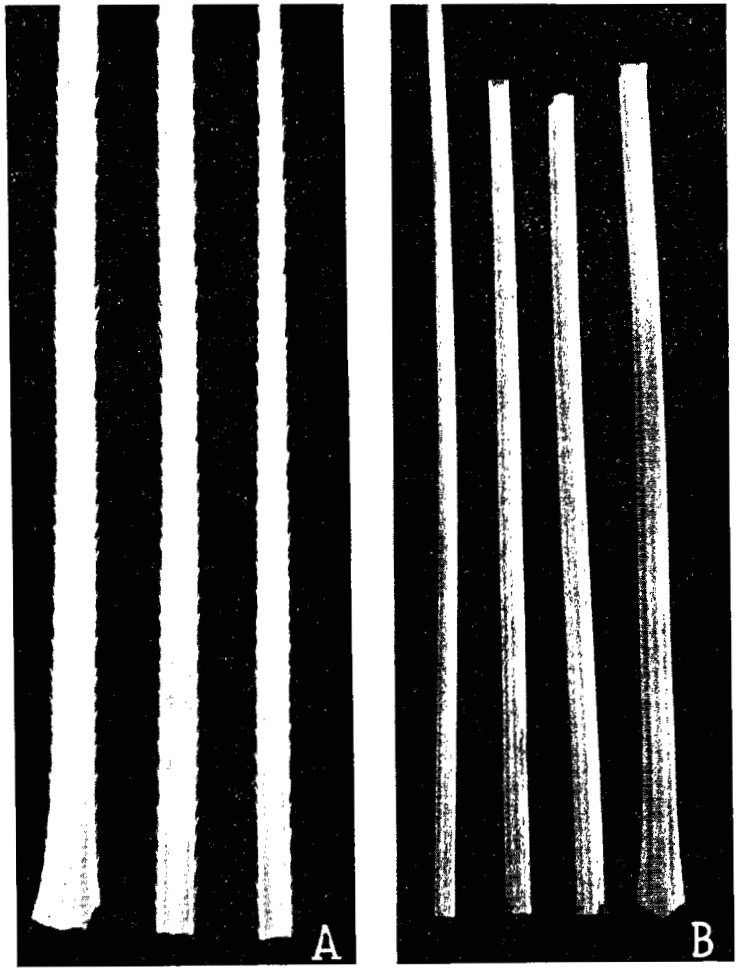

Fig. 5. A: view showing awns with sharp barbs, found on such varieties as Stavropol; B: view showing awns without barbs as found on Flynn barley. Photographs supplied through the courtesy of the Colorado Agricultural Experiment Station.

awns of barley may have sharp barbs which point away from the base of the head. These barbs are larger and more severe at the base of the awn and gradually become less prominent at

the tip. In some varieties the awns are smooth; that is, without barbs throughout their entire length. In others, slight roughness may be noted indicating a remnant of the barbs. Barbs on the awns of barley can be felt by stroking the awns downward between the thumb and forefinger. Barley with a strong awn that does not break off close to the kernel is objectionable because, when fed unground to livestock, remnants of the barbed awns may cause festering sores in the mouths and digestive tracts of the animals. In the hooded varieties, three short-lobed appendages take the place of the awn at the upper end of the kernel. Most varieties of barley when threshed retain the hull; a few varieties, however, are hull-less.

Barley with barbed awns has been the type most frequently grown in Kansas. It yields much higher than the hooded type. Recently high-yielding varieties with smooth awns hare been developed for Kansas farmers. No varieties of hull-less or hooded barley have been found to be well adapted in the state.

The term "hog" or "feed" barley is commonly used in Kansas for barley with strong awns which may not break close to the seed when threshed. In the so-called "malt" barley the awns usually break off short. "Feed" barley is generally used for feed. It may or may not be of the variety and quality desired by maltsters. The term "feed" is used industrially for any barley not suited for malting purposes. Varieties classed as "hog" or "feed" barley may have malting value if the season is favorable and great care has been taken to produce a satisfactory quality of grain. "Malt" barley is also used for feed. Farmers like "malt" barley because it threshes cleaner, has a high test weight, and the awns cause no trouble in feeding. Objections to the "malt" barley grown in Kansas are that it tends to ripen later, to shatter more easily, and to yield less than the better varieties of the feed type.

