The Pendleton Experiment Station

Its Development, Program, and Accomplishments . . . 1928 to 1966

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THE PENDLETON EXPERIMENT STATION

ITS DEVELOPMENT, PROGRAM, AND ACCOMPLISHMENTS

1928 to 1966

M. M. Oveson and R. S. Besse

Historical Background

In northeastern Oregon and southeastern Washington, immediately west of the Blue Mountains, are large tracts of productive land that have been devoted to cereal production for nearly a century. These were among the first lands east of the Cascades to come under the plow in either state. For many years these lands were continuously cropped. Later they were alternately cropped to grain and left fallow to better control weeds, release plant food such as nitrogen, and allow the accumulation of two years' rainfall to produce one wheat crop. Under these farming methods, these fertile lands produced yields of from 35 to 45 bushels per acre.

Farmers, however, began noticing consistently lower yields, increased production costs, more washing and gullying of the land, a reduction in the protein content of the grain, and greater incidence of smut in their fields.

Preliminary testing of soils from Umatilla County indicated that virgin soils contained 28 percent more organic matter and 30 percent more nitrogen in the first foot than soil which had been cropped for 50 years. This meant that the continuously cropped land had lost approximately 27,600 pounds of organic matter and 1,455 pounds of nitrogen per acre in the first foot of soil, in addition to the unmeasured losses in the subsoil. It was evident that erosion and the prevailing system of farming had taken a heavy toll of these essential nutrients.

The growing realization of these problems caused wheat growers to seek funds from the Oregon Legislature and the United States Department of Agriculture to conduct research for the purpose of developing a system of farming that would maintain the native fertility of the land and reduce soil erosion.

Branch Experiment Station Established

The 1927 Oregon Legislature appropriated $2,000 annually for development of a more profitable system of farming east of the Cascade Mountains. The research included investigations on crop rotations; tillage; varietal testing, breeding, and improvement; introduction of new crops; and maintenance and improvement of soil fertility.

The first official name of the research set-up was "The Pendleton Field Station." This terminology was changed in 1942 to the "Pendleton Branch Experiment Station," and in 1962 to "Pendleton Experiment Station."

Federal Participation Obtained

Under a Memorandum of Understanding between the Oregon Agricultural Experiment Station and the United States Bureau of Plant Industry, effective December 1, 1928, the federal bureau, through its Office of Dry Land Agriculture, allocated $9,000 for "cooperative research work on the production of field crops--through breeding, tillage, rotation and other experimental methods." Through its Division of Cereal Crops, the bureau allocated $300 for cereal breeding work in 1931 and $2,800 in 1932. This federal cooperation has continued through the years, with federal funds and personnel enabling more extensive research on problems of the area.

Research Facilities and Physical Plant

In 1928, Umatilla County Court purchased a 160-acre tract of good wheat land, representative of the area, at a cost of $30,000 and leased it to the "State Agricultural College of the State of Oregon for use by the Agricultural Experiment Station, for and during such time hereafter as the said premises shall be maintained and used as a branch Agricultural Experiment Station of the State Agricultural College of the State of Oregon." For special research purposes, other parcels of land have been leased by the Station for short periods.

The buildings at the Station consist of laboratory and office facilities, a greenhouse with a head house containing the central heating plant and living quarters on the second floor; a machine shop, a machine storage shed, automobile storage facilities, a grain storage-cleaning building, and two residences. These buildings were constructed primarily with funds from sales of crops produced at the Station; in recent years the Oregon Wheat Commission has assisted in providing funds for enlargements and improvements of buildings.

Technical laboratory equipment, field experiment equipment, and heavy farm equipment essential to research and practical field operations are owned by the state and the federal government. Occasionally some farm equipment is leased from equipment companies.

Technical Positions and Personnel

The extensive research program of this Station utilizes the skills of a technically trained superintendent, an agronomist, an agricultural engineer, a soil scientist, several assistants, a secretary, and varying numbers of farm laborers.

Since the opening of the Pendleton Station in 1928, the following technical personnel have contributed directly to its accomplishments.

