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High Altitude Substation

Tillage Methods for High Altitude Dry Farming

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Summary

Wheat on good summer fallow yielded the heaviest.

Winter wheat matured more often than spring wheat without being injured by frost.

Harrowing pays well for the time and labor involved. Four harrowings more on good fallow increased the yield 3.3 bushels per acre.

June plowing with good fallow, yielded 4.48 bushels of wheat more per acre than with poor fallow.

The plowed plots yielded enough more wheat per acre than the disked plots to pay well for the plowing. The May-plowed plots yielded an average of 3.2 bushels more per acre than the May-disked plots, while the June-plowed plots yielded 4.3 bushels of wheat more than the June-disked plots.

Fall plowing for summer fallow resulted in an increased yield of wheat over spring plowing.

Disking previous to fall plowing did not increase the yield of wheat but disking previous to spring plowing did. The acre-yield of wheat was greater on late spring-plowed or June-plowed land than on May-plowed land.

Tillage Methods for High Altitude Dry Farming

W. A. Moss*

THE term "dry-farming" is usually understood to include all the cultural practices followed in producing crops without irrigation under conditions of limited rainfall. The purpose of this bulletin is to furnish information on cultural methods to farmers operating under such conditions. Conclusions are drawn from data and observations covering six years of experimental work at the High Altitude Substation, Felt.

The High Altitude Substation is located in a typical dry farm area in Teton county at an altitude of more than 6000 feet. The soil is a fine sandy loam of sufficient moisture holding capacity for dry farming purposes.

The frost-free period determines to a great extent the crops that can be successfully grown in any locality. The temperatures at the Felt Substation vary from a maximum of 92° in the summer to a minimum of –50° in the winter. The last killing frosts in the spring usually occur in this locality between the first and fifteenth of May. The first killing frosts in the fall usually occur between the eighteenth of August and the first of September. June frosts do considerable damage to gardens and to the more tender field crops. In some years frosts occur every month. These do not always hurt wheat unless it is in the blooming stage. Other years may have a fairly long frost-free period which will permit the maturing of a larger variety of crops. However, the average growing season is short and it is better to confine cropping to the production of the more certain crops such as the grains, sweet clover, and alfalfa.

The following table gives the precipitation as recorded at the High Altitude Substation from 1919 to 1930.

*Superintendent of the High Altitude Experimental Substation.

TABLE I

Precipitation at the High Altitude Substation 1919-1929

Month	Year											
	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	Ave. (Inches)
January	.....	.16	1.31	.88	.75	1.09	1.67	.86	.85	.92	2.26	.87
February	.....	.29	.98	.30	.38	.43	.85	.73	.87	.73	.94	.65
March	.....	.90	.52	.50	.75	.55	1.05	.09	.24	1.34	.79	.67
April	.85	.81	.73	.28	1.14	.48	1.86	.89	1.06	1.20	1.01	.74
May	.32	.79	3.62	.73	2.18	.29	1.43	1.39	1.61	1.61	1.18	1.37
June	.....	1.04	.50	1.02	2.52	.54	3.68	1.30	1.69	2.21	.69	1.38
July	.18	1.19	.45	1.40	1.48	.56	1.33	1.63	.61	1.70	.53	1.00
August	.82	1.09	1.84	1.91	.72	.01	1.59	2.06	1.48	.....	1.83	1.21
September	2.82	1.93	1.47	.....	.47	.39	2.84	1.40	2.15	.45	2.50	1.40
October	1.01	1.18	.40	.51	.75	2.78	.54	.15	1.12	.67	.94	.91
November	.39	1.16	.40	.73	.47	.08	1.50	1.19	1.67	1.31	.24	.83
December	.72	.81	1.25	1.50	.74	1.72	1.53	.83	2.38	.62	.33	1.13
Total	.....	11.3	13.5	19.8	12.3	8.9	19.8	12.6	15.7	12.1	13.2	12.16

The average annual precipitation is 12.1 inches and almost half of this, 5.7 inches, falls as rain during the growing season from April first to September first, while 4.56 inches falls in the form of snow. February and March have the lightest precipitation of any month with .65 and .67 inches respectively. The average annual rainfall, for the period that these experiments were run, (1923-29 inclusive) was 13.6 inches, or just a little above the normal. The season of 1924 had the lowest precipitation while 1925 had the highest.

