

# WHEN CAN YOU SEED FALLOW GROUND IN THE FALL? AN HISTORICAL PERSPECTIVE ON FALL RAIN

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## Abstract

Seeding at the optimum time is one key to producing the greatest yield of any crop. Successful seeding of winter wheat and other crops is predicated on having sufficient moisture in the seed zone to foster rapid germination and emergence. The objective of this work was to estimate the likelihood of receiving sufficient rainfall to bring about consistent germination. We searched the weather records at the Columbia Basin Agricultural Research Center (CBARC) to determine the likelihood of receiving 0.4-0.6, 0.6-0.8, and more than 0.8 inches of rainfall within any 3-, 5-, or 7-day period in September and October at the Pendleton Station. Conditions in September were infrequently optimum for seeding; 0.8 inch of rain or more was received within 3 days in only 9 of 77 years and within 7 days in only 17 of 77 years. We found only 47 years of 77 in which 0.4-0.6 inch of rainfall occurred within 7 days, the minimum we determined to be adequate to promote germination. We also used the information to develop graphs that show the cumulative probability of receiving 0.4-0.6, 0.6-0.8, or more than 0.8 inch of rain in 3, 5, or 7 days for any date in September and October. For example, by September 30, there is about a 15 percent chance of having received more than 0.8 inch of rain within 3 days and about a 28 percent chance of having received 0.6-0.8 inch of rain within 3 days.

**Keywords:** alternate crops, fallow, precipitation, seeding date, soil moisture, winter wheat

## Introduction

Seeding at the optimum time is one key to producing the greatest yield of any crop. Seeding winter wheat or other fall-seeded crops at the optimum time permits the crop to become established in the fall, reducing the chance of winter injury and increasing the yield potential. The optimum seeding date varies for different crops; optimum seeding date for winter wheat is a balance between having adequate seed-zone moisture following summer fallow and the increased incidence of diseases such as *Cephalosporium* stripe and *Fusarium* crown rot that can occur with early seeding of winter wheat. In the higher rainfall areas around Pendleton, the optimum seeding date for winter wheat is generally considered to be late September to early October, depending on the specific location. Seeding earlier can markedly increase disease incidence in the intermediate and high rainfall regions. In contrast, early seeding in lower rainfall regions is often necessary to place the seed in moist soil. Later seeding can reduce the yield potential because the plants accumulate fewer growing degree days before they mature, and they mature later in the summer when they are more likely to experience water stress.

Some crops, such as canola, have been found to require earlier seeding than winter wheat. Research in the Pendleton area has shown that canola produced the highest yield when seeded by September 20 (Wysocki et al. 1991, Wysocki et al. 1992) because seedlings have time to grow to sufficient size to avoid winter injury. J. Brown (personal communication) indicated that canola should have four true leaves in

the fall to avoid winter injury. The optimum seeding date for other potential alternative crops is unknown but will be an important factor in their ultimate success or failure in dryland cropping systems.

The success of fall seeding in dryland agriculture depends on the availability of adequate moisture in the seed zone. Seed placed in dry soil will not germinate; soil moisture must be at least 11 percent on a weight basis for the seed to imbibe (take up) water and to begin the germination process. Water imbibition is more consistent and germination is more uniform and rapid if the soil has at least 13 percent moisture.

The timing and amount of fall rain affects other crop production practices in addition to crop seeding date. Early fall rain leads to the germination of downy brome, goat grass, volunteer cereals, and other winter annual plants that can then be controlled by herbicides or tillage. This in turn reduces the “green bridge” effect and reduces the severity of *Rhizoctonia* root rot (Veseth 1992).

Daily weather data have been recorded at the Pendleton Station since the fall of 1929 and we recently completed entering these data into an electronic database that permits easy access to daily, monthly, and seasonal weather data. Information currently collected includes daily precipitation, maximum and minimum air temperature, wind run and direction, pan evaporation, maximum and minimum water temperature, and soil temperature at 1-, 4-, and 8-inch depth. Not all data have been collected since 1929 but we have a complete database for daily precipitation and air temperature.

Questions about the likelihood and timing of rain have arisen from many quarters including farmers, researchers, and bankers.

The objective of our research was to determine the likelihood of various amounts of rainfall in September and early October that would permit successful fall seeding and crop establishment. Such information can be used in the decision-making process when evaluating potential alternative crops or for other uses.

