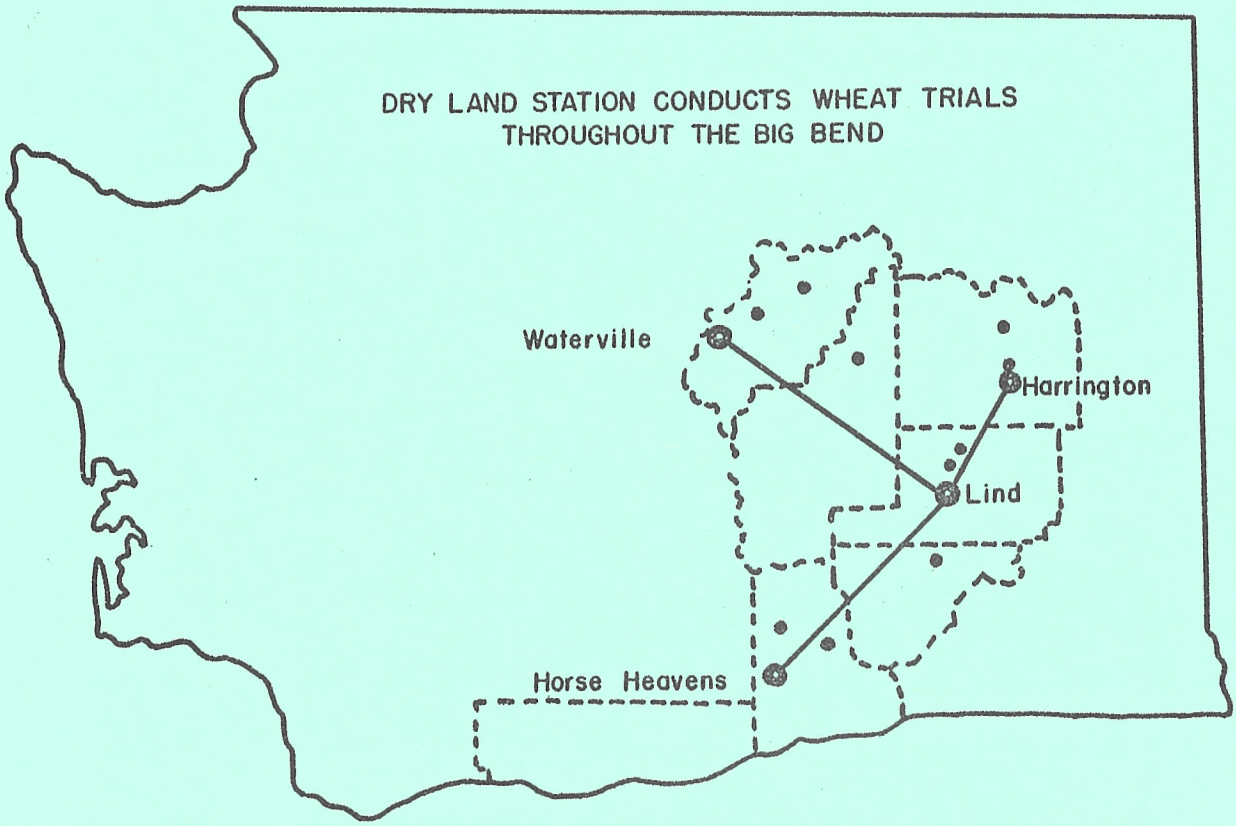
40th ANNUAL

FIELD DAY

DRY LAND EXPERIMENT STATION



LIND, WASHINGTON
JUNE 27, 1956

Washington Agricultural Experiment Stations, Institute of Agricultural Sciences, State College of Washington

INTRODUCTION

The Dry Land Experiment Station, formerly the Adams Branch Experiment Station, was established in 1910 near Ritzville, when a 10-acre plot of land was leased and experiments with cereals, forage crops, and certain phases of soils work commenced. Largely through the efforts of Spokane businessmen, the Milwaukee Railroad, and Adams County, a site was leased from Adams County approximately 3 miles northeast of Lind. Buildings were erected, and the Station moved to its present location in 1915.

Originally, the Station was operated with county, USDA, and state funds. At present it is state-supported, aside from a small labor fund contributed by federal agencies. The farm consists of 320 acres of land, of which approximately 260 acres are devoted to crop production experiments. The remainder consists of grass and rough land.

