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Humboldt, Saskatchewan

# Final Report

## CNH CR9.90 Elevation Combine Benchmarking in 2015 Saskatchewan Wheat and Canola

For:

**CNH Industrial**
**New Holland, Pennsylvania**

PAMI
Innovative Solutions for Agriculture and Beyond

# Table of Contents

# 1. Executive Summary

CNH Industrial (the Client) contracted the Prairie Agricultural Machinery Institute (PAMI) to conduct combine productivity comparison tests on 2015 New Holland (NH) CR9.90 Elevation and John Deere (JD) S690 combines. The tests were conducted in wheat and canola near Humboldt, Saskatchewan, Canada, in September 2015. Fuel use measurements were conducted when operating at the productivity targets.

Combine productivity is a measure of the typical sustained grain harvesting capacity when operated at an acceptable grain loss or other limiting factor, whether it is engine power, feeding, or any other factor. It is important to understand that combine productivity differs from combine capacity, which was the traditional way that PAMI publicly reported combine performance. Combine capacity was determined using specialized test equipment to develop curves of grain loss versus feedrate. Capacity was a precisely controlled measurement of performance over a small area of the field, while productivity provides an indication of sustained performance over a larger field area.

Fuel and diesel exhaust fluid (DEF) consumption efficiency was determined by calculating the amount of grain harvested per volume of fuel and DEF.

Although this project was funded by the Client, PAMI conducted the tests as an independent agency with full control of the testing and the data and without any influence from CNH. In regards to combine configuration, setting, and operation, PAMI led this activity; however, CNH reps were present to assist with optimization of CNH combine performance; with the JD combine, PAMI personnel only were involved in the optimization as no JD reps were present for any part of this project. It is also important to note that for this project, the field testing was conducted in one field condition per crop; therefore, the test results may not represent performance in all crops or conditions.

In each crop, four to six test repetitions were conducted with each combine. The maximum productivity based on grain loss, engine power, and crop feeding was measured for each test and recorded. The data from the replicated tests was then averaged and compared between combines. The test results are summarized in **Table 1-1**.

The wheat testing was conducted in conditions where engine power was the limiting factor for harvesting productivity. In wheat, there was no statistically significant differences between the NH CR9.90 Elevation and JD S690 harvesting productivity, fluid consumption efficiency, and fluid rate per hour at a 90% confidence level. The only statistically significant difference in wheat was fluid rate per area harvested where the NH CR9.90 Elevation consumed 94% as much fuel and DEF per area harvested as the JD S690.

Due to wind and rain in August 2015, which tangled and lodged crop, poor windrow formation in canola was common in the Humboldt, Saskatchewan, area, where the tests were performed. The canola windrows used for testing were inconsistent and poorly formed, which led to a difficult feeding condition. Under these conditions, even with all available settings and adjustments made to improve feeding, the JD S690 was more prone to feeder plugging than the NH CR9.90 Elevation. If the tests had been conducted in more typical canola windrows, different feeding results could have occurred.

The results presented in **Table 1-1** for canola are adjusted to eliminate the effects of the combine feeder plugging on performance. In canola, excluding time spent unplugging due to feeding issues, the NH CR9.90 Elevation combine had a 6% higher harvesting productivity (tonne/hour) than the JD S690. When, including unplugging time, the NH CR9.90 Elevation harvesting productivity was 10% higher than the JD S690.

Additionally, the NH CR9.90 Elevation harvested 8% more grain per liter of fuel and DEF than the JD S690. Lower grain loss levels at the feedrates tested at for the NH CR9.90 Elevation indicate that it may have even more harvesting capacity than the test results show. The total fluid consumption (fuel and DEF) rates per hour were not significantly different. The NH CR9.90 Elevation consumed 6% less fuel and DEF per area than the JD S690.

**Table 1-1.** Summary of productivity test results in wheat and canola.

| | | | | **Fuel and DEF Combined** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Harvesting Productivity** | | **Fluid Consumption Efficiency** | | **Fluid Rate per Hour** | | **Fluid Rate per Acre** | |
| | | **t/h** | **bu/h** | **kg grain /L** | **bu grain /gal (US)** | **L/h** | **gal (US) /h** | **L/ha** | **gal (US)/ac** |
| **WHEAT** | **JD S690** | 35.9 | 1,320 | 356 | 49.5 | 101.1 | 26.7 | 11.5 | 1.23 |
| | **NH CR9.90 Elevation** | 37.5 | 1,377 | 371 | 51.6 | 101.4 | 26.8 | 10.8 | 1.15 |
| | **NH compared to JD** | 104% [1] | | 104% [1] | | 100% [1] | | 94% [2] | |
| **CANOLA** | **JD S690** | 18.5 | 816 | 220 | 36.7 | 84.4 | 22.3 | 13.2 | 1.41 |
| | **NH CR9.90 Elevation** | 19.7 | 868 | 237 | 39.5 | 82.9 | 21.9 | 12.3 | 1.32 |
| | **NH compared to JD** | 106% [2] | | 108% [2] | | 98% [1] | | 94% [2] | |

[1] Not statistically significant at a 90% confidence level.
[2] Statistically significant at a 90% confidence level.

# 2. Introduction

CNH Industrial (the Client) of New Holland, Pennsylvania, contracted the Prairie Agricultural Machinery Institute (PAMI) of Humboldt, Saskatchewan, to conduct combine productivity comparison tests in September 2015. Model year 2015 New Holland (NH) CR9.90 Elevation and John Deere (JD) S690 combines were tested.

The goal of this project was to compare performance results from the two combines in typical harvesting conditions in wheat and canola in western Canada. Data was collected and analyzed to calculate the following harvesting performance parameters:

- Productivity (bu/h) at a given grain loss (bu/ac).

At the targeted productivity, measurements were also taken of:

- fuel use (gal (US)/h and bu/gal), and
- diesel exhaust fluid (DEF) use (as a percent of fuel by volume).

PAMI has forty years of experience testing harvesting equipment in various locations worldwide with a specialty in western Canadian crops and conditions. PAMI has successfully conducted various testing and development projects for the Client over the past twenty years. PAMI has developed a specific procedure for benchmarking combines and has the equipment, expertise, and third-party impartiality to provide accurate, meaningful data to the Client.

Although this project was funded by the Client, PAMI conducted the tests as an independent agency with full control of the testing and the data and without any influence from CNH. In regards to combine configuration, setting, and operation, PAMI led this activity; however, CNH reps were present to assist with optimization of CNH combine performance; with the JD combine, PAMI personnel only were involved in the optimization as no JD reps were present for any part of this project. It is also important to note that for this project, the field testing was conducted in one field condition per crop; therefore, the test results may not represent performance in all crops or conditions.

# 3. Test Procedure

In years past, PAMI and CNH developed the general test procedures to ensure each combine is tested fairly under equal conditions. The equipment and test procedures and methods are described below.

Although this project was funded by the Client, PAMI conducted the tests as an independent agency with full control of the testing and the data and without any influence from CNH. In regards to combine configuration, setting, and operation, PAMI led this activity; however, CNH reps were present to assist with optimization of CNH combine performance; with the JD combine, PAMI personnel only were involved in the optimization as no JD reps were present for any part of this project. It is also important to note that for this project, the field testing was conducted in one field condition per crop; therefore, the test results may not represent performance in all crops or conditions.

## 3.1 Harvesting Equipment

The New Holland combine tested was a 2015 NH CR9.90 Elevation (**Figure 3-1**). For wheat, the straight cut header was a 12.19 m (40 ft) NH 840CD (model year 2013). For canola, the belt pickup header was a NH 790CP.

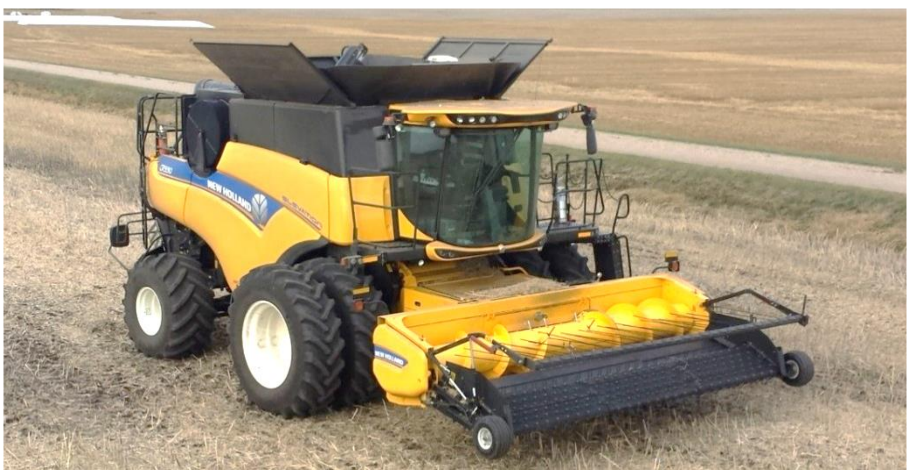

**Figure 3-1.** New Holland CR9.90 Elevation combine with belt pickup header.

The John Deere combine tested was a 2015 JD S690 (**Figure 3-2**). For wheat, the straight cut header was a 12.19 m (40 ft) MacDon FD70 (model year 2010). For canola, the belt pickup header was a JD 615P.

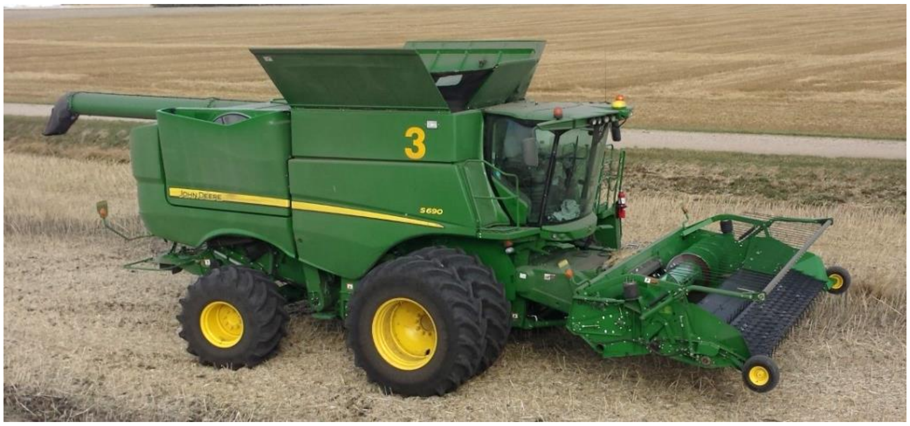


**Figure 3-2.** JD S690 combine with 615P belt pickup header**.**

## 3.2 Grain Loss Measurement

Two methods were used to measure combine grain loss: windrowing or with choppers and spreaders engaged. The windrowing method was used for combine optimization. The choppers and spreaders engaged method was used to verify grain loss during productivity tests. For all loss collections, a portable sample cleaner (**Figure 3-3**) was used to separate the material-other-than-grain (MOG) from the grain loss.

