B-1091
December 1969

Growing Oats in Texas

TEXAS A&M UNIVERSITY
TEXAS AGRICULTURAL EXPERIMENT STATION
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CONTENTS

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 herewith made of the cooperation of the many people and agencies taking part in the statewide small grain performance trials: Lucas Reyes and Edward Neal, Texas A&M University Agricultural Research Station at Beeville; Eldon D. Cook and Ralph Baird, Blackland Research Center, Temple; Keith A. Lahr and James Mulkey, Texas A&M University Agricultural Research Station at Chillicothe; Virgil Woodfin, Texas A&M University Agricultural Research Station at Iowa Park; Oliver E. Smith, Texas A&M University-Prairie View Experiment Station, Prairie View; M. J. Norris and H. O. Hill, Texas A&M University Agricultural Research Center at McGregor; and K. B. Porter, USDA Southwestern Great Plains Research Center at Bushland.

Appreciation is expressed to Francis Gough, research pathologist, Crops Research Division, ARS, USDA, College Station and Robert W. Tolar, pathologist, Plant Sciences Department, Texas A&M University, College Station, for suggestions on the disease section.

Appreciation is also expressed to Cary D. Palmer, agricultural statistician-in-charge, Texas Crop and Livestock Reporting Service, U.S. Department of Agriculture, Austin, for permission to use the maps and statistical data on oat acreages and production.

SUMMARY

Oats, one of the most widely grown crops in Texas, are used extensively for grain production, winter pasture, hay, silage, greenchop feeding and other purposes. During the 10-year period, 1959-68, the average seeded acreage of oats was 1,896,000 acres, but the average harvested acreage was only 730,600 acres or approximately 39 percent of the seeded acreage. Several factors contribute to the low harvested acreage: use of the crop exclusively for forage purposes, severe drouth during all or part of the growing season and winterkilling. Average production during the period was 18,720,500 bushels.

Most oats are fall sown in Texas and used for winter pasture during the winter months. If a grain crop is to be harvested, the livestock are removed between February 15 and March 15. Other acreages are grazed to maturity. A small acreage is spring sown in Northwest Texas. During seasons of favorable spring rainfall or when the fall-sown crop is winterkilled, the spring-sown acreage is increased. Oats are a well balanced feed grain, and most of the Texas crop is used for feed within the state.

Oats are grown under a wide range of soil and climatic conditions from the 15-inch rainfall belt of northwest Texas to the 50-inch rainfall belt of southeast Texas. Because of the wide range of conditions and uses made of the crop, a considerable number of varieties are needed. Cold tolerant winter-type varieties such as Wintok, Norline, Cimmaron and others are adapted mainly to the high elevation and severe winter conditions of northwest Texas. Less cold tolerant and more rapidly growing intermediate winter-type varieties can be used in the northern part of Central and East Texas. Included in this group are New Nortex, Norwin, Alamo-X, Ora, Moregrain and others. Less cold tolerant varieties and near-spring type varieties, such as Houston, Florida 500, Coronado, Cortez and others may be fall sown in South Texas.

Oats can be fitted into rotation schemes to diversify labor and income in all parts of the state. They are usually seeded in the fall after harvest of corn, grain sorghum, cotton or other row crops. The labor of seeding and harvesting does not conflict too greatly with any of these crops. Oats respond well to improved farm practices and to applications of fertilizer, giving economical increases in grain and forage yields. While the state grain yield average is low, this is in part due to the extensive use for grazing, especially late grazing, of the crop by livestock. Under good management practices, oats provide good grain yields, which when combined with forage value, allow them to compete in income with other crops in the areas. Winterkilling is a hazard of production, varying in importance with the area, but this can be reduced by keeping the crop dormant by grazing, applying phosphate fertilizer in the fall to stimulate root growth and practicing careful management.

Diseases are important in oat production throughout the eastern half of the state. Throughout the southern part of the state, diseases may be limiting factors in grain production and instrumental in reducing their value for forage. The major diseases are crown (leaf) and stem rust. The Helminthosporium rootrots are prevalent and, occasionally, barley yellow dwarf, halo blight and powdery mildew cause significant losses in certain areas.

The major insect pest of oats is the greenbug (an aphid). Several other aphid species attack the crop at times but are less damaging. The winter grain mite is a formidable pest in the eastern half of the state, and the brown wheat mite attacks all small grains in the western part of the state some seasons. Armyworms and cutworms may damage the crop in the seedling state and when spring growth is very rank. Insecticides are now available for control of all of these insects when it is practical to use them.

Performance tests are conducted at from 8 to 12 locations in the state each season. Data from these tests are used to make recommendations on commercial varieties and to determine the range of adaptation of these and of experimental strains developed in the breeding program. Results of these tests are reported annually and summarized at intervals of 5 years. Breeding work to further improve varieties for Texas growers is in progress. The objectives include development of higher yielding varieties, control of diseases and insects through development of resistant varieties, improvment of forage characteristics of adapted varieties and improvement of grain quality. To date, only limited progress toward development of hybrid oats has been made.

ADAPTED OAT VARIETIES FOR GROWING AREAS

Area	Extension districts	Fall seeding	Spring seeding
I	1, 2	Wintok, Norline, Norwin, Cimarron, Bronco	Cimarron, Norwin, Alamo-X, Moregrain, Coronado, Cortez
II	3, 6, 7	Cimarron, Norwin, Bronco, Mustang, New Nortex, Ora, Alamo-X, Nora	do.
III	4, 5	Ora, Nora, New Nortex, Norwin, Alamo-X, Moregrain	Coronado, Cortez, Alamo-X, Moregrain
IV	8, 9, 11	Ora, New Nortex, Moregrain, Coronado, Cortez, Houston	None recommended
V	10, 12	Florida 500, Suregrain, Houston, Coronado, Cortez, Alber	None recommended

Growing Oats in Texas

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OATS, ONE OF THE MOST WIDELY GROWN CROPS in Texas, are used extensively for grain, winter pasture, hay, silage, greenchop feeding and other purposes. While oats are an important cash grain crop in the areas of more concentrated production, their indirect contribution to farm income through their many forage uses often equals or exceeds their value for grain.

During 1959-68, the seeded acreage of oats, Table 1, averaged 1,896,000 acres and the harvested acreage, 730,600 acres. The largest acreage ever devoted to oats in Texas was in 1957 when 2,670,000 acres were seeded. The lowest harvested acreage was in 1967 when only 315,000 acres were harvested. The distribution of the seeded acreage of oats in Texas in 1968 is shown in Figure 1.

Several factors contribute to the lower harvested acreage in Texas in recent years. The major factor is the increasing use of the crop exclusively for winter and spring livestock pasture. The small grains are the only crops which will produce succulent, high protein forage during this period. Winterkilling and spring drouths destroy some of the fall-sown crop each season. When these hazards reduce the prospects for a profitable grain crop or reduce stands, then additional acreages are grazed to maturity as the most economical means of harvesting the crop. Differences between the seeded and harvested acreages are greater in South Texas, where rusts frequently endanger grain production, and in the range areas where livestock feed is at a premium.

ADAPTATION

Oats are grown under a wide range of soil and climatic conditions in Texas. Many varieties can be and need to be grown because of not only the wide range of conditions but also the several uses for which the crop is seeded. Along the Gulf Coast, either spring-type varieties or others with little cold tolerance can be fall sown for livestock pasture. Spring-type varieties also may be spring sown in northwest Texas. In north central Texas, varieties which can withstand wide fluctuations in winter temperatures are needed. Damage by low temperature occurs about 1 year in 4 in this area and may range from minor leaf injury to complete destruction of the crop on thousands of acres.

The Low Rolling and High Plains areas require varieties with maximum cold tolerance. Because temperatures in these areas, especially soil temperatures, are more uniformly low during the winter months, hardy varieties survive most seasons. Winterkilling is an important hazard, but when the crop is destroyed, a spring-sown crop may be substituted.

The wide range in climatic conditions and length of growing season is shown for selected locations in Table 2. For example, the growing season at Beaumont is nearly 300 days, and annual rainfall is 54 inches. In contrast, at Amarillo in northwest Texas, the growing season is 185 days and precipitation is 20 inches while in parts of the Trans-Pecos area the precipitation averages less than 10 inches.

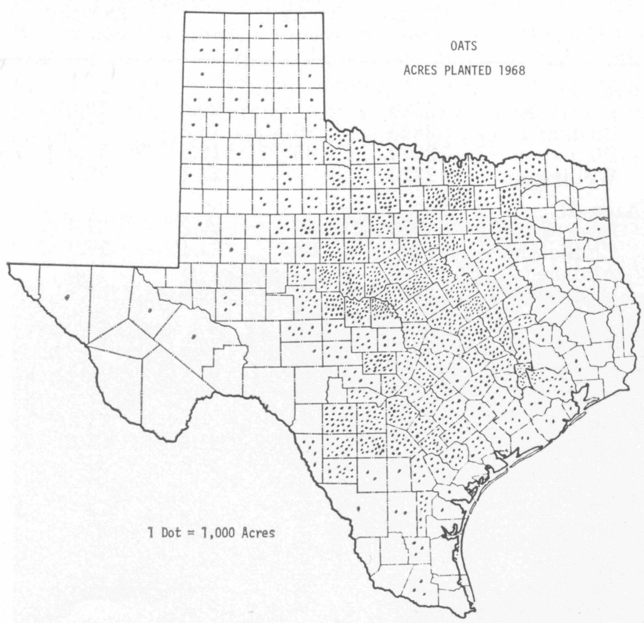

Figure 1. Distribution of the seeded acreage of oats in Texas in 1968.

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TABLE 1. SEEDED AND HARVESTED ACREAGES, AND PRODUCTION OF OATS IN TEXAS 1959-68[1]

Year	Acreage: Seeded	Acreage: Harvested	Production bushels	Yield, bushels per acre	Farm price per bushel
1959	2,173,000	942,000	21,195,000	22.5	$0.67
1960	1,825,000	942,000	24,492,000	26.0	0.71
1961	2,062,000	1,074,000	28,998,000	27.0	0.69
1962	2,186,000	655,000	14,082,000	21.5	0.76
1963	2,208,000	616,000	12,628,000	20.5	0.81
1964	1,899,000	752,000	21,808,000	29.0	0.73
1965	1,994,000	797,000	19,925,000	25.0	0.71
1966	1,635,000	630,000	17,640,000	28.0	0.75
1967	1,357,000	315,000	6,615,000	21.0	0.82
1968	1,628,000	583,000	19,822,000	34.0	0.74
Average	1,896,700	730,600	18,720,500	25.6	

[1]Data supplied by the Texas Crop and Livestock Reporting Service, Austin, Texas.

Because of this wide diversity in climatic conditions, the state has been divided into five research testing areas, Figure 2. Also for convenience, these testing areas encompass and coincide with Texas Agricultural Extension Service Districts. Since land use areas do not exactly fit these areas, these lines are only approximate limitations.

One or more performance trials are grown in each research area. The seeded and harvested acreages and oats production, grouped by research testing areas, are given in Table 3. Data were taken from the reports of Crop Statistics of the U.S. Crop Reporting Service (18). Extension districts do not coincide exactly with the crop reporting districts of this agency; therefore, data were not summarized as they appear in Crop Statistics.

