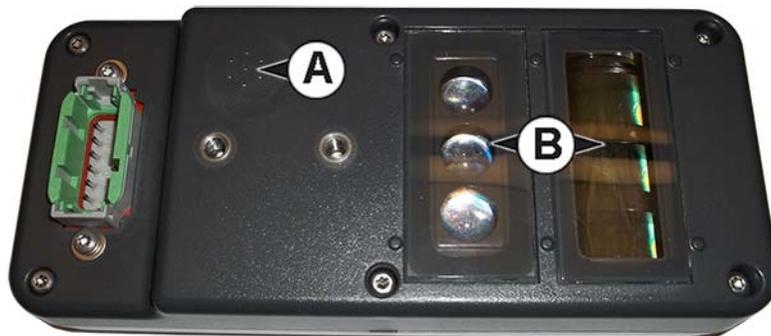


OptRx uses sensors, usually mounted on the sprayer's booms, to assess reflected light to determine plant vigor. It assigns numeric values to the varying levels of vigor to create a Vegetative Index (VI). Using the VI, OptRx calculates nitrogen application rates, to apply a variable rate on the go. OptRx creates nitrogen rates either by using the N Algorithm or by using the user defined Application Rate Table. OptRx can also be used for scanning purposes.

 Attention: Proper care of sensor will ensure accuracy and dependability.

Sensor is designed with a vent (A) to prevent moisture from accumulating and damaging the electronics. Use care when attaching/using/storing sensor, so that nothing blocks the vent.

Ensure that the optics (B) are not exposed to direct water and sunlight for extended periods of time. Because direct sun (UV light) can be destructive, sensor should be oriented so that optics face the ground (even when not in use). To maximize the life and performance of sensors, they should be removed from equipment and housed in a protective environment when not in use.



Load Configuration

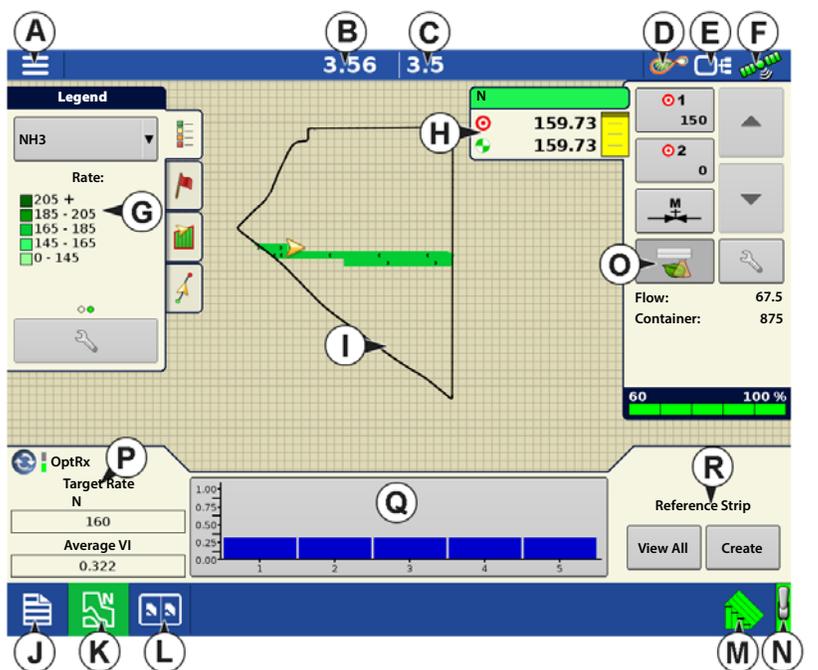


Press the Application App from the home screen. This will take you through the steps needed to load a configuration.

Once a configuration has been completed, the Map View screen appears.

Map View

- A. Menu button
- B. Total Logged Field Area
- C. Ground Speed
- D. AgFiniti Status
- E. Diagnostics
- F. GPS Signal Indicator
- G. Display Legend
- H. Product Control toolbox
- I. Vehicle Icon
- J. Event Summary
- K. Map View
- L. Split screen
- M. AutoSwath
- N. Master Switch Status
- O. OptRx button
- P. Target Rate/Average VI
- Q. Bar Graph
- R. Reference Strip buttons

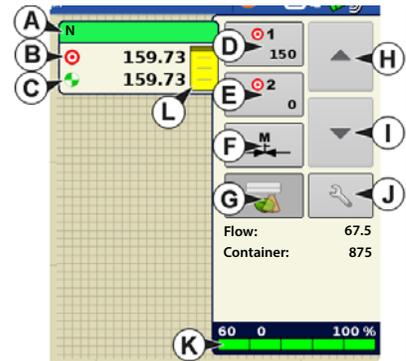




NOTE! Pressing the Map View button will cycle between the available Map Screen views, and the appearance of the Map View button changes.