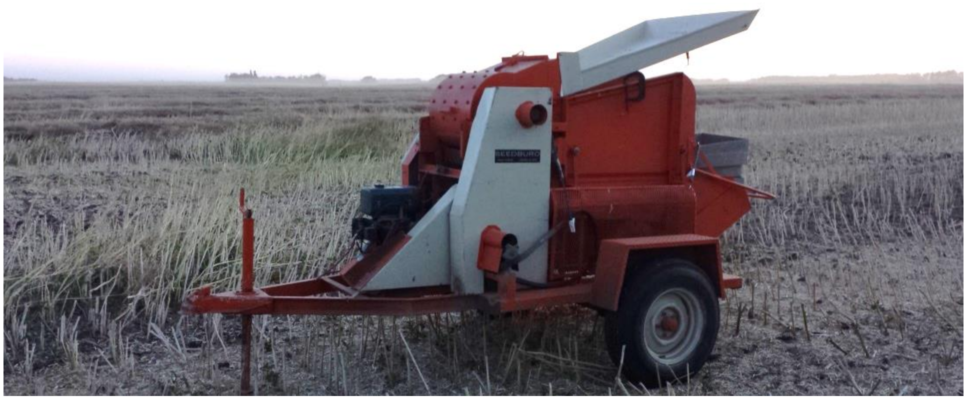

**Figure 3-3.** Loss sample cleaner.

### 3.2.1 Windrowed Loss Collection

Windrowed loss collection is more accurate than collecting loss while spreading crop residue (with choppers and spreaders engaged). Using a loss pan dropper (installed on the underside of the combine; **Figure 3-4**), the operator can drop a 0.61 x 1.88 m (24 x 74 in) loss pan when desired. While harvesting at the target throughput, the operator triggers the release mechanism, which drops the pan. The operator continues harvesting until the combine has cleared over the loss pan. This pan collects all the MOG and grain loss that was harvested over the 0.61 m (24 in) distance of the pan (**Figure 3-5**). Grain loss expressed as kg/ha (bu/ac) can be obtained by dividing the amount of grain loss by the effective loss catch area. In this case, the effective loss catch area is the width of cut multiplied by 0.61 m (24 in) pan distance.

For the JD S690, the chopper and Powercast tailboard was moved to the raised position and disengaged. For the NH CR9.90 Elevation, the chop-to-drop door was positioned for windrowing straw, and the chaff spreader was lowered and disengaged.

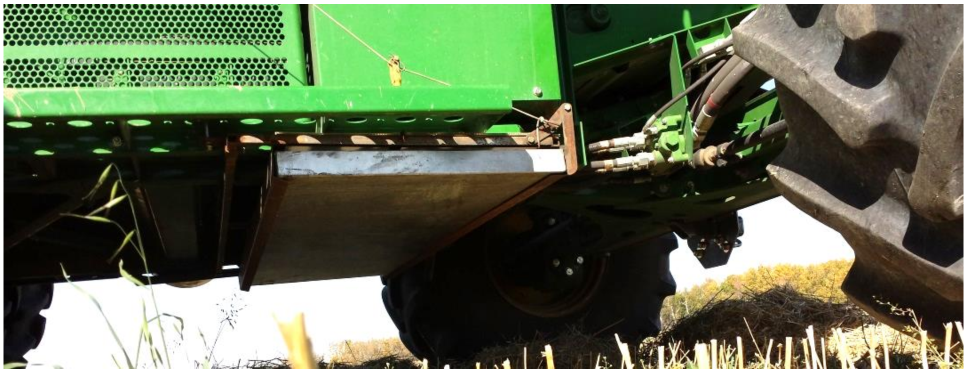

**Figure 3-4.** Loss pan dropper installed on a JD combine.

**Figure 3-5.** Loss pan catch while windrowing in wheat.

### 3.2.2 Chopper and Spreaders Engaged Loss Collection

Collecting loss with choppers and spreaders engaged is not as accurate as windrowed loss collections, but it better represents typical harvesting methods. Loss collections with choppers and spreaders are used to verify that grain loss during productivity test runs is within the expected or acceptable range.

Five loss pans (**Figure 3-6**) were used for each collection. The center loss pan (0.61 x 1.88 m or 24 x 74 in) was dropped by the same method as describe for windrowed loss collections. As the combine passed, test personnel manually placed four pans (0.41 x 1.22 m or 16 x 48 in). On each side, two pans were placed centered approximately 2.13 m (7 ft) and 4.88 m (16 ft) from the combine centerline. The total pan spread was approximately 10.36 m (34 ft).

Provided the combine is spreading discharge over approximately the same width as the cut width and reasonably even across the spread, the effective loss collection area is equal to the loss pan area. With the pans used, the effective loss collection area was

3.13 m$^2$ (33.7 ft$^2$).

**Figure 3-6.** Loss pan layout for chopper and spreaders engaged loss collection.

## 3.3 Grain Yield Measurement

A grain truck with an integral scale was used to measure the grain yield of each test run. Each test run began with the combine having an empty grain tank. Immediately after the test run, each combine emptied the grain tank into the grain truck, and the weight was recorded.

The net grain harvested weight was determined from a tare weight (immediately prior to filling the grain truck) followed by a gross weight after filling.

Prior to reading the grain truck scales, the truck hoist control was cycled (with pump disengaged) to eliminate hydraulic pressure, which can affect the weight reading. By using this procedure prior to weighing, the grain truck scale accuracy is ± 0.7% at 9,300 kg (20,500 lb).

## 3.4 Fuel and Diesel Exhaust Fluid (DEF) Measurement

Fuel use was measured for each productivity test run by two methods. In a separate test (once in each crop), DEF consumption of each combine was determined as a percent of fuel used. The fuel used was #2 diesel for both combines.

### 3.4.1 Fuel Use Measurement

Fuel use was measured by monitoring the weight of an auxiliary fuel tank and also using data from the combine Controller Area Network (CAN) systems. The results obtained by the two methods were typically within 1% or 2%.

For the wheat productivity tests, the auxiliary tank method was used. For the canola productivity tests, data from the CAN systems from each test run was analyzed and used for calculations. The fuel consumption data (from the CAN system) was then verified by the weighed auxiliary tank method.

The auxiliary tank was plumbed in parallel with the combine’s main fuel tank. Selector valves were used to divert the fuel source and return either to the main or auxiliary tank.

Prior to each test, the tank was filled and weighed. Just before each test began, the operator switched the valves to run off the auxiliary tank. Immediately after the test, the operator switched the valves back to the main tank, and weighed the auxiliary tank.

HBM Somat eDAQ data acquisition systems were used to record various parameters from each combine's CAN network and an external Global Positioning System (GPS) receiver during each test. The recording rate was 1 Hz. The key parameters recorded were fuel usage rate (L/h) and ground speed (mph). The amount of fuel used can be calculated by integrating the fuel usage rate during the period of time that the test was performed.

#### 3.4.2 Diesel Exhaust Fluid (DEF) Use Measurement

A test was conducted for each combine, in each crop, to determine the DEF use as a percentage of fuel use.

Diesel Exhaust Fluid (DEF) use was determined by filling the DEF tank to an exact level (very near full) prior to the test. With the combine parked in the exact same location, the amount of DEF used was measured by weighing the amount of DEF required to refill the tank to the pre-test level.

Each combine engine was shut off and the DEF system allowed to complete its shutdown procedure prior to DEF tank filling. The fuel use during the DEF test was measured by the auxiliary tank method described in **Section 3.4.1**.

### 3.5 Combine Optimization Procedure

The following procedure was used to optimize the combine settings and determine the target operating parameters and corresponding grain loss monitor indication at the target grain loss for each combine. Target grain loss was 67 kg/ha (1 bu/ac) for wheat and 56 kg/ha (1 bu/ac) for canola.

- To start, all settings and configurations were set in accordance with the recommendations found in the operator's manual for a specific crop.
- The chaffer and sieve openings were optimized by visual observation of the grain tank sample, while sieve and fan adjustments were made from the cab.
- The cleaning fan speed was optimized at a low feedrate, increasing the fan speed until the airflow was blowing grain over the cleaning system. The fan speed was then reduced 25 to 50 rpm to ensure that even at lower cleaning system loads the fan would not blow grain out.
- To optimize the rotor speed, it was adjusted on-the-go while periodically catching a residue sample from the rotor discharge. Starting with a slow rotor speed (and observing noticeable rotor loss), the rotor speed was increased until rotor loss diminished. Higher rotor speed helps reduce rotor loss. Lower rotor speed helps

reduce the cleaning system load. Loss checks indicated that the rotor loss monitor showed a reasonable indication of rotor loss level.

- Numerous loss collections were taken with the straw choppers and spreaders disengaged such that all grain loss was captured in a 0.61 x 1.88 m (24 x 74 in) loss pan.
- For each combine, in each crop, between 7 and 17 loss collections were conducted adjusting various settings in an attempt to achieve maximum ground speed at up to the target grain loss.

## 3.6 Productivity Testing Procedure

The following procedure was followed for the productivity testing:

- Tests were conducted between 12:00 p.m. and 6:00 p.m. to achieve relatively consistent crop conditions.
- The combines were tested one at a time in alternating order, on approximately 30 minute intervals. This ensured each combine was exposed to similar crop and weather conditions throughout the day.
- The combine operator used the combine loss monitor, percent engine load, and crop feeding as targets for maintaining maximum productivity. The loss monitor level at the target amount of grain loss was previously established during the optimization procedure. Throughout each test, due to crop variability, the operator adjusted ground speed appropriately to maintain an acceptable amount of loss, optimum crop feeding, and maximum engine power.
- Using the fuel measurement procedure described in **Section 3.4.1**, fuel use was determined for each test.
- To ensure the actual grain loss was acceptable, two loss checks were conducted for each test run using the procedure described in **Section 3.2.2**.
- Test time was measured by stopwatch and also analyzed from the recorded CAN system data. Productivity test run results do not include time spent
    - turning at headlands,
    - to reload a second loss pan (at mid test), or
    - unloading grain after a test.
- After each test, the grain harvested was weighed using the procedure described in **Section 3.3**.
- A grain sample was taken for each test for measurements of grain moisture, dockage, and green seed count.
- For wheat, GPS controlled steering was used for each test run with target swath spacing of 11.89 m (39.0 ft).
- For canola, the operator steered the combine, following windrows that were laid with GPS on 11.74 m (38.5 ft) spacing.
- In each crop, the data from each combine's test runs was averaged and then compared to the other combine.

## 3.7 Grain Sample Dockage and Moisture Test Procedure

The grain moistures reported were measured using a Labtronics table top moisture meter and at various local grain elevators.

The grain dockage tests and canola green seed counts were conducted by a local grain elevator (Bunge at Dixon, Saskatchewan).

# 4. Wheat Test Results

The wheat harvesting productivity testing spanned over five days, from September 22 to 26, 2015. The crop conditions, combine optimization, and results are presented in the following sections.

## 4.1 Crops and Conditions

The crop harvested for testing was AC® Carberry Canadian Western Red Spring (CWRS) wheat. AC® Carberry is an awned, semi-dwarf CWRS variety.

The field average yield was 3.96 t/ha (59 bu/ac) with average grain moisture of 14.5%. The crop (**Figure 4-1**) was standing well (no lodging) with height ranging from 0.69 to 0.76 m (27 to 30 in). The average crop cut height was 0.24 m (9.3 in). The average MOG-to-grain ratio was 0.8.

The ambient temperature during testing ranged from 17 to 22°C (63 to 72°F). The relative humidity ranged from 33 to 63%. Test runs were made east and west with wind conditions 3 to 27 km/h (2 to 17 mph) predominantly from the south.

Located near Humboldt, Saskatchewan, the field topography was relatively level with undulating hills and water runs scattered throughout. Ground conditions were firm. Elevation was approximately 575 m (1,886 ft).

The field had been sprayed with glyphosate approximately two weeks prior to harvest (a common practice in the Humboldt, Saskatchewan, area). The sprayer tires had flattened approximately 0.38 m (1.25 ft) of crop per tire. Each test run noted how many sprayer tire tracks were encountered. For each run with sprayer tracks, the harvested area was adjusted accordingly.

**Figure 4-1.** Wheat field during testing.

## 4.2 Combine Optimization

Combine settings were optimized on September 22 and 23, 2015, establishing the maximum harvesting productivity at 67 kg/ha (1 bu/ac) loss. Windrowed grain loss collections were conducted to accurately determine grain loss. In wheat, for each combine, at least seven loss collections were conducted adjusting various settings in an attempt to achieve maximum ground speed at up to the target grain loss.