VARIETIES OF BARLEY RECOMMENDED OR OF PROMISE

Since 1924 approximately 3,000 strains and selections of barley from various parts of the United States and other countries of the world have been grown in nursery rows or plots on the experiment stations at Hays and Colby. Some of the varieties have been tested by the experiment stations at Manhattan, Garden City and Tribune and in cooperative tests with farmers.

The following brief description is given of varieties which are now or have been extensively grown in Kansas and of a few new varieties which appear to be promising.

STAVROPOL

The oldest and most prominent variety grown in Kansas is Stavropol. It is sometimes referred to as "Kansas Common Six-Rowed." Also because of its long, stiff-barbed awns it is one of the varieties farmers frequently refer to as "hog" or "feed"

barley. While it is not definitely known, it is believed that several small lots of Stavropol were brought into Kansas from southern Russia in the early '80's by the German-Russian immigrants. The more remote origin of Stavropol is believed to be northern Africa. The variety is widely distributed over western Kansas and it has been observed growing in eastern Colorado and southwestern Nebraska.

Stavropol has been among the highest in yield at the Hays station. Its average height has been 24 inches with a range of

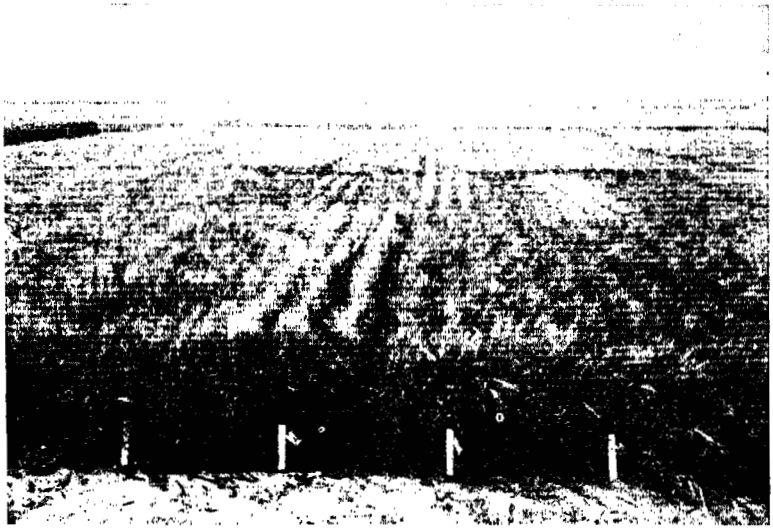

Fig. 6. Barley testing nursery at Hays, Kansas.

from 14 to 39 inches, depending on the season. It has required an average growing season of 34 days. The stiff-barbed awns, which do not break close to the kernel in threshing, prevent the threshed grain from packing. This lowers its test weight. The seed may not feed through the drill readily unless it is first agitated and rolled to break the awns.

Stavropol is highly susceptible to loose smut. It ripens somewhat late and so may be injured by drought in June; however, over a period of years its yield has been satisfactory.

COAST

Coast is similar to Stavropol and for many years has been an important variety in the western half of the United States. Coast is also known as Bay Brewing, Common, California Feed, and Blue. It is still an important variety in California. It is said to be of North African origin. At Hays the variety has differed from Stavropol in having a plant of bluish-green tinge.

In early experimental work at Hays the variety yielded about two bushels less than Stavropol. So far as is known, there is no appreciable acreage of Coast in Kansas now.

"MALT" BARLEY

"Malt" barley as known to Kansas farmers is not a pure strain or variety but rather a type, widely grown throughout the barley belt of Kansas but found particularly in the Colby-Goodland territory. Previous to the dry seasons, 1933-1936, this type because of its freedom from barbed awns, appeared to be replacing Stavropol which had been grown extensively in the region since 1900.

