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Barley Production in Texas

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Summary

Barley is grown in Texas on a less extensive scale than wheat or oats, but it has unique characteristics as a feed and winter pasture crop. The acreage is widely distributed, but the majority is grown in North and Northwest Texas. All barley grown for grain is used for livestock feed, but large acreages are grown exclusively for winter forage.

Most barley is fall sown, although when spring moisture conditions are favorable, small acreages may be spring sown in northwest Texas. Because of the wide range of climatic conditions in Texas, winter, intermediate-winter and spring types are needed to provide adapted varieties for all areas. Cold tolerant, winter-type varieties, such as Will, Harrison and Kearney are adapted to the High Plains, Texas Extension Districts 1 and 2. Less cold tolerant, intermediate-winter type varieties, such as Cordova, Era, Wintex, Zora and Rogers are adapted to central, north central and the Rolling Plains areas. Spring-type varieties are adapted to fall seeding in the southern one-third of Texas. Barley performance trials are grown at from 8 to 12 locations each season and provide information on the best adapted varieties for each growing area.

Diseases are important in barley production in the eastern half of the state and are frequently limiting factors in production in southern Texas. The leaf diseases caused by several Helminthosporium species cause the greatest losses, and no satisfactory means of control is known. Leaf rust and mildew cause damage in some seasons, but resistant varieties are available.

The greenbug (a species of aphid) is the major insect attacking barley. Several other species of aphids attack the crop but are less damaging. Greenbugs, as well as some other aphid species, may transmit the barley yellow dwarf virus disease. Three varieties of barley, Will, Kearney and Era, are resistant to the greenbug but not to other aphids. Insecticides are available for control of aphids and mites where such is practical. Other insects and mites which at times attack barley are winter grain mites, brown wheat mites, chinch bugs, armyworms and cutworms.

Work to improve barley is in progress. Objectives of this research include the development of higher yielding varieties for each growing area, the improvement of forage production and characteristics and the breeding of disease and insect resistant adapted varieties. Hybrid barley research is in progress, but no adapted hybrid seed is yet available to Texas growers.

ADAPTED BARLEY VARIETIES FOR GROWING AREAS

Area	Extension districts	Fall seeding	Spring seeding
I	1, 2	Will, Harrison, Kearney, Chase, Rogers	Arivat, Cordova, Era, Rogers
II	3, 6, 7	Cordova, Rogers, Zora, Era, Will	Cordova, Era, Rogers
III	4, 5,	Cordova, Zora, Era, Rogers	none recommended
IV	8, 9, 11	Cordova, Zora, Rogers, Era	none recommended
V	10, 12	Goliad, Arivat, Florida 102	none recommended

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BARLEY RANKS WELL BELOW WHEAT AND OATS in acreage, production and value in Texas but deserves further consideration by growers in certain areas because of its dual value as a feed grain and winter pasture crop. Expansion of livestock feeding in Texas and the recent development of cold tolerant varieties adapted to northwest Texas now provide a better market for the crop and more stable production.

During the 10-year period, 1959-68, barley was seeded on an average of 367,700 acres. The average harvested acreage, 219,900 acres, was much smaller because large acreages are seeded exclusively for livestock pasture and some acreage is lost to drouth or winterkilling each year. The largest acreage of barley in Texas was in 1961 when 582,000 acres were seeded, producing 10,104,000 bushels of grain. The smallest harvested crop since 1952 was in 1967 when only 75,000 acres were harvested. Annual acreages and production figures for 1959-68 are given in Table 1. The distribution of barley in Texas is shown in Figure 1.

AREAS OF ADAPTATION

Barley is grown over a wide range of climatic conditions and on many soil types in Texas. It does best on well-drained soils of moderate to high fertility and is not well adapted to areas having high rainfall, high humidity or poorly drained soils. Barley is more tolerant of high salt concentrations in irrigated areas than are the other small grains.

Climatic conditions, especially low winter temperatures, amount and distribution of rainfall and humidity are important in establishing the limitations of barley varieties. The crop thrives best in a cool

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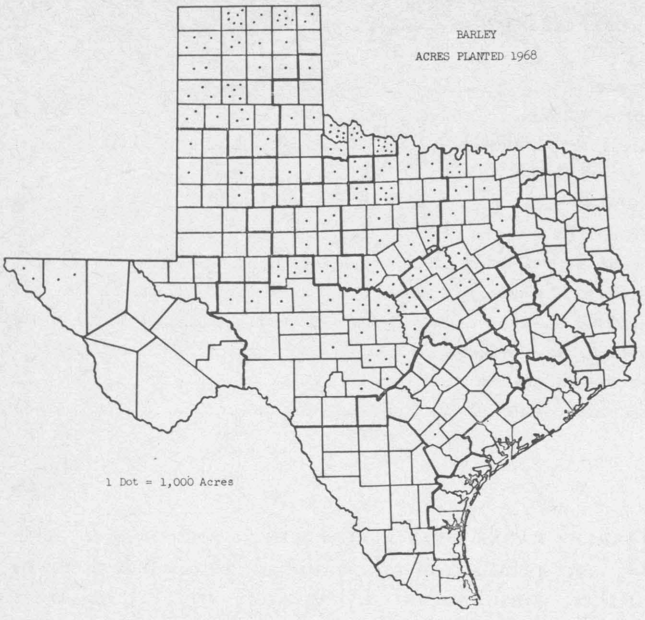

Figure 1. Seeded acreage of barley, Texas, 1968.

climate; hence, nearly all Texas barley is fall sown and grown during the winter and spring months. Harvest of the crop begins in May in central Texas and is completed in early June in northwest Texas. When favorable spring moisture conditions prevail, some barley is seeded in early spring (February or March) in northwest Texas.

Barley is rather widely distributed throughout the state, but the largest acreages are in north and northwest Texas. It is usually grown on the "tighter" soils of these areas and is less frequently sown on sandy soils. Winterkilling in varying degrees and extent occurs in some years. Only very cold tolerant, winter-type varieties should be fall sown in the High Plains area. When the crop is winterkilled, a spring-sown crop may be substituted, but this usually produces lower yields. Fall seeding is almost exclusively practiced in other parts of the state.

For research purposes, to determine the range of adaptation of varieties and for easy reference in making recommendations, the state has been divided into five research areas, Figure 2. These research areas include Extension Districts, as designated, which have fairly similar climatic conditions. However, these are only guidelines as conditions may overlap the designated areas. Data on elevation, soil type and climatic characteristics are given for the representative stations in the research areas in Table 2. Acreages and production of barley by Extension Districts and research areas are given in Table 3.

TABLE 1. STATISTICAL DATA ON BARLEY ACREAGE AND PRODUCTION IN TEXAS, 1959-68[1]

Year	Acreage Seeded	Acreage Harvested	Production, bushels	Yield per acre, bushel	Farm price per bushel
1959	481,000	300,000	6,300,000	21.0	$0.80
1960	524,000	405,000	9,518,000	23.5	0.79
1961	582,000	421,000	10,104,000	24.0	0.87
1962	454,000	227,000	3,859,000	17.0	0.94
1963	450,000	180,000	3,780,000	21.0	0.92
1964	360,000	200,000	4,400,000	22.0	0.87
1965	248,000	142,000	2,698,000	19.0	0.90
1966	211,000	125,000	2,750,000	22.0	0.98
1967	175,000	75,000	1,350,000	18.0	1.00
1968	192,000	124,000	3,348,000	27.0	0.89
Average	367,700	219,900	4,810,700	21.9	0.90

[1]Data furnished by the U.S. Department of Agriculture, Statistical Reporting Service, Austin, Texas.

USES OF BARLEY

Grain

All barley grain produced in Texas is used for livestock feed. Barley is an excellent grain for fattening cattle, lambs, goats or hogs. Also, it may be used for chickens (1). It is approximately equal in feeding value to corn and grain sorghum, but it has more crude fiber and slightly higher values of protein, ash and digestible nutrients. It is lower in nitrogen-free extract and productive energy per 100 pounds of feed, Table 4.

Winter pasture

Barley is an excellent winter pasture, Figure 3. While the total seasonal production for barley is not greatly different from that of oats or wheat, it grows

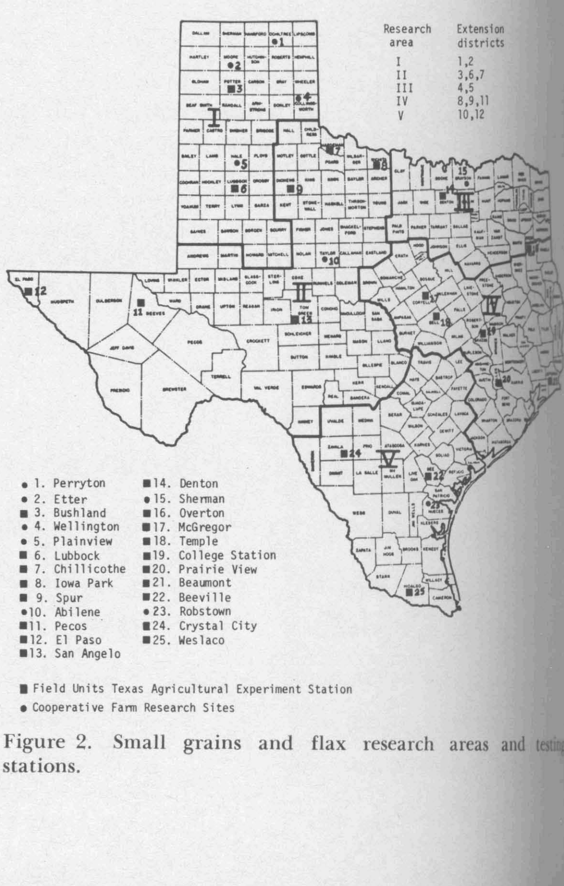

Figure 2. Small grains and flax research areas and testing stations.