Wheat is the leading grain crop for this region. It was therefore used in the experiments described in this bulletin. The data on yields for the different cultural methods will apply to oats and barley as well as to wheat.

The land on which these experiments were conducted had been in cultivation for eight years previous to starting these investigations in 1919. Grain had been grown exclusively in alternate years following summer fallow.

Outline of Tillage Experiment

In the tillage experiment duplicate plots were used for each treatment. A double set of plots were employed to permit the use of a crop each season to eliminate the effect of seasonal variations. Fourteen one-tenth-acre plots were employed. These experiments were divided into three parts. There was a slight amount of duplication within the three parts of the experiments but this was necessary in order to bring out the effects of the different treatments at different dates.

Part I. This part of the experiment was a comparison of summer fallow versus stubbling in for wheat; also of wheat following wheat on fall and spring plowing. This necessitated a three-year rotation, of which two years were devoted to crop and one year to summer fallow.

Part II. This part was conducted to determine the time of plowing and method of cultivation which would give the best results in storing moisture by means of summer fallow.

Part III. This part was conducted to determine the effect of early and late fall and spring plowing, together with the effect of disking before plowing, also to determine the effect of disking in lieu of plowing. In all these experiments the effect of the different treatments was measured by the yield of grain obtained from the plots.

The implements used in these experiments were a two-way mould-board plow, disk harrow, spike-tooth harrow, duck-foot weeder, and disk drill.

Table II shows the data obtained from Part I of this experiment.

Due to seasonal variations data were not obtained every year from all the plots. Therefore, on account of seasonal variations comparisons can be made only for the same years that both spring and winter wheat are used. In comparing the yield of winter wheat on summer fallow, with that of winter wheat following winter wheat, there was a difference of 7.9 bushels per acre in favor of the summer fallow. After a crop of wheat is taken off the subsoil moisture is exhausted and the surface is left too dry for the preparation of a good seed bed. This accounts for the reduction in yield of late seeded, winter wheat on fall plowing.

Spring wheat on fall plowing averaged 2.8 bushels more per acre than winter wheat following wheat. Therefore, it is preferable when two wheat crops are grown in succession, to plant spring wheat the second year. Winter wheat on fallow averaged 13.7 bushels per acre more than wheat on stubble, and that on stubble land was weedy and hard to handle. The seeding of either fall or spring wheat on stubble is not recommended, therefore, on account of small yields and poor weed control. Spring wheat averaged 4 bushels more per acre on summer fallow than on spring plowing, and 1.4 bushels more on summer fallow than on fall plowing. Spring wheat averaged 3.1 bushels per acre more on spring plowing than on stubble. This increase is sufficient to pay for the plowing.

Some of the farmers in the region where experiments were conducted practice summer fallowing every other year, while others raise two crops and then summer fallow their land. The crop on the fallow has more reserve moisture stored up

TABLE II

Effect of Treatment Employed in Part I of Experiment on Yields of Wheat

Year	Winter Wheat on Summer Fallow Bu. per acre	Winter Wheat on Stubble Bu. per acre	Winter Wheat Following Wheat Reseeded on Fall Plowing, Bu. per acre	Spring Wheat On Spring Plowing Bu. per acre	Spring Wheat On Fall Plowing Bu. per acre	Spring Wheat On Fallow Bu. per acre	Spring Wheat On Stubble Bu. per acre
1923	40.0	17.3	23.3	24.8	.....	.....	21.1
1924	12.7	2.1	6.4	.....	.....	.....	4.6
1925	30.6	19.3	21.1	29.8	28.8	.....	20.9
1926	11.7	.....	10.0	3.8	.....	.....	2.7
*1927	12.7	3.9	10.2	.....	8.1	9.6	2.8
1928	31.3	16.0	20.5	17.1	.....	19.9	15.6
†1929	.....	.....	.....	11.4	14.3	16.6	10.3