"Malt" barley probably belongs to the Oderbrucker-Manchuria group commonly grown in Wisconsin and Minnesota, and to the Odessa group grown in the Dakotas. Its immediate origin is believed to be Manchuria, but importations into this country were through Russia and Germany. At Hays, "malt" barley has required an average of 83 days to mature. The time from heading to ripening has been two to four days shorter than for Flynn or Stravopol, probably due to high temperatures in June which cause it to dry up rather than to ripen normally. This injury has tended to reduce its yield from three to five bushels.

The average height of "Malt" at Hays is 28 inches with a range of from 18 to 42 inches. The heads are long with awns which very readily break close to the grain. Unfortunately, the grain shatters easily. To prevent shattering loss, "Malt" must be harvested soon after it has turned a golden color. The popularity of the variety has been due to the plump, bright grain and its freedom from troublesome awns in the threshed grain. "Malt" barley produced under good growing conditions in western Kansas, if carefully harvested, threshed, and stored, would probably meet the maltsters' requirements better than other varieties now grown in the state.

"Franklin" and "Wingfield" are two strains of the "malt" barley grown on farms near Colby which have been tested at the several stations in Kansas as representative of the group.

FLYNN

Flynn is a six-rowed smooth-awned hybrid barley developed in the cooperative breeding experiments of the United States Department of Agriculture and the Minnesota Agricultural Experiment Station. It is a cross between Club Mariout and Lion. It was tested in the nurseries at the Hays and Colby experiment stations where it was observed to be impure for smooth awns, a character which was expressly sought along with high yield.

In 1931 a new supply of Flynn seed known as Selection No 1 was received from D. E. Stephens, Sherman Branch Experiment Station, Moro, Oregon, where the variety also was tested. After

