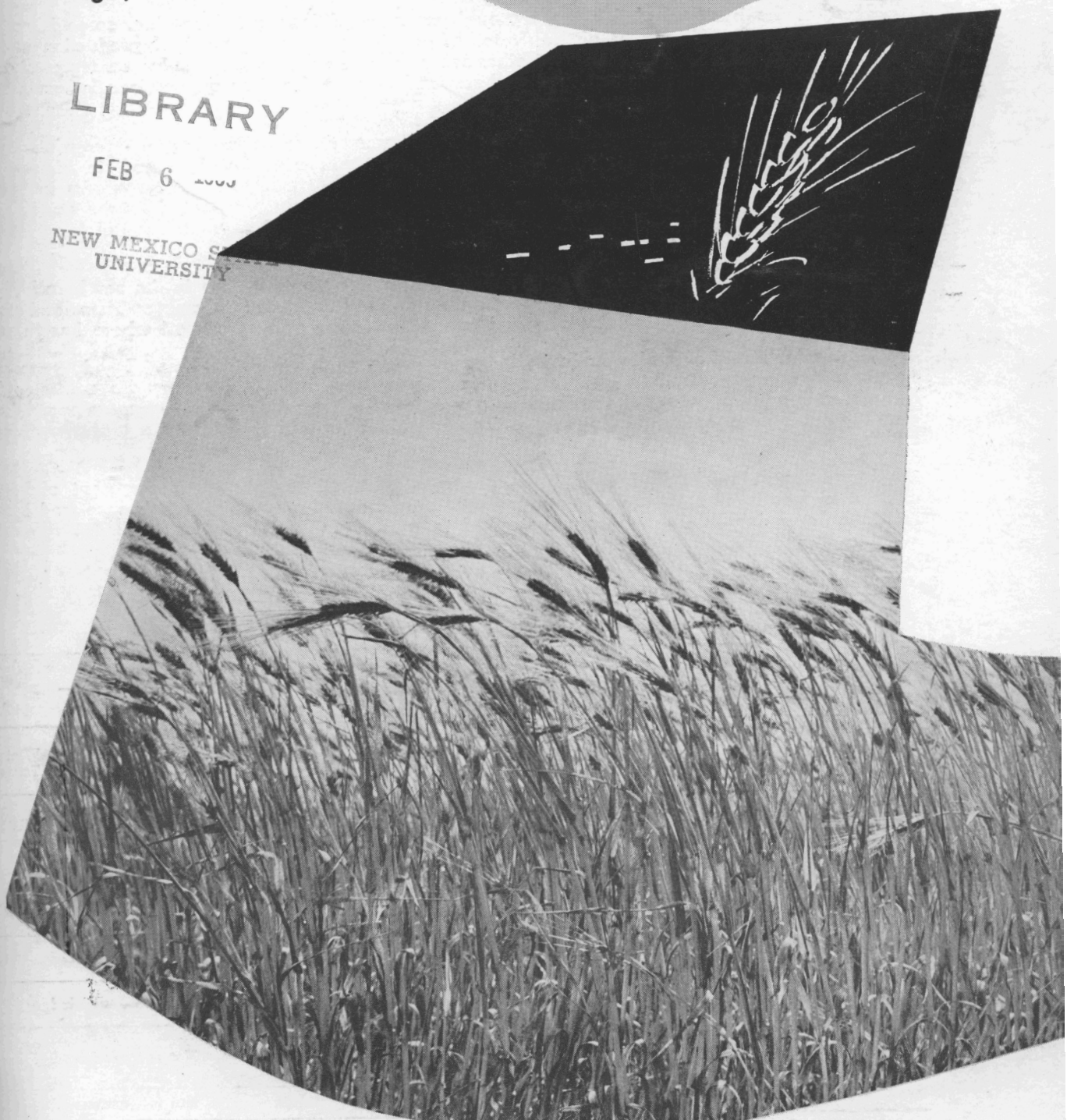
BARLEY PRODUCTION IN TEXAS . . .

Bulletin 918

September 1958



TEXAS AGRICULTURAL EXPERIMENT STATION

R. D. LEWIS, DIRECTOR, COLLEGE STATION, TEXAS,

IN COOPERATION WITH THE U. S. DEPARTMENT OF AGRICULTURE

SUMMARY

Barley is a relatively minor crop in Texas, but it has a dual value to growers as a grain crop and as winter pasture for livestock. The use of barley as a winter pasture crop for livestock has expanded considerably in recent years.

The barley acreage is distributed widely over the State. The type and varieties of barley grown in an area are determined by winter temperatures and uses made of the crop. All barley grown for grain in Texas is used for livestock feed. Large acreages are grown exclusively for winter pasture and grazed to maturity.

Most of the barley is fall sown, although when conditions are favorable, some is spring sown in the northwestern part of the State. Winterkilling is one hazard of production in the northwestern part of Texas, but in most other sections barley seldom is killed by low temperatures. Barley does best on well-drained land and responds well to fertilizer applications for grain and forage production.

All barley varieties grown in Texas are of the common six-row awned type. True winter-type varieties such as Kearney, Reno and Ward are the most winter hardy. Intermediate winter-type varieties make up the majority of the acreage. Spring-type varieties may be grown in South Texas for forage purposes. Barley performance tests are conducted throughout the small grain growing areas of Texas. Recommendations are based on yield tests at several locations in each area.

Diseases are important in barley production some years, especially in the southern half of the State. The major diseases are net blotch, leaf and stem rust and the smuts. These and other diseases are described in this bulletin and control measures are suggested where known.

The major insect of barley in Texas is the greenbug (a species of aphid). Breeding work to develop varieties resistant to the greenbug is in progress. Insecticides now are available for control of this insect where it is practical to use them. Other insects which may cause serious damage some seasons include other species of aphids, the winter grain mite, armyworms and cutworms.

Improvement work on barley is in progress. Objectives include development of better grain and forage varieties for the several growing areas, improvement of disease and insect resistance and development of varieties suited to special purposes or areas.

RECOMMENDED AND ACCEPTABLE BARLEY VARIETIES BY AREAS

	Fall seeding		Spring seeding	
	Recommended	Acceptable	Recommended	Acceptable
Area 1	Kearney Reno Ward	Cordova Harbine Rogers	Cordova	Wintex Texan
Area 2	Cordova Harbine Rogers Ward	Wintex Kearney Texan	Cordova	Wintex Texan
Area 3	Cordova Rogers Harbine	Texan Wintex	Not recommended	
Area 4	Cordova	Texan Harbine[1]	Not recommended	
Area 5	Goliad	Cordova Texan	Not recommended	
Area 6	Cordova Rogers Harbine	Texan	Not recommended	
Area 7	Cordova	Texan	Not recommended	

[1]Edwards Plateau area only.

Barley Production in Texas

I. M. ATKINS, J. H. GARDENHIRE and K. B. PORTER*

BARLEY RANKS well below wheat and oats in acreage and farm value in Texas, but warrants further consideration by growers in some areas because of its dual value as a feed grain crop and as winter pasture for livestock.

During the 10-year period, 1947-56, which included some years of low production because of drouth, barley was grown on an average of 120,200 acres in Texas. The crop averaged 16.0 bushels per acre to give an average production of 1,923,000 bushels. The largest acreage ever devoted to barley was in 1944 when 340,000 acres produced 7,548,000 bushels. The smallest crop, only 45,000 acres, was grown in 1951 when fall and winter drouth prevented establishment of the crop. However, acreage reports do not show the barley seeded exclusively for winter pasture and grazed to maturity. Unofficial estimates indicate that in recent years this use of the crop has exceeded 75,000 acres. The distribution of barley harvested for grain in 1954 is shown in Figure 1.

AREAS OF ADAPTATION

Barley is grown under a wide range of climatic conditions and on many soil types although it does much better on some than on others. It is not well adapted to high rainfall, humid areas or poorly drained soil. Barley is one of the most tolerant crops for growing on irrigated soils of high salt concentration. It thrives best on well-drained, fertile soils in a cool climate; hence, it usually is fall sown in Texas.

Climatic conditions, such as winter temperatures, rainfall and humidity, are important in establishing the limitations of the crop or of varieties. For reference purposes and a guide in making recommendations, the State is divided into 7 areas, Figure 2. These areas are the same ones used in the statewide small grain testing program. Locations of substation and cooperative farm tests are shown on this map.