Name	Position	Dates
George A. Mitchell	Assistant Agronomist, Superintendent (USDA, OSU)	1928-1948
J. Foster Martin	Assistant Agronomist (USDA)	1931-1950

Name	Position	Dates
Merrill M. Oveson	Agent (USDA, OSU) Superintendent (OSU,USDA)	1931-1938 1948-1966
Jack T. McDermid	Agent (USDA)	1943-1944
Francis H. McNeal	Assistant Agronomist (USDA)	1947-1948
Carroll H. Ramage	Assistant Agronomist	1949-1953
Theo. R. Horning	Agricultural Engineer (USDA)	1949-1964
H. Marr Waddoups	Assistant Agronomist	1951-1956
Charles R. Rohde	Agronomist	1952-present
David E. Bayer	Assistant Agronomist	1953-1954
Cleveland J. Gerard	Assistant Soil Scientist (USDA, OSU)	1954-1957
Donald W. George	Assistant Agronomist (USDA)	1954-1965
Dean G. Swan	Assistant Agronomist	1955-1965
John Slosser	Agricultural Engineer (USDA)	1955-1957
Kendell G. Woodward	Research Assistant	1956-1957
Laurn K. Beutler	Assistant Agronomist	1957-1963
Charles M. Smith	Soil Scientist (USDA)	1957-1961
Robert E. Ramig	Soil Scientist (USDA)	1961-present
Arnold P. Appleby	Assistant Agronomist	1962-1963
Donald J. Rydrych	Assistant Agronomist	1965-present

This Station also has had the benefit of counsel and direct technical assistance of scientists in the related departments of Oregon State University and in various divisions of the United States Department of Agriculture. Chief among these are the university departments and federal agencies dealing with field crops, soils, agricultural engineering, soil conservation, entomology, and plant pathology. The Cooperative Extension Service (through the county agricultural agents of Umatilla and adjacent counties) and leading wheat growers have also supported the research at the Station.

Problems, Projects, and Progress

The Experiment Station was established to maintain soil fertility and develop more profitable crop production; therefore, an extensive research program was organized to find methods to maintain organic matter and nitrogen in the soil at a satisfactory level for economic crop production, increase the soil's water-holding capacity, improve tilth, and check erosion. This program required the development of research projects to investigate better rotation, the efficient use of fertilizers, proper tillage, and the practical utilization of crop residues. It also required creating and testing of improved wheat varieties, a continued search for new crops, effective weed control, and investigation of other problems that might affect the economy of the area.

Best Rotations Determined

Thirty-three rotations were tested over a period of 30 years. A rotation of wheat and peas resulted in the highest net income in the 16-inch rainfall area of Umatilla County (OSU Circular of Information 573). A rotation of wheat and fallow proved to be the most profitable in the lower rainfall area (below 15 inches).

In the 18-inch rainfall area, a rotation of winter wheat and peas, with 40 pounds of nitrogen added to the wheat crop, produced an average of 8.2 bushels more wheat per acre than the wheat-pea rotation without the addition of nitrogen; the addition of 40 pounds of nitrogen per acre to the winter wheat-fallow rotation increased the average yield of wheat by 9.9 bushels per acre.

In areas where a livestock-wheat combination was practical, a 16-year rotation in which alfalfa was grown for 4 years, followed by wheat and summer fallow for 12 years, gave a good measure of the soil-building qualities of the alfalfa and the length of time the residual effect influenced wheat yields. The wheat yield following alfalfa was reduced 5 bushels an acre the first year due to the fertility stimulation of the alfalfa, but was increased 3 bushels the second year, 8 bushels the third year, 5 bushels the fourth, 2 bushels the fifth, and one-half bushel the sixth year, as compared with the yields on the check plots of wheat and summer fallow. In this rotation, one quarter of the land was in the alfalfa soil-building crop each year and provided a large amount of forage for livestock production.

The 33 rotations that were tested were classified into six groups:

1. Land alternately cropped and fallowed, involving seven rotations.

2. Eight three-year rotations, each with one year of fallow in various combinations.

3. Continuous cropping with spring wheat, winter wheat, oats, corn, barley, and peas in different combinations.

4. Eight rotations involving the use of green manure crops.

5. A four-year rotation which included winter wheat, corn, spring wheat, and fallow.

6. A six-year rotation which included winter wheat, corn, and alfalfa for three years and fallow.

The four top-ranking rotations were: (1) spring wheat and peas, peas; (2) spring wheat and peas; (3) winter wheat and peas; and (4) spring wheat, peas, peas, and peas. All of these were continuous cropping with wheat and a combination of peas in the 16-inch rainfall area.

New and Improved Wheat Varieties Released

Breeding, crossing, selecting, testing, and screening many varieties of wheat, including the "world collection" of 13,000 varieties, produced a succession of new varieties, each of which has certain qualities superior to its predecessors. At the present time, the wheat varieties grown produce from 10 to 15 bushels per acre more than those grown 25 years ago, and the hazard from the diseases of smut and rust is almost eliminated.