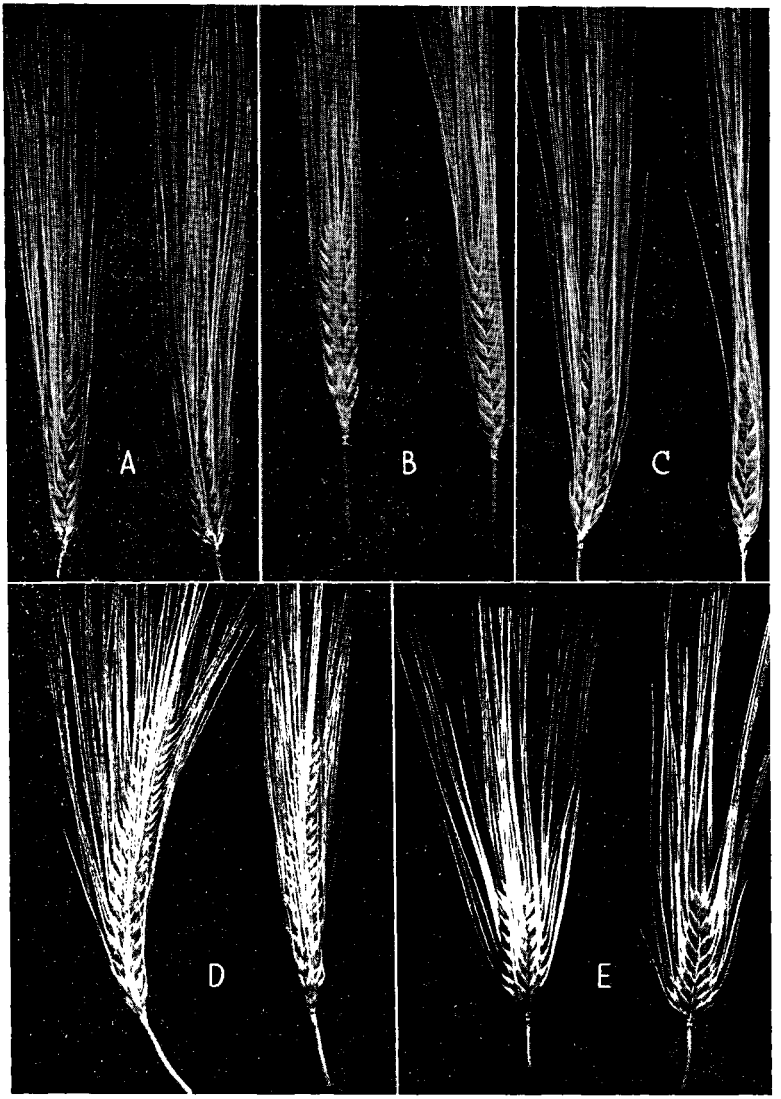

Fig. 7. Typical side and front views of heads of barley: (a) Stavropol (b) Coast (c) Flynn (d) Manchurian type, similar to "Malt" as grown in Kansas (e) Club Mariout. Illustrations supplied through the courtesy of Division of Cereal Crops and Diseases, Bureau of Plant Industry, Washington, D. C.

careful study the new strain was found not to differ from the original seed, except that it was pure for smooth awns. The first certification and distribution of this variety by the Hays station was in 1933. The dry seasons from 1933 to 1936 limited the production as well as a rapid distribution of Flynn to farmers. However, by the spring of 1938, more than 9,000 bushels of certified seed were available for sowing.

Flynn has ripened two to three days earlier than Stavropol. The average height of the plants has been 23 inches, with a range of 18 to 35 inches depending on the season. The average yield of Flynn for eight years has been 1.5 bushels higher than that of Stavropol, at Hays. Flynn is believed to be one of the best varieties to grow in Kansas.

VAUGHN

Vaughn, like Flynn, has Club Mariout and Lion as parents but is a hybrid from another cross of these varieties. Vaughn differs from Flynn in being slightly earlier and shorter, and in having a somewhat rougher awn and a stiffer straw. Among the varieties in Kansas, Vaughn probably has the stiffest straw and will stand better than other varieties after it is ripe. The variety therefore may be of importance where it is desired to harvest with the combine.

CLUB MARIOUT

Club Mariout is a six-rowed, compact, short-headed variety which was imported from Cairo, Egypt, by the Division of Plant Exploration and Introduction of the U. S. Department of Agriculture. The average height of the variety at Hays has been 25 inches. Club Mariout requires about the same number of days to mature as Stavropol but has shown slightly higher yielding ability than Stavropol when harvested promptly. Unfortunately, when it produces a heavy crop the heads of Club Mariout are inclined to break off just below the base, with attendant loss of grain. Club Mariout appears to be more susceptible to stripe disease than most varieties. The variety is grown in eastern Colorado, extensively in California, and occasionally in Kansas.

TREBI

Trebi barley is a pure-line selection made by Dr. H. V. Harlan at the Minnesota Agricultural Experiment Station at St. Paul. It came from a lot of seed imported from Trebizond, in northeast Asia Minor, by the U. S. Department of Agriculture. It is a six-rowed, stiff-awned, late-maturing variety which is not well adapted in Kansas probably because of dry weather which is likely to occur during the last of June. Trebi has been grown to some extent in the extreme northwestern corner of Kansas but even there is is too late for best results. It appears to be better adapted in certain areas farther north and in irri-

gated regions. Trebi is discriminated against by the maltsters, and its stiff, barbed awns are undesirable in a feed barley.

OTHER VARIETIES

Of the two-rowed types, White Smyrna has been among the highest in yield. The variety has short slick straw which sometimes makes it difficult to harvest with a binder. It also breaks over-readily after ripening and so is not well adapted to harvesting with the combine. Spartan, a two-rowed barley from Michigan, has a stiffer straw than White Smyrna, and in the tests so far has made a good yield record.

Occasional fields of black barley are grown in Kansas. Several strains of this type yield satisfactorily, but the color of the grain is an undesirable market factor. So hooded variety of barley has been found equal in yield to the better bearded sorts. Nor has any variety of hull-less barley been equal to such varieties as Flynn or Stavropol. Among the late varieties of barley grown in the northern states, none has been found to be well adapted in Kansas.