A few representative examples of ground speed near the target grain loss (using the process described in **Section 3.5**) are listed below.

- JD S690 — 8.0 km/h (5.0 mph) with 81 kg/ha (1.2 bu/ac) of loss; 7.2 km/h (4.5 mph) with 27 kg/ha (0.4 bu/ac) of loss
- NH CR9.90 Elevation — 8.0 km/h (5.0 mph) with 27 kg/ha (0.4 bu/ac) of loss

During optimization, the grain loss monitors in both combines were calibrated and displaying acceptable loss in the green range. This provided the operator with a target for operation during productivity tests.

The settings used for each combine are shown in **Table 4-1**. All settings reported are actual measurements rather than settings indicated on the combine display.

**Table 4-1.** Combine settings after optimization in wheat.

| **Setting** | **JD S690** | **NH CR9.90 Elevation** |
|---|---|---|
| Rotor Speed (rpm) | 910 | 1,270 |
| Concave (mm) | 18 | 17 |
| Fan Speed (rpm) | 1,010 | 880 |
| Presieve (mm) | 23 | 10 |
| Upper Sieve (mm) | 21 | 21 |
| Upper Sieve Extension (mm) | 17 | 21 |
| Lower Sieve (mm) | 6 | 10 |

## 4.3 Combine Settings for Productivity Tests

The functional combine adjustments used during wheat testing are shown in **Table 4-2**. Where a range is shown, a note is provided to explain why the change was made during testing. The settings reported are based on actual measurements rather than those indicated on the combine display.

**Table 4-2.** Combine settings used during wheat productivity testing.

| Setting | JD S690 | NH CR9.90 Elevation |
|---|---|---|
| Rotor Speed (rpm) | 900 to 950 | 1,270 |
| Concave (mm) | 13 to 18 | 17 to 25 |
| Fan Speed (rpm) | 1,010 | 880 to 950 |
| Presieve (mm) | 23 | 10 |
| Upper Sieve (mm) | 21 | 21 |
| Upper Sieve Extension (mm) | 17 | 21 |
| Lower Sieve (mm) | 6 | 10 |

Combine settings notes:

- JD S690
  - Concave – adjusted from 18 to 13 mm during test W8 (and remaining tests) to increase threshing to reduce unthreshed heads, known as white caps, in the grain tank sample.
  - Rotor – increased speed from 900 to 950 rpm during test W10 (and remaining tests) to increase threshing to reduce white caps in the grain tank sample.
- NH CR9.90 Elevation
  - Concave – adjusted from 17 to 25 mm in small increments over the course of testing to reduce cracked grain and shoe load.
  - Fan – adjusted from 880 to 950 rpm during test W5 (and remaining tests) for a cleaner grain sample.

**Table 4-3** identifies the combine configurations as tested in wheat. Where possible, the adjustable configurations and settings were set for wheat in accordance with recommendations found in the operator's manual.

**Table 4-3.** Combine configurations for wheat testing.

| | JD S690 | NH CR9.90 Elevation |
|---|---|---|
| Feeder drum position | up | 3 |
| Feeder jackshaft speed | fixed | fixed |
| Feeder chain speed | slow (26 tooth sprocket) | fixed |
| Stone protection type | standard | Dynamic Stone Protection (DSP) |
| Feed accelerator/DSP speed | high | high (1,100 rpm) |
| Feed accelerator type | Tough Crop | N/A |
| Rotor type | Xstream Standard Configuration | Twin Pitch, 22 in. |
| Concave type | small wire | small grain |
| Concave extension position | N/A | in |
| Concave covers (de-awning plates) | none | none |
| Separator grate type | heavy duty | bar and Wire |
| Separator Grate Covers | None | None |
| Separator Vanes | adjustable, standard position | fixed |
| Discharge beater | tough crop | grate cover installed |
| Chaffer type | general purpose | 1-1/8 in. HC |
| Sieve type | general purpose | 1-1/8 in. NH lower sieve |
| Presieve type | adjustable | 1 - 1/8 in. NH presieve |
| Rethresher position | grain | spiked covers, mid position |
| Tailings drive speed | N/A | high |
| Spreader speed | 410 rpm | chaff = 480 rpm<br>straw = 790 rpm |
| Returns speed | fixed | 580 rpm |
| Elevator speed | fixed | 410 rpm |
| Chopper type | standard | standard |
| Chopper speed | high | high |
| Chopper knife bank position | mid | mid |
| Spreader type | Standard, Powercast Tailboard | Opti-Spread |
| Grain tank covers | powered covers | powered covers |
| Grain tank tent position | fully raised | fully raised |
| Drive tires | 650/85R38 duals | IF580/85R42 duals |
| Drive tire pressure | 207 kPa (30 psi) | 130 kPa (20 psi) |
| Steering tires | 750/65R26 | 750/65R26 |
| Steering tire pressure | 248 kPa (36 psi) | 200 kPa (29 psi) |
| Rated power [hp = metric hp] | 405 kW (551 hp) | 390 kW (530 hp) |

## 4.4 Test Results

The wheat harvesting productivity results were based on the average results of six test runs each (JD S690 tests: W2, W4, W6, W8, W10, and W12; NH CR9.90 Elevation tests: W3, W5, W7, W9, W11, and W13). Individual test run data is in **Appendix A**. The length of each test run ranged from 1.12 to 1.34 km (0.70 to 0.84 mi) for a harvested area ranging from 1.30 to 1.61 ha (3.20 to 3.97 ac). The harvesting duration per test run ranged from 8 to 12 minutes.

An analysis of variance (ANOVA) of the test results using the general linear model in the software program Minitab (version 16) was performed. To determine if the differences in combine performance were statistically significant, a confidence level of 90% was used.

Each test is described in detail in the following sections.

### 4.4.1 Productivity and Efficiency

The results of the combine performance in wheat are compared in **Table 4-4**. The results show the NH CR9.90 Elevation with a slight advantage over the JD S690 in both harvesting productivity and fluid consumption efficiency. Analysis shows the differences in harvesting productivity and fluid consumption efficiency in **Table 4-4** are not statistically significant.

**Table 4-4.** Average harvesting productivity and fuel efficiency results in wheat.

| | Harvesting Productivity | | Grain Loss | | Fluid Consumption Efficiency (Fuel and DEF Combined) | | |
|---|---|---|---|---|---|---|---|
| | **t/h** | **bu/h** | **kg/ha** | **bu/ac** | **kg harvested /L** | **bu harvested /gal (US)** | **Harvesting Limitation** |
| **JD S690** | 35.9 | 1,320 | 40 | 0.6 | 356 | 49.5 | engine power [1] |
| **NH CR9.90 Elevation** | 37.5 | 1,377 | 27 | 0.4 | 371 | 51.6 | engine power [1] |
| **NH compared to JD** | 104% [2] | | N/A | | 104% [2] | | N/A |

[1] Test runs W2 and W3 were limited by cleaning system loss.
[2] Not statistically significant at a 90% confidence level.

A grain sample was collected from each test run. A composite sample of each combine's test runs was analyzed for dockage and moisture content. Results are presented in **Table 4-5**.

**Table 4-5.** Grain dockage and moisture results.

| | Dockage | Grain Moisture |
|---|---|---|
| **JD S690** | 0.7% | 14.4% |
| **NH CR9.90 Elevation** | 0.6% | 14.7% |

### 4.4.2 Fuel and DEF Consumption Results

The average fluid consumption rates in wheat are shown in terms of time and area harvested in **Table 4-6**. There was no difference in total fluid rate based on time with each combine consuming approximately 101.1 L/h (26.7 gal US/h). A statistically significant difference in fluid rate, based on area harvested was measured. The NH CR9.90 Elevation total fluid rate per area was lower at 10.8 L/ha (1.15 gal US/ac), which was 93% of the JD S690 rate of 11.5 L/ha (1.23 gal US/ac). Aside from total fluid rate per hour, all performance differences reported in this paragraph are statistically significant.

**Table 4-6.** Detailed fuel and DEF consumption results from wheat tests.

| **Fluid consumption based on time** | | | | | |
|---|---|---|---|---|---|
| | **Fuel Rate** | | **DEF rate (% of fuel by volume)** | **Total Fluid Rate** | |
| | **L/h** | **gal (US)/h** | | **L/h** | **gal (US)/h** |
| **JD S690** | 99.2 | 26.2 | 2.1% | 101.1 | 26.7 |
| **NH CR9.90 Elevation** | 92.7 | 24.5 | 9.5% | 101.4 | 26.8 |
| **NH compared to JD** | 94% [1] | | N/A | 100% [2] | |
| | | | | | |
| **Fluid consumption based on area harvested** | | | | | |
| | | | | | |
| | **Fuel Rate** | | **DEF rate (% of fuel by volume)** | **Total Fluid Rate** | |
| | **L/ha** | **gal (US)/ac** | | **L/ha** | **gal (US)/ac** |
| **JD S690** | 11.3 | 1.21 | 2.1% | 11.5 | 1.23 |
| **NH CR9.90 Elevation** | 9.8 | 1.05 | 9.5% | 10.8 | 1.15 |
| **NH compared to JD** | 87% [1] | | N/A | 93%[1] | |

[1] Statistically significant at a 90% confidence level.
[2] Not statistically significant at a 90% confidence level.

In wheat, the NH CR9.90 Elevation, DEF consumption at 9.5% of fuel (by volume) was considerably higher than the JD S690 at 2.1% of fuel. The DEF use rate (as percent of fuel) was determined in a separate test. A summary of DEF test data is shown in **Appendix A**.

### 4.4.3 Productivity Limiting Factors

As noted in **Section 4.4.1**, in tests W2 and W3, the limiting factor was cleaning system loss. These tests were conducted towards the end of the day on September 23, 2015. The majority of the tests (W4 through W13) were conducted on September 24, 2015, where the limiting factor was engine power. The productivity limitation changed from one day to the next because of a damp night that caused an increase in straw moisture, thus requiring more engine power for crop throughput.

Both straight cut headers fed the combines well and did not limit productivity. Crop feeding was consistent and even.

# 5. Canola Test Results

The canola harvesting productivity testing spanned four days, from September 27 to 30, 2015. The crop conditions, combine optimization, and results are presented in the following sections.

## 5.1 Crops and Conditions

The ambient temperature during testing ranged from 19 to 23°C (65 to 73°F). The relative humidity ranged from 21 to 31%. Test runs were made east and west with wind conditions of 8 to 20 km/h (5 to 13 mph) from the south.

Located near Humboldt, Saskatchewan, the field topography was flat and level with a few small water runs scattered throughout. Ground conditions were firm. Elevation was approximately 575 m (1,886 ft).

The crop harvested (**Figure 5-1**) for testing was Bayer Crop Science InVigor L261 canola. Prior to windrowing, the field had lodged badly due to wind and rain. The field was windrowed with 12.2 m (40 ft) windrowers equipped with GPS navigation on 11.7 m (38.5 ft) spacing. The windrows were inconsistent with plants laying pods first and stems first in the same windrow. The windrows laid west-bound were more consistent than the windrows laid east-bound. The windrow quality led to a very challenging feeding condition.

The field average yield was 2.91 t/ha (52 bu/ac) with average grain moisture of 6.6%. The windrow width ranged from 2.3 to 2.9 m (7.7 to 9.5 ft) and ranged in height from 0.3 to 0.5 m (1.0 to 1.5 ft). The average crop cut height was 0.24 m (9.4 in). The average MOG-to-grain ratio was 1.5.