USES

Grain

Almost all oat grain produced in Texas is utilized as feed for livestock within the state. The large areas devoted to livestock production provide a good market for surplus grain produced in other parts of the state. Also, the rapid increase in the number of riding horses in recent years provides an additional market for the grain. Oats have been known as one of the best balanced and desirable grain feeds for young livestock and breeding stock. Large quantities are used as scratch grain for poultry, and still larger quantities are used in commercial mixed feeds for all classes of livestock. The chemical analysis of oats and several other Texas grain crops are given in Table 4.

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	Oct. 22	Apr. 20
Bushland	3825	26	18.3	11.0	72.0	42.0	57.0	192	Oct. 28	Apr. 18
Plainview	3370	36	19.0	11.9	73.7	45.7	59.7	206	Nov. 2	Apr. 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	Nov. 29	Mar. 30
Chillicothe	1406	63	24.4	17.0	76.6	50.2	63.4	217	Nov. 6	Apr. 3
Abilene	1750	83	24.3	13.6	76.0	53.0	64.5	229	Nov. 13	Mar. 23
El Paso	3641	19	6.9	3.7	79.0	44.8	61.9	238	Oct. 31	Apr. 3
Area III:										
Denton	621	44	32.3	24.9	77.5	52.6	64.2	237	Nov. 15	Mar. 24
Stephenville	1466	27	26.9	23.8	77.1	53.3	65.2	239	Nov. 13	Mar. 21
Overton	520	63	43.9	28.7	76.3	55.3	65.8	249	Nov. 17	Mar. 12
Area IV:										
McGregor	713	34	31.6	27.6						
Temple	740	56	34.0	27.3	78.9	55.6	67.3	252	Nov. 22	Mar. 15
Area V:										
College Station	308	78	39.8	30.1	79.1	57.1	68.2	263	Nov. 27	Mar. 8
Prairie View	250	18	39.3	30.6	76.0	57.0	67.0	263	Nov. 30	Mar. 5
Beaumont	26	55	54.1	39.5	78.3	58.5	68.5	276	Nov. 28	Feb. 26
Beeville	240	78	29.8	22.2	82.1	60.0	70.9	291	Dec. 6	Feb. 20
Weslaco	100	25	27.3	19.9				311	Dec. 23	Feb. 15

[1]September through May.

TABLE 3. ACREAGES AND PRODUCTION OF OATS BY EXTENSION DISTRICTS AND RESEARCH TESTING AREAS IN TEXAS, 1968[1]

Extension district	Research testing area	Land use area	Acreage seeded	Acreage harvested	Percent of state: Total seeded	Percent of state: Total harvested	Production bushels	Percent of seeded acreage harvested for grain
1	I	Northern High Plains	13,510	7,590	0.83	1.30	205,000	56.2
2	I	Southern High Plains	16,720	6,590	1.03	1.13	181,420	39.4
3	II	Northern Low Rolling Plains	150,600	81,770	9.21	14.02	2,987,000	54.3
6	II	Trans-Pecos	8,350	4,230	0.51	0.73	158,300	50.7
7	II	Southern Rolling Plains and Edwards Plateau	301,280	184,070	18.50	31.50	6,440,300	61.1
4	III	North Central Blacklands, Prairies and Cross Timbers	242,950	106,580	14.91	18.28	4,060,900	43.9
5	III	Northeast Texas Timberlands	34,280	8,100	2.11	1.47	282,550	23.6
8	IV	Central Blacklands, Prairies and Cross Timbers	374,950	149,820	23.00	25.63	4,588,700	40.0
9	IV	Central East Timberlands	50,630	1,390	3.11	0.24	37,700	2.7
11	IV	Upper Coast and Southeast Texas Timberlands	86,750	2,210	5.33	0.38	48,730	2.5
10	V	South Central Blacklands, Prairies and Coastal Bend	212,500	12,150	13.05	2.08	303,400	5.7
12	V	Rio Grande Plain, South Texas	134,770	18,330	8.28	3.15	502,700	13.6

[1]Literature reference, Palmer (18).

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

Crop	Protein	Crude fibre	Nitrogen free extract	Water	Ash	Digestable nutrients	Productive energy for 100 pounds
Oats	11.4	12.8	58.6	8.6	3.7	8.9	70.5
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
Wheat	14.0	1.7	69.4	10.0	1.9	11.3	78.8

[1]From Texas Agri. Expt. Sta. Bul. 461, "The Composition and Utilization of Texas Feeding Stuffs".

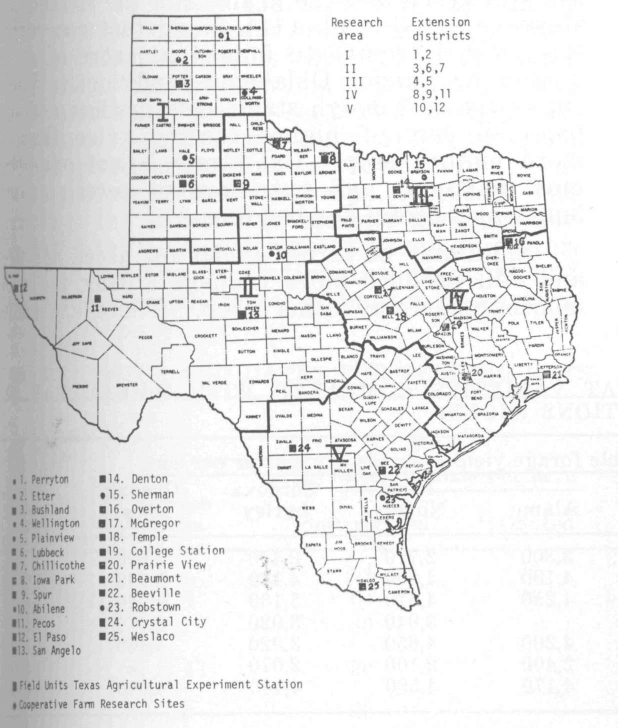

Figure 2. Small grains and flax research areas and testing stations.

Winter Pasture

The high value of oats as a winter pasture for all classes of livestock has been recognized for many years, Figure 3. The acreage of oats has declined less in Texas than in most other states; one reason is the favor with which oats are held as a winter pasture crop. Livestock prefer oats to barley or rye and, under many conditions, they prefer oats to wheat.

Figure 3. Cattle grazing on fall-sown oats at Temple.

Research on management practices of small grains for forage is reported by Holt (13), Holt and Norris (14), Atkins (7) and in reports from several locations (8, 10, 15, 16, 21, 22). Experiments have shown that from 3,000 to 6,000 pounds of air-dry forage per acre may be produced under average conditions in many parts of the state. Under irrigation and with adequate fertilization, production can be raised to 10,000 pounds per acre if weather conditions are favorable. Marion, Fisher and Jones (15) report that calves wintered on small grain pasture in 10 of 14 years at Spur made the second highest average winter gain, the third highest summer gain and the highest total winter and summer gain of those compared.

Varieties differ considerably in their production of forage and in the time at which they produce the maximum amount. They likewise differ in response to temperatures, some producing little forage during very cold weather. Growers should select the varieties best adapted to their forage needs. The differences in seedling growth habit of three varieties, representing the three types available, are illustrated in Figure 4. Houston, an erect growing type is representative of the near-spring type. New Nortex (center) represents the moderately hardy, intermediate growth habit. Bronco (right) represents the narrow leaf prostrate growing seedling of most of the hardy strains. A general classification of seedling growth habit of varieties is given in a later section. Average production of air-dry forage at representative locations in Texas is given in Table 5, together with yields of wheat, barley and rye for comparison. Additional details of varieties may be obtained at the nearest field unit of the Texas Agricultural Experiment Station.

Greenchop feeding of oats is practiced on a limited scale in Texas. By this method, oats are allowed to develop sufficient growth to be cut with a field ensilage cutter. The chopped feed is hauled to feedlots for dairy or beef animals. Only enough is cut each time to supply the daily needs. The harvesting proceeds across the field as needed, and the harvested portion is allowed to regrow to a considerable height before being cut again. Often fertilizer is applied,

Figure 4. Growth-habit types of oats: erect spring type (left), intermediate winter (center) and winter type (right).

or if water is available, the field may be irrigated to stimulate regrowth. Varieties differ in their ability to recover from such mechanical clipping. Erect-growing types may be damaged more than prostrate growing types by either clipping or close grazing.

Oats in the soft dough stage of growth may be used for ensilage, either alone or in mixtures. A good oat crop will yield from 6 to 10 tons of silage per acre. Some growers find it desirable to add dry corn, dry hay or stover to oat silage as supplements. Oats can be made into silage earlier in the season than other crops. This may be especially valuable for dairymen or for those carrying other livestock through a summer drouth.

Oats alone, or in mixtures with sweetclover or other legumes, make a valuable hay crop. The crop should be cut while the leaves and stems are still green and the grain is in the soft dough stage. Curtis, et al. (11) found that oat varieties yielded from 3 to 5 tons per acre of good quality hay under Oklahoma conditions. When cut in the soft dough stage, oats produce a more palatable hay of higher feeding value than a more mature crop. Oat straw is not only the most palatable and nutritious of cereal straws but is also useful for bedding.

Oats may be turned under for green manure and will produce more tonnage during the cool months than any other crop. There are some

TABLE 5. FORAGE PRODUCTION OF SELECTED OAT VARIETIES COMPARED WITH WHEAT, BARLEY AND RYE PRODUCTION, AT SELECTED TEXAS STATIONS (HOLT)

Location and period	Comparable forage yields, pounds dry matter per acre						
	Mustang	Bronco	Alamo	New Nortex	Cordova barley	Quanah wheat	Elbon rye
Denton, three seasons, 1956-58	3,440	3,530	3,300	2,770	2,460	2,690	
Nacogdoches, six seasons, 1952-58	4,650	4,860	4,190	4,500	4,160	3,690[1]	5,010
McGregor, five seasons, 1953-58	5,110	4,960	4,250	4,510	5,130	4,730	4,020
Temple, six seasons, 1952-58	2,600	2,800		3,040	3,020	2,470[1]	2,580
College Station, four seasons, 1955-58	4,280	4,210	4,200	4,650	3,920	4,460[1]	4,730
Beeville, six seasons, 1952-58	2,230	2,020	2,400	2,100	2,070		1,530[2]
Beaumont, four seasons, 1953-58	4,790	4,450	4,170	4,580	4,140	4,660[1]	5,370

[1]Atlas 66 wheat.
[2]Abruzzi rye.

TABLE 6. COMPARATIVE YIELDS OF FALL-SOWN AND SPRING-SOWN NEW NORTEX OATS IN COMPARABLE SEASONS OF NO WINTERKILLING

	Mean yield, bushels per acre	
	Fall-sown	Spring-sown
Denton, seventeen seasons	57.7	38.3
Temple, seven seasons	53.2	31.5
Chillicothe, fifteen seasons	36.3	13.0
Bushland, irrigated, four seasons	71.0	72.1

problems of management when a large tonnage of green manure is plowed down before a summer crop such as cotton or grain sorghum, but these problems are not insurmountable. The many fine, fibrous roots of oats give a good distribution of organic matter in the soil, and the tonnage produced during the winter is greater than that produced by vetch or winter peas. Shredding of the crop before plowing and addition of nitrogen fertilizer will assist in decaying the green manure crops. Oats are a valuable companion crop for sweetclover in the Central Prairies and Blacklands of Texas. They may also be used as a cover crop for wind or water erosion control.

