STATE COLLEGE OF WASHINGTON
INSTITUTE OF AGRICULTURAL SCIENCES
AGRICULTURAL EXPERIMENT STATIONS

PROGRESS REPORT
32ND ANNUAL
FIELD DAY

JUNE 18, 1948

DRY LAND EXPERIMENT STATION
LIND, WASHINGTON

Introduction

The Dry Land Experiment Station, formerly known as the Adams Branch Experiment Station, first began in 1910 near Ritzville when a ten-acre plat of land was leased and experiments with cereals, forage crops and certain phases of soils work commenced. Largely through the efforts of Spokane business men, the Milwaukee railroad, and Adams County a site was purchased approximately three miles northeast of Lind and the station was moved to its present location. Under the leadership of the Washington Agricultural Experiment Station, the Dry Land Experiment Station has carried out a continuous program of research since 1915. The station at present consists of 320 acres of land, of which approximately 260 acres are devoted to crops production experiments, while the remainder consists of grass and rough land. The land is leased from the County of Adams. The station is supported by state funds, aside from a small labor fund contributed by federal agencies.

Experiments are planned and conducted cooperatively with the different divisions of the Washington Agricultural Experiment Station at Pullman, Soil Conservation Service and Bureau of Plant Industry U.S.D.A., and with the U.S. Weather Bureau, Department of Commerce.

The field day is an annual affair held about June 15, for the purpose of acquainting farmers, ranchers and townspeople of Central Washington with the nature of the work being conducted and to furnish information collected from the many experiments in progress. The public is especially invited to attend these field days, although visitors are welcomes at all times.

Personnel

John J. Sturm	Superintendent & Agronomist
Clarence H. Morgan	Resident Foreman
Marian Morgan	Secretary

Note: Data presented hereafter in this report are not for publication without consent of the Washington Agricultural Experiment Station and cooperating agencies.

CLIMATIC STUDIES

Climatic measurements are made daily, and consist of readings made with standard U. S. Weather Bureau instruments consisting of maximum and minimum thermometer. In addition, a continuous record of soil and air temperatures, relative humidity and precipitation is taken by means of automatic instruments recording.

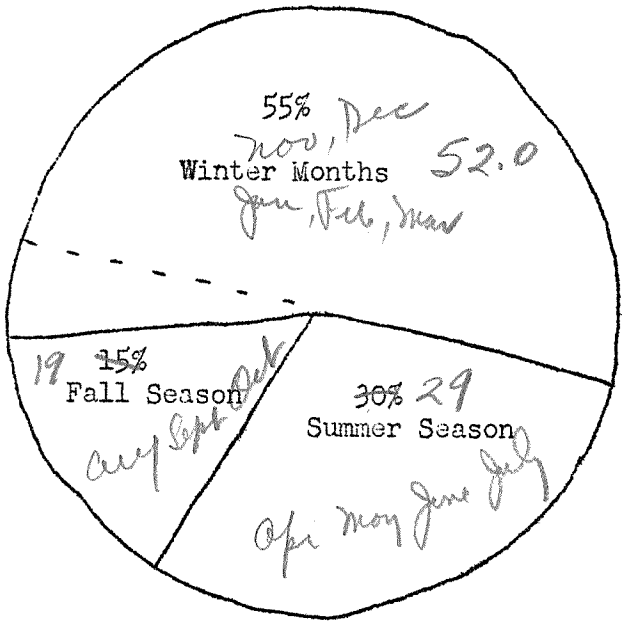
Temperatures. Temperatures at this station are usually not harsh, rarely dropping below zero or exceeding the hundred degree mark although 116° F. and -33° F. extremes of have been recorded. The average frost-free period is approximately 150 days, the last spring frost occurring on May 10 and the first fall one about October 8. In the winter months the soil remains frozen only part of the time, usually totaling 70 to 75 days during any winter and not more than 40 days continuously.