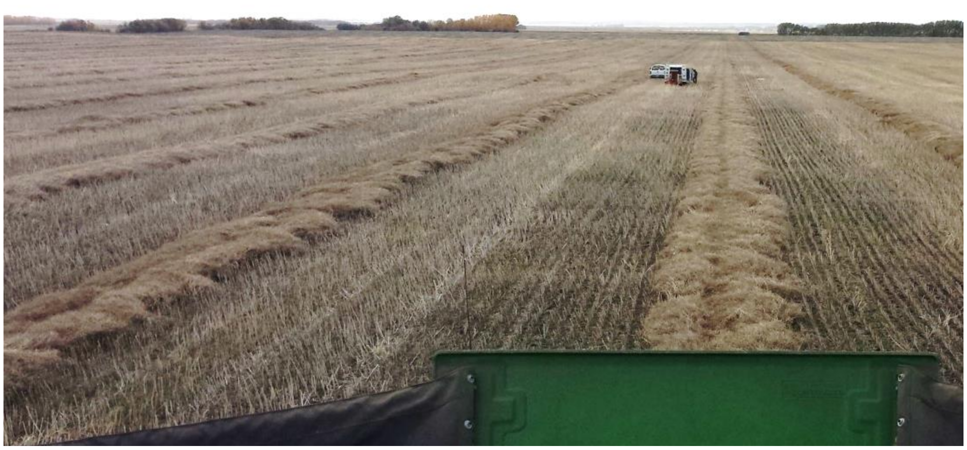

**Figure 5-1.** Canola field during testing.

## 5.2 Combine Optimization

Combine settings were optimized on September 27 and 28, 2015, establishing the maximum productivity at 56 kg/ha (1 bu/ac) loss. Windrowed loss pan collections with choppers and spreaders disengaged were conducted to accurately determine loss. In canola, for each combine, at least 11 loss collections were conducted adjusting various settings in an attempt to achieve maximum ground speed at up to the target grain loss.

A few representative examples of ground speed near the target grain loss (using the process described in **Section 3.5**) are listed below.

- JD S690 — 5.1 km/h (3.2 mph) with 45 kg/ha (0.8 bu/ac) of loss
- NH CR9.90 Elevation — 5.4 km/h (3.4 mph) with 17 kg/ha (0.3 bu/ac) of loss
  5.9 km/h (3.7 mph) with 62 kg/ha (1.1 bu/ac) of loss

During optimization, the grain loss monitors in both combines were calibrated and displaying acceptable loss in the green range. This provided the operator with a target for operation during productivity tests.

The settings for each combine are shown in **Table 5-1**. All settings reported are actual measurements rather than settings indicated on the combine display.

**Table 5-1.** Combine settings after optimization in canola.

| **Setting** | **JD S690** | **NH CR9.90 Elevation** |
|---|---|---|
| Rotor Speed (rpm) | 850 | 830 |
| Concave (mm) | 19 | 22 |
| Fan Speed (rpm) | 750 | 700 |
| Presieve (mm) | 22 | 6 |
| Upper Sieve (mm) | 14 | 13 |
| Upper Sieve Extension (mm) | 10 | 14 |
| Lower Sieve (mm) | 4 | 9 |

In the JD S690 operator’s manual, the recommended rotor speed for canola is 350 to 650 rpm. In the NH CR9.90 Elevation operator’s manual, the recommended rotor speed for canola is 500 rpm. For both combines, the rotor speed used was higher than the settings recommended in the operator’s manual. Recommended rotor speeds were tried, and high rotor loss was observed. Rotor speed was increased until rotor loss was reduced. The higher than recommended rotor speeds aligns with the straw condition, which was green with very large stalks.

## 5.3 Combine Settings for Productivity Tests

The functional combine adjustments used for canola testing are shown in **Table 5-2**. Where a range is shown, a note is provided to explain why the change was made during testing.

All settings reported are actual measurements rather than settings indicated on the combine display.

**Table 5-2.** Combine settings used during canola productivity testing.

| Setting | JD S690 | NH CR9.90 Elevation |
|---|---|---|
| Rotor Speed (rpm) | 830 | 720 to 830 |
| Concave (mm) | 19 | 22 |
| Fan Speed (rpm) | 750 | 730 |
| Presieve (mm) | 22 | 6 |
| Upper Sieve (mm) | 14 | 16 to 19 |
| Upper Sieve Extension (mm) | 10 | 17 |
| Lower Sieve (mm) | 4 | 9 |

Combine settings notes:

- NH CR9.90 Elevation
    - Rotor – adjusted from 830 to 720 rpm during test C8 to reduce over-threshing and reduce shoe loss.
    - Upper Sieve – adjusted from 16 to 19 mm during test C8 to reduce shoe loss.

**Table 5-3** identifies the combine configurations as tested in canola. Where possible, the adjustable configurations and settings were set for canola as recommended in the operator's manual.

**Table 5-3.** Combine configurations for canola testing.

| | JD S690 | NH CR9.90 Elevation |
|---|---|---|
| Feeder drum position | up | 3 |
| Feeder jackshaft speed | fixed | fixed |
| Feeder chain speed | fast (32 tooth sprocket) | fixed |
| Stone protection type | standard | Dynamic Stone Protection (DSP) |
| Feed accelerator/DSP speed | high | high (1,100 rpm) |
| Feed accelerator type | tough crop | N/A |
| Rotor type | Xstream Standard Configuration | Twin Pitch, 22 in. |
| Concave type | small wire | small grain |
| Concave extension position | N/A | out |
| Concave covers (de-awning plates) | none | none |
| Separator grate type | heavy duty | bar and wire |
| Separator grate covers | none | none |
| Separator vanes | adjustable, standard position | fixed |
| Discharge beater | tough crop | grate cover installed |
| Chaffer type | general purpose | 1-1/8 in. HC |
| Sieve type | general purpose | 1-1/8 in. NH lower sieve |
| Presieve type | adjustable | 1 - 1/8 in. NH presieve |
| Rethresher position | grain | smooth covers, mid position |
| Tailings drive speed | N/A | slow |
| Spreader speed | 410 rpm | chaff = 480 rpm<br>straw = 790 rpm |
| Returns speed | fixed | 530 rpm |
| Elevator speed | fixed | 410 rpm |
| Chopper type | standard | standard |
| Chopper speed | high | high |
| Chopper knife bank position | mid | mid |
| Spreader type | standard, Powercast Tailboard | Opti-Spread |
| Grain tank covers | powered covers | powered covers |
| Grain tank tent position | fully raised | fully raised |
| Drive tires | 650/85R38 duals | IF580/85R42 duals |
| Drive tire pressure | 207 kPa (30 psi) | 130 kPa (20 psi) |
| Steering tires | 750/65R26 | 750/65R26 |
| Steering tire pressure | 248 kPa (36 psi) | 200 kPa (29 psi) |
| Rated power [hp = metric hp] | 405 kW (551 hp) | 390 kW (530 hp) |

## 5.4 Test Results

The canola harvesting productivity results were based on the results of five NH CR9.90 Elevation test runs (C4, C6, C8, C10, andC12) and four JD S690 test runs (C5, C7, C9, and C11). The results of each run were calculated and then averaged. Individual test run data is in **Appendix A**.

The length of each test run was 1.47 km (0.92 mi) on 11.7 m (38.5 ft) swaths for a harvested area of 1.74 ha (4.29 ac). The harvesting duration per test ranged from 14.9 to 16.6 minutes. If time spent unplugging the feederhouse is included, test duration ranged from 14.9 to 17.8 minutes.

Tests C1 through C3 were conducted but eliminated from the results because of extreme feeding issues on the JD S690. Following test C3, adjustments were made to the JD S690, which improved feeding performance.

The testing performed was not designed to quantify crop feeding performance. Comparing the number of times each feederhouse plugs may not be a representative means to compare feeding performance. However, the number of feederhouse plugging events was the only measurable data available. On average during the valid tests (C4 through C12), the JD S690 feederhouse plugged three times per test run compared to 0.2 times for the NH CR9.90 Elevation.

An analysis of variance (ANOVA) of the test results using the general linear model in the software program Minitab (version 16) was performed. To determine if the differences in combine performance were statistically significant, a confidence level of 90% was used.

A discussion of the results of each test is given in the following sections.

### 5.4.1 Productivity and Efficiency

The windrow quality led to very difficult feeding conditions. Under these conditions, the JD S690 experienced significantly more difficulty with feeder plugging than NH CR9.90 Elevation.

Test results are calculated and presented in two formats: excluding and including time spent unplugging due to feeding issues. In PAMI's experience, the difficult feeding conditions experienced were an extreme harvesting condition, which should neither be considered normal nor represent the average canola harvesting condition. Caution must be used when considering the data that includes time spent unplugging because the cause, magnitude of a plug, and the time it takes to unplug is highly variable (which does not lead to repeatable test data). Further discussion on the JD S690 feeding issues is in **Section 5.4.3**.

The results of the combine performance in canola are compared in **Table 5-4** and **Table 5-5**. If feeding issues are excluded from the analysis, the NH CR9.90 Elevation had a 6% harvesting productivity advantage and harvested 8% more grain per liter of fuel and DEF than the JD S690. If feeding issues are included in the analysis, the NH CR9.90 Elevation had a 10% harvesting productivity advantage and harvested 9% more grain per liter of fuel and DEF.

It is noteworthy that the grain loss from the NH CR9.90 Elevation was less than from the JD S690. It is assumed that the difference between combine spreaders does not affect the grain loss collection, though it is noted that it could contribute to differences in grain loss collected. Additionally, with the variability of the crop and windrows, only two loss checks per test run also could contribute to differences in grain loss collected. Still, the lower NH CR9.90 Elevation grain loss reported implies that it has more capacity than test results show.

**Table 5-4.** Average harvesting productivity and fuel efficiency results for canola factoring time spent harvesting only (*excluding* time spent unplugging due to feeding issues).

| | **Harvesting Productivity** | | **Grain Loss** | | **Fluid Consumption Efficiency (Fuel and DEF combined)** | | |
|---|---|---|---|---|---|---|---|
| | **t/h** | **bu/h** | **kg/ha** | **bu/ac** | **kg harvested /L** | **bu harvested /gal (US)** | **Harvesting Limitation** |
| **JD S690** | 18.5 | 816 | 73 | 1.3 | 220 | 36.7 | grain loss and feeding |
| **NH CR9.90 Elevation** | 19.7 | 868 | 39 | 0.7 | 237 | 39.5 | grain loss and feeding |
| **NH compared to JD** | 106% [1] | | N/A | | 108% [1] | | N/A |

[1] Statistically significant at a 90% confidence level.

**Table 5-5.** Average harvesting productivity and fuel efficiency results for canola factoring total test duration (*including* time spent unplugging due to feeding issues).

| | **Harvesting Productivity** | | **Grain Loss (% of yield)** | | **Fluid Consumption Efficiency (Fuel and DEF combined)** | | |
|---|---|---|---|---|---|---|---|
| | **t/h** | **bu/h** | **kg/ha** | **bu/ac** | **kg harvested /L** | **bu harvested /gal (US)** | **Harvesting Limitation** |
| **JD S690** | 17.7 | 782 | 73 | 1.3 | 216 | 36.1 | grain loss and feeding |
| **NH CR9.90 Elevation** | 19.6 | 862 | 39 | 0.7 | 236 | 39.4 | grain loss and feeding |
| **NH compared to JD** | 110% [1] | | N/A | | 109% [1] | | N/A |

[1] Statistically significant at a 90% confidence level.

A grain sample was collected from each test run. A composite sample of each combine's test runs was analyzed for dockage, moisture content, and green seed count (**Table 5-6**). Though the grain dockage varies between combines, dockage levels reported are well within acceptable limits.

