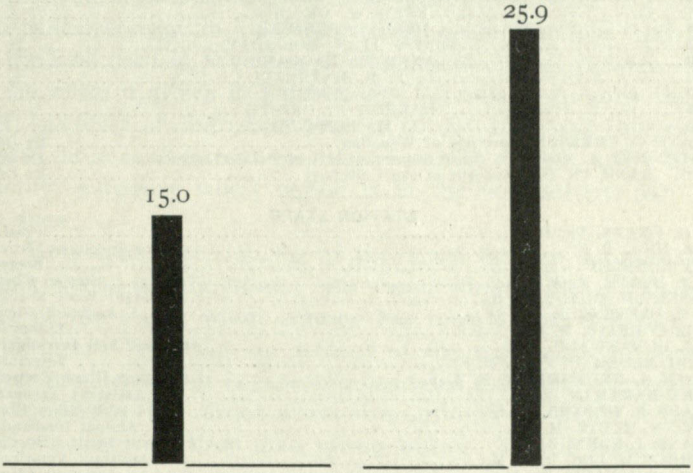
BULLETIN NO. 151 FEBRUARY, 1927

UNIVERSITY OF WYOMING

AGRICULTURAL EXPERIMENT STATION

AVERAGE WINTER WHEAT YIELD, THREE YEARS, CHEYENNE EXPERIMENT FARM
(Bushels Per Acre)



Produced on late plowed fallow by use of common drill.

Produced on late duck-footed fallow by use of furrow drill.

A Better Method for Winter Wheat Production

Bulletins will be sent free upon request.
Address: Director of Experiment Station, Laramie, Wyoming.

UNIVERSITY OF WYOMING
Agricultural Experiment Station
LARAMIE, WYOMING

BOARD OF TRUSTEES

Officers

JOSEPH A. ELLIOTT	President
FRANK A. HOLLIDAY	Vice President
FRED W. GEDDES	Treasurer
FAY E. SMITH	Secretary
E. O. FULLER	Fiscal Agent

Executive Committee

JOSEPH A. ELLIOTT, FRED W. GEDDES, FRANK A. HOLLIDAY, ANNA B. HAGGARD

Members

Appointed		Term Expires
1921	JOSEPH A. ELLIOTT	1927
1921	FRED W. GEDDES	1927
1921	DEAN T. PROSSER	1927
1923	FRANK ALAN HOLLIDAY	1929
1923	ANNA B. HAGGARD	1929
1923	D. P. B. MARSHALL	1929
1923	P. J. QUEALY	1931
1925	HARRIET T. GRIEVE	1931
1925	J. M. SCHWOOB	1931
FRANK C. EMERSON, Governor of Wyoming		Ex Officio
KATHARINE A. MORTON, State Superintendent of Public Instruction		Ex Officio
A. G. CRANE, Ph. D., President of the University		Ex Officio

STATION STAFF

A. G. CRANE, Ph. D.	President
J. A. HILL, B. S.	Wool Specialist, Director
FAY E. SMITH	Secretary
O. A. BEATH, M. A.	Station Chemist
ROBERT H. BURNS, M. S.	Assistant Wool Specialist
C. B. CLEVENGER, Ph. D.	Assistant Chemist
C. L. CORKINS, M. S.	Entomolgist
T. J. DUNNEWALD, M. S.	Assistant Soil Investigations
CECIL ELDER, D. V. M., M. S.	Veterinarian
EDITH G. GRUNDMEIER, B. S.	Assistant Home Economics
GLEN HARTMAN, B. S.	Assistant Agronomist
FRANK E. HEPNER, M. S.	Head of Weather Station
FRED S. HULTZ, M. S.	Animal Husbandman
FRANK J. KOHN, B. S.	Assistant Poultry Specialist
AUBREY M. LEE, D. V. M.	Assistant Veterinarian
O. C. McCREARY, Ph. D.	Assistant Chemist
ELIZABETH McKITTRICK, M. S.	Home Economics
AVEN NELSON, Ph. D.	Botanist and Horticulturist
HARRY PEARSON, B. S.	Assistant Agronomist
W. L. QUALYE, B. S.	Director of Experiment Farms
JOHN W. SCOTT, Ph. D.	Zoologist and Parasitologist
A. F. VASS, Ph. D.	Agronomist
S. S. WHEELER, M. S.	Assistant Animal Husbandman
H. S. WILLARD, M. S.	Assistant Animal Husbandman
*MARION V. HIGGINS	Librarian
EULA GEORGE	Clerk

*On leave.

