Final Report – 2021 (for Wyoming Bean Commission)

Planting Date Effects on Performance of Early and Late Maturing Cultivars – Year Two

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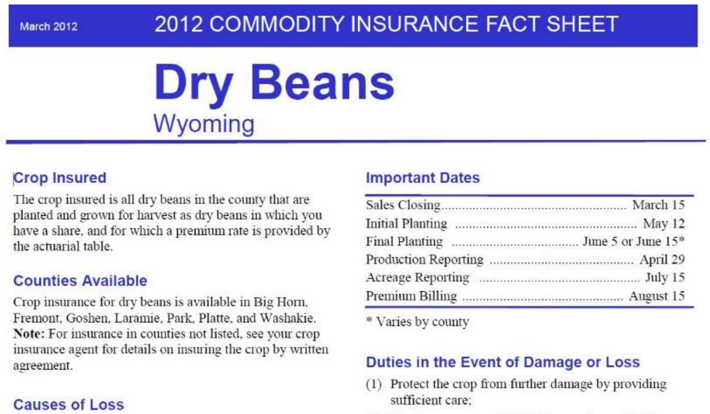
Document was prepared in February 2022; Funding Awarded, $4,500

Introduction

For nearly all crops, producers and insurance adjusters benefit from having yield and quality data as affected by planting date. Due to unpredictable and varying severity of September frosts in Wyoming, dry bean performance can be negatively affected if the crop has not yet matured. Obviously, timely planting in the spring mitigates this risk to frost but delayed planting increases this risk. For this reason, Risk Management Agency (RMA) and producers can benefit from having research data on dry bean planting dates.

In 2020, we were able to obtain yield data from six varieties subjected to three planting dates (late May, early June, and late June). An 8 Sept 2020 freeze compromised that study. Yields were similar for the first two planting dates suggesting that a three-week delay in planting (after 25 May) might not be fatal. But the early-maturing lines definitely performed better than the late-maturing lines for the 10 June planting due to that early fall frost. The late-June planting was much lower yield but that 8 Sept killing frost made it difficult to make sweeping conclusions about that very late planting date.

In addition to comparison of yield across planting dates, seed quality needs to be assessed. Oftentimes, a dry bean crop is hit with a frost prior to the completion of normal pod/seed maturation. Seed from that crop might be harvested and collected but to the extent it is marketable remains a question. Additionally, our 2020 observations clearly indicate that early-maturing cultivars assume less late-season-frost risk than later-maturing cultivars. Going forward, it is unclear how the insurance industry intends to deal with differences in cultivar maturity when deciding upon Final Planting Date rules. The complexity of dealing with cultivar maturity in association with an insurance planting date cutoff may create more confusion than it solves. Although planting date trials (such as the one described above and the one summarized in this report) cannot answer all of the questions, these studies are slowly building a body of evidence that can prove very useful to the Wyoming bean industry.



March 2012 2012 COMMODITY INSURANCE FACT SHEET

Dry Beans
Wyoming

Crop Insured
The crop insured is all dry beans in the county that are planted and grown for harvest as dry beans in which you have a share, and for which a premium rate is provided by the actuarial table.

Counties Available
Crop insurance for dry beans is available in Big Horn, Fremont, Goshen, Laramie, Park, Platte, and Washakie. **Note:** For insurance in counties not listed, see your crop insurance agent for details on insuring the crop by written agreement.

Causes of Loss

Important Dates

Sales Closing	March 15
Initial Planting	May 12
Final Planting	June 5 or June 15*
Production Reporting	April 29
Acreage Reporting	July 15
Premium Billing	August 15

* Varies by county

Duties in the Event of Damage or Loss
(1) Protect the crop from further damage by providing sufficient care;

Figure 1. Example of insurance fact sheet provided by RMA. The link below grants access to the most recent information for all crops and locations. As of Jan 2022, the final planting date for Big Horn, Fremont, Park, and Washakie was 5 June. For Goshen, Laramie, and Platte, the final planting date was 15 June.
https://webapp.rma.usda.gov/apps/ActuarialInformationBrowser2022/CropCriteria.aspx

Objectives

The primary objective of this project is provide data on the yield of dry bean as affected by delayed planting dates and to see if early- or late-maturing varieties are affected differentially by delayed planting. A secondary objective is to document the effects of planting date on other dry bean traits such as seed per pound, maturity, and upright stature.

Methods

Field area was prepared by applying 80 units of N, 130 units of P_2O_5, 80 units of K_2O, and 8 units of Zn. Sonalan and Outlook were preplant incorporated. Beds were established in early May. Plots were sown on 27 May, 11 June, 17 June, and 23 June 2021. Plots were six-rows wide with a 22-inch row spacing, and 15-foot length. Each planting date was allocated four randomized 11-foot-wide strips (Fig. 1). Seeding rate was approximately 90K per acre. Ten cultivars were tested within each of the 16 strips (please see Figure 1 and/or the results in Table 1 for the cultivar entries). The study consisted of 180 plots.

As we strategized planting strips next to each other on different dates, strips were furrow-irrigated individually (or avoided if necessary) in order ensure that we could conduct planting on the scheduled dates and not drought-stress or over-water strips growing in the already emerged plants. Once all canopies were established, we were able to synchronize the irrigation across the four different planting dates. Likewise, as the growing season reached a conclusion, water was withheld from the strips with ripening plots so as to not compromise the research. No water stress was ever observed during the study.

Normalized difference vegetation index (NDVI) was collected on 8 July in order to document differences in canopy cover that were conspicuous early in the season. Throughout the season, flowering dates and maturity dates were recorded. A photo of several strips is provided in Figure 2.