TABLE 2. ELEVATION AND SELECTED CLIMATOLOGICAL DATA FOR RESEARCH STATIONS IN TEXAS

Location	Elevation	Number years record	Precipitation, long-time mean: Annual	Precipitation, long-time mean: Growing season[1]	Mean temperatures: Maximum	Mean temperatures: Minimum	Mean temperatures: Mean	Length of growing season	Average date of: First fall frost	Average date of: Last spring frost
Area I:										
Perryton	2930		20.4	12.0	70.7	42.1	57.0	185	October 22	April 20
Bushland	3825	26	18.3	11.0	72.0	42.0	57.0	192	October 28	April 18
Plainview	3370	36	19.0	11.9	73.7	45.7	59.7	206	November 2	April 10
Wellington	2320		23.1	15.7	74.0					
Area II:										
Iowa Park	978	43	29.2	21.4	78.0	51.7	64.5	211	November 4	March 30
Chillicothe	1406	63	24.4	17.0	76.6	50.2	63.4	217	November 6	April 3
Abilene	1750	83	24.3	13.6	76.0	53.0	64.5	229	November 13	March 23
El Paso	3641	19	6.9	3.7	79.0	44.8	61.9	238	November 31	April 3
Area III:										
Denton	621	44	32.3	24.9	77.5	52.6	64.2	237	November 15	March 24
Stephenville	1466	27	26.9	23.8	77.1	53.3	65.2	239	November 13	March 21
Overton	520	63	43.9	28.7	76.3	55.3	65.8	249	November 17	March 12
Area IV:										
McGregor	713	34	31.6	27.6						
Temple	740	56	34.0	27.3	78.9	55.6	67.3	252	November 22	March 15
Area V:										
College Station	308	78	39.8	30.1	79.1	57.1	68.2	263	November 27	March 8
Prairie View	250	18	39.3	30.6	76.0	57.0	67.0	263	November 30	March 5
Beaumont	26	55	54.1	39.5	78.3	58.5	68.5	276	November 28	February 26
Beeville	240	78	29.8	22.2	82.1	60.0	70.9	291	December 6	February 20
Weslaco	100	25	27.3	19.9				311	December 23	February 15

[1]September through May.

off more rapidly in the fall and will furnish pasture more quickly than the other small grains. Forage yields, derived from clipping experiments, for barley and other small grains were summarized by Holt (11, 12) and Atkins (7). Data for local conditions may usually be obtained at the nearest research center or field unit, Cook (9), Baltensperger (8) and McLean and Norris (13). Under many conditions, barley produces a greater amount of forage during the fall season but may produce less than oats or wheat in the spring months. However, because barley is earlier in maturity, it may be injured more severely by late

TABLE 3. ACREAGES AND PRODUCTION OF BARLEY BY EXTENSION DISTRICTS AND RESEARCH AREAS, 1968

Extension district	Research testing area	Land use area	Number acres: Seeded	Number acres: Harvested	Percent harvested	Percent of state: Seeded	Percent of state: Harvested	Production, bushels
1	I	Northern High Plains	38,650	32,150	83	20.1	25.9	820,700
2	I	Southern High Plains	8,990	6,200	69	4.6	5.0	180,500
3	II	Low Rolling Plains	53,450	34,080	65	27.8	27.4	1,046,200
6	II	Trans-Pecos	10,750	6,450	60	5.6	5.2	139,750
7	II	Rolling Plains and Edwards Plateau	28,950	18,750	68	15.1	15.1	453,400
4	III	North Central Blacklands, Prairies and Cross Timbers	16,170	9,600	59	8.4	7.7	282,100
5	III	Northeast Timberlands	0	0				
8	IV	Central Blacklands, Prairies and Cross Timbers	29,430	15,380	54	15.3	12.4	417,050
9	IV	Central Blacklands, Prairies and Timberlands	2,260	200	9	1.4	0.1	
11	IV	Upper Coast and Southeast Timberlands	0					
10	V	South Central Blacklands, Prairies and Coastal Bend	2,750	200	7	1.4	0.1	2,900
12	V	Rio Grande Plain and South Texas	600	300	50	0.3	0.2	3,000
State Total			192,000	124,000	65			3,348,000

TABLE 4. ANALYSIS OF SOME TEXAS-GROWN GRAINS[1]

Crop	Protein	Crude fiber	Nitrogen free extract	Water	Ash	Digestible nutrients	Productive energy per 100 pounds
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

[1]Taken from "The composition and utilization of Texas feeding stuffs." Texas Agr. Expt. Sta. Bull. 461.

spring grazing than other crops if it is to be left to mature a grain crop. For the same reasons, it does not provide livestock pasture as late in the spring as oats or wheat where it is used exclusively for forage. Methods of clipping to evaluate varieties for forage production are shown in Figure 4. Grain yields may be damaged by mechanical clipping of forage. For example, barley clipped for forage evaluation at College Station from 1960 to 1964 yielded only 27.5 bushels per acre compared to 40.1 for unclipped plots. Top dressing with nitrogen at time of livestock "take-off" will greatly increase grain yields if moisture is available. Grazing by livestock can be equally as detrimental to grain production if the crop is grazed too close or too late in the season. If the crop is to be left to mature grain, livestock should be removed by March 1 in areas I and II and by February 15 in areas III, IV and V.

Other uses

Barley is an excellent winter cover crop for reducing or preventing wind and water erosion of soils. Plants emerge quickly and soon cover the ground to protect the soil. Barley grown on such soils may be left to develop a good green manure crop. While the crop can be made into a good quality hay if cut at early dough stage and before the awns become hard, it is not used extensively for hay. Barley grain grown in Texas is not used for malting. Only varieties developed for this special purpose are acceptable to the malting trade. Furthermore, the environmental conditions are usually not suitable for the production of grain of malting quality.

Figure 3. Supplementing grain rations with barley winter pasture in steer feeding operations, Blackland Research Center, Temple.

Figure 4. Clipping procedures to determine forage production of barley varieties: spring-type, erect seedling growth (left) and winter-type, postrate growth (right).

CULTURE

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

Barley may be either fall or spring sown in research area I, the High Plains. Fall-sown barley usually produces higher yields and better quality grain than spring-sown barley in all northern areas of Texas. Table 5 gives comparative yields of fall-sown and spring-sown Cordova barley in comparable years when no winterkilling occurred (4). Fall-sown barley also provides additional income from livestock

TABLE 5. COMPARATIVE YIELDS OF CORDOVA BARLEY FROM FALL AND SPRING SEEDING

Location	Fall sown	Spring sown
	– – Bushels per acre – –	
Denton, 1935-45	41.7	29.5
Denton, 1953-58	33.9	16.4
Bushland, 1939-44	37.7	20.3

pasture. Although low temperatures may damage the crop in some seasons, the risk has been reduced by the development of more cold tolerant varieties. When the fall-sown crop is winterkilled, spring-type varieties may be used for reseeding but usually yield less, Table 5. Under irrigation, barley may follow in sequence any of the adapted crops of the area, but if heavy tonnages of sorghum stubble are plowed under ahead of a barley crop, fertilizing with nitrogen to assist in decaying this residue is desirable. On non-irrigated soils, barley will be most successful when sown on summer-fallowed ground. A field of irrigated Rogers barley near Bushland is shown in Figure 5.

Barley has recently become of increased importance in Extension District 6, the Trans-Pecos area of area II. Reasons for increased interest in barley are its tolerance to salt concentrations which damage other irrigated crops and for its value in livestock feeding and in three-crop, 2-year rotations of cotton-barley-grain sorghum. Since winter temperatures are less severe in this area than in area I, intermediate-winter and spring-type varieties have been grown to provide both winter pasture and a grain crop.

Fall seeding of barley is the predominant practice in the Rolling Plains of research area II. Small acreages are spring sown, and the spring-sown proportion is increased when low temperatures kill the fall-sown crop. Only limited areas are irrigated, and little irrigated land is used for barley. On non-irrigated soils, barley produces yields and total income comparable to other crops. Fertilizer response in forage production is frequently greater than that in grain yields.

Fall seeding is almost universal in the northeastern, central and southern parts of Texas, research areas III, IV and V. As temperatures at seeding time are frequently high in these areas, barley germinates, establishes stands and provides forage more quickly than other small grain crops. Barley may follow any of the adapted crops if proper attention is given to control of weeds or volunteer grain. The acreage of barley in south Texas is small, and the crop is frequently damaged by leaf diseases. Spring-type, erect-growing varieties should be grown in this area.

Figure 5. Field of Rogers barley near Bushland.

Seedbeds should be firm and level. If the ground is to be plowed, this should be done sufficiently early to firm the seedbed before planting time. Relatively shallow tillage with one-way, disc plows or tandem discs may be desirable on row-crop land where the time between crops is short. Seeding should be done with a drill to insure uniform rate and depth of seeding.

Rates and dates of seeding vary greatly in Texas because of the wide range of climatic conditions and use of the crop. Suggested rates and dates are given in Table 6. Earlier seeding dates are suggested if the crop is seeded primarily for forage. However, early seeding may increase the problems of diseases and of greenbugs or other insects.

Direct combine harvesting of barley grain is the predominant practice throughout the state, Figure 6. Windrow harvesting, followed by threshing later with a pickup attachment, may be desirable where weeds are a problem, where there is danger of lodging or where there is difficulty in getting seed sufficiently dry for storage. Most varieties stand well for direct harvesting, but some may lodge or shatter if allowed to become overripe or grow excessively tall. The grain should be fully mature and have approximately 13 percent moisture for safe storage. Grain of high moisture may heat in storage, reducing its value for feed

TABLE 6. RATES AND DATES FOR SEEDING BARLEY

Research areas	Extension districts	Rates, pounds per acre		Seeding date: Fall		Seeding date: Spring
		Dryland	Irrigated	Grain and pasture	Grazing only	
I	1, 2	48	72	October 1	September 1	February 15
II	3, 6, 7	48	72	October 15	October 1	February 15
III	4, 5	72		October 15	October 1	February 1
IV	8, 9, 11	72		November 1	October 15	[1]
V	10, 12	72	72	November 1	October 15	[1]

[1]Spring seeding not recommended.