YIELDS OF BARLEY IN KANSAS

The acre yields of barley in Kansas for the 10 year period 1923-1932 have ranged from 14.6 bushels in southwestern Kansas to 21.3 bushels in the central part of the state. The average

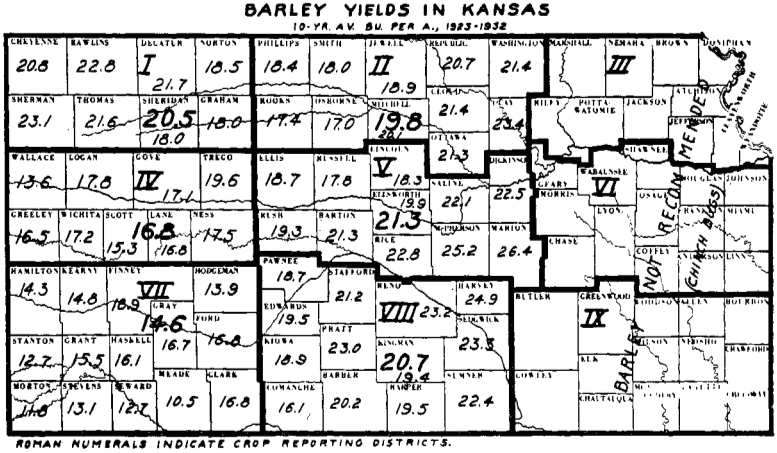

Fig. 8. Average yields of barley on Kansas farms as reported by the Kansas State Board of Agriculture.

county and district yields of barley as reported by the Kansas State Board of Agriculture are shown in figure 8.

The yields of the more important varieties of barley tested on the experiment stations at Hays, Garden City, Tribune,

TABLE III.—COMPARATIVE YIELDS OF THE LEADING VARIETIES OF BARLEY AT HAYS, COLBY, GARDEN CITY, TRIBUNE AND MANHATTAN, KANSAS. *a*

Variety	Hays *b*		Colby *b*		Garden City	Tribune *c*	Manhattan
	4 yr. ave. 1932-1936	9 yr. ave. 1928-1937	9 yr. ave. 1928-1937	14 yr. ave. 1922-1936	6 yr. ave. 1932-1937	7 yr. ave. 1929-1936	4 yr. ave. 1930-1933
Flynn	18.4	27.6	22.8	21.4	7.3	12.0	32.9
Stavropol	17.2	26.1	22.6	20.5	4.0	11.2	25.7
Vaughn	18.1	27.3	22.3	.....	6.7	10.3	31.4
Club Mariout	18.5	26.5	19.1	19.5	.....	.....	.....
Trebi	14.4	.....	.....	18.6	9.0	10.4	.....
Malt	13.6	.....	18.8	19.2	6.7	.....	.....

a The data for Colby, Garden City and Tribune were supplied by the superintendents of the respective branch experiment stations: E. H. Coles, F. A. Wagner, T. B. Stinson.

b No barley planted at Hays or Colby in 1935 because of drought.

c No yields for 1932.

Colby and Manhattan are shown in Table 3. The yields of Flynn barley at the various stations were higher than Stavropol, which for many years has been the standard variety for Kansas. The yield of "malt" barley was lower than Flynn and lower than Stavropol except at Garden City. The lateness of Trebi has been a factor in its relatively low yield when compared with several other varieties.

Flynn, Stavropol (Common six-rowed), Vaughn and Trebi barley have also been tested on many farms in Kansas for all or part of the years since 1927. Paired comparisons of the above varieties in cooperative tests made by the Kansas Agricultural Experiment Station are shown in Table 4.

Since northwestern Kansas is normally a better barley growing area than the southwestern section, the Smoky Hill River has been made the dividing line between the two sections. Flynn yielded more in both sections than the common six-row which is similar to Stavropol. Also, Flynn made a yield of 1.7 bushels more per acre than Vaughn in southwestern Kansas, and 1.3 bushels more in northwestern Kansas. Flynn yielded 1.6 bushels per acre more than Trebi in southwestern Kansas, but only 0.9 bushels more in the northwestern section.