Barley is distributed throughout the small grain growing areas of the northern and western parts of the State. It usually is found on the "tighter" soils and less frequently on sandy soils. In the High Plains portion of area 1, fall seeding is somewhat hazardous. When winterkill-

*respectively, agronomist in charge of small grain research, Texas Agricultural Experiment Station and Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, College Station, Texas; agronomist, Substation No. 6, Denton, Texas; and agronomist, Southwestern Great Plains Field Station, Bushland, Texas.

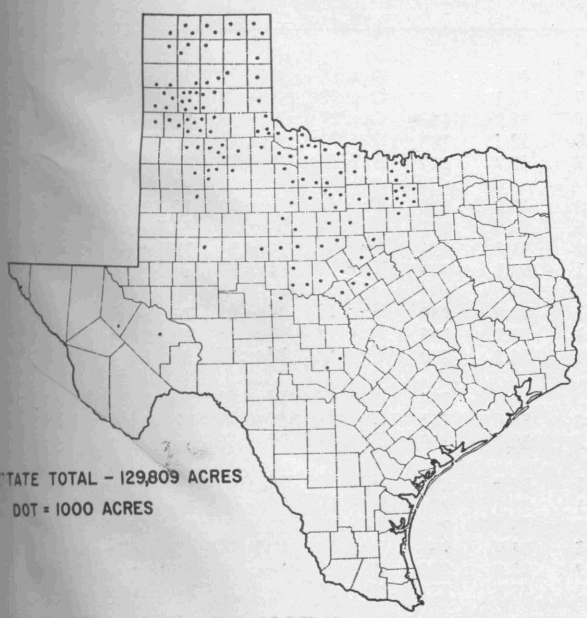


Figure 1. Distribution of barley in Texas, 1954.

CONTENTS

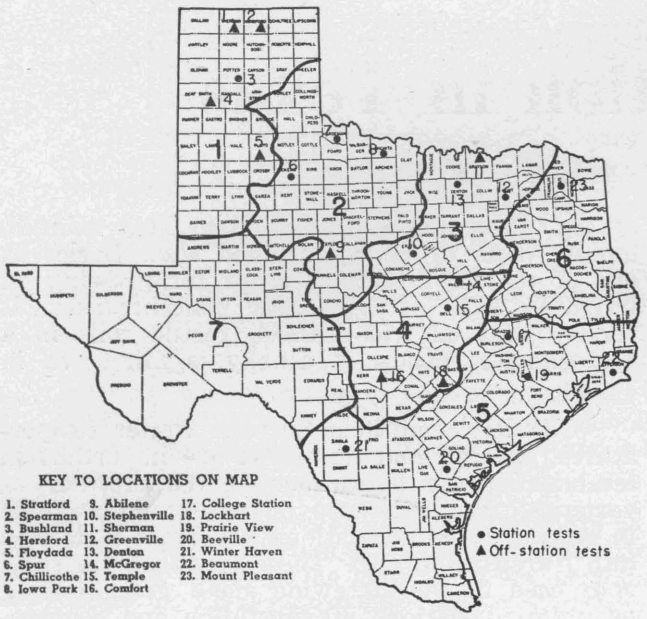


Figure 2. Small grains growing areas and test locations.

ing does occur or the fall season is unfavorable for seeding, the spring acreage may be expanded. Fall seeding predominates in areas 2, 3 and 4, and spring seeding is practiced only as a last resort because yields usually are unsatisfactory. All barley is fall sown in areas 5, 6 and 7. The acreage in area 7 is small, but recently there has been increased interest in the crop. The acreage sown in South Texas is used primarily for livestock pasture and only small acreages are harvested to supply seed needs.

Table 1 gives climatic data and other information for substations and cooperative farm locations where barley varietal trials are conducted in Texas.

USES

Practically all the barley grain grown in Texas is used as feed for livestock. Barley is a desirable grain for fattening hogs or steers or it may be used as part of the maintenance ration of breeding stock. It is nearly equal to corn or grain sorghum in feeding value, being slightly higher in protein, ash and crude fiber but lower in nitrogen-free extract and productive energy per 100 pounds of feed. The analysis of barley and some other Texas-grown feed grains, as given in Texas Experiment Station Bulletin 461, "The Composition and Utilization of Texas Feeding Stuffs," is shown in Table 2.

The development of the livstock industry, both dairy and beef cattle, in Central and East Texas in recent years has stimulated the use of small grains as forage crops. Small grains are being used for winter pasture, greenchop harvesting, hay and silage, as well as for grain feed. Barley can contribute to this program by producing winter pasture and a desirable feed grain. In this respect it has advantages over corn or grain sorghum.

TABLE 1. AVERAGE RAINFALL, TEMPERATURE, LENGTH OF GROWING SEASON AND SOIL TYPE AT TEST LOCATIONS

Location	Elevation, feet	Number years of record	Rainfall			Temperature			Length of growing season, days	Average date		Soil type
			Long-time average		Average 1949-56	Average annual	Average maximum	Average minimum		First killing frost	Last killing frost	
			Annual	Growing season[1]								
Area 1												
Stratford	3699	30	17.5	9.9	14.4	55.4	71.0	40.2	177	Oct. 16	Apr. 22	
Spearman	3100	45	21.3	16.7	19.7	57.0	70.7	42.1	185	Oct. 22	Apr. 20	
Bushland	3590	18	17.7	12.7	17.0	57.7	72.9	42.2	193	Oct. 27	Apr. 16	Pullman silty clay loam
Hereford	3806	26	19.6	14.1	15.5	57.5	72.6	42.4	187	Oct. 22	Apr. 18	
Plainview	3250	30	21.3	12.6	15.8	59.8	73.7	45.7	206	Nov. 2	Apr. 10	
Area 2												
Spur	2274	46	20.4	13.6	18.2	62.2	77.3	47.0	216	Nov. 4	Apr. 3	Abilene clay loam
Chillicothe	1406	51	24.3	17.2	23.5	63.4	76.6	50.3	231	Nov. 10	Mar. 24	Abilene clay loam
Iowa Park	978	31	29.0		28.5	65.0	78.2	51.9	221	Nov. 4	Apr. 1	Miller sandy loam
Abilene	1759	71	22.6	19.4	18.9	64.1	76.1	52.1	241	Nov. 19	Mar. 23	
Area 3												
Stephenville	1283	15	26.9	23.8	25.2	65.2	77.1	53.3	239	Nov. 13	Mar. 21	Denton clay
Greenville	550	36	40.0	32.9	37.3	64.1	75.1	53.2	235	Nov. 11	Mar. 15	Hunt clay
Denton	621	44	32.0	24.6	27.2	65.0	77.3	54.2	233	Nov. 12	Mar. 22	San Saba clay
Area 4												
McGregor	713	34	31.6	25.6	23.3				254	Nov. 24	Mar. 24	San Saba clay
Temple	675	44	33.7	27.3	27.2	67.4	79.3	55.4	251	Nov. 24	Mar. 18	Houston Black clay
Comfort	1412	71	30.5	26.5	25.6	64.5	78.2	50.7	216	Nov. 1	Mar. 30	
Area 5												
College Station	314	50	38.9	30.0	33.7	68.4	79.5	57.2	263	Nov. 25	Mar. 6	Lufkin fine sandy loam
Lockhart	518	60	31.6	27.9	24.6	68.5	79.1	57.8	268	Dec. 1	Mar. 4	Houston Black clay
Prairie View	251	42	40.5	25.1	32.8	68.0	90.0	45.0	275	Nov. 28	Feb. 18	Hockley fine sandy loam
Beeville	225	53	29.4	22.9	16.7	70.7	82.5	61.2	291	Dec. 6	Feb. 20	Clareville clay
Winter Haven	596	36	23.2			74.0	84.7	63.2	330	Dec. 20	Jan. 25	Willacy sandy loam
Beaumont	18	43	54.2	39.4	49.9	68.6	80.3	57.4	271	Nov. 25	Feb. 27	Beaumont clay

[1]September 1 to June 1.

