

SmartFirmer™

**Setup & Operations
For Gen 3 Display**

Precision Planting®

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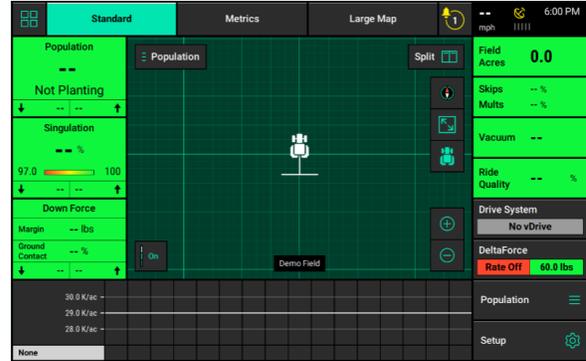
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Setting up the 20|20 SeedSense Display

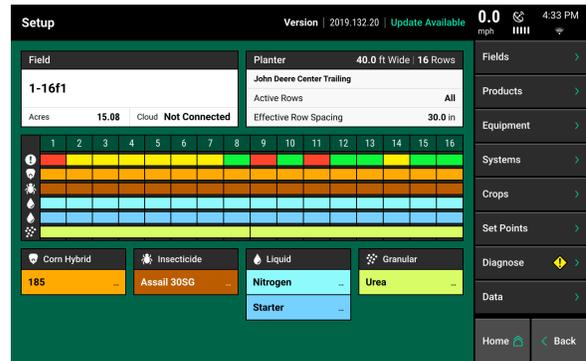
Note: Before Installing SmartFirmers: Update 20/20 with 2018 Software found at www.precisionplanting.com.

Assign SmartFirmer as your soil system before proceeding.

From the Home Screen press setup.

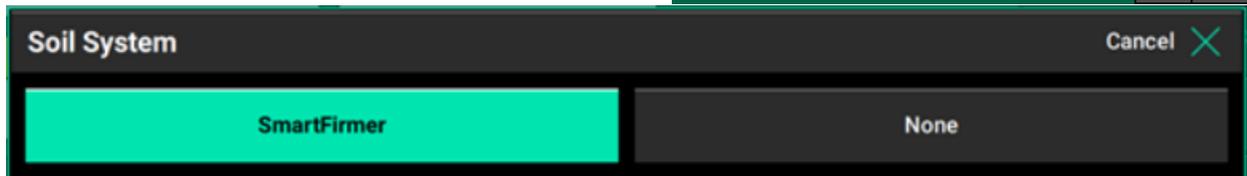
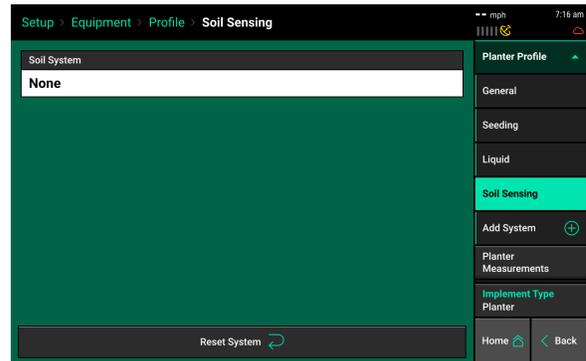


Select Equipment to assign soil system.



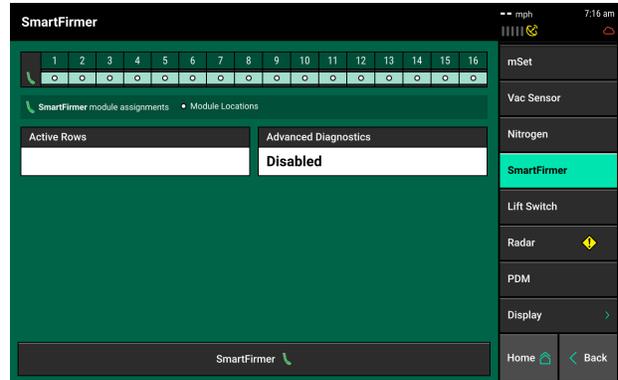
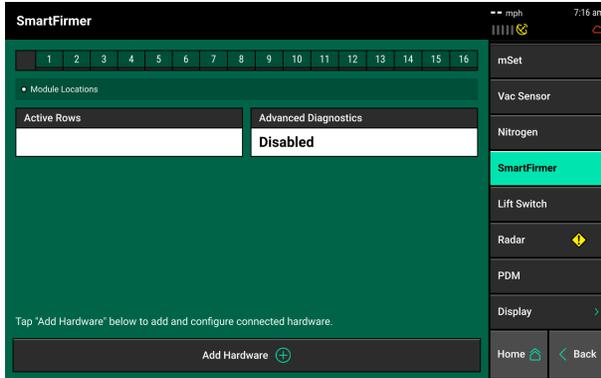
Assign SmartFirmer as your Soil System under the Soil Sensing section of the Planter Profile.

Note: If the system is running 2020.0.x or older software, the Soil System will be located under the general Planter Profile section of the Equipment setup.



Assign SmartFirmer rows by navigating to Setup — Systems — SmartFirmer. Use the 'Add Hardware' button at the bottom of the screen to select what rows have SmartFirmer installed.

Note: If the system is running 2020.0.x or older software, this step is not required.



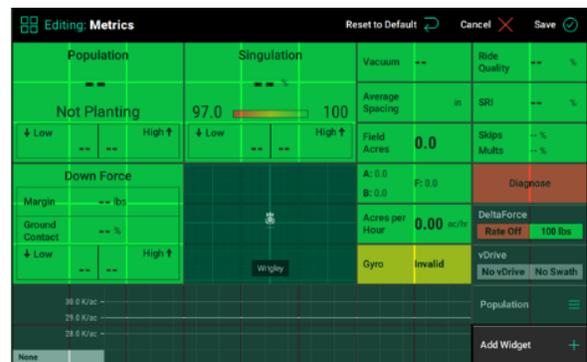
Once SmartFirmer rows have been assigned, individual rows can be enabled or disabled by using the Active Rows button.

Assigning SmartFirmer Metrics to the Home Screen

From the Home Screen select button in upper left hand corner.



Press Add Widget + to customize widgets (Metrics) on the Home Screen.

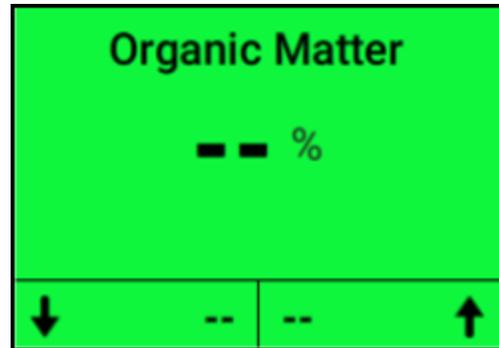


Metrics: The metrics are all of the buttons that display planter information on the home screen. Metrics can be displayed in three different sizes.

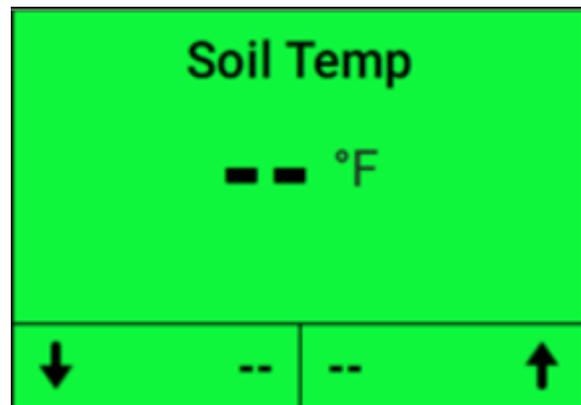


SmartFirmer Metrics Definitions

Organic Matter (OM) is the portion of the soil that consists of plant material in various stages of decomposition. The SmartFirmer organic matter measurement includes all of this except the visible crop residue. The reported organic matter values are similar to what is reported in a lab using the "Loss On Ignition" organic matter test. For most fields, reported organic matter will be greater than 0.5% and less than 6%. The value should be fairly stable each second and only change over hundreds of feet.



Soil Temperature (Temp) is the real time temperature at seeding depth. Goal is above 50 degrees.



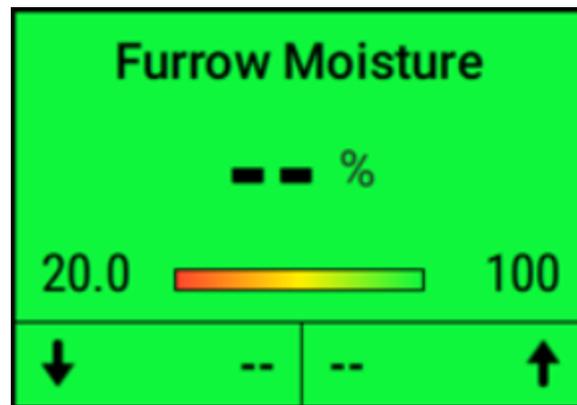
Uniform Furrow: Variation in furrow (light, cloddiness, moisture changes).