Product Control Toolbox

During DirectCommand Run Time operations, the Product Tabs are shown in the upper right-hand side of the Map screen. Press the Product Tabs, and an extended view shows the Rate buttons, Manual Valve Control button, Prescription button, Rate Increase and Rate Decrease arrows, and the Rate Setup button, all of which are described below.



- A. Product
- B. Target Rate
- C. Actual Rate
- D. Rate 1 button
- E. Rate 2 button
- F. Manual Valve Control
- G. OptRx button
- H. Rate Increase arrow
- I. Rate Decrease arrow
- J. Rate Setup button
- K. Section Status Indicator
- L. Container Level

Target Rate—The Target Rate is desired application rate.



NOTE! In some conditions, the Target Rate may increment more quickly than the Actual Rate.

Actual Rate—The Flow Sensor returns the actual rate being applied.



NOTE! In some conditions, the Actual Rate may increment slower than the Target Rate, or its numeric values may vary before matching the Target Rate.

Container Level—The Container Level shows the amount of product in the container.

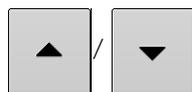


Rate 1 and Rate 2 buttons—The Rate 1 and Rate 2 settings represent preset application rates that allow operators to quickly change between desired target rates for each individual product.



Manual Valve Control button — The Manual Valve Control button allows operators to specify the position of the control valve. Operators use this option to prime the system before application or clean out the equipment at the end of the day.

Rate Increase and Decrease Arrows —



allow Product Application Rate to be changed according to

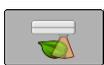
the Target Rate Increment. In using manual valve control, the increase and decrease buttons allow the position of the control valve to be defined by the operator.

Prescription button—



Rate Setup button—





Press the OptRx prescription button to engage the OptRx system to apply variable rate N, based on data received from the sensors. The OptRx button will not be selectable until a Reference Strip is made or Application Rate Table is in use.

Create Configuration

A wizard will guide you through the process of selecting or creating a configuration with application settings.

The configuration can be started in two places:



OR



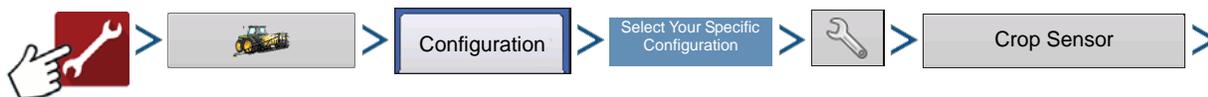
Your Operating Configuration will then be viewable when you start a new Field Operation with the Application Wizard.



You can also use the **Manage Equipment** button to create or edit specific vehicles and implements.

Application Rate Table

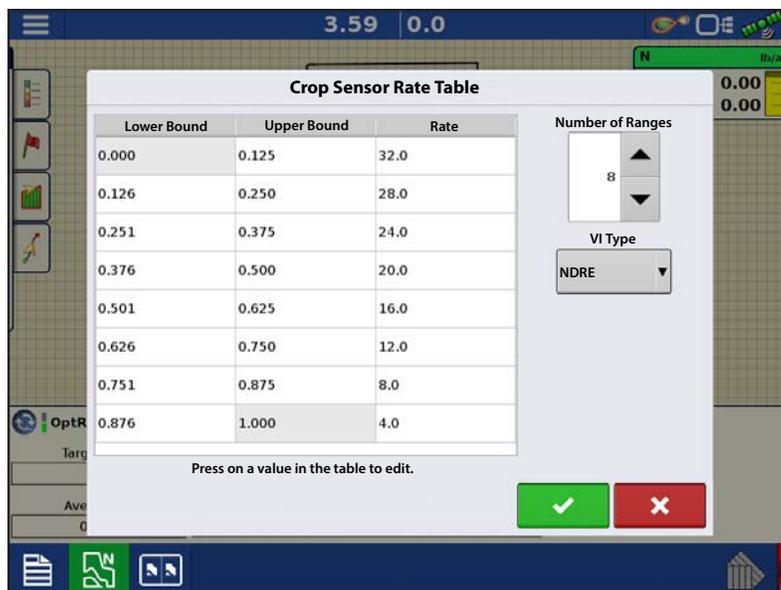
To use the Application Rate Table, you need to activate it by check marking the "Use Application Rate Table" box in the Crop Sensor setup. It can be accessed one of two ways:



OR



The Application Rate Table allows a user to define their desired rates to apply any product to any crop type, based on the vegetative index. You can create up to 16 ranges and assign a desired rate to these ranges. You also have the ability to select your VI type to NDRE or NDVI. (For more information about NDRE and NDVI, refer to the Glossary.) If you select to use the Application Rate Table you will not make a reference strip. You will set up the rate table and start applying. If you don't select to use the Application Rate Table you will have to make a reference strip before you apply. The exact values for these settings are up to the grower, ideally after consulting with an agronomist. Ag Leader Technology does not provide agronomic advice.



