Planting Date Effect on Corn Yield and Water Productivity in the Bighorn Basin

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Introduction

Wyoming’s short growing season (on average 125 freeze-free days in the Bighorn Basin) poses a challenge to agriculture. To avoid crop exposure to harsh weather (conditions that can result in yield loss), farmers need to plant in a timely manner. Corn planting in Wyoming typically occurs between April 25 and June 6 and hits its peak between May 3–21 (NASS, 2010). Interestingly, little research is found backing the current planting practice. Field studies typically only last a few years so may be limited in determining the long-term effects of management practices. Crop models, on the other hand, enable researchers to evaluate changes over several seasons. Determining optimal planting dates for corn can increase the efficacy of the production system and profitability, as weather conditions have significant impact on yield and water productivity.

Objectives

This study evaluates the impact of planting dates on corn yield and water productivity. (Water productivity is the ratio of marketable yield—in this case, corn—to water use [evapotranspiration]).

Materials and Methods

Corn was planted May 16, 2011, on a subsurface drip irrigated field at the Powell Research and Extension Center (PREC), and it was maintained at optimal conditions of growth. Weather conditions were monitored using an automated weather station deployed at the experimental field, and plant samples were collected for growth analysis. The experimental data were used to calibrate the cropping system model (Decision Support System for Agrotechnology Transfer; Hoogenboom, 2010). DSSAT’s seasonal analysis tool was used to simulate corn growth across a 30-year period (1980–2009) and 10 different planting dates, ranging from March 30 to June 30. The simulation triggered irrigation at 50% soil-available water, with an application efficiency of 100%, and was set to unlimited nutrient uptake. This isolated the effects of the planting dates on corn growth.

Results and Discussion

The results from simulations showed that average corn grain yield across a 30-year period was higher when planting around April 20, steadily decreasing for later planting dates (Figure 2). Water
productivity decreases for the two earliest planting dates, March 30 and April 10, as well as for the latest planting date on June 30, but it plateaus close to 900 pounds of corn per acre-inch of water for the remaining planting dates (Figure 1). Decreased water productivities were driven by higher probability of crop failure and lower productivity during the earlier and later planting dates. Despite the high average yields for corn planted on March 30 and April 10, the risk of crop failure for corn planted at those dates is high (Figure 2). Planting later than June 10 also increased the probability of crop failure and decreased the likelihood of obtaining high yields (Figure 2).

The simulations indicate that farmers may benefit from earlier planting dates through increases in yield. Crop exposure to early frost and irrigation water availability, however, are important limitations to early planting. According to our results, the period between April 30 and May 20 appears to be the most appropriate for corn planting in the Bighorn Basin, as yield and water productivity are at the higher end of our simulation. These results are in agreement with the overall current practice of planting between May 3 and May 21 in the state (NASS, 2010), highlighting the effects of early planting for maximum yield if the aversion to weather-related risks is low.

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