Goal: Above 95%.



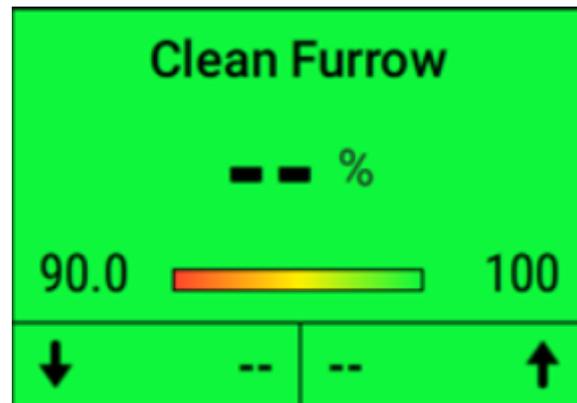
Note: Can indicate row unit mechanical problems, tillage patterns, opportunity to use row cleaners, windrowed residue.

Furrow Moisture is the percent water weight that a corn seed is projected to absorb in a 3 day time period. A corn seed needs to take up 30% of its weight in moisture to start germination. It is recommended to keep this value above 20% for adequate moisture conditions. Conditions that may result in values lower than 20% could be cloddy conditions, sandy soils, and light knobs. If the SmartFirmer is highlighting dry areas, please stop & dig to ensure seeds are in an environment with moisture.



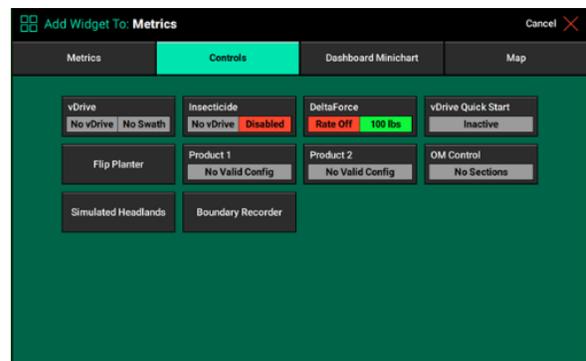
Goal: Above 20%.

Clean Furrow is a measure of the crop residue in the furrow. A value of 100% represents a perfectly clean furrow, but any value above 90% is considered to be acceptable. Either surface residue dropping into the furrow or incorporated residue will be sensed by SmartFirmer if it passes by the sensor window.



Goal: Above 95%.

Controls: The OM Control button is used for Real Time Control based on Organic Matter. (All Control Buttons are 2x1 size).



Real time control- This feature allows grower to control seeding population, hybrid selection, insecticide rates, and fertilizer application (Liquid) based upon organic matter. Refer to the Real Time Control section for instructions on setup and operations.

Real Time Control: All Product Setup/Procedure

Introduction

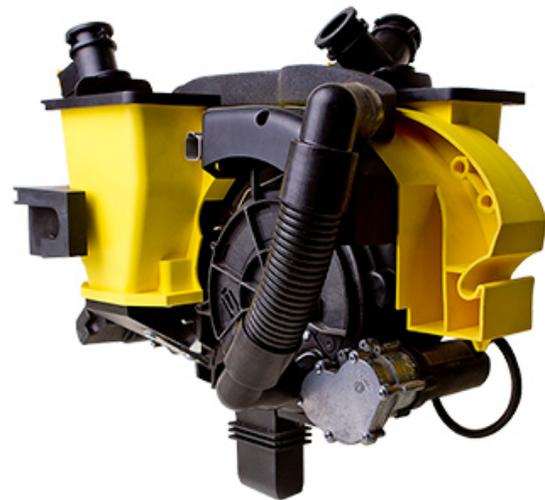
A primary contributor to soil productivity is the soil organic matter. Organic matter (OM) is the portion of the soil that consists of plant material in various stages of decomposition. SmartFirmer can control seeding, hybrid selection, insecticide rates, and fertilizer application rates (liquid) based on the real-time organic matter measurements and the corresponding population/hybrid/rate selected by the user.

Note: Products can be enabled or disabled individually: Example- User can use Real Time control to variable rate population (vDrive) and fertilizer rates (vApply) based upon organic matter readings, but use a static rate for insecticide application (vDrive Insecticide).

vDrive: Real Time Control of Population.



vSet Select: Real Time Control of Population and Hybrid.



vApply: Real Time Control of Fertilizer Application Rates.



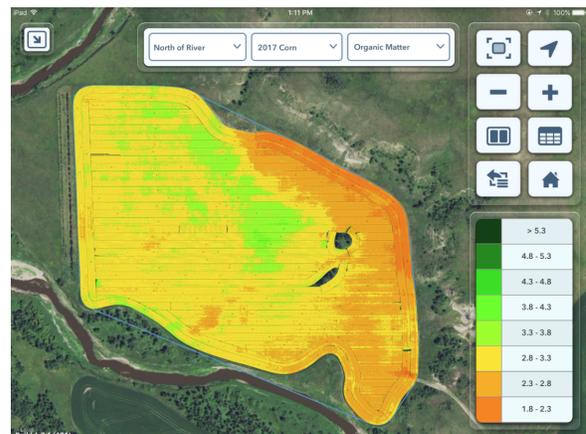
vDrive Insecticide: Real Time Control of Insecticide Application Rate.



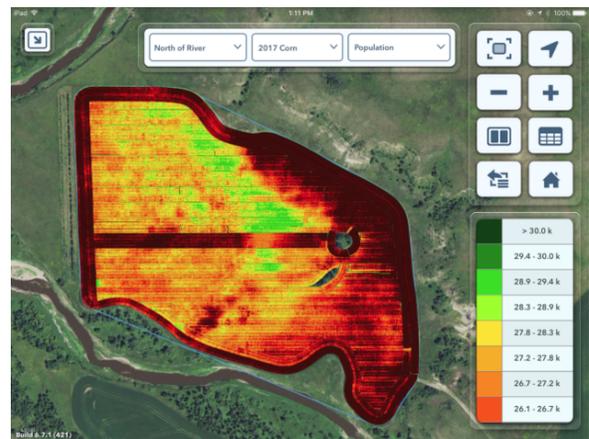
Procedure

Plant 1 or 2 headland rounds, and a couple planter passes in your field without enabling control to make sure the OM is responding as expected. With Real-Time control from SmartFirmer, it is critical to make sure the SmartFirmer OM readings are in line with your expectations. Select the OM control range based on what you see in these first passes.

Organic Matter Map: Plant headland passes and two planter passes to understand field variability, and OM % ranges before enabling OM Control.



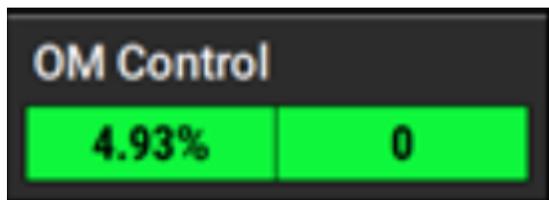
Population Map: Headland Passes and two middle passes are planted at static rate. Using OM% data from SmartFirmer select setpoints to change population, hybrid, nutrient application, & insecticide rate.



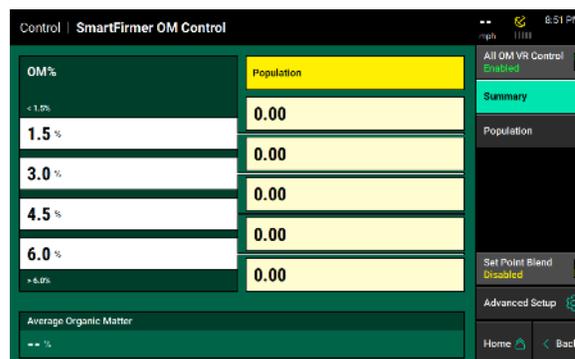
Setting Up Organic Matter Setpoints

This step is universal and used for all Real Time Control Products.

Add the OM control widget to the homepage from the homescreen customization menu. Use this control button to access the SmartFirmer control menu and configure the real time control of Population, Hybrid, & Nutrient Application.