TABLE IV.—YIELD OF FOUR VARIETIES OF BARLEY IN TWO SECTIONS OF KANSAS. *a*

Period	Number tests	Variety	Yield, bushels per acre
		Tests in Southwest Kansas	
1927-1936	50	Flynn	26.6
	50	Stavropol (Common 6-row)	24.3
1930-1936	33	Flynn	25.7
	33	Vaughn	24.0
1930-1936	33	Flynn	25.7
	33	Trebi	24.1
		Tests in Northwest Kansas	
1927-1937	53	Flynn	24.4
	53	Stavropol (Common 6-row)	22.8
1929-1937	33	Flynn	20.8
	33	Vaughn	19.5
1929-1937	37	Flynn	23.4
	37	Trebi	22.5

a Taken from report of cooperative barley variety tests, 1937, by A. L. Clapp, C. D. Davis, and F. G. Parsons, Department of Agronomy, Kansas Agricultural Experiment Station, Manhattan, Kansas.

PRODUCTION OF WINTER BARLEY

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 winter-kill than any of the varieties of winter wheat ordinarily grown in this state. Fall-sown barley will rarely fully survive the winter in north central and northwestern Kansas. The chances are considerably better that it will survive in the south central and southeastern parts of the state, although losses from winter-killing frequently occur even in those sections.

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. Barley that does not winter-kill will furnish a large amount of nutritious pasture in the spring, and if not pastured too long or too heavily during the spring will produce a grain crop. Limited experiments indicate the superiority of winter barley for pasture during the fall and early winter and show that rye and wheat furnished more grazing than barley in midwinter and in the spring. Considering both the fall and spring grazing periods, rye and wheat are apparently superior to barley for pasture.

The best results with winter barley may ordinarily be secured in eastern and central Kansas by sowing the crop between the fifteenth and twenty-fifth of September at the rate of two bushels per acre. The land should be prepared in the same way as for winter wheat. 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 winter-killing. If barley winter-kills, the land can be put in condition for a spring crop at little expense.

Fall-sown barley like spring barley is highly susceptible to chinch bug injury, but winter barley may escape some of this injury because it ripens earlier than spring barley. It will, however, serve as a place for chinch bugs to harbor and multiply.

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, on the other hand, if sown in the fall will soon be killed by cold weather.

Most of the winter barley in Kansas is probably Tennessee Winter or strains of that variety. No varieties of barley tested by the experiment station have been more winter-hardy than some of the Kansas strains and most of the varieties have been decidedly inferior in this respect.

Fall-sown barley, when not injured by winter-killing, ordinarily will produce higher yields of grain than spring barley, probably because it ripens one to two weeks earlier and thus often escapes injury by hot, dry weather as well as damage by chinch bugs.

TABLE V.—YIELD OF WINTER BARLEY IN KANSAS.

Location and variety	Acre yield, bushels						
	1934	1935	1936	1937	2 yr. ave. 1936-1937	3 yr. ave. 1935-1937	4 yr. ave. 1934-1937
Columbus							
Kansas Winter (Southeast strain)	32.0	41.5	15.2	43.7	29.5	33.5	33.1
" " (South central strain)	.....	42.4	20.5	38.1	29.3	33.7	.....
Missouri Early Beardless	.....	.....	15.1	30.7	22.9	.....	.....
Kingman							
Kansas Winter (So. central strain)	31.0	19.4	23.3	18.9	21.1	20.5	23.2
" " (Sedgwick strain)	.....	22.7	20.7	.....	.....	21.7	.....
" " (Southeast strain)	.....	17.8	.....	.....	.....	.....	.....
Missouri Early Beardless	.....	.....	14.3	13.2	13.8	.....	.....
Wichita							
Kansas Winter (So. central strain)	.....	22.0	15.3	30.2	22.8	22.5	.....
" " (Sedgwick strain)	.....	22.3	19.0	.....	.....	.....	.....
" " (Southeast strain)	.....	25.9	14.3	29.5	21.9	23.2	.....
Missouri Early Beardless	.....	.....	14.7	.....	.....	.....	.....
Stavropol spring barley	.....	30.7	33.1	25.4	29.3	29.7	.....
Manhattan							
Kansas Winter (Southeast strain)	19.4	40.7	43.4	17.9	30.7	34.0	30.4
" " (So. central strain)	18.3	44.1	48.4	21.0	34.7	37.8	33.0
Missouri Early Beardless	.....	.....	32.6	15.4	24.0	.....	.....
Stavropol spring barley	2.6	31.9	21.0	35.9	28.5	29.6	22.9