SUPERINTENDENTS OF EXPERIMENT FARMS

Axell Christensen, B. S.	Torrington
L. W. Grandy, B. S.	Eden
R. J. Hyer, B. S.	Grover
A. L. Nelson, M. S.	Cheyenne
J. F. Peterson	Worland
L. R. Reed	Lyman
D. R. Sabin, B. S.	Gillette
John H. Steinbrech	Lander
R. S. Towle, B. S.	Sheridan

A Better Method for Winter Wheat Production*†

W. L. Quayle
A. L. Nelson

Of the several cash crops produced upon Wyoming farms, wheat is most important from the standpoint of its distribution and value. This is particularly true with reference to the non-irrigated farms of the state where the bulk of the wheat is grown. The wheat acreage in 1926 represented more than one-tenth of all the land used in Wyoming for harvested crops. A large part of the wheat is grown in Southeastern Wyoming. In 1925 nearly half (44.6%) of the wheat arceage of the state was comprised in the three southeastern counties, Laramie, Goshen and Platte. Another extensive wheat region is in the northeastern part of the state

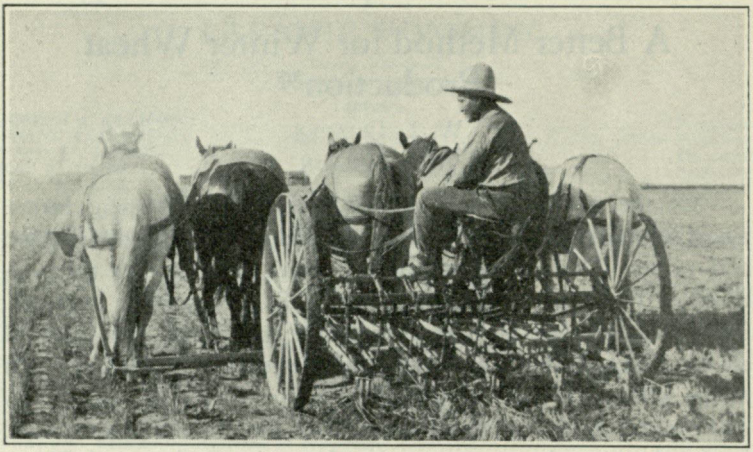
More than three-fourths of the wheat acreage in 1926 was spring seeded and the balance was winter wheat. The preponderance of the spring wheat acreage has come about, especially in southeastern Wyoming, on account of the uncertainty of winter wheat production. It is generally conceded that, under dry-farming conditions, fall seeded wheat if it survives the winter is more likely to mature a crop than spring wheat. This is because the winter wheat has an earlier start than the spring seeded grain and by the time of the usual dry spells of late June and the fore part of July the winter wheat is sufficiently matured so that less injury results to it than to the spring wheat. This is especially true when winter wheat is seeded on fallow land. The quality of the winter grain is generally superior to that of the spring seeded crop because it escapes to some extent, the shrivelling action of summer drouths.

---

*Division of State Farms Bulletin No. 10.

†The results reported here are from the Cheyenne Experiment Farm, which is operated cooperatively by the University of Wyoming and Office of Dry-land Agriculture Bureau of Plant Industry, U. S. D. A. Mr. A. L. Nelson, joint author of this bulletin, is superintendent of the Cheyenne Experiment Farm.

State Farms—Cheyenne, Laramie County; Eden Sweetwater County; Gillette, Campbell County; Grover, Lincoln County; Lander, Fremont County; Lyman, Uinta County; Sheridan, Sheridan County; Torrington, Goshen County; Worland, Washakie County. (Cheyenne and Sheridan Farms cooperating with U. S. D. A.)



"DUCKFOOTING" STUBBLE LAND, CHEYENNE EXPERIMENT FARM

Farmers are cognizant of these facts, but the uncertainty of fall seeded wheat surviving the winter has deterred the planting of winter wheat especially in southeastern Wyoming where winter losses have been quite severe. Much of the damage has resulted from wind action. In an open winter when the fields are bare for a considerable part of the season the wind dries the roots of the young wheat plants to such an extent that the plants die. A factor which accelerates this cause is the shifting of the soil which not only causes damage by the cutting effect of the fast moving soil particles but also uncovers the crown of the wheat plants so that the roots are exposed to undue drying and many of the plants are lost. Seeding in small grain stubble and between growing corn rows has resulted in less winter injury but the yields have been too small to make this seeding method satisfactory.