NOTE! When utilizing the Application Rate Table, a minimum of two sensors are required in order to actively apply product.

N Algorithm Setup

OptRx has a very powerful N Algorithm to calculate the optimal rate of nitrogen to apply to the crop. A product containing nitrogen must be selected for the N Algorithm to become active. In order for the OptRx Crop Sensor Module to use the N Algorithm to recommend an N rate, you must scan a portion of the field to create a V.I. Reference Value.

Create an OptRx V.I. Reference Value

In order for the OptRx Crop Sensor Module to use the N Algorithm to recommend an N rate, you must scan a portion of the field to create a V.I. Reference Value.

This V.I. Reference Value is a baseline that the system uses to evaluate the rest of the field.

When creating a reference strip you need to select one of the four Sensor Rx's:

Corn—Scan the most vigorous portion of your field for 300 seconds (5 minutes).

Wheat North America(Post-Tillering)—Scan the most vigorous portion of your field for 300 seconds (5 minutes).

Wheat North America(Tillering)—Scan the most vigorous portion of your field for 300 seconds (5 minutes).

Europe—Scan the portion of your field where the plants show an average amount of vigor and growth. Scan this area for 150 seconds (2.5 minutes).

 NOTE!: In order to create a reference strip, a minimum of two sensors is required.

Scan a Reference Strip

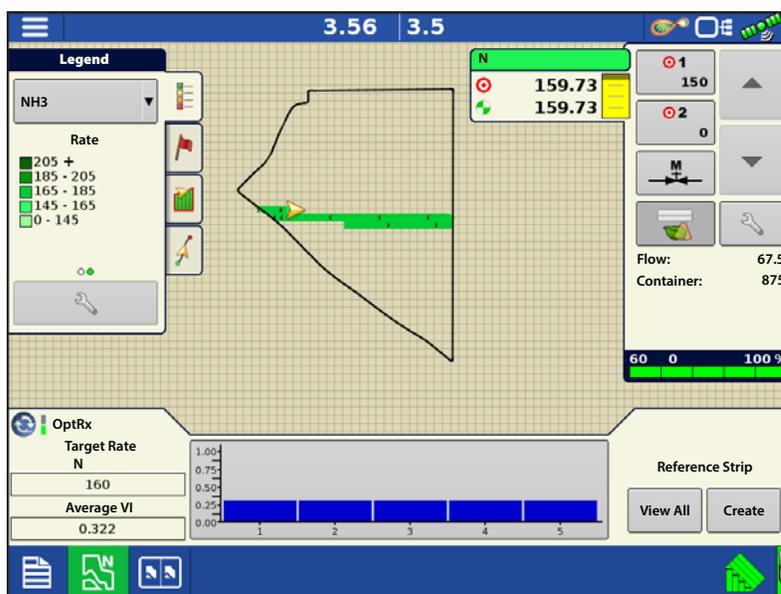
This section describes how to scan a reference strip into the display. This reference strip determines the V.I. Reference Value. It assumes that you have already performed the following tasks:

- Chosen the appropriate part of your field to create a reference strip.
- Created an OptRx module configuration.
- Created a Field Operation Configuration.

1. **Press Create Button**—Press the



, located on the bottom right-hand side of the Map screen's Equipment Tab.



 If a reference strip has already been created, a warning appears, notifying you that this will unload the current reference strip. Press  to continue.

2. Enter Reference Strip Information—

The Reference Strip Information screen appears.

Select the correct **Sensor Rx**. Press



to enter the Name, Growth Stage, and Variety. For Europe Algorithm Settings view below.



NOTE! For Corn, a growth stage of V5 or later is needed for accurate application.

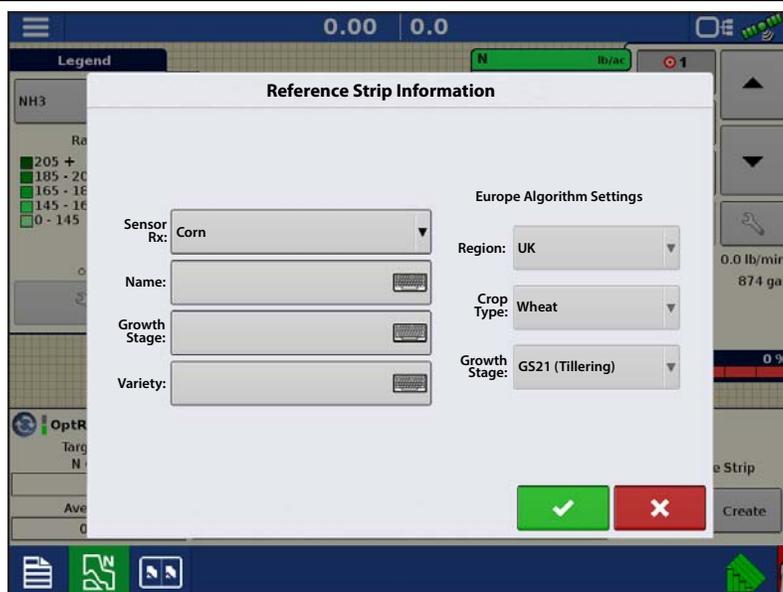
When selecting Europe as Sensor Rx, the **Europe Algorithm Settings** become active. A region, a crop type and a Growth Stage need to be selected.