CULTURE

The cultural operations for oats are similar to those used for other small grains. Best results are obtained when well-adapted varieties are sown on fertile, well-drained soil with proper seedbed preparation and adequate fertilization.

Place in the Rotation

In the principal oat growing areas of Central Texas, oats may follow any of the major crops such as corn, grain or forage sorghum or cotton. Cotton is an ideal crop to precede oats as the soil is usually firm and free of weeds and the preparation of the oat seedbed is inexpensive. Corn matures sufficiently early to permit good seedbed preparation for fall-sown oats. Sorghums are less desirable as crops to precede oats because of the depletion of summer moisture and the slow decay of crop residues. Sorghum stover, left after combine harvesting the grain, should be shredded immediately and plowed down with an application of nitrogen to assist in decaying the stubble.

Oats may be used as a companion crop for sweetclover in testing areas III and IV. The clover may be either fall or spring sown in a separate operation as it should be seeded very shallow. After the oats are harvested, the clover may produce a hay, pasture or seed crop.

Oats may be spring sown following cotton, grain sorghum or corn in Area I. Fall-sown oats cannot follow these crops as the oats must be sown before the other crops are harvested. With proper control of volunteer plants, oats may follow wheat or barley in this area, or they may be placed on fallowed ground.

Oats should not follow oats or other small grains in Central Texas because of volunteer grain and wild oats. Volunteer plants cause undesirable mixtures, and wild oats may become a serious weed pest. Both type plants provide host material for early infestation of insects or disease infection which may spread to the seeded crop.

Fall Versus Spring Seeding

Marked changes have taken place in farm practices in recent years. Thirty years ago, at least half of the oats in Texas were spring seeded. Several factors have contributed to the change to almost exclusive fall seeding of oats in Texas. These include increased emphasis on use of the crop for winter pasture, the development of more winter hardy varieties, the shift of cotton acreage to West Texas and the development of machinery which facilitates rapid harvest of crops, destruction of residues and preparation of seedbeds. Fall seeding permits use of the crop for winter pasture and, in addition, the crop produces higher yields and better quality grain than from spring seeding. Yields of New Nortex oats from fall and spring seeding for comparable years at four locations are given in Table 6.

Rate and Date of Seeding

Rates and dates of seeding vary considerably depending upon the location and the use of the crop. Suggested rates and dates by testing areas are given in Table 7. The livestock producer or dairyman may find it practical to seed

TABLE 7. RATES AND DATES FOR SEEDING OATS

		Rates, pounds per acre[1]		Seeding Date		
				Fall		
Research area	Extension districts	Non-irrigated	Irrigated	When sown for grazing only	When sown for grain and forage	Spring
I	1, 2	64	96	Sept. 1	Sept. 1	Mar. 1
II	3, 6, 7	64	96	Sept. 1	Oct. 1	Feb. 15
III	4, 5	80		Sept. 15	Oct. 15	Feb. 1
IV	8, 9, 11	80		Sept. 15	Oct. 15	None recommended
V	10, 12	80		Oct. 1	Nov. 15	None recommended

[1]Rates for spring sown oats should be increased from 16-32 pounds per acre for each area.

TABLE 8. AVERAGE YIELDS OF THREE VARIETIES OF OATS SOWN AT FIVE RATES OF SEEDING AT DENTON, 1953-55

Rate of seeding, pounds	Average yield of grain, bushels per acre		
	Alamo	New Nortex	Mustang
64	49.1	33.5	43.8
80	50.1	34.6	45.1
96	48.0	33.4	42.2
112	47.5	33.4	41.4
128	47.6	34.6	42.2

as soon as moisture is available or to seed in dry soil in anticipation of effective rains. If irrigation water is available, the crop may possibly be established as soon as soil temperatures are suitable in the fall.

The grain producer who does not plan to use the crop for supplemental livestock pasture should delay seeding until much later. An early seeded crop, which is not pastured, may deplete the soil moisture and produce excessively rank plants that may be damaged by low temperatures. Very late seeding also is undesirable because the plants may not establish good root systems before cold weather occurs.

Rate of seeding is relatively unimportant for grain production of fall-sown oats because the plants have several months in which to tiller and compensate for thin stands. Table 8 gives yields of three varieties grown at five rates of seeding in two seasons at Denton, showing that rates of seeding made no significant difference in grain yields.

Higher rates of seeding may be desirable for maximum forage production and for grain production under irrigation, where moisture is not a limiting factor in yield. Yields of forage at three clipping dates for four seeding rates at Winter Haven, Table 9, show important increases in first clipping forage yields from the higher rates of seeding. There was no advantage for the higher rates at the later clippings or for the total seasonal production. Higher rates of seeding are desirable on soils of low fertility because plants will tiller less on such soils, and weeds may become a problem.

TABLE 9. EFFECT OF SEEDING RATE ON AIR-DRY FORAGE PRODUCTION OF IRRIGATED OATS AT WINTER HAVEN, TEXAS, 1952-53 (HOLT)

Rate of seeding	Average yield of forage, pounds per acre			
	Early winter	Mid-winter	Early spring	Total
48 pounds	3,110	2,380	4,050	9,540
64 pounds	3,060	2,790	3,480	9,330
80 pounds	3,380	1,740	3,480	8,600
96 pounds	4,400	2,010	3,680	10,090

TABLE 10. FERTILIZER RESPONSE OF SMALL GRAINS IN GRAIN, FORAGE AND SILAGE PRODUCTION AT SELECTED LOCATIONS IN TEXAS

	Forage yield, pounds per acre of dry matter			
Temple, 1962-68 (10)	No fertilizer	15-30-0	30-30-0	60-60-0
Oats forage, five clippings	2697	2514	3959	4043
McGregor, 1963-67 (16)	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
College Station 1960-64 (7)	No fertilizer	20-40-40	40-40-40	
Oats forage, two clippings	833	1196	1397	
Oats silage, tons per acre	8.1	9.6	10.7	

Fertilizers

Oats respond with increased grain and forage yields to the application of commercial fertilizers or barnyard manure if moisture and environmental factors are favorable. Excessive amounts of nitrogen may increase lodging under some conditions, Figure 5. Fortunately, varieties with greater straw strength are now available and permit the practical use of more fertilizer. Data showing the response to fertilizer in increased forage, silage and grain production at several locations are given in Table 10.

Specific recommendations on fertilizer cannot be given here. A soil test by the nearest Soil Testing Laboratory and a conference with county agents or personnel at the nearest research unit will provide information for a specific location.

Winterkilling

Winterkilling of the crop, thinning of stands or damage to foliage by low temperatures are important hazards of oat production in Texas. Damage to some degree occurs on an average of one year in four, varying with the production area. Complete destruction of the crop over

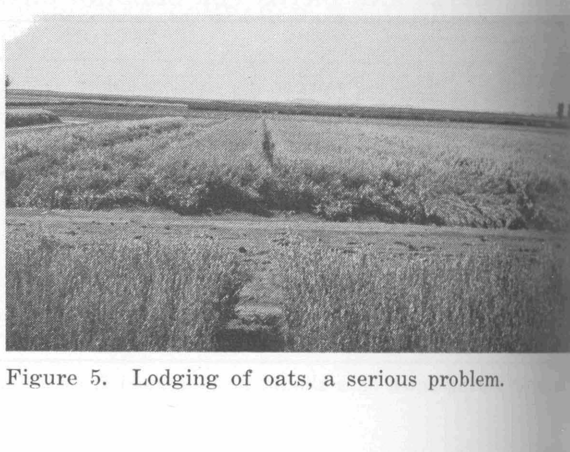

Figure 5. Lodging of oats, a serious problem.

Figure 6. Survival at low temperatures of New Nortex oats at Temple in 1948; unfertilized, left; phosphorus banded with the seed, right.

large areas occurred in 1935, 1943, 1947, 1949, 1962 and 1963. During 1963 an estimated 45 percent of the oat crop of Texas was lost during a severe period of low temperatures in January. The loss in revenue from grain and forage was estimated to exceed 27 million dollars[1]. Varieties with greater cold tolerance have recently become available and do reduce this hazard. However, as more hardy varieties became available, fall seeding of the crop was extended farther north so that winterkilling remains a hazard in this area.

The fall-sown oat crop that is well established and growing in fertile soil is less frequently damaged by low temperatures than one poorly established or growing on poor soil. Rank, succulent plants in unpastured fields also are more easily winterkilled. Adequate available phosphorus stimulates good root development and aids in reducing winterkilling. At Temple, in 1948, New Nortex oats survived low temperatures with a good stand when phosphorus was banded with the seed at planting time, but the adjoining unfertilized portion of the field had stands thinned to approximately 30 percent, Figure 6.

Varieties vary greatly in their tolerance to cold. The highest degree of resistance to low temperatures is found in winter-type varieties such as Wintok and Norline. Less hardy, but usually sufficiently hardy for the main oat growing areas, are New Nortex, Alamo-X and others. Varieties of low cold tolerance are Houston and other erect growing types. The rating for cold tolerance of commercial varieties is given in a later section. The value and effectiveness of cold tolerance is illustrated in Figure 7. At Iowa Park in 1951, Bronco and Mustang survived a temperature of 0°F. and yielded 59.7 and 44.1 bushels per acre, respectively, when all other varieties were almost completely destroyed.

[1]Private estimate compiled by the authors from reports by county agents.

Harvesting

Because oats have weaker straw than wheat or barley, they present additional problems in harvesting. Storms, wind and rain may cause severe lodging which increases the cost of harvesting and may reduce grain quality. New varieties, such as Houston, Alamo-X, Coronado and others will stand for direct combine harvesting much better than New Nortex and others with weaker straw. When leaf diseases attack the crop, the straw is weakened which increases the chances of lodging. Nearly all varieties break over soon after they become fully ripe.

Under some conditions, it may be more practical to windrow the crop and thresh it a few days later, Figure 8. Windrowing is preferred if the crop is lodging, if weeds are a problem or if humidity or other factors prevent the prompt harvest of the ripe grain. The crop is usually damaged less by rains when in the windrow than when standing fully ripe. For storage, the grain should not contain more than 13 percent moisture. If grain drying equipment is used to dry excessively moist grain, the drying temperature

Figure 7. Cold tolerance of Mustang and Bronco oats at Iowa Park, 1951. Survival of Bronco was 92 percent, yield 59.7 bushels; survival of Mustang was 60 percent, yield 44.1 bushels. New Nortex and other varieties were almost completely killed.

Figure 8. Windrowing oats (top) followed by combine threshing from windrow (bottom) for oat seed production.

should not be above 105° F. or the viability of the seed may be damaged. Storage of grain with a high moisture content provides favorable conditions for damage by storage, insects or molds and other fungi.

VARIETIES

Due to the wide range of climatic conditions and uses of oats in Texas, a considerable number of varieties are needed to provide adapted varieties for each area. The estimated acreages of varieties grown in Texas in 1968[2], summarized by testing areas, are given in Table 11. Ora, Moregrain and New Nortex are the most popular varieties and together make up 67.1 percent of the total seeded acreage. The pedigrees, release date and state of origin are given in Table 12. For convenience in making comparisons, some characteristics of the varieties are listed in Table 13.