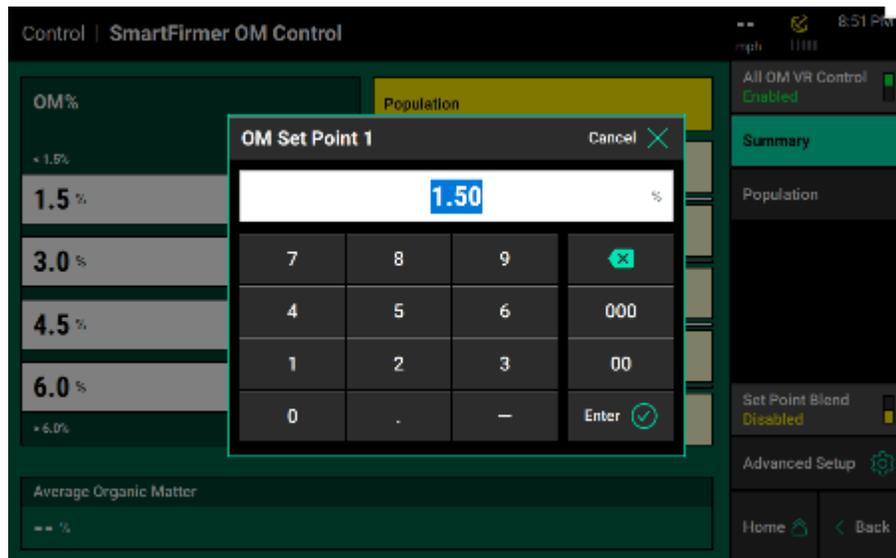
Pressing the "OM Control" button will display the SmartFirmer Variable Rate Control Screen. Real-Time control is enabled or disabled by pressing the All OM VR Control button on the right of this screen. (Current screen shows OM Control Enabled).



SmartFirmer OM Control Page: Adjust the OM set points according to what the SmartFirmer has reported from the previous procedure (Headland passes and 2 planter passes). Set the adjustments to what you are comfortable with from the Smartfirmer readings. Adjustments are made to the Base Population or Rate that is entered from the individual product control screens. Enter Organic Matter set points in the "OM Set Point" boxes.

Selecting OM Setpoints

- Press OM% this will take the user to the OM control setpoint page.
- Edit the Setpoints by selecting the Setpoint and adjust using the number pad on the right.
- The set points should be set by driving the headlands (1 or 2 passes) and 2 (or more) planter passes. This will give a range of OM points to set adjustments to.



vDrive: Real Time Control

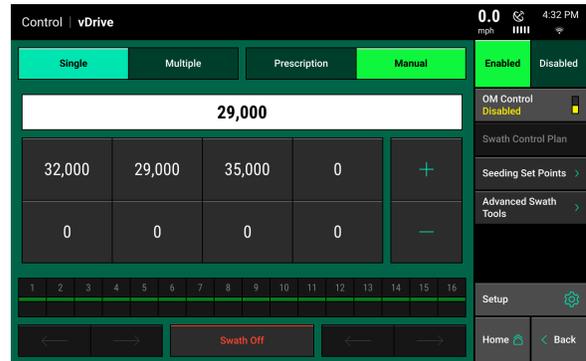
If using prescriptions go to OM Control with prescription section.

Refer to vDrive Setup and Operations manual to ensure proper setup of vDrive prior to attempting SmartFirmer: Real Time Control

Note: All referenced setpoints are examples, consult with your local agronomist before setting up your populations.

From the home screen, Press vDrive to open the vDrive Control Page.

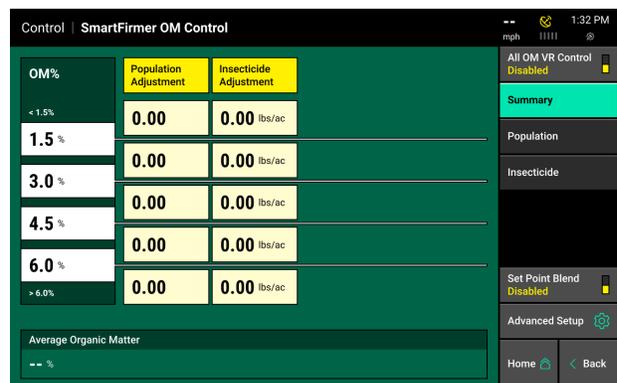
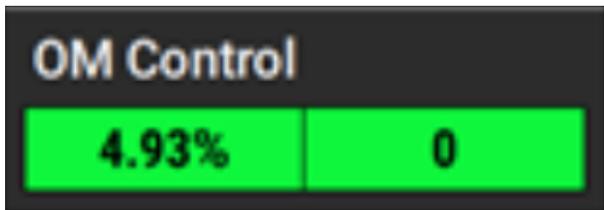
Set the “Base Population” in the vDrive control screen. The Base Population should be approximately in the middle of your planned population range. The SmartFirmer makes adjustments from this Base Population. For example, the grower is planning to plant from 26,000 to 34,000 seeds per acre, so the base population 30,000.



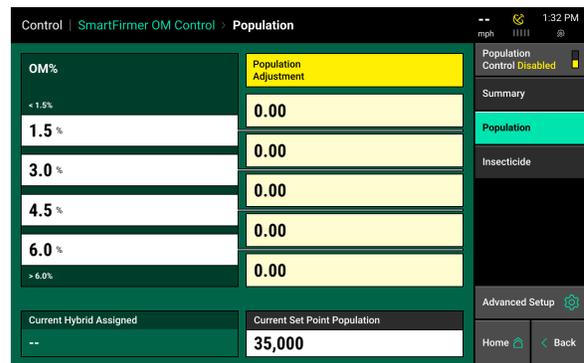
The base rate does not need to be the middle of the population range. It could be the low or high population as well. All inputs are user defined.

From the home screen, press the “OM Control” button. The SmartFirmer Variable Rate Control Screen will appear as shown. Real-Time control is enabled or disabled by pressing the All OM VR Control button on the right of this screen.

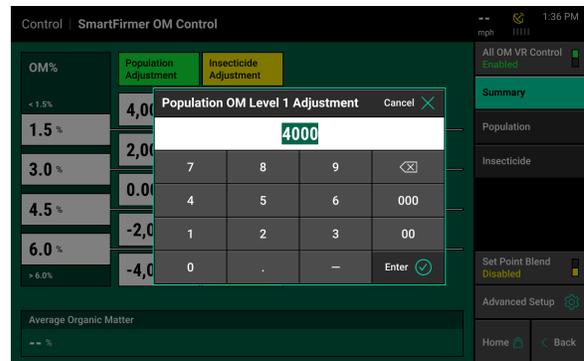
Real time OM% control for vDrive:



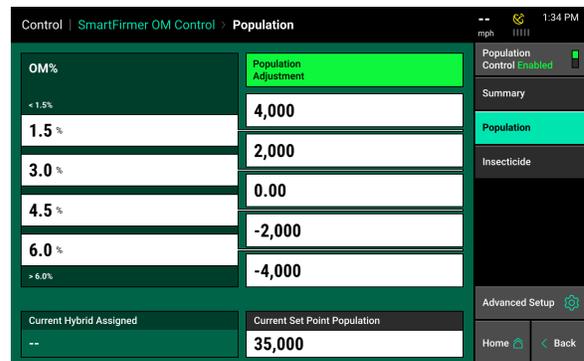
On the right hand side press Population, his page shows population adjustments. These adjustments will be the variation wanted in variable rate seeding.



To make adjustments press one of the adjustments that correspond to the OM% setpoints.



Selecting Population Adjustments-All population adjustments are set corresponding to OM%. in this example the middle adjustment will be the base population.



Summary of Population Adjustments After adjustments have been inputted, press Summary on right hand side of screen to verify inputs are correct.

Overview

Adjust the OM set points according to what the SmartFirm has reported for the first part of the field, and set the population adjustments to what you are comfortable with. The population adjustments are made to the population that is entered in the normal vDrive control screen. Fill out all the “OM Set Point” boxes and the “Population Adjustment” boxes. In this example, the population would be controlled as follows:



Below 1% OM, reduce population by 4,000 seeds from base population to a total of 28,000 seeds per acre.

From 1 — 3% OM, reduce population by 2,000 seeds from the base population to a total of 30,000 seeds per acre.

From 3 — 4% OM, make no adjustment to the base population to a total of 34,000 seeds per acre.

From 4-6% OM, increase population by 2,000 seeds from base population to a total of 34,000 seeds per acre.

Above 6% OM, increase population by 4,000 seeds from base population to a total of 36,000 seeds per acre.

vSet Select: Real Time Control

If using prescriptions please go to OM Control With Prescription section.

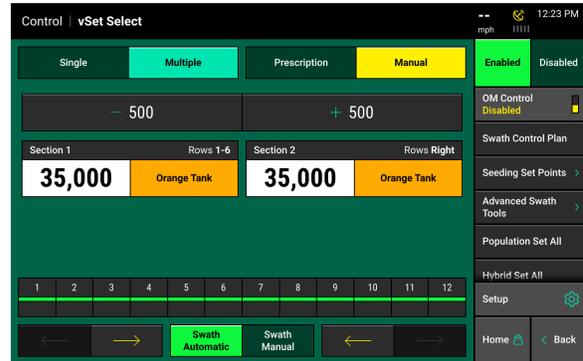
Note: Refer to vSet Select Setup and Operations manual to ensure proper setup of vSet Select prior to attempting SmartFirmer: Real Time Control

Note: All referenced setpoints are examples, consult with your local agronomist before setting up your populations.

From the home screen, Press vSet Select to open the Control Page.