TABLE 2. ANALYSIS OF SOME TEXAS-GROWN GRAINS

Crop	Protein	Crude fiber	Nitrogen-free extract	Water	Ash	Digestible nutrients	Productive energy per 100 pounds
				Percent			
Barley	12.0	6.3	67.5	9.3	2.8	9.6	74.4
Corn	10.4	4.4	72.5	9.1	1.3	6.4	84.8
Grain sorghum	11.1	2.9	70.9	10.7	1.9	8.1	84.8
Oats	11.4	12.8	58.6	8.6	3.7	8.9	70.5
Wheat	14.0	1.7	69.4	10.0	1.9	11.3	78.8

Barley usually grows off more rapidly in the fall than do oats or wheat, and provides a succulent, nutritious forage in a few weeks. The forage yields of barley in many areas are higher than comparable plantings of wheat in the fall and winter, but lower during the spring. Late spring grazing of barley is more likely to damage grain production than is similar grazing of oats and wheat. Figure 3 shows livestock pasturing on Cordova barley at the Temple station in Central Texas.

Barley is an excellent cover crop for preventing soil erosion during the winter. Soil and water loss is much less on land seeded to small grain than on unprotected cropland. Barley may be used as a green manure crop but is seldom cut for hay, because oats are preferred. At present, little, if any, of the barley grain grown in Texas is used for malting purposes.

CULTURE

The cultural operations for barley are similar to those required for other small grains. A well-adapted variety should be selected and then grown on fertile, well-drained land with proper attention given to seedbed preparation, weed control and adequate fertilization.

Barley may be fall or spring sown in the High Plains portion of area 1. Fall seeding is somewhat hazardous but usually is worth the risk because fall-sown barley may provide an income from winter pasture and usually yields better than spring-sown barley. On dry land, barley is most successful when sown on summer fallow but also may be grown following other small grains. In cotton growing areas it may follow cotton. Under irrigation barley may follow any of the other adapted crops, but if heavy tonnages of sorghum stubble are plowed under, it may be desirable to fertilize with nitrogen at seeding time.

At the lower elevations of northwestern Texas, such as the Rolling Plains, fall seeding is recommended and spring seeding should be practiced only as an emergency measure in years when winterkilling occurs. Throughout the eastern half of the State, barley always should be fall sown and may follow a number of crops successfully. Row crops such as cotton, corn or legumes are preferable to grain sorghum. If the crop must follow grain sorghum, nitrogen should be applied at seeding time. Previous crops of small grain are not objectionable except for the problem of mixtures from volunteer grain.

The seedbed should be firm and level. If the ground must be plowed, it should be done several months before barley is seeded. Seedbeds may be inexpensively prepared on cotton land by disking or harrowing. Seeding should be done with a drill to insure a uniform rate and depth of seeding. In West Texas the wide-row, deep-furrow drills commonly are used, since they can operate in trashy ground. Also, this crop residue combined with the deep seeding provides some protection from soil blowing and low temperatures and catches moisture received as snow. Figure 4 shows a deep-furrow drill in operation in West Texas.

The rate and date of seeding barley vary greatly in the State because of different climatic conditions and because of the uses made of the crop. Suggested rates and dates for grain production in the several areas are given in Table 3. Earlier dates and higher rates may be used for winter pasture in some areas and higher rates may be desirable under irrigation.

The combine harvester now is used almost exclusively for harvesting and threshing barley. Although barley normally stands well for direct combining, it may be desirable under humid conditions or where weeds are present to windrow the crop and return a few days later to thresh

Figure 3. Barley pasture is used to supplement the fattening ration of yearling steers at the Temple station in Central Texas.

TABLE 3. RATES AND DATES FOR SEEDING BARLEY

Area	Rate, pounds per acre		Date	
	Dryland	Irrigated	Fall seeding	Spring seeding
1	48	72	Oct. 1	Mar. 1
2	60	72	Oct. 1	Feb. 1
3	72		Oct. 15	Feb. 1
4	72		Oct. 15	Not recommended
5	72		Nov. 1	"
6	72		Oct. 15	"
7	72	72	Oct. 15	"

the grain from the swath. The grain should be fully ripe and sufficiently low in moisture content to store when it is threshed. Grain of high moisture content (above 13 percent) may heat in storage, which may reduce its commercial value and its germination. Furthermore, these conditions favor increased activity and damage by insects and by mold organisms. Rough-awned barley to be used for feed should be threshed closely to break off and remove the awns, since these may damage the mouths of livestock.

Barley responds well to fertilizers. Proper applications will give good returns in forage growth and grain yields. Fertilizer recommendations are made by areas of the State; see Texas Agricultural Extension Service L-220, L-221, L-225, L-226, and L-228 for specific recommendations.

VARIETIES

All barley varieties of commercial importance in Texas are of the common six-row head type in which all florets are fertile, resulting in the production of six rows of seed, three on each side of the central stem or rachis. Other types, which may be found occasionally, are the hooded (beardless) type and the two-row type in which only two rows of seed develop from the fertile central florets. The commercial varieties described herein are divided into three types based on their growth habit. These are the true winters, the intermediate winters and the spring types. Figure 5 shows heads or spikes of several types of barley.

Winter-type Varieties

Varieties of this group behave like winter wheats in producing prostrate-growing, narrow-leaf seedling plants which normally do not head unless they are subjected to a period of cool or cold weather. Freezing temperatures are not necessary. Winter-type varieties usually will not head from spring seeding. They vary greatly in cold resistance but generally are more cold tolerant and better adapted by their growth habit to withstand low temperatures. The exact origin of these winter barleys is not known, but they are believed to have originated in the Balkans-Caucasus region of Europe or possibly in eastern Asia. They were brought to America by early colonists and strains have developed by natural selection. These strains became known by their origin such as Tennessee Winter, Texas Winter and Wisconsin Winter. More recently plant breeders have selected superior strains for given areas.

Reno, Ward and *Pueblo* are similar strains selected from Tennessee Winter and distributed respectively in Kansas, Oklahoma and Colorado. They are typical winter types with good cold resistance. They are moderately tall with rather weak straw. These have extended the growing of winter barley northward in recent years.

Two recently developed varieties, *Kearney* and *Dicktoo,* have even greater hardiness than Reno, Ward and Pueblo, and, in addition, have considerable resistance to the greenbug (aphid). Both are tall growing varieties similar to Reno and Ward, and are adapted for fall seeding in area 1. Several other varieties have been tested in a limited way and are listed in tests of area 3.

The behavior of a winter-type variety when spring seeded or when its cold requirements have

Figure 4. Deep-furrow drill used in West Texas to permit seeding in trashy ground which provides some protection from soil blowing.

Figure 5. Types of barley. Left to right: hooded, awnless, six-row short-awned, awned club, common six-row awned and two-row awned.

not been satisfied is shown in Figure 6. Harbine failed to head when it emerged in March 1951 at Comfort, Texas, while Cordova and Texan headed normally.

Intermediate Winter-type Varieties

Varieties of this group are less winter hardy than most true winter-type varieties. They also differ in that seedling growth is more upright, leaves are broader and usually they are more responsive to periods of warm weather. This type makes up most of the Texas acreage and it is sufficiently cold tolerant for most seasons. These varieties head normally from either fall or spring seeding and under most conditions in Texas produce the best forage and grain yields.

Cordova was developed from a cross of Wintex x Texan. It is the most extensively grown variety in Texas, making up an estimated 49 percent of the acreage. Cordova has the capacity for very high yields of high test-weight grain. Seedling growth is vigorous and semi-erect and it tillers well. Plants are of moderate height. The spikes or heads are awned, but its awns have no barbs. Cordova has been resistant to local races of mildew and loose smut and is more tolerant to net blotch than some varieties, but it may be susceptible to these diseases under some conditions. The variety is early maturing. Figure 7 shows the smooth or barbless awns of Cordova in contrast to the rough awns of Wintex.

Texan is one of the parents of Cordova and similar to it in many respects. It is slightly earlier and shorter and has weaker straw. This variety was developed as a selection from Harlan Hybrid Composite C. I. 5530 and was distributed in 1941.

Wintex, the other parent of Cordova, was selected in 1931 from a local type of barley grown in North Texas for many years. The variety is similar to Texan but has rough awns and is very susceptible to mildew.

Harbine is an Oklahoma variety which is well adapted in areas 1, 2 and 3 in Texas. Its most outstanding characteristic is its strong straw. While the variety approaches an obligate winter-type and may not head from spring seeding, Figure 6, it is not equal to the true winter-type varieties in hardiness. It is awned and the awns are barbed. It is resistant to some races of mildew, leaf rust and loose smut.