Winter Hardy Varieties

Oat culture was not successful in Texas before 1860 because the only varieties available were spring-type varieties brought in from northern states. These were susceptible to cold, drouth, heat and diseases. The Red Rustproof oats were introduced about 1865 and rapidly established themselves as the dominant type grown. An estimated 500,000 acres of oats were grown in Texas in 1888, 1 million acres by 1914 and almost 2 million in 1921. However, all varieties lacked sufficient cold tolerance to be fall sown in northwest Texas. During the past 20 years, through plant breeding efforts in several states, varieties have become available which make fall seeding of oats much less hazardous in north and northwest Texas. This group of varieties includes Wintok, Winter Excel, Norwin,

[2]Private estimate based on local estimates made by county agents and data on file.

TABLE 11. ACREAGES AND PERCENT OF TOTAL FOR OAT VARIETIES GROWN IN TEXAS IN 1968

Research testing area	I	II	III	IV	V		
Extension district	1, 2	3, 6, 7	4, 5	8, 9, 11	10, 12	Total	Percent of total
Varieties							
Alamo-X	1,040	107,746	5,515	36,132	12,055	159,488	8.6
Alber				50	18,650	18,710	1.0
Arkwin		5,136	11,205			16,341	0.9
Bronco	1,512	27,788	16,575	9,500	300	55,675	3.0
Cimarron	3,506	53,203	36	360		57,050	3.1
Coronado		712		3,820	1,260	5,792	0.3
Dubois	828	3,683	3,750			8,261	0.4
Florida 500				400	960	1,360	0.1
Houston					8,010	8,010	0.4
Kanota		750				750	Tr.
Moregrain	1,318	59,680	56,680	121,254	135,990	374,922	20.2
Mustang	2,556	28,674	10,575	10,285	2,850	54,940	3.0
New Nortex	2,537	72,773	88,213	169,727	15,175	348,426	18.8
Nortex 107	10	2,075	1,385	1,870	5,100	10,440	0.6
Nora	0	11,975	4,750	9,275	0	26,000	1.4
Norline	0	200	0	0	0	200	Tr.
Norwin	810	10,021	3,000	200	0	14,031	0.8
Ora	3,250	133,032	124,390	192,515	67,345	520,532	28.1
Suregrain	580	17,648	2,370	25,740	82,120	128,458	6.9
Taggart	0	3,164	500	12,330	300	16,294	0.9
Wintok	422	2,200	0	0	0	2,632	0.1
Others	30	4,854	1,350	2,728	14,850	23,812	1.3

TABLE 12. PEDIGREE OF AND STATE RELEASING COMMERCIAL VARIETIES OF OATS GROWN IN TEXAS

Variety	State developing or releasing	Year released	Pedigree
Alamo	Texas	1954	Fulghum-Victoria x Victoria-Hajira-Banner
Alamo-X	Texas	1962	Selection from irradiated Alamo
Alber	Louisiana	1942	Introduced from Argentina
Arkwin	Arkansas	1951	Tennessee 1922 x Bond-Iogold
Bronco	Texas	1956	Fulwin x Lee-Victoria
Cimarron	Oklahoma	1955	Woodward Oat Composite, C.I.3527 selection
Coronado	Texas	1967	[Santa Fe-Clinton x Hajira-Joanette] x [New Nortex-Landhafer) x (Black Mesdag x ab 101)]
Cortez	Texas	1968	do.
Dubois	Indiana	1952	Clinton x Forkedeer
Florida 500	Florida	1967	Florad x Coker 58-7, C.I.7403
Forkedeer	Tennessee		Selection from Winter Type Fulghum
Houston	Texas	1965	[Fulwin-Lee-Victoria x Red Rustproof-Victoria-Richland] x [Bond-Rainbow-Hajira-Joanette x Landhafer]
Moregrain	So. Carolina[1]	1962	Arlington-Delair-Trispermia x Bond-Fulghum-Victorgrain
Mustang	Texas	1954	Fulwin x Lee-Victoria
New Nortex	Texas	1936	Selection from Appler Red Rustproof
Nortex	Texas	1926	Selection from Texas Red Rustproof
Nora	Arkansas	1967	[(Lee-Victoria-Fulwin x Bonda) x Landhafer] x Moregrain
Norline	Indiana	1960	Lee-Victoria x Forkedeer[2]
Norwin	Texas	1967	Colo-Wintok x (Hajira-Joanette x Atlantic-Clinton-Santa Fe)
Ora	Arkansas	1964	[(Lee-Victoria-Fulwin x Bonda) x Landhafer] x Moregrain
Radar I	Georgia	1960	Victorgrain x [(Bond-Rainbow-Hajira-Joanette) x Landhafer]
Suregrain	So. Carolina	1962	(Arlington x Delair) x Trispermia
Taggart	Arkansas	1948	Fulghum x Bond
Wintok	Oklahoma	1940	Hairy Culberson x Winter Fulghum
Winter Excel	Oklahoma[2]	1956	Unknown

[1]Developed and distributed by the Coker Seed Company, Hartsville, South Carolina.
[2]Developed by Joseph Doane, private plant breeder.

TABLE 13. SUMMARY OF CHARACTERISTICS OF THE MORE IMPORTANT COMMERCIAL OAT VARIETIES UNDER TEXAS CONDITIONS

Variety	Growth habit[1]	Seedling characteristics	Leaf width[2]	Hardiness rating[3]	Plant height	Maturity	Straw strength
Alamo	I	erect	W	++	tall	early	strong
Alamo-X	I	erect	W	+++	tall	midseason	strong
Alber	I	moderately erect	I	++	tall	late	strong
Arkwin	IW	moderately erect	NI	++++	tall	late	strong
Bronco	W	prostrate	N	+++++	tall	very late	strong
Cimarron	IW	moderately erect	NI	+++++	medium	early	weak
Coronado	I	do.	I	++	tall	midseason	strong
Cortez	I	do.	I	++	tall	early	strong
Dubois	W	prostrate	N	+++++	tall	late	strong
Florida 500	IS	erect	W	++	tall	midseason	strong
Forkedeer	W	prostrate	N	+++++	tall	late	strong
Houston	IS	erect	W	++	short	early	strong
Moregrain	I	erect	WI	+++	medium	midseason	strong
Mustang	IW	moderately erect	NW	++++	medium	early	moderately weak
New Nortex	IW	do.	N	+++	medium	late	weak
Nortex	IW	do.	N	+++	medium	late	weak
Nora	W	do.	N	++++	short	midseason	strong
Norline	W	prostrate	N	+++++	medium	late	strong
Norwin	IW	moderately erect	NI	+++++	short	early	medium
Ora	I	do.	I	+++	medium	midseason	strong
Radar I	IS	erect	W	+	short	early	strong
Suregrain	IS	erect	W	+	short	early	strong
Taggart	I	erect	W	++	medium	early	strong
Wintok	W	prostrate	N	+++++	medium	midseason	weak
Winter Excel	W	prostrate	N	+++++	medium	midseason	weak

[1]Growth habit types: W = Winter; IW = Winter, approaching intermediate; I = intermediate; IS = intermediate, approaching spring.
[2]Leaf width types: W = Wide; WI = wide, approaching intermediate; I = intermediate; NW = narrow, approaching intermediate; N = narrow.
[3]Hardiness rating + lowest; +++++ highest.

Norline, Forkedeer, Dubois, Bronco, Arkwin and Mustang.

Classification of cold tolerance of varieties is difficult because the degree of hardiness depends so much on the environmental conditions under which they are grown. Within the groups shown in Table 13, there are additional subdivisions based on hardiness. Wintok, Winter Excel and Norline are the most hardy. Cimarron, Dubois, Forkedeer and Bronco are slightly less hardy than the first three and Mustang and Arkwin are somewhat less hardy than Bronco. All these varieties are adapted to fall seeding in the northern Low Rolling and High Plains, Areas I and II. All are very susceptible to leaf and stem rust, but these diseases are not usually of major importance in these areas. Cimarron and Norwin have leaves which are more upright and broader than those of the other cold tolerant varieties, characteristics which make them well suited for planting for winter pasture. Bronco is a tall variety which is well adapted for hay or grass silage because of the high tonnage it will produce.

Moderately Hardy Varieties

Varieties within this group also vary in cold tolerance but, because they produce more upright growing seedlings, many are better suited for winter pasture use than most varieties of the hardy group. Nora and Ora are the most hardy within this group, followed by a second subgroup of Alamo-X, Moregrain and New Nortex. New Nortex is only moderately hardy, yet it has the ability to tiller and recover well when it is thinned by low temperatures. Coronado and Cortez have not been tested sufficiently to accurately evaluate their hardiness. All varieties of this group, except New Nortex, have strong straw and under most conditions may be direct combine harvested. New Nortex usually should be windrowed for threshing. Alamo-X has some resistance to stem rust, and all varieties, except New Nortex, have resistance to some races of crown rust. All are susceptible to some new races of both rusts.

Varieties of Low Cold Tolerance

Within this group there also are degrees of hardiness. The most cold tolerant of this group are Taggart and Alber, which, if adequately hardened, will survive moderate winter temperatures. Houston and Suregrain are very tender, and the exact rating of Florida 500 under Texas conditions is not yet known. All varieties of this group grow rather upright in the seedling stage and have broad leaves. All have good straw strength. Considering present races of crown rust, Florida 500 and Suregrain have the best resistance although these were attacked by certain new races or biotypes in 1968. Alber has a tolerant, slow rusting characteristic which has enabled a small acreage to persist in South Texas for many years. All varieties of this group are susceptible to stem rust.

Spring-type Varieties

The common white or yellow-seeded, *Avena sativa* L., oats of spring-growth habit of the Midwest or Corn Belt are not sufficiently cold tolerant to be fall sown in most parts of Texas. They can be grown in Area V for livestock pasture but, unless very carefully managed, they are damaged by grazing and may soon be killed. Also, they can be used in the High Plains for spring seeding. However, as will be pointed out later, they are not superior to local intermediate-type varieties for this purpose.

PERFORMANCE TRIALS

Fall-sown Oats

Intrastate performance trials of small grains are conducted at locations representative of the growing areas in the state as part of the small grain improvement program. Varieties and experimental strains are included in these tests to determine their range of adaptation and comparative performance. These results are used as a basis for variety recommendations to growers. The five testing areas, with one or two test locations in each, were shown in Figure 2.

Yields and agronomic data are summarized each season (5) and published for varying periods of years (6). A brief summary of comparable yields and agronomic data are given in accompanying tables. All varieties are not tested in all years or at all stations. In order to compare varieties grown for varying periods of time, a comparable figure, based on a standard group of varieties grown for the full period of years, was calculated for each variety. By means of a correction factor suggested by Patterson (20), data on varieties grown for less than the full number of years were adjusted so that all varieties may be directly compared. Performance trials are conducted in four-row, 12-foot nursery plots with four replications. As strains are considered for release, they may be grown in larger field plots for more extensive observations of agronomic characteristics.