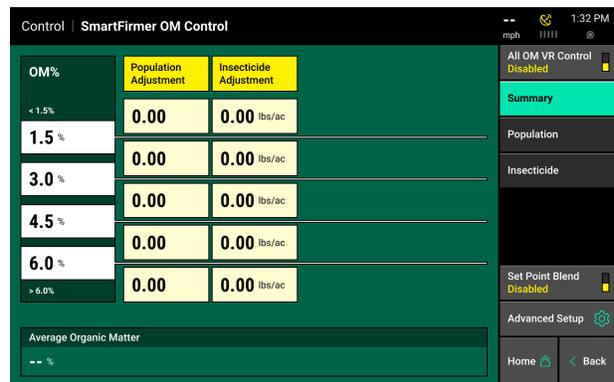
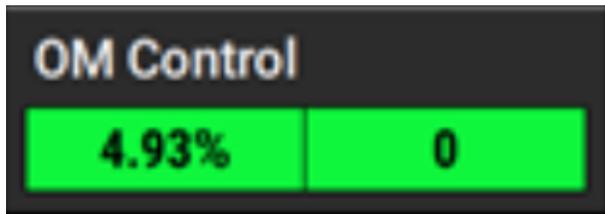
Set the “Base Population” in the vSet Select control screen. The Base Population will be the base of the population range and hybrid.

The base rate does not need to be the middle of the population range. It can be the low or high population as well. All inputs are user defined.

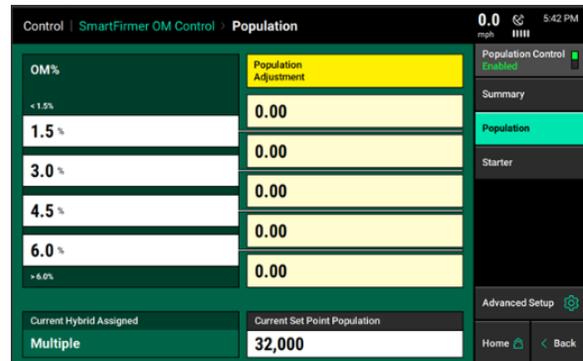


Press the “OM Control” button. The SmartFirmer Variable Rate Control Screen will appear as shown. Real-Time control is enabled or disabled by pressing the All OM VS Control button on the right of this screen.

Real time OM% control for vSet Select .



On the right hand side press Population: This page shows population adjustments. These adjustments will be the variation wanted in variable rate seeding.

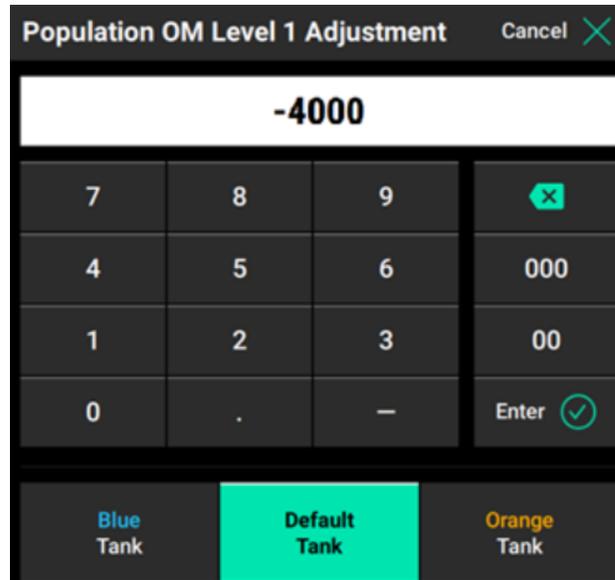
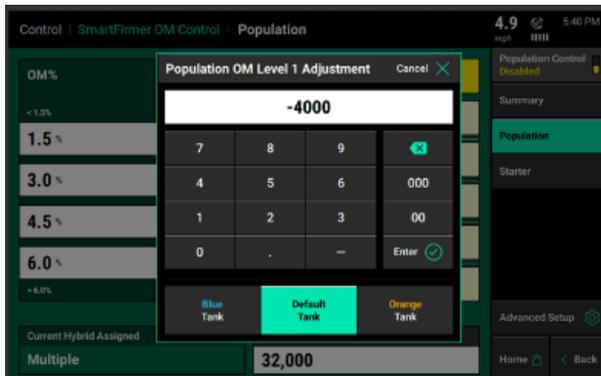


To make adjustments press one of the adjustments that correspond to the OM% setpoints.

Adjustments: These set points will correlate to the related OM%. Adjust population set points off of the Base population selected in vSet Select control. Do not enter the wanted.

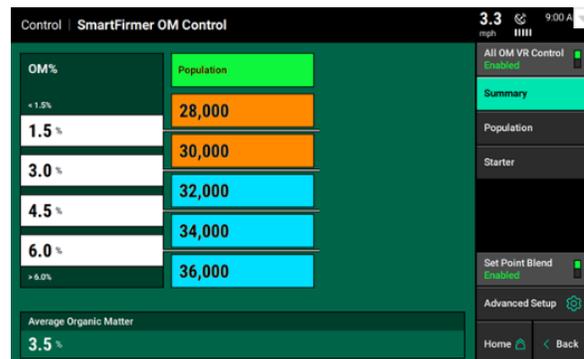
When selecting Population OM Adjustments, you have the ability to assign a hybrid to each adjustment.

To do this select which tank (Hybrid) you want to assign to specific adjustment population; instead enter the deviation from the population base point.



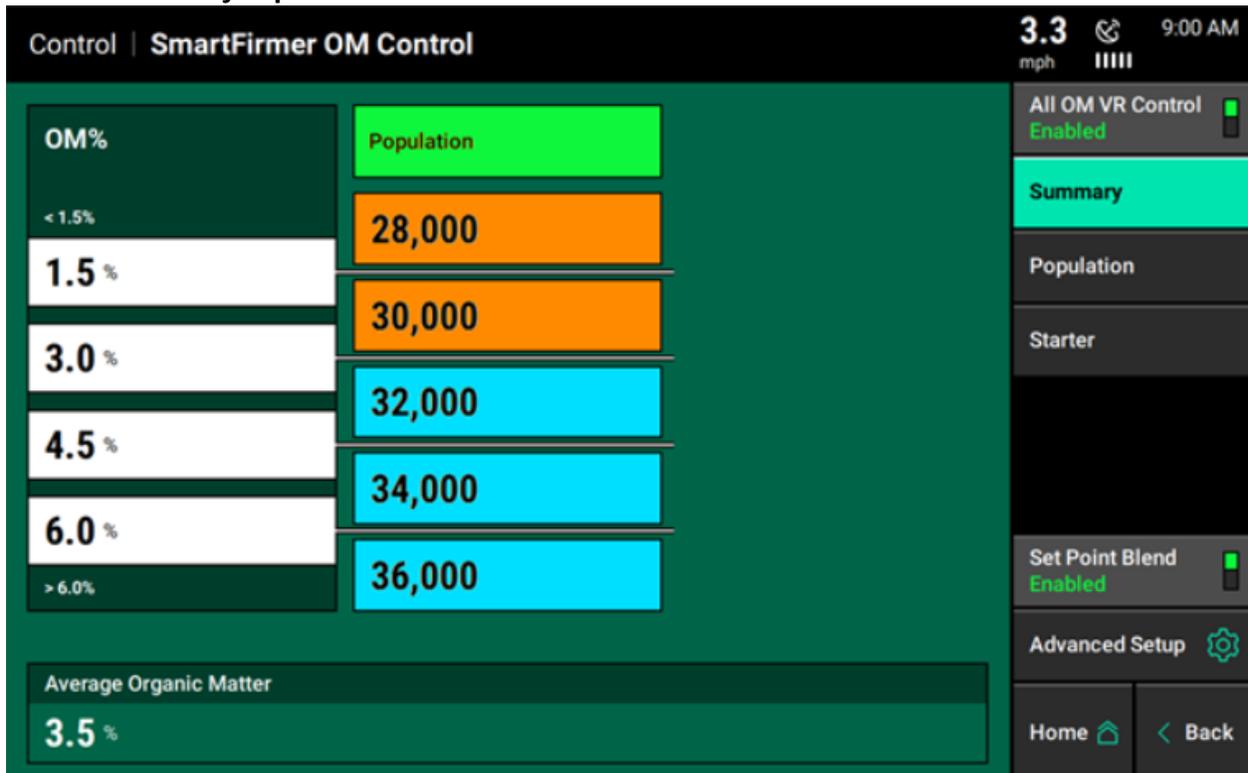
Press Summary to view the actual population and hybrid assignments based upon adjustment made in previous steps.

Example of vSet Select Summary with adjustments & hybrid assignments.



Overview

After adjustments have been inputted, press Summary on right hand side of screen to verify inputs are correct.



Adjust the OM set points according to what the SmartFirmer has reported for the first part of the field, and set the Population & Hybrid adjustments to what you are comfortable with. The population adjustments are made to the population that is entered in the normal vSet Select control screen. Fill out all the "OM Set Point" boxes and the "Population Adjustment" boxes. Use the Hybrid Override to assign hybrids to OM% assignment & population.