### **Materials and Methods**

Climate data, including daily precipitation, have been collected at CBARC-Pendleton Station since the fall of 1929. Instrumentation consists of standard National Weather Service Cooperative Program instruments that are calibrated and serviced twice yearly by the local National Weather Service Office at Pendleton. During the winter of 2004-05 we converted paper-based weather records into a comprehensive electronic database that permits us to readily search for the frequency of specific weather conditions. We searched the database for occasions in September and October when the rainfall total was 0.4-0.6, 0.6-0.8, and more than 0.8 inch within in 3, 5, or 7 days. We used an “expansive” search query in order to find periods that ended on the first day or started on the last day of the search period.

### **Results and Discussion**

The soil surface following fallow is air dry and there is insufficient moisture for seed germination. The depth of the “dust-mulch” layer on the soil surface will vary depending on the depth of rodweeding in a tillage-based fallow system, but it is usually about 4-6 inches deep. The depth to the moist soil in a chemical fallow system is more variable both from field to field and within a given field but typically ranges from 6 to 9 inches. The amount of moisture needed to wet the dry soil to the minimum moisture content necessary to bring about germination is determined by the moisture content of air

dry soil, the minimum moisture content necessary for seed germination, the depth to which the soil must be moistened, and the weather conditions prior to and immediately following the rainfall.

The soil in the dust mulch layer has about 4 percent moisture by weight (Schillinger and Young 2004) and the minimum soil moisture for germination is 11 percent (Schillinger and Young 2004), although germination is more uniform and rapid at 13 percent moisture. For the purposes of this paper, we made the following assumptions: (1) the soil will be wetted from 4 to 13 percent so that germination is more regular and the stand is uniform; (2) the dust mulch layer is 5 inches thick; and (3) the dust mulch layer is “fluffed up” by tillage and thus the bulk density is less than normal. The normal bulk density of the surface of a Walla Walla silt loam soil ranges from 1.1 to 1.3 (Umatilla County Soil Survey) so we will use a value of 1.2 in our calculations. Based on these assumptions, a minimum of 0.45 inches of moisture is required to completely wet the dust mulch layer and increase the water content from 4 to 13 percent. If the dust mulch layer is thicker than 5 inches, then more moisture is required, and less moisture is needed if the dust mulch layer is less than 5 inches thick.

The moisture line in a chemical fallow field is more variable than in a tillage fallow field and is generally deeper. However, it has been observed that the same amount of moisture will wet the soil deeper in a chemical fallow situation where the soil has not been “fluffed up” by tillage.

The amount of rainfall needed for the surface soil to become moist to the moisture line is greater than the minimum of 0.45 inches rainfall because of evaporative losses. Evaporative losses are minimized when

conditions are cool, overcast, and the wind is calm. Conversely, evaporative losses can be substantial if the conditions following the rain are hot, sunny, and windy. Inspection of the weather records shows many cases where the potential evaporative loss the day after a rain exceeded the amount of the rainfall. Thus, the actual amount of rainfall needed to wet the soil to the moisture line is greater than the minimum.

Eastern Oregon is characterized by low intensity rainfall events with daily rainfall amounts rarely exceeding 0.5 inch in September and October. Of the 4,697 days in September and October between 1930 and 2005, 958 days or 20.4 percent had precipitation of 0.01 inch or greater. Only 1.3 percent of the days had rain that exceeded 0.50 inch; only 6.6 percent of the rainy days exceeded 0.50 inch of rain. Thus, it is usually necessary for two or more rainfall events to occur close together for the total rainfall to exceed the minimum amount needed to wet the surface soil.

We assumed that 0.4-0.6 inch of rainfall was barely adequate to wet the surface soil unless the dust mulch layer was unusually thin. Germination from this amount of rainfall is likely to be uneven and slow, especially if the soil is disturbed by tillage or seeding that results in evaporation losses. Rainfall of 0.6-0.8 inch is probably adequate to wet the surface soil and bring about good conditions for germination and more than 0.8 inch of rainfall is almost always adequate to wet the surface soil and result in good germination. We considered how often the various amounts of rainfall fell within 3, 5, or 7 days. This represents a range of conditions from unlikely to be sufficient (0.4-0.6 inch in 7 days) to almost certainly adequate to moisten the surface soil (more than 0.8 inch in 3 days). We examined the month of September to

determine the likelihood of being able to successfully seed in September and we also examined the period from September 1 to October 15.