Harvest began on 27 August for the early-maturing cultivars within the first planting date and was ultimately completed by 20 October for the late-maturing cultivars associated with the last planting date. A Zurn research plot combine was used to collect grain from the two-center rows of each plot. Plants from 10-feet of the two center rows were hand-tossed into the combine. We harvested on approximately eight different harvest dates in an effort to capture the optimal time for each cultivar-planting date combination. The collected seed was cleaned free of trash and dirt with a Clipper® unit prior to recording yield weights. Ultimately, yield and seed size (a.k.a., number of seed per pound) were recorded (100-seed count). For parts of this report, the results are separated into two groups with the five popular pinto cultivars in one group and the five experimental lines in the second group.

12	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	Buffer	12
11	Buffer	Nez Perce	Monterrey	Othello	Poncho	Croissant	PT 9-5-6	Yellow Stone	Nez Perce	Croissant	Yellow Stone	Wind breaker	Southwest Red	Monterrey	Othello	Nez Perce	Southwest Red	Buffer	11
10	Buffer	Poncho	Yellow Stone	Croissant	Southwest Red	Wind breaker	Max	Othello	Wind breaker	Southwest Red	Othello	Monterrey	PT 9-5-6	Yellow Stone	PT 9-5-6	Poncho	Othello	Buffer	10
9	Buffer	Max	Othello	Nez Perce	PT 9-5-6	Nez Perce	Monterrey	Southwest Red	Max	Poncho	Max	Max	Nez Perce	Poncho	Wind breaker	Yellow Stone	PT 9-5-6	Buffer	9
8	Buffer	PT 9-5-6	Poncho	Max	Monterrey	Othello	Southwest Red	Nez Perce	Poncho	PT 9-5-6	Nez Perce	Poncho	Croissant	Max	Max	Monterrey	Poncho	Buffer	8
7	Buffer	Croissant	Wind breaker	PT 9-5-6	Yellow Stone	Max	Poncho	Monterrey	Croissant	Monterrey	PT 9-5-6	Southwest Red	Wind breaker	Nez Perce	Poncho	Croissant	Yellow Stone	Buffer	7
6	Buffer	Southwest Red	Max	Poncho	Nez Perce	PT 9-5-6	Croissant	Max	Othello	Yellow Stone	Wind breaker	Croissant	Othello	PT 9-5-6	Southwest Red	Othello	Monterrey	Buffer	6
5	Buffer	Othello	Croissant	Southwest Red	Wind breaker	Poncho	Yellow Stone	Wind breaker	Yellow Stone	Othello	Croissant	Othello	Yellow Stone	Wind breaker	Nez Perce	PT 9-5-6	Croissant	Buffer	5
4	Buffer	Monterrey	PT 9-5-6	Wind breaker	Croissant	Yellow Stone	Othello	Croissant	PT 9-5-6	Nez Perce	Monterrey	Yellow Stone	Poncho	Croissant	Monterrey	Wind breaker	Nez Perce	Buffer	4
3	Buffer	Wind breaker	Nez Perce	Monterrey	Max	Monterrey	Nez Perc e	Poncho	Monterrey	Max	Poncho	PT 9-5-6	Max	Southwest Red	Yellow Stone	Southwest Red	Max	Buffer	3
2	Buffer	Yellow Stone	Southwest Red	Yellow Stone	Othello	Southwest Red	Wind breaker	PT 9-5-6	Southwest Red	Wind breaker	Southwest Red	Nez Perce	Monterrey	Othello	Croissant	Max	Wind breaker	Buffer	2
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Figure 1. Schematic of planting date field trial.

Figure 2. Example of the field during late-season with two early-maturing plots (part of an early-planted) senescing in the back next to a later-planted strip (left photo) and a close-up a fully mature plot adjacent to later-maturing and later-planted plots later that same season.

Results

Values of NDVI recorded in early July indicated that canopy establishment was proportional to earliness of planting (Table 1). Yields from 2020 are provided in Figure 2. Yields for the cultivars across the four 2021 planting dates are provide in Figures 3 and 4. The cultivar Max outyielded the other pinto cultivars for the first two planting dates. However, for the final two planting dates, Poncho ranked highest. Yield of Max and Monterrey declined steadily as planting date was delayed. For the experimental lines, PT9-5-6 outyielded the other four lines across planting dates.

Table 1. NDVI as affected by planting date and varied on 8 July 2021. Planting date, cultivar, and the planting date-by-cultivar interaction were all statistically significant (P=0.001). Each values is the average of four plots.

Cultivar	------------------------------------- **Planting Date** ---			
	27 May	**11 June**	**17 June**	**23 June**
Croissant	0.41	0.29	0.21	0.18
Max	0.47	0.35	0.28	0.23
Monterrey	0.37	0.30	0.25	0.21
Nez Perce	0.35	0.29	0.23	0.19
Othello	0.42	0.30	0.25	0.19
PT9-5-6	0.54	0.34	0.29	0.22
Poncho	0.44	0.34	0.28	0.20
Southwest Red	0.42	0.30	0.24	0.20
Windbreaker	0.38	0.32	0.24	0.21
Yellowstone	0.34	0.31	0.23	0.19
Average	0.41	0.31	0.25	0.20
LSD (0.05)	-- 0.04 --			