In this example, Population & Hybrid would be controlled as follows:

Below 1.5% OM, reduce population by 4,000 seeds from base population to a total of 28,000 seeds per acre.

From 1.5 - 3% OM, reduce population by 2,000 seeds from base population to a total of 30,000 seeds per acre.

From 3 - 4.5% OM, make no adjustment to the base population of 32,000 seeds per acre.

From 4.5-6% OM, increase population by 2,000 seeds from base population to a total of 34,000 seeds per acre.

Above 6% OM, increase population by 4,000 seeds from base population to a total of 36,000 seeds per acre

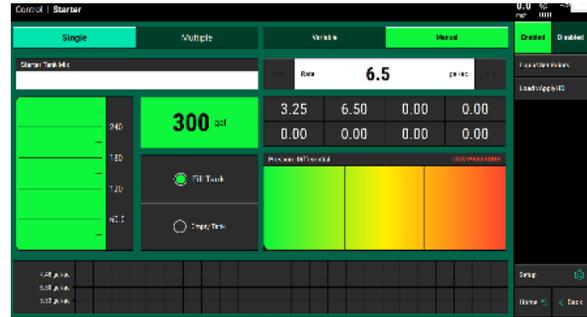
vApplyHD: Real Time Control

If using prescriptions please go to OM Control With Prescription section.

Refer to vApplyHD Setup and Operations manual to ensure proper setup of vApplyHD prior to attempting SmartFirmer: Real Time Control

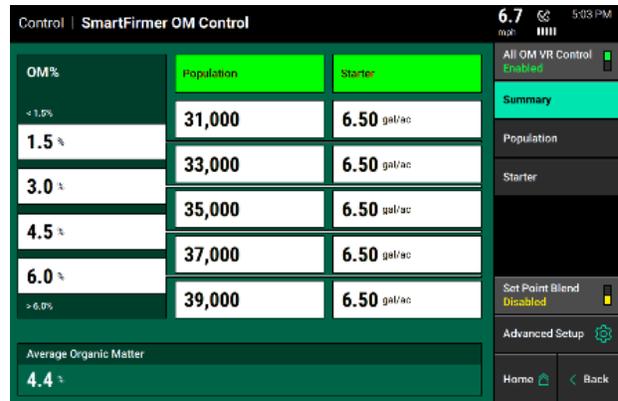
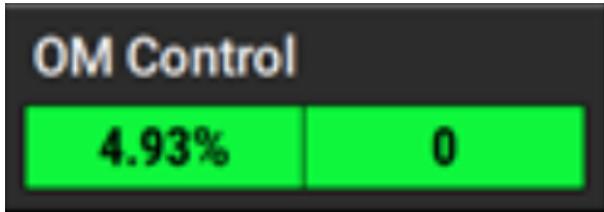
Note: All referenced setpoints are examples, consult with your local agronomist before setting up your populations.

Select vApplyHD control button on the homepage, and set an appropriate rate in the command rate box.



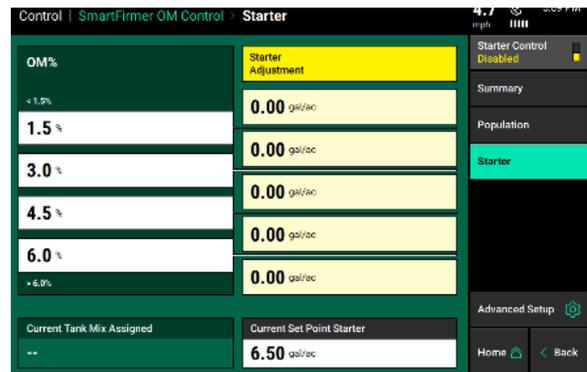
Press the “OM Control” button, the SmartFirmer Variable Rate Control Screen will appear as shown below. Real-Time control is enabled or disabled by pressing the All OM VR Control button on the right of this screen.

Real Time OM% Control for vApplyHD



Real time OM% control for vApply HD:

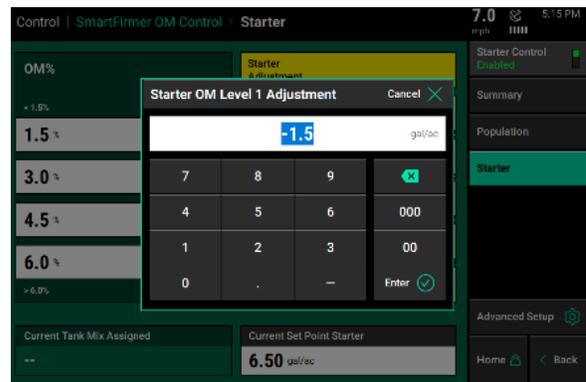
On the right side of the page select your liquid product nickname; for example Starter setup during vApply Setup: this example is Starter.



Note: This process is applicable for more than one vApplyHD module. If two modules are installed, use the same process for real time control of the second vApplyHD module by selecting the second product’s nickname.

Selecting Rate Adjustments: If no OM% adjustments are wanted for the base rate leave the adjustment at 0.

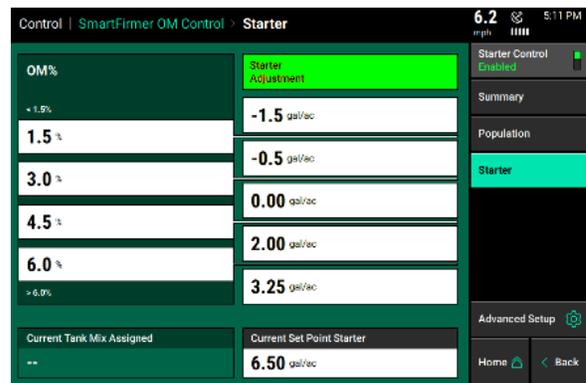
Adjustments: These set points will correlate to the related OM%. Adjust liquid set points off of the liquid set points selected in vApply control page. Do not enter the wanted rate; instead enter the deviation from the liquid base point.



Rate Adjustments: These set points will correlate to the related OM% displayed to the left.

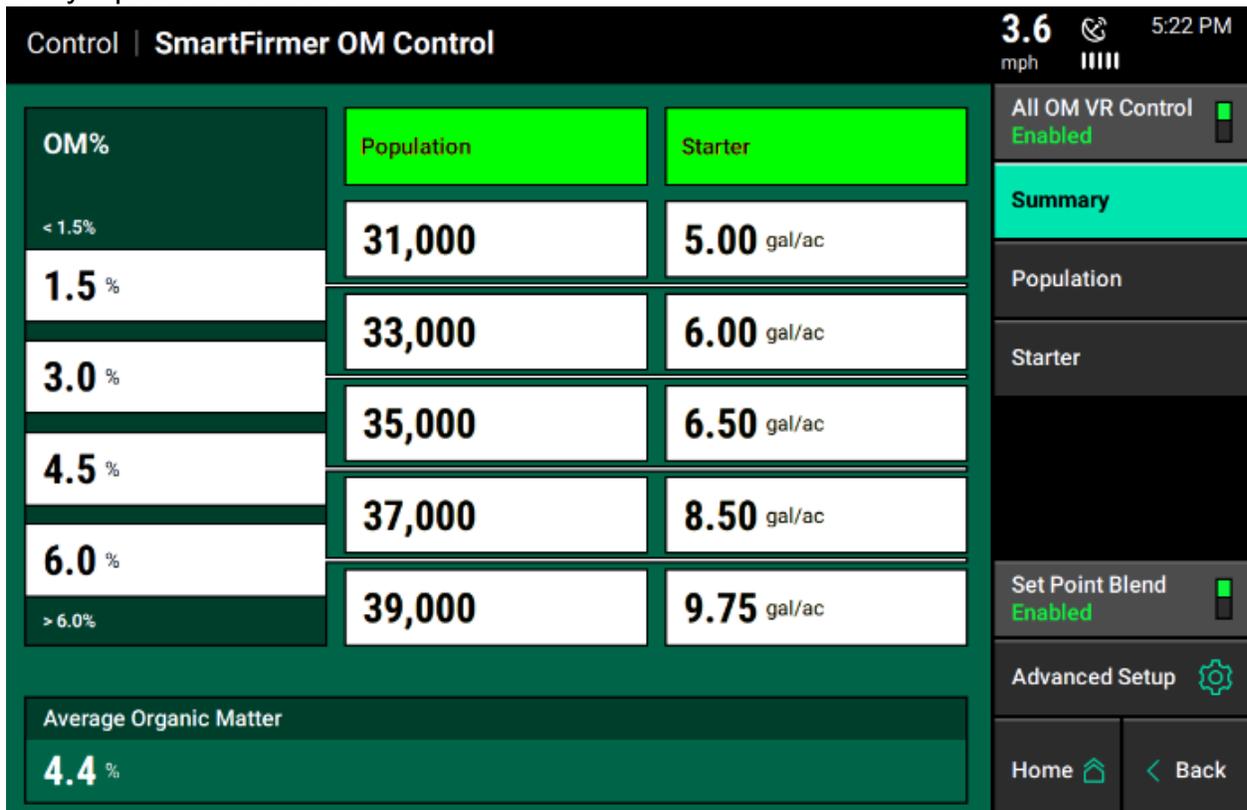
Use Rate Adjust set points off of the Base rate selected in vApplyHD control.