Rogers also appears well adapted in Texas 1, 2 and 3, but it has been tested only 3 years. This variety is rather tall, has rough awns but yields well and has a strong straw. It is slightly more winter hardy than Harbine.

Tenkow is an Oklahoma variety similar to Wintex. It has done well in Texas trials, but seed supplies are no longer easily available.

Spring-type Varieties

Varieties of this group produce erect seedling growth, require no cold weather for normal heading and have little cold resistance. Because of the mild winters, this type can be fall sown in South Texas and may be used for spring seeding in area 1. Varieties of this type have been tested in areas 1 and 3 from spring seeding but often do not yield as well as intermediate winter-type varieties. As they have no advantage, they are grown very little in Texas. In South Texas, diseases are a major factor in production and only the Goliad variety, developed specifically for this area, is recommended now.

Figure 6. Harbine barley (center) failed to head when spring emerged at Comfort, 1951, whereas Cordova (left) and Texan (right) headed normally.

Goliad is a spring-type variety having resistance to stem rust and some resistance to leaf rust and stripe. In recent years it has been damaged by net blotch. The variety is tall, has long rough awns and produces only fair yields of grain. It is used mainly for livestock pasture with only enough harvested for grain to insure seed supplies.

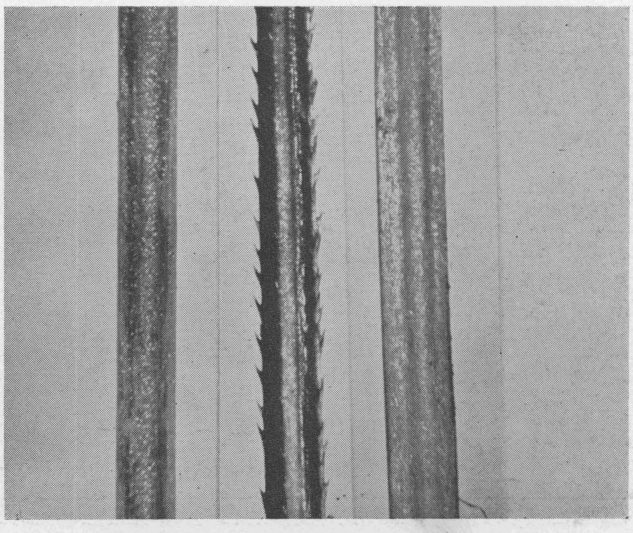


Figure 7. The smooth or barbless awns of Cordova are shown (left and right) in contrast to the barbed or rough awns of Wintex (center).

TABLE 4. COMPARABLE YIELDS AND AGRONOMIC DATA FOR FALL-SOWN BARLEY VARIETIES GROWN AT TESTING STATIONS IN AREA 1, 1949-57

Variety	Dryland tests[1]		Irrigated tests[2]			Test weight, pounds	Date, first head	Date, full ripe	Plant height, inches	Winter survival, percent	Estimate of forage value[3]
	Yield of grain, bushels	Number comparisons	Yield of grain, bushels	Number comparisons	Rank in yield						
Cordova	29.3	4	28.1	7	8	46.1	5-10	6-13	26	61	135
Texan	26.6	2	32.9	2	3	44.9	5-11	6-16	27	50	
Harbine	26.6	2	25.0	7	11	46.5	5-11	6-13	24	62	125
Tenkow	26.3	2	33.9	2	1	45.2	5-15	6-15	28	61	130
Wintex	23.2	4	30.2	7	5	45.6	5-15	6-16	27	52	135
Rogers	22.9	2	31.2	5	4	47.9	5-13	6-16	26	68	125
Mo-B-400	22.8	3	23.0	2	12	44.9	5-7	6-14	26	90	
Kearney	22.4	3	29.0	7	7	46.4	5-14	6-17	30	95	85
Pueblo	20.6	2	29.6	7	6	45.9	5-11	6-14	26	78	105
Tennessee Winter	20.5	4	22.9	7	13	45.2	5-10	6-14	27	68	100
Dicktoo	19.7	2	28.3	7	9	45.7	5-13	6-16	29	81	85
Ward	19.5	4	28.0	7	10	45.8	5-9	6-14	29	83	90
Reno	16.8	3	33.5	2	2	46.0	5-9	6-14	26	92	
Mo. Early Beardless	16.7	4	14.7	7	14	41.4	5-7	6-12	27	69	115

[1]Amarillo only, tests in 1950 and 1951 were winterkilled; those in 1955 and 1956 were destroyed by drouth.
[2]Grown at Amarillo and Floydada.
[3]Visual estimate of forage value, Tennessee Winter 100 percent.

Arivat is a variety that has been grown to a small extent in this area but is less well adapted than Goliad.

Varieties Grown in Texas

A survey of barley varieties grown on farms in Texas in 1957 gave the following estimated percentages of the total acreage:

Variety	Percent
Cordova	49.0
Wintex	20.7
Goliad	6.4
Kearney	4.5
Harbine	3.5
Texan	2.5
Reno	2.5
Tunis	0.2
Tennessee Winter	0.1
Others and unknown	10.3

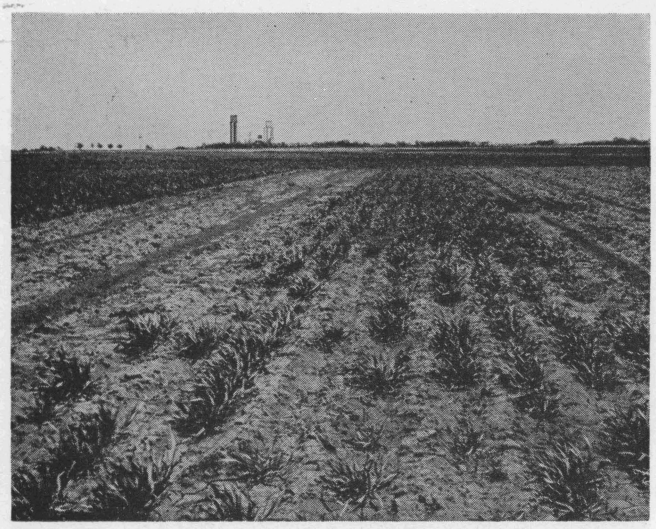


Figure 8. The winter hardiness of Kearney barley (center) compared with Ward and Reno (left and right of center plot) which were killed by low temperatures at Amarillo, 1951.

PERFORMANCE TESTS

Performance trials are conducted with barley on a statewide basis and detailed data on yield, test weight, winterkilling, reaction to diseases and such are reported annually in mimeographed form and recently have been published in TAES Bulletin 899 "Performance of Small Grain Varieties in Texas." Growing areas and testing station locations are given in Figure 2, while data on weather and other information are given in Table 1.

Area 1

This area is made up largely of the High Plains or the Panhandle of Texas. Until recently it was devoted to ranching and dry farming. In the past 15 years, as better equipment for irrigation and for handling irrigated crops have become available, large acreages have been put under irrigation. Winters are severe in this area and fall seeding is somewhat hazardous. When winterkilling occurs or spring-seeding conditions are favorable, considerable acreages are spring sown.

Yields and agronomic data for trials at Amarillo and at cooperative farm locations in the area, both on dryland and under irrigation, are given in Table 4.

Cordova, Texan, Tenkow and Harbine lead in average yield under dryland conditions and lead the true winter-type strains by considerable margins in spite of winter injury in some years. They also produce more forage. Some winterkilling occurred in 5 of the 11 tests but serious losses in stand occurred only in 1951. Under irrigation, the best yields were from Tenkow, Reno, Texan and Rogers. Reno produced relatively much better under irrigation than in dryland tests. Kearney ranked eighth on dryland and seventh under irrigation, but has some advantage in its high degree of winter hardiness and resistance to greenbugs.