Early in 1949, Adams County deeded 2.06 acres to the Board of Regents of the State College of Washington. There the new state-financed office and greenhouse buildings were constructed. Under the leadership of the Washington Agricultural Experiment Stations, the Dry Land Experiment Station has carried out a continous program of research since its establishment.

Experiments are planned and conducted cooperatively with the different departments of the Main Experiment Station at Pullman; Soil Conservation Service and Bureau of Plant Industry, USDA; and with the U.S. Weather Bureau, Department of Commerce.

The Field day is an annual affair held in June to acquaint farmers, ranchers, and townspeople of central Washington with the nature of the work being conducted and to furnish information collected from the experiments in progress. The public is especially invited to attend these field days, although visitors are welcome at all times.

Walter L. Nelson

Walter L. Nelson, Superintendent

CLIMATIC INFORMATION

Approximately 55 per cent of the rainfall occurs during the winter months, 30 per cent in summer, and 15 per cent in the fall.

Climatic measurements are made daily. They consist of readings made with such standard U.S. Weather Bureau instruments as maximum and minimum thermometers, a manual precipitation gauge, sling psychrometer, and evaporation instruments. In addition, a continuous record of soil and air temperatures, relative humidity, and precipitation is kept by means of automatic recording instruments.

RESEARCH ON CEREAL CROPS

In 1950, the Dry Land Experiment Station enlarged the cereal breeding and testing program. The object of this program is to produce new varieties of cereals adapted to the Big Bend area where annual rainfall is from 9 to 13 inches. This program includes the testing of new varieties and selections developed at other experiment stations throughout the Midwest and Pacific Northwest, and the breeding of new varieties.

Three new testing sites were set up in 1950 to adequately check cereal varietal response throughout the Big Bend. These sites are: Nelson Brothers farm, Waterville; Leonard Schultz farm, Harrington; and Vollmer & Bayne, Prosser. All experimental work at the outlying locations is conducted under the same methods as the work at the Station.

In addition to the locations mentioned above, small variety trials were established in 1953 and 1954 on the following farms: R. P. Nicoson and Ed Tyacke in Benton County; Phil Wainscott and Ted Cornehl in Douglas County; Oscar McCoy in Grant County; and L. H. Bowman, Davenport. About ten varieties each of winter and spring wheat are grown at most of these locations. Varieties included in these small trials are standard varieties and new selections being considered for possible release. Farmers in these areas are urged to visit the plots on county tours or at any other time. The results of these small trials and larger testing areas and the trials at the Station will determine the value of any new selection for the Big Bend area.

WINTER WHEAT

Table 2 tabulates the yields of standard varieties of white winter and hard red winter grown at Lind. The white winter-wheat varieties are consistently higher yielding than either Rio or Turkey. Although Elmar and Elgin are higher yielding, these varieties have not been recommended because of poor quality. When grown under dry conditions of the Big Bend, these varieties tend to produce high-protein wheat. At protein above 9 per cent, the flour does not make good pastry and is unsuitable for bread flour. The production of good quality wheat has become increasingly important as surpluses become larger. With the exception of Hymar, all of the white winter wheat varieties are less winter hardy than Rio. Rex is discounted because of poor milling quality. Rex has been a consistently poor yielder in this area and will be dropped from the testing program.

Table 1. Annual Rainfall near Lind, Washington, 1897-1956.

Data Obtained by Dan Krehbiel		Data Obtained by O. W. Goodenough		Data Obtained by the Dry Land Experiment Station			
1897-98	6.34	1909-10	8.74	1916-17	7.60	1935-36	8.09
1898-99	8.76	1910-11	8.10	1917-18	6.64	1936-37	8.93
1899-00	12.00	1911-12	10.33	1918-19	8.10	1937-38	11.89
1900-01	15.34	1912-13	8.24	1919-20	6.56	1938-39	5.32
1901-02	12.33	1913-14	10.50	1920-21	7.01	1939-40	13.01
1902-03	13.67	1914-15	10.54	1921-22	6.97	1940-41	18.00
1903-04	15.03	1915-16	13.59	1922-23	10.90	1941-42	12.29
1904-05	11.34			1923-24	6.62	1942-43	11.65
1905-06	12.01			1924-25	8.32	1943-44	8.60
				1925-26	6.65	1944-45	10.65
				1926-27	12.65	1945-46	11.82
				1927-28	10.83	1946-47	8.02
				1928-29	5.77	1947-48	22.71
				1929-30	4.80	1948-49	7.00
				1930-31	6.91	1949-50	9.89
				1931-32	9.78	1950-51	9.85
				1932-33	8.39	1951-52	8.11
				1933-34	9.79	1952-53	7.71
				1934-35	7.48	1953-54	7.98
						1954-55	7.40
Average	11.87		10.01				9.23