Conditions in September were infrequently optimum for seeding. We found that there was 0.8 inch of rain or more in 3 days in only 9 of 77 years (Table 1). There were only 17 of 77 years when we received more than 0.8 inch of rainfall in 7 days. Even when we examined the frequency of 0.4-0.6 inch of rainfall in 7 days, a condition not likely to lead to adequate soil moisture for germination, we found only 47 years of 77 in which this minimal amount of rainfall occurred. Using 0.6-0.8 inch of rain in 5 days as a realistic minimum to moisten the surface soil sufficiently, we found only 27 of 77 years in which this occurred. The likelihood of being able to seed successfully by September 30 depends on more factors than simply rainfall; wind, temperature, and

cloud cover all markedly affect evaporation and hence, the effectiveness of the rainfall. Nonetheless, these data show that there is at best a 61 percent chance of being able to successfully seed a crop by September 31 (0.4-0.6 inches of rain in 7 days). Using more realistic assumptions, these data show only a 35 percent chance of being able to successfully seed in September.

We also examined the period from September 1 to October 15 to cover the period of optimum seeding for winter wheat at Pendleton. The likelihood of sufficient rainfall for germination increased for all categories (Table 2). The number of years in which the rainfall exceeded 0.8 inch in any 3-day period increased from 9 to 16 and there were 27 years in which rainfall exceeded 0.8 inch in 7 consecutive days. There were 37 years (48 percent) in which 0.6-0.8 inch of rain fell in 5 days, a realistic minimum to permit seeding.

Table 1. Occurrence and probability of various amounts of rainfall in September at Pendleton, Oregon.

Amount of rainfall	In 7 days		In 5 days		In 3 days	
	# in 77 yr	-- % --	# in 77 yr	-- % --	# in 77 yr	-- % --
0.4-0.6	47	61	43	56	39	51
0.6-0.8	30	39	27	35	19	25
>0.8	17	22	13	17	9	12

Table 2. Occurrence and probability of various amounts of rainfall from September 1 to October 15 at Pendleton, Oregon.

Amount of rainfall inches	In 7 days		In 5 days		In 3 days	
	# in 77 yr	-- % --	# in 77 yr	-- % --	# in 77 yr	-- % --
0.4-0.6	61	79	59	77	55	71
0.6-0.8	43	56	41	53	33	43
>0.8	31	40	24	31	18	23

We also used the information to develop graphs that show the cumulative probability of receiving 0.4-0.6, 0.6-0.8, or more than 0.8 inch of rain within 3, 5, or 7 days (Figs. 1-3). The vertical lines on the graphs are placed at September 30 and October 15. By examining the appropriate figure, the cumulative likelihood of receiving various amounts of rainfall can be estimated for any

date. This information is useful to determine the likelihood of being able to successfully seed a crop into moist soil and have it sufficiently developed to withstand winter injury. For example, by September 20 there is about 9 percent chance of having received more than 0.8 inch of rain within 3 days and about 18 percent chance of having received 0.6-0.8 inch of rain within 3 days.