TABLE 5. COMPARABLE YIELDS OF SPRING-SOWN BARLEY AT AMARILLO

Variety	1948	1949	1952	1954	1956	Average		Number tests
						For years grown	Comparable	
				Bushels				
Arivat		64.6		38.9		51.8	40.9	2
Harlan				39.0	45.8	42.4	37.8	2
Gem	16.8	66.2	20.4	39.2		35.7	36.9	4
Custer				41.4	40.7	41.1	36.4	2
Otis				42.4	39.2	40.8	36.2	2
Cordova				31.4	46.8	39.1	34.5	2
Munsing		46.5	26.7			36.6	34.2	2
Vaughn	17.1	57.7	19.4	35.4		32.4	33.7	4
Flynn	18.7	54.2	23.9	32.2	38.4	33.5	33.5	5
Atlas 46	14.1	58.0	18.1	35.2	34.0	31.9	31.9	5
Beecher	14.8	46.7	18.5	44.4	31.2	31.1	31.1	5
Plains	16.5					16.5	29.6	1
Spartan	13.5	46.7				30.1	27.9	2
Stavropol	15.3	42.8	10.4	35.8	32.4	27.3	27.3	5
Feebar	18.8	42.2	11.9	26.9		25.0	26.2	4
Club Mariout	15.1	44.3	14.1	30.5	24.9	25.8	25.8	5
Texan	16.3	35.2	13.2	25.5	38.1	25.7	25.7	5
Wintex	14.2	42.3	6.6	25.5	37.4	25.2	25.2	5

Figure 8 shows the survival of Kearney as compared with Reno and Ward at Amarillo, 1951. Recommended varieties for this area are Kearney, Cordova, Harbine and Rogers. Wintex, Reno, Ward and Pueblo also may be considered satisfactory. Little Tenkow or Texan seed are available.

Spring seeding also may be practiced in area 1. Only limited tests of spring seeding have been made. All tests were under irrigation and averages were based on tests harvested. A test in 1950 was destroyed by greenbugs and one in 1955 was destroyed by March freezes. Spring-seeding conditions were unfavorable in 1951, 1953 and 1956. Annual and average yields are given in Table 5.

Arivat, Harlan, Gem and Custer have produced the highest comparable yields of spring-sown barley at Amarillo, although the number of tests is small. Yields probably are higher than may be expected under farm conditions. Of varieties grown for 5 years, Flynn, Atlas 46 and Beecher have the highest average. Commercial seed of these varieties generally are not available in this area but may be obtained from commercial sources or from the respective states from which they were distributed. Arivat, Gem, Custer, Flynn, Atlas 46 and Beecher originated respectively in Arizona, Utah, Nebraska, Kansas, California and Colorado. The spring-sown barley variety tests grown in nursery plots at Amarillo are shown in Figure 9.

TABLE 6. YIELDS OF FALL-SEEDED VERSUS SPRING-SEEDED WINTEX BARLEY AT AMARILLO

Year	Wintex barley			
	Spring		Fall	
	Irrigated	Dryland	Irrigated	Dryland
		Bushels		
1939	16.2	4.8	43.6	31.8
1940	14.9	0	39.4	8.7
1941	56.5	53.3	71.8	75.6
1942		8.3		15.6
1949		42.3		51.9
1952		6.6		13.4
1954	25.5		10.1	
Average	28.3	19.2	41.2	32.9

A comparison of fall-seeded versus spring-seeded barley at Amarillo, using the same variety (Wintex) is shown in Table 6. Since 1939, the variety has been included in most fall and spring seedings. The fall seedings were injured or killed in 1943, 1948, 1950 and 1951. On the other hand, spring seedings were destroyed by drouth in 1943, 1947, 1950, 1951, 1953 and 1955. This leaves seven seasons in which comparisons can be made. The fall-seeded Wintex has averaged 41.2 bushels compared with 28.3 for spring seeding.

Area 2

This area is made up largely of the land-use areas designated as the Rolling Plains and North Central Prairies. A considerable proportion of these areas is in grass. Small grains are

Figure 9. Spring-sown barley nursery, Amarillo, 1951.

TABLE 7. COMPARABLE YIELDS AND AGRONOMIC DATA FOR FALL-SOWN BARLEY VARIETIES GROWN AT TESTING STATIONS IN AREA 2, 1949-57

Variety	Irrigated tests[1]		Dryland tests[2]		Test weight, pounds	Date, first head	Date, full ripe	Plant height, inches	Estimate of forage value[3]
	Yield of grain, bushels	Number comparisons	Yield of grain, bushels	Number comparisons					
Harbine	50.4	8	23.1	13	45.8	4-13	5-19	19	102
Rogers	56.5	4	21.9	8	46.3	4-16	5-20	21	106
Cordova	40.7	9	21.1	14	43.8	4-10	5-21	19	112
Texan	37.5	7	20.4	8	42.4	4-8	5-22	19	117
Tenkow	43.6	6	18.4	8	42.9	4-17	5-23	19	121
Ward	43.8	9	18.1	14	44.4	4-19	5-23	20	99
Wintex	42.2	9	16.4	14	42.8	4-17	5-24	18	100
Reno	43.5	5	16.1	8	42.6	4-19	5-24	18	100
Pueblo	40.8	4	16.1	10	43.8	4-17	5-24	19	100
Tennessee Winter	37.2	9	15.0	14	42.0	4-15	5-20	19	103
Mo. Early Beardless	28.3	9	14.8	14	39.5	4-10	5-18	20	109
Dicktoo	41.6	4	14.5	10	45.6	4-20	5-27	19	90
Kearney	45.5	7	13.6	12	45.6	4-19	5-25	20	96

[1]Iowa Park only.
[2]Chillicothe, Abilene and Spur.
[3]Visual estimate of forage value, Wintex 100 percent.

grown on the heavy soils and cotton, grain sorghum or other feed crops on the sandy soils. The area ranges from 1,000 to 2,300 feet in elevation and lies roughly in the 20 to 30-inch rainfall belt. Winter temperatures are fairly severe but plants usually continue well hardened by low night temperatures and barley seldom is winterkilled. The intermediate winter-type varieties are sufficiently hardy and yield better than true winter-type varieties.

Performance trials have been conducted for many years at Iowa Park and Chillicothe. Less extensive trials have been conducted at Spur since 1949 and at Abilene since 1953, but drouth has caused low yields or loss of the tests. A summary of performance tests for the area is given in Table 7 with the irrigated test in Iowa Park reported separately because only a small commercial acreage is irrigated.

The Harbine, Rogers, Cordova and Texan varieties have produced the highest average yields in dryland tests, and these are considerably higher than the winter-type varieties, Reno and Kearney. Under irrigation at Iowa Park the yields vary widely, with Rogers and Harbine producing outstanding yields. Recommended varieties are Harbine, Rogers, Cordova and Texan.

Area 3

This area is made up of the northern parts of the West Cross Timbers, Grand Prairie and Blackland Prairies. The elevation varies from 600 to 900 feet and the average rainfall is 28 to 38 inches. While the winters are relatively mild, they are subject to wide extremes which may cause rapid growth of plants in winter followed by a rapid drop in temperature and subsequent killing of barley leaves or reduction in stands. Late spring freezes may damage the crop after jointing or heading starts.

Barley is well adapted to this area, except for the hazards of temperature just mentioned, and the crop fits well into farming systems. The returns to the farmer from winter grazing often approach the value of the grain crop of barley. Performance trials of barley have been conducted at Greenville, Denton and Stephenville in this area throughout the period reported. Data summarized for the area are given in Table 8.

Fall seeding is preferable to spring seeding because of the value of winter pasture and because it produces higher grain yields. Comparative yields of fall sown and spring-sown barley at Denton are given in Table 9.

TABLE 8. COMPARABLE YIELDS AND AGRONOMIC DATA FOR FALL-SOWN BARLEY VARIETIES GROWN IN AREA 3, 1949-5

Variety	Yield of grain, bushels	Number comparisons	Test weight, pounds	Date, first head	Date, full ripe	Plant height, inches	Percent leaf rust
Cordova	35.5	25	44.8	4-17	5-22	23	33
Rogers	33.5	11	46.5	4-25	5-23	25	
Texan	33.4	25	44.8	4-16	5-22	23	25
Tenkow	30.5	17	41.4	4-22	5-23	24	24
Harbine	30.5	20	44.4	4-22	5-23	24	23
Mo-B-400	30.4	7	43.5	4-16	5-21	25	
Wintex	28.0	25	44.3	4-22	5-24	22	27
Tennessee Winter	24.8	25	42.9	4-20	5-22	22	38
Ward	24.7	25	43.6	4-23	5-23	24	48
Kearney	24.1	16	43.6	4-22	5-23	24	39
Mo. Early Beardless	20.4	25	40.0	4-16	5-19	24	28
Reno	18.5	16	43.7	4-24	5-24	23	43

TABLE 9. COMPARISONS OF FALL AND SPRING-SEEDED BARLEY AT DENTON, 1936-57

Variety	Number comparisons	Yield of grain, bushels	
		Fall sown	Spring sown
Wintex	13	26.3	20.2
Texan	11	26.7	21.8
Cordova	3	30.3	17.3

Cordova ranks first in grain production, averaging 35.5 bushels per acre or 1,675 pounds per acre. Rogers, Texan, Tenkow and Harbine rank next in order among the commercial varieties tested. The true winter-type varieties are considerably less productive in this area and produce less winter pasture. Recommended varieties are Cordova, Rogers, Texan and Harbine. A good field of Cordova barley at Plano (Collin county), Texas, 1953, is shown in Figure 10.