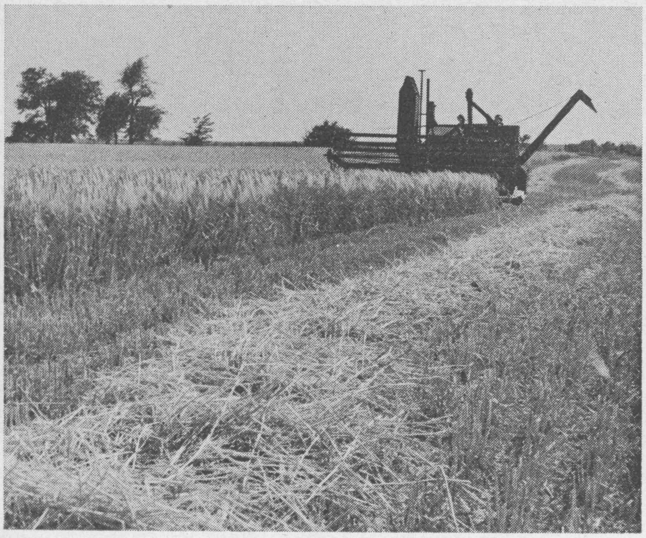

Figure 6. Field of Cordova barley near Dallas.

and destroying its ability to germinate. Rough-awned varieties, Figure 7, to be used for livestock feed should be threshed sufficiently close to break off and remove awn segments as these can cause damage to the mouths of livestock.

Barley and other small grains respond well to fertilizers (15). A soil analysis will provide the best basis for fertilizer recommendations for any location. The amount and distribution of rainfall will influence the extent to which fertilizer applications will be profitable. Revenue from improved livestock gains due to increased forage growth is frequently greater than that due to increased grain yields. Table 7 shows the response in forage and grain yield from fertilizer applications at selected locations. Direct placement of phosphorus component with the seed has been shown by Spence and Dudley (17) to increase forage growth and yield. Numerous tests in the Blackland soils of North Central Texas gave average yields of 38.0 bushels of wheat per acre when phosphorus was banded with the seed and 33.3 bushels when it was not banded with the seed. Growers should consult their nearest county agricultural agent for more details. Fertilizer recommendations are found in Extension Service Fact Sheets.

TABLE 7. FERTILIZER RESPONSE OF SMALL GRAINS IN GRAIN, FORAGE AND SILAGE PRODUCTION

Forage yield, pounds per acre of dry matter				
College Station (7)				
Crop	No fertilizer	400 pounds 5-10-10 at seeding	400 pounds 5-10-10 at seeding plus 30 N in spring	
Barley, forage	871	1182	1143	
Temple, 1962-68 (9)				
	No fertilizer	15-30-0	30-30-0	60-60-0
Oats (5 clippings)	2697	2514	3959	4043
McGregor, 1963-67 (13)				
	No fertilizer	20-40-0	40-40-0	60-60-0
Oats, forage	2002	3208	4146	4784
Oats, grain	38.3	49.1	60.7	59.0
Denton, 1950-53 (8)				
	No fertilizer	30-0-0	30-60-0	60-60-0
Wheat, forage	557	493	1562	2093
Wheat, grain	28.3	32.4	37.4	39.2

VARIETIES

Most barley varieties of commercial importance in Texas are the common, six-row head type. One exception is Tokak, a two-row winter barley developed in New Mexico. The six-row head type, Figure 8-E, has three fertile florets in each spikelet which results in six rows of seed around the spike. The two-row type develops seed only in the center florets. Other types grown in other states are the hooded, awnless, short awned and compact or club head type which may or may not be awned. The awns may be barbed (as in Rogers), partially barbed or smooth awned as in Cordova, Figure 7.

The commercial varieties are divided also into three growth habit types based on juvenile growth, response to low temperature and day-length response and leaf type. These are winter, intermediate-winter and spring. Early growth habit is shown in Figure 9 with representative varieties Goliad (spring) Cordova

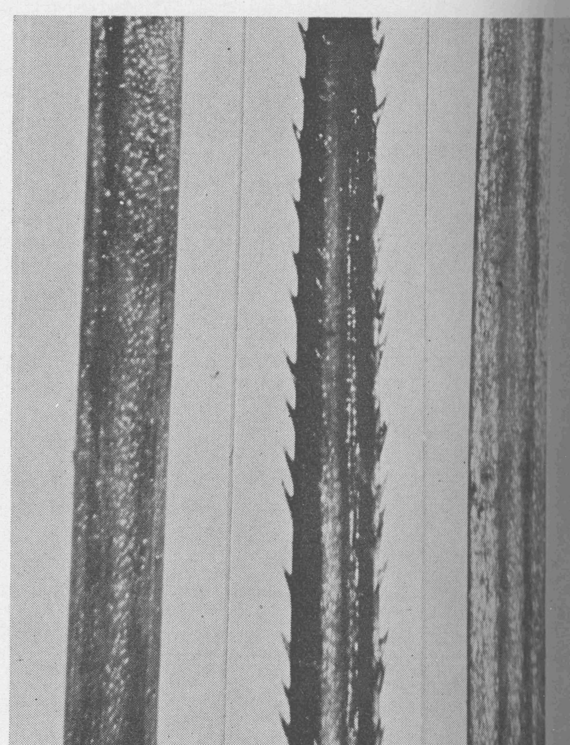

Figure 7. Smooth awn of Cordova, right and left, and rough awn (barbed), center.

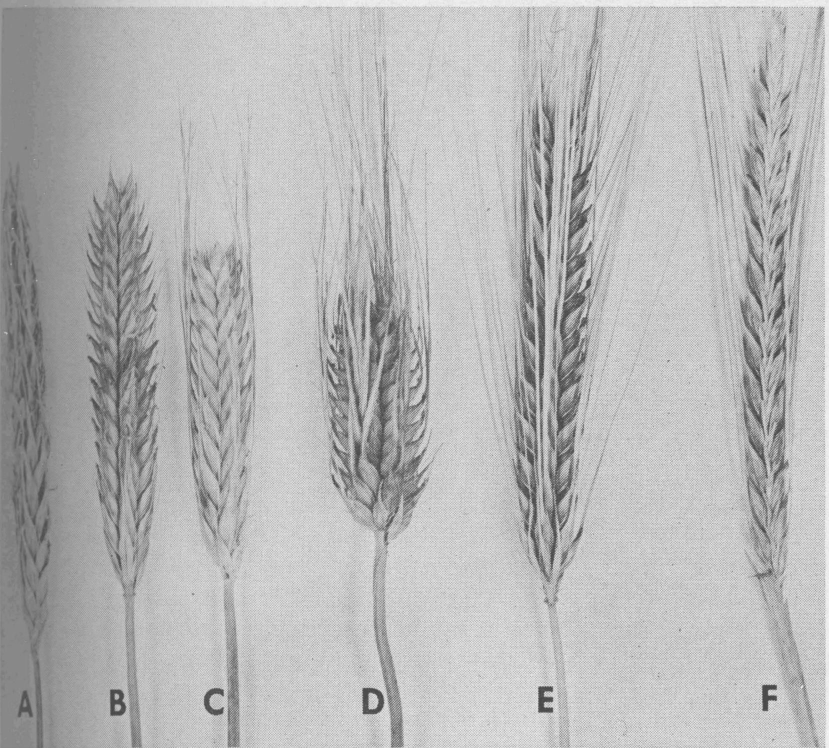

Figure 8. Head types of cultivated barley: A, Hooded; B, Awnless; C, Short awned; D, Compact six-row; E, Common six-row; F, Two-row.

(intermediate) and Will (winter). The pedigrees of commercial varieties grown in Texas are given in Table 8 and characteristics of varieties in Table 9.

Winter-type varieties

Varieties of this group behave like winter wheats in producing prostrate-growing, narrow-leaf seedlings which usually do not produce spikes normally unless subjected to a period of cold or cool weather. Freezing temperatures are not necessary to induce normal heading, but some exposure to cool weather which causes the plant to become dormant or grow slowly is required. This vernalization, in combination with reaction to day length, initiates the heading process. Winter-type varieties usually will not head from spring seeding, Figure 10. In part because of the dormant

TABLE 8. PEDIGREE, STATE AND DATE OF RELEASE OF COMMERCIAL VARIETIES OF BARLEY GROWN IN TEXAS

Variety	Released by State	Year	Parentage
Arivat	Arizona	1948	Atlas x Vaughn
Barsoy	Kentucky	1967	Azer x Dayton
Chase	Nebraska	1961	Selection from C.I. 7404, a Korean barley
Cordova	Texas	1951	Wintex x Texan
Davie	North Carolina	1952	Sunrise x Bolivia
Decatur	Indiana	1960	Comfort, Purdue 1101, Wisconsin barbless, Chevron, Bolivia, Kentucky 1, Purdue 400-17
Era	Texas	1968	Texas x Ludwig
Ga-Jet	Georgia	1960	[(Hooded 16 x Sunrise) x Tenwase] x Wong-Jet
Goliad	Texas	1950	Juliaca x Peatland
Grande	California	1964	Selection from composite Cross II, C.I. 5461
Florida 102	Florida	1967	Manchuria ms x Rabat
Harrison	Indiana	1963	[(Comfort - Purdue 21) x (Bolivia-Chevron) x Kentucky 1-Purdue 400-17] x Wong
Hudson	New York	1951	Michigan Winter x Wong
Jefferson	Indiana	1967	Same as Harrison
Kearney	Nebraska	1952	Selection from Composite Cross III, C.I. 5530
Meimi	Colorado	1956	Selection from Korean barley
Rogers	Oklahoma	1956	Selection from Composite Cross III, C.I. 5530
Tennessee Winter	Tennessee	1930	Selection from introduced southern European barleys
Texan	Texas	1941	Selection from Composite Cross III, C.I. 5530
Tokak	New Mexico	1965	Selection from barley introduced from Turkey
Wade	North Carolina	1961	Kenbar x Davie
Will	Oklahoma	1963	Rogers x Kearney
Wintex	Texas	1938	Selection from farmers field
Zora	Arkansas	1965	(Rogers x Kenbar) x (Kenbar x C.I. 6511)

Figure 9. Juvenile growth habit of barley varieties: prostrate winter-type (left), intermediate winter-type (center) and spring-type erect (right).