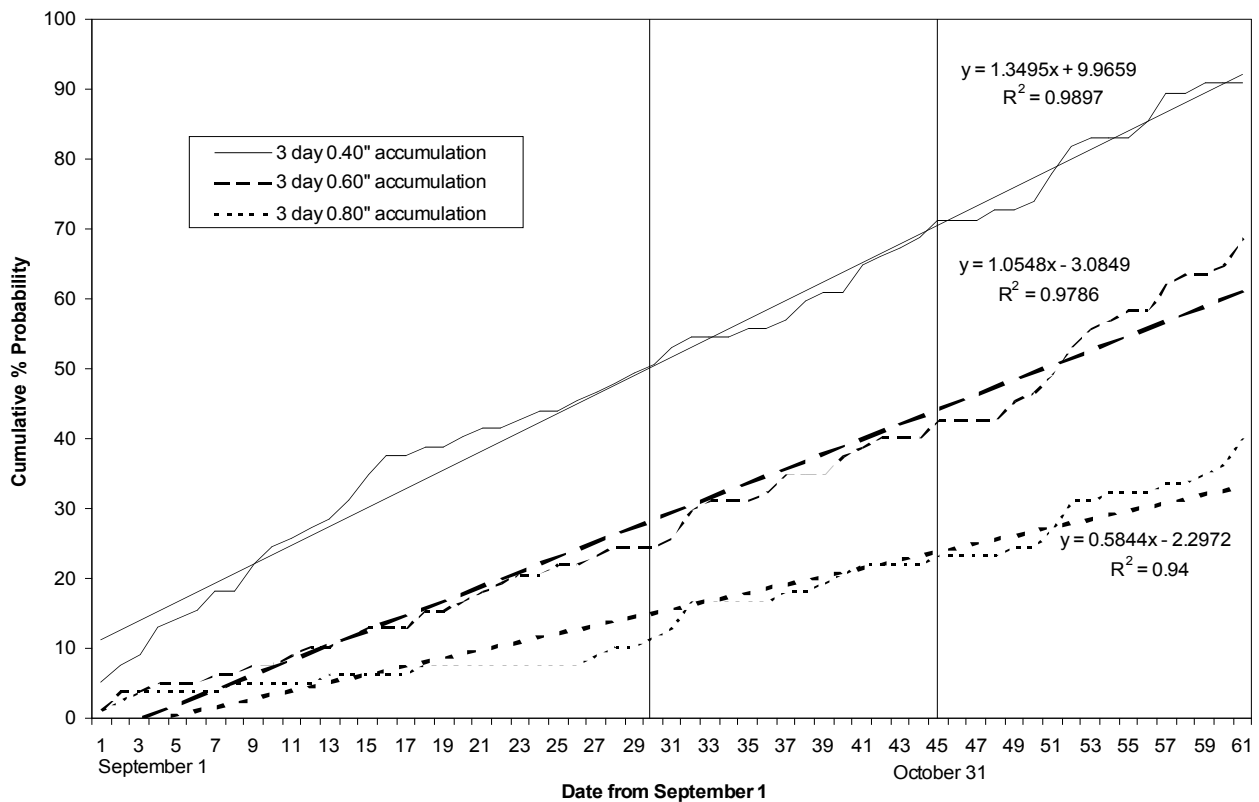


Figure 1. Cumulative probability of receiving specific amounts of rainfall in 3 days at Pendleton, Oregon.

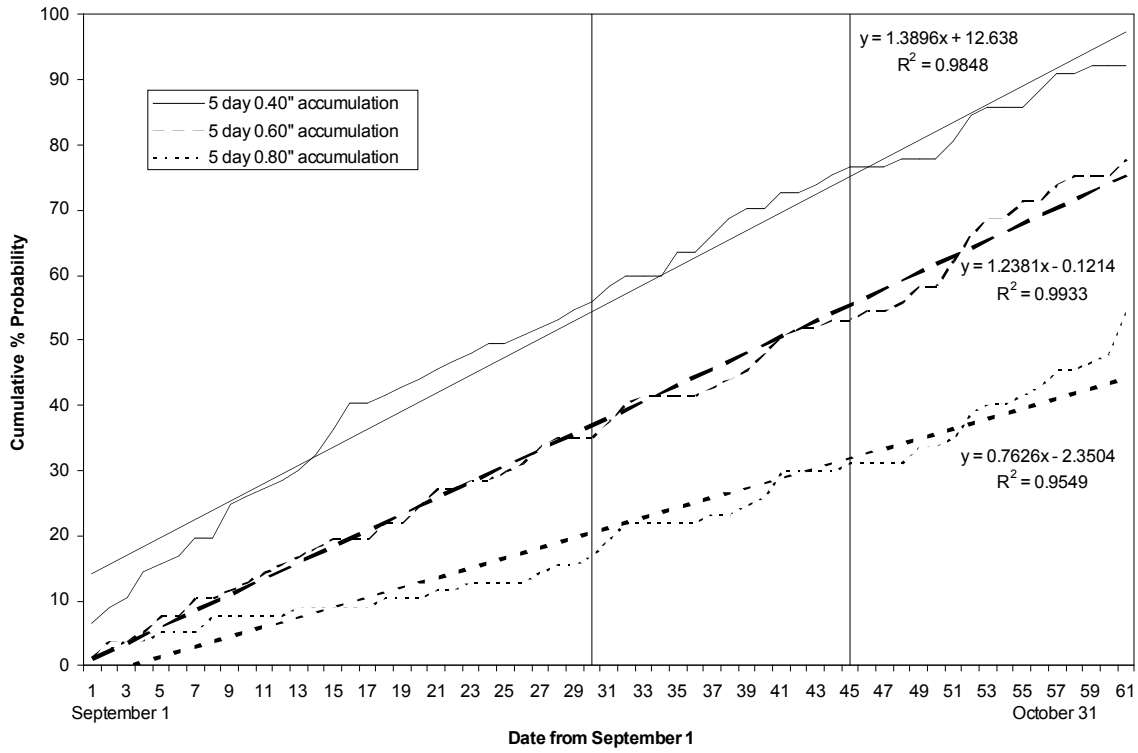


Figure 2. Cumulative probability of receiving specific amounts of rainfall in 5 days at Pendleton, Oregon.

