# Yara N-Sensor
# User Guide

TAYLORED AGRI

## Help & Support

Between the Hours off 8am-5pm, Monday to Friday

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For the best help and support we recommend joining are WhatsApp group, you can Join via the QR code below or simply ask a member of Taylored-Agri Ltd to add you.

The WhatsApp group is monitored before and after usual working hours as well as weekends, post any issues or agronomic questions into the group and a member of Taylored-Agri will get back to you ASAP.

# Introduction

Please note this document is designed as a reference guide for the use of the Yara N-Sensor and will not cover all features and operations of the use of the Yara N-Sensor

The purpose of this document is to be used as a guide for the operation of the Yara N-Sensor and should not be considered to replace or constitute the advice given by a “FACTS” qualified advisor.

If not maintained properly or used without due care or attention the result could cause damage to the crop health or failure.

# Aim

The Yara N-Sensor is designed to deliver precise levels of N input according to the crop’s requirement, helping to both reduce environmental impact whilst increasing profit margins and nitrogen efficiency.

# Principle of Use

The Yara N-Sensor is a tool for “Real-Time Variable Rate Nitrogen”. In active use the N-Sensor determines the nitrogen/chlorophyll content using an S1 Index. From this base reading we then use Yara’s in-built agronomy to determine the nitrogen uptake (SN) of a variety of crops at different growth stages. From knowing crop N-Uptake this allows the N-Sensor to change the N-Recommendation to the implement Rate Controller.

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# Operational Modes

## Absolute N-Application OSR

The purpose of Absolute OSR is to achieve a total of 250± Kg N /ha over 2 applications for a 4.5 t/ha Crop.

After autumn growth the N-Sensor on the first application we expect to see around 60± Kg N /ha in the crop and the sensor will supply around 90± Kg N/ha totalling 150± Kg N/ha after the first pass.

On the second application the N-Sensor is expecting to see around 140± Kg N/ha and would supply the crop with 110± Kg N/ha to total the 250± Kg N/ha after application.

## Absolute N-Application Cereals

The Purpose of Absolute Cereals in Winter Wheat and Winter Barley, is to achieve the optimum amount of N for the Crop at its growth stage. This is done over 3 applications.

For both Winter Wheat and Winter Barley, the first application should be done as a flat uniform rate.

This quantity can be calculated as 120Kg N/ha – the Soil N Status (SNS) this should provide a good indicator as to the first application rate.

The second application in Winter Wheat and Winter Barley is independent of expected yield, in “Winter Wheat” for example at GS31 the N-Sensor hopes to see around 65 SN (Nitrogen Uptake) and would apply around 50 Kg N/ha.

The third application adapts and uses the nitrogen readings (SN) to recommend a rate in response to the nitrogen response curve of a 9T/ha Winter Wheat & 8T/ha Winter Barley crop, the recommendation is then corrected by the expected yield and soil mineralisation status.

## Target Rate Application

Target Rate Application allows you to variably apply your own recommended rate variable, The target rate can be provided by yourself, an agronomist or by the Yara N-Tester.

The rate is then evenly distributed as “Low SN = Higher rate” and “High SN = lower rate” Selecting the Protein dressing mode can reverse this however.

Simply pick the rate you wish to apply in Kg N/ha and then and then allow the N-Sensor its limitations of a maximum rate and minimum rate, e.g.

Minimum rate: 60Kg N/ha

Target Rate: 90Kg N/ha

Maximum rate: 120Kg N/ha

You do not necessarily need to have a balanced change; some customers previously have set the following:

Minimum rate: 90Kg N/ha

Target Rate: 90Kg N/ha

Maximum rate: 120Kg N/ha

This change means the sensor has the ability increase the rate in the poor area’s whist not restricting the rate in the higher SN areas.

Crops include: Winter Wheat, Winter Barley, Winter OSR, Oats, Winter Rye, Potatoes, Maize, Triticale, Spring Wheat, Spring Barley, Spelt Durum Wheat and Standard Grassland

## Target Rate Application - Grassland

The Grassland module in “Target Rate Application” works under the same principles however instead of crop changes we have changes in “Cuts”

“Cut 1 Top Dressing”, “Cut 2 Top Dressing” – Applications 10+ Days prior to Mowing (Recommended)

“Cut 1”, “Cut 2”, ”Cut 3-6” – Applications within 2 Days prior to mowing date.

## Scanning

The Scanning mode allows you to scan a crop and take a biomass reading without application. Simply tell the N-Sensor the Crop and the implement width on the vehicle and record.

## N-Application

The original N-Sensor mode, This mode requires the operator to do a calibration run up a tramline in which a reference value in nitrogen uptake (SN) is calculated, you are then required to tell the system the quantity (Kg N/ha) the rate you wish to apply over the calibration strip, from this you can now add a maximum and minimum rate and the sensor will adjust its rate depending on the SN.

Crops include: Winter Wheat, Winter Barley, Winter OSR, Oats, Winter Rye, Potatoes, Maize, Triticale, Spring Wheat, Spring Barley, Spelt and Durum Wheat

## Base Application

Base Application is used for the application of fertilisers and minerals using pre-made prescription maps. Prescription maps should be in the form of either,

- .rst - Raster Maps
- .grd – Grid File
- .shp – Shape File (file must include .shp + .dbf + .shx)

## Protein Dressing's & Plant Growth Regulators

At GS 37+ in "Target Rate Application" & "N-Application" you will see the "Application Index" can be changed from "Booting" to "Protein Dressing" this now reverts what the N-Sensor usually does in these modes, meaning, Higher SN = Higher Rate & Lower SN = Lower Rate.

For growth regulators you can then tell the N-Sensor the N% in the Fertiliser product is now 100% and instead of working in Kg N/ha you can work in total product, e.g. N%100,

Minimum rate: 100 Kg N/ha = 100L/ha

Target rate: 150 Kg N/ha = 150L/ha

Maximum rate: 200 Kg N/ha = 200L/ha

# Quick Start Guide

1. Check all Warning Symbols are Grey and ready for Operation
2. Start a “New Task” in Task Selection
3. Check or change the “Operational Mode” in Task Selection
4. Check or change the “Agronomic Calibration” Settings
5. Press “Start”
6. Check the product rate is correct and changing on the fertiliser/product rate controller screen, Press the VRA Icon on the N-Sensor monitor to view the product rate in Kg/ha or L/ha, not Kg N/ha

## Liquid Nitrogen Customer (Except Yara Liquid N)

Make sure to change you’re N% in the fertiliser from a “Weight by Weight” metric to a “Weight by Volume” metric, see page 118

If you have any issues, questions or need help setting up the N-Sensor please do not hesitate to ask.

## Biomass Cutoff (Recommended by Taylored-Agri)

Absolute OSR, (SN)

- 1st Application = 25 SN
- 2nd Application = 40 SN
- Dead Biomass 10%

Absolute Cereals, (%)

- 2nd Application = 100%
- 3rd Application = 100%

Target Rate Application, (%)

All Crops excluding Grassland

- GS 22-30 = 20%
- GS 30-32 = 40%
- GS 35-39 = 50%
- Protein/PGR, GS37+ = 10%

Grassland,

- Cut 1 Top Dressing = 10%
- Cut 2 Top Dressing = 20%

N- Application (SN)

- GS 22-30 = 5 SN
- GS 30-32 = 25 SN
- GS 35-39 = 40 SN
- Protein/PGR, GS37+ = 10 SN

Biomass Cutoff Factor = 100%

Base Application

When selecting a new task,

1. Application Mode,