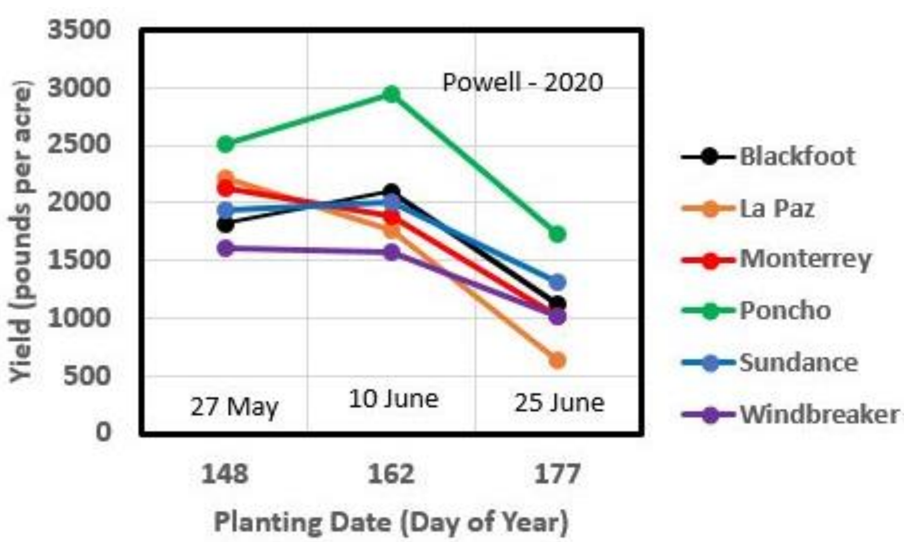

Figure 2. Yields from the 2020 trial as affect by three planting dates.

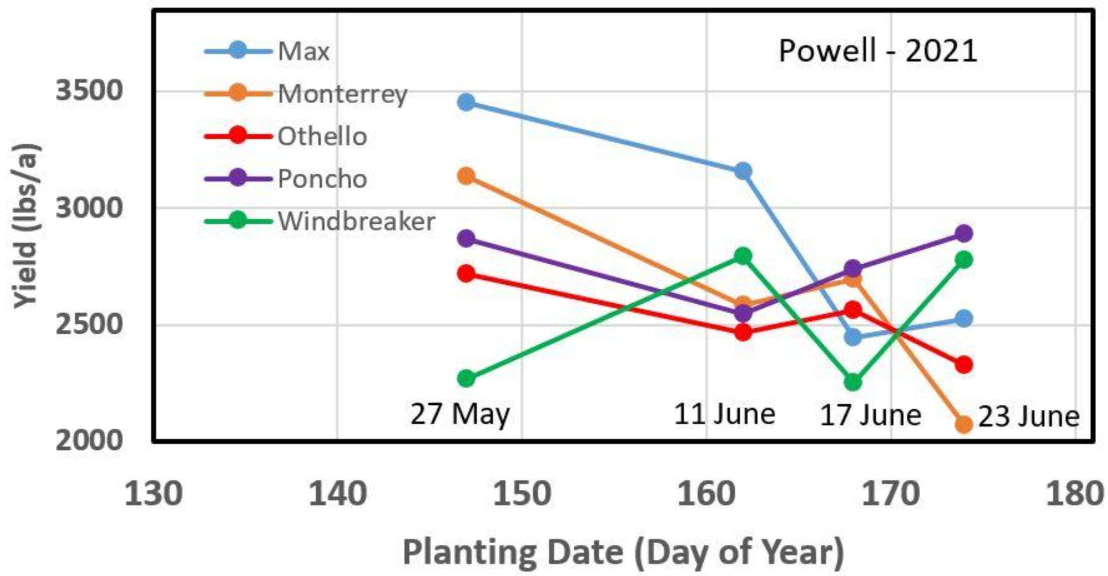

Figure 3. Yield of five pinto bean cultivars sown at different dates across May and June at Powell. Each data point represents four plots.

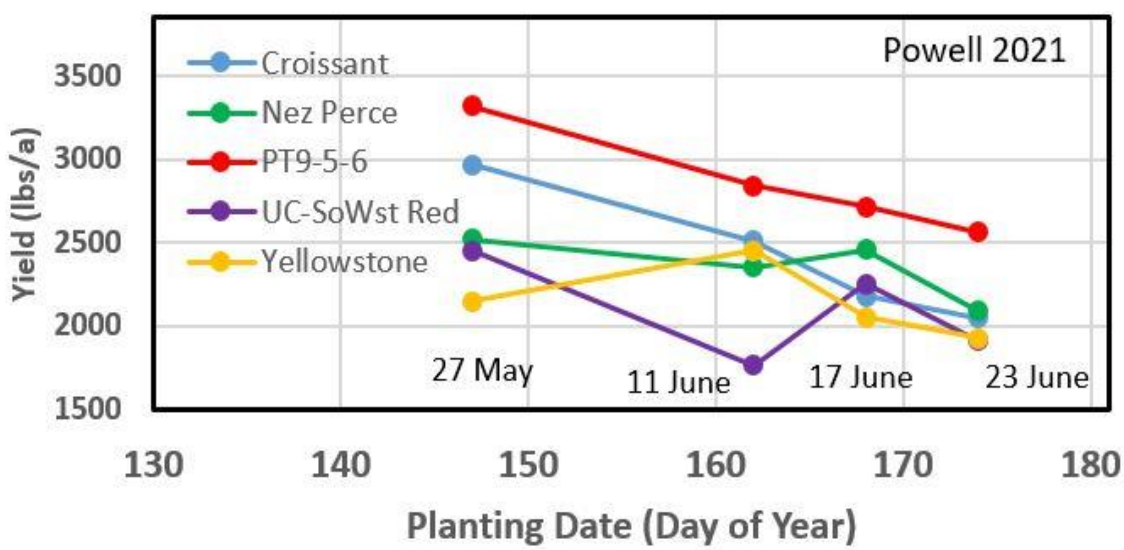

Figure 4. Yield of five pinto bean cultivars sown at different dates across May and June at Powell. Each data point represents four plots.

