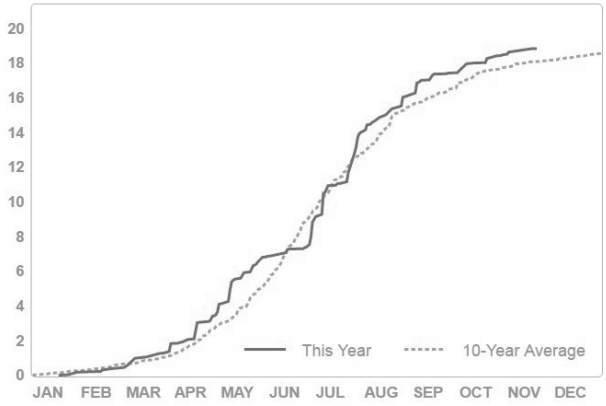
Dry Bean Direct Harvest Combine Speed Evaluation

Study ID: 601161201602
County: Sheridan
Soil Type: Keith loam gravelly substratum; Johnstown loam 0-2% slope
Planting Date: 6/6/16
Harvest Date: 9/26/16
Population: 90,000
Row Spacing (in): 30
Hybrid: Sinaloa Pinto Bean
Reps: 4
Previous Crop: Corn
Tillage: Strip-till
Herbicides: ***Pre:*** 14 oz/ac Outlook® and 32 oz/ac Sonalan® ***Post:*** 21 oz/ac Varisto™
Seed Treatment: None
Foliar Insecticides: None
Foliar Fungicides: None
Fertilizer: 55 lb N/ac and 55 lb P/ac
Irrigation: Pivot, Total: 8-10 in
Rainfall (in):



Introduction:

Combining harvest is the final and one of the most critical aspects of raising dry beans. You can grow a good crop but combine operation is critical to successfully harvesting that crop. The purpose of this study is to examine combine speed and the affect it has on harvest loss and bean quality. In this case we looked at a Case International 2388 combine with a 24 foot Case International 1020 flex auger head. The plots were 300 feet long by the width of the combine and the speeds were 1.0, 2.5 and 4.0 mph. The beans were harvested on September 26th. The beans were planted in 30 inch rows with an estimated population of 90,000 plants/ac. No desiccant was applied to the crop. The temperature was 70ºF and relative humidity was 31% at harvest time. The harvested bean moisture was 13.5%. The overall yield for the field was 44.7 bu/ac. Nine square foot samples were taken randomly in the harvested area in the left, center and right zones behind the combine and header to estimate harvest loss. The bean variety was Sinaloa and the pod height was measured at 92.6% being two inches or more above the soil surface. In the table, damage means any seed visibly split, cracked or broken *(Figure 1)*, and seed coat damage means visibly intact beans that show wrinkling during a 5 minute water soak test *(Figure 2)*. One hundred grams of seed was examined for damage and damage percent by weight was recorded. One hundred seeds were soaked in water for five minutes to determine seed coat damage and the percent by number of seeds was recorded.

Figure 1. Bean seed damage (splits and cracks).

Figure 2. Seed coat damage. Left-damaged (wrinkled), right-not damaged as determined by soak test.

Because combine speed impacts harvest loss and damaged seed, combine speed directly influences profit. Profit lost due to harvest loss was calculated by multiplying the harvest loss by the price beans would have been sold for ($18/bu). Total damaged beans for each treatment strip (bu/acre) were determined using the average yield for the field (44.7 bu/acre) adjusted for harvest loss (adding in bu/acre lost for each treatment strip to determine a relative total yield) and multiplied by the percent damaged beans. No payment is made for damaged beans, therefore the bu/acre of damaged beans for each treatment strip was multiplied by the price the beans would have been sold for. The profit loss due to harvest loss and due to damaged beans were summed to determine the total profit loss. Seed coat damage does not impact profit.

Results:

	Harvest Loss (bu/ac)	Damaged (%)	Seed Coat Damage (%)	Profit Loss ($/acre)
Combine Speed 1 mph	4.3 B*	5.2 A	22 A	122.98 B
Combine Speed 2.5 mph	5.5 B	2.2 B	14 B	118.20 B
Combine Speed 4 mph	10.8 A	0.9 B	12 C	202.09 A
P-Value	0.0011	0.0039	<0.0001	0.0183

*Values with the same letter are not significantly different at a 90% confidence level.

Summary Observations:

1) The higher speed of 4 mph had significantly more harvest loss than the 1 mph and 2.5 mph harvest speeds. Higher combine speeds doubled the harvest loss and was not acceptable. At higher speeds the cutter bar could not effectively cut the beans, resulting in plants being laid over and pushed under the header bar.
2) Visibly broken seed *(Figure 1)*, was significantly higher at the slowest speed. The medium and high speed treatments were not significantly different from one another. This is probably due to a lower volume of plant material moving through the machine at the slower speeds, resulting in bean seeds having greater contact with the metal surfaces within the combine.
3) Wrinkling of seed coats from the five minute soak test *(Figure 2)* showed greatest damage under the slowest speed tested, reinforcing increased seed contact with metal surfaces inside the combine during the harvesting process.
4) The 4 mph combine speed resulted in a significantly greater profit loss when compared to the 1 mph and 2.5 mph combine speeds. The grower's standard operation is at 2.5 mph, therefore increasing the combine speed to 4 mph resulted in an additional profit loss of $83.89/acre. In the profit loss figures shown, increased harvest time for slower combine speeds is not accounted for, but is certainly an economic and practical consideration. Growers need to evaluate the expected profit loss associated with different combine speeds and determine the level of loss and length of harvest time that works with their operation.
5) This study evaluated harvest loss and seed damage at varying harvest speeds. Ideal harvest speeds may vary depending on the harvest equipment and the operator's comfort level. However, we would expect similar trends between harvest speed and loss or damage. This study demonstrates the need for operators to understand the importance of harvest speed and take observations on loss or damage in order to determine an optimal harvest speed.

Sponsored by: University of Nebraska Lincoln; Nebraska Corn Board

In Partnership with: Nebraska Soybean Checkoff; Nebraska Corn Growers Association; Nebraska Dry Bean Commission