Average for 55 years: 9.76

Rainfall September 1, 1955 to June 1, 1956: 9.97

Table 2. Yield, Test Weight and Plant Height of Winter-Wheat Varieties Grown at the Dry Land Experiment Station.

Variety	No. Yrs Grown	Yield 1955	Av. Bu/A.	Test Wt. Average	Plant Ht. Average	Rank
Elmar	6	37.9	33.3	58.4	24	1
Elgin	10	40.0	29.7	58.7	24	2
Brevor	6	34.6	29.4	60.0	24	3
Triplet	10	34.0	26.5	60.2	28	4
Kharkof	10	29.0	24.9	60.4	28	5
Rio	10	30.2	24.4	60.5	28	6
Golden	10	32.8	23.6	57.6	28	7
Rex	10	32.6	22.6	59.6	28	8

Table 3 compares the yield of three new bread type winter wheat selections with standard white and red winter wheat varieties. The variety Columbia was released to growers in 1955. Columbia was developed by the Sherman Branch Experiment Station, Moro, Oregon. Columbia is selection from the cross Rio-Rex x Nebred. Columbia is about five days earlier than Rio, smut resistant, stiff strawed and shatter resistant. Columbia is equal to Rio in winter hardiness, milling and baking quality. The variety is bearded, red chaffed and easily distinguished from other hard red varieties. In tests all over the Big Bend Area during the past 4 years, Columbia has been equal in yield and generally superior to Rio. In all tests Columbia has exceeded Rio yield by 5 per cent.

The variety 27-15 x Rio-Rex Selection 41 will be considered for release this fall. The selection is superior in yield to all varieties tested, averaging 27 per cent more than Rio in the Big Bend area during the past 4 years. Selection 41 is smut resistant, stiff strawed, bearded, white chaffed, and 2 to 3 days earlier than Rio. It is somewhat susceptible to shattering, only slightly superior to Elmar in winter-hardiness, and less winter hardy than Columbia. It is a hard white wheat with bread quality. Final quality tests this year will determine the release of this variety.

Blackhull-Rex x Cheyenne is a selection developed with Columbia. It is a superior yielding, hard red winter, with good winter hardiness, stiff straw and quality. However, it is resistant to only part of the smut races. This variety will need more testing to decide whether or not it will be released.

The winter-wheat breeding program at the Station is pointed toward increasing the yield, maintaining and improving smut resistance, and improving the winter hardiness and quality of hard red winter-wheat varieties. Winter hardiness will be tested at Pendleton, Oregon, in the cold-chamber facilities available there. Smut and disease testing is in cooperation with USDA at Pullman under the direction of Dr. C. S. Holton. Quality testing is conducted at the USDA Western Wheat Quality Laboratory under the direction of Dr. M. A. Barmore at Pullman. These cooperating agencies make it possible for better and more rapid evaluation of the selections in a breeding program.

Variety recommendations for eastern Washington for wheat, oats, and barley are given in Extension Miscellaneous Publication 14 available from your County Agent. In areas of less than 12 inches of rainfall, Rio and Wasatch are recommended winter-wheat varieties. Wasatch is recommended only for dwarf

Table 3. Yield of Winter Varieties Grown at Lind, Harrington Waterville, and Horse Heavens during Years Indicated. Dry Land Experiment Station, Lind, Washington.