Seed quality was visually rated for all plots. Examples of good and poor quality seed are shown in Figure 5.

9 or 10

2 or 3

5 or 6

Figure 5. Example of varying seed qualities obtained from the 2021 planting date trial. Seed from all 180 plots were rated visually.

For the three early-maturing pinto cultivars, visual seed quality was consistent across the four planting dates (Fig. 6). However, for the two late-maturing cultivars (Monterrey and Windbreaker), seed quality dropped slightly for the third planting date then dropped dramatically for the final planting date. For the experimental lines, seed quality of the ultra-early UC-Southwest Red held steady across planting dates whereas the other four showed a drop in seed quality on the final planting date (Fig. 7).

Regarding seed per pound for the pintos, Max held steady across the four planting dates whereas Monterrey increased the later it was planted (Fig. 8). For the experimental lines, seed per pound for UC-Southwest Red held steady whereas the other four lines increased the later they were planted (Fig. 9). Conversely, the inverse variable to seed per pound is seed size (mg per seed). As was shown for seed per pound, Max seed size held steady whereas seed from Monterrey failed to fill normally when planted late (Fig. 10). Within the experimental line group, seed size for UC-Southwest Red held steady throughout the four planting dates whereas the other four lines had reduced seed size on the final two planting dates (Fig. 11).

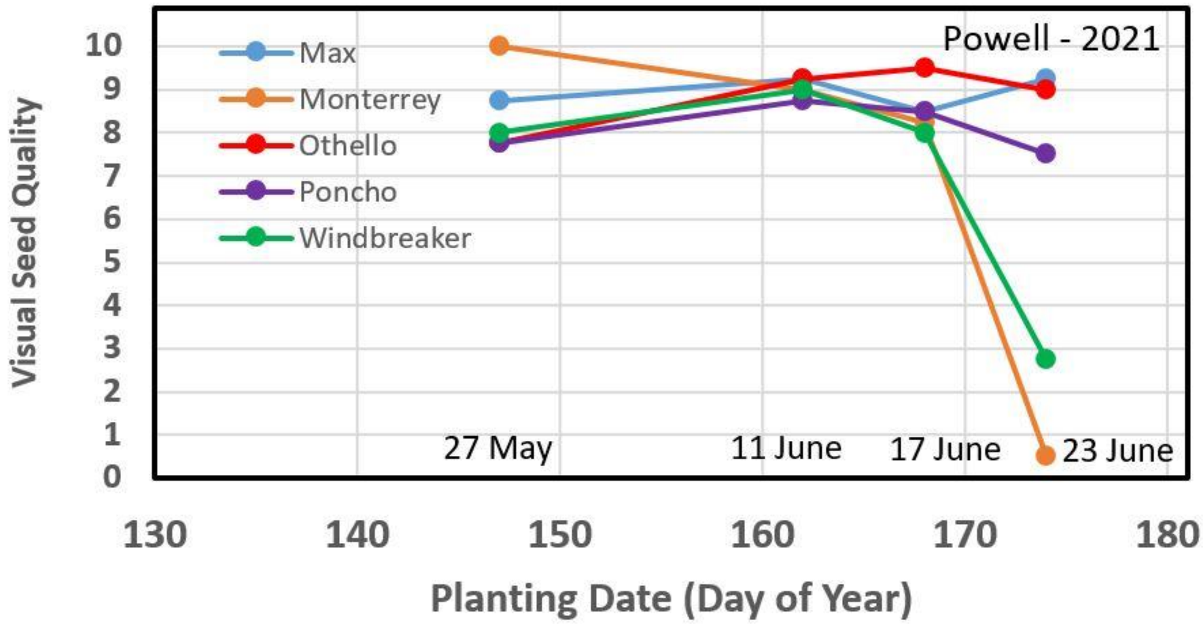

Figure 6. Seed quality of five pinto cultivars as affected by planting date in 2021.