Figure 10. Failure of winter-type variety Will to head from spring seeding (center) compared with Cordova (right).

growth habit, the winter-type varieties are generally more cold tolerant than other types and better adapted to withstand low winter temperatures.

The exact origin of the winter-type barleys is not known, but they are believed to have originated in the Balkans-Caucasus region of Europe-Asia. They were brought to America by early colonists, and distinct strains were developed by natural selection and by plant breeders in several states. Tennessee winter, Texas winter, Oklahoma winter, Wisconsin winter, Reno, Ward, Pueblo and other local strains were grown from 1915 to 1955. Recently, a number of strains of even greater hardiness have been developed by plant breeders, by hybridization followed by selection. These include varieties such as Kearney, Dicktoo, Chase, Meimi, Will, Hudson, Dayton, Harrison and others which have extended the fall-sown barley area as far north as southern Nebraska.

Intermediate-winter type varieties

Varieties of this group are less cold tolerant than most true-winter varieties. They also differ from winter-type varieties in that juvenile growth is more upright, leaves are broader and growth response to periods of warm weather is quicker. The intermediate-winter type commercial varieties, Cordova, Texan, Wintex, Rogers and Era, which are grown extensively in Texas, will head normally from either fall or spring seeding. These varieties are widely adapted because they are sufficiently cold tolerant to withstand most winters in Texas and also to produce well in central and east Texas. Wintex, for example, has been damaged by low temperatures in only three seasons since 1936. These varieties produce more early forage than winter-type varieties and are more popular for use as winter pasture crops. An unofficial estimate made in 1968 indicated that Cordova was grown on an

TABLE 9. SUMMARY OF CHARACTERISTICS OF SOME BARLEY VARIETIES UNDER TEXAS CONDITIONS

Variety	Source	Growth habit[1]	Hardiness rating	Maturity	Plant height	Straw strength	Test weight	Awns	Mildew re-action[2]	Leaf rust re-action[2]
Arivat	Arizona	S	low	early	tall	good	good	rough	S	S
Chase	Nebraska	W	high	midseason	medium	fair	good	rough	S	S
Cordova	Texas	I-W	medium	mid-early	medium	good	good	smooth	R-S	MS
Dicktoo	Nebraska	W	high	midseason	tall	fair	good	rough	S	S
Era	Texas	I-W	medium	early	tall	good	good	rough	R-S	VS
Goliad	Texas	S	low	early	tall	good	good	rough	R	R
Grande	California	S	low	early	tall	good	good	rough	R	MR
Florida 102	Florida	S	low	early	tall	good	good	rough	R	R
Harrison	Indiana	W	high	mid-early	medium	good	good	rough	R	MR
Hudson	New York	W	high	late	tall	good	fair	rough	R	S
Jefferson	Indiana	W	high	late	short	good	good	short	R	MS
Kearney	Nebraska	W	high	late	tall	good	fair	rough	R	S
Meimi	Kansas	W	high	medium	medium	fair	fair	rough	S	S
Rogers	Oklahoma	I-W	med. high	med. late	tall	fair	good	rough	R	MS
Tennessee Winter	Tennessee	W	high	midseason	medium	fair	fair	rough	S	S
Texan	Texas	I-W	medium	midseason	medium	good	fair	smooth	R	MS
Tokak	N. Mexico	W	medium	late	medium	good	fair	rough	R	S
Wade	N. Carolina	W	med. high	midseason	short	good	poor	short	R	S
Will	Oklahoma	W	high	late	tall	good	good	rough	R	MS
Wintex	Texas	I-W	medium	late	medium	fair	fair	rough	S	S
Zora	Arkansas	I-W	med. high	mid-early	tall	good	good	rough	R	MS

[1]S = spring, I-W = intermediate winter, W = winter.

[2]S = susceptible, MS = moderately susceptible, R-S = resistant to susceptible, R = resistant.

TABLE 10. ACREAGES AND PERCENT OF TOTAL FOR BARLEY VARIETIES GROWN IN TEXAS, 1968[1]

Variety — Extension district / Research testing area	1, 2 / I	3, 6, 7 / II	4, 5 / III	8, 9, 11 / IV	10, 12 / V	Total	Percent of total
Arivat		116		500	1,250	1,866	0.7
Cordova	3,412	51,889	17,447	23,660	2,860	99,468	38.2
Goliad	217	2,100	58	1,525	4,915	8,815	3.4
Harbine	120	1,242	62			1,424	0.6
Harrison	75	100	500			675	0.3
Kearney	4,625	1,175				5,800	2.1
New Mexico Winter		462				462	
Meimi		100				100	
Rogers	8,425	37,226	5,310	5,660	3,220	59,841	23.0
Texan	550	120	342	50		1,052	0.4
Tokak	1,585	972		180		2,737	1.1
Wacus	18,000					18,000	6.9
Wade		75				75	
Will	16,310	26,585	4,650	2,600		50,145	19.3
Wintex	2,087	1,333	389			3,809	1.5
Zora		3,594	1,375	250		5,219	2.0
Others	105	1,018				1,123	0.4

[1]Based on estimates made by county agricultural agents.

estimated 38 percent of the Texas acrage and Rogers on 23 percent, Table 10.

Spring-type varieties

True-spring type varieties may be fall sown in south Texas (approximately Temple-Austin southward) with only infrequent damage by low temperatures. They have also been used with considerable success in the irrigated Trans-Pecos area of research area II in recent years. They may be spring sown in northwest Texas (4). Because of their rapid seedling growth and broad leaves they produce forage rather quickly. However, spring-type varieties may be damaged more by livestock grazing than more prostrate growing varieties. Goliad and Arivat have been the varieties most extensively grown, but recent tests have shown that Florida 102 is well adapted in south Texas. The danger from winter injury must be recognized and considered when growing these varieties. Figure 11 shows Cebada Capa killed at McGregor by

Figure 11. Winterkilling of spring-type barley variety, Cebada Capa (right), McGregor, 1963, compared with reaction of more cold tolerant variety, Cordova (left).

a temeperature of 7° F. in 1963 whereas Cordova, at left, was not injured.

PERFORMANCE TRIALS

Statewide performance trials are conducted at most of the field units of the Texas Experiment Station shown in Figure 2 and at a number of co-operative farm locations as well. Data from such tests provide information on adaptation of commercial varieties available for the area and their range of adaptation. New experimental lines are tested in the same trials to determine their value. Data on grain yield, grain quality and reaction to diseases, insects, low temperature and drouth are reported in mimeographed form (5) and in published 5-year or 10-year summaries (6). Data for local areas are published by research units for local use. The acreages of barley varieties grown in research areas in 1968 are given in Table 10.

Research Area I

This area consists of the North and South High Plains or Extension Districts 1 and 2. It ranges approximately from 3000 to 4000 feet in altitude with average rainfall from 18 to 22 inches, the majority being received during the summer months. Wheat and grain sorghum are the principal cash crops on the heavier soils in District 1, while cotton and grain sorghum are the principal cash crops in District 2. During the past 30 years, this area, which once was devoted to ranching and dry farming, has become largely an irrigated farming area. More than 63,000 wells are in operation, and an estimated 1,052,[illegible] acres of wheat were irrigated[1].

Barley is grown both under irrigation and as a dryland crop. Winter temperatures are severe, and temperature drops below 0° F. at one or more times during the winter. The development of more cold-tolerant varieties, such as Will, Kearney, Harrison, Chase and others has reduced winterkilling in this area. Spring seeding of barley is practiced when low temperatures kill the fall-sown crop, and spring barley also may be sown when spring moisture conditions are favorable.

Comparable grain yields and agronomic data for performance trials at Bushland are given in Table 11 and for Etter and Plainview in Table 12. All the tests were irrigated. The same varieties also may be used for dryland production. The best varieties for this area are Will, Harrison, Rogers, Kearney and Chase because of their good yield record and cold tolerance. Wade has yielded well but lacks adequate cold tolerance. Will, Kearney and Chase are resistant to greenbug injury as well. Zora, Tokak, Era and Hudson have performed well in 3 years of testing, but their tolerance to low temperatures has not been fully tested. Cordova and Wintex produce well when not injured by low temperatures.

[1]High Plains Irrigation Survey, 1968. Unpublished data provided by Leon New, area irrigation specialist, Texas Agricultural Extension Service.

TABLE 11. COMPARABLE GRAIN YIELD AND AGRONOMIC DATA FOR FALL-SOWN IRRIGATED BARLEY VARIETIES GROWN AT BUSHLAND, 1959-68

Variety	Number years tested	Comparable data[1]						
		Grain yield, bushels per acre	Test weight, pounds per bushels	Date first head	Plant height, inches	Lodging, percent	Winter survival, percent
Cordova[2]	8	62.1	47.3	5-3	33.6	22	53
Rogers[2]	8	72.9	48.8	5-7	35.3	28	51
Tennessee Winter[2]	8	52.4	44.6	5-6	32.4	7	72
Average		62.5	46.9	5-5	33.7	19	59
Barsoy	2	40.4	48.5	4-28	28.1	0	53
Chase	2	86.7	48.6	5-7	37.1	39	100
Carstens	1	63.1	50.3	4-28	25.8	0	
Dicktoo	1	65.6	45.4	5-3	32.4	29	
Era	4	68.5	49.4	5-3	36.2	23	56
Harbine	4	47.0	46.2	5-4	33.2	9	41
Harrison	4	77.6	48.9	5-7	33.7	11	56
Hudson	3	77.6	49.3	5-6	38.8		93
Kearney	7	67.6	45.7	5-7	35.9	29	100
Meimi	3	71.7	49.2	5-4	36.3		100
Penrad	1	49.7	38.9	5-9	40.8		
Pueblo	2	51.1	45.0	5-7	32.4	49	
Tokak	3	73.4	47.3	5-8	35.9	58	60
Wade	4	95.8	47.2	5-5	33.6	11	75
Ward	3	56.1	44.3	5-6	32.4	39	81
Will	5	86.3	48.9	5-8	36.6	31	100
Wintex	1	69.8	44.6	5-7	33.5	49	60
Zora	4	79.5	47.8	5-2	34.4	11	62

[1]Calculated comparable average based on data for years grown.
[2]Check varieties used in computing comparable data.