If your region is not noted in the drop-down menu, select the **Region** that reflects your current position best when comparing geographic location, climate, general soil types and farming practices. The region setting is used for fine-tuning and optimizing the N Algorithm.

Select the **Crop Type** on which you are applying fertilizer. For the crops Wheat, Barley and Rapeseed the N Algorithm is verified by independent field experiments.

Select the **Growth Stage** that reflects your current crop status. For Wheat and Barley the Growth Stage is used to select the most appropriate VI index, NDVI or NDRE, further it will be used for fine-tuning and optimizing the N-Algorithm.

Press  when finished.



3. Drive Reference Strip—

A screen appears, stating that you should drive the applicator to the start of the reference strip. When ready, press  and drive the reference strip.

4. Recording Reference Strip—

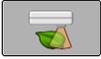
When you are driving the Reference Strip,  appears in the Equipment Tab. This bar counts the number of seconds that you record the reference strip.

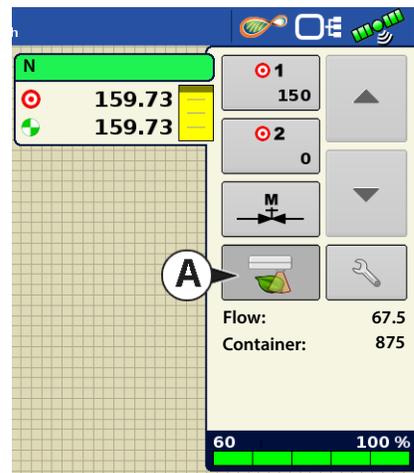
For best results when driving the Reference Strip, it may be beneficial to Pause the Reference Strip when driving over parts of the field that are in a lower than average condition, such as the headlands.

After the minimum required time elapses to create a Reference Strip, the “Cancel” button will change into .

5. File Name—

Press the Stop button when you wish to finish creating the Reference Strip. A dialog appears indicating the Reference Strip is saved. Press  to accept.

6. **OptRx Sensors Apply Variable Rate**—The OptRx sensors will apply variable rate N, based on data received from the sensors and the current N Algorithm settings. N Algorithm settings must be reviewed for each application to verify correct inputs are used.  appears in the Product Control Toolbox. **(A)**



7. (OPTIONAL) **View Reference Strip**

If desired, you may review this reference strip by pressing the **View All** button, located on the bottom right-hand side of the Map screen's Equipment Tab. The file name of the new reference strip appears in the Reference Strip Selection screen.

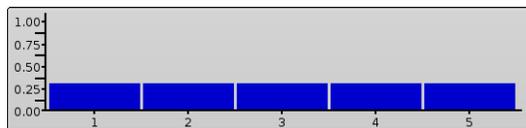
 To delete a reference strip, highlight the file name and press .



Crop Sensor Settings

The Crop Sensor Settings screen is where you can adjust application rate settings specified by the OptRx Crop Sensor module. The VI Zero and VI Minimum settings are used as a buffer to prevent applying the wrong amount of N or applying it in areas where doing so would be ineffective.

To access the Settings screen, press the OptRx Crop Sensor button,



located in the box containing the Map screen's VI Bar Graph.

VI Zero — The threshold below which the Crop Sensor applies a zero rate. This setting is used to prevent applying N over bare ground or

permanently damaged crops. You may enter in a value either by pressing , or you may enter in the current VI value by pressing .

VI Minimum — The threshold below which the Crop Sensor applies the minimum rate. This setting is used to apply a minimum amount of N on ground with damaged crops. You may enter in a value either by pressing , or you may enter in the current VI value by pressing .

 The minimum rate may be adjusted at the Crop Sensor screen, which is accessed by pressing the **Algorithm Settings** button.

Reference Strip — The name of the Reference Strip that you entered during the scanning procedure.

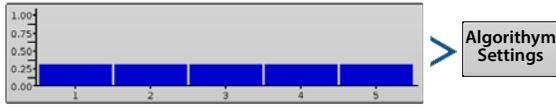
VI Reference — Value of a healthy crop biomass used in reference for calculating the proper N application rate

Algorithm Settings — Press this button to access the Sensor Setup screen, where you can adjust the inputs used by the N Algorithm to calculate to optimal Nitrogen rate. Without a valid Reference Strip this button will not be active. Please refer to the Crop Sensor Setup section below for information on how to decide on what inputs to use for the N Algorithm.