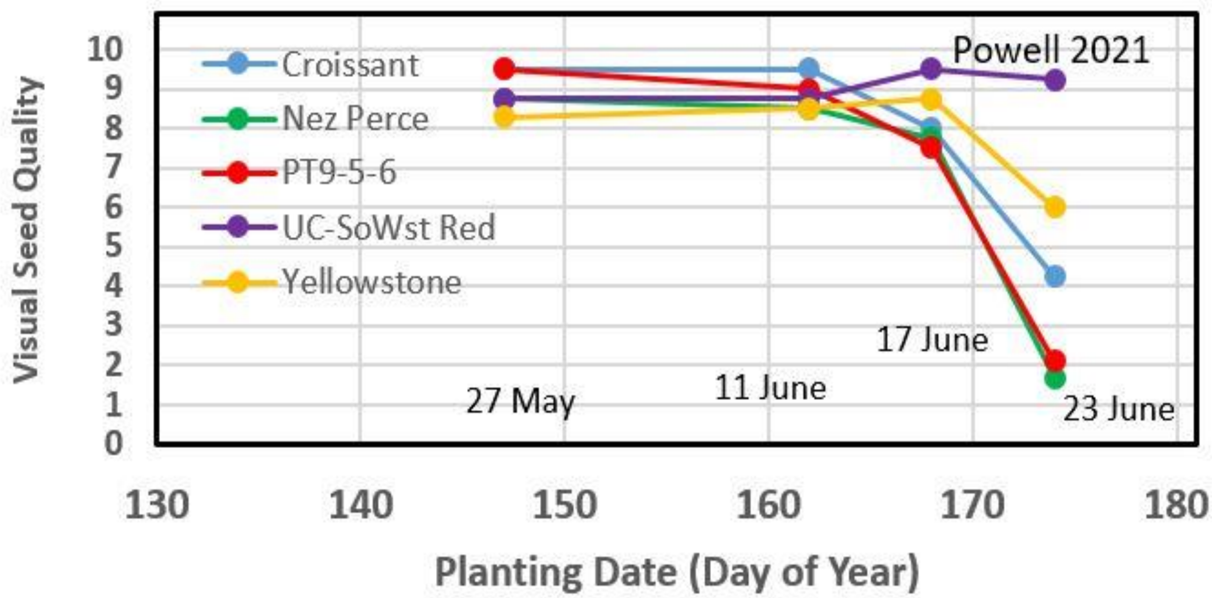

Figure 7. Seed quality of five experimental lines cultivars as affected by planting date in 2021.

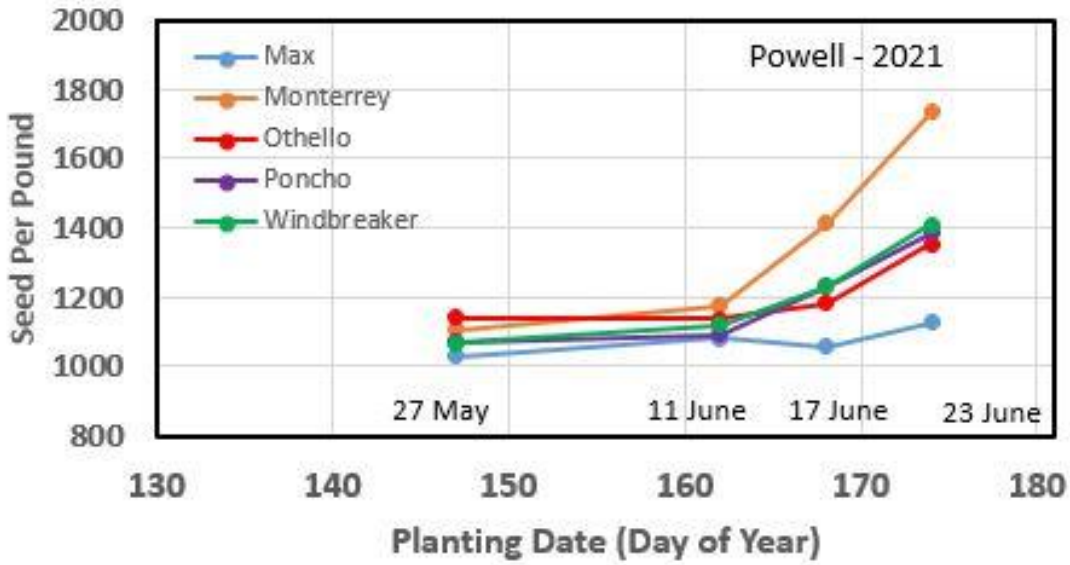

Figure 8. Effect of planting date on seed per pound for five pinto cultivars in 2021**.**

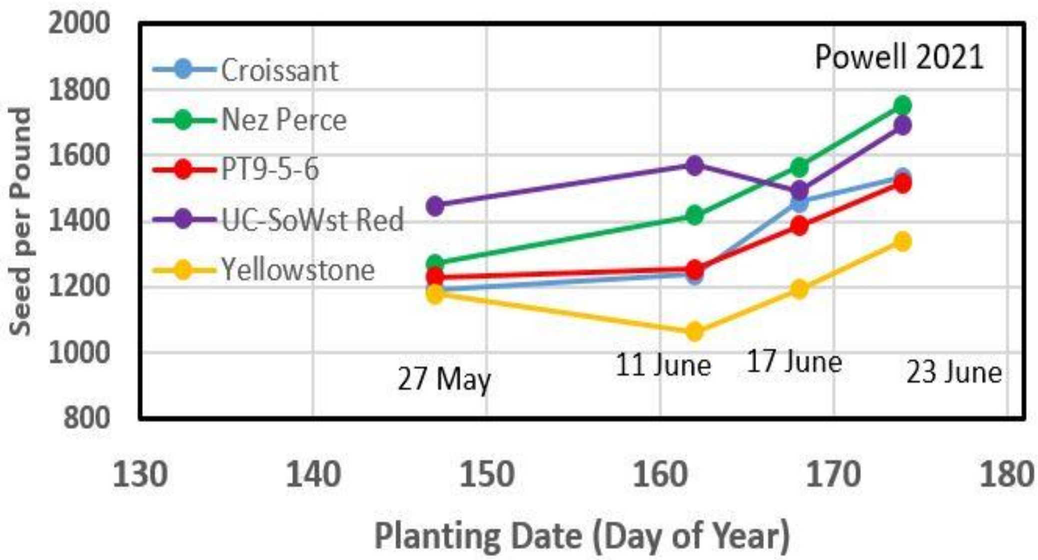

Figure 9. Effect of planting date on seed per pound for five pinto cultivars in 2021**.**