**Table 5-6. G**rain dockage and moisture results.

| | Dockage | Grain Moisture | Green Count |
|---|---|---|---|
| **JD S690** | 1.6% | 6.6% | 0.6% |
| **NH CR9.90 Elevation** | 1.0% | 6.6% | 1.2% |

### 5.4.2 Fuel and DEF Consumption Results

The average fluid consumption rates in canola are shown in terms of time and area harvested, both excluding and including time and fuel consumed unplugging the feederhouse due to feeding issues in **Table 5-7** and **Table 5-8.**

As shown in **Table 5-7**, excluding time and fuel used while unplugging due to feeding issues, the difference in total fluid rate per hour was negligible. The difference in fluid rate per area harvested between combines was statistically significant with the NH CR9.90 Elevation rate of 12.4 L/ha (1.32 gal US/ac) being 94% of the JD S690 rate of 13.2 L/ha (1.41 gal US/ac).

As shown in **Table 5-8**, including time and fuel used while unplugging due to feeding issues, the difference in total fluid rate per hour was negligible. Additionally, the fuel rate per hour was not statistically significant. The NH CR9.90 Elevation fluid rate per area harvested was 93% of JD S690 rate.

**Table 5-7.** Detailed fuel and DEF consumption results from canola tests (*excluding* time and fuel used while unplugging due to feeding issues).

| Fluid consumption based on time | | | | | |
|---|---|---|---|---|---|
| | Fuel Rate | | DEF rate (% of fuel by volume) | Total Fluid Rate | |
| | L/h | gal (US)/h | | L/h | gal (US)/h |
| **JD S690** | 82.5 | 21.8 | 1.9% | 84.4 | 22.3 |
| **NH CR9.90 Elevation** | 78.7 | 20.8 | 5.3% | 82.9 | 21.9 |
| **NH compared to JD** | 95% [1] | | N/A | 98% [2] | |
| | | | | | |
| **Fluid consumption based on area harvested** | | | | | |
| | Fuel Rate | | DEF rate (% of fuel by volume) | Total Fluid Rate | |
| | L/ha | gal (US)/ac | | L/ha | gal (US)/ac |
| **JD S690** | 12.9 | 1.38 | 1.9% | 13.2 | 1.41 |
| **NH CR9.90 Elevation** | 11.8 | 1.26 | 5.3% | 12.4 | 1.32 |
| **NH compared to JD** | 91% [1] | | N/A | 94% [1] | |

[1] Statistically significant at a 90% confidence level.
[2] Not statistically significant at a 90% confidence level.

**Table 5-8.** Detailed fuel and DEF consumption results from canola tests (*including* time and fuel used while unplugging due to feeding issues).

| Fluid consumption based on time | | | | | |
|---|---|---|---|---|---|
| | Fuel Rate | | DEF rate (% of fuel by volume) | Total Fluid Rate | |
| | L/h | gal (US)/h | | L/h | gal (US)/h |
| **JD S690** | 80.3 | 21.2 | 1.9% | 81.8 | 21.6 |
| **NH CR9.90 Elevation** | 78.7 | 20.8 | 5.3% | 82.9 | 21.9 |
| **NH compared to JD** | 98% [1] | | N/A | 101% [1] | |
| | | | | | |
| **Fluid consumption based on area harvested** | | | | | |
| | Fuel Rate | | DEF rate (% of fuel by volume) | Total Fluid Rate | |
| | L/ha | gal (US)/ac | | L/ha | gal (US)/ac |
| **JD S690** | 13.10 | 1.40 | 1.9% | 13.4 | 1.43 |
| **NH CR9.90 Elevation** | 11.79 | 1.26 | 5.3% | 12.4 | 1.33 |
| **NH compared to JD** | 90% [2] | | N/A | 93% [2] | |

[1] Not statistically significant at a 90% confidence level.
[2] Statistically significant at a 90% confidence level.

In canola, the NH CR9.90 Elevation DEF consumption at 5.3% of fuel (by volume) was considerably higher than the JD S690 at 1.9% of fuel. The DEF use rate (as percent of fuel) was determined in a separate test. A summary of DEF test data is shown in **Appendix A**.

### 5.4.3 Productivity Limiting Factors

The productivity limiting factor for each combine was both cleaning system grain loss and crop feeding. For both combines, in each test, ground speed was reduced or limited for both reasons.

The cleaning system grain loss is considered a normal productivity limiting factor and the harvesting productivity rate results were within the expected range for class 9 combines.

The feeding issues were due to extremely challenging windrows due to the crop variety and weather conditions. In PAMI's experience, the windrow quality was well below normal. Under these conditions, the JD S690 had much more difficulty feeding than the NH CR9.90 Elevation. If the tests were conducted in more typical windrow conditions, different feeding results could have occurred.

The number of times each combine plugged the feeder house is reported at the beginning of **Section 5.4** and in the data in **Appendix A**.

The following adjustments were made to improve feeding on the JD S690:

- Feed accelerator – high speed.
- Feeder chain tension – checked, correct tension.
- Feeder front drum – raised position.
- Feeder chain drive speed – high speed (32 tooth sprocket).
- Feeder chain slip clutch – replaced with new slip clutch.
- Belt pickup gauge wheels – adjusted to lower picking roller.
- Belt pickup belt speed – adjusted to optimize picking/feeding.
- Belt pickup belt tension – checked, correct tension.

# 6. Conclusions

## 6.1 Wheat

In the engine-power limited wheat condition tested, the results did not show statistically significant productivity performance differences between combines. Fluid consumption (fuel and DEF) in terms of grain harvested and per hour did not result in statistically significant differences. The only significant difference in performance reported was fluid consumption rate per area, where the NH CR9.90 Elevation fluid rate per area was 93% of the JD S690 rate.

## 6.2 Canola

In the canola productivity testing, when considering harvesting time only (excluding time and fuel used unplugging due to feeding issues), the NH CR9.90 Elevation combine had approximately a 6% harvesting productivity (tonne/hour) advantage over the JD S690. The NH CR9.90 Elevation harvested 8% more grain per liter of fuel and DEF than the JD S690. Lower grain loss levels for the NH CR9.90 Elevation indicate that it may have even more harvesting capacity than these test results show. The total fluid consumption (fuel and DEF) rates were approximately equal per hour. Per area harvested, the NH CR9.90 Elevation consumed 94% of the fuel and DEF that the JD S690 consumed.

The canola windrows used for testing were uneven, which led to a difficult feeding condition. Under these conditions, the NH CR9.90 Elevation combine performed considerably better than the JD S690 combine. With all available settings and adjustments made to improve feeding, the JD S690 was still much more prone to feeder plugging than the NH CR9.90 Elevation. If these tests were conducted in more typical windrows, different feeding results could have occurred.