Rainfall. The amount of rainfall received often is correlated very closely with the kind of crop harvested, particularly that portion of moisture which is received during the winter months and stored up in the soil for crop use. Rains are measured in hundredth inches by means of a standard instrument consisting of a tube, funnel and rule. The intensity of the rain is measured by an automatic instrument which weights the amount of water and records it on a suitable chart. Since the chart is mounted on a revolving drum run by a clock, the record shows the length of time during which a given amount of rain falls. The precipitation record at this station is continuous since 1916, and is supplemented by records obtained during the period 1897-1906 by Dan Krehbiel at his farm 1 1/2 miles north of the station, and by O. W. Goodenough from 1909-1916 at his farm south of Lind. Thus, over a period of 52 years, records for only three are missing. On the next page, the annual rainfall by crop years is shown.

Annual Rainfall Near Lind, Washington
1897-1947

Data Obtained by Dan Krehbiel		Data Obtained by O. W. Goodenough		Data Obtained by The station			
1897-98	6.34	1909-10	8.74	1916-17	7.60	1932-33	8.39
1898-99	8.76	1910-11	8.10	1917-18	6.64	1933-34	9.79
1899-00	12.00	1911-12	10.33	1918-19	8.10	1934-35	7.48
1900-01	15.34	1912-13	8.24	1919-20	6.56	1935-36	8.09
1901-02	12.33	1913-14	10.50	1920-21	7.01	1936-37	8.93
1902-03	13.67	1914-15	10.54	1921-22	6.99	1937-38	11.89
1903-04	15.03	1915-16	13.59	1922-23	10.92	1938-39	5.32
1904-05	11.34			1923-24	6.62	1939-40	13.01
1905-06	12.01			1924-25	8.32	1940-41	18.00
				1925-26	6.65	1941-42	12.29
				1926-27	12.65	1942-43	11.65
				1927-28	10.83	1943-44	8.60
				1928-29	5.77	1944-45	10.05
				1929-30	4.88	1945-46	11.80
				1930-31	6.91	1946-47	8.02
				1931-32	9.79	1947-48	23.29
Totals							456.41 all years
Average	11.87		10.02				9.02
		Average for 47 years	9.71				9.46

Rainfall distrubution during the different seasons of the year is shown in the diagram below.



Near Annual
9.81

The percent of possible sunshine is low in winter, and high in summer, being nearly double the number of hours in summer as in winter. Throughout the year, approximately 165 days are clear, 95 days partly cloudy, and on 105 days cloudy weather prevails.

Relative Humidity, Evaporation and Wind Movement. These three factors are of lesser importance than the preceding ones. However, the amount of wind movement in a given period has an important effect on evaporation, the amount of soil movement, and the physical condition of crops during certain seasons of the year. Wind movement is measured in miles of air movement past a given point in a twenty-four hour period, by means of a three-cup anemometer. Maximum velocities are not readily measured by the instruments available at the station. Relative humidity is measured by means of suitably mounted wet and dry bulb thermometers, which are collectively known as a sling psychrometer. Humidity is an important factor in the comfort of human and indirectly affects plant growth. In semi-arid regions such as ours the effect of low humidity and hot winds often results in failure of fruits and vegetables to bear because of damage from the hot, dry air. Evaporation is measured from a free-water surface in thousandths of inches, and is an important observation in relation to storage of water in open reservoirs, the amount of runoff expected in mountainous areas and the amount of rainfall stored in summerfallow. Until recently, evaporation from natural land surfaces has defied measurement and the evaporation tank has remained the common method of measuring this type of water loss.

CEREAL INVESTIGATIONS

Many winter and spring cereal varieties are tested each year at this station, some old and others new. The standard procedure is to test a new variety in a row a rod in length against standard varieties. If the new one shows promise it is advanced to larger plats and again tested, usually for a five-year period. If the variety shows superiority in yield, disease resistance, stiffness of straw, quality and other factors it is considered for release as a new variety. Many new hybrids never get out of the singlerow stage of testing, while others fail in the bigger plat tests. Formerly, varieties originated as selections within named sorts, but new varieties now are nearly always the result of crosses made between two to eight varieties. From ten to twenty years is often required to produce a variety, from the time the cross is made until it reaches the farm grower.