The long and technical process of developing new wheat varieties often becomes a cooperative endeavor between several experiment stations in the region and the United States Department of Agriculture. In development of most of the new varieties released by the Pendleton Experiment Station, a major or minor role was played by the Idaho Experiment Station, the Washington Experiment Station, the Sherman Experiment Station, and the United States Department of Agriculture. In some cases, crosses made by another station were tested at the Pendleton Station and jointly released, or vice versa.

At the time of the establishment of the Pendleton Experiment Station (1928), the principal varieties of wheat grown in eastern Oregon were Turkey, Gold Coin, Hybrid 128, and Federation, the latter having been testing and released by the Sherman Experiment Station. Shortly thereafter, however, there was a gradual shift toward the soft white varieties because they gave higher yields and were more acceptable to millers.

A new variety named "Rex" was selected, tested, and released jointly by the Pendleton and the Sherman experiment stations in the early 1930's. It yielded about three bushels an acre more than Federation and was highly resistant to smut. During the years that the Rex variety was prominent, the smut dockage at the market place was reduced from around 30 percent to less than 10 percent. The milling quality of Rex proved to be rather poor, however, and the search for a variety more acceptable to millers continued.

In 1932, the Station was instrumental in the selection of "Alicel." This variety never became important commercially, but it possessed qualities; a later selection from it became the well-known variety, "Elgin." By 1949 Elgin was the leading variety grown in eastern Oregon, yielding about three bushels per acre more than Rex. Elgin was highly susceptible to smut, and smut dockage soon increased.

Elgin was replaced by "Elmar," which was developed and tested by the Washington Experiment Station and released after being concurrently tested and screened at the Pendleton Station. At the time of its release, Elmar was resistant to the prevalent strains of smut in eastern Oregon, but later it became susceptible to other smut strains.

"Omar" succeeded Elmar. This was one of a large number of highly smut-resistant strains developed by the Washington Experiment Station. Omar was tested in eastern Washington and at the Pendleton Station. It was resistant to all prevalent strains of smut at the time of its release.

Omar was succeeded by "Gaines," which provided an increase in yield of six to eight bushels per acre in some areas. It was jointly released from the Washington, Idaho, and Oregon experiment stations, after testing and screening in these areas.

The newest variety of wheat, "Moro," was developed by the Pendleton Station and released in 1965. It proved to be resistant to smut and also to stripe rust, which has caused heavy losses to wheat growers in recent years. Its resistance to stripe rust was derived from one of the varieties from Turkey included in the "world collection" under test at this Station.

During these many years of research, the Experiment Station has aided in breeding improved wheat varieties that have disease resistance, quality to meet market requirements, and yielding ability to promote economic production. This research has brought millions of dollars of new wealth to the area.

Spring wheats improved. The principal contribution of this Station in respect to spring wheat was the testing of many varieties developed by other states to determine if they were superior to those grown here.

The variety "Lemhi" was found to yield two bushels more per acre than "Federation" and was well adapted to production in irrigated areas of eastern Oregon. "Idaed" provided a spring wheat resistant to stripe rust. In years when stripe rust was severe, this variety often yielded twice as much per acre as the susceptible varieties.

Improved winter barley released. The winter barley, "Alpine," was tested and released here. It possessed greater winter hardiness and gave higher yields than the old varieties of White Winter and Olympia.

Seed and Forage Grasses Recommended

Practical recommendations for the production of the most suitable grasses for seed or forage use are now available as a result of testing of hundreds of varieties in collaboration with the United States Department of Agriculture Soil Conservation Service. The adaptability, yield, growing habits, and usage of such grasses have been determined, and a body of information is available whenever needed.

Soil Erosion Reduced by Straw Utilization

One of the major problems in wheat-producing areas is soil erosion by wind and water. Control of erosion is one of the major objectives of the research program, and extensive research has been conducted on the Station since 1930.

In 1949 the Station's research was expanded to include three pilot farms, where experiments in stubble utilization and soil conservation could be further tested on a commercial farm basis, using relatively larger plots and heavy machinery. These farms consisted of 89 acres on the Jim Hill farm and 74 acres on the Lester King farm, both in the 11-13 inch rainfall area, and 160 acres on the S. C. Crow farm in the area of 17-20 inches of rainfall.

The Hill and King farms were operated as a unit, one being in fallow and the other in wheat, alternating as a wheat-fallow system of farming. The Crow farm, located in the higher rainfall area, was managed under a rotation of annual cropping to wheat and peas.

In an effort to control erosion, various methods of tillage in utilizing stubble and the effectiveness of different types of equipment were tested.