AREA I, *The High Plains (Extension Districts 1 and 2)*: As shown in Table 2, this area is a high plateau of 3,000 to 4,000 feet elevation with annual rainfall of about 18 inches. Large acreages of wheat, sorghum and cotton are irrigated. Only about 2 percent of the state seeded oat acreage is grown in this area. Some is fall seeded, and some is spring seeded. Tests were made at Bushland throughout the period of study, Table 14. Less extensive tests were conducted at Floydada from 1956-60 and at Plainview and Etter in 1966 and 1967, Table 15. Fall sown oat tests were winterkilled in 1963 and seriously damaged by low temperatures in 1962. Yield data indicate that Wintok, Norwin, Cimarron, Dubois, Norline, Bronco and Mustang are all well adapted to fall seeding in this area. Survival data show that New Nortex, Frazier and Mustang are somewhat less hardy and yield somewhat less. Cimarron was the highest yielder

TABLE 14. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR IRRIGATED, FALL-SOWN OAT VARIETIES, BUSHLAND, TEXAS 1956-68[1]

Variety	Number years tested	Grain yield, bushels per acre	Test weight, pounds per bushel	Date first head	Plant height, inches	Winter survival, percent	Lodging, percent
Frazier[2]	10	84.2	34.6	5-7	31.6	60	11
Fulwin[2]	10	76.7	34.8	5-13	36.2	79	54
New Nortex[2]	10	81.4	35.0	5-10	32.4	50	33
Average	10	80.7					
Blount	1	99.4	35.4	5-14	32.7	48	
Bronco	10	85.9	33.2	5-17	35.9	64	37
Cimarron	10	93.4	36.1	5-7	30.2	78	19
Compact	1	63.0	33.1		26.1		
Dubois	4	93.1	37.1	5-13	32.6	65	7
Fultex	5	72.0	34.4	5-10	29.1	49	6
Mustang	7	89.3	32.7	5-13	32.3	45	43
Nora	1	178.3[3]	36.2	5-6	24.1		
Norline	5	89.5	36.4	5-16	36.5	75	5
Norwin	5	108.6	35.5	5-8	29.5	72	28
Winter Excel	2	93.6	41.2	5-10	31.7	79	
Wintok	9	87.3	35.9	5-13	33.2	83	29

[1]Calculated comparable data based on years grown.
[2]Check varieties used to compute comparable data.
[3]Actual yield, 1 year only.

at Plainview and Etter, but Mustang produced the best yields at Floydada.

AREA II, *The Rolling Plains, Edwards Plateau and Trans-Pecos (Extension Districts 3, 6 and 7)*: Together, these three extension districts grew 460,230 acres of oats in 1968 or about 28 percent of the state seeded acreage. About half is harvested for grain, and the other half is grazed to maturity by livestock. Practically all is grown with the natural rainfall which ranges from 20 to 30 inches per year over most of the area but is less than 10 inches in the Trans-Pecos area. Cold resistance is of considerable importance in this area, but diseases are usually of minor importance because of the low rainfall and humidity.

Only one testing station is available in this large area, although results are available from Iowa Park up to 1965, Table 16. The highest yields at Chillicothe were produced by Norwin, Alamo-X, Cimarron, Wintox and Mustang. Ora, Nora, Moregrain and Suregrain had the highest test weight, Table 17. Survival in 1963 showed Winter Excel, Norwin, Cimarron and Wintok to be the most cold tolerant. Visual forage estimates indicated that Alamo-X, Cimarron and Moregrain produced the most forage. At Iowa Park, Ora, Cimarron, Norwin, Mustang and Bronco produced the best grain yields.

AREA III, *North Central and Northeast Texas (Extension Districts 4 and 5)*: Oats are one of the major grain crops in the Blacklands and Prairie soils of this testing area. However, there are many sandy soil areas, and for the entire area only 44 percent of the oats in District 4 and only 25 percent of those in District 5 were harvested. An estimated 17 percent of the state acreage is seeded in Area III, but about one-fourth of the state oat grain crop is harvested from this area. Winterkilling is important in this area because plants do not remain dormant. Winter temperatures fluctuate greatly, and periods of warm weather may bring plants into rapid

TABLE 15. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR IRRIGATED, FALL-SOWN OATS PLAINVIEW, ETTER AND FLOYDADA, 1956-68

Variety	Comparable yield of grain,[1] bushels per acre			Comparable test weight,[1] pounds per bushel			Plant height, inches	Survival percent, 1966	Lodging percent, 1966
	Plainview 1966-67	Etter 1966-67	Floydada 1956-60	Plainview 1966-67	Etter 1966-67	Floydada 1956-60			
Bronco	96.9	104.1	53.4	33.0	32.0	36.2	25.3	80	32
Cimarron	119.8	106.5	48.9	34.0	34.5	35.6	21.8	78	55
Dubois	103.9	99.0		37.7	34.4			75	32
Frazier		100.4	51.8		34.7	35.5	23.5	78	70
Fulwin		84.1	50.1		31.4	36.0	29.5	81	45
Fultex			49.8			35.9	20.3		
Mustang			59.2			33.6	22.0		
New Nortex		84.6	55.7		33.0	35.6	23.5	74	45
Norline	84.4	97.0			33.9			77	12
Norwin	119.3	97.1			34.3			79	70
Wintok	109.9	78.9	52.8		33.4	36.9	24.3	83	37

[1]Calculated comparable averages based on years grown.

TABLE 16. COMPARABLE YIELDS AND AGRONOMIC DATA FOR FALL-SOWN IRRIGATED OATS, IOWA PARK, TEXAS, 1956-65[1]

Variety	Number years tested	Grain yield, bushels per acre	Test weight, pounds per bushel	Date first head	Plant height, inches	Winter survival, percent, 2 years	Forage estimate
Frazier[2]	9	70.2	33.2	4-14	34	35.0	105
Mustang[2]	9	78.0	30.7	4-23	34	42.0	97
Wintok[2]	9	67.1	33.3	4-23	33	91.5	98
Average		71.8	32.4	4-19			
Alamo	6	72.7	33.8	4-17	31	13.8	100
Alamo-X	2	64.4	32.6	4-17		48.0	
Arkwin	2	61.7	34.9	4-21			103
Bronco	8	77.7	30.4	4-26	34	85.0	97
Cimarron	9	80.6	33.3	4-15	30	88.5	100
Fultex	3	72.0	32.1	4-20	32		98
Fulwin	8	68.1	31.8	4-25	37	87.0	98
Moregrain	6	60.2	35.2	4-12		9.5	98
New Nortex	8	67.9	31.7	4-21	33	3.5	100[3]
Norwin	3	79.6	35.1				
Ora	1	81.2	34.1			43.2	
Suregrain	4	71.6	33.3	4-15		14.8	100
Victorgrain	4	77.3	33.0	4-19			100
Winter Excel	4	72.8	35.1	4-24		46.5	

[1]Calculated comparable yields based on years grown.
[2]Check varieties used to compute comparable data.
[3]Forage check.

growth prior to periods of very cold weather. During the January 1963 storm, which killed much of the oat crop, temperatures dropped to 8° F. at Denton after a week of 80 to 90-degree temperatures. Then the temperature soared to 56° F. in a few days and again dropped to 7° F. Under such conditions, most small grain crops are seriously damaged.

Comparative agronomic data obtained at Denton, Table 18, show that the highest comparable yields were produced by Ora, Nora, Bronco, Mustang and New Nortex. During three seasons when winterkilling occurred, Norwin, Fulwin, Dubois and Bronco survived best while stands of Alamo-X, Moregrain and Suregrain were greatly reduced. A field of New Nortex oats grown at Denton in 1962 is shown in Figure 9.

Data at Overton for 1968 are given in Table 19. Coronado, Moregrain, Cortez and Houston all gave excellent yields and also are well suited for forage uses in this area.

TABLE 17. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR OAT VARIETIES GROWN AT CHILLICOTHE, TEXAS, 1958-68[1]

Variety	Number years tested	Grain yield, bushels per acre	Test weight, pounds per bushel	Date first head	Plant height, inches	Forage estimate, percent	Lodging percent	Survival 1963
Frazier[2]	10	32.5	32.4	4-25	26.0	104	43	11
Fulwin[2]	10	32.0	32.1	4-30	28.7	102	71	33
New Nortex[2]	10	31.8	30.7	4-29	24.1	100[3]	39	2
Average		32.1	31.7	4-28	26.3			
Alamo-X	8	38.8	31.8	4-28	24.4	117	19	21
Arkwin	2	31.9	32.6	5-2	23.0	85	32	
Blount	4	36.4	32.2	4-29	25.9		19	
Bronco	5	34.3	32.6	5-5	26.3	86	27	21
Cimarron	10	37.4	32.8	4-23	23.1	110	51	43
Coronado	2	36.6	33.9	4-26	22.9			
Dubois	3	31.7	33.9	4-27	23.8		19	
Moregrain	8	34.4	35.5	4-25	20.7	107	19	6
Mustang	7	37.4	30.9	4-30	23.8	102	33	14
Nora	2	31.1	35.6	4-27	20.4			
Norline	5	33.2	29.6	5-5	26.5		19	
Norwin	6	41.7	33.5	4-27	24.7		49	50
Ora	5	35.6	35.6	4-25	21.4		19	
Suregrain	3	33.0	34.5	4-26	20.4	97	79	
Winter Excel	7	36.4	33.7	4-28	24.6		53	71
Wintok	10	37.1	33.1	4-29	24.1	104		38

[1]Calculated comparable data based on years tested.
[2]Check varieties used to compute comparable data.
[3]Forage check variety.

TABLE 18. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR FALL-SOWN OAT VARIETIES GROWN AT DENTON, TEXAS 1959-68[1]

Variety	Number years tested	Grain yield, bushels per acre	Test weight, pounds per bushel	Date first head	Plant height, inches	Crown rust, percent	Percent survival 3 years	Lodging percent
Frazier[2]	10	61.5	32.8	4-12	35.7	22	70	49
Fulwin[2]	10	63.5	28.9	4-22	40.8	56	97	39
New Nortex[2]	10	70.5	30.9	4-22	33.2	14	69	31
Average	10	65.2	31.0	4-19	36.6			
Alamo-X	8	61.2	31.0	4-16	37.0	23	50	23
Arlington	7	64.1	31.4	4-20	39.8	15	81	
Arlington 23	3	63.4	31.6	4-19	41.7	34		31
Blount	5	67.5	32.3	4-21	34.0	21	93	21
Bronco	10	72.2	30.2	4-23	37.5	25	97	10
Bruce	6	63.2	32.0	4-15	35.1	23		21
Carolee	7	69.7	30.8	4-20	34.2	17	61	17
Coker 242	4	69.5	33.8	4-19	34.8	11		
Coronado	3	69.4	32.1	4-17	32.1	7		19
Cortez	2	65.1	31.0	4-14	30.2	11		17
Dubois	3	61.3	32.3	4-20	33.6	36	99	23
Fairfax	9	65.5	30.9	4-21	40.6	15	78	14
Jefferson	9	68.3	33.0	4-18	37.3	22		24
Mustang	7	71.6	30.1	4-20	34.6	23	83	10
Moregrain	10	68.4	33.6	4-14	30.1	15	68	22
Nora	2	77.9	32.0	4-15	30.2	19		16
Norwin	7	66.8	31.6	4-15	31.1	31	99	38
Ora	7	83.1	31.1	4-15	31.0	6	96	3
Roanoke	6	66.5	31.9	4-21	40.9	18	72	7
Sumter	5	56.8	32.0	4-17	35.0	14	58	14
Sumter 3	4	47.8	30.6	4-17	36.7	26		18
Suregrain	5	66.7	33.5	4-16	30.5	Tr	51	20
Victorgrain	7	74.1	33.0	4-17	36.4	18	74	11

[1]Calculated comparable data based on years grown.
[2]Check varieties used to adjust yields.