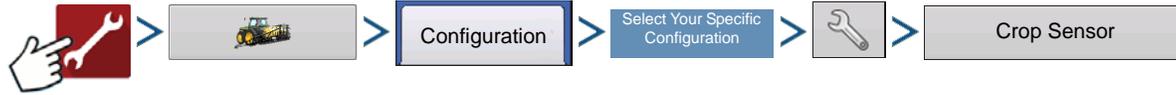


Crop Sensor Setup

The Crop Sensor Setup screen is where you can adjust how OptRx calculates the nitrogen rate to apply. Here you can also select the usage of the Application Rate Table. You can access the Sensor Setup screen by:



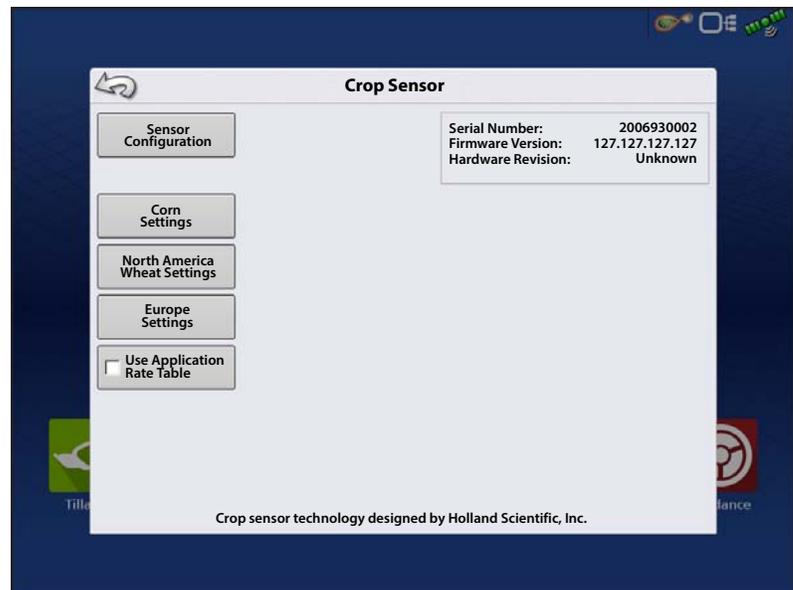
OR



OR



NOTE!: You must have a Reference Strip loaded for the Algorithm Settings button to be active.



Depending on the Sensor Rx that was selected when making the Reference Strip you will use one of the three Algorithm Setup menus:

- Corn Settings
- North American Wheat Settings
- Europe Settings



All units represent pounds (kilograms) of nitrogen.



Corn Settings

Minimum Rate—This input should be reviewed and set for each application.

Algorithm implication: The Minimum Rate is the amount of nitrogen the operator wants applied to the healthiest areas of a field. Keep in mind, OptRx may apply very low amounts or zero N if crop appears healthy at the time of application, however the N reserves in the soil may not be adequate to achieve target yield. This ensures some amount of N is applied in these healthy areas.

Maximum Rate—This input should be reviewed and set for each application.

Algorithm implication: This is the maximum amount of nitrogen the operator wants applied to the poor areas of a field. Keep in mind, OptRx may recommend a high rate if crop appears very unhealthy at the time of application, however the crop may not benefit from extremely high rates of nitrogen.

Rate Increment—This input is dependent on your controller and N-product; it can vary per application.

Algorithm implication: The Rate Increment will define the step size for the variable rate prescribed by the N Algorithm. The system will not change the application rate unless OptRx prescribes a new target that is greater than the Rate Increment. If your system is frequently changing target rates and the flow controller has a hard time responding appropriately, increase this setting.

Economic Optimal Rate—This input is dependent on the crop per field.

Algorithm implication: The Economic Optimal Rate reflects the estimated total amount of nitrogen uptake by the plant over the growing season. To calculate this, the operator should use a reasonable estimated yield after evaluating current crop conditions and the growing season leading up to application. Once that target yield is determined, multiply it by the nitrogen use efficiency (NUE) for your particular region and management practice. For this system, NUE is defined as the pounds of nitrogen needed to produce one bushel of corn. NUE can typically range from 0.85 to 1.2*.

N Credits—This input should be reviewed and set for each application.

Algorithm implication: The N Credits is the estimated amount of nitrogen that is available to the plant in the soil from previous year's crop.

Pre-Sidedress Rate—This input should be reviewed and set for each application.

Algorithm implication: The Pre-Sidedress Rate is the amount of nitrogen that has been applied for the current year's crop before side-dressing. Keep in mind, not all pre-sidedress nitrogen may be available to the crop due to environmental factors. You may need to adjust this input accordingly**.

* NUE can vary based on climate, soil organic matter range, form of N applied, timing of N applied, number of N applications, previous crop residue, etc. It is recommended to consult an agronomist if you are uncertain what the NUE should be for the current year's crop.