Do not enter the wanted rate; instead enter the deviation from the base rate +/-.



Overview

After adjustments have been inputted, press Summary on right hand side of screen to verify inputs are correct.



vDrive Insecticide: Real Time Control

Refer to vDrive Insecticide Setup and Operations Manual to ensure proper setup of vDrive Insecticide prior to attempting SmartFirmer: Real Time Control.

Note: All referenced setpoints are examples, consult with your local agronomist before setting up your populations.

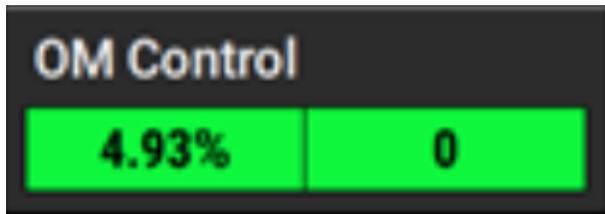
From the home screen, Press vDrive Insecticide to open the Control Page.



Set the “Base Rate” in the control screen. The Base Rate (lbs/acre) will be the base of the application range.

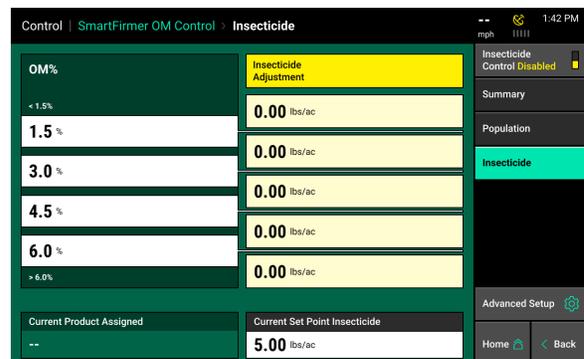
The base rate does not need to be the middle of the range. It can be the low or high adjustment. All inputs are user defined.

Press the “OM Control” button, the SmartFirmer Variable Rate Control Screen will appear as shown below. Real-Time control is enabled or disabled by pressing the All OM VR Control button on the right of this screen.



Real time OM% control for vSet Select Insecticide:

On the right side of the page select Insecticide.



Selecting Rate Adjustments- If no OM% adjustments are wanted for base rate leave the adjustment at 0.

Adjustments: These set points will correlate to the related OM%. Make changes to the insecticide adjustments off of the base rate from the control page. Do not enter the wanted rate; instead enter the deviation from the insecticide base rate.

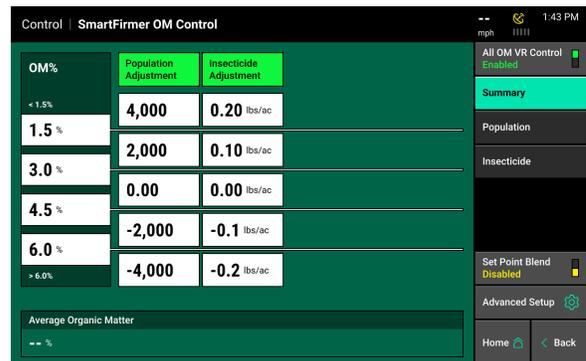
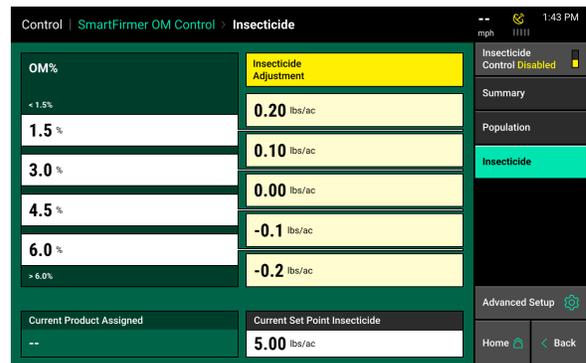
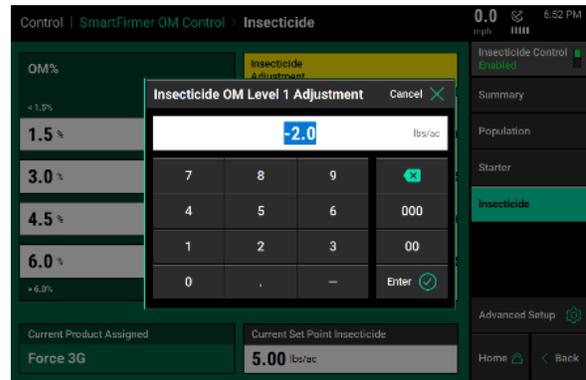
Rate Adjustments: These set points will correlate to the related OM% displayed to the left.

Use Rate Adjust set points off of the Base rate selected in vDrive Insecticide control.

Do not enter the wanted rate; instead enter the deviation from the base rate +/-

vDrive Insecticide Summary

After adjustments have been inputted, press Summary on right hand side of screen to verify inputs are correct.



Prescription: Real Time Control

Refer to 20|20 Setup & Operations manual for setting up prescriptions for the 20|20 Seedsense Monitor

Note: This function is useful for prescriptions that capture features that are not influenced by Organic Matter (like a pivot, drainage issues, etc). This feature is not intended to be used on Soil Zone based prescriptions.

Overview: Real Time Control can be used in tandem with prescriptions. For specific setup for compatible Precision Planting products, please use product setup for Real Time Control listed previously.

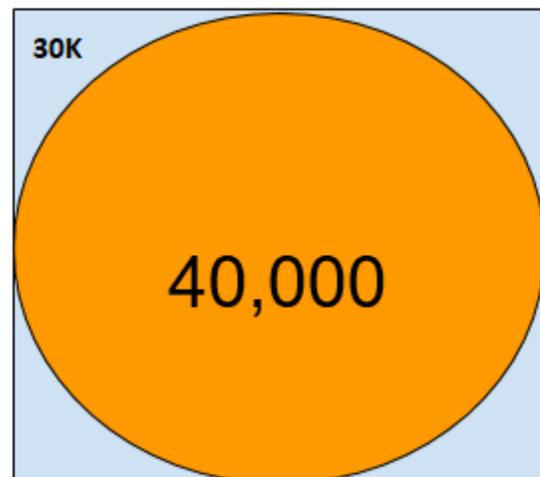
Real time control within prescriptions will function like your prescriptions currently do.

To assign a Seeding Prescription to the selected field, press the “Seeding Prescription” button. This will display ALL shapefiles that have been imported into the display. Choose the appropriate prescription for the field name. After selecting the prescription name, an attribute **MUST** be selected for each rate section that has been setup for the planter. An attribute is based on a defined product and contains a single defined rate for each management zone and is defined/named during the creation of the prescription. A different attribute can be selected for each rate section (allowing each rate section to be controlled by a different attribute/seeding rate), or the same attribute can be selected for each rate section.

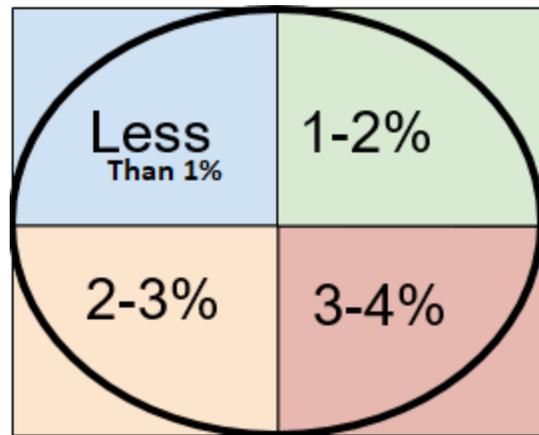
When Real Time Control is enabled inside a prescription adjustments will be made based upon percentage of organic matter being read. This function will act the same as it does when no prescription is assigned. Adjustments will be made to the commanded population, hybrid, &/or rate base assigned in the prescription and adjust based upon organic matter % readings.

Example: Population

Prescription commands a 30,000 base rate for drylands, and 40,000 under the pivot.

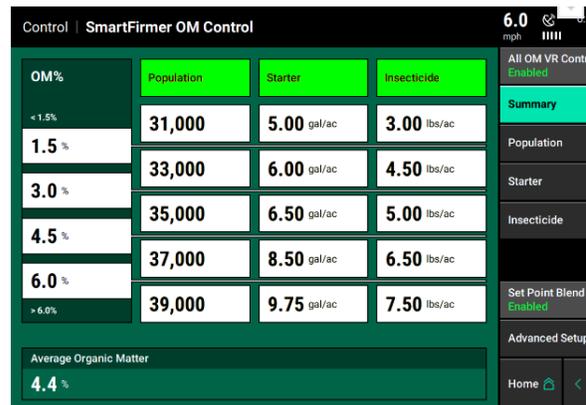


Organic Matter readings from Smartfirmer.