Experiments covering a 33-year period (1931-1964) at this Station and 15 years on the pilot farms showed that consistently higher yields of wheat were obtained when the stubble was turned under with a moldboard plow than when the stubble residue was incorporated in the soil as a mulch. However, when 20 pounds of nitrogen was added to the stubble mulch, the wheat yields were greater than after moldboard plowing with no added nitrogen. The moldboard plowing practice, however, failed to protect the soil from serious wind and water erosion, whereas the stubble mulch method of operation, with the nitrogen added, maintained yields and protected the basic soil resource by reducing erosion. By this practice the soil was held in place, and its productive and basic values were conserved.

Handling stubble mulch described. Machinery is available which is capable of handling straw residues up to 12,000 pounds per acre and incorporating them into the soil. This a practical way to reduce erosion. When nitrogen fertilizer is added to this soil, it is possible to maintain yields equal to those obtained when the stubble is burned.

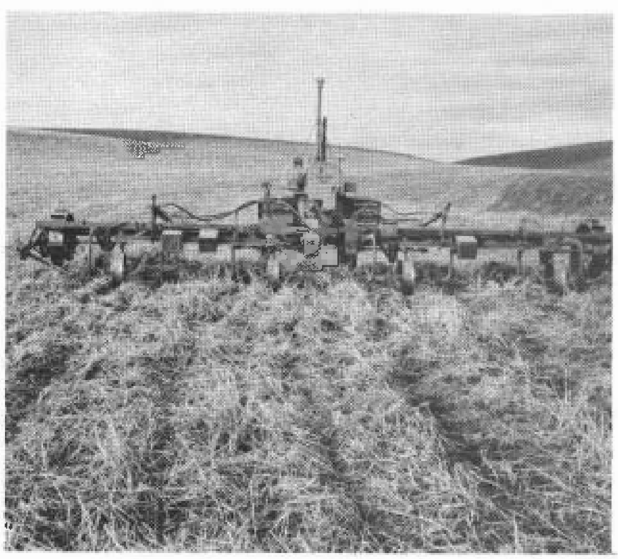
The important steps in utilizing such heavy stubble were determined in a joint federal-state research project conducted by the United States Department of Agriculture and the Pendleton Experiment Station under the leadership of T. R. Horning. Results of this project were reported by the United States Department of Agriculture in Agricultural Information Bulletin No. 253, 1962. This research indicated that stubble mulch farming in a wheat-fallow system can be successful if the proper equipment is used at the right time. Proper handling of stubble mulch is described below.

1. Essential features for the successful operation of tillage equipment are adequate vertical and horizontal clearance to avoid clogging, and a shallow and uniform depth of cultivation.

2. A straw spreader should be used on the combine to distribute the straw uniformly.

3. When straw is not uniformly distributed, a stubble buster, skew treaders, or a spike tooth harrow will be effective in stubble reduction.

A field of Moro wheat at the Pendleton Station.



Rod weeding in heavy stubble mulch controls wind and water erosion.

Seeding wheat in heavy stubble mulch at the Pendleton Experiment Station.

4. Initial tillage normally should be done in the spring after growth of weeds and volunteer grain has begun and the immediate surface soil has dried out. Stubble cultivators, subsurface sweeps, or one-way discs are the most satisfactory implements. Disc plows equipped with large, widespread discs can be used in stony ground or in excessively heavy stubble if they are properly operated to avoid burying too much of the residue. Depth of operation should not exceed 4 to 6 inches.

5. The initial tillage operation may be performed in the fall following harvest, but this is not recommended except where soil freezing is common, a severe weed or volunteer grain problem exists, distribution of the work load is necessary, or where difficulties must be avoided in a wet spring.

6. A follow-up tillage, as soon as possible after initial spring tillage, is needed to complete the weed kill, to pack the soil, or both. The skew treader, rod weeder, or stubble cultivator are recommended, depending on the amount of residue, climatic conditions, and growth of weeds and volunteer grain.

7. Summer weeding operations can be accomplished with the rod weeder, stubble cultivator, or medium-width sweeps (24 to 30 inches wide). Tillage should be performed only often enough to control weeds and should not exceed 3 to 4 inches in depth. If residues after initial tillage are less than 3,000 pounds per acre, care should be taken during subsequent tillages to leave as much residue on or near the soil surface as possible.

8. Every tillage operation should fulfill a special need. Any tillage in excess of this need not only costs extra money but reduces protective residues and adversely affects soil condition.

9. Drilling is best accomplished by semi-deep furrow drills with wide-row spacing (8 to 14 inches). Closed packer wheels cause less disturbance of residue and soil between rows than open wheels. Place seed in firm, moist soil; then cover seed uniformly and pack the soil.

