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STORED MOISTURE ASSURES POTATO CROP FOR WESTERN DRY LAND

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In most years the production of a potato crop in the western dry land areas depends more upon the moisture stored in the soil before planting time than upon summer rainfall. If rains occur during the growing season "bumper" potato crops may be produced. During the drouth years of 1934 and 1936 the total amount of rainfall useful to plants, that fell between July 1 and September 30 amounted to only 1.44 and 1.22 inches respectively. Nevertheless in these two years potato plats at the Box Butte Experimental Farm yielded 81 and 63 bushels per acre. These plats had been summer fallowed the year prior to planting potatoes. During these same two years potatoes following corn yielded 22 and 30 bushels and following small grain only 5 and 4 bushels per acre respectively. These differences in yield were the result of differences in soil moisture.

Table 1. Relation of previous crop to inches of water stored in soil and yield of potatoes in two severe drouth years.
(Box Butte Experimental Farm)

Crop preceding potatoes	Inches of available moisture stored in upper 5 ft. of soil in early July		Total yield of potatoes Bushels per acre	
	1934	1936	1934	1936
Small grain	2.3	1.1	5	5
Corn	4.6	5.0	22	30
Summer fallow	6.3	6.4	81	63

Effective rainfall from Oct. 1 to June 30 was 5.84 inches prior to 1934 crop and 1.22 inches prior to 1936 crop.

When the plants came through the soil in 1934 and 1936 the available moisture in the top 5 feet was equivalent to 6.3 and 6.4 inches of rainfall respectively in the two plats that had been fallowed the previous year, 4.6 and 5.0 inches following corn and only 2.3 and 1.1 inches following small grain. (Table 1) Following small grain there was practically no available moisture below the second foot of soil. In these rainless summers the potato plants removed practically all available moisture from the top 2 feet by August 1, and by September 2 all moisture was gone from the top 3 feet and half out of the 4th and 5th feet. This explains why the potato plants following small grain died during August without producing tubers whereas after summer fallow the plants were still green in September and were able to produce a good crop of tubers during the cool short September days (which are the most suitable of the season for tuber development).

If the upper few feet of soil are kept supplied with available moisture during late July and August either by rainfall or irrigation, yields will be increased greatly. A certain amount of water is required by the plants before they produce any tubers but with more moisture available in western Nebraska soils the potato plants seem to produce potatoes in proportion to the amount of water. If this additional moisture is not received the plants will draw upon the deeper subsoil moisture and while they will survive and produce a crop it will necessarily be of limited size because of the difficulties which the plant incurs in getting the moisture.
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A total of about 8 inches of rainfall must be stored in the top 5 feet of soil to replace the moisture removed by a small grain crop. Because of losses due to runoff, snow blowing and evaporation, about 50% more rainfall or a total of 12 inches must occur in order to permit these 8 inches to be stored before potato planting time.

According to the official rainfall records for 48 years at Hay Springs 12 inches of precipitation occurred between October 1 and May 31 in less than one-third of the years and 10 inches in only a little over half of them (Table 2). Although the situation was better by June 30 more than 12½ inches precipitation had occurred in only about 6 out of 10 years (57%) and 10 inches in only 8 out of 10 years (77%). The storage moisture at plant emergence time was inadequate to insure a satisfactory crop in about one-fourth of the years.

Table 2. Percentage of years with sufficient rainfall during the winter and spring to supply the soil with moisture to a depth of 4 or 5 inches.

Period Covered	Years with given amount of rainfall before dates specified	
	10 inches or more	12½ inches or more
Rainfall at Hay Springs (48 years)		
Oct. 1 to May 31	54%	31%
Oct. 1 to June 30	77	57
Rainfall at Kimball (44 years)		
Oct. 1 to May 31	32%	7%
Oct. 1 to June 30	57	34

At Kimball--with a lower annual rainfall the situation has been even less favorable. There in 44 years the precipitation has been 12½ inches or greater from October 1 to May 31 in only one out of about 14 years (7%) and above 10 inches in only one out of 3 years (32%). By June 30 the situation was only a little better, 12½ inches having occurred in 1 out of 3 years (34%) and 10 inches in 6 out of 10 years (57%). In the Kimball district the rainfall situation by June 30 has been about like that existing at Hay Springs a month earlier. These records indicate that while summer fallowing is desirable in all western Nebraska districts it is of greatest value in the southwestern panhandle counties where the rainfall is the lowest in the state.

Yield records from potato crops grown in the vicinity of Alliance are available for the last 20 crops. These show that a very close relationship existed between the rainfall from October 1 and June 1 and the total yield of potatoes. In only two seasons was a satisfactory or large crop produced when this pre-planting time rainfall was deficient. In those seasons the June or July rainfall was unusually high.

Soil samples secured in farmers' fields in late June of 1936 yielded additional useful evidence. These samples, secured to a depth of 3 feet in the fields of 18 farmers in 4 counties contained very little moisture. In twelve fields that had been in small grain the average available moisture stored in the top 3 feet was equal to only 1.6 inches of rain, while in three fields after corn the average was 2.6 inches

and in two after fallow it amounted to 4.2 inches. The total yields from these groups of fields averaged 10.7, 20.6 and 71.6 bushels per acre respectively. (Detail data for each field are given in table 3.)

Table 3. Soil moisture in northwestern Nebraska potato fields in late June 1936 and total bushels per acre produced. (Rainfall after planting, that crops could use, varied from 0 to 1.0 inch for various fields.)

Field No.	County	Acres in field	Crop in 1935	Inches rainfall in top 3 feet	Total yield per acre
1	Box Butte	25	Wheat	2.1	20 bu.
2	" "	45	"	1.6	11.7
3	" "	90	"	2.0	10.0
4	" "	85	"	2.0	12.0
5	" "	25	Oats	1.6	14.0
6	" "	10	Wheat	2.1	4.6
7	Sioux	5	"	1.1	5.0
8	"	37	"	1.6	7.0
9	Sheridan	25	Barley	1.3	8.0
10	"	80	Wheat	3.3	12.0
11	"	25	Rye	3.9	20.0
12	Dawes	45	Wheat	0.3	5.5
13	Sheridan	90	Sweet Clover	1.6	5.0
14	"	25	Corn	3.2	17.0
15	Box Butte	10	"	3.2	30.0
16	" "	10	"	2.9	15.0
17	" "	55	Fallow	4.7	80.0
18	" "	10	"	3.4	63.1
Average of fields		1 field	Sweet clover	1.3	5.0
		12 fields	Small grain	1.6	10.7
		3 fields	Corn	2.6	20.6
		2 fields	Summer fallow	4.2	71.6

Conclusions

There seems to be sufficient evidence to warrant the conclusion that the production of most dry land potato crops depends upon the precipitation occurring before potato planting time rather than upon the summer rainfall. Since this winter-spring rainfall is very frequently insufficient to replace the moisture removed by small grain, the most desirable plan is to plant potatoes after summer fallow, with second choice being after corn or beans. The last choice is to plant potatoes after small grain or sweet clover and should be resorted to only if the soil is filled with moisture to a depth of 4 or 5 feet as after a very wet winter or spring and after the soil moisture condition has been determined by sampling to a depth of at least 3 feet and preferably to 4 or 5 feet. If the soil looks dry it is practically exhausted of water that plants can use and weighing and drying the soil is unnecessary. Planting after summer fallow or some clean cultivated row crop is the most effective means of insuring a dry land potato crop and of keeping down the per bushel production cost. As the potato crop is the most expensive dry land crop to grow and brings in the greatest cash income per acre, efficient production methods are very much to be desired.

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