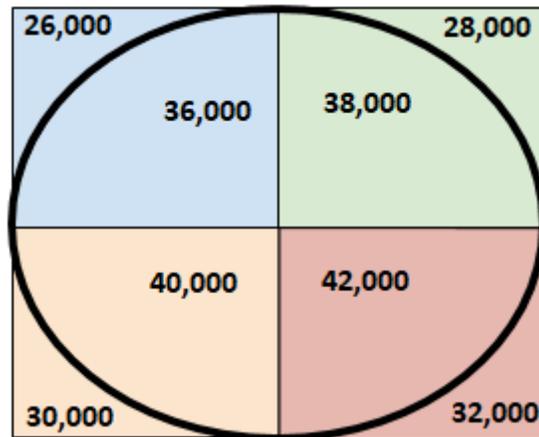


SmartFirmer Adjustments:

Adjustments will be made according to inputs made on the SmartFirmer OM Control Page. The setpoints assigned will make commanded adjustments to the population, hybrid, and/or rate attributes.



This process will be the same for vDrive, vSet Select, vApply, and vDrive insecticide. Real Time Control commanded population based upon organic matter readings.



Blue	Less than 1% OM	Adjustment —4000	Adjusted Dyland Pop: 26,000	Adjusted Pivot Pop: 36,000
Green	1–2% OM	Adjustment —2000	Adjusted Dyland Pop: 28,000	Adjusted Pivot Pop: 38,000
Orange	2–3% OM	Adjustment 0	Adjusted Dyland Pop: 30,000	Adjusted Pivot Pop: 40,000
Red	3–4% OM	Adjustment +2000	Adjusted Dyland Pop: 32,000	Adjusted Pivot Pop: 42,000

Note: All products use the same principles for Real Time Control within a prescription.

Diagnose Page

For Troubleshooting please see troubleshooting section

There are 4 levels to the SmartFirmer diagnose page. To toggle between screens press the top level. (Example press OM% or Moisture %)



OM Control Product Metrics: Individual row metrics for SmartFirmer's Real Time Control features for:

vDrive/vSet Select

vApplyHD (1 or 2 HD Modules)

vDrive Insecticide

SmartFirmer Metrics: This page displays metrics from SmartFirmer readings on a per row basis.

The screenshot shows the 'SmartFirmer' screen with a table of metrics for rows 1, 2, 3, and 4. The table includes columns for OM %, Pop Act, Pop Cmd, HD 1 Act, HD 1 Cmd, HD 2 Act, HD 2 Cmd, lb/ac Act, and lb/ac Cmd. A status bar at the bottom shows 'Lift State Lowered', 'Radar Speed 6.5 mph', 'GPS Speed 6.0 mph', 'FWD Accel 0.000 ft/s/s', 'Master Plant On', and 'Turn Rate Missing'.

Row	OM %	Pop Act	Pop Cmd	HD 1 Act	HD 1 Cmd	HD 2 Act	HD 2 Cmd	lb/ac Act	lb/ac Cmd
1	3.5	36.5	36.4	4.7	4.0	6.7	6.5	6.7	7.0
2	3.3	36.3	36.4	4.5	4.0	6.5	6.5	6.5	7.0
3	3.6	36.6	36.4	4.0	4.0	6.7	6.5	7.0	7.0
4	3.2	36.7	36.4	4.4	4.0	6.4	6.5	6.4	7.0

The screenshot shows the 'SmartFirmer' screen with a table of metrics for rows 1, 2, 3, and 4. The table includes columns for Supply Volts, Organic Matter, Uniform Furrow, Moisture, Clean Furrow, and Temperature. A status bar at the bottom shows 'Lift State Lowered', 'Radar Speed 0.0 mph', 'GPS Speed 0.0 mph', 'FWD Accel 0.000 ft/s/s', 'Master Plant On', and 'Turn Rate Missing'.

Row	Supply Volts	Organic Matter	Uniform Furrow	Moisture	Clean Furrow	Temperature
1	13.50	2%	98%	45%	99%	74
2	13.65	3%	99%	42%	99%	74
3	13.65	3%	99%	39%	99%	74
4	13.63	2%	99%	37%	99%	74

Reflectance Percentages: Displays emitter and detector percentages based on reflectance percentages on a per row basis.



The screenshot shows the 'SmartFirmr' interface with a table of reflectance percentages. The table has 7 columns: Row, Supply Volts, Blue, Yellow, IR A, IR B, and IR C. The data is as follows:

Row	Supply Volts	Blue	Yellow	IR A	IR B	IR C
1	13.50	2.3%	2.4%	3.0	2.0	4.0
2	13.65	2.9%	2.3%	2.4	5.9	2.0
3	13.65	3.0%	4.5%	2.9	2.0	2.5
4	13.63	2.4%	2.0%	2.0	3.5	2.0

At the bottom of the screen, there are several status indicators: Lift State (Lowered), Radar Speed (Wait Signal), GPS Speed (Waiting Comm), FWD Accel (0.000 ft/s/s), Master Plant (Off), and Turn Rate (Missing). The right sidebar contains buttons for Reset Modules, Show Error Rows, DeltaForce, SRM, Seed Tube, vApplyHD (Starter), vDrive, and AUX Sensors. The top right shows the time as 7:52 PM.

Sensor Voltages: Displays emitter and detector voltages.



The screenshot shows the 'SmartFirmr' interface with a table of sensor voltages. The table has 7 columns: Row, Supply Volts, Blue Voltage, Yellow Voltage, IR A Voltage, IR B Voltage, and IR C Voltage. The data is as follows:

Row	Supply Volts	Blue Voltage	Yellow Voltage	IR A Voltage	IR B Voltage	IR C Voltage
1	13.45	0.74	4.6	4.5	3.43	4.6
2	13.43	0.78	5.5	4.6	3.45	4.8
3	13.45	0.85	4.8	4.8	3.45	5.1
4	13.45	0.72	4.4	5.1	3.55	5.3

At the bottom of the screen, there are several status indicators: Lift State (Lowered), Radar Speed (Wait Signal), GPS Speed (Waiting Comm), FWD Accel (0.000 ft/s/s), Master Plant (Off), and Turn Rate (Missing). The right sidebar contains buttons for Reset Modules, Show Error Rows, DeltaForce, SRM, Seed Tube, vApplyHD (Starter), vDrive, and AUX Sensors. The top right shows the time as 8:20 PM.

Interpreting SmartFirmer Data on FieldView Maps

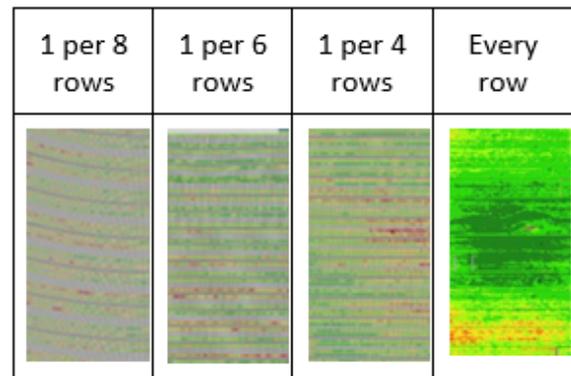
SmartFirmer mapping resolution will vary depending on the metrics being viewed. The more SmartFirmers on a planter, the higher the data resolution. Organic Matter & Soil Temperature maps with interpolate data in between SmartFirmer rows presenting the data for a full planter. Furrow Moisture, Uniform Furrow, and Clean Furrow maps will not interpolate data between SmartFirmers. Readings can vary greatly row by row with these metrics, therefore we do not interpolate data sets to map full planter passes.

Resolution Examples No Interpolation

Organic Matter:

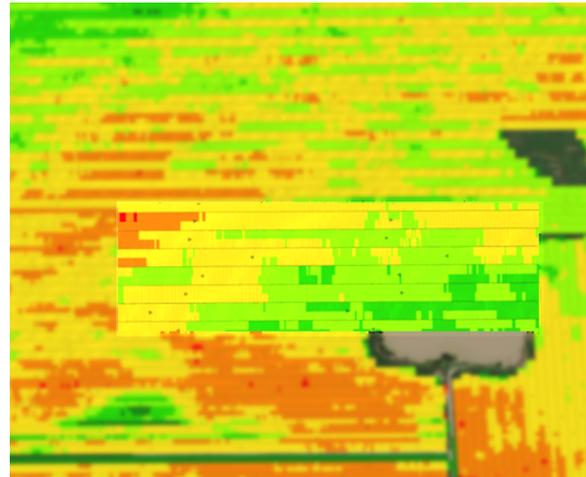
Definition: Percentage of Soil Organic Matter

Range 0% — 60%

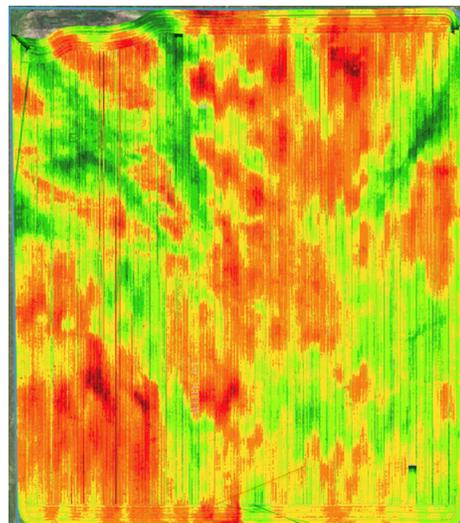


Note: Excellent spatial zone/variability mapping.