** Consider the weather and the form of N that was applied prior to your side-dress application. Out of the "X" lbs/acre of N that was applied earlier in the season, enter how much is believed to be available for that crop at the time of application. Talk to an agronomist or an adviser if there are questions about how to estimate this value for your fields.



NOTE!: The exact values for these inputs are up to the grower, ideally after consulting with an agronomist. Ag Leader Technology does not provide agronomic advice.

North American
Wheat Settings

North American Wheat Settings

Minimum Rate—This input should be reviewed and set for each application.

Algorithm implication: The Minimum Rate is the amount of nitrogen the operator wants applied to the healthiest areas of a field. Keep in mind, OptRx may apply very low amounts or zero N if crop appears healthy at the time of application, however the N reserves in the soil may not be adequate to achieve target yield. This ensures some amount of N is applied in these healthy areas.

Maximum Rate—This input should be reviewed and set for each application.

Algorithm implication: This is the maximum amount of nitrogen the operator wants applied to the poor areas of a field. Keep in mind, OptRx may recommend a high rate if crop appears very unhealthy at the time of application, however the crop may not benefit from extremely high rates of nitrogen.

Rate Increment—This input is dependent on your controller and N-product; it can vary per application.

Algorithm implication: The Rate Increment will define the step size for the variable rate prescribed by the N Algorithm. The system will not change the application rate unless OptRx prescribes a new target that is greater than the Rate Increment. If your system is frequently changing target rates and the flow controller has a hard time responding appropriately, increase this setting.

Economic Optimal Rate—This input is dependent on the crop per field.

Algorithm implication: Economic Optimum N Rate (ENOR) as prescribed by regional agronomists or universities. This value will equal the total amount of nitrogen that is recommended for the crop over its entire life cycle. This will be a user defined value.

N Credits—This input should be reviewed and set for each application.

Algorithm implication: The amount of N credits from previous year's crops or manure applications. This will be a user defined value.

Pre-Topdress Fertilizer—This input should be reviewed and set for each application.

Algorithm implication: The amount of fertilizer that has already been applied. This includes pre-plant fertilizer, planting fertilizer and post-planting fertilizer that has been applied before topdressing. This will be a user defined value.



NOTE!: The exact values for these inputs are up to the grower, ideally after consulting with an agronomist. Ag Leader Technology does not provide agronomic advice.

Europe Settings

Europe Settings

Planned Rate—This input should be reviewed and set for each application.

Algorithm implication: The planned rate will be the average rate that the OptRx N-algorithm will prescribe, considering that the reference strip reflects the field average and that the Minimum and Maximum Rate have an equal offset from the Planned Rate. The Planned Rate should be set to the intended flat rate to apply if the OptRx N-Algorithm was not used.

Minimum Rate—This input should be reviewed and set for each application.

Algorithm implication: For the Planned Rate to reflect the average OptRx rate prescription, the difference between the Minimum Rate and Planned Rate should be the same as the difference between the Maximum Rate and Planned Rate. The Minimum Rate is the lowest amount of nitrogen operator wants applied. If OptRx prescribes a lower rate system will default to the Minimum Rate.

Maximum Rate—This input should be reviewed and set for each application.

Algorithm implication: For the Planned Rate to reflect the average OptRx rate prescription, the difference between the Maximum Rate and Planned Rate should be the same as the difference between the Minimum Rate and Planned Rate. The Maximum Rate should be set to the highest amount of nitrogen operator wants applied. If OptRx prescribes a higher rate system will default to the Maximum Rate.

Rate Increment—This input is dependent on your controller and N-product; it can vary per application.

Algorithm implication: The Rate Increment will define the step size for the variable rate prescribed by the N Algorithm. The system will not change the application rate unless OptRx prescribes a new target that is greater than the Rate Increment. If your system is frequently changing target rates and the flow controller has a hard time responding appropriately, increase this setting.

Managed Rate—This input is dependent on the crop; it should not be changed during the season.

Algorithm implication: The Managed Rate reflects the total amount of nitrogen the crop will uptake throughout a single season. A higher Managed Rate will increase the algorithms aggressiveness, the target rate will show more variation.

Number of Applications—This input is dependent on your season planning; it should not be changed during the season.

Algorithm implication: The Number of Applications reflects the total amount on N-applications throughout a season, including pre-seeding applications. A higher Number of Applications will decrease the algorithms aggressiveness, and the target rate will show less variation.

Application Trend—This input should be reviewed and set for each application.