Figure 10. A good field of Cordova barley on a farm near Plano, 1953.

Area 4

This area differs from area 3 principally in the degree with which temperature influences the crop. However, in addition to the land resource areas mentioned for area 3, it includes portions of the Edwards Plateau and Central Basin. Winters are mild in this area and winterkilling normally is not a factor in production. More severe conditions and late spring frosts characterize the Edwards Plateau area where the elevation also is higher, ranging up to 2,000 feet in some parts.

Performance tests for area 4 were conducted at McGregor on Grand Prairie soil, at Temple on the Blackland Prairie type soil and at Comfort in the Edwards Plateau. Data are summarized in Table 10. Cordova has led all other varieties by a wide margin and is the only variety generally recommended for this area, although Texan is satisfactory. Harbine has yielded well in the Edwards Plateau area but under some conditions may not head normally. The true winter-type varieties such as Kearney are poorly adapted in this area, while Goliad is subject to injury by low temperatures, especially late spring freezes.

Area 5

This area is made up of the Coast Prairie, the southern part of the Blackland Prairie and parts of the Rio Grande Plain. Winters are mild, except for occasional freezes and spring-type small grains may be grown from fall seeding. Since diseases are limiting factors in the use of the crop for forage as well as grain, only Goliad, developed for use in this area, is recommended.

Limited performance trials with Goliad, Cordova and experimental strains have been carried out at Beeville, Prairie View, College Station and Lockhart. Failures have been frequent. Owing to the dry seasons of recent years, Cordova actually has yielded better than Goliad but this may not be expected under normal conditions. Arivat has been introduced by seedsmen and sold for forage purposes, but no yield data are available on this variety.

Area 6

This area is made up largely of the East Texas Timberlands which for the most part is a sandy soil area with average annual rainfall of more than 40 inches. Only limited acreages of barley are grown, but there has been increasing interest in the crop because of the expansion of livestock production. No performance tests have been conducted in this area, but based on

TABLE 10. COMPARABLE YIELDS AND AGRONOMIC DATA FOR FALL-SOWN BARLEY GROWN AT STATIONS IN AREA 4, 1949-57

Variety	Yield of grain, bushels	Number comparisons	Test weight, pounds	Date, first head	Date, full ripe	Plant height, inches	Estimate of forage value[1]
Cordova	34.9	18	42.3	4-10	5-16	24	107
Texan	31.6	18	41.9	4-8	5-17	25	100
Harbine	29.3	16	42.6	4-17	5-19	24	94
Wintex	28.7	6	39.9	4-17	5-18	25	101
Tennessee Winter	25.1	17	40.5	4-13	5-17	25	92
Tunis	24.8	3	39.9	4-6	5-15	21	
Mo. Early Beardless	24.5	17	37.9	4-9	5-15	28	90
Calhoun 4	23.6	2	37.8	4-19	5-18	17	105
Calhoun 3	23.6	3	38.4	4-19	5-18	20	92
Goliad	22.5	18	41.9	4-2	5-17	26	119
Kearney	19.7	9	40.6	4-13	5-21	26	86

[1]Visual estimate of forage value, Texan 100 percent.

TABLE 11. COMPARATIVE YIELDS AND AGRONOMIC DATA FOR FALL-SOWN BARLEY VARIETIES IN AREA 5

Item	Goliad	Cordova
Grain yield, bushels per acre		
College Station, 1955	21.8	35.0
College Station, 1956	31.1	38.6
Lockhart, 1955	14.9	14.6
Prairie View, 1956	12.6	14.7
Test weight, pounds	44.0	45.0
Forage value, estimate	100.0	78.3
Reaction to leaf rust[1]	R	S
Reaction to stem rust[1]	R	S
Reaction to spot blotch[1]	R	S
Reaction to net blotch[1]	S	MR

[1]R = resistant, MR = moderately resistant, S = susceptible.

records in adjoining areas, Cordova is recommended.

Area 7

Very little barley is grown in area 7 and no yield trials have been made. Based on records in adjoining areas, it is suggested that Cordova would be satisfactory for grazing purposes and for grain production in the limited areas where irrigation water is available. Recently, the variety Arivat has been grown successfully in the El Paso area.

DISEASES

A number of diseases attack barley under Texas conditions, and may be of considerable importance in grain or forage production. In South Texas, where humidity is high and frequent showers occur during the winter, several diseases may influence the value of the crop for winter pasture and also may prevent grain production. Barley matures so early in the main grain producing areas that often it escapes damage from foliage diseases. A discussion of the more important diseases together with suggested measures for their control follows.

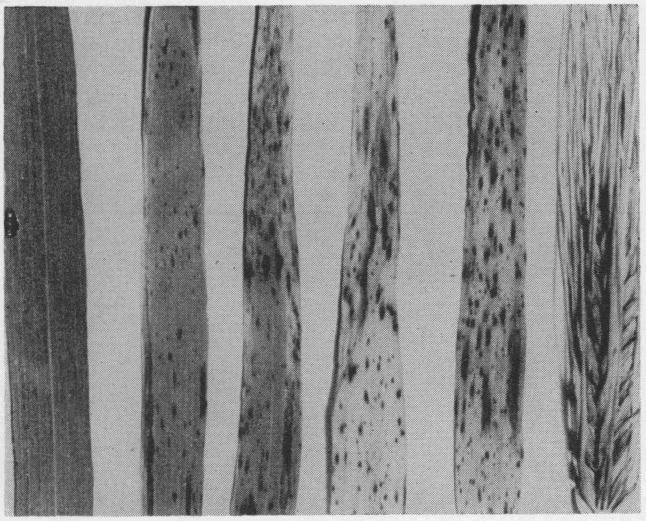


Figure 11. Normal Goliad barley leaf (left) is shown in contrast with leaves infected with net blotch (center) and infected head (right).

Net Blotch

Net blotch, *Pyrenophora teres* (Died.) Drechs., has become important in South Texas with the increase in commercial acreage of the Goliad variety. In some seasons the foliage has been badly damaged, not only reducing its value but making it unpalatable to livestock. The disease is carried on the seed and also is transmitted by airborne spores from old barley stubble and other sources. Seedlings may be attacked as they emerge and stands may be reduced. The young plants develop brown reticulate blotches near the tips of the blades. Local lesions develop on the leaves, forming a brown reticulate pattern which later may coalesce into dark brown stripes. On the kernel a light brown discoloration with conspicuous netted appearance is characteristic. Figure 11 shows this disease on Goliad barley. Damage is caused by reduced stands, destruction of foliage and reduction in kernel weight. None of the commercial varieties adapted in Texas is highly resistant. Adequate and efficient control can be effected only by breeding resistant varieties. Seed treatment with organic mercury fungicides will reduce seedling injury, but there is no means of preventing the spread of airborne inoculum.

Spot Blotch

Spot blotch, *Helminthosporium sativum* Pam., King et. Bakke, attacks a wide range of grasses as well as barley and wheat. Both seedlings and more mature plants may be attacked, since the disease is both seedborne and airborne. Infected seedlings have dark brown lesions near the soil line or extending into the leaf blade. The leaf spots vary in size and shape but have definite margins. The color is uniformly dark brown and the spots coalesce to form large blotches. The older leaves develop an olivaceous cast and then dry up. Lesions occur on the kernels and later form a characteristic "black point" end on the kernel. The disease reduces tillering and stunts the plant, so that heads are poorly exserted and the kernels are reduced.