Cloddy seedbeds halt erosion. Extensive tests showed that wheat which was seeded in clods, with no seedbed preparation, produced practically as good yields as wheat which was seeded in the conventional pulverized seedbeds. Seeding wheat in clods practically eliminated erosion in the higher rainfall areas under the wheat-peas rotation system. Plowing the pea fields in July soon after harvest leaves the soil in a very cloddy condition. With no additional tillage, the wheat is seeded in this cloddy seedbed. Naturally, in the experiments some of the clods were crushed by the equipment during fertilizing and seeding operations, but the elimination of the regular seedbed preparation reduced production costs.

Practical Tillage Methods Determined

Proper tillage in a wheat-fallow system of farming is vital to economic production. For 22 years this station has searched for practical economic methods of tillage that will allow the greatest moisture penetration during the first winter following the crop, prevent depletion of moisture and plant food during the fallow season, control volunteer wheat and weed growth, and minimize the danger of wind and water erosion.

Treatment of land before plowing. Neither fall nor spring discing before plowing is recommended, since tests show nondisced land to yield 2.7 bushels per acre more than land disced in the fall and 1.5 bushels more than land disced in the spring.

Burning the straw residue is not recommended, because the residue is more useful in reducing erosion when incorporated with the soil; also, the wheat yields are about equal in both methods of residue treatment.

Plowing. Early spring plowing, around the middle of March, produced a 22-year average yield of 2.2 bushels an acre higher than land plowed around the middle of April, 4.3 bushels more than land plowed in mid-May, and 1.9 bushels higher than fall-plowed land.

Deep plowing (9 inches) produced an average of 2.1 bushels an acre more than shallow plowing (5 inches).

Moldboard-plowed land averaged 4.5 bushels more wheat per acre than land plowed with a one-way disc, and 3.4 bushels per acre more than land prepared with the double disc.

Cultivation of summer fallow. Delaying cultivation of summer fallow for 30 days after plowing has proved to be superior to immediate cultivation. A cloddy mulch is formed when cultivation is delayed, and this aids in erosion control and eliminates one cultivation for weed control.

Economic Use of Fertilizers Found

Present fertilizer practices of wheat growers in the Columbia Basin are based on the recommendations of the Experiment Station. Many fertilizers were tested and screened at the Station in an effort to select the most effective and economical ones for the area. Considered in the tests were the amounts and kinds of fertilizers and the dates and methods of application. This research stimulated the wide use of nitrogen, especially during the last 15 years. The net increase in wealth in the area as a result of improved wheat yields is estimated to exceed one million dollars annually.

Available nitrogen limits wheat production. Wheat yields were found to be influenced by the availability of nitrogen in the soil as much as by the amount of moisture, in the 15-16 inch rainfall summer fallow areas. This was determined by the water-requirement measurements on tillage, residue, and rotation plots.

The discovery of the close relationship of soil moisture and available nitrogen pointed to the need for the addition of varying amounts of nitrogen for increasing yields.

This discovery paved the way for establishing a soil-testing laboratory in the area to assist farmers in developing their own fertilizer programs. Farmers were warned against overapplication of nitrogen in short-moisture years and were provided with information in regard to the maximum amounts of nitrogen that should be applied in high-moisture years for the most economic returns. Farmers were saved unnecessary fertilizer expenditures by the discovery that certain fertilizers such as phosphorous and potash did not increase wheat yields under the summer fallow system of farming.

Soil nitrogen conserved. The need for supplying nitrogen to the soil in a wheat-fallow system of farming was determined in a series of experiments covering a 34-year period. The available nitrogen level in the soil was found to be directly responsible for the productivity of the land.

For many years prior to the establishment of the Station, the standard practice was to burn all straw residue from the previous wheat crop before plowing the land for fallow. This method gave higher yields of wheat on the burned-over land and greatly reduced plowing problems. Plowing under stubble with a heavy straw residue on the surface was sometimes nearly impossible with the old moldboard plow. The amount of nitrogen that was removed from the soil by a 40-bushel wheat crop with 8 percent protein was determined to be about 30 pounds per acre. It then became obvious that continually taking from the soil and never putting anything back would eventually result in a depletion of soil nitrogen and organic matter, and wheat yields would continue to decline.

The average wheat yields from 1931 to 1964 on plots receiving different treatments of wheat straw and other residues are shown in Table 1. Also shown in the table is the amount of nitrogen found in the top foot of the soil at the beginning and at the end of the experiment; the loss or gain of nitrogen is expressed in pounds per acre.