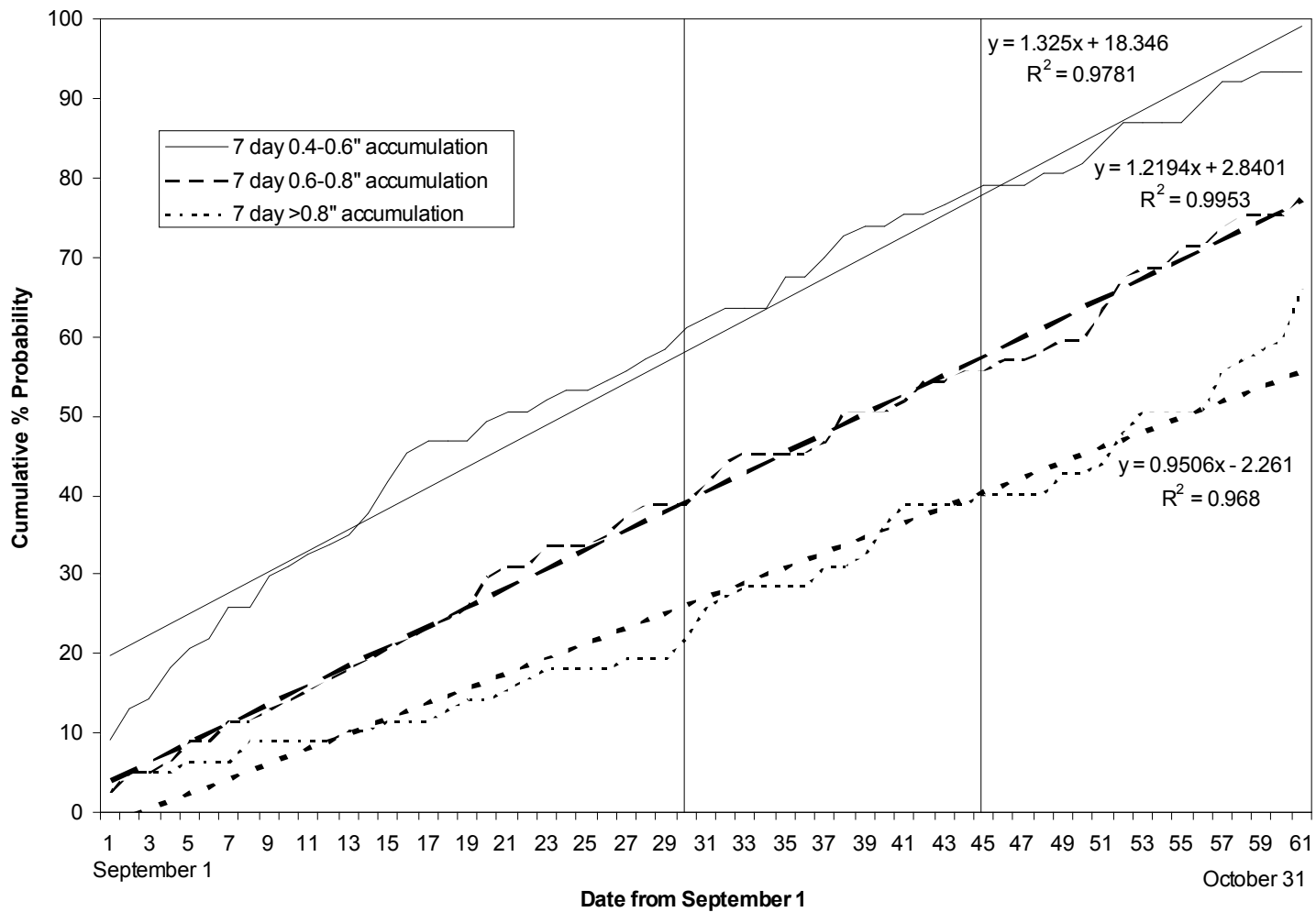


Figure 3. Cumulative probability of receiving specific amounts of rainfall in 7 days at Pendleton, Oregon.

### **Conclusion**

This information can be used to help decision makers be better informed about potential seeding dates near Pendleton. This information is helpful to determine the likelihood of successful seeding after chemical fallow where the moisture line is usually too deep to successfully seed winter wheat using a deep furrow drill. Seeding must be delayed until there has been sufficient rain to wet the surface soil to the moisture line. Another situation involves crops that must be seeded early so that they achieve a specific growth stage to minimize winter injury. In both cases, the information in the figures can be used to calculate the likelihood of combinations of rainfall amount and time during which the rainfall occurs.

### **References**

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