TABLE 12. COMPARABLE GRAIN YIELD AND AGRONOMIC DATA FOR FALL-SOWN, IRRIGATED BARLEY VARIETIES GROWN AT ETTER AND PLAINVIEW, 1966-68

	Comparable data[1]						
	Etter		Plainview				
Variety	Number years tested	Grain yield bushels per acre	Number years tested	Grain yield, bushels per acre	Test weight, pounds per bushel	Plant height, inches	Date first head
Cordova[2]	3	62.5	2	62.8	48.0	28	5-3
Rogers[2]	3	67.8	2	55.4	46.6	29	5-7
Tennessee Winter[2]	3	52.6	1	43.6	44.7	23	5-5
Average		61.0		47.1	46.4		
Barsoy	1	35.8	1	51.7	43.8	22	
Chase	2	67.3	1	44.7	49.0		5-6
Era	1	65.3			50.3		
Harrison	1	80.5	2	57.5	46.3	27	5-6
Hudson	1	88.9			47.3		5-7
Tokak	2	65.6	1	72.1	48.4	30	
Wade	3	74.6	1	79.4	46.6	24	5-4
Will	3	78.6	2	67.1	47.3	30	5-5
Zora	3	72.5	1	35.9	45.8	27	5-1

[1]Calculated comparable average based on data for years grown.
[2]Check varieties used in computing comparable data.

Only limited testing of spring-type varieties has been practiced in recent years since more cold tolerant winter varieties became available. When spring seeding is necessary, the spring-type varieties Arivat, Flynn, Beecher and Goliad may be used. However, the intermediate winter-type varieties Cordova, Rogers, Wintex and Texan have produced equally well. Winter-type varieties should not be sown in the spring as they may not head normally, Figure 10.

Research Area II

This area consists of the Rolling Plains, the upper Edwards Plateau and the Trans-Pecos land use areas. A considerable proportion of this area is non-cultivated ranch land devoted to permanent pastures. Small grains are grown on the heavier soils while grain sorghum, cotton and feed crops are grown on the sandy soils. The area ranges from 1000 to 2300 feet elevation. The Rolling Plains receives 20 to 30 inches of rainfall. Winter temperatures are fairly severe, but minimum daily temperatures in winter usually are sufficiently low that plants remain dormant and well hardened so that little winterkilling occurs. The intermediate winter-type varieties are sufficiently hardy for this area and produce good winter forage and grain yields.

TABLE 13. COMPARABLE GRAIN YIELD AND AGRONOMIC DATA FOR FALL-SOWN IRRIGATED BARLEY VARIETIES GROWN AT IOWA PARK, 1956-63

	Comparable data[1]				
Variety	Number years tested	Grain yield, bushels per acre	Test weight, pounds per acre	Date first head	Survival, 1963
Cordova[2]	8	48.2	44.0	4-14	20
Harbine[2]	8	49.9	45.0	4-18	79
Kearney[2]	8	55.2	44.4	4-20	93
Tennessee Winter[2]	8	45.1	42.3	4-18	91
Wintex[2]	8	51.5	43.3	4-20	24
Average		50.0	43.8	4-18	
Chase	1	57.0	44.8	4-15	100
Dicktoo	3	48.4	42.1		
Era	1	73.1	44.8	4-12	85
Hudson	2	55.6	45.1	4-19	97
Meimi	3	44.4	45.3	4-17	98
Mo. E. Beardless	3	33.2	40.1	4-14	
Pueblo	4	44.9	41.3	4-19	
Rogers	8	65.6	46.9	4-20	89
Wade	1	58.3	43.8	4-15	91
Ward	5	45.0	42.7	4-23	
Will	2	71.9	46.3	4-12	99

[1]Calculated comparable averages based on data for years grown.
[2]Check varieties used in competing comparable data.

Performance trials were conducted at Chillicothe throughout the testing period and at Iowa Park until 1963. The Iowa Park test was irrigated sufficiently to insure fair production but not sufficiently to produce maximum yields. Data at Iowa Park for 1956-63 are given in Table 13 and for Chillicothe, 1959-68 in Table 14.

Rogers and Will have produced outstanding yields at Iowa Park and Chillicothe. Era, a relatively new, greenbug resistant variety, has performed well during recent years. Chase, Hudson and Wade have performed well in Iowa Park tests but produced much poorer yields under dry farming conditions at Chillicothe. Unfortunately, no facilities are available for yield trials in Extension District 7. Tests in earlier years at Comfort, Kerr County, showed that Cordova, Will and Rogers were well adapted, and these are grown extensively, Table 10.

The Trans-Pecos area, Extension District 6, is largely devoted to ranching and receives only 5 to 15 inches of rainfall. Small areas along the Rio Grande, Pecos and other streams are irrigated. Salt accumulation has produced problems with some crops. Since barley is more tolerant of high salt concentrations than many other crops, it has become important as a feed and grazing crop in three-crop, 2-year rotations of cotton-barley-grain sorghum. Unfortunately, no barley trials have been conducted in this area.

Grower experience has shown that, even though winter temperatures are severe, spring varieties such as Arivat have survived and provided good winter pasture. For fall seeding, the intermediate winter-type varieties Cordova, Zora, Era and Rogers should perform well and provide abundant winter pasture. December and January seeding, following cotton, require quicker maturity, and the spring varieties would fit into this program.

Research Area III

This area, Extension Districts 4 and 5, is made up of the Blackland Prairie soils of north central Texas, the somewhat lighter Grand Prairie series and the sandy east Texas and Cross Timbers areas. The elevation ranges from about 300 feet in the east to 900 feet in the western part, and the area receives from 28 to 42 inches of rainfall annually. While the winters are relatively mild, temperatures fluctuate rapidly and widely. Periods of warm weather in winter may cause plants to lose hardiness and start rapid growth. When rapid drops in temperatures occur, barley and other crops may suffer considerable damage and killing. Spring freezes may occur even after jointing or heading has started.

Barley is well adapted to this area, except for low temperature and disease hazards, and the crop fits well into the farming systems. Returns from winter grazing in this area often approach the value of the barley grain crop. Fall seeding is much preferable to spring seeding because of the value of the forage and the higher yields produced. As shown in Table 5, fall-sown Cordova barley averaged 41.7 bushels

TABLE 14. COMPARABLE GRAIN YIELD AND AGRONOMIC DATA FOR FALL-SOWN BARLEY VARIETIES GROWN AT CHILLICOTHE, 1959-68

Variety	Comparable data[1] Number years tested	Grain yield, bushels per acre	Test weight, pounds per bushel	Date first head	Plant height, inches	Visual estimate forage,[3] percent	Lodged, percent	Winter survival, 1963
Cordova[2]	10	24.7	43.8	4-28	22.2	117	25	86
Rogers[2]	10	28.3	46.1	4-29	22.6	107	18	88
Tennessee Winter[2]	10	16.8	39.7	4-28	21.4	100	60	84
Average	10	23.2	43.2	4-28	22.1	108	34	86
Barsoy	2	16.0	47.1	4-20	16.4		10	
Chase	4	19.1	42.4	4-31	19.8			99
Era	6	24.7	42.5	4-25	23.2		20	86
Harbine	10	25.9	43.9	4-27	21.7	110	40	95
Harrison	5	21.4	46.4	5-2	20.1		0	
Hudson	4	17.3	43.8	5-6	20.7		16	85
Kearney	6	20.7	44.0	4-30	22.5	103		91
Meimi	4	17.4	41.6	4-28	22.6	119		95
Penrad	1	27.4	41.8	5-7	21.4			
Pueblo	1	18.4		5-1	22.4	98		
Tokak	3	23.2	44.3	5-5	21.6		50	
Wade	3	22.0	43.7	4-30	15.4			85
Ward	2	14.6	42.4	4-30	20.4	89	16	
Will	7	25.0	43.9	4-28	21.9		13	99
Wintex	5	14.4	41.1	5-2	21.5	100	26	96
Zora	6	27.2	42.9	4-26	20.9			88

[1]Calculated comparable averages based on data for years grown.
[2]Check varieties used in computing comparable data.
[3]Based on Tennessee Winter as 100 percent.

per acre compared to 29.5 bushels for spring-sown Cordova.

Data on grain yields and agronomic characteristics are given in Table 15. Will, Dayton, Rogers and Cordova have produced the best yields among varieties grown 8 to 10 years. For shorter periods, Barsoy, Zora, Harrison and Wade have produced outstanding yields. Chase, Kenbar, Rogers, Will and Wade are the more cold tolerant varieties. Diseases are of considerable importance in this area, with mildew, leaf rust and net blotch being the most damaging.

Research Area IV

Extension Districts 8, 9 and 11 make up this research area which, like area III, has a rather wide range in rainfall and soil type. Winter temperatures are less severe here and low temperature injury occurs only in occasional years. Higher temperatures and humidity provide better conditions for leaf diseases. Only the intermediate-winter type varieties should be seeded in these districts. Cordova, Rogers and Zora are the principle varieties grown and these have given the best results in performance trials, Tables 16 and 17. True spring-type varieties may be used for winter pasture and while they will provide abundant forage, they may be injured by low temperatures.

Research Area V

Extension Districts 10 and 12 are included in this area, and data from College Station are used as representative of the northern part of this area. The area has a wide variation in rainfall ranging from 39 inches at College Station to 26 inches at Beeville and the distribution is very poor. A few small areas have supplemental irrigation. Winters are mild with only occasional problems from low temperatures. Leaf diseases, mildew, Helminthosporium species, scald and leaf rust are constant problems. True spring-type varieties may be fall sown for forage. Very little of the barley is harvested for grain.