Winter Cereals. In a great many years, soil moisture and rainfall conditions are unfavorable to establishing stands of winter-type small grains. It is estimated that in only one year out of five are moisture conditions adequate. Some control over fall seeding is accomplished by using the ordinary 7-inch drill when surface conditions are favorable, and generally speaking, if good stands can be obtained, fall sown grains out yield those sown in the spring.

Average comparative data for certain selected varieties of winter wheat and Rye 1918-1946

Variety	Yield Per Acre		Wt. Per Bu.	No. Yrs. Grown
	Grain Bu.	Straw Pounds		
Turkey	17.3	1606	59.4	20
Khorkof	17.0	1617	59.6	18
Rio	16.9	1563	56.6	9
Hymar	19.4	1682	56.6	10
Golden	16.6	1612	56.2	7
Elgin	17.7	1354	56.7	7
Requa	18.3	1682	58.7	4
Orfed	17.3	1749	60.5	6
Wasatch	16.9	1649	60.1	4
Rosen Rye	14.2	2306	51.4	27

Of the winter wheats, Hymar has shown the highest yield, but is not recommended for this area because of its unsatisfactory quality when grown under semi-arid conditions. Rio, a turkey type of winter wheat is recommended. Rio has equalled other turkey wheats in yield and test weight and has the advantage of superior smut and rust resistance. Orfed has shown some promise among the white wheats, but is primarily grown in those areas of eastern Washington where soft wheats are produced. Orfed can be sown either in the fall or the spring, but appears to be less hardy under our conditions than the Turkey red sorts.

Requa has received limited testing at this station. This variety has shown some superiority over commonly grown Big Bend varieties in yield and is rapidly expanding in acreage particularly in Garfield County and the Horse Heaven area of Benton County. It rates only fair as a bread flour. Although classed as soft white, it frequently grades hard white under limited rainfall conditions. Some of the objections to this variety are: weak straw, tends to shatter, susceptible to common and dwarf smut, all common rusts and to powdery mildew. It is not a recommended variety.

Spring Cereals. Although spring cereals yield somewhat less than winter ones when emergence stands are equal, they are in most years the predominent crops in Central Washington. This station has long placed major emphasis on the development of high yielding, high quality spring wheat varieties. In the table on the next page, important spring wheat and other cereal varieties are listed.

Average data for certain Spring Cereals
1918-1946

Variety	Yield Per Acre		Wt. Per Bu.	No. Yrs. Grown
	Grain Bu.	Straw Pounds		
Baart	16.0	1176	58.9	30
Ceres	15.1	1299	58.7	21
Onas	16.2	1120	53.0	21
Federation	14.7	1069	55.0	28
Orfed	16.2	1288	59.4	5
Pacific Bluestem	14.7	1336	53.3	29
Marfed	16.9	1105	54.9	5
Awned Onas	18.8	1295	56.2	4
Reliance	14.8	1204	58.6	13
Marquis	13.8	1222	55.0	27
Common Sp. Rye	11.3	1464	50.5	25
Markton Oats	27.5	1132	34.2	25
Hannchen Barley	25.7	1056	47.2	4
Glacier Barley	19.0	862	42.8	2
Compana	25.7	1379	45.9	4

Over a 30-year period Baart has successfully maintained a primary position among spring wheats grown in the Big Bend. It will grade hard white under our conditions and is considered a high protein variety. The flour from Baart wheat is in demand among bakers, grading excellent for bread and good for crackers and cake. The hard red spring wheats have not been outstanding in our area. Among the newer varieties, Awned Onas, a bearded selection from Onas white wheat has shown considerable promise.

Many varieties of oats, barley and rye have been tested at this station, among these, Markton oats and Hannchen barley have been most satisfactory. Common spring rye is usually low in yield of grain, but produces a relatively heavy hay crop.

ANNUAL LEGUMES

Fall seedings of winter peas and vetch have been somewhat unsatisfactory because of winter annual weed growth. The more satisfactory spring sown peas, because of a cool temparature seedling growth requirement, must be sown very early in the spring, and are best grown in 28-inch double rows to allow cultivation. According to records here, about 9.5 bushels of seed can be expected, on the average. No peas are in test at present.