Goliad is moderately resistant to spot blotch. Other adapted commercial varieties are susceptible. Seed treatment with organic mercury dusts or slurry fungicides greatly reduces seedling losses and damage.

Barley Stripe

Barley stripe, *Helminthosporum gramineum* Rabh., is not common in Texas but it may occur. Infected seedlings develop yellow stripes which turn brown as tissues are killed and later the leaves fray and split lengthwise. Plants may be seriously stunted and often develop an olive-gray color. No adapted resistant varieties are available, but seed treatment with organic mercury fungicides will control the disease.

Powdery Mildew

Powdery mildew, *Erysiphe graminis* DC., occurs rather generally in the State when fav-

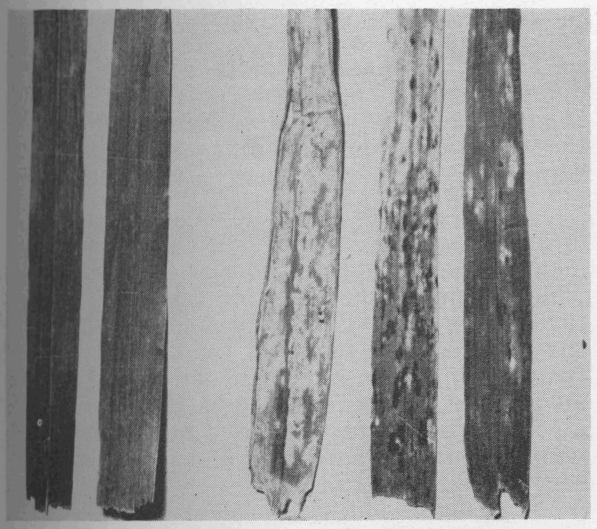


Figure 12. Normal barley leaves (left) compared with leaves infected with powdery mildew (right).

orable conditions such as high humidity, cloudy skies, frequent showers and cool temperatures occur. The disease disappears when the weather becomes hot and dry. Powdery mildew develops as gray mycelium on the leaves and leaf sheaths. The host tissues become yellow, then brown, and gradually die as the fungus invades the tissue. Later, tiny black dots, the fruiting bodies of the fungus, may appear on the leaf. The leaf tissue is reduced, plant growth is retarded and serious losses in yield result from severe cases. The disease is spread by airborne spores.

While the disease can be controlled with sulfur and perhaps other new fungicides, such control is not practical for commercial grain fields. The most economical control consists of growing resistant varieties. Fortunately, Cordova, Texan, Rogers, Harbine and Goliad are resistant to prevalent races in Texas, although there may be races of mildew which can attack them in other states. Wintex, Tenkow, Reno,

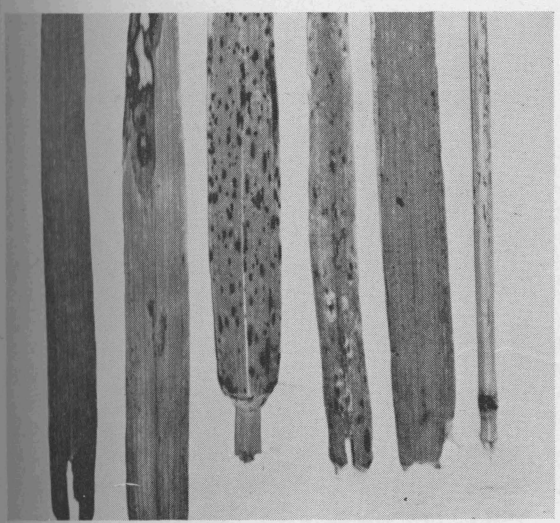


Figure 13. Foliage diseases of barley. Left to right: normal leaf, scald, net blotch, mildew, leaf rust and stem rust.

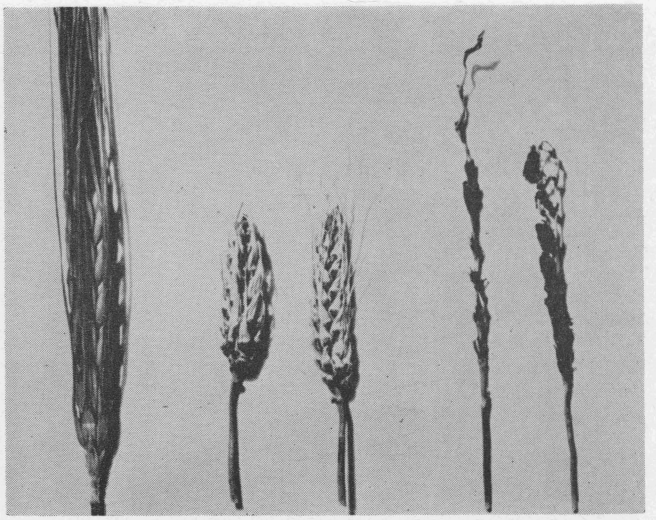


Figure 14. Normal spike of barley (left) compared with heads destroyed by covered smut (center) and loose smut (right).

Ward and Tennessee Winter are very susceptible. Leaves infected with powdery mildew are shown in Figure 12.

Rusts

Both leaf rust, *Puccinia hordei* Otth., and stem rust, *Puccinia graminis* Pers., attack barley under some conditions but the crop matures too early in most seasons for the diseases to cause serious losses in the major barley-producing areas of the State. Of possibly greater importance is the fact that the barley in South Texas may serve as a host for overwintering and early increase of these rusts, which then may spread to more northern growing areas. Goliad is resistant to many races of stem rust, but all other varieties grown in Texas are susceptible. Goliad, Harbine and Rogers are resistant to some races of leaf rust but susceptible to others. The development and growing of resistant varieties is the only presently known practical method for the control of these diseases.

Other Foliage Diseases

Several other foliage diseases occur occasionally and may become important in the future. These include scald, *Rhynchosporium secalis* (Oud.), J. J. Davis, which was observed for the first time in 1957; bacterial blight, caused by *Xanthomonas translucens*, L. R. Jones, A. G. Johnson and Reddy Dowson; stripe mosaic, a seedborne virus disease; and brown spot, considered nonparasitic. During the last few seasons numerous plants and small areas in barley fields have been affected by what is believed to be yellow dwarf, a virus disease transmitted by aphids. The extent of the disease is not known but it is potentially important. Some of these diseases are shown in Figure 13.

Smuts

Three smuts occur on barley in Texas. Covered smut, *Ustilago hordei* (Pers.) Lagerh., is

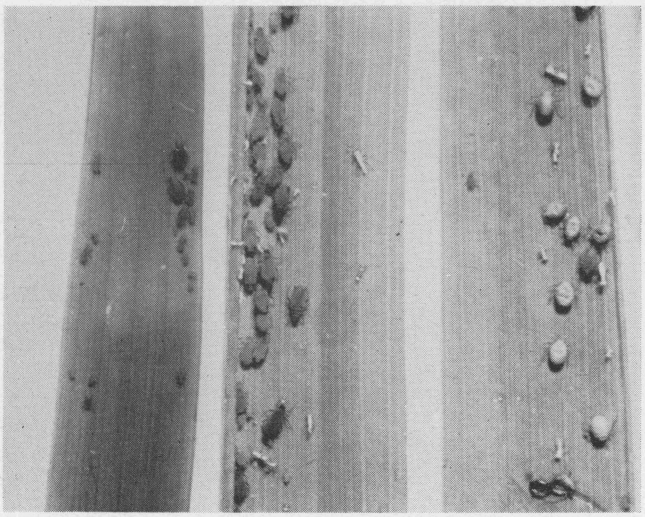


Figure 15. Greenbugs on leaf of barley (left), corn leaf aphids (center) and parasitized aphids (right).

transmitted on the seed and beneath the hull covering and from there it infects the young seedling during or immediately following germination. A head of barley infected by covered smut is shown in Figure 14. Control of this smut with organic mercury compounds or other approved dust or slurry treatments is relatively easy. (Note: All seed disinfectants are poisonous and sometimes even irritating to the skin. Follow manufacturers' recommendations carefully and use masks if the fumes are encountered when treating seed.)