The spring-type varieties Goliad, Florida 102, Grande and Arivat are the best grain and forage varieties for this area. Seed supplies are a constant

TABLE 15. COMPARABLE GRAIN YIELD AND AGRONOMIC DATA FOR FALL-SOWN BARLEY VARIETIES GROWN AT DENTON, 1958-68

		Comparable data[1]							
Variety	Number years tested	Grain yield, bushels per acre	Test weight, pounds per bushel	Date first head	Plant height, inches	Winter survival, percent	Leaf rust, percent	Mildew re- action	Lodging, percent
Cordova[2]	10	46.7	43.7	4-14	31.5	61	28	R-S	9
Rogers[2]	10	48.5	45.0	4-19	33.6	85	16	R	30
Tennessee Winter[2]	10	37.2	42.5	4-17	29.5	66	21	VS	16
Average	10	44.2	43.7	4-17	31.5	70	15		18
Barsoy	3	59.3	45.8	4-17	33.0		37	R	10
Carstens	1	34.7	46.1	4-19	27.2		34		25
Chase	3	41.7	43.1	4-15	31.4	100	38	S	
Colonial 2	10	46.3	37.8	4-19	27.6		15	R	16
Davie	6	38.1	41.6	4-18	27.1		13	R	
Dayton	9	49.0	43.5	4-13	32.0	82	25	MR	11
Early Marconee	4	41.9	40.8	4-14	32.3		29	R-S	
Era	8	50.6	44.4	4-12	32.5		29	R-S	18
Ga-Jet	5	37.8	39.2	4-13	27.2		25	R	
Harbine	2	36.6	44.6	4-19	32.5		13		8
Harrison	5	47.9	46.7	4-19	30.6		7	R	
Hudson	5	38.6	43.1	4-21	32.4		23	R	
Jefferson	2	31.2	44.6	4-21	29.2		7	R	5
Kearney	2	28.9	40.8	4-21	30.0		20		
Kenbar	6	45.7	44.1	4-15	32.7	90	21	R	20
Kenate	3	39.1	43.3	4-21	29.8		33	R	
Marconee	5	34.8	38.3	4-17	31.6		16	R	10
Miller	1	41.0	39.6	4-13	30.2		19		
Oma	2	43.7	44.3	4-16	33.0		19		
Pace	3	44.2	42.9	4-16	31.5		26	R	
Penrad	2	38.6	42.9	4-21	32.7				
Texan	2	41.7	43.8	4-14	31.0		17		
Tokak	2	40.4	40.6	4-19	31.7		57		60
Wade	4	46.4	38.7	4-17	26.2	84	21	R	3
Will	8	51.6	44.8	4-18	33.0	82	29	R	28
Wintex	5	31.6	42.2	4-21	29.8	63	23	VS	
Wong	10	31.7	39.7	4-18	33.0		30	R	12
Zora	4	55.8	44.6	4-13	32.8		14	R-S	21

[1]Calculated comparable average based on data for years grown.
[2]Check varieties used in computing comparable data.

TABLE 16. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR FALL-SOWN BARLEY VARIETIES GROWN AT McGREGOR, 1958-68

Variety	Number years tested	Comparable data[1] Grain yield, bushels per acre	Test weight, pounds per bushel	Date first head	Plant height, inches	Winter survival, 1963	Forage estimate, percent[2]
Cordova[3]	10	42.3	47.5	4-11	27.8	90	100
Rogers[3]	10	43.3	48.6	4-16	30.0	100	80
Tennessee Winter[3]	10	30.8	44.3	4-15	27.4	95	77
Average	10	38.8	46.8	4-14	28.4		
Chase	1	29.5	45.8	4-12	29.1		91
Cebada Capa	3	15.2	45.8	4-7	28.7		111
Era	5	42.6	44.7	4-9	29.3	85	89
Florida 102	1	46.1	48.1	4-9	31.4		
Goliad	5	37.4	44.6	4-5	30.5		110
Harrison	3	30.5	47.8	4-13	26.9		84
Kenbar	3	40.7	45.8	4-15	28.6		69
Kenate	2	37.4	46.5	4-18	30.3		69
Pace	5	37.6	44.7	4-6	27.8	80	93
Penrad	1	37.1	43.8	4-17	29.1		90
Texan	3	37.1	47.1	4-11	27.6		106
Wade	1	38.4	45.5	4-16	24.1	95	
Will	6	42.3	46.6	4-14	29.3	100	84
Zora	5	44.6	48.4	4-9	30.1	100	92

[1]Calculated comparable average based on data for years grown.

[2]Percent of Cordova.

[3]Check varieties used in computing comparable data.

problem because the crop is largely sown for forage. Data for College Station and Beeville are given in Tables 18 and 19.

DISEASES

Diseases are a constant hazard in barley production in many parts of the state and may be a major consideration in the use of of the crop for forage, grain or a combination of the two. In both research areas 4 and 5, where humidity is high and showers occur frequently, leaf diseases are very important in winter forage production and may prevent grain production. Barley matures earlier than the other crops, an advantage under many conditions. A brief

TABLE 17. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR FALL-SOWN BARLEY VARIETIES GROWN AT TEMPLE, 1958-68

Variety	Number years tested	Comparable data[1] Grain yield, bushels per acre	Test weight, pounds per acre	Date first head	Plant height, inches	Winter survival, percent, 1962	Forage estimate percent[2]
Cordova[3]	10	36.5	45.6	4-11	28.1	100	100
Rogers[3]	10	35.9	48.8	4-13	29.9	100	101
Tennessee Winter[3]	10	25.6	44.0	4-11	25.0	100	99
Average	10	32.7	46.1	4-12	27.7		
Cebada Capa	3	17.3	43.1	4-11	28.2	0	116
Chase	2	24.8	45.6	4-5	29.1		
Era	6	30.4	45.0	4-8	28.9		105
Florida 102	1	28.8	46.1	3-22	30.2		124
Goliad	4	29.9	46.3	4-8	30.8		94
Harrison	4	32.9	50.5	4-16	25.2		
Kenbar	2	28.1	47.5	4-13	28.7		82
Pace	4	29.1	44.1	4-7	27.1	100	102
Penrad	1	25.4	44.1	4-16	33.0		
Texan	2	32.7	45.5	4-11	27.7	100	102
Wade	2	29.3	45.5	4-10	25.2		102
Will	7	31.8	46.8	4-13	29.3	100	97
Zora	6	41.0	47.8	4-5	28.6		101

[1]Calculated comparable average based on data for years grown.

[2]Percent of Cordova.

[3]Check varieties used in computing comparable data.

TABLE 18. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR FALL-SOWN BARLEY VARIETIES GROWN AT COLLEGE STATION, 1958-68

Variety	Number years tested	Comparable data[1] Grain yield, bushels per acre	Test weight, pounds per bushel	Date first head	Plant height, inches	Leaf rust, percent
Cordova[2]	10	29.4	43.7	3-31	28.1	27
Goliad[2]	10	29.0	43.8	3-21	31.6	13
Rogers[2]	10	30.9	44.9	4-6	30.6	17
Average		30.0	44.1	3-29	30.1	19
Arivat	7	26.5	42.6	3-13	26.3	38
Cebada Capa	4	14.8	38.4	4-15	29.8	0
Colonial 2	6	28.0	40.9	4-5	27.0	16
Davie	6	25.6	42.0	4-2	27.7	10
Dayton	6	31.5	42.4	3-31	29.7	44
Dickson	2	28.8	46.1	3-5	25.1	0
Early Marconee	3	33.1	40.5	3-29	30.2	22
Era	3	28.8	40.4	4-3	27.2	33
Florida 102	3	40.8	44.3	3-9	33.0	26
Ga-Jet	4	23.9	38.4	3-25	25.9	22
Grande	4	39.0	46.1	3-12	30.2	60
Harrison	4	28.3	45.8	4-14	26.5	18
Kenbar	6	36.0	43.7	4-2	29.9	24
Kenate	3	19.9	44.2	4-4	28.5	46
Marconee	5	20.1	35.6	3-30	29.3	40
Oma	3	26.6	43.1	3-28	28.3	18
Pace	6	27.5	42.5	3-24	27.5	14
Tennessee Winter	2	21.0	35.1	4-8	29.6	46
Wade	3	23.3	42.2	4-2	26.9	14
Will	6	31.2	41.7	4-6	30.4	25
Wong	6	25.2	42.6	3-30	30.2	19
Zora	7	35.2	44.2	3-30	30.3	18

[1]Calculated comparable average based on data for years grown.
[2]Check varieties used in computing comparable data.

discussion of the more important diseases and the best control measures available follows. More detailed information may be found in TAES Bulletin 921 (3).

Net Blotch

Net blotch, caused by *Pyrenophora teres* (Died) Drechs, has been the most important disease of barley in recent years, causing an estimated 7.7 percent loss

TABLE 19. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR FALL-SOWN BARLEY VARIETIES GROWN AT BEEVILLE, 1958-68

Variety	Number years tested	Comparable data[1] Grain yield, bushels per acre	Test weight, pounds per bushel	Date first head	Plant height, inches	Leaf rust, percent
Cordova[2]	9	15.2	40.8	3-31	24.9	46
Goliad[2]	9	22.8	41.9	3-19	28.4	14
Average		19.0	41.4	3-25	26.6	30
Arivat	6	24.8	39.1	3-9	23.8	51
Dickson	1	27.4	43.8	3-16	24.1	
Florida 102	1	36.4	38.8	3-21	27.1	
Grande	2	35.0	40.8	3-20	25.1	43
Harrison		15.2	43.8		17.4	30
Kenbar	2	11.7	38.3	4-4	22.4	58
Pace	5	24.3	40.3	3-24	27.2	39
Rogers	9	14.2	41.8	4-6	27.0	56
Will	3	11.7	40.8	4-6	22.9	50
Zora	2	18.8	41.8	3-29	23.1	

[1]Calculated comparable averages based on data for years grown.
[2]Check varieties used in computing comparable data.

in Texas in 1965. In some seasons, the foliage has been damaged, both reducing the amount and making it unpalatable to livestock. The disease is carried on the seed and straw and also is transmitted by airborne spores. Seedlings may be attacked as they emerge, young seedlings killed and stands reduced. 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 netted appearance is characteristic. In addition to reduced stands and damage to foliage, many kernels will fail to develop or be shriveled. No variety is highly resistant, although there are some differences in reaction. Seed treatment with organic mercury fungicides will reduce seedling infection, but there is no means of preventing the spread of air borne inoculum. Adequate and efficient control can be obtained only by breeding resistant varieties, but no adequate source of resistance is known. Leaves infected with net blotch are shown in Figure 12.