Organic residues supplement nitrogen supply. Further experiments showed that nitrogen could be supplied in organic residues, such as legume straw or manure, as well as in the form of commercial fertilizers. The highest average yields of Rex M-1 winter wheat were produced by four different methods of fertilization.

1. Ten tons of strawy manure per acre added to wheat stubble before plowing -- 49.5 bushels per acre.

2. One ton of dry pea vines added to stubble before plowing -- 45.3 bushels per acre.

3. Stubble fall disced plus 30 pounds of nitrogen per acre as ammonium sulfate before plowing -- 43.5 bushels per acre.

4. Stubble spring disced plus 30 pounds of nitrogen per acre as ammonium sulfate before plowing -- 42.8 bushels per acre.

The average precipitation during this experiment was 16.1 inches.

Table 1. Effect of various treatments of wheat straw on wheat yield and soil nitrogen loss

Treatment	Average yield	Nitrogen per surface foot of soil 1931	1964	Loss or gain of nitrogen
	Bu./A	%	%	Lbs./A
Check -- all straw returned to soil	36.7	.0970	.0843	- 423
All straw burned in fall	36.9	.0945	.0788	- 526
All straw burned in spring	39.4	.0933	.0828	- 352
All straw returned plus 30 lbs. nitrogen	43.2	.0959	.0879	- 268
All straw returned plus 1 ton dry pea vines	45.3	.0972	.0938	- 114
All straw returned plus 10 tons strawy manure	49.5	.0943	.1014	plus 238

Figure 1 shows the yield performance for each of the treatments by 7-year periods. The effect of various treatments on the loss or gain in soil nitrogen is shown in Figure 2. The treatments that increased or maintained the nitrogen supply also increased or sustained the average wheat yields, while treatments that reduced soil nitrogen showed a steady decline in wheat yields.

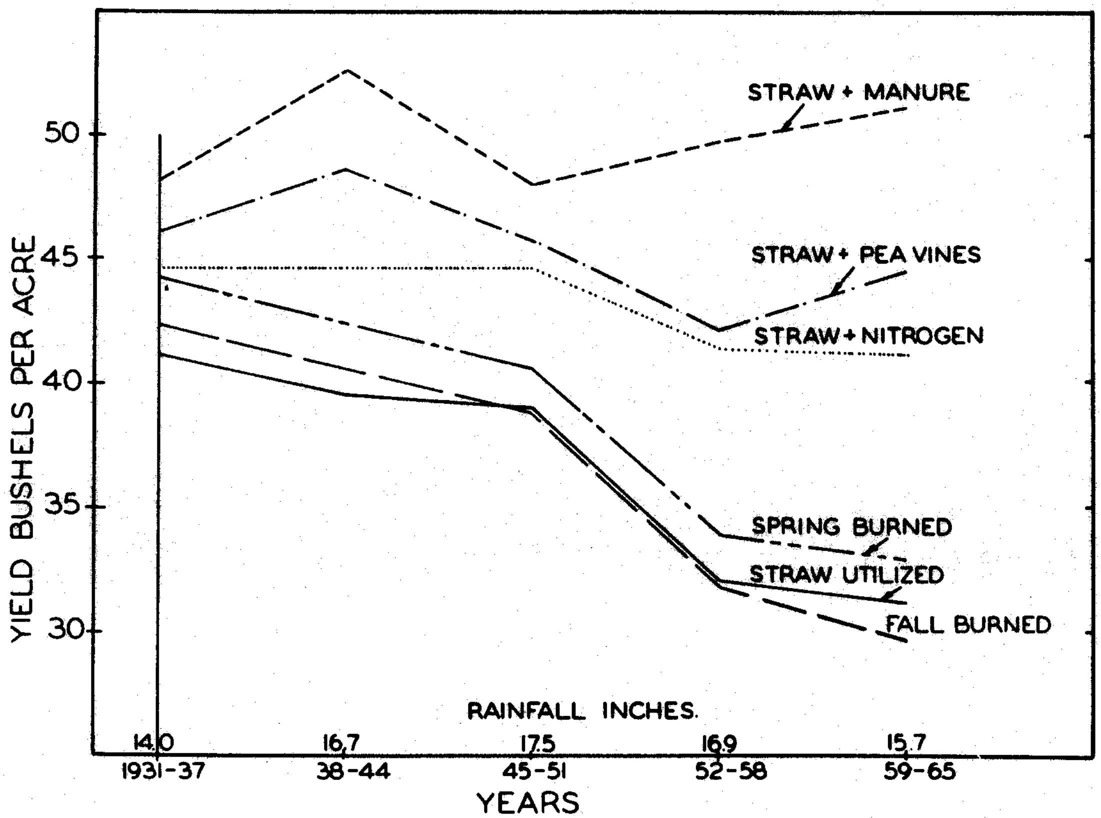


Figure 1. Effect of wheat straw and other residue on winter wheat yield.