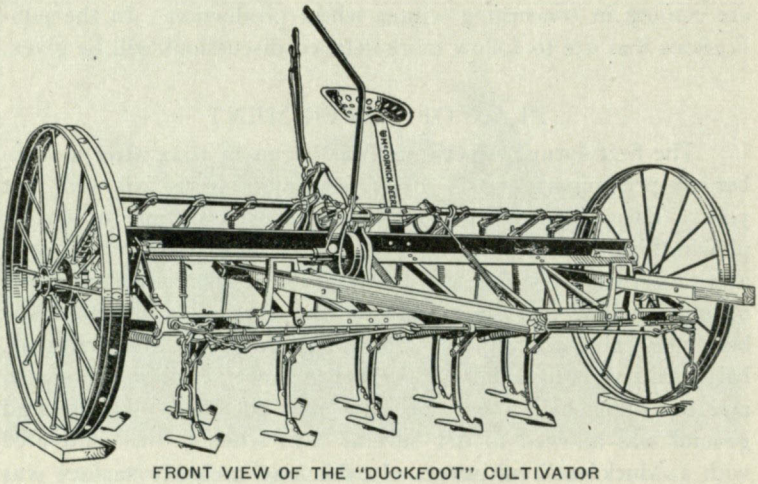
It was to overcome these difficulties that beset the farmer's efforts to produce winter wheat that the Cheyenne Experiment Farm undertook a series of experiments in methods of fallowing and of seeding winter wheat.

This bulletin is the first of a series that will deal with crop production on the Cheyenne Experiment Farm. These pages have been written to answer in a general way the urgent inquiries that

are coming in concerning winter wheat production. In the publications that are to follow more detailed discussions will be given.

PLAN OF EXPERIMENT

The first formal experiment was begun in 1922 after a number of preliminary tests. Four field plats were fallowed that year. Two of them were plowed at the usual time of spring plowing, in the first part of April and the other two were plowed after most of the spring work was finished, about the latter part of May. Each year since 1922 the preparation of the plats has been done in practically the same way that it was the first year, half of the plats to be left fallow, being plowed early in the season and the other half about the later part of May. The plowed ground was allowed to dry several days when it was cultivated with a "duckfoot" cultivator. In this way a cloddy surface was secured which retarded wind action and which also decreased the amount of runoff from summer rains. During the remainder of the summer the fallow was given just sufficient cultivation to check weeds. Half of the early plowed plats and half of the late plowed plats were seeded with the common press drill. The remaining plats of each plowing were seeded with a furrow drill. This was an ordinary disk drill in which only every other grain hole was used. Every other disk was removed. These were matched with the remaining disks in tandem fashion so that the front disk threw the soil in the opposite direction from the back disk, the back disk running in the furrow made by the front disk. The arrangement of the drill was such that the back disk cut deeper into the soil than the front disk. In this way furrows were made about five inches deep and fourteen inches apart. The grain hose conveyed the seed to the bottom of these furrows and immediately behind the back disks. The press wheels following, firmed the soil over the seed. Besides these plats used for seeding methods on fallow, two other groups of plats were used for winter wheat seeding. On one set of plats the wheat was seeded between the corn rows with a corn row drill, and on the other set it was seeded in oats stubble. Kanred wheat produced on the farm was used as seed. The wheat was drilled about the



FRONT VIEW OF THE "DUCKFOOT" CULTIVATOR

first of September at the rate of three pecks per acre. No further work was done to the plats until harvesting in the following year.

The Cheyenne Experiment Farm is trying to find ways and devise means of reducing to a minimum the winter killing of fall seeded wheat. Four years of work have just been completed. The results of this work in grain yields are set forth in Table I.

TABLE I

Yields of Winter Wheat Seeded with the Common Drill and Seeded with the Furrow Drill.

(Bushels per acre.)