Yields of grain of several strains and varieties of winter barley grown at different places in Kansas are reported in Table 5. Yields of Stavropol spring barley at Wichita and Manhattan are included for general comparison with winter barley. The higher yields of Kansas winter barley compared with the Missouri Early Beardless barley are probably due in part to the greater winter hardiness and better adaptation of the Kansas strains.

FEEDING BARLEY

Success with barley 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. 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 a protein supplement to a ration of barley and alfalfa hay.

Ground barley is an excellent feed for dairy cows, as observed by E. H. Coles, superintendent of the Colby Experiment Station. The Wisconsin Experiment Station[4] showed that, ton for ton, ground barley was equal to corn in feeding value for dairy cows when either formed 60 percent of the concentrate or grain mixture. For horses, barley is somewhat too heavy to be fed alone, but makes a desirable feed when mixed with one third of oats or bran.

DISEASES OF BARLEY

The important diseases of barley in Kansas are loose smut, covered smut, and stripe disease. Scab is a serious disease of barley in the more humid part of the corn belt, but it has not been important in the barley belt of Kansas.

It is not uncommon for loose smut or covered smut to occur to the extent of 5 to 10 percent or more. Since the powdery mass of loose smut is soon blown or washed away, the losses from this source are not conspicuous but are none the less real. Two forms of the loose smut, brown and black, infect barley. Evidence of the covered smut remains in the harvested grain. The seriousness of the stripe disease and consequent losses are not fully realized by barley growers. It is not unusual for 5 to 15 percent of the plants to be affected by stripe disease as evi-

3. Weber, A. D. Cattle Feeding Experiments, 1935-36, Mimeo. Circ. 36A Manhattan, Kansas; and, Barley as a Feed for Beef Cattle; Reprint Amer. Soc. Animal Prod. Nov. 27, 1936.

4. Leith, B. D., Shands, H. L., and Moore, R. A. Quality Barley, How to Grow, How to Handle; Extension Service of the College of Agriculture, University of Wisconsin, Circular 278. 1936.

denced by stripes, yellow to brown in color, which appear on the leaves shortly before heading. The affected plants are stunted; the heads fail to emerge properly; and the grain is discolored and shrunken.

Fortunately there are methods of control for the various diseases by the use of dusts, formaldehyde liquid, or the hot water treatment.

A brief description of the several diseases mentioned and directions for seed treatment of barley are here reproduced as given in United States Department of Agriculture Miscellaneous Publication No. 199, "Barley Diseases," by R. W. Keukel and V. P. Tapka:

COVERED SMUT

"In barley affected with covered smut, smutted heads appear about a week after heading time. Frequently they are borne on short stalks and do not fully emerge from the boot. The smut mass is hard, difficult to rub off, and remains intact until broken in threshing.

"Control — Treat seed with an effective organic mercury dust, formaldehyde dust, or formaldehyde solution."

BROWN LOOSE SMUT AND BLACK LOOSE SMUT

"Heads affected with brown or black loose smut are readily observed only at heading time. The smut mass is powdery and easily rubbed off. Soon after heading, the smut is blown or washed away, leaving only the bare central stalk of the head (rachis), The brown and the black loose smuts are very similar in appearance and difficult to distinguish. The former is olive brown. The latter is dark chocolate brown, almost black in color.

"Control — For brown loose smut treat the seed with hot water. For black loose smut treat the seed with an effective organic mercury dust or formaldehyde solution."