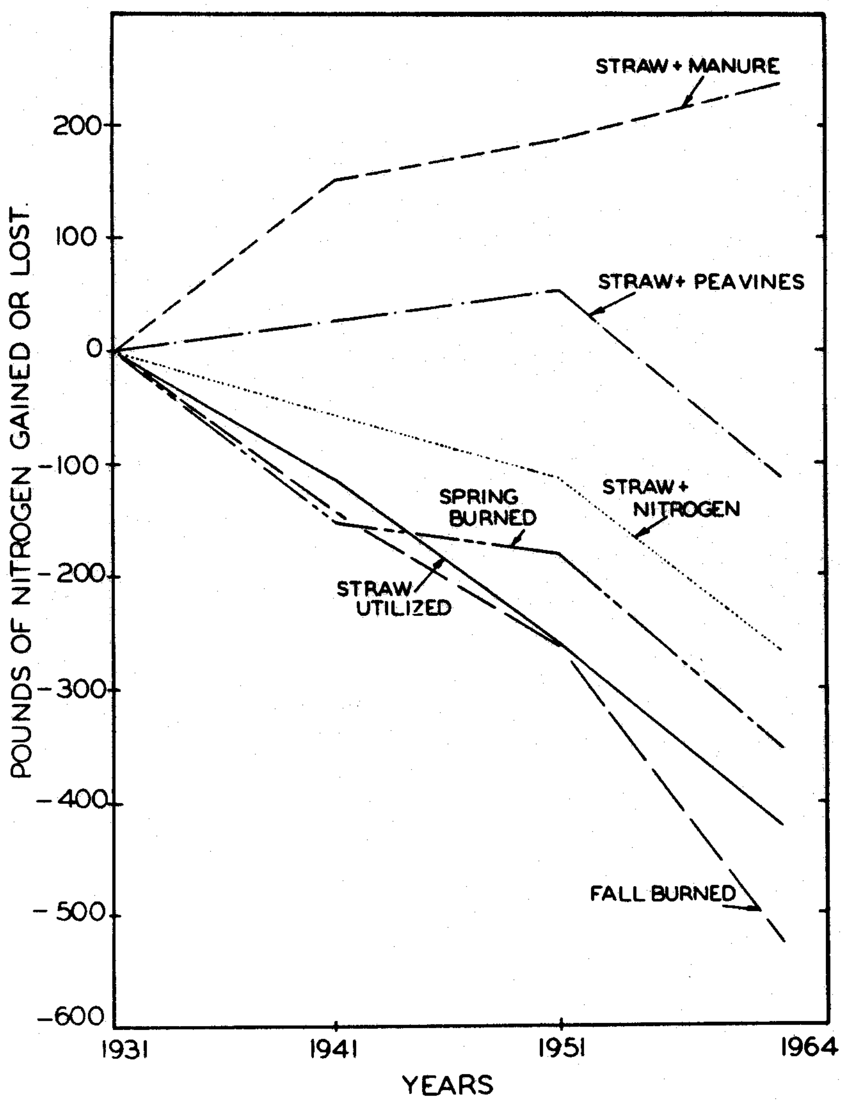


Figure 2. Effect of wheat straw and other residue on gain or loss of soil nitrogen.

A nitrogen-sulfur relationship found for wheat. Nearly all farmers in the wheat-pea rotation area of 18-inch rainfall now use sulfur-containing fertilizers because experiments proved the effectiveness of adding sulfur to nitrogen fertilizer. In experimental use of low rates of nitrogen, or no nitrogen, there was no significant response to sulfur. However, with the usual application of nitrogen fertilizer, it was found that sulfur soon became a limiting factor, and that it must be applied for maximum yields. Tests showed that one application of 15 pounds of sulfur was adequate for 4 to 6 years of wheat and pea crops. Since it was not necessary to apply sulfur each year, the cost to farmers was reduced.

Weeds Controlled Effectively

Effective control measures have significantly reduced losses from the annual toll of weeds. Many different chemicals have been tested on field bindweed, cheatgrass, wild oats, Canada thistle, and other weeds in fields of various crops -- wheat, alfalfa, peas, and corn -- and on roadside areas. Included in the tests were the kinds and amounts of chemicals applied, and their time of application.