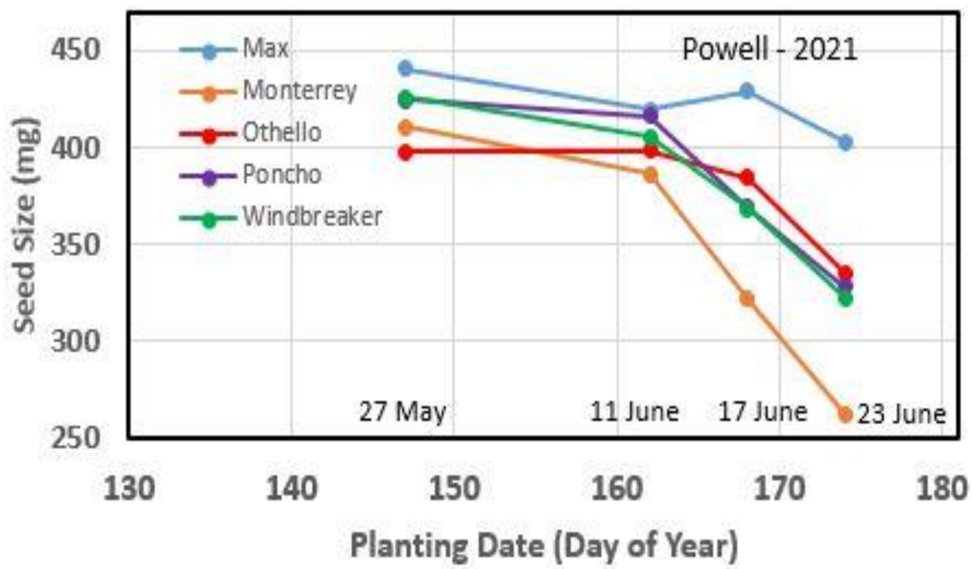

Figure 10. Effect of planting date on seed size of five pinto cultivars in 2021.

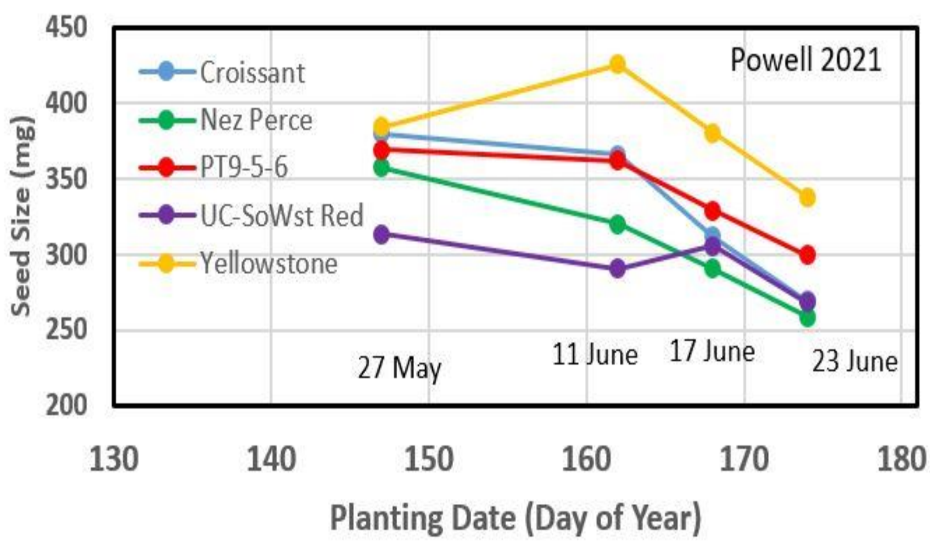

Figure 11. Effect of planting date on seed size of five experimental lines in 2021.

Regarding maturity of the pinto cultivars, we observed that the late-maturing lines required slightly fewer days to reach maturity when planted late and the early-maturing lines required slightly more days to mature (Fig. 12). This pattern was not observed with the experimental lines (Fig. 13).

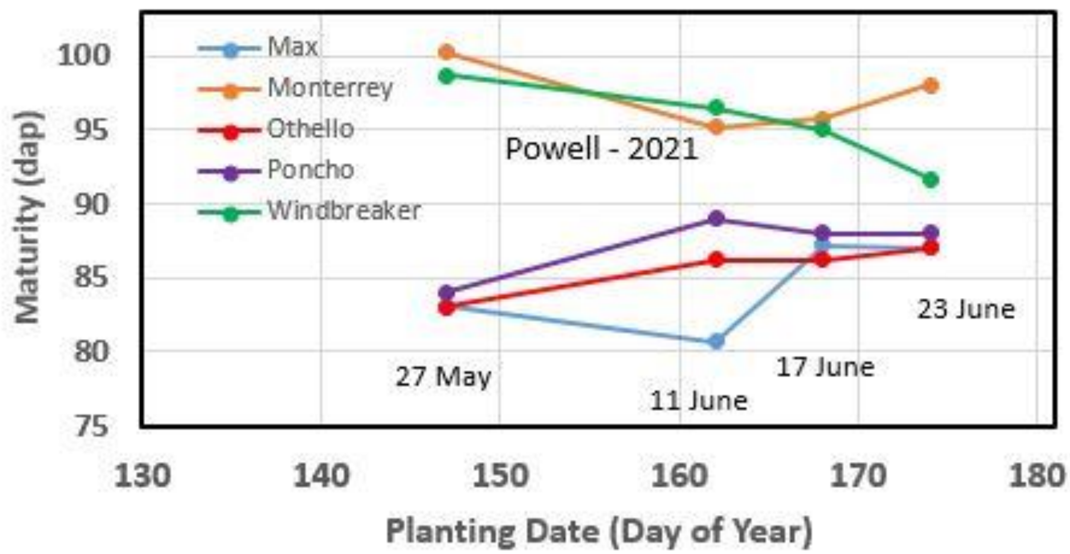

Figure 12. Maturity (days after planting of five pinto cultivars as affected by planting date in 2021.