Spot Blotch and Barley Stripe

Spot blotch, caused by *Helminthosporium sativum* Pam., King et Bakske, and barley stripe, caused by *Helminthosporium gramineum* Rab., are important leaf diseases in some areas. Neither has caused serious losses in Texas in recent years. Barley stripe is seed and crop residue borne and attacks both seedlings and more mature plants. Seedlings infected with barley stripe develop yellow stripes which turn brown as tissues are killed; later the leaves fray and split lengthwise. Plants may be seriously stunted and often develop an olive-gray color. Seedlings infected with spot blotch have dark brown lesions near the soil line or extending into the leaf blade. The spots have definite margins but coalesce to form large blotches. The symptoms are hard to distinguish from net blotch. The older leaves develop an olivaceous cast and then dry up. Lesions occurring on the kernel may form a characteristic "black point" end on the kernel. Seed treatment greatly reduces seedling loss and damage. Rotation with non-susceptible crops is advised.

Barley Stripe Mosaic Virus

Barley stripe mosaic virus is a seedborne virus disease. Under field conditions, the disease is transmitted by contact of leaves from plant to plant. No insects have been identified which transmit the virus. As the virus is within the seed, seed treatment with fungicides will not control the disease. Symptoms on the leaves, Figure 12, are somewhat like the symptoms of barley stripe. Isolation of virus-free seed for foundation seed increase is the only means of control.

Barley Yellow Dwarf Virus

Yellow dwarf, caused by an insect transmitted virus, is present in Texas in varying degrees nearly every season. Although only recently described, it probably has been present for a long time. Damage may occur to single plants, small areas or may involve much of certain fields. The plants are stunted or may be killed if infection occurs early in the growth cycle. Plants infected later may produce a few tillers with small or sterile spikes and greatly reduced grain yields.

Symptoms appear as irregular yellowish-green blotches on the leaves, especially near the tips. These areas may then take on a reddish cast, but the color ranges from yellow through brilliant scarlet. Eventually the entire leaf becomes discolored. Plants are stunted in varying degrees, mature early and produce few and light seed.

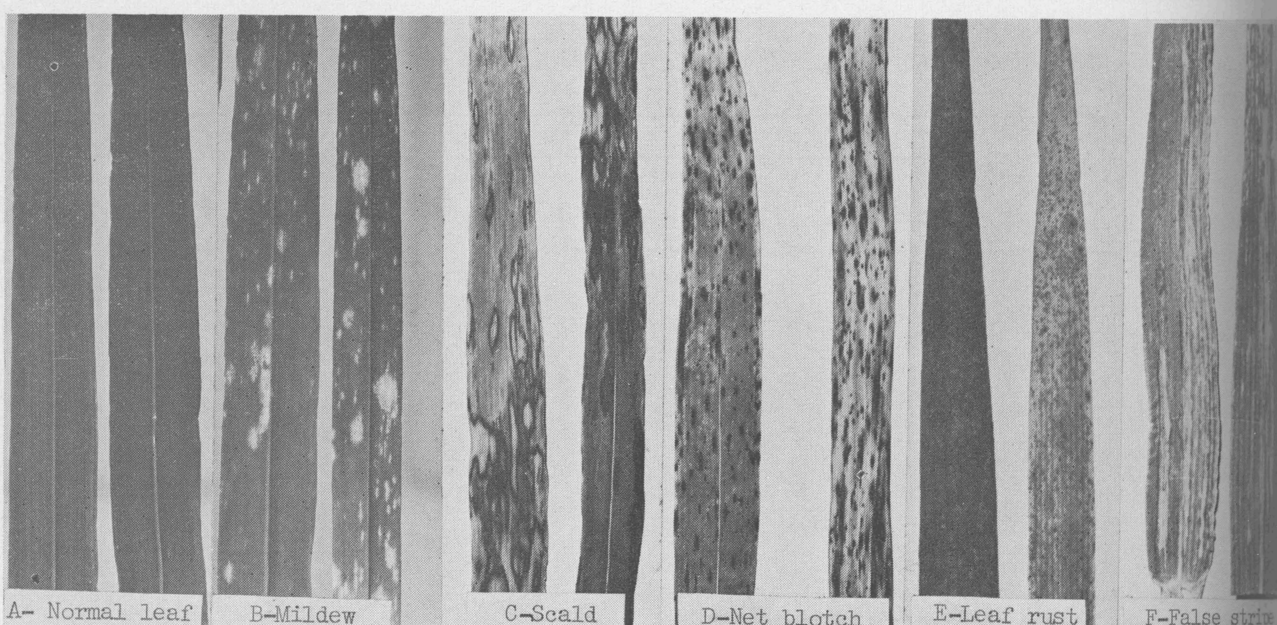

Figure 12. Barley leaf diseases.

Oswald and Houston (14) were able to transmit the virus causing yellow dwarf by five species of grain-infesting aphids. Of these the corn leaf aphid, *Rhopalosiphum maidis* Fitch., the English grain, *Macrosiphum avenae* (Fab.), the apple-grain aphid, *Rhopalosiphum fitchii* Sand., and the greenbug, *Schizaphis graminis* Rond., are common pests in Texas crops. The insects may or may not carry the virus. The insects can be controlled by sprays but may be found in the fields from crop emergence to maturity; therefore, spraying simply for disease prevention is not practical. Varietal differences in response to yellow dwarf occur, but no resistant varieties adapted in Texas are available. A plant infected with barley yellow dwarf is shown in Figure 13.

Powdery Mildew

Powdery mildew, caused by *Erysiphe graminis* [DC] Mérat. occurs rather generally in the eastern half of the state when humid, cloudy and cool conditions prevail over several weeks. The disease disappears when the weather becomes hot and dry. Powdery mildew develops as gray mycelium on the leaf sheaths and leaves. The host tissues become yellow, then brown and gradually die as the fungus invades the tissues. Later, tiny black dots, the spore-producing fruiting bodies of the fungus, may appear on the leaf. The leaf tissue is reduced, plant growth is retarded and serious losses in yield may result.

The disease is spread by air-borne spores. While it can be controlled with fungicides, such control is not practical for commercial grain production. Fortunately, resistant varieties are known, and the resistance can be transferred to other varieties. Physiologic races able to attack some varieties and not others are known. The reaction of commercial varieties was given in Table 9. Leaves infected with mildew are shown in Figure 12.

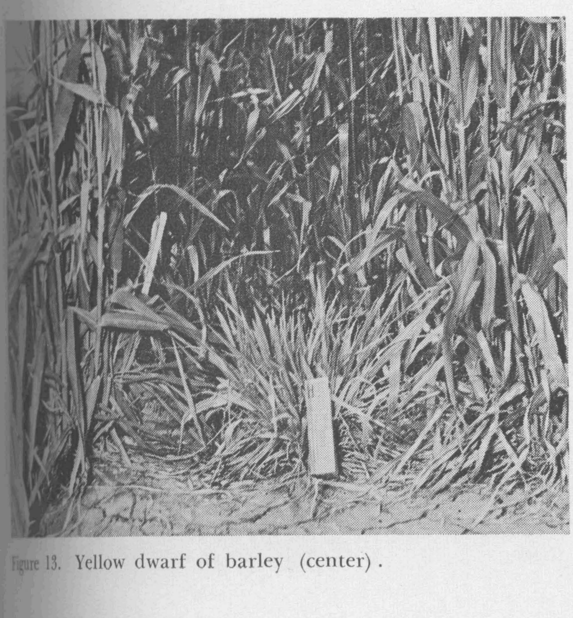

Figure 13. Yellow dwarf of barley (center).

Rusts

Both leaf rust, caused by *Puccinia hordei* Otth., and stem rust, caused by *Puccinia graminis* Pers., attack barley. The species of stem rust found on barley is one which also attacks wheat, but leaf rust of barley does not attack wheat or oats. Stem rust is found on barley, but, because of the early maturity of barley, it seldom causes important losses. Goliad is the only adapted variety with resistance to stem rust. Leaf rust has been of considerable importance throughout the eastern part of the state in recent years. Data on leaf rust infection are given in Tables 15, 18 and 19. Goliad, Harrison, Rogers and others have resistance to some races, but Cebada Capa is the only variety tested which is resistant to all races. The development of resistant varieties is the only practical means of control.

Other Foliage Diseases

Several other foliage diseases occur occasionally and may become important in some seasons or areas. Scald, caused by *Rhynchosporium secalis* (Oud.), J. J. Davis, Figure 12, has been of some importance in experimental nurseries in south Texas. Large, water soaked areas develop, then turn brown to black, and spots may coalesce to kill the entire leaf. Bacterial blight, caused by *Xanthomonas translucens,* (L. R. Jones, A. G. Johnson and Reddy Dowson) has been observed a few times but has not become commercially important.

Smut

Three smuts occur on barley in Texas, but, with seed treatment fungicides now available, each can be easily controlled. Covered smut, caused by *Ustilago hordei* (Pers.) Lagerh., Figure 14, produces a mass of smut spores which are held together by the glumes. Spores are scattered to other grain in the threshing operation where they cling to the seed and glumes until the seed germinates. At that time the spore germinates and infects the young seedling. Control of this smut with a dust or slurry of organic mercury or other approved fungicides is easy and effective. (Note: all seed disinfectants are poisonous and may be irritating to the skin. Follow manufacturer's recommendations carefully and use masks if the fumes are encountered in treating seed). For latest seed treatment recommendations see the County Agent.