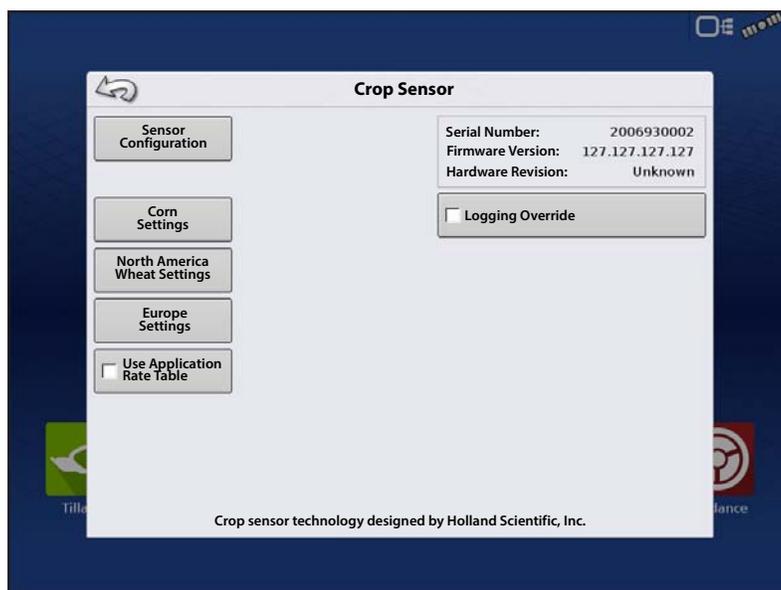
Algorithm implication: The Application Trend setting decides whether good crops get a higher N rate, or if poor crops get a higher N rate. The Increase setting trends the N application rate towards the healthier crops. This could result in witnessing greater plant variance within a field. The Decrease setting trends the N application rate towards the unhealthy crops. This could result in witnessing little plant variance within a field.

i NOTE!: The exact values for these inputs are up to the grower, ideally after consulting with an agronomist. Ag Leader Technology does not provide agronomic advice.

Override Serial Logging

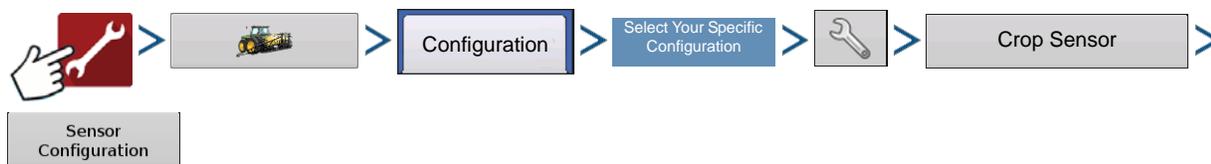
Checking Logging Override will allow OptRx to disable logging based on speed if a reference strip is loaded or an application rate table is being used. This checkbox will only be available when OptRx is configured with a non-Ag Leader product controller (Generic ISOBUS or Serial controller).

i NOTE!: If left unchecked in these types of configurations, the Event may not be able to be Suspended or Closed due to OptRx being in a logging state.



Sensor Setup

The crop Sensor Setup screen is where you can review and adjust sensor settings. You can access the Sensor Setup screen one of two ways:



OR



Sensor Setup

Sensor Setup screen appears. Each sensor is shown, with the status of "ON" or "OFF".

Enable—Turns On the individual OptRx sensor.

Disable—Turns Off the individual OptRx sensor.



Installation

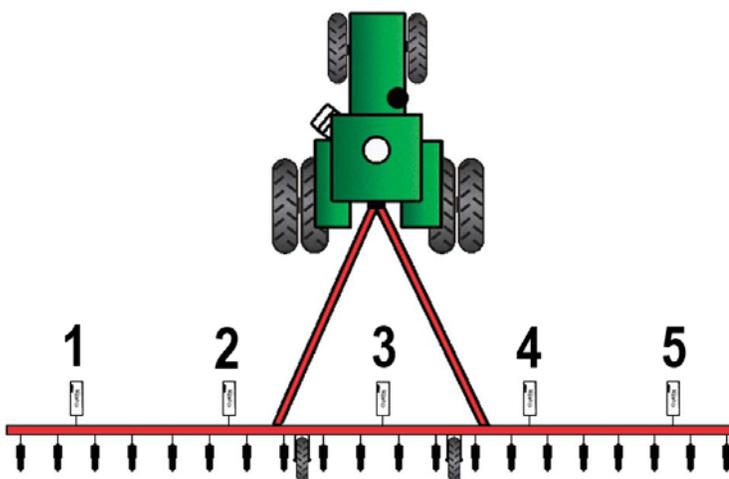
The display supports up to 10 OptRx sensors. For swaths that are 80 ft (24 m) or larger, five sensors or more should be used. For swaths less than 80 ft (24 m), a minimum of three sensors is recommended.

When installing sensor cables, you must install them in the correct order from left to right.

i NOTE!: If you do not install the sensors in their proper places, then the map created by the display will not accurately reflect actual field conditions according to row sensor placement.

Checklist

- Sensors should be equally spaced apart. Sensors should not be mounted on the ends of the booms.
- Each sensor should be mounted so that it is centered over the top of a crop row.
- Sensor can operate 20 - 50 in. (51 -127 cm) above the crop canopy. Sensors perform best at 30 - 36 in. (76-91 cm).



h ATTENTION!: A minimum of two sensors is required to actively apply product. With one sensor installed, you can only scan and record VI.