AREA IV, *The Central Blacklands and East Texas (Extension Districts 8, 9 and 11):* This testing area grows an estimated 26 percent of the state acreage, most of it in District 8, and produces about one-fourth of the harvested grain. Diseases frequently are important hazards to production in this area. Only 40 percent of the seeded acreage is harvested in District 8 and 3 percent in Districts 9 and 11.

Data on performance of oat varieties at McGregor and Temple are reported in Tables 20 and 21. Among varieties grown for most or all of the period, the best yields were made by Ora, New Nortex and Moregrain. Of those grown for shorter periods, Cortez, Coronado, Nora and Florida 500 have produced good yields. Suregrain and Florida 500 have the highest crown rust resistance, but none of the varieties now available are resistant to stem rust. Cold tolerance is usually less important in this area, but many varieties were damaged in 1962 and 1963.

AREA V, *South Texas and the Rio Grande Plain (Extension Districts 10 and 12):* Oats are grown in this area largely for winter pasture. A total of 347,270 acres was seeded but only about 10 percent, 30,480 acres, was harvested, Table 3. Rust resistance is of major importance most seasons, not only for grain production, but also because rust may seriously reduce the period of forage production as well.

TABLE 19. YIELDS AND TEST WEIGHT OF OAT VARIETIES GROWN AT OVERTON, TEXAS IN 1968

Variety	Mean yield, pounds per bushel	Test weight, bushels per acre
Alamo-X	82.7	30.0
Coker 242	96.4	33.0
Coronado	109.3	30.3
Cortez	97.0	31.0
Florida 500	88.4	32.5
Houston	93.5	30.0
Moregrain	101.5	36.0
New Nortex	46.4	24.5
Suregrain	88.8	30.0

Figure 9. A fine field of New Nortex oats at Denton.

TABLE 20. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR FALL-SOWN OAT VARIETIES GROWN AT McGREGOR, TEXAS, 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	Survival, 1962-63	Forage estimate[3]
Frazier[2]	10	51.5	33.9	4-9	35.2	43	80	111
Fulwin[2]	10	41.9	29.0	4-19	34.2	62	100	89
New Nortex[2]	10	61.9	30.6	4-20	32.6	16	85	100
Average	10	51.8	31.2	4-16	34.0			
Alamo	7	52.5	31.8	4-12	32.6	27	15	111
Alamo-X	8	59.5	31.5	4-13	34.2	16	87	112
Arkwin	1	53.7	31.4	4-16	34.6	71		103
Bronco	6	47.7	29.5	4-23	34.3	43	70	79
Coker 242	3	52.3	29.5	4-13	33.4	21		104
Coronado	3	62.9	34.0	4-14	33.1	20		99
Cortez	2	68.7	36.0	4-10	32.3	28		
Florida 500	3	61.4	35.6	4-11	27.8			109
Houston	5	51.6	34.0	4-14	28.1	22		109
Moregrain	10	61.4	37.2	4-11	30.8	13	80	109
Mustang	8	60.0	31.3	4-17	33.8	36	96	79
Nora	2	61.8	32.0	4-15	31.8	27		
Norwin	2	53.6	35.0	4-15	30.3	34		
Ora	5	69.4	32.6	4-15	32.5	22	100	104
Victorgrain	3	60.8	34.4	4-13	33.9			115
Suregrain	10	59.9	36.1	4-13	30.9	4	17	107
Taggart	5	57.6	32.7	4-19	35.3	57		105

[1]Calculated comparable averages based on years grown.
[2]Check varieties used to compute comparable data.
[3]Percent of New Nortex check.

Data obtained at College Station, where supplemental irrigation is used when needed, and Beeville, with natural rainfall, are given in Tables 22 and 23. The varieties Coronado, Cortez, Houston, Florida 500 and Coker 242 produced the best grain yields at College Station. Rust is usually less damaging than at Beeville. Races of crown rust have changed rapidly during the testing period. Alamo-X was highly resistant at the start of this period, Coronado and Cortez

TABLE 21. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR FALL-SOWN OAT VARIETIES AT TEMPLE, TEXAS, 1959-68[1]

Variety	Number years tested	Grain yield, bushels per acre	Test weight, pounds per bushel	Date first head	Plant height, inches	Forage estimate, percent of New Nortex	Percent winter survival, 3 years
Frazier[2]	10	52.1	34.6	4-7	36.2	111	97
Fulwin[2]	10	48.0	32.4	4-16	35.7	97	98
New Nortex[2]	10	61.6	34.0	4-18	34.1	100	97
Average		53.9	33.7	4-14	35.3		
Alamo	6	47.4	32.7	4-12	33.5	111	77
Alamo-X	9	48.3	31.9	4-11	34.1	116	91
Arkwin 60	2	43.8	35.0	4-15	35.3	88	
Blount	4	50.7	35.4	4-8	35.2	106	99
Bronco	7	47.5	34.2	4-16	36.2	90	97
Coker 242	4	54.7	37.8	4-15	31.4	112	
Coronado	3	55.6	36.7	4-11	33.0	107	
Cortez	2	58.4	37.0	4-7	31.2	110	
Dubois	2	42.1	32.0	4-17	31.8		
Florida 500	3	58.4	35.0	4-6	37.7	113	
Forkedeer	1	53.4	32.0	4-13			
Houston	7	37.1	34.2	4-9	25.9	112	31
Jefferson	1	54.1	35.0		36.3		
Midsouth	3	52.2	36.8	4-11	32.9	111	
Moregrain	10	55.2	36.6	4-9	30.6	110	95
Mustang	9	53.7	32.9	4-13	34.3	103	100
Nora	2	59.1	35.0	4-12	32.7	101	
Norwin	3	48.8	34.3	4-11	29.0	100	
Ora	6	60.3	36.6	4-12	31.1	105	99
Radar I	2	59.5	33.7	4-7	32.3	110	
Suregrain	10	53.0	36.1	4-10	29.8	111	85
Taggart	4	49.1	34.7	4-19	33.8	116	
Victorgrain	2	46.4	34.8	4-11	31.7	110	

[1]Calculated comparable data based on years grown.
[2]Check varieties used to calculate comparable data.

TABLE 22. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR FALL-SOWN OAT VARIETIES GROWN AT COLLEGE STATION, TEXAS, 1959-68

		Comparable data[1]					
Variety	Number years tested	Grain yield, bushels per acre	Test weight, pounds per bushel	Date first head	Plant height, inches	Forage estimate[3]	Leaf rust, percent
Frazier[2]	10	39.2	30.4	3-28	37.9	114	75
New Nortex[2]	10	47.6	29.4	4-9	37.0	100	26
Average	10	43.4	29.9	4-4	37.5		
Alamo	7	47.5	30.2	4-2	36.3	123	38
Alamo-X	8	49.0	27.7	4-3	37.0	124	50
Appler Rustproof	9	48.9	27.9	4-6	38.0	101	38
Coker 242	6	60.9	34.7	4-4	36.1	117	12
Coronado	4	87.6	36.3	4-5	39.5	106	Tr
Cortez	4	85.7	36.1	3-26	34.2	116	Tr
Clintland 64	4	49.4	32.7	4-8	38.4	125	16
Florad	4	35.2	30.7	4-1	38.8	127	16
Floriland	4	30.8	30.9	3-28	36.7	115	27
Florida 500	5	70.2	34.5	3-27	35.5	100	Tr
Houston	7	65.4	34.0	4-4	30.7	130	7
Midsouth	3	38.1	32.1	4-5	39.5	106	73
Moregrain	10	58.7	34.3	3-29	33.5	118	38
Nora	2	53.3	28.0	4-6	31.4	85	Tr
Norwin	1	53.4	29.9	4-3	33.9	85	69
Ora	6	65.0	31.9	4-2	34.7	104	12
Radar I	4	54.9	30.4	3-30	32.7	117	16
Ranger	3	33.1	27.1	4-12	35.5	100	28
Suregrain	10	63.0	33.0	4-2	34.5	117	10
Victorgrain	2	43.6	30.6	4-5	39.6	110	64

[1]Calculated comparable data based on years grown.
[2]Check varieties used to compute comparable data.
[3]Percent of New Nortex forage check.

were resistant until 1967 and Florida 500 and Suregrain were resistant until 1969.

At Beeville, Florida 500 and Suregrain produced the best grain yields because of their better rust resistance. Coronado and Cortez yielded well until 1968, and Ora and Moregrain yielded well before 1966. Forage estimates at both locations showed superior forage production by Houston, Alamo-X, Florida 500, Coronado and Cortez.

Spring-sown Oats

A small acreage of spring-sown oats is grown in Texas. In seasons when there is a large amount of winterkilling of the fall-sown crop or spring moisture conditions are favorable in northwest Texas, a larger acreage is sown. As pointed out earlier, Table 6, spring-sown oats usually yield less than fall-sown oats, and quality may be less desirable.

Data from a small performance trial of

TABLE 23. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR FALL-SOWN OAT VARIETIES GROWN AT BEEVILLE, TEXAS, 1959-68[1]

Variety	Number years grown	Grain yield, bushels per acre	Test weight, pounds per bushel	Plant height, inches	Leaf rust, percent	Stem rust, percent	Forage estimate, percent
Frazier[2]	9	15.6	29.3	32.6	71	12	116
New Nortex[2]	9	22.9	26.3	31.9	53	9	100[3]
Average			27.8	32.3	62	11	
Alamo	6	23.1	28.6	34.7	48	2	110
Alamo-X	7	26.0	27.3	35.4	57	3	120
Clintland 64	3	19.8	27.7	34.5	41	7	133
Coker 242	2	26.2	31.6	28.8	61		124
Coronado	2	36.1	32.6	32.8	36		124
Cortez	2	42.9	32.4	36.8	36		122
Florida 500	3	48.4	29.8	33.8	19		124
Houston	6	34.9	32.4	31.1	40	11	129
Moregrain	8	39.0	33.8	34.4	25	35	118
Nora	2	24.4	33.7	29.8	55		99
Ora	5	33.9	28.9	30.9	30		117
Radar I	5	34.5	29.3	31.1	39	10	110
Ranger	3	26.4	25.4	32.4	53	15	100
Suregrain	8	44.8	32.2	33.2	8	38	113

[1]Calculated comparable data based on years grown.
[2]Check varieties used in calculating comparable data.
[3]Forage check variety.

TABLE 24. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR IRRIGATED, SPRING-SOWN OATS AT BUSHLAND, TEXAS, 1956-58

Variety	Number years tested	Grain yield, bushels per acre	Test weight, pounds per bushel	Plant height, inches	Date first head
Frazier	7	70.4	31.9	28.0	5-24
New Nortex	7	74.5	32.4	30.6	5-21
Average	7	72.4	32.1	29.3	
Alamo	5	78.0	32.0	29.1	5-24
Alamo-X	6	73.5	30.6	28.4	5-24
Cimarron	6	77.9	32.7	28.6	5-24
Clintland 64	2	58.3	35.1	31.5	5-25
Coronado	1	103.6[1]	33.7	29.8	
Cortez	1	107.5[1]	31.6	29.8	
Florida 500	1	107.3[1]			
Houston	5	69.8	33.8	24.8	5-20
Moregrain	5	82.0	34.3	27.4	5-22
Mustang	5	73.4	31.0	29.1	5-22
Neal	2	80.7	32.4	29.3	5-23
Norwin	4	83.0	31.7	28.5	5-21
Ora	2	83.1	34.3	24.8	
Suregrain	4	79.2	32.5	27.1	5-20
Tonca	1	66.8	38.6	29.8	

[1]Actual yield, 1 year only.

spring-sown oats conducted at Bushland, Chillicothe and Denton are given in Tables 24, 25 and 26. More details are given in a separate report (4). Neal, Tonka and Clintland 64 were included in some tests to represent the true spring-type varieties grown in the spring-sown oat area of the Midwest. None of these did as well under Texas conditions as the intermediate or near-spring types sown in Central and South Texas.