The two types of loose smut are similar in appearance. Both destroy the floral parts and entire head, Figure 14. One is called black or semiloose smut, *Ustilago nigra* Tapke, and the other, brown loose smut, *Ustilago nuda* (Jens.) Rostr. The brown loose smut infects the ovary at blooming time and is carried as mycelium within the seed, where it cannot be destroyed by dust or slurry disinfectants. The black or semiloose smut is similar in general appearance but the spores are carried in the husk of the seed and the disease can be controlled by seed disinfectants. The ideal control for smuts is to grow resistant varieties. Fortunately, most of the varieties grown in Texas have considerable resistance or field tolerance to loose smut.

Until recently, the only method of controlling loose smut was the modified hot water treatment. A new soak method now has been devised which removes the need for controlled temperature treatments[1]. This method consists of soaking the infected seed in water for 2 to 6 hours, and then holding the soaked seed for 34 to 38 hours in an airtight container, such as an oil drum with a cover. Grain must be dried immediately afterward to prevent sprouting and to permit normal seeding with a drill.

INSECTS

A number of insects may cause serious damage to barley if conditions for their development are favorable. A complete description of these insects with control measures for each is given in Texas Agricultural Experiment Station Bulletin 845, "Greenbugs and Some Other Pests of Small Grains," November 1956.

Perhaps the most serious insect pest of barley is the greenbug (aphid), *Toxoptera graminum* (Rond.). This insect prefers barley to other small grains. Several other aphids also may attack barley but usually they do not cause serious damage. Greenbugs cause a characteristic yellowing or reddening of the leaf tissue where they feed. Under favorable conditions for greenbug reproduction, entire plants may be killed causing small to large yellow or dead areas in fields. If the infestation continues, these spots may enlarge rapidly and engulf the entire field. Green

[1]Hebert, T. T. A new method of controlling loose smut of barley. Plant Disease Reporter 39:20-22, 1955.

Figure 16. Controlled environment laboratory at the Denton station where varieties of barley are tested for reaction to greenbugs.

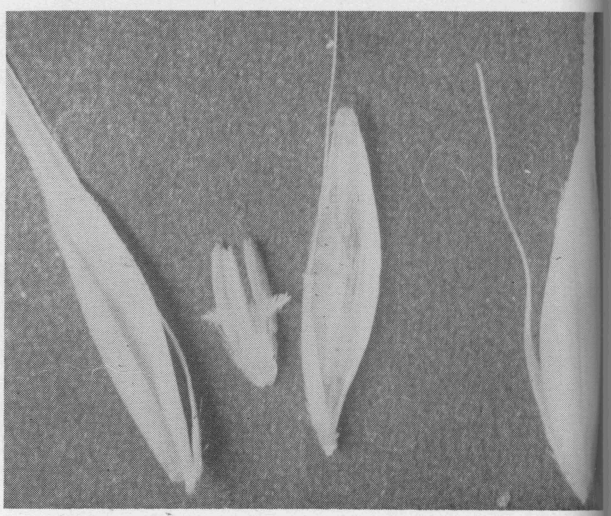


Figure 17. Barley floret (left) has been separated to show outer glume, inner glume and flower parts compared with unopened floret (right).

bugs, along with the killing of tissue, are shown on the leaf in Figure 15.

Effective insecticidal sprays for the control of aphids have recently become available but under many conditions are too expensive for practical use. Greenbug resistant barley varieties have been found and this resistance now is being transferred to adapted varieties through modern breeding methods. Figure 16 shows the controlled environment laboratory at Substation No. 6, Denton, where varieties and hybrid strains are tested for their reaction to greenbugs.

IMPROVEMENT WORK

As part of the small grain improvement program in Texas, breeding work to improve barley is carried on at College Station, Denton, Chillicothe and Amarillo. All new varieties and many experimental strains from adjoining states are tested in the Intra-State Barley Performance tests at 15 to 20 locations.

The development of a new variety of barley requires from 10 to 15 years and often involves a major investment of research funds. However, if the new variety yields more or has advantages in disease or insect resistance, or other favorable characteristics, then the increased revenue in yield or the reduction in a growing hazard will return large dividends on the research expenditure when projected to a large acreage.

Barley is self-fertile and varieties must be cross-pollinated by hand to produce a hybrid. After the cross is made, selected progenies must be grown for 4 to 8 years before true breeding strains can be obtained for testing. Because tedious hand pollination is necessary, the production of commercial hybrid seed, such as is done with corn, is impractical. Several years are necessary for thoroughly testing the new lines and determining their adaptation. Provided a new superior strain is found, several additional years are necessary to get this new variety into commercial production. Figure 17 shows the floral parts of a barley flower.

Figure 18. Barley nursery test at the Denton station where hundreds of strains are tested.

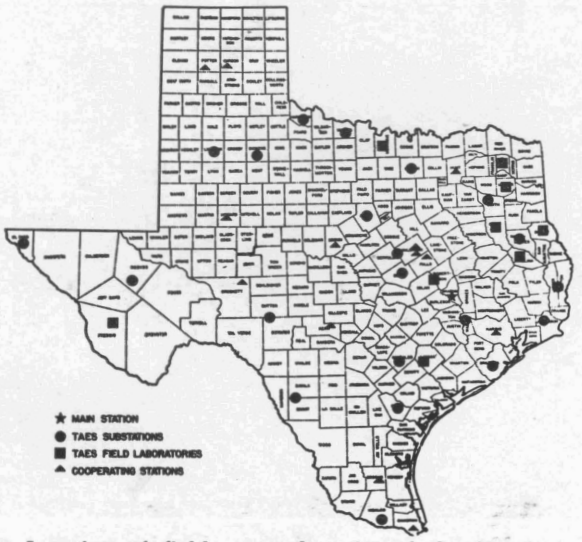
Figure 19. Harvesting field plots of barley varieties at Denton, where final tests are made before release of new varieties.

Varieties of many characteristics are needed to fit specific needs of the several areas because of the wide range of climatic conditions in Texas. Characteristics that must be considered include resistance to cold, drouth, diseases, insects, lodging, shattering, test weight and value for winter pasture. All these may contribute in part to grain production or value to the grower. Figure 18 shows the extensive barley nursery at the Denton station where hundreds of strains are tested. Figure 19 shows the more advanced plot tests of barley in the final stages of testing before distribution to growers.

ACKNOWLEDGMENTS

These investigations were conducted cooperatively by the Texas Agricultural Experiment Station and the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture.

Acknowledgment is made of the cooperation of all substation personnel who have conducted varietal trials, disease or insect studies and cultural tests which form the basis of these recommendations.



Location of field research units of the Texas Agricultural Experiment Station and cooperating agencies

State-wide Research

★

The Texas Agricultural Experiment Station is the public agricultural research agency of the State of Texas, and is one of ten parts of the Texas A&M College System

ORGANIZATION

IN THE MAIN STATION, with headquarters at College Station, are 16 subject-matter departments, 2 service departments, 3 regulatory services and the administrative staff. Located out in the major agricultural areas of Texas are 21 substations and 9 field laboratories. In addition, there are 14 cooperating stations owned by other agencies. Cooperating agencies include the Texas Forest Service, Game and Fish Commission of Texas, Texas Prison System, U. S. Department of Agriculture, University of Texas, Texas Technological College, Texas College of Arts and Industries and the King Ranch. Some experiments are conducted on farms and ranches and in rural homes.

OPERATION

THE TEXAS STATION is conducting about 400 active research projects, grouped in 25 programs, which include all phases of agriculture in Texas. Among these are:

Conservation and improvement of soil	Beef cattle
Conservation and use of water	Dairy cattle
Grasses and legumes	Sheep and goats
Grain crops	Swine
Cotton and other fiber crops	Chickens and turkeys
Vegetable crops	Animal diseases and parasites
Citrus and other subtropical fruits	Fish and game
Fruits and nuts	Farm and ranch engineering
Oil seed crops	Farm and ranch business
Ornamental plants	Marketing agricultural products
Brush and weeds	Rural home economics
Insects	Rural agricultural economics
Plant diseases	

Two additional programs are maintenance and upkeep, and central services.

Research results are carried to Texas farmers, ranchmen and homemakers by county agents and specialists of the Texas Agricultural Extension Service

AGRICULTURAL RESEARCH seeks the WHATS, the WHYS, the WHENS, the WHERES and the HOWS of hundreds of problems which confront operators of farms and ranches, and the many industries depending on or serving agriculture. Workers of the Main Station and the field units of the Texas Agricultural Experiment Station seek diligently to find solutions to these problems.

Today's Research Is Tomorrow's Progress