METHODS OF SEEDING CEREALS

Best results have been obtained in seeding spring cereals by working the land early with a springtooth, or other suitable weeder, followed by seeding with a drill having press wheels. A moderately heavy pressure on the press wheels is desirable, although the depth should be relatively shallow. The usual rate of seeding has been 40 pounds of spring, and 70 pounds of winter wheat per acre.

Best results have been obtained when winter wheat was sown between September 1 and October 20. For spring wheat, early spring sowing has been most productive, although yields are not greatly reduced by deferring seeding until April 1.

FURROW SEEDING OF CEREALS

Semi-furrow seedings usually are superior to ordinary drills from the standpoint of yield. The deep furrow drill with 14-inch spacings has not been in test at this station, but there is good reason to believe this machine to be as satisfactory as the semi-deep furrow drill.

PURE SEED PRODUCTION

The modern combine, plus the bulk system of handling crops has greatly complicated the production of relatively pure seed on the farm. Mixtures between varieties as well as crops has been steadily increasing, more especially between wheat and rye. Winter wheat will usually be free from spring wheat mixtures due to winterkilling, but it is difficult to prevent winter wheat mixtures in spring wheat. Volunteer rye is almost impossible to eradicate owing to its early ripening habit, plus the fact that it readily shatters.

At this station a policy of constant watchfulness and frequent rogueing plus the use of clean seed has prevented the establishment of rye in the fields.

The method of producing pure seed for distribution as practiced at this station is as follows: each winter a lot of from 200 to 300 pounds of choice seed of Baart or Rio is carefully fanned, and hand sorted to eliminate all off-type kernels. Although this is a time-consuming process, it prevents the planting of many mixtures and variant which would later show up in the field. These lots of seed are planted at reduced rates in isolated areas for basic increase. By this means enough seed is usually obtained to plant large station fields the following year to be used for distribution. During the growing season the fields are rogued several times to remove any undesired plants, and again at maturity,

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* are most noticeable. In spite of these precautions, a few natural field

when plants showing off-color chaff and straw* crosses occur, rodents carry in seeds and whirlwinds deposit stray heads in the fields. At irregular intervals several thousand heads that are true to type are selected, threshed separately and grown in short rows for field inspection. From these rows which are again threshed separately and bulked after inspection a new stock of pure seed is obtained which is again increased until enough is secured to allow distribution. It is only in this manner that stocks of any variety can be maintained.

Pure seed stocks can be secured from this station by applying directly, or through your county agent.

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 supplements material presented at previous field day Fall 1943, Dryland 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.

Table on top of page 9 gives a three year summary of yields. Hay yields along with root production, longevity, drough resistance, ground cover and availability of seed should be considered in selecting grasses for conservation seeding. The following grasses have been outstanding under dryland conditions at Lind:

Dryland Bunchgrasses:	Crested wheatgrass and Whitmar beardless wheatgrass
Sod forming grasses:	Pubescent wheatgrass
Dryland bluegrasses:	Sherman big bluegrass
Fine-leaved fescues:	Sheep fescue P-274

Annual and three year average production of grasses seeded in the fall of 1943 at Lind, Washington.

Species	Acc. No. P-	Yield lbs. / Acre 1945	1946	1947	Three Year Average
	Dryland Bunchgrasses				
Siberian wheatgrass	27	3351	2811	635	2266
Crested wheatgrass	Standard	2505	1555	570	1543
Crested wheatgrass	Fairway	2652	1317	477	1482
Beardless wheatgrass	Whitmar	1693	1851	735	1426
Bluebunch wheatgrass	6409	1981	1923	1199	1701
Tall wheatgrass	2326	2171	1107	555	1278
Russian wildrye	8662	1929	2501	456	1629
	Sod Forming Grasses				
Intermediate wheatgrass	2327	2751	1321	515	1529
Pubescent wheatgrass	41	2395	1520	493	1469
Smooth brome	Manchar	(a)	1335	131	489
Erect brome	2336	1864	941	157	987
	Dryland Bluegrasses				
Big bluegrass	Sherman	1603	3363	886	1951
Big bluegrass	8903	2941	1816	1011	1923
Canby bluegrass	851	--	1163	259	474
Bulbous bluegrass	4874	811	2528	242	1194
	Fine-leaved Fescues				
Sheep fescue	274	1017	2128	1210	1452
Idaho fescue	3764	--	2021	1061	1027

(a) Not Harvested.