STRIPE

"Shortly before heading time, long yellow-to-brown stripes appear in the leaves. Later the leaves may become shredded by splitting along these stripes. Affected plants are usually stunted. The head usually does not emerge from the boot, is discolored and shrunken, and rarely produces sound kernels. By harvest time the diseased plants have died and are hard to find.

"Control — Treat seed with an effective organic mercury dust."

DUST TREATMENTS

"Formaldehyde dust—There are several brands of formaldehyde dust on the market. They contain from 4 to 8 percent of formaldehyde by weight. Formaldehyde dust controls covered smut only, although it may partly control other diseases. The cost of the dust may vary from 3 to 6 cents per bushel of seed. It is applied at the rate of 3 ounces per bushel in a rotary seed treater or by the shovel method. After treatment the grain should be stored in sacks or in a covered pile for not less than 1 nor more than 5 days.

"Organic mercury dusts —One of the commercial organic mercury dusts has been found to control covered smut, black loose smut, stripe, and seedling blight, and is recommended for barley seed treatment. (Consult your county agricultural agent for further information.) It costs about 2 cents for each bushel of seed. It is applied at the rate of only one-half ounce per bushel either by means of a rotary seed treater or by the shovel method. After treatment the grain should be stored in sacks or in a covered pile for not less than 1 nor more than 10 days."

LIQUID FORMALDEHYDE TREATMENT

"Liquid formaldehyde treatment controls covered smut and the black loose smut and reduces seedling blight due to infected seed. Occasionally it causes some injury to germination, especially when not properly applied, when sowing is delayed too long after treatment, or when the seed is sown in dry soil. For these reasons dust treatments are to be preferred, although the materials may cost somewhat more. Liquid formaldehyde costs about 1 cent for each bushel of seed treated, but its application is more laborious and disagreeable; and it is less effective in disease control than dust treatments.

"First clean the seed thoroughly and put it in loosely woven burlap or gunny sacks half filled and tied at the top. Mix 1 pint of commercial formaldehyde in 40 gallons of water in a tub, tank or barrel. Immerse the half filled sacks of grain in this solution for 1 hour. Then let them drain a few minutes, and spread out the grain in a thin layer on a clean floor or canvas to dry. Stir it occasionally to hasten drying. Sow as soon as it is dry enough to flow readily through the drill. Make allowance for its swollen condition by setting the drill to sow about one fourth more per acre. If sowing is delayed it is important the treated seed be thoroughly dried to prevent injury."

HOT WATER TREATMENT

Seed treatment by the hot water method requires considerable care and efficient control equipment to hold the water at the proper temperature. Otherwise injury to the seed may easily occur. Because of the difficulty in properly carrying out this treatment, it is usually advisable when treating seed on the farm to use one of the other methods. Information on the best brands of dust to use or the best methods of control for a given disease can be obtained from the local county agricultural agent.

INSECT ENEMIES OF BARLEY

The chinch bug is perhaps the most important insect pest of barley, and often the success or failure of the crop in eastern Kansas is determined by the prevalence of this insect. When infested with chinch bugs, barley is much more susceptible to drought injury. Therefore, the combined effect of chinch bugs with only moderate drought frequently results in low yields of barley or a failure of the crop.

SUMMARY

Kansas ranks tenth among the states in the production of barley. Barley is sixth in importance among crops of the state, and 75 percent of the acreage is in the northwest corner of the state, Kansas barley is used chiefly as a feed crop although a limited amount of the better grade may be used for malting purposes. Barley is an excellent grain for all 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 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 rota-

tions including this crop are sorghum, barley and wheat, or sorghum, barley, fallow and wheat.

The best rate of seeding is from five to seven pecks depending upon the locality. The best time to seed barley is usually between March 15 and April 10, depending again on locality.

Flynn, a new spring variety, is probably the best one to grow in Kansas. It yields well and does not have barbs on the awns. Stavropol has long been grown in the state with success. "Malt," an Oderbrucker-Manchurian type of barley, has also found favor because the grain threshes free of awns. The above named varieties are all spring varieties.

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 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 country agricultural agent.