At Bushland in irrigated tests, Coronado, Cortez and Florida 500 produced outstanding yields in 1968. Among varieties grown for longer periods, Moregrain, Ora, Suregrain and Alamo-X produced the best yields. The hardy varieties Cimarron and Norwin also produced excellent yields from spring seeding.

Yields at Chillicothe were low on the average, and in several years the spring oats were complete failures. Comparable yields of Cortez, Moregrain, Norwin, Suregrain and Alamo-X were the highest. At Denton, Cortez and Coronado yielded well in 1967, the first year they were entered in the test. For longer periods of testing, Ora, Moregrain, Suregrain, Houston and Norwin produced good yields.

DISEASES

Diseases are important hazards in oat production in the humid, high rainfall areas of Texas, Areas III, IV and V. Occasionally they may be seriously destructive in other parts of the state. Depending upon the causal organism, diseases cause reduced stands, damage to young seedlings, destruction of leaf tissue, reduced seedset or seed size and low grain yields or quality. Smuts destroy the entire kernel, thereby reducing grain yields. Major losses from

TABLE 25. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR SPRING-SOWN OAT VARIETIES AT CHILLICOTHE, TEXAS, 1958-68[1]

Variety	Number years tested	Grain yield, bushels per acre	Test weight, pounds per bushel	Date first head	Plant height, inches
Frazier[2]	10	16.2	26.5	4-14	20.6
New Nortex[2]	10	13.4	24.3	4-21	17.2
Average		14.8	25.4		
Alamo	3	12.9	24.9	4-16	
Alamo-X	9	16.6	25.8	4-16	15.8
Cimarron	9	17.3	27.5	4-15	19.8
Clintland 64	5	13.6	27.9	4-19	21.4
Coronado	3	16.3	29.6	4-17	17.4
Cortez	2	19.6	30.1	4-14	16.4
Houston	7	13.4	27.1		15.4
Moregrain	10	17.7	29.3	4-15	17.2
Mustang	6	16.3	26.1	4-16	19.7
Norwin	6	17.6	27.9	4-17	20.4
Ora	3	13.0	27.1	4-18	16.4
Suregrain	6	16.7	29.1		
Tonka	3	15.0	31.4		

[1]Calculated comparable data based on years grown.
[2]Check varieties used to calculate comparable data.

TABLE 26. COMPARABLE GRAIN YIELDS AND AGRONOMIC DATA FOR SPRING-SOWN OAT VARIETIES AT DENTON, TEXAS, 1960-67

Variety	Grain yield, bushels: Number years compared	Grain yield, bushels: Comparable average	Test weight, pounds per bushel	Date first head	Crown rust, percent	Plant height, inches	Lodging percent, 2 years
Frazier	7	52.9	31.2	5-1	29	31.0	75
New Nortex	7	49.4	27.0	5-9	20	27.5	24
Average	7	51.2	29.1				
Alamo	4	44.9	28.2	5-5	25	28.8	24.3
Alamo-X	7	48.0	26.1	5-5	24	30.5	20.5
Cimarron	5	50.3	26.9	5-4	39	30.6	28.5
Clintland 64	4	38.3	30.5	5-13	8	33.4	
Coronado	2	60.8	30.6	5-6	4	26.3	
Cortez	1	61.6	30.1	5-3			28.3
Fulwin	2	53.1	27.4	5-6	39	32.8	
Houston	6	53.6	28.9	5-4	11	24.8	41.5
Moregrain	6	55.3	29.9	5-4	24	27.2	15.0
Mustang	4	49.0	26.2	5-7	22	29.4	20.3
Neal	3	39.3	25.6	5-8	17	31.3	9.8
Norwin	5	53.4	27.6	5-5	29	28.1	39.8
Ora	3	61.7	31.6	5-3	1	22.8	39.8
Suregrain	6	58.2	30.3	5-5	16	26.6	7.5
Tonka	3	34.9	32.0	5-5		30.3	35.3

diseases of oats occurred in 1949, 1957 and 1958 when losses were estimated at 22, 28 and 11 percent of the crop or 7, 14.5 and 5 million bushels, respectively (2, 3). Less destructive losses have occurred in other years. Detailed descriptions of the most important diseases are available (3).

Smuts

Loose smut, caused by *Ustilago avena* (Pers.) Rostr., and covered smut, caused by *Ustilago kolleri* Wille. are controlled by the same measures; therefore, they will be treated together. Both types are found in Texas, but loose smut is more common. Loose smut destroys the entire spikelet, leaving only the center rachis, while covered smut destroys the kernel but not the glumes, Figure 10.

Oat smuts are caused by parasitic fungi which enter the seedling plant at time of germination, grow as mycelium within the oat tissues during the growth of the plant and finally replace the kernel or panicle with a mass of smut spores. These spores are spread to healthy kernels by the wind or in the threshing process. The spores remain on or within the hulls of the kernel until the seed germinates.

Control of oat smuts is easy and inexpensive. Most commercial seed cleaning establishments have equipment for applying dust or slurry fungicides. They also may be applied on the farm if equipment is available. Those working with fungicides should wear masks and follow the manufacturer's instructions closely. Treated seed is poisonous and should not be fed to livestock. Proper treating of seed with a fungicide will not only control smuts but also improve germination by controlling other seedborne fungi. Many commercial products are effective and available for controlling oat smuts. The local county agent has the most recent recommendations available.

Rusts

Crown rust, caused by *Puccinia coronata* Cda. var. *Avenae* Fraser & Led., and stem rust, caused by *Puccinia graminis* Pers. f. sp. *Avenae* Eriks. & E. Henn. are important diseases of oats in Texas. Crown rust is usually the more destructive disease and may reduce grain yields to near zero, Figure 11, or destroy or reduce the available oat forage for livestock. Crown and stem rust are shown, along with other leaf diseases, in Figure 12.

The leaf rust of oats is called crown rust because of the peculiar appendages on the black, overwintering teliospore. The rusts are caused by fungi which enter plant tissues through stomata. The organisms grow within the plant tissues and reproduce, forming pustules on the surface in about 10 days. The pustules contain thousands of tiny, orange spores which may be carried to other plants or fields by wind currents. The diseases develop most rapidly during warm, humid weather accompanied by dews or frequent showers. The spores of the organism may be carried long distances by winds. The disease overwinters in South Texas or in Mexico and spreads northward progressively as the crop develops in the state. In a similar manner, the spores may be carried south into Texas from more northern growing areas by cold fronts in the fall.

The fungus causing crown rust is made up of many races (similar to varieties of a crop species). Some races can attack only a few varieties, while others can attack many varieties. The prevalence of races change in accordance with the host varieties grown in an area. Varieties derived from the variety Victoria were highly resistant from 1940 to 1957 but are now susceptible to prevalent races.

Growing resistant varieties is the only practical means of controlling crown or stem rust.

Figure 10. Normal panicle of oats, left; two panicles infected with covered smut, center; and one destroyed by loose smut, right.

Figure 11. A field of oats completely destroyed by rust at College Station.

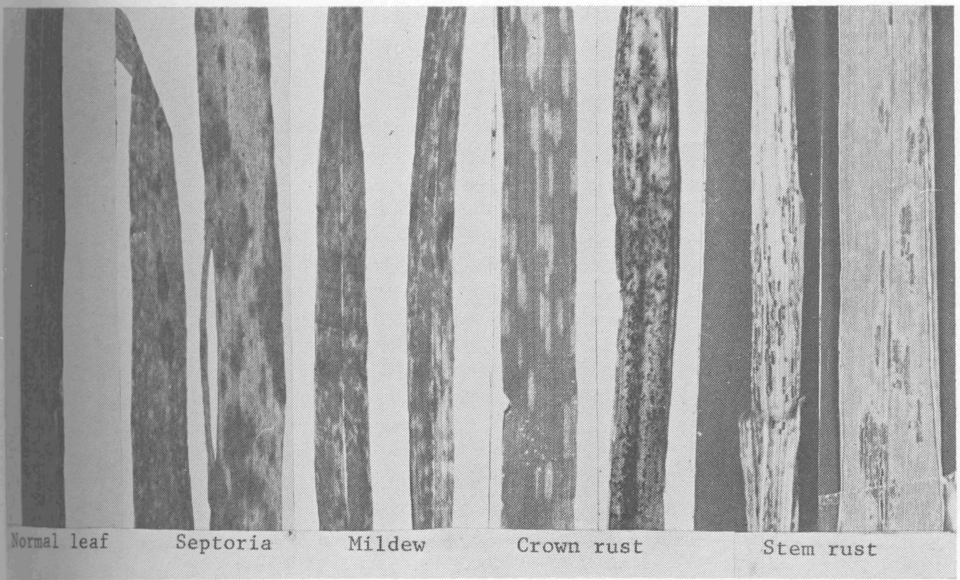

Figure 12. Leaf diseases of oats.

Research to develop fungicides for use as sprays to protect the crop is underway by a number of commercial companies. Some products that are effective have been developed but, to date, all are too expensive or their effects on animal and man have not yet been determined. A number of resistant varieties have been available to Texas growers for many years and have contributed to reduced losses from crown rust. From 1940 to 1957, the Victoria derived varieties, Ranger, Rustler, Fultex, Victorgrain, Alamo and Mustang gave good protection from crown rust damage in Texas. From 1960 to 1967, the varieties Houston, Alamo-X, Moregrain, Suregrain and Ora were highly resistant and grown on a considerable scale. Houston, Coronado and Cortez are resistant to many races, but in 1968 were attacked by new races. Florida 500 and Suregrain, formerly highly resistant, were attacked in 1969. The Red Rustproof and Alber varieties have an unusual late rusting characteristic which may enable them to produce relatively good yields even in moderate rust epidemics. Maturing early also is a means of escaping rust damage.

Stem rust differs from crown rust in that it is a disease of the stems which weakens them and causes lodging of the crop. Stem rust may also be found on the leaves, leaf sheaths and panicles of oats. Stem rust produces red, elongated pustules which are much larger than those produced by the crown rust organism. The two diseases are caused by two different, but closely related, organisms. Stem rust develops rapidly at temperatures of 75 to 85° F., a slightly higher range than that for best development of crown rust. This higher temperature requirement usually delays the development of stem rust so that it does not damage oats for forage, but the disease can severely reduce yields and quality of grain. Alamo and Alamo-X are the only Texas varieties which have some stem rust resistance. This resistance was effective from 1954 to 1965, but in recent years, races which can attack these varieties have become prevalent.