Two types of loose smut occur, but neither has been an important factor in production. Both destroy the floral parts and entire head, Figure 14. Black, or semiloose smut, is caused by *Ustilago nigra* Tapke, and brown, loose smut, is caused by *Ustilago nuda* (Jens.) Rostr.

The two smuts are similar in general appearance, but the spores of the nigra smut are carried within the husk covering or on the seed. This form can be controlled with the same fungicides used to control covered smut. The ideal control for smuts is to grow

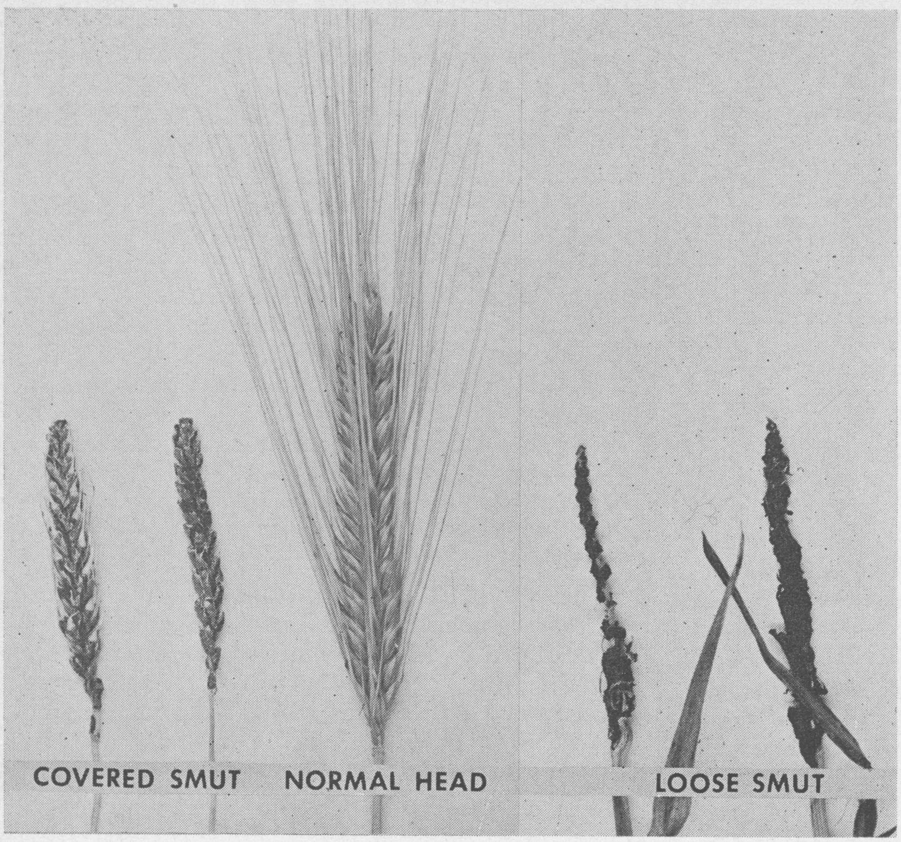

Figure 14. Covered smut of barley (left), normal head (center) and loose smut (right).

resistant varieties, and most Texas varieties have considerable field tolerance or escape mechanisms as natural infection has been very low. The brown loose smut infects the ovary at blooming time and is carried as mycelium within the seed. Since it is within the seed, it cannot be controlled with the usual dust or slurry funcigides. Recently a new fungicide, Vitavax[2], has been perfected which effectively controls this internally borne smut. This product may be used on seed-increase fields but not on barley grown for commercial production. The long-soak method and hot water treatment for control of loose smut of barley and wheat are effective but difficult to carry out (16).

INSECTS

A number of insects may cause serious damage to barley if conditions for their development are favorable. A description of these insects, with control measures for each, was given by Daniels *et al.* (10).

Probably the most destructive insect pest of barley is the greenbug (aphid), *Schizaphis graminum* (Rond.). Several other aphids attack barley but cause less serious damage. Greenbugs cause a characteristic yellowing or reddening of the leaf tissue where they feed. Under favorable conditions for greenbug reproduction, plants in large areas may be killed leaving large yellow-green to dead areas in fields. If the infestation continues, the entire field may be destroyed. Greenbugs and corn leaf aphids are shown on a leaf of barley in Figure 15.

Effective insecticidal sprays for control of greenbugs and other aphids are now available. The economics of using these will have to be determined by each grower in each situation. Greenbug resistant varieties of barley were found in 1942 by Atkins and

Figure 15. Greenbugs on barley leaf (right); corn leaf aphids (left).

[2]Use of a trademark name does not constitute a guarantee or warranty by the USDA or the Texas Agricultural Experiment Station and does not imply its approval to the exclusion of other products that may be suitable.

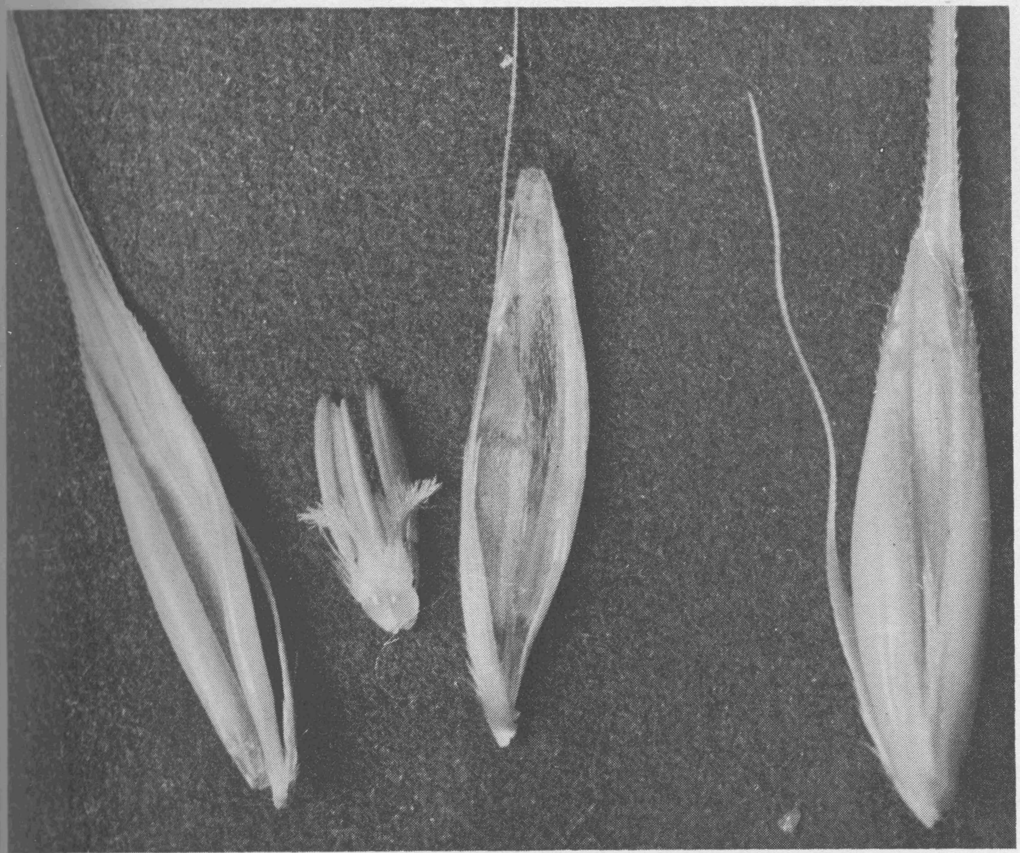

Figure 16. Barley florets showing flower parts.

Dahms (2). Several resistant varieties have been developed. Will barley, adapted to Texas and Oklahoma, and Era, adapted to research areas II, III and IV, are now available.

Chinch bugs, *Blissus leucopterus* (Say), the winter grain mite, *Penthaleus* major (Duges), and the brown wheat mite, *Petrobia latens* (Müller) may become pests of barley under some conditions. Effective sprays are now available, but their use will depend upon the economics of the crop involved. Crop rotation is of considerable aid in controlling mites.

BARLEY IMPROVEMENT

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 10 to 15 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, has advantages of disease or insect resistance or has other desirable characteristics, then the increased revenue in yield or the reduction in a growing hazard, when projected to a large acreage, will return large dividends on the research expenditure.

Barley is self fertile, and varieties must be cross-pollinated by hand to produce a hybrid. Figure 16 shows the floral parts of a barley flower. After the cross is made, selected progenies must be grown for 4 to 8 years before true breeding strains can be selected for testing. Several years are necessary for thoroughly testing the new lines and determining their adaptation. If a superior new strain is found, several additional years are necessary to get this new variety into commercial production.

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

Figure 17. Barley nursery at Denton where hundreds of experimental strains are evaluated.

Figure 18. Field plots of barley, Denton.

to cold, drouth, diseases, insects, lodging, shattering, test weight and value for winter pasture. All these may contribute in part to grain or forage production. Figure 17 shows the extensive barley nursery at the Denton station where hundreds of strains are tested. Figure 18 shows the more advanced plot tests of barley in the final stages of testing before distribution to growers.

Hybrid Barley

The widespread use and increased financial returns from growing hybrid corn, sorghum and other crops have stimulated research work to develop hybrid small grains for commercial production. Due to the fact that small grains are almost entirely self-pollinated, this task is difficult. Genetic male-sterile barley strains have been known for some time, but cross pollination on this plant is not satisfactory under most conditions. Mechanisms for producing hybrid barley have been worked out under conditions in Arizona, and small quantities of hybrid seed have been made available to growers. No systems have been found effective under Texas conditions. Although production of hybrid barley is possible at some time in the future, hybrid barley is not now available to Texas growers.

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