Organic Matter Map: Two SmartFirmers on Planter



Organic Matter Map: SmartFirmers on every row (High Resolution)

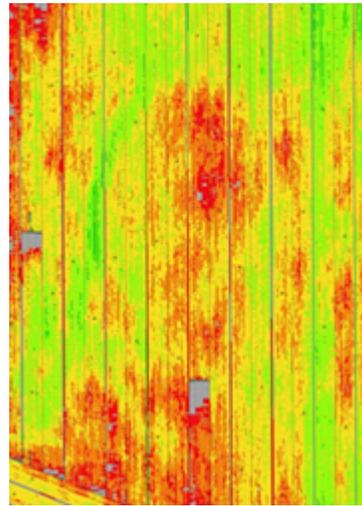


Furrow Moisture:

Definition: 3 day seed weight gain in that moisture.

Range: 0% — 60%

Goal: Above 20%



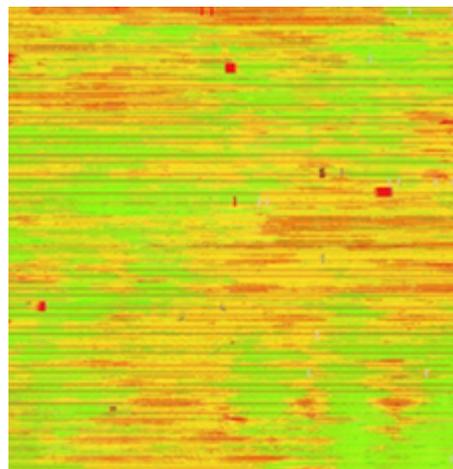
Note: Intended to guide depth decision, also use forecast in decision making (Rain or drought).

Uniform Furrow:

Definition: Variation in furrow (light, cloddiness, moisture changes).

Range: 0% — 100%

Goal: Above 95%



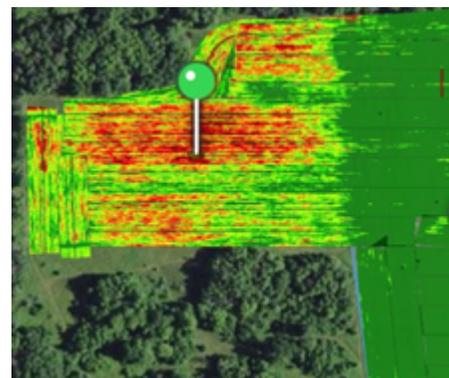
Note: Can indicate row unit mechanical problems, variation due to tillage patterns, windrowed residue.

Clean Furrow:

Definition: Absence of crop residue.

Range: 0 — 100%

Goal: above 95%



Note: Use information to set CleanSweep, also may help in management decisions for tillage and harvest.

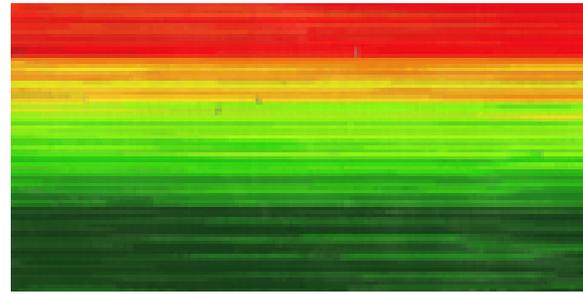
Temperature:

Definition: Real time soil temperature during planting.

Range: 32 – 100F

Goal: above 50F

Note: Use best judgement and look at upcoming weather forecast.



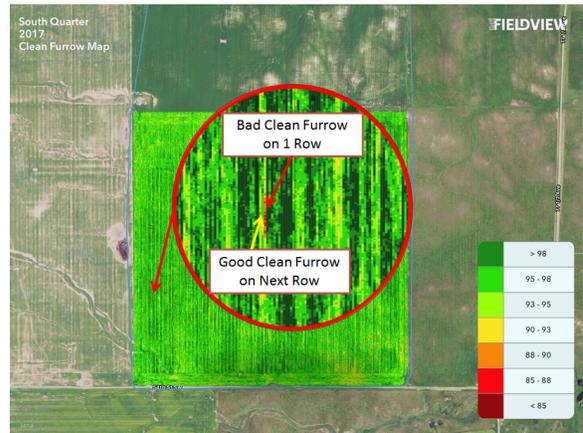
Mechanical Issue Detection With SmartFirmer

SmartFirmer readings can detect issues that are caused by mechanical failures on the row unit. Anytime readings vary dramatically between rows (Specifically neighboring rows), it is advised to stop and visually inspect the row for mechanical faults. The following maps are examples of mechanical failures detected in SmartFirmer readings.

Metric: Clean Furrow

Symptom: Poor clean furrow reading on single row, when neighboring rows were reading clean furrow.

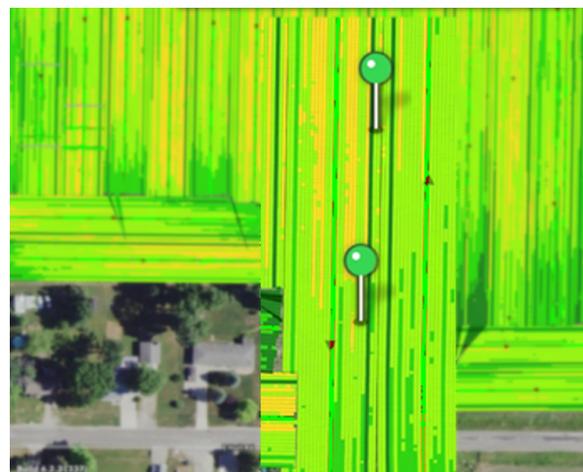
Mechanical Issue: stuck row cleaner causing row cleaner to plow.



Metric: Uniform Furrow

Symptom: Single row (row 3) reading higher uniform furrow than neighboring rows.

Mechanical Issue: Siezed opening discs plowing deeper than intended planting depth.



TroubleShooting

SmartFirmer diagnostics should begin by comparing readings to neighboring rows.

If user has 4 SmartFirmers on planter, and 3 out of 4 are showing similar readings, the 1 that is reading differently needs to be under investigation for deviated readings.

Thought Process for Diagnosing Issues

1. Does ground truth match SmartFirmer readings?

a. Dig in furrow to verify SmartFirmer readings are accurate. If SmartFirmer readings show lack of moisture, ensure planting depth is adequate to reach moisture line.

2. Is the issue found in the SmartFirmer

a. Visually inspect SmartFirmer for damage or obstruction to lens.

i. Soil buildup

ii. Inspect harness for damage

iii. Condensation inside lens

iv. Scratched lens.

3. Is the issue mechanical on planter

a. SmartFirmer can detect mechanical issues on a row unit. Inspect row unit for mechanical failures. Mechanical failures can be but are not limited to. Seized opening discs, plugged row cleaners, improperly shimmed gauge wheels/opening discs, worn opening discs. Etc.

4. Can the issue be fixed now?

a. Different metrics will alert user of various field conditions. If Furrow Moisture shows lack of available moisture, user may need to adjust depth to ensure moisture is adequate for germination. If Clean Furrow percentage drops, row cleaners may need to be used more aggressively.

5. What operationally could of caused the issue.

a. There are a wide array of situations that can affect SmartFirmer readings; i.e. Tillage, weather, residue management, combine mechanical components. Understanding how these factors correlate with one another can assist on making management decision in the current season or the following growing season.

Event Codes

Event Log Text	Pop Up Text	Action
SmartFirmer Not Detected	Lost Communication with SmartFirmer on row #____ . Check connections:	Row # is showing an open input on the SmartFirmer input. This may indicate: damaged harness / connector; circuit failure of the SmartFirmer; or damaged SRM. Verify by plugging recognized SmartFirmer into row showing failure.
SmartFirmer Optics Damaged	SmartFirmer Signal Error Detected on row #____. Inspect for damage on lens and electronics housing:	Row # is showing an abnormal reflectance reading (relative to neighboring rows) for extended time period. Can indicate physical issue on row unit or a problem with one or more LED's, contamination inside of optics assembly, broken lens.
SmartFirmer Lens Blocked	SmartFirmer Lens Blockage detected on row #____.	Inspect SmartFirmer lens for build up, if lens is obstructed clean lens.
SmartFirmer Erratic Reading	Erratic SmartFirmer Readings on row #____ :	Inspect Row unit for potential ride issues and SmartFirmer for damage.