# Appendix A

## Test Data Summary

**Table A-1.** Wheat productivity test data summary.

| WHEAT | | | | | | | | | | | | | | AVERAGE (see note 2) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Test Number** | **W2** | **W3** | **W4** | **W5** | **W6** | **W7** | **W8** | **W9** | **W10** | **W11** | **W12** | **W13** | **JD** | **NH** | **DIFFERENCE (NH less JD)** | **NH compared to JD** | **Stat analysis P value** |
| TEST DATA | **Combine** | JD S690 | NH CR9.90 Elevation | JD S690 | NH CR9.90 Elevation | JD S690 | NH CR9.90 Elevation | JD S690 | NH CR9.90 Elevation | JD S690 | NH CR9.90 Elevation | JD S690 | NH CR9.90 Elevation | | | | | |
| | **Test Accepted (Y/N)** | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | | | | | |
| | **EDAQ Run #** | 4 | 4 | 5 | 7 | 6 | 8 | 7 | 9 | 8 | 10 | 9 | 12 | | | | | |
| | **DATE** | 9/23/2015 | 9/23/2015 | 9/24/2015 | 9/24/2015 | 9/24/2015 | 9/24/2015 | 9/24/2015 | 9/24/2015 | 9/24/2015 | 9/24/2015 | 9/24/2015 | 9/24/2015 | | | | | |
| | **Time Of Day** | 4:25 PM | 5:08 PM | 1:04 PM | 1:32 PM | 2:17 PM | 2:42 PM | 3:21 PM | 3:47 PM | 4:27 PM | 4:46 PM | 5:17 PM | 5:40 PM | | | | | |
| | **Total time (s)** | 714 | 649 | 658 | 614 | 534 | 517 | 550 | 515 | 551 | 508 | 566 | 528 | | | | | |
| | **Time Turning (s)** | 20 | 23 | 21 | 17 | 18 | 20 | 18 | 20 | 17 | 18 | 14 | 20 | | | | | |
| | **Harvesting Time (s)** | 694 | 626 | 637 | 597 | 516 | 497 | 532 | 495 | 534 | 490 | 552 | 508 | | | | | |
| | **Harvesting Time (min)** | 11.6 | 10.4 | 10.6 | 10.0 | 8.6 | 8.3 | 8.9 | 8.3 | 8.9 | 8.2 | 9.2 | 8.5 | | | | | |
| | **Harvesting Time (h)** | 0.193 | 0.174 | 0.177 | 0.166 | 0.143 | 0.138 | 0.148 | 0.138 | 0.148 | 0.136 | 0.153 | 0.141 | | | | | |
| | **Fuel Used (lb)** | 33.1 | 26.4 | 32.8 | 28.7 | 26.6 | 24.3 | 27.5 | 24 | 29.2 | 24.2 | 28.9 | 26.6 | | | | | |
| | **Fuel Used (gal US)** | 4.7 | 3.7 | 4.6 | 4.0 | 3.7 | 3.4 | 3.9 | 3.4 | 4.1 | 3.4 | 4.1 | 3.7 | | | | | |
| | **DEF Rate (% of Fuel)** | 2.1 | 9.5 | 2.1 | 9.5 | 2.1 | 9.5 | 2.1 | 9.5 | 2.1 | 9.5 | 2.1 | 9.5 | | | | | |
| | **DEF Consumed (gal US)** | 0.1 | 0.4 | 0.1 | 0.4 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.4 | | | | | |
| | **Grain Harvested (kg)** | 6390 | 6255 | 6595 | 6160 | 5530 | 5535 | 5345 | 5100 | 5305 | 5090 | 5310 | 5255 | | | | | |
| | **Grain Harvested (bu)** | 234.8 | 229.8 | 242.3 | 226.3 | 203.2 | 203.4 | 196.4 | 187.4 | 194.9 | 187.0 | 195.1 | 193.1 | | | | | |
| | **Test Distance (mi)** | 0.84 | 0.84 | 0.84 | 0.84 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | | | | | |
| | **Test Area (ac)** | 3.97 | 3.97 | 3.97 | 3.97 | 3.31 | 3.31 | 3.31 | 3.31 | 3.31 | 3.31 | 3.31 | 3.31 | | | | | |
| | **Ambient Temp (°C)** | 17.7 | 17.2 | N/A | 19.4 | 20.3 | 20.8 | 21.8 | 22.3 | 20.9 | 21.1 | 19.5 | 18.4 | | | | | |
| | **RH (%)** | 41.1 | 33.0 | N/A | 36.7 | 52.0 | 47.9 | 50.1 | 43.7 | 53.0 | 53.0 | 60.3 | 63.0 | | | | | |
| | **MOG yield, both loss catch areas combined (lb)** | 4.91 | 3.12 | 3.97 | 3.98 | 4.57 | 4.37 | 5.35 | 4.56 | 5.35 | 4.37 | 4.93 | 4.76 | | | | | |
| | **Grain yield, both loss catch areas combined (lb)** | 5.48 | 5.37 | 5.66 | 5.29 | 5.69 | 5.70 | 5.50 | 5.25 | 5.46 | 5.24 | 5.47 | 5.41 | | | | | |
| | **MOG to Grain Ratio** | 0.90 | 0.58 | 0.70 | 0.75 | 0.80 | 0.77 | 0.97 | 0.87 | 0.98 | 0.83 | 0.90 | 0.88 | **0.9** | **0.8** | | | 0.160 |
| | **Grain M.C. (%)** | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | **14.4** | **14.3** | | | |
| | **Grain Dockage (%)** | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | **0.7** | **0.6** | | | |
| | **Engine % Load Average from EDAQ (see note 4)** | 79.6 | 81.6 | 88.8 | 85.5 | 87.8 | 87.7 | 88.4 | 85.0 | 90.9 | 90.3 | 90.8 | 89.7 | **87.7** | **86.6** | | | |
| | **Harvest Rate Limitation** | shoe loss | | engine power | | | | | | | | | | | | | | |
| | **Grain Yield (bu/ac)** | 59.1 | 57.9 | 61.0 | 57.0 | 61.4 | 61.5 | 59.3 | 56.6 | 58.9 | 56.5 | 59.0 | 58.4 | **59.8** | **58.0** | -1.8 | 97% | 0.066 |
| CORRECTED FOR SPRAYER TRACKS | **Sprayer Tracks (total)** | 2 | 2 | 0 | 2 | 2 | 0 | 2 | 2 | 0 | 2 | 1 | 1 | | | | | |
| | **Sprayer Track Area (ac)** | 0.13 | 0.13 | 0.00 | 0.13 | 0.11 | 0.00 | 0.11 | 0.11 | 0.00 | 0.11 | 0.05 | 0.05 | | | | | |
| | **Total crop area (ac)** | 3.84 | 3.84 | 3.97 | 3.84 | 3.20 | 3.31 | 3.20 | 3.20 | 3.31 | 3.20 | 3.26 | 3.26 | | | | | |
| | **Grain Yield, corrected for sprayer tracks (bu/ac)** | 61.1 | 59.8 | 61.0 | 58.9 | 63.4 | 61.5 | 61.3 | 58.5 | 58.9 | 58.4 | 59.9 | 59.3 | **60.9** | **59.4** | -1.6 | 97% | 0.072 |
| LOSS CATCH #1 | **Loss Catch 1 (g)** | 16 | 8 | 10 | 6 | 10 | 6 | 6 | 6 | 14 | 6 | 12 | 8 | | | | | |
| | **Loss (bu/ac)** | 0.8 | 0.4 | 0.5 | 0.3 | 0.5 | 0.3 | 0.3 | 0.3 | 0.7 | 0.3 | 0.6 | 0.4 | **0.5** | **0.3** | | | |
| | **MOG + Loss (lb)** | 2.2 | 1.4 | 2.2 | 2.0 | 3.0 | 2.4 | 2.6 | 2.4 | 2.8 | 2.2 | 2.4 | 2.4 | **2.5** | **2.1** | | | |
| | **Left Cut Height (in)** | 9.5 | 11 | 10 | 11 | 8 | 10 | 7 | 8 | 8 | 6 | 10 | 9 | | | | | |
| | **Center Cut Height (in)** | 10 | 10 | 10 | 10 | 8 | 9 | 6 | 11 | 9 | 7 | 8 | 9 | | | | | |
| | **Right Cut Height (in)** | 10 | 11 | 11 | 10 | 9 | 7 | 5 | 12 | 10 | 9 | 8 | 9 | | | | | |
| | **AVG Cut Height (in)** | 9.8 | 10.7 | 10.3 | 10.3 | 8.3 | 8.7 | 6.0 | 10.3 | 9.0 | 7.3 | 8.7 | 9.0 | **8.7** | **9.4** | | | |
| LOSS CATCH #2 | **Loss Catch 2 (g)** | 24 | 30 | 4 | 4 | 2 | 6 | 16 | 14 | 10 | 6 | 22 | 12 | | | | | |
| | **Loss (bu/ac)** | 1.1 | 1.4 | 0.2 | 0.2 | 0.1 | 0.3 | 0.8 | 0.7 | 0.5 | 0.3 | 1.0 | 0.6 | **0.6** | **0.6** | | | |
| | **MOG + Loss (lb)** | 2.8 | 1.8 | 1.8 | 2.0 | 1.6 | 2.0 | 2.8 | 2.2 | 2.6 | 2.2 | 2.6 | 2.4 | **2.4** | **2.1** | | | |
| | **Left Cut Height (in)** | 9 | 9 | 9 | 7 | 16 | 10 | 7 | 7 | 8 | 8 | 7 | 10 | | | | | |
| | **Center Cut Height (in)** | 10 | 15 | 11 | 8 | 15 | 11 | 7 | 9 | 5 | 10 | 8 | 10 | | | | | |
| | **Right Cut Height (in)** | 10 | 11 | 11 | 8 | 15 | 10 | 9 | 10 | 6 | 11 | 8 | 10 | | | | | |
| | **AVG Cut Height (in)** | 9.7 | 11.7 | 10.3 | 7.7 | 15.3 | 10.3 | 7.7 | 8.7 | 6.3 | 9.7 | 7.7 | 10.0 | **9.5** | **9.7** | | | |
| | **AVG Loss (bu/ac)** | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | **0.6** | **0.4** | | | 0.325 |
| RESULTS | **Grain Feedrate (bu/h)** | 1218 | 1322 | 1369 | 1365 | 1418 | 1473 | 1329 | 1363 | 1314 | 1374 | 1272 | 1368 | **1320** | **1377** | 57 | 104% | 0.136 |
| | **Average Ground Speed (mph)** | 4.4 | 4.8 | 4.7 | 5.1 | 4.9 | 5.1 | 4.7 | 5.1 | 4.7 | 5.1 | 4.6 | 5.0 | **4.7** | **5.0** | 0.36 | 108% | 0.002 |
| | **Area Harvest Rate (ac/h)** | 19.9 | 22.1 | 22.4 | 23.2 | 22.3 | 24.0 | 21.7 | 23.3 | 22.3 | 23.5 | 21.2 | 23.1 | **21.7** | **23.2** | 1.53 | 107% | |
| | **Fuel Rate (gal US/h)** | 24.2 | 21.4 | 26.1 | 24.4 | 26.1 | 24.8 | 26.2 | 24.6 | 27.7 | 25.0 | 26.5 | 26.5 | **26.2** | **24.5** | -1.7 | 94% | 0.069 |
| | **Fuel Rate (gal US/ac)** | 1.21 | 0.97 | 1.16 | 1.05 | 1.17 | 1.03 | 1.21 | 1.06 | 1.24 | 1.06 | 1.25 | 1.15 | **1.21** | **1.05** | -0.15 | 87% | 0.000 |
| | **Grain Harvested per Fuel (bu/gal US)** | 50.4 | 61.8 | 52.5 | 56.0 | 54.2 | 59.4 | 50.7 | 55.4 | 47.4 | 54.9 | 47.9 | 51.5 | **50.5** | **56.5** | 6.0 | 112% | 0.008 |
| | **DEF Rate (gal US/h)** | 0.5 | 2.0 | 0.5 | 2.3 | 0.5 | 2.4 | 0.6 | 2.3 | 0.6 | 2.4 | 0.6 | 2.5 | **0.5** | **2.3** | 1.8 | 423% | 0.000 |
| | **DEF Rate (gal US/ac)** | 0.03 | 0.09 | 0.02 | 0.10 | 0.02 | 0.10 | 0.03 | 0.10 | 0.03 | 0.10 | 0.03 | 0.11 | **0.03** | **0.10** | 0.1 | 395% | 0.000 |
| | **Fluid Rate (gal US/h)** | 24.7 | 23.4 | 26.7 | 26.7 | 26.7 | 27.1 | 26.8 | 26.9 | 28.3 | 27.4 | 27.1 | 29.1 | **26.7** | **26.8** | 0.1 | 100% | 0.934 |
| | **Fluid Rate (gal US/ac)** | 1.24 | 1.06 | 1.19 | 1.15 | 1.19 | 1.13 | 1.23 | 1.16 | 1.27 | 1.17 | 1.28 | 1.26 | **1.23** | **1.15** | -0.08 | 94% | 0.026 |
| | **Grain Harvested per Fluid (bu/gal US)** | 49.3 | 56.4 | 51.4 | 51.1 | 53.1 | 54.3 | 49.7 | 50.6 | 46.4 | 50.1 | 46.9 | 47.1 | **49.5** | **51.6** | 2.1 | 104% | 0.239 |

NOTES:
1. Test W1 eliminated due to stopwatch and grain loss check errors.
2. For JD, averaged results include tests W2, W4, W6, W8, W10, and W12. For NH, averaged results include tests W3, W5, W7, W9, W11, and W13.
3. Fuel use for test W2 taken from EDAQ data. Recorded value of 40.4 lb was deemed a recording error, since it results in 25% higher consumption than any other test run.
4. Engine % load is for indication only. The EDAQ records any value greater than 100 as 100. This parameter is used to show consistency and relative comparison. Absolute numbers are not representative.
5. Due to significant figures and the effects of rounding and conversions, values reported in the body of the report may not exactly match this table.

| CONSTANTS | | |
|---|---|---|
| Wheat | 60 | lb/bu |
| Diesel | 7.1 | lb/gal US |
| Loss catch area | 33.67 | $ft^2$ |
| Header cut width | 39.0 | ft |
| Sprayer Tire Width | 1.25 | ft |
| Sprayer Tire Width | 0.381 | m |

| CONVERSIONS | |
|---|---|
| 2.2046 | lb/kg |
| 5280 | ft/mi |
| 43560 | $ft^2$/ac |
| 2.47105 | ac/ha |
| 3.28084 | ft/m |
| 3.78541 | L/gal US |

**Table A-2.** DEF use test summary for wheat and canola.

| | WHEAT | | | CANOLA | |
|---|---|---|---|---|---|
| **TEST** | NH Test 1 | NH Test 2 | JD Test 1 | NH Test 1 | JD Test 1 |
| **Date** | 9/24/2015 | 9/25/2015 | 9/25/2015 | 9/30/2015 | 9/30/2015 |
| **Start time** | 11:27 a.m. | 6:27 p.m. | 6:02 p.m. | 12:36 p.m. | 1:27 p.m. |
| **Temp (°C)** | 13.7 | 21.3 | 24.8 | 19.2 | 19.4 |
| **RH (%)** | 65.8 | 59.9 | 51.6 | 48.7 | 42.9 |
| **Test Duration (s)** | 2282 | 1020 | 1035 | 2108 | 2310 |
| **Test Duration (min)** | 38.0 | 17.0 | 17.3 | 35.1 | 38.5 |
| **Test Duration (h)** | 0.634 | 0.283 | 0.288 | 0.586 | 0.642 |
| **Fuel Consumed (lb)** | 99.4 | 49.5 | 60.86 | 94.8 | 104.5 |
| **Fuel Consumed (gal US)** | 14.0 | 7.0 | 8.6 | 13.4 | 14.7 |
| **Fuel Rate (gal US/h)** | 22.1 | 24.6 | 29.8 | 22.8 | 22.9 |
| **DEF Consumed (lb)** | 8.8 | 6.0 | 1.6 | 6.4 | 2.6 |
| **DEF Consumed (gal US)** | 0.97 | 0.66 | 0.18 | 0.70 | 0.29 |
| **Total Fluids Rate (gal US/h)** | 23.6 | 26.9 | 30.4 | 24.0 | 23.4 |
| **Grain Harvested (kg)** | 18250 | 10645 | 10050 | 10905 | 10595 |
| **Grain Harvested (bu)** | 671 | 391 | 369 | 481 | 467 |
| **Grain Feedrate (bu/h)** | 1058 | 1380 | 1284 | 821 | 728 |
| **Area harvested (ac)** | 12.07 | 6.70 | 6.70 | 8.59 | 8.59 |
| **Engine % Load AVG from EDAQ (see note 2)** | 81.8 | 91.3 | 94.0 | 86.7 | 80.0 |
| **DEF usage by vol (as % of fuel)** | 6.9% | **9.5%** | **2.1%** | **5.3%** | **1.9%** |
| **Grain Yield, average (bu/ac)** | N/A | 56.7 | | 55.2 | |
| **Harvesting Limitation** | N/A | engine power | | grain loss/feeding | |