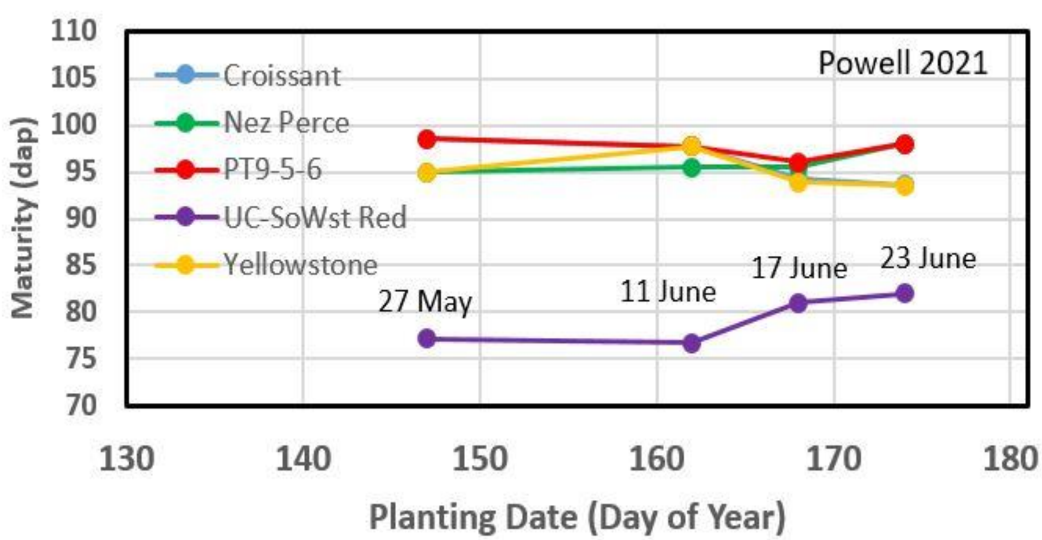

Figure 13. Maturity as affected by planting of five experimental lines as affected by planting date in 2021.

Regarding maturity of the pinto cultivars when rated on a day of year basis, later planting obviously delayed maturity (Fig. 14). A similar observation was found with the experimental lines (Fig. 15).

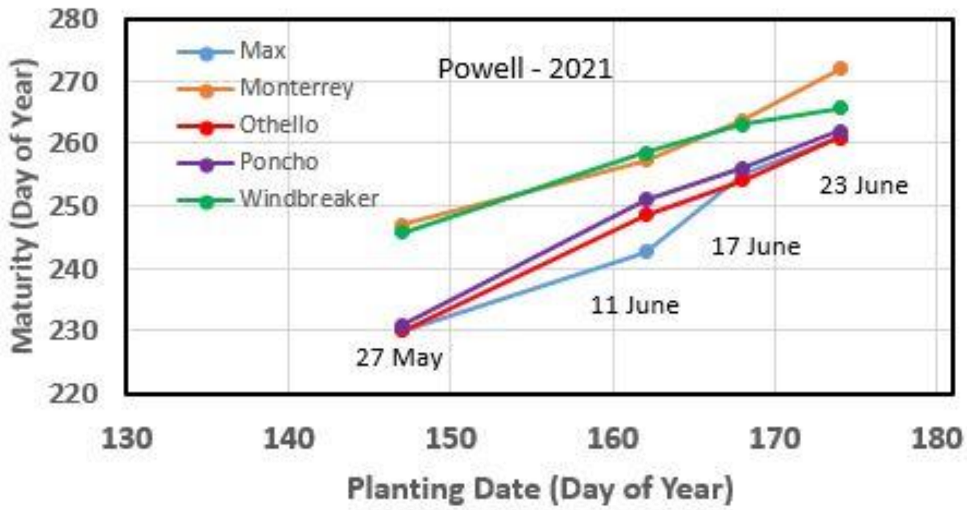

Figure 14. Effect of planting date on maturity day of year of five pinto cultivars.

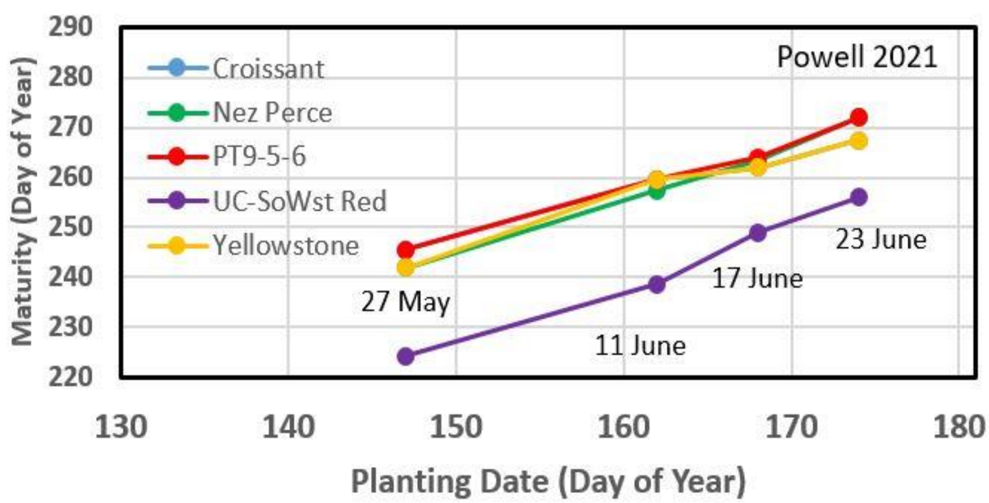

Figure 15. Effect of planting date on maturity day of year of five experimental lines.