Kind of drill	Time of plowing fallow	1923	1924	1925	1926	Average
Common	Early	3.0	4.2	13.0	14.8	8.8
Common	Late	8.8	17.5	14.5	13.0	13.5
Furrow	Early	12.0	21.7	19.3	20.5	18.4
Furrow	Late	17.3	22.3	16.5	18.7	18.7

DISCUSSION

From the table it is quite evident that the least desirable method of producing winter wheat on fallow is using the common press drill on fallow that is plowed early in the spring. This combination is the one most generally employed by farmers where fallow is used in the production of winter wheat. The use of the furrow drill on early plowed fallow shows an increase of 9.6 bushels per acre compared with the common drill seeding. This is at the rate of 109 per cent increase in yield.

On the late plowed fallow, the use of the furrow drill gave a return of five bushels more per acre than did the common drill. It will also be noted that with the use of the common drill on the late plowed fallow the yield averaged 13.5 bushels per acre, an increase of 4.7 bushels compared with the yield when the same drill was used on early plowed fallow. The results of the individual years all show that the furrow drill is better than the common drill. The yields secured during 1926 show that early plowed fallow produced the largest yields. This is due, no doubt, to the fact that during the winter of 1925 and 1926 there was practically no soil blowing. If it were not for soil blowing the early plowed fallow might produce the largest average yields. It is important to note that even during the winter of 1925-26 when there was practically no soil blowing the yield by seeding with the furrow drill was 5.7 bushels more per acre, 38.5 per cent, than that seeded with the common drill.

The comparison of the yields of winter wheat by the several seeding methods indicates that yields are materially increased when the furrow drill is used instead of the common drill. It is also apparent that late plowing for fallow results in larger yields than early plowing. The combination of the furrow drill and late plowed fallow produced an increase in the yield of 112 per cent over wheat seeded with the common drill on early plowed fallow.

PART TWO

After the first year's work with the furrow drill, an experiment was started to determine the possibility of reducing the amount of work necessary in preparing the fallow for winter wheat. Four plats were used in this test, two being cropped and two being left fallow, each year The soil preparation consisted of cultivating the plats with a "duckfoot" cultivator at the time of the late plowing for fallow mentioned in the first part of this bulletin. The cultivator shovels stirred the soil to a depth of from four to five inches. After the first operation with the cultivator it was used only often enough to keep down excessive weed growth. This has generally required three cultivations during the summer. The soil is not turned by the duckfoot cultivator and exposed to the drying action of the sun as it is in the case of plowing. Stubble and weeds are not turned under but remain on top of the land. Such a surface receives moisture more readily and also tends to conserve it. It retards wind action and checks evaporation. The cultivator used in this work is six feet wide. It requires five good horses or six average horses to draw it when set at the usual depth of from four to five inches.

Running parallel to the test in preparing fallow by means of the duckfoot, has been a test in duckfooting oats stubble as a seed bed preparation for winter wheat. The stubble plats were cultivated with the "duckfoot" as soon as the oats crop had been removed. The average seeding date has been about September 1st. On the duckfooted fallow two seeding methods have been used each year, the common drill and the furrow drill. Only the furrow drill was used on the duckfooted oats stubble. Kanred wheat was used for the seed which was drilled September 1st.

TABLE II

Yields of Winter Wheat from Duckfooted Fallow and from Duckfooted Oats Stubble.

(Bushels yer acre.)

Seedbed	1924	1925	1926	Average
Duckfooted Fallow	30.6	25.8	21.2	25.9
Duckfooted Oats Stubble	16.9	7.6	12.0	12.2

It will be seen from Table II that the yields on the late duckfooted fallow are more than two times as large as they are on oats stubble ground that had been duckfooted just before seeding.

A comparison of duckfooted fallow, plowed fallow and duckfooted oats stubble is shown in Table III.

TABLE III.

Yields of Winter Wheat on Duckfooted Fallow, Plowed Fallow and Duckfooted Oats Stubble. Furrow Drill used.

(Bushels per acre.)

Seedbed	1924	1925	1926	Average
Duckfooted Fallow	30.6	25.8	21.2	25.9
Plowed Fallow	22.3	16.5	18.7	19.2
Duckfooted Oats Stubble	16.9	7.6	12.0	12.2

As set forth in Table III the lowest yield, 12.2 bushels per acre, resulted from seeding the wheat with the furrow drill on oats stubble which had been duckfooted. A three year average yield of 19.2 bushels per acre was obtained from fallow which had been plowed late and seeded with the furrow drill. The highest yield of 25.9 bushels to the acre was produced on duckfooted fallow seeded with the furrow drill. This is 6.7 bushels more per acre than was produced by use of the furrow drill on late plowed fallow, for the three year period.