Fall and Spring Seeding of Dryland Grasses and Legumes Alone and In Alternate Row Mixtures.

The preliminary trial was seeded in the fall of 1945 and the spring of 1946. The fall seeding was made late enough, November 16th, that no germination took place until the following spring. The spring seeding was made as early as possible, March 1st. This preliminary trail indicated that late fall seedings were better for both dryland grasses and legumes.

Another trail was set up to make similar seeding in late fall and early spring for three consecutive years to check these results. These results still show the better stands obtained by fall seeding the grasses but the legumes gave better stands in the spring seedings. The yields on these plantings have been very erratic due to variable stands and limited moisture. Under dryland conditions, thinly spaced plants will produce more per acre than thick stands.

The second seeding of this project was made November 12, 1947 and March 15, 1948. The results obtained will be observed in the field.

Spring 1943, Dryland Legume Seeding

Six promising dryland legumes were seeded for adaptation tests and comparison with Ladak alfalfa.

Annual and average yield from 1944 through 1947 of legumes seeded in spring of 1943 at Lind, Washington.

Species	Yield lbs. per acre				Four-year Average
	1944	1945	1946	1947	
Sainfoin	1178	1341	966	303	921
Ladak alfalfa	1757	2290	1311	487	1461
Hybrid alfalfa	2032	2350	1344	458	1546
Siberian alfalfa	1905	3132	1594	345	1744
Cicer milk vetch	2658	2019	1197	183	1514
Sickle milk vetch	2252	2287	1785	426	1688
Perennial vetch	1301	1396	925	236	965

There is a need in the rotation for a legume that will produce and maintain a stand under dryland conditions. There is very little difference in the production of the top five legumes used here. Ladak alfalfa has maintained the best ground cover and stand. Cicer milk vetch stays green longer than other legumes and would lengthen the grazing season in a pasture. The legume adds nitrogen, the grass builds soil.

Forage Crop Improvement. The forage crop program consists mainly of selecting strains that are most suitable for dry-land farming and range land plantings. The selection of grasses takes into account fall and spring recovery, amount of growth, quality of forage and desirable seed habit.

Each year, general observations are made in the grass nursery and field plantings to select certain plants that may have desirable characteristics. Some of these plants are taken up and cloned in small plots to study their behavior and habits under field conditions.

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 summerfallow. 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 of the year. Since the grass grows very slowly during the seedling stage the seed-bed must be free from weeds.

Broadcasting often is done with considerable success. This should be followed by light harrowing to cover the seed. A danger in broadcasting is the production of an uneven stand of grass.

The rate of seeding grass most suitable for pasture purposes is about eight pounds per acre. This will establish a stand uniform enough to prevent invasion of weeds. The depth should not be over one inch, preferably it should be from one-quarter to one-half inch deep. Proper depth can be secured by using depth regulator on the furrow openers or having the hose fastened outside of the furrow openers. A drag chain may be used with the latter to cover the seed with about one-quarter inch of soil.

The best time to seed grass is in the fall of the year. If moisture conditions are suitable, it can be sown from as early as September 1 to as late as January 1, but the ideal time is from October 1 to 15. Spring seeding is not recommended unless it is sown early enough to get a head start on the weeds and to become well established before the onset of hot weather.

Depending on the use to which the grass is put, row spacing may vary from seven inches to three feet. The wider the row spacing, the greater the forage and seed yield. Beyond the two-foot row spacing, additional 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. Much wider than this makes the grass coarse and less desirable for pasture purposes.

A more uniform stand of grass can be established by seeding a cereal nurse crop in alternate rows with grass. The grain yield of the nurse crop is within 90 per cent of normal while permitting the grass to become satisfactorily established. The nurse crop can be cut for hay which is sometimes more desirable than leaving it to mature for grain. The nurse crop utilizes the soil moisture which would otherwise be used up by the weeds, thereby providing a satisfactory weed control measure. The ordinary 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 but for any desired variation, reducers made of heavy wire can be used very effectively. Recommended rate of grass and nurse crop seeding is eight pounds and 40 pounds respectively. If rye is used as a nurse crop, the rate should be cut down to 20 pounds per acre. Spring tension should be lessened on the furrow openers of the drill sowing grass so that the seed will not be buried too deep in the soil.