The effectiveness of chemicals has been evaluated in an effort to find a material that will reduce the amount of tillage necessary in the control of annual weeds on summer fallow. A practical chemical application is currently being recommended and used in this area.

A practical control of cheatgrass, wild rye, and quackgrass in alfalfa fields has been found. Uncontrolled cheatgrass in wheat fields, especially on the lighter soils, causes serious reduction in yields. Certain chemicals which give some indication of selective control leave chemical residues in the soil, and this tends to reduce wheat yields the following year. Other chemicals give promise of selective control without creating a residue problem.

The Station's recommendations for weed control have been widely adopted by wheat growers in the area.

The Station developed a light plastic, rustproof, transparent concentrate tank for use on a weed sprayer in testing different chemicals for weed control in small experimental plots. This eliminates the rust and corrosion problem common to metal tanks and enables the operator to see the level of the solution in the tank.

Seeding Rates Reduced

The rate of seeding wheat (60 to 100 pounds per acre) was reduced by 30 pounds per acre without reducing the yield per acre, saving about 400,000 bushels of wheat annually. The heavier rates of seeding produced no better yields than the lighter rates in extensive experiments over a period of years.

The time of seeding appeared to influence the rate of seeding. Tests indicated that the rate of 25 to 35 pounds per acre was adequate for seeding between the middle of September and the first of October, 40 to 50 pounds per acre were necessary by the middle of October, and 60 pounds per acre were required for planting in November.

Pea Industry Started

Many varieties of peas were tested at the Experiment Station and by farmers under farm conditions. It was shown that peas could be grown successfully in the area, and this resulted in the development of a pea production and processing industry. This industry now (1966) utilizes 50,000 acres in Umatilla County and about 50,000 acres in Walla Walla County in Washington.

Further research has established optimum dates, rates, and methods of seeding peas; the kinds and amounts of fertilizers to use; and the most suitable dates and methods of application. The best dates for harvesting peas for optimum tenderometer reading and quality also have been determined.

New Crops Evaluated

Many different crops have been tested at this Station in its continuous search for new and promising crops of economic potential and adaptability in the several rainfall sections of this area.

Oil crops such as safflower, soybeans, seed flax, mustard, rape, crambe, castor bean, sunflower, cape marigold, and Camelina sativa have been evaluated. Flax and safflower have shown considerable promise, but they have not been able to compete with wheat economically.

Seed and forage crops, including a great number of varieties and crosses of grasses, alfalfa, corn, and sorghum, also have been tested at this Station. In the early years, the testing of different species and varieties of grasses was carried out in cooperation with the Soil Conservation Service of the United States Department of Agriculture.

Vegetable crops which have been tested at the Station include sweet corn, carrots, potatoes, and beans.

This research provides a body of important information which saves farmers the expense of trying out untested, uncertain varieties. A negative result of research may often be as helpful as a positive one, in that it shows what not to plant and what not to do.

Weather Data Proved Valuable

Detailed information on the amounts of precipitation that occurred daily and monthly during the crop year and the calendar year, for a period of 37 years, aided wheat growers in planning farm operations. Precipitation was found to have a closer correlation with the response of crops to rainfall during the crop year (September 1 to August 31) than it did during the calendar year. This is especially important in the annual crop area where the rainfall is needed to fill the soil profile that supplies moisture during the late crop maturity period.

The highest precipitation recorded at the Pendleton Station during this 37-year period was 21.85 inches (1950), and the lowest was 10.57 inches (1935). The average was 15.96 inches.

The Station also supplied data on daily maximum and minimum air temperatures, soil temperatures (4-inch depth), wind velocity, evaporation, dates of latest killing frost (28 degrees F. or colder) in the spring, earliest killing frost in the fall, and the average number of days in the year free of killing frost. The latest killing frost in the spring during this period was 28 degrees on June 5, 1939. The first killing frost in the fall was on September 17, 1965, at 23 degrees F. The longest frost-free period was 237 days in 1947, and the average number of days free of killing frost through the 37 years was 169.

During the past three years, the Pendleton Station has become part of a team which releases a daily agriculture weather forecast. Weather records are phoned in daily to the local weather station which, in turn, reports to a central weather station covering the state. From these combined data, forecasts are sent out to all parts of the state.

Economy of Area Improved

It would be difficult to measure the financial benefits of the research program accurately. These benefits undoubtedly have played a very important role in stabilizing and maintaining a prosperous agriculture in the area. All of the research conducted by the Station has contributed to the advancement of the economy of the area by increasing crop yields and lowering production costs. Most of this new wealth is cumulative -- once created, it continues annually.

PUBLICATIONS

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