Variety	1952-55 Inc. Harrington	1952-54&55 Horse Heaven	1952-54&55 Waterville	1952-53&55 Lind	% Rio All Locations
Rio	41.3	18.2	28.8	22.4	100
Columbia	43.6	18.5	31.9	23.2	105
Blackhull-Rex/Cheyenne	44.3	19.2[a]	38.7[a]	27.4	111
Elmar	47.0	21.3[b]	32.5	29.8	116
Brevor	44.7	21.1[b]	31.3	28.1	109
27-15 Rio-Rex (Sel 41.)	53.1	22.1[b]	34.8	32.3	127

[a]Variety not grown at this location in 1955.

[b]Variety not grown at this location in 1952.

bunt areas of Douglas County. Wasatch will be dropped from recommended list when Columbia seed is available for production.

SPRING WHEAT

The spring wheat program at the Dry Land Experiment Station has four main objectives: (a) testing and introduction of available spring wheat varieties and breeding material from other areas, (b) improvement of superior spring wheat varieties by various breeding methods, (c) incorporation of resistance to leaf and stem rust, including 15B stem rust, in varieties adapted to the Big Bend area, and (d) improving the quality and protein content of spring wheat adapted for this area.

Awned Onas has been crossed with good milling types of spring wheat. Selections from this cross have been milled and are now in yield trials. Thousands of additional selections with Awned Onas, Baart, and other good yielding varieties in their pedigree are being tested for quality and will be included in future yield trials. Milling quality is tested on a 5-gram milling--about 150 kernels. This can be done on an individual plant basis, and selection for quality can be started about 4 to 5 years sooner in the breeding program. By this early selection for quality, new high quality varieties may be developed in a much shorter time.

Considerable emphasis is being placed on breeding for protein and yield. Recent research has shown that both high protein and high yield can be attained in the same variety. Many of the recent crosses have included parents which have the ability to produce high protein with good yield. The goal of our breeding program is to have high yield, high protein, good milling quality, and varieties with good agronomic characteristics.

In Table 4 are shown the yields, test weights, and heights of ten spring wheat varieties grown at the Dry Land Experiment Station. Of those varieties tested for 7 years or more, Baart is one of the highest yielding. Only Awned Onas and Lemhi are superior, and these varieties are not recommended because of poor quality. At the Station in certain years, Marfed and Idaed have been superior to Baart. But over the long-time average, they have not proved to be any higher yielding than Baart. For spring-wheat recommendations for your area, contact your County Agent.

Table 4. Yield, Test Weight, and Height of Spring-Wheat Varieties Grown at the Dry Land Experiment Station.

Variety	No. Yrs Grown	Yield 1954	Av. Bu/A.	Av. Test Wt.	Av. Plant Ht.	Rank
Awned Onas	10	15.1	25.5	58.4	25	1
Lemhi	10	14.6	25.1	57.2	26	2
Marfed	9	17.1	24.2	58.5	25	3
Baart	10	12.0	23.6	60.1	28	4
Federation	10	13.8	23.5	57.9	24	5
Idaed	10	14.3	23.5	59.0	25	6
Henry	4	12.0	18.7	58.6	26	7
Thatcher	6	12.2	18.6	58.2	25	8

In Table 5 are shown the yields of ten spring wheat varieties grown at Waterville, Harrington, Horse Heaven, and Lind for 2 or more years. The average yeild figures at all locations shows Marfed, Lemhi, Onas 52, and Awned Onas are the highest-yielding varieties for these years. These four varieties have poor milling quality and have not been recommended for the Big Bend area.

The Dry Land Experiment Station, in cooperation with the Agronomy Department at Pullman, is testing and breeding for resistance to 15B stem rust in spring wheat. To date, this disease is not a problem in the Big Bend. This resistance is being incorporated in new hybrids as protection in case 15B rust becomes serious. The first of these resistant selections were in the yield-testing stage in 1955. The hybrids are tested for 15B rust in a cooperative program with the University of Manitoba, Winnepeg, Canada, and in rust nurseries in Mexico.

FERTILIZER TRIALS

In cooperation with the Agronomy Department, Pullman, the Dry Land Experiment Station has conducted experiments with nitrogen fertilizer for six years. Previously reported work (Stations Circular 179) has shown that the type of nitrogen fertilizer was less important than the method of application.

Table 5. Yield of Spring-wheat Varieties Grown at Harrington, Horse Heaven, Waterville, and Lind on Years Indicated, Dry Land Experiment Station, Lind.