Care and Handling of Grass Stands. Almost as much importance should be given to the care and handling of a stand of grass as to the seed-bed preparation and seeding. The grass in the seedling stage during dry seasons often does not develop brace roots without which it cannot stand any pulling or other mechanical distrubances. If the moisture condition is above normal, the brace roots are quite well developed during the first year's growth. At the end of the second year, the grass can be moderately pastured without serious damage to the plants. In the third year the grass will stand normal grazing. The normal field carrying capacity for an established stand of grass ranges from five to twenty acres per animal unit depending on the soil moisture and the type of soil.

During the time the grass is in the seedling stage, weeds can be mowed in their blossom stage. Mustard can be harrowed down or cabled just after it heads out and before the stems become tough.

The age of maximum productivity of crested wheatgrass is three to five years after which it declines to a normal productive capacity resulting from the exhaustion of residual soil moisture and nitrates from the soil. This station has a 20-year old stand of crested wheatgrass which produces as well now as it did ten years ago. In order to increase the productivity it may be desirable to use a cultivating implement both in late fall and in early spring to loosen the soil and thin out the thick stand. The cultivation increases the rate of nitrification so that the increased growth will be as much as 25 per cent over the non-cultivated stand. Usually this is recommended for grasses that are over four years old.

The Use of Nitrogen in Seed Production of Grasses. In 1948, light applications of ammonium sulphate to both cultivated and uncultivated old stand of grass were begun. Ammonium nitrate also will be used. Although no data are available, inspection of the plats indicates that a positive response has been obtained, treated plats showing a darker color and more luxuriant growth.

SOIL INVESTIGATIONS

Tillage Experiments. There are 16 different tillage treatments in the experiment to determine the effects of different types of implements, dates of tillage and amount of trashiness on crop yields and on erosion control. The present tillage series was started in 1938.

In past experiments, the best yields were obtained by wet fall or early spring plowing. There was a steady decrease in yield as the time of the initial tillage was delayed until about April 15 when the decrease became greater due to volunteer growth and weeds exhausting the soil moisture.

Deep tillage gave the best yield only when the annual rainfall was above normal, but for below normal rainfall shallow tillage gave more satisfactory results.

Because the plow turns under the trash, this implement is not desirable for soil erosion control. Tillage by a lister type of implement makes the surface soil layer extremely open and causes greater loss of moisture by evaporation. However, such tillage leaves the greatest amount of trash on the surface.

After-harvest tillage reduces the yield in relation to the amount of moisture lost in the fall by increased evaporation from the loose soil. If the depth of harvest tillage in the stubble is relatively shallow very little moisture is lost by excessive evaporation in the fall, and such tillage becomes extremely important in destroying thistles before producing seed and in retaining the moisture that otherwise would be lost in maturing the weeds in the stubble. A blade machine, if properly adjusted, and other implements having suitable underground cutting devices are satisfactory for destroying weeds in the stubble. The stubble is then left standing to catch drifting snow in the winter and to control erosion.

In the table following page 13 the several methods of tillage are compared.

Crop Rotations. Because soil moisture is the major limiting factor for plant growth, very few crops can be successfully grown other than winter and spring cereals in most of the Big Bend Country. Therefore, a rotation system must take into account the limitation of suitable crops that can be grown and the value of such rotation from the standpoint of maintaining productivity and erosion control. Although several crops have been included in a rotation system in the past experimental work at this station, the only satisfactory crop was wheat alternating with fallow. A new set of rotation plots was set up in 1938 using grass and wheat in a rotation system. The grass stand is left remaining for four years followed by wheat alternating with summerfallow in the next eight years. This type of grass and wheat rotation was based on the probable effective and maximum development of grass root density and on the number of years required for a complete decomposition of the grass roots in the wheat fallow. Since crested wheatgrass makes its maximum plant development at the age of four years, it is assumed that the root density is also at its maximum and this should be an ideal time to break up the sod for wheat and fallow. The remaining eight years should be ample time for complete decomposition of the grass roots after which the land should be put back into grass to replenish the organic matter supplied by the grass roots. Although the organic matter depletion is retarded by this rotation, the greatest advantage is the erosion control afforded by the protective machanical act of the fibrous grass roots. Such a rotation system could be well adapted to the dry-land farming system in Central Washington.