Leaf Blotches and Seedling Blights

Several blights attack oats in Texas. During the period 1940 to 1960, when varieties derived from crosses on Victoria were available (Fultex, Victorgrain, Ranger, Alamo, Alamo-X and Mustang), serious losses were experienced from Victoria blight, caused by *Helminthosporium victoriae*, Meehan and Murphy, Figure 13. This disease is both seed and soil borne. It may attack seedlings as the seed germinates and cause poor stands or weak, stunted plants. The roots are damaged so that mature plants lodge. Rotation of crops and seed treatment reduce damage to some extent. The disease occurs more frequently in the high rainfall, humid parts of the state. Fortunately, most varieties now recommended are resistant to this blight. *Helminthosporium sativum* Pam., King and Bakke, causes a crown and culm rot to which Bronco and a few other varieties are highly susceptible. *Helminthosporium avenae*, Eidam, may, under some conditions, cause seedling blights and leaf lesions (brown spots) but this disease has not consistently been a factor in yield in Texas.

Yellow Dwarf

Caused by an insect transmitted virus, this disease is present in Texas to varying degrees nearly every season. Although only recently described, it probably has been present for a long time. Damage may occur to single plants, to small aras, or it may involve most 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

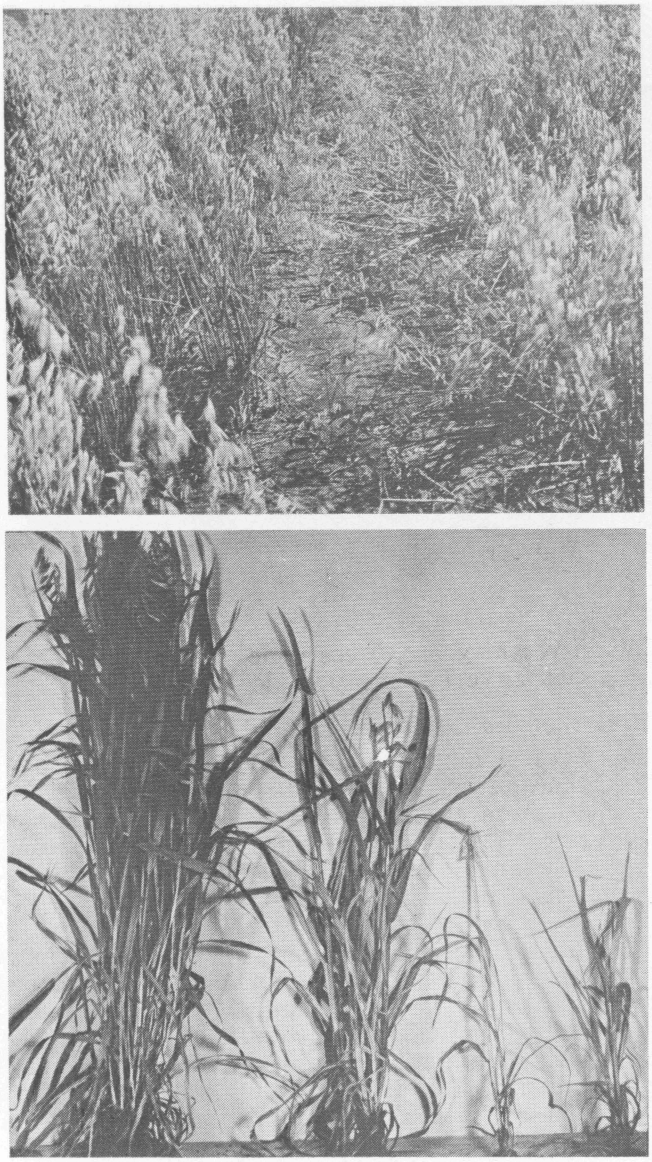

Figure 13. Top, a field of oats in which plants have lodged and broken over from blight damage. Bottom, oat plants at right show varying degrees of damage by Victoria blight compared with a normal plant.

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.

Oswald and Houston (17) 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 aphid, *Macrosiphum avenae* (Fab.), the apple-grain aphid, *Rhopalosiphum fitchii* Sand. and the greenbug, *Schizaphis graminum* Rond. are common pests in Texas crops. The insects may or may not carry the virus. They can be controlled by sprays, but since they may be present in the fields from crop emergence to maturity, spraying simply for disease prevention is not practical. Varietal differences in response to yellow dwarf occur and may eventually be transferred to adapted varieties. At present, no highly resistant, adapted varieties are available in Texas. Plants infected with yellow dwarf are shown in Figure 14.

Other Diseases

Several other diseases occur in certain seasons in local areas but have not been important. These include powdery mildew, Septoria leaf blotch, halo blight and blast of the panicle, Figures 12 and 15. Blast is caused by unfavorable environmental conditions or unknown physiological factors. Varying numbers of spikelets will be sterile. Varieties differ in reaction to this condition, but no control measures are known.

INSECTS

A number of insects may cause serious damage to oats if conditions are favorable for their increase and survival. A description of these insects, with control measures for each, was given by Daniels, Chada, Ashdown and Cleveland (12).

Probably the most destructive insect pest of oats is the greenbug (aphid), *Schizaphis graminum* (Rond.). This and several other aphid species may be found on oats. 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 the fields. If the infection continues, these insects may destroy the entire field. Greenbugs and corn leaf aphids are shown on a leaf of oats in Figure 16. Moderate varietal resistance to the greenbug has been found (1, 9), and efforts are being made to transfer this resistance to adapted varieties.

Figure 14. Oat plants infected and damaged by yellow dwarf.

Figure 15. Oat blast, a non-parasitic disease.

Effective insecticidal sprays for control of greenbugs and other aphids are available. The economics of using them will have to be determined by each grower in each situation. Differences in reaction to greenbug attack were observed in oats and barley by Atkins and Dahms (1) in 1942. Additional sources of resistance have been found more recently (9). Breeding work to transfer this resistance to adapted varieties is in process, but no resistant varieties have been released.

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

WEEDS

Fall-sown oats are usually free of serious weed infestations in Texas. However, if small grains are grown continuously on the same land, several winter annuals may present a problem. Johnsongrass, *Sorghum halapense* L. (Pers.), is a problem when harvest is delayed by wet weather, but oats usually mature before Johnsongrass becomes troublesome. Numerous sprays are available for this weed grass. Suggestions for control of weeds are published annually, the most recent publication being Texas Agricultural Experiment Station B-1029 (19).

A number of winter annual grasses may influence yields if allowed to increase to high populations. Chess or cheat, *Bromus secalinus* L., darnell, *Lolium temulentum* L., and little barley, *Hordeum pusillum* Nutt. may encroach from

Figure 16. Greenbugs on oat leaf at left; note yellowing of the feeding area; corn leaf aphids at right.

fencerows or ditches or become established from seeding oats continuously on the same land. Cultural operations before seeding and rotation of crops are the best control measures. If spraying becomes necessary, the latest recommendations for control are available from county agricultural agents.

Probably the most troublesome weeds in oats under Texas conditions are wild oats, *Avena fatua* L., and derived lines of false wild and near cultivated types which grow along roadsides or fencerows and spread into fields, Figure 17. These not only cause undesirable mixtures in seed supplies, but the volunteer plants also serve as early hosts for rusts or virus diseases and for aphids, mites and other insects which may carry these diseases. Crop rotation and destruction of volunteer grain are suggested to prevent movement of insects and diseases from these volunteer plants to cultivated grain.

The wild and false wild oats shatter before the cultivated crop is harvested. This enables these types to increase rapidly. Furthermore, much of the seed may lie dormant for several years, some germinating each time the land is cultivated and the seed brought near the surface.

IMPROVEMENT OF OATS

Research to improve oat varieties for Texas was started in 1911 with the establishment of the Texas Experiment Station at Denton. Extensive selection in the Red Rustproof and Fulghum types of oats was carried on for many years. Selection and testing continued until 1926, when the Nortex variety was released to growers. A second strain of Red Rustproof, New Nortex, was released in 1936. These strains have been grown widely in Texas and the Southern States since that time.

Oat breeding work to incorporate crown rust resistance from the variety Victoria started in 1930. The Ranger, Rustler and Fultex varieties were released in 1942; and, after a series of severe winters in the early 1940's, the varieties Mustang and Bronco were released in 1954 and 1956. Breeding to incorporate stem rust resistance was started about 1940 and resulted in the variety Alamo and, later, Alamo-X. Numerous other varieties with additional desirable characteristics have been released since.

The breeding of new varieties is a long and expensive process, usually requiring 10 to 15 years and the testing of thousands of strains to find the strains that incorporate the good characteristics from both parents. The floral parts of the oat spikelet are shown in Figure 18. Crosses are made by transferring the pollen from one variety to the stigma of another variety. Varieties for crossing are chosen carefully to incorporate the best characteristics possible in the new strain. The hybrid populations must be grown for four to eight generations before selections can be made. Selections must be tested for reaction to disease, cold resistance, ability to stand for harvesting without lodging and shattering, forage and grain production, test weight and other characteristics.

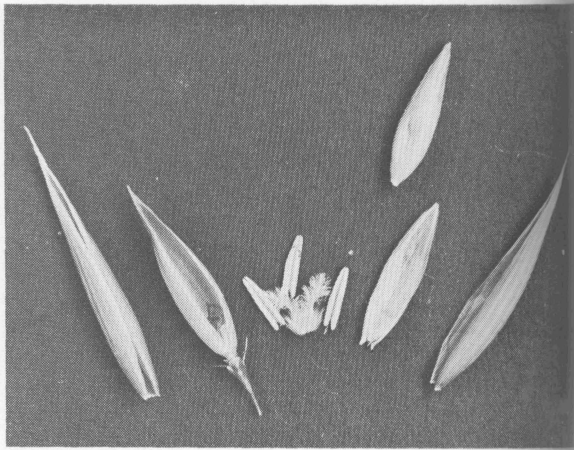

Figure 18. Floral parts of an oat spikelet.

Figure 17. Wild oats along roadside in North Texas.

Figure 19. Oat testing nursery at Denton where large numbers of varieties and experimental strains are tested.

Figure 20. New varieties considered for release are placed in large field plots for observation of performance and agronomic characteristics.

New strains of promise are tested first in single plots at the breeding station and then in replicated plots. Later they are tested at several locations to determine the best area of adaptation. Figure 19 shows the manner in which large numbers of strains can be compared in a relatively small space and under similar conditions. Figure 20 shows a larger field plot where approximate field conditions can be obtained for comparing the new strain with commercial varieties. Because cold tolerance is an important consideration, large numbers are tested for several years to determine their cold resistance. Figure 21 shows the 1959 nursery at Denton when differential winterkilling provided the breeder with information on the relative hardiness of new strains.

The breeding of oats for Texas conditions must include emphasis on characteristics that will make a variety suited to a certain growing area. For Northwest Texas, this emphasis must be on true tolerance to low temperatures, while for North Central Texas, the cold tolerance must include the ability to withstand wide fluctuations in temperature. For South Texas, less emphasis is placed on cold tolerance, but the variety must be adapted to provide well distributed forage production, must be able to recover rapidly if clipped or grazed and must be resistant to diseases.

The development of new varieties and research to control diseases or insects through fungicides, insecticides or plant resistance requires a major investment in funds, facilities and personnel. However, any improvement in varieties, when projected to the nearly 2 million acres of oats grown in Texas, brings major returns for the investment dollar.

Figure 21. Differential winterkilling of oats in the Denton nursery in 1954. Information obtained in such tests assists the plant breeder in evaluating strains considered for release as varieties.

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