*Wheat damaged by hail.
†Winter wheat plots destroyed by false wire worm.

and usually makes the better yield. There is some question as to which method pays the better. There are years when the farmer is able to do considerable fall plowing for spring wheat and in that way increase his wheat acreage for the following year and cut down the amount of summer fallowing he otherwise would have to do.

In Part II there are three different dates of plowing and two dates of disking. For each date there are three methods of treating the fallow. The "no cultivation" or "poor fallow" plot was plowed and then not disturbed until mid-season when it was weeded with the duck-foot weeder. Just previous to drilling, the plots were gone over with the spike-tooth harrow.

The medium fallow plot was harrowed once immediately after plowing and once during the summer. It was weeded once then harrowed again just previous to drilling.

The "good fallow" plot was harrowed twice immediately after plowing in order to work the seed bed down and conserve the moisture. Then, usually after a rain, it was harrowed two more times during the summer to keep the crust broken. It was again weeded and harrowed just previous to seeding. All plots for each date were plowed and seeded the same time. The poor fallow received one harrowing; the medium fallow, three; and the good fallow, five harrowings.

Table III gives the six-year average of the yields of wheat per acre for the different dates of plowing and disking, with the different methods of treating the summer fallow.

TABLE III

Effect of Different Dates of Plowing and Disking with Different Methods of Summer Fallowing.

Date of Plowing	Method of Cultivating the Fallow		
	No Cultivation Bu. per acre	Medium Cultivation Bu. per acre	Good Fallow Bu. per Acre
May 15	14.8	16.3	18.3
June 15	14.6	16.6	19.1
July 15	13.6	14.7	15.4
Date of Disking			
May 15	15.8	14.4	15.1
June 15	14.0	12.9	14.8

The highest percentage of increase in yield of the good fallow plots over the poor fallow plots was in 1926 when a fairly high precipitation occurred during the growing season and a good precipitation the previous fall. The greatest increase in yield was in 1925 when 9.87 inches of moisture fell during the growing season and the subsoil had been well moistened the previous fall.

These data indicate that the wheat grower should not stop work on his summer fallow when there appears to be sufficient moisture. For example: 1925 was a wet season and land that was well prepared for the 1926 crop gave the highest yield. In 1924 the season was dry when the plots were fallowed for the 1925 crop, which gave the largest increase in bushels per acre of the good fallow over the poor fallow. There was also a slight increase in yield for the June plowing over the May plowing. However, the increase was not so great where the plots were not disked previous to plowing. The July plowing was too late for the best results, as the soil when plowed was dry and lumpy and supported a heavy growth of weeds.

The average gain for May, June, and July plowing, on the good fallow over the poor fallow, was 3.3 bushels per acre, or a gain of .82 bushels per harrowing. Considering the price of wheat at one dollar per bushel, this means that the farmer would realize eighty-two cents per acre for harrowing, which is a good price for the extra labor required to produce good fallow. The good fallow plots which were plowed in June yielded an average of 4.48 bushels more per acre than the poor fallow plots.

The plowed plots yielded enough more than the disked plots to pay for the plowing. The soil was in much better condition to work and it was much easier to keep clean of weeds. The May-plowed plots yielded 3.2 bushels per acre more than the May-disked plots, and the June-plowed plots yielded 4.3 bushels per acre more than the June-disked plots. The disk is a good tool to use but data in this experiment indicate that it should not replace the plow but should be used previous to plowing.

Table IV gives the average yield of the May-, June-, and July-plowed plots for each method of fallow for each year.

TABLE IV

Average Yield of Plots Plowed in May, June, and July Respectively for Each Method of Fallow.