Average Agronomic Data for a test comparing several methods of tillage - 8-year average

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	Average Per Acre				
	Straw Applied	Bus. Grain	Percent Protein	Lbs. Nitrate Nitrogen	Inches Available Moisture
Early spring disk (check)	0	21.7	12.4	52.8	6.27
Dry fall disk	1200	22.7	11.5	42.9	6.42
Harvest Weed	1200	24.0	11.3	45.4	6.75
Wet fall disked	0	21.3	11.4	38.6	6.39
Wet fall disked	1200	21.4	11.3	50.1	5.76
Early spring disked intermediat cult.	1200	22.6	11.1	36.3	6.41
Early spring disked (check)	0	22.7	11.4	39.6	6.30
Spring disk and plow alternately	1200	21.6	11.6	30.2	6.49
Early spring plow	0	23.2	12.3	25.0	6.50
Early spring plow	1200	22.3	12.3	46.8	6.52
Late spring disked	0	19.5	11.1	30.9	6.32
Late spring disked	1200	20.4	11.1	42.6	5.99
Early spring disked (check)	0	21.5	11.4	42.9	6.41
Early spring disked	1200	21.5	11.1	46.9	6.73
Duckfooted	1200	20.3	11.2	41.0	6.43
Chisel cultivation	1200	21.0	11.6	46.6	6.49
Non-tilled	1200	16.4	10.7	30.5	5.98
Non-tilled	0	16.7	10.8	47.5	5.23
Early spring disked (check)		20.3	12.2	--	6.06
Stubble burned	1200	21.1	--	--	--

During the past several years, this station has broken up field areas of crested wheatgrass sod in strips of nine-rods wide and the full length of the field. These are arranged to provide a rotation of wheat and fallow in alternate strips with a narrow strip of grass separating each rotation strip. The grass sod is broken when the stand reaches the age of five years by means of a one-way disk in late fall or in the spring just after the spring recovery is completed. The yield of the first crop of wheat produced on the sod land was about 75 per cent of the normal field yield. The succeeding crops approached normal production quite rapidly.

In the table following page 14, preliminary data are presented showing the yields and other results obtained from these rotations.

Application of Fertilizers to Maintain Soil Fertility. Except under extremely abnormal conditions, the application of fertilizers for maintaining soil fertility is not practical in dry-land farming. During years of abundant rainfall, the addition of a small amount of fertilizer will promote more normal development of plants in the early growing period. However, the increase in the grain yield has not been sufficient to cover the cost of applying the fertilizer.

This station started a series of permanent plots of eight variations of fertilizer applications in 1923. In 1941 the soil from these plots was analyzed for organic matter content to determine what effect the application for fertilizers had on soil fertility. The analysis showed definite effects of fertilizers on the soil organic matter. Although the carbon content of the soil was increased for all applications, the nitrogen was increased only on two plots, namely, one having 3200 pounds of straw applied each crop year and the other having 3 1/2 tons of manure applied. Since moisture is the limiting factor in crop production, the yield is naturally affected very little by theapplication of fertilizers.

In the table preceding page 15, are presented the results for this experiment.

Trees and Shrubs for Dry-Land Planting. Several species of trees and shrubs are included in the station forestry for farm home landscaping and wind-break purposes. Some trees on the station are 24 years old while others are 16 years old. Trees are a valuable asset to any farm for improving rural living conditions and for increasing the value of the property.

Initial observational tests of woody species are carried on at the Soil Conservation Nursery at Pullman. Secondary tests are carried cooperatively on branch experiment stations at Prosser and Lind, Washington, and at Moro, Oregon. The testing at Lind was started in 1928 by the Dryland Experiment Station and the Washington State College Department of Forestry.