The time required in preparing the fallow by the two methods is in favor of the "duckfoot" cultivator. For plowing three

horses were used on a sixteen inch bottom, while for duckfooting six average or five good horses drew the six foot cultivator. Since it required the same number of operations with the "duckfoot" cultivator for the late plowed fallow as it did for the "duckfooted" fallow and since an additional cultivation was given the early plowed fallow it is evident that fallowing by means of the "duckfoot" cultivator requires less time and also less horse power than is required when the plow is used.

CONCLUSIONS

From the data considered in the foregoing pages, it is clear that there is a marked difference in yields of winter wheat, depending upon the methods used in its production. The yields from the usual fallowing method, that of early plowing and seeding with the common drill, averaged for four years less than half as much as was obtained when the furrow drill was used. The low yield from the first method was the result of a low per centage of wheat plants surviving the winter which was due, no doubt, to the damage caused by soil blowing.

The common drill seeded the grain comparatively near the surface where the soil was dry. The early plowing had left the soil mellow and soft so that by seeding time it had become quite fine. It was largely because of this fine condition of the soil that the wind during the winter and spring caused serious injury to the wheat plants.

Due to the adverse season of 1922-23, seventeen per cent of Wyoming's winter wheat acreage which had been seeded in 1922 was abandoned.* The seeding with the common drill that year at the Cheyenne Experiment Farm produced only 3 bushels per acre on early plowed fallow, while the furrow drill on the same kind of fallow produced at the rate of twelve bushels per acre. In view of these results it is probable that if the Wyoming farmers who seeded winter wheat in 1922 had used a furrow drill the seventeen per cent abandoned acreage would have been harvested. It is also probable that the yield of winter wheat in 1923 on fallow would have been increased at least 100 per cent. On the

*Wyoming Crop Report, May 1, 1923. U. S. D. A.

experiment farm it was increased 300 per cent. In other words if the furrow drill had been used in 1922 for the seeding of winter wheat in Wyoming on fallow, assuming that the fallow represents half the acreage used for this crop, then the increased yield would have been 271,000 bushels for that one year.

The average yield for the three years, 1924-1926, during which the "duckfoot" cultivator was used points a way by which the wheat grower can increase not only his yields but by which he can also reduce the cost of his operations.

The additional land required if a fallowing system is used is urged by some as an objection to producing winter wheat on fallow. However, since our non-irrigated lands are low in price and since the wheat yields on fallow, particularly in the "dry year," are so much greater than on stubble ground, it would seem that giving over part of the wheat fields every year for fallow is a necessary precaution against total failure. In terms of man an horse labor the use of the "duckfoot" cultivator as against plowing reduces the cost of fallowing more than one-half. With this decreased cost of preparing fallow and with the yields increased two fold compared with yields on duckfooted oats stubble it appears worth while to continue and extend these methods for the production of winter wheat.

SUMMARY

1. Wyoming farmers would increase the winter wheat acreage if there were less risk from winter killing.
2. "Stubbling in" and seeding between rows have not been satisfactory.
3. Wheat seeded with the common drill on fallow is usually severely injured by winter weather.
4. The furrow drill places the seed nearer moisture than the common drill, a fact which insures better germination.
5. The furrows tend to hold snow and rain which afford protection and facilitate germination and growth.

6. The ridges between the rows of wheat plants reduce the severity of the wind and prevent extreme drying of the root system and death of the plants.
7. The use of the furrow drill on early plowed fallow produced 109 per cent more wheat than was produced by the use of the common drill.
8. Plowing the fallow late in the spring when the soil is becoming dry leaves a more cloddy surface that increases the capacity for moisture conservation and reduces soil blowing.
9. Stirring the soil by use of the "duckfoot" cultivator exposes a minimum of moist earth to the drying effect of the weather and leaves the field in better condition to catch rain and snow.
10. Duckfooted fallow reduces excessive runoff from torrential showers and prevents soil shifting.
11. Late fallowing distributes farm labor better because it is done after the spring rush of work is over.
12. Late fallowing is more effective in controlling weed growth.
13. Plats fallowed by use of the "duckfoot" gave a larger wheat yield than plats fallowed by plowing.
14. The man and horse labor for "duckfoot" fallowing was less than half as much as it was for plowing the fallow.