	Bushels per acre						
	1924	1925	1926	1927*	1928	1929†	Ave.
No Cultivation	10.3	21.4	12.6	10.7	24.6	6.3	14.3
Medium Cultivation	9.4	24.9	15.8	10.3	27.4	7.3	15.8
Good Fallow	12.1	28.1	17.8	10.2	26.5	10.9	17.6

*Badly damaged by hail.
†Damaged by false wire worm.

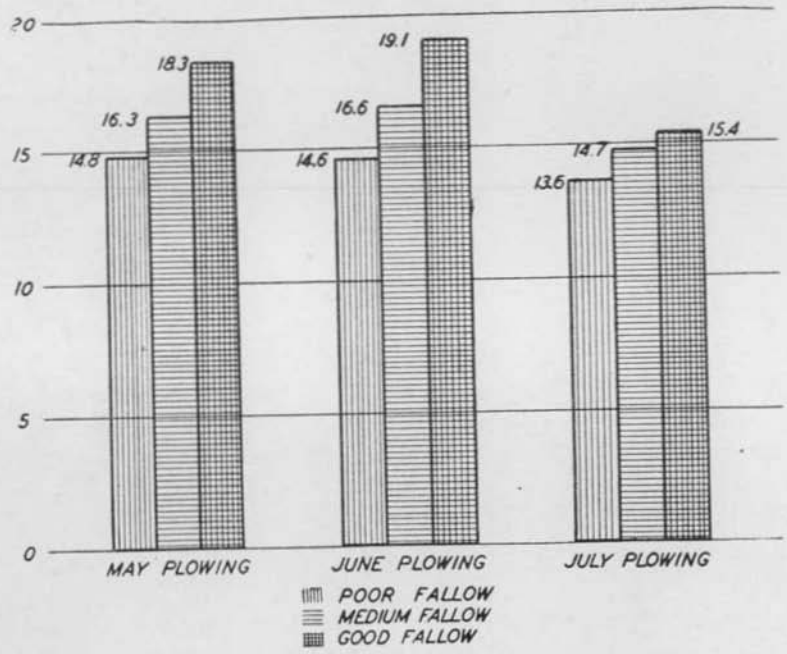

Table V gives the six-year average yield in bushels per acre for Part III of this experiment and compares the effect of early spring, late spring, and fall plowing as well as the effect of disking in lieu of plowing. Work was started on the fall-plowed plots one year previous to planting.

TABLE V

Six Year Average Yield of Plots in Part III of the Experiment.

Time of disking	Time of plowing	Average yield Bu. per acre
After harvest	Early fall	17.4
After harvest	Late fall	20.2
Not disked	Early fall	20.6
Not disked	Late fall	20.5
Early spring	Early spring	19.0
Early spring	Late spring	20.2
No disking	Early spring	17.8
No disking	Late spring	18.9
Early fall	Not plowed	17.2
Early spring	Not plowed	16.7

There was an increase in yield of 1.25 bushels per acre, due to disking the ground early in the spring previous to spring plowing for summer fallow. Disking did not increase the yield on fall-plowed land. This may be due to several of the following causes: The disked ground when plowed is left in a little finer condition. Not being cloddy, it is not as much exposed to the weather during the winter months. There is also greater packing due to the fine condition in which the soil is left. Water from melted snow runs off more from fine, packed soil than from more lumpy soil. Spring disking previous to plowing for fallow pays from the standpoint of increased yield by holding moisture in the soil, increasing availability of plant food, and killing weeds and volunteer grain. It causes the soil to work up better giving a better seed bed. The plow pulls easier on the disked land and by holding the moisture the plowing season is extended over a longer period of time.

Fall-plowed plots when seeded to winter wheat produced an increased yield over spring-plowed plots; therefore, if the weather is favorable for fall plowing and the farmer has much land to plow, it is advisable in the fall to start the summer fallow for the succeeding year.

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