Notes:
1. NH Wheat Test 1 was not utilized because the JD combine was not tested immediately following.
2. Engine % load is for indication only. The EDAQ records any value greater than 100 as 100. This parameter is used to show consistency and relative comparison. Absolute numbers are not representative.
3. Due to significant figures and the effects of rounding and conversions, values reported in the body of the report may not exactly match this table.

| CONSTANTS | | |
|---|---|---|
| Wheat | 60 | lb/bu |
| Canola | 50 | lb/bu |
| Diesel | 7.1 | lb/gal US |
| DEF | 2.403 | lb/L |
| DEF | 9.096 | lb/gal US |

| CONVERSIONS | |
|---|---|
| 2.2046 | lb/kg |
| 5280 | ft/mi |
| 43560 | $ft^2$/ac |
| 2.4711 | ac/ha |

**Table A-3.** Canola productivity test data summary.

| CANOLA | | | | | | | | | | | | | | | | AVERAGE (see note 1) | | Difference | NH compared | Stat analysis |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Test Number** | C1 | C2 | C3 | **C4** | **C5** | **C6** | **C7** | **C8** | **C9** | **C10** | **C11** | **C12** | C13 | C14 | **JD** | **NH** | (NH less JD) | to JD | P value |
| **TEST DATA** | **Combine** | NH CR9.90 Elevation | JD S690 | JD S690 | NH CR9.90 Elevation | JD S690 | NH CR9.90 Elevation | JD S690 | NH CR9.90 Elevation | JD S690 | NH CR9.90 Elevation | JD S690 | NH CR9.90 Elevation | JD S690 | NH CR9.90 Elevation | | | | | |
| | **Test Accepted (Y/N)** | See note 2 | | | Y | Y | Y | Y | Y | Y | Y | Y | Y | See note 3 | | | | | | |
| | **EDAQ RUN #** | 16 | 13 | 14 | 17 | 15 | 18 | 16 | 19 | 17 | 20 | 18 | 21 | 2 | 24 | | | | | |
| | **Date** | 9/28/2015 | 9/28/2015 | 9/29/2015 | 9/29/2015 | 9/29/2015 | 9/29/2015 | 9/29/2015 | 9/29/2015 | 9/29/2015 | 9/29/2015 | 9/29/2015 | 9/29/2015 | 9/30/2015 | 9/30/2015 | | | | | |
| | **Time Of Day** | 4:49 PM | 5:17 PM | 12:11 PM | 12:42 PM | 1:36 PM | 2:04 PM | 3:00 PM | 3:28 PM | 4:16 PM | 4:40 PM | 5:10 PM | 5:41 PM | 2:49 PM | 3:16 PM | | | | | |
| | **Total Test Duration from stopwatch (s)** | 1031 | 1536 | 1461 | 1067 | 1139 | 1038 | 1076 | 973 | 1063 | 976 | 1064 | 1015 | 1205 | 1249 | | | | | |
| | **Time turning + loss pan from stopwatch (s)** | 84 | 90 | 72 | 98 | 69 | 65 | 63 | 78 | 61 | 58 | 60 | 77 | 60 | 67 | | | | | |
| | **Total Test Time (s) See note 4** | 947 | 1446 | 1389 | 969 | 1070 | 973 | 1013 | 895 | 1002 | 915 | 1004 | 938 | 1145 | 1182 | **1022.25** | **938.00** | | | |
| | **Total Test Time (min) See note 4** | 15.8 | 24.1 | 23.2 | 16.2 | 17.8 | 16.2 | 16.9 | 14.9 | 16.7 | 15.3 | 16.7 | 15.6 | 19.1 | 19.7 | | | | | |
| | **Number of Feeder Stalls/Plugs** | 0 | 11 | 5 | 0 | 4 | 1 | 3 | 0 | 2 | 0 | 3 | 0 | 3 | 3 | | | | | |
| | **Harvesting Time (time @ > 0.1mph) via EDAQ (s)** | 946 | 1212 | 1232 | 969 | 995 | 942 | 979 | 895 | 980 | 915 | 962 | 938 | 1094 | 1083 | | | | | |
| | **Harvesting Time (time @ > 0.1mph) via EDAQ (min)** | 15.8 | 20.2 | 20.5 | 16.2 | 16.6 | 15.7 | 16.3 | 14.9 | 16.3 | 15.3 | 16.0 | 15.6 | 18.2 | 18.1 | | | | | |
| | **Harvesting Time (time @ > 0.1mph) via EDAQ (h)** | 0.263 | 0.337 | 0.342 | 0.269 | 0.276 | 0.262 | 0.272 | 0.249 | 0.272 | 0.254 | 0.267 | 0.261 | 0.304 | 0.301 | **0.27** | **0.26** | | | |
| | **Fuel Used as measured by weight (lb)** | 40.5 | 53.9 | 48.5 | 39.9 | 46.0 | 40.6 | 44.3 | 36.2 | 45.0 | 37.9 | 44.2 | 39.2 | 49.8 | 45.9 | | | | | |
| | **Fuel Used as measured by weight (gal US)** | 5.7 | 7.6 | 6.8 | 5.6 | 6.5 | 5.7 | 6.2 | 5.1 | 6.3 | 5.3 | 6.2 | 5.5 | 7.0 | 6.5 | | | | | |
| | **Fuel Used as measured by weight (L)** | 21.6 | 28.7 | 25.9 | 21.3 | 24.5 | 21.6 | 23.6 | 19.3 | 24.0 | 20.2 | 23.6 | 20.9 | 26.6 | 24.5 | | | | | |
| | **Grain Gross Weight (kg)** | 5860 | 5255 | 5910 | 5295 | 5285 | 5215 | 5260 | 5250 | 5275 | 5375 | 5290 | 5530 | 5625 | 5710 | | | | | |
| | **Grain Tare Weight (kg)** | 855 | 240 | 180 | 220 | 220 | 235 | 245 | 250 | 250 | 255 | 265 | 250 | 210 | 215 | | | | | |
| | **Grain Harvested, Net (kg)** | 5005 | 5015 | 5730 | 5075 | 5065 | 4980 | 5015 | 5000 | 5025 | 5120 | 5025 | 5280 | 5415 | 5495 | | | | | |
| | **Grain Harvested, Net (bu)** | 220.7 | 221.1 | 252.6 | 223.8 | 223.3 | 219.6 | 221.1 | 220.5 | 221.6 | 225.8 | 221.6 | 232.8 | 238.8 | 242.3 | | | | | |
| | **Test Distance (miles)** | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | | | | | |
| | **Test Area (acres)** | 4.29 | 4.29 | 4.29 | 4.29 | 4.29 | 4.29 | 4.29 | 4.29 | 4.29 | 4.29 | 4.29 | 4.29 | 4.29 | 4.29 | | | | | |
| | **Ambient Temp (°C)** | 11.5 | 10.7 | 19.0 | 18.5 | 19.2 | 20.3 | 22.5 | 22.2 | 20.3 | 20.2 | 19.4 | 19.1 | 21.2 | 21.6 | | | | | |
| | **RH (%)** | 23.1 | 23.0 | 33.5 | 31.0 | 24.2 | 24.3 | 20.6 | 21.8 | 27.3 | 27.1 | 27.8 | 29.3 | 47.1 | 41.9 | | | | | |
| | **Windspeed min (fpm)** | ---- | ---- | ---- | 450 | 530 | 860 | 450 | 540 | 500 | 550 | 510 | 460 | ---- | ---- | | | | | |
| | **Windspeed max (fpm)** | ---- | ---- | ---- | 760 | 980 | 1100 | 700 | 720 | 710 | 950 | 790 | 620 | ---- | ---- | | | | | |
| | **MOG yield, both loss catches combined (lb)** | 5.51 | 5.72 | 5.37 | 4.95 | 5.52 | 4.35 | 6.07 | 5.75 | 6.67 | 5.93 | 5.74 | 7.57 | 5.54 | 5.79 | | | | | |
| | **Grain yield, over area of both loss catches (lb)** | 3.97 | 3.98 | 4.55 | 4.03 | 4.02 | 3.95 | 3.98 | 3.97 | 3.99 | 4.06 | 3.99 | 4.19 | 4.30 | 4.36 | | | | | |
| | **MOG to Grain Ratio** | 1.39 | 1.44 | 1.18 | 1.23 | 1.37 | 1.10 | 1.52 | 1.45 | 1.67 | 1.46 | 1.44 | 1.81 | 1.29 | 1.33 | **1.50** | **1.41** | | | 0.547 |
| | **Grain M.C. (%)** | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | **6.7** | **6.6** | | | |
| | **Grain Dockage (%)** | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | **1.6** | **1.0** | | | |
| | **Green Count (%)** | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | **0.6** | **1.2** | | | |
| | **Engine % Load AVG from EDAQ (see note 5)** | 82.9 | 74.2 | 72.1 | 82.2 | 78.0 | 81.0 | 80.0 | 81.6 | 79.6 | 80.8 | 79.7 | 82.1 | 79.4 | 79.3 | **79.3** | **81.5** | | | |
| | **Harvesting Productivity Limitation** | grain loss/feeding | | | grain loss/feeding | | | | | | | | | 3.3 mph | | | | | | |
| | **Grain Yield (bu/ac)** | 51.4 | 51.5 | 58.8 | 52.1 | 52.0 | 51.1 | 51.5 | 51.3 | 51.6 | 52.6 | 51.6 | 54.2 | 55.6 | 56.4 | **51.7** | **52.3** | | | |
| **LOSS CATCH #1** | **Loss Catch 1 (g)** | 22 | 22 | 10 | 18 | 12 | 10 | 30 | 2 | 34 | 18 | 24 | 10 | 24 | 2 | | | | | |
| | **Loss (bu/ac)** | 1.3 | 1.3 | 0.6 | 1.0 | 0.7 | 0.6 | 1.7 | 0.1 | 1.9 | 1.0 | 1.4 | 0.6 | 1.4 | 0.1 | **1.4** | **0.7** | | | |
| | **MOG + Loss (lb)** | 3.0 | 2.6 | 2.6 | 2.6 | 2.6 | 2.4 | 3.2 | 3.0 | 3.8 | 3.4 | 3.6 | 3.8 | 3.4 | 2.8 | **3.3** | **3.0** | | | |
| | **Left Cut Height (in)** | 9 | 5 | 8 | 9 | 8 | 9 | 11 | 8 | 6 | 6 | 7 | 6 | 8 | 9 | | | | | |
| | **Center Cut Ht (in)** | 8 | 3 | 8 | 6 | 14 | 6 | 7 | 7 | 6 | 5 | 6 | 5 | 7 | 9 | | | | | |
| | **Right Cut Height (in)** | 10 | 3 | 10 | 10 | 9 | 9 | 8 | 8 | 9 | 6 | 5 | 5 | 6 | 11 | | | | | |
| | **Average Cut Height (in)** | 9.0 | 3.7 | 8.7 | 8.3 | 10.3 | 8.0 | 8.7 | 7.7 | 7.0 | 5.7 | 6.0 | 5.3 | 7.0 | 9.7 | **8.0** | **7.0** | | | |
| **LOSS CATCH #2** | **Loss Catch 2 (g)** | 18 | 16 | 4 | 6 | 24 | 14 | 30 | 20 | 24 | 12 | 4 | 4 | 2 | 4 | | | | | |