Glossary of OptRx Terminology

Active VI — The Vegetation Index (VI) that the OptRx sensors read instantaneously during field operations.

Max Rate (shown at Crop Sensor Setup) — The highest amount of N that should be applied.

Min Rate (shown at Crop Sensor Setup) — The lowest amount of N that should be applied.

N — Refers to Nitrogen being applied.

N Algorithm — The OptRx Crop Sensor Module uses an N algorithm to calculate an N rate through a Sufficiency Index reading.

$$\text{NDVI Normalized Difference Vegetation Index} = \frac{\text{Near Infrared Reflective} - \text{Red Reflective}}{\text{Near Infrared Reflective} + \text{Red Reflective}}$$

$$\text{NDRE Normalized Difference Red Edge} = \frac{\text{Near Infrared Reflective} - \text{Red Edge Reflective}}{\text{Near Infrared Reflective} + \text{Red Edge Reflective}}$$

NDRE vs. NDVI—Both are vegetation indices that compare scanned crop vigor and biomass (and algorithms) against the reference strip to assess plant health.

- NDVI is used in early growth stage crops as it picks up variances in small plant vigor better than NDRE
- NDRE does a better job at picking up variances in biomass at later growth stages
 - NDRE is more effective in later growth stages or in larger plants such as corn because the algorithm provides more response at higher vegetation index (VI) rates.
 - NDVI is more effective in earlier growth stages or in smaller plants where the algorithm is used to gain a more accurate reading at lower VI values. However, in later stages, NDVI's scanning tends to saturate at higher VI values which results in less response to changing VI values and recommended rates.

Rate Increment (shown in Crop Sensor Setup) — An optional increment that the display can use to round the N rate applied, if the operator desires. For example, if the operator enters the number 5 and the display is applying a rate of 27, the number will be rounded to 25.

Reference Strip — The healthiest portion of your field where you are satisfied that N is sufficient. This allows a baseline of optimum crop performance that the system can compare against other cropland.

Reflectance — The light reading of the plant measured by individual light spectral wavelength. The comparison of different reflectance values can be used to determine the health of the plant.

VI — Vegetation Index. The recorded value from remote sensing that displays a comparison of crop vigor and biomass of the scanned plant. This value, which is taken from a reference scan of a Reference Strip, uses a ratio that indicates the health of the plant. NDVI and NDRE are examples of different vegetation indexes.

VI Minimum (shown at Settings screen) — The threshold below which the Crop Sensor applies the minimum rate. This setting is used to apply a minimum amount of N on ground with damaged or diseased crops.

VI Reference (shown at Settings screen) — The value of a healthy crop biomass used in reference for calculating the proper N application rate. The VI Reference value is determined by the creation of a Reference Strip.

VI Zero (shown at Settings screen) — The threshold below which the Crop Sensor applies a zero rate. This setting is used to prevent applying N over bare ground or permanently damaged crops.

Troubleshooting OptRx Error Messages

The OptRx Crop Sensors have error messages to inform the user of complications in communication and performance. The following error messages are the most common ones. Follow the recommended troubleshooting steps to correct these errors.

Error Message: “Sensor Lost Communication”

Possible Cause: The cabling between the OptRx sensor and the ACS Master Module is disconnected.

Solution: Check all connections and cables for disconnections, cuts, breaks, or crimps in the line.

Error Message: “Bad Data”

 **NOTE!** The “Bad Data” error messages are disabled when user does not intend to log data or while the reference strip is being created.

Possible Cause: The sensors are either too far from the crop or too close to the crop.

Solution: Adjust the height of the sensor to approximately 30 inches (76 cm.) above the crop canopy by adjusting the boom height or the height on the crop sensor bracket

Error Message: "Sensor Failure"

Possible Cause: The sensors are either too far from the crop or too close to the crop.

Solution: Adjust the height of the sensor to approximately 30 inches (76 cm.) above the crop canopy by adjusting the boom height or the height on the crop sensor bracket.

Error Message: "Sensor Failure"

Possible Cause: There has been a drop in voltage to the OptRx Crop Sensors.

Solution: Check voltage on the high current power cable to ensure voltage provided to the sensors is approximately 12 V.

Error Message: "Too Few Sensors for Application"

Possible Cause: The OptRx configuration must have at least two working sensors to make an N rate recommendation.

1. There has been a drop in voltage to the OptRx Crop Sensors, or
2. The OptRx Crop Sensor is not detecting communication from the OptRx Crop Sensor Module

Solution: Perform the following actions, depending upon the possible cause of the error:

If 1), check cabling.

If 2), check the OptRx Diagnostic screen to determine if the OptRx Crop Sensors are still communicating.