As far as architectural stature of the normally upright pintos, Max, Monterrey, and Windbreaker held steady across planting dates whereas the normally prostrate Poncho and Othello trended toward better upright status as planting date was delayed (Fig. 16). A slightly different pattern was observed for the experimental lines, all which are normally upright. Yellowstone and Nez Perce held steady whereas the other three improved upright stature as planting date was delayed (Fig. 17). The trend for some cultivar/lines to improve stature upon late planting is undoubtedly related to a reduced pod-load weighing down the main stem.

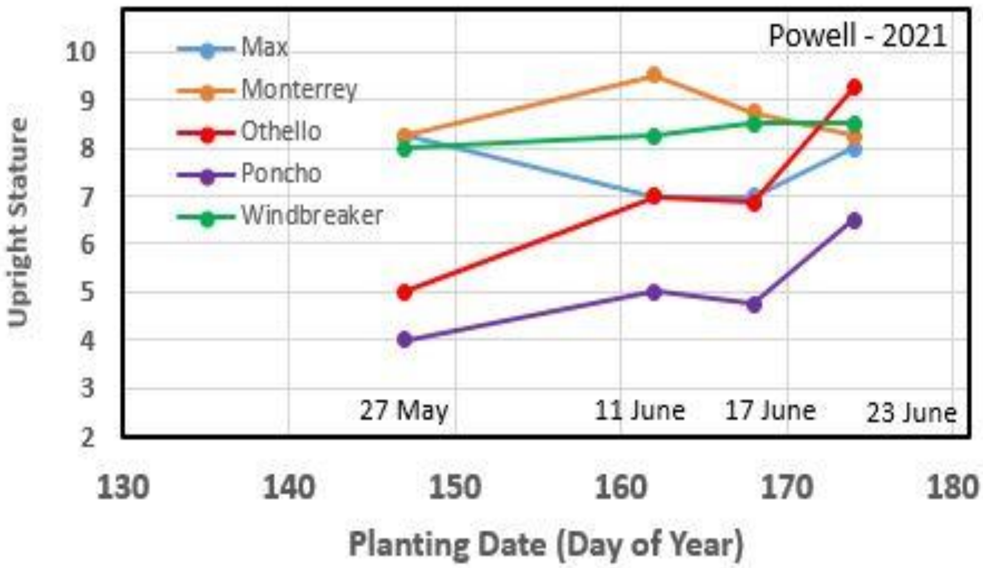

Figure 16. Upright stature of five pinto cultivars as affected by planting date in 2021.

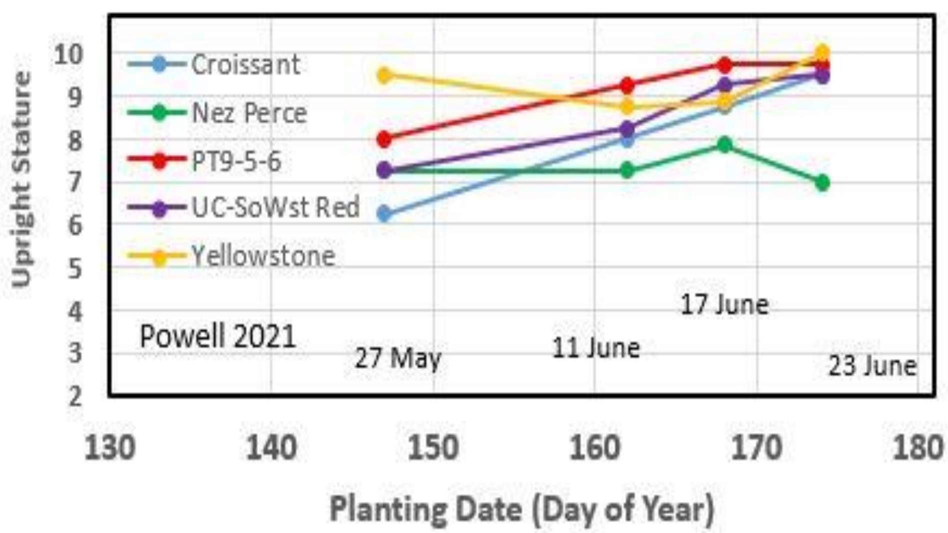

Figure 17. Upright stature of five experimental cultivars as affected by planting date in 2021.

Discussion and Summary

The results of this study quantified the negative effects of delayed planting across a wide range of maturities. Clearly, the downside risk of planting on 11 June or later was greater for late-maturing cultivars. On one hand, our results might suggest that if planting as late as mid-June, a producer would be better off sowing Max, Othello, and Poncho. But if the data for the relatively late-maturing PT9-5-6 is considered, planting in mid-June may not be too risky. It was only for the late-June planting that the risk for late-maturing lines was conspicuous. As far as a tentative recommendation based upon our first two years of research, it seems apparent that selecting an early-maturing cultivar is warranted if planting late due cold/wet spring conditions or other factors.

Besides yield, our research provided some insight into other traits and how those respond to delayed planting. Obviously, gauging seed quality is among the top concerns. In this research, we only weighed the yield sample after cleaning with a machine that removed only trash and dirt. If we were to have discarded visibly damaged seed and kept only marketable seed, the yield values would have been dramatically reduced for the late-maturing lines.

In summary, this study is relatively inexpensive to conduct. Growers and crop insurance agencies need data from these types of planting date studies to guide management changes, gauge revenue expectations, and determine fair payouts for insurance. RMA is very interested in the data that these planting-date experiments deliver. Although the first two years of our research were somewhat consistent with each other (early-maturing varieties had greater yield stability across planting dates than late-maturing varieties), additional years of data are likely to be needed in order to quantify the magnitude of the effects.