| | **Loss (bu/ac)** | 1.0 | 0.9 | 0.2 | 0.3 | 1.4 | 0.8 | 1.7 | 1.1 | 1.4 | 0.7 | 0.2 | 0.2 | 0.1 | 0.2 | **1.2** | **0.6** | | | |
| | **MOG + Loss (lb)** | 2.6 | 3.2 | 2.8 | 2.4 | 3.0 | 2.0 | 3.0 | 2.8 | 3.0 | 2.6 | 2.2 | 3.8 | 2.2 | 3.0 | **2.8** | **2.7** | | | |
| | **Left Cut Height (in)** | 13 | 12 | 13 | 11 | 12 | 11 | 12 | 11 | 14 | 15 | 12 | 12 | 14 | 8 | | | | | |
| | **Center Cut Ht (in)** | 9 | 10 | 12 | 8 | 10 | 12 | 8 | 10 | 11 | 13 | 11 | 11 | 10 | 10 | | | | | |
| | **Right Cut Height (in)** | 10 | 11 | 13 | 12 | 10 | 12 | 10 | 11 | 13 | 13 | 11 | 11 | 10 | 8 | | | | | |
| | **Average Cut Height (in)** | 10.7 | 11.0 | 12.7 | 10.3 | 10.7 | 11.7 | 10.0 | 10.7 | 12.7 | 13.7 | 11.3 | 11.3 | 11.3 | 8.7 | **11.2** | **11.5** | | | |
| | **Average Loss (bu/ac)** | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | **1.3** | **0.7** | | | 0.009 |
| **RESULTS EXCLUDING PLUGS and TURNING** | **Grain Feedrate (bu/h)** | **840** | **657** | **738** | **831** | **808** | **839** | **813** | **887** | **814** | **888** | **829** | **893** | 786 | 805 | **816** | **868** | **52** | **106%** | 0.013 |
| | **Area Harvest Rate (ac/h)** | 16.3 | 12.8 | 12.5 | 16.0 | 15.5 | 16.4 | 15.8 | 17.3 | 15.8 | 16.9 | 16.1 | 16.5 | 14.1 | 14.3 | **15.8** | **16.6** | | | |
| | **Average Ground Speed (mph)** | 3.5 | 2.7 | 2.7 | 3.4 | 3.3 | 3.5 | 3.4 | 3.7 | 3.4 | 3.6 | 3.4 | 3.5 | 3.0 | 3.1 | **3.4** | **3.6** | | | |
| | **Fuel Used via EDAQ (L)** | 21.5 | 26.3 | 25.8 | 21.43 | 22.41 | 20.41 | 22.71 | 19.66 | 22.62 | 19.85 | 22.19 | 20.76 | 25.36 | 22.90 | | | | | |
| | **Fuel Used via EDAQ (gal US)** | 5.7 | 7.0 | 6.8 | 5.7 | 5.9 | 5.4 | 6.0 | 5.2 | 6.0 | 5.2 | 5.9 | 5.5 | 6.7 | 6.0 | | | | | |
| | **DEF Rate (% of Fuel)** | 5.3 | 1.9 | 1.9 | 5.3 | 1.9 | 5.3 | 1.9 | 5.3 | 1.9 | 5.3 | 1.9 | 5.3 | 1.9 | 5.3 | | | | | |
| | **DEF Consumed (gal US)** | 0.3 | 0.1 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 | | | | | |
| | **DEF Rate (gal US/h)** | 1.1 | 0.4 | 0.4 | 1.1 | 0.4 | 1.1 | 0.4 | 1.1 | 0.4 | 1.1 | 0.4 | 1.1 | 0.4 | 1.1 | **0.4** | **1.1** | 0.7 | **266%** | 0.000 |
| | **DEF Rate (gal US/acre)** | 0.07 | 0.03 | 0.03 | 0.07 | 0.03 | 0.07 | 0.03 | 0.06 | 0.03 | 0.06 | 0.03 | 0.07 | 0.03 | 0.07 | **0.03** | **0.07** | 0.04 | **253%** | 0.000 |
| | **Fuel Rate (gal US/h)** | 21.6 | 20.7 | 19.9 | 21.0 | 21.4 | 20.6 | 22.1 | 20.9 | 22.0 | 20.6 | 21.9 | 21.0 | 22.0 | 20.1 | **21.8** | **20.8** | -1.0 | **95%** | 0.001 |
| | **Fuel Rate (gal US/acre)** | 1.32 | 1.62 | 1.59 | 1.32 | 1.38 | 1.26 | 1.40 | 1.21 | 1.39 | 1.22 | 1.37 | 1.28 | 1.56 | 1.41 | **1.38** | **1.26** | -0.13 | **91%** | 0.001 |
| | **Grain Harvested per Fuel (bu/gal US)** | 38.9 | 31.8 | 37.0 | 39.5 | 37.7 | 40.7 | 36.9 | 42.4 | 37.1 | 43.1 | 37.8 | 42.5 | 35.6 | 40.1 | **37.4** | **41.6** | 4.3 | **111%** | 0.001 |
| | **Fluid Rate (gal US/h)** | 22.7 | 21.1 | 20.3 | 22.1 | 21.8 | 21.7 | 22.5 | 22.0 | 22.4 | 21.7 | 22.4 | 22.2 | 22.5 | 21.2 | **22.3** | **21.9** | -0.3 | **99%** | 0.113 |
| | **Fluid Rate (gal US/acre)** | 1.4 | 1.7 | 1.6 | 1.4 | 1.4 | 1.3 | 1.4 | 1.3 | 1.4 | 1.3 | 1.4 | 1.3 | 1.6 | 1.5 | **1.41** | **1.32** | -0.09 | **94%** | 0.009 |
| | **Grain Harvested per Fluid Consumed (bu/gal US)** | 36.9 | 31.2 | 36.3 | 37.5 | 37.0 | 38.7 | 36.2 | 40.3 | 36.4 | 40.9 | 37.1 | 40.3 | 35.0 | 38.0 | **36.7** | **39.5** | 2.9 | **108%** | 0.006 |
| **RESULTS INCLUDING PLUGS, EXCLUDING TURNING** | **Grain Feedrate (bu/h)** | **839** | **551** | **655** | **831** | **751** | **812** | **786** | **887** | **796** | **888** | **794** | **893** | 751 | 738 | **782** | **862** | **81** | **110%** | 0.007 |
| | **Area Harvest Rate (ac/h)** | 16.3 | 10.7 | 11.1 | 16.0 | 14.4 | 15.9 | 15.3 | 17.3 | 15.4 | 16.9 | 15.4 | 16.5 | 13.5 | 13.1 | **15.1** | **16.5** | | | |
| | **Average Ground Speed (mph)** | 3.5 | 2.3 | 2.4 | 3.4 | 3.1 | 3.4 | 3.3 | 3.7 | 3.3 | 3.6 | 3.3 | 3.5 | 2.9 | 2.8 | **3.2** | **3.5** | | | |
| | **Fuel Used via EDAQ (L)** | N/A | N/A | N/A | 21.43 | 22.94 | 20.72 | 22.97 | 19.66 | 22.83 | 19.85 | 22.55 | 20.76 | 25.84 | 24.06 | | | | | |
| | **Fuel Used via EDAQ (gal US)** | N/A | N/A | N/A | 5.7 | 6.1 | 5.5 | 6.1 | 5.2 | 6.0 | 5.2 | 6.0 | 5.5 | 6.8 | 6.4 | | | | | |
| | **DEF Rate (%of Fuel)** | N/A | N/A | N/A | 5.3 | 1.9 | 5.3 | 1.9 | 5.3 | 1.9 | 5.3 | 1.9 | 5.3 | 1.9 | 5.3 | | | | | |
| | **DEF Consumed (gal US)** | N/A | N/A | N/A | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 | | | | | |
| | **DEF Rate (gal US/h)** | N/A | N/A | N/A | 1.1 | 0.4 | 1.1 | 0.4 | 1.1 | 0.4 | 1.1 | 0.4 | 1.1 | 0.4 | 1.1 | **0.4** | **1.1** | 0.7 | **273%** | 0.000 |
| | **DEF Rate (gal US/acre)** | N/A | N/A | N/A | 0.07 | 0.03 | 0.07 | 0.03 | 0.06 | 0.03 | 0.06 | 0.03 | 0.07 | 0.03 | 0.08 | **0.03** | **0.07** | 0.04 | **250%** | 0.000 |
| | **Fuel Rate (gal US/h)** | N/A | N/A | N/A | 21.0 | 20.4 | 20.3 | 21.6 | 20.9 | 21.7 | 20.6 | 21.4 | 21.0 | 21.5 | 19.4 | **21.2** | **20.8** | -0.5 | **98%** | 0.167 |
| | **Fuel Rate (gal US/acre)** | N/A | N/A | N/A | 1.32 | 1.41 | 1.27 | 1.41 | 1.21 | 1.40 | 1.22 | 1.39 | 1.28 | 1.59 | 1.48 | **1.40** | **1.26** | -0.14 | **90%** | 0.000 |
| | **Grain Harvested per Fuel (bu/gal US)** | N/A | N/A | N/A | 39.5 | 36.9 | 40.1 | 36.4 | 42.4 | 36.7 | 43.1 | 37.2 | 42.5 | 35.0 | 38.1 | **36.8** | **41.5** | 4.7 | **113%** | 0.001 |
| | **Fluid Rate (gal US/h)** | N/A | N/A | N/A | 22.1 | 20.8 | 21.3 | 22.0 | 22.0 | 22.1 | 21.7 | 21.8 | 22.2 | 21.9 | 20.4 | **21.6** | **21.9** | 0.2 | **101%** | 0.506 |
| | **Fluid Rate (gal US/acre)** | N/A | N/A | N/A | 1.4 | 1.4 | 1.3 | 1.4 | 1.3 | 1.4 | 1.3 | 1.4 | 1.3 | 1.6 | 1.6 | **1.43** | **1.33** | -0.10 | **93%** | 0.004 |
| | **Grain Harvested per Fluid Consumed (bu/gal US)** | N/A | N/A | N/A | 37.5 | 36.2 | 38.1 | 35.8 | 40.3 | 36.1 | 40.9 | 36.5 | 40.3 | 34.3 | 36.2 | **36.1** | **39.4** | 3.3 | **109%** | 0.004 |

Notes:

1. For JD, averaged results include tests C5, C7, C9, and C11. For NH, averaged results include tests C4, C6, C8, C10, and C12.
2. Tests C1, C2, and C3 are not included in averaged test results. Following test C3, adjustments were made to JD feeder house which improved feeding performance.
3. Tests C13 and C14 are not included in averaged test results. C13 and C14 were "fixed speed" tests at target speed of 3.3 mph.
4. Total time, less time spent turning @ headland and time spent reloading the 2nd loss pan. This time includes time spent de-slugging feederhouse.
5. Engine % load is for indication only. The EDAQ records any value greater than 100 as 100. This parameter is used to show consistency and relative comparison. Absolute numbers are not representative.
6. Due to significant figures and the effects of rounding and conversions, values reported in the body of the report may not exactly match this table.

| CONSTANTS | | |
|---|---|---|
| Loss Catch area | 33.67 | ft^2 |
| Header cut | 38.5 | ft |
| Canola | 50 | lb/bu |
| Diesel | 7.1 | lb/gal US |

| CONVERSIONS | |
|---|---|
| 2.2046 | lb/kg |
| 5280 | ft/mile |
| 43560 | $ft^2$/acre |
| 3.7854 | L/gal US |
| 3.2808 | ft/m |
| 2.4711 | ac/ha |

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