Variety	C. I.	Waterville 1951 & 53-54	Harrington 1951-55	Horse Heaven 1951 & 1953-55	Lind 1951-52 & 54-55	Av. Yield	Per Cent Baart.
Marfed	11919	31.3	35.7	23.6	23.6	28.8	111
Lemhi	11415	33.4	34.6	22.0	22.1	28.1	108
Onas 52[a]	12946	31.4	38.1	22.0	21.5	28.8	109[b]
Awned Onas	12235	31.6	35.4	21.1	22.1	27.8	107
Federation	4734	30.1	33.7	20.6	20.3	26.4	102
Idaed	11706	29.1	34.6	21.5	19.2	26.5	102
Baart	1697	29.6	32.2	20.9	20.4	26.0	100
Henry	12265	27.9	33.6	20.8	18.7	25.6	99
Thatcher	10003	23.5	30.7	18.5	17.7	23.1	89

[a]Onas 52 not grown in 1951.

[b]Percentage of Baart figured for years grown.

The data showed that placing the fertilizer was more effective than broadcasting. The wheat utilizes the added nitrogen more efficiently when it is placed below the straw layer. For recommendations on nitrogen fertilizer, farmers are referred to their County Agents, who are kept up to date on recommendations for particular rainfall areas.

In Table 6, 6-year average data are given on different rates of anhydrous ammonia fertilizer applications on summer fallow and seeded to Rio winter wheat. Fertilizer applications were made in the fall preceding seeding. Cost figures and net profit figures are approximations on average for a 6-year period. In 2 of the 6 years, fertilizer response was not significant. Protein content of the wheat was increased at 40- and 80-pound treatments, which would increase the net return slightly above figures given. The most return was from 40-pound application, with a net loss at 80-pound application, although yield was increased over check. Recommendations for 9- to 11-inch rainfall area based on these 6 years' data and other trials are 25 to 40 pounds of nitrogen per acre on summerfallow. All types of nitrogen fertilizer have been equal in yield response when placed at a depth of 6 inches. Broadcast application is not recommended in 9- to 10-inch rainfall area.

Farmers are urged to check the response to fertilizer applications. A soil test to determine available nitrogen in the soil is advisable. However, it is not complete without a yield check on the response to the recommended rate of nitrogen application. Reliable field checks on response to fertilizer can be made by leaving a check strip unfertilized over a representative portion of the field. By a double application along the side of this unfertilized strip, the farmer can check if his fertilizer rate was high enough. Harvesting these strips and weighing separately will require more time in harvest, but will return many times over the cost and time involved if the farmer finds his rate of application was too high or too low. Each 3 or 4 pounds of nitrogen should

increase the yield by 1 bushel per acre. This ratio can be used as a guide to determine if the correct rate of nitrogen has been applied.

To date, experiments with sulfur and phosphate have not given any significant yield increase. The Station will continue testing with these elements to determine when they might be used profitably in wheat production.

Table 6. Summary of 6 years' Data of Different Rates of NH_3 Fertilizer on Winter Wheat, Variety Rio, Dry Land Experiment Station Lind, Washington.

Treatment lbs N/A	1950-55 6-yr. Av. Yield	Lbs N per bu. inc.	Av. bu. per Acre inc.	Net per Acre profit[b] cost-ret. from Fertilizer
0	20.9	0.0	0.0	0.0
20	24.6	5.4	3.7	4.40
40	26.5	7.2	5.6	5.20
80	25.2[a]	18.6	4.3	-3.40

[a] Four-year average.

[b] Cost of N at 15¢ a pound applied. Wheat value at $2.00 per bushel.

ANNUAL CROPPING

Research on annual cropping was revised in 1952. The Dry Land Experiment Station and Agronomy Department, Pullman, set up four locations for annual cropping experiments. These are on farms scattered throughout eastern Washington at locations with a range in rainfall from 9.5 to 15 inches annually. Cooperating farms are: C. W. Eckhart, Packard; Leonard Schultz, Harrington; and Ed Steckle, LaCrosse. The fourth location is on the Dry Land Station. The location at LaCrosse is conducted in cooperation with the Soil Erosion Farm at Pullman and includes the study of crop rotation, green manure crops, and nitrogen fertilizers in annual cropping. The Dry Land Experiment Station does not obtain the data at the LaCrosse location.

At all locations, conventional equipment is used for tillage and harvesting. Three rates of fertilizer are used on both summer fallow and annual cropping plots. The soil is sampled in the fall to determine the amount of available nitrates and again in the spring for available moisture. In 1955, annual cropping at Lind and Packard was a failure. Yields at Harrington were from 6 to 8 bushels per acre. These yields are included in the 3-year average given in Table 7. The 3-year average indicates approximately as much wheat can be grown under annual cropping as with summer fallow at all three locations. Additional costs of cropping annually would make annual cropping less profitable. In 2 of the 3 years, annual cropping at Harrington was more profitable than summer fallow. From the results to date, only Harrington appears to have possibilities of annual cropping. To be profitable at Harrington, annual cropping could be used only in years of good spring soil moisture reserve.

Table 7. Yield of Winter and Spring Wheat on Summer Fallow and Annual Cropping at Three Locations, Dry Land Experiment Station, Lind, Washington.

Location	Av. Annual Precipitation Crop Year	N. Applied Lbs./A.	Yield Bu./A		
			Winter wheat 3 yr. av. summer fallow	yearly av. s. fallow	Spring wheat yearly av. annual cropping
Lind	7.69	0	15.7	7.9	------
		20	16.5	8.3	6.9
		40	15.9	8.0	7.9
C. W. Eckhardt Packard	10.11	0	18.2	9.1	------
		20	21.0	10.5	10.1
		40	19.7	9.9	10.8
L. Schultz Harrington	10.91	0	43.8	21.9	------
		30	47.3	23.7	22.7
		60	46.8	23.4	25.7

FORAGE INVESTIGATIONS

Forage Adaptation Tests

Grasses and legumes for soil and moisture conservation are being tested at the Dry Land Experiment Station in cooperation with the Soil Conservation Service, Nursery Division. The initial testing is done at Pullman; Lind is one of a system of outlying nurseries under different soil and climatic conditions to carry on secondary testing.

The following data supplement material presented at previous field days.

Fall 1943, Dry-Land Grass Plots

Eighteen grasses were selected on the basis of past performance at Lind and seeded in the fall of 1943. The purpose of this planting was to compare conservation uses and hay yields for the 10- to 14-inch rainfall area. In dry-land rotations, grass roots add organic matter to the soil. This aids in maintaining fertility and improves the physical condition. The soil is more resistant to wind and water erosion when it is well supplied with fibrous grass roots and active organic matter. Hay yields, along with root production, longevity, drought resistance, ground cover, and availability of seed, should be considered in selecting grasses for conservation seeding. The following grasses have been outstanding under dry-land conditions at Lind:

Dry-land bunch grasses:	Crested wheatgrass Whitmar beardless wheatgrass
Sod-forming grasses:	Pubescent wheatgrass
Dry-land blue grasses:	Sherman big bluegrass
Fine-leaved fescues:	Sheep fescue P-274

From results obtained at this Station and in other dry-land areas, the following grasses can be recommended in the wheat-fallow area from 8 to 14 inches annual rainfall:

Range and pasture

1. Crested wheatgrass, 6 pounds; and Bulbous bluegrass, * 2 pounds.
2. Whitmar beardless wheatgrass, 8 pounds; and Bulbous bluegrass, * 2 pounds.

Hay

1. Sherman big bluegrass, 4 pounds; and Ladak alfalfa, 2 pounds, seeded in alternate rows.
2. Sherman big bluegrass, 4 pounds

*Bulbous bluegrass not recommended where rainfall is less than 11 inches.

METHODS OF PLANTING GRASSES

Among the several methods of planting grasses, the most satisfactory stands have been obtained by using a drill in a clean summer fallow. The drill can be adjusted to seed any desired rate and depth. If the stubble land is clean, grass can be successfully established by seeding the stubble in early fall. Since the grass grows very slowly during the seeding stage, the seed bed should be free of weeds.

The rate of seeding grass most suitable for pasture purposes is 5 to 8 pounds per acre. This will establish a stand uniform enough to prevent invasion of weeds. The depth should not be over 1 inch. Preferably it should be seeded 1/2 inch deep. Proper depth can be secured by using depth regulators on the furrow openers or having the hose fastened outside of the furrow openers. A drag chain or press wheel may be used with the latter to cover the seed with about 1/2 inch of soil.

The best time to seed grass in the 10-to-12-inch rainfall area is in the fall. If moisture conditions are suitable, grass can be sown from as early as September 1 to as late as January 1, but the ideal time is in October. Spring seeding is not recommended, except in years of high spring moisture.

Depending on the use to which the grass is to be put, row spacing may vary from 7 inches to 3 feet. The wider the row spacing the more care is required to control the weeds that may invade the stand between the rows. The 14-inch row spacing seems to be the most satisfactory for forage. Wider spacing than this make the grass coarse and less desirable for pasture purposes. Seed production is more successful in rows 28 to 36 inches apart. Seed production

fields must be cultivated for good yields and weed control.

Uniform stands of grass can be established by seeding a cereal nurse crop in alternate rows with grass. The grain yield of the nurse crops is approximately 70 per cent of normal, while at the same time satisfactory grass stands are established. The nurse crop can be cut for hay or left to mature for grain. The nurse crop utilizes the soil moisture that would otherwise be used up by the weeds, thereby providing a satisfactory weed-control measure.

The ordinary double-run grain drill can be adjusted to seed the two crops in alternate rows by having removable partitions placed in the grain box. The rate of seeding for both the crops can be made at the same setting. Reducers made of heavy wire can be used very effectively to change seeding rate of either grass or wheat. Recommended rate of grass and nurse crop seeding is 8 pounds and 30 pounds respectively. If rye is used as a nurse crop, the rate should be cut to 20 pounds per acre. Spring tensions should be lessened on the furrow openers of the drill sowing grass so that the seed will not be buried too deeply in the soil.

TREES AND SHRUBS FOR DRY-LAND PLANTING

Several species of trees and shrubs are included in the Station forestry project for farm-home landscaping and windbreak purposes. The first plantings are now 30 years old. Plantings have been made at intervals since the original planting. The Station planting is now considered to be one of the best in the West for study of trees and shrubs adapted to dry-land conditions.

Initial observational tests of wood species are carried on at the Soil Conservation Nursery at Pullman. Secondary tests are carried on cooperatively at experiment stations at Prosser and Lind, Washington, and Moro, Oregon. The present testing program at Lind was started in 1928 by the Dry Land Experiment Station and the Department of Forestry and Range Management, State College of Washington.

A standard dry-land windbreak planting consists of a minimum of five rows which, when properly established, give excellent protection from the winds. Results to date indicate that Caragana is still the best erect shrub. Blue leaf honeysuckle and Nanking cherry are showing considerable promise. Russian olive is the recommended species of intermediate shrubs. Hawthorn and a strain of wild crab apple are showing promise. Black locust is still the most promising deciduous tree. Green ash and Chinese elm are good but they do not show the promise of black locust. Austrian pine is the outstanding evergreen tree, being superior to both Scotch and Ponderosa pine. Norway spruce, Douglas fir and Blue spruce can be grown but require more special care and have a much slower growth. Rocky mountain juniper is showing the most promise in this group.

Farmers contemplating a shelterbelt planting should realize that considerable work is involved. To survive under dry-land conditions, trees require continuous clean cultivation. Row spacing between trees should be arranged so available machinery can be used. Trees and shrubs should be transplanted as soon as you get them. Pine and juniper require special care when transplanting. Transplanted evergreen stock has given better survival than seeding stock. Although transplanted stock is more expensive, the superior survival

will compensate for the extra cost.

Table 8. Standard Species, Arrangement, and Spacing of Trees and Shrubs for Windbreak Plantings in the 8-10 Inch Rainfall Area.

Row No.	Species	Growth Habit	Spacing in Row	Minimum Distance from Next Row[a]
1	Caragana	Erect shrub	3 ft.	18 ft.
2	Russian Olive	Intermediate shrub	6 ft.	18 ft.
3 & 4	Black Locust	Deciduous tree	12 ft.	18 ft.
5	Austrian pine Scotch pine Ponderosa pine Norway spruce	Evergreen	12 ft.	27 ft.

[a]Rows may be spaced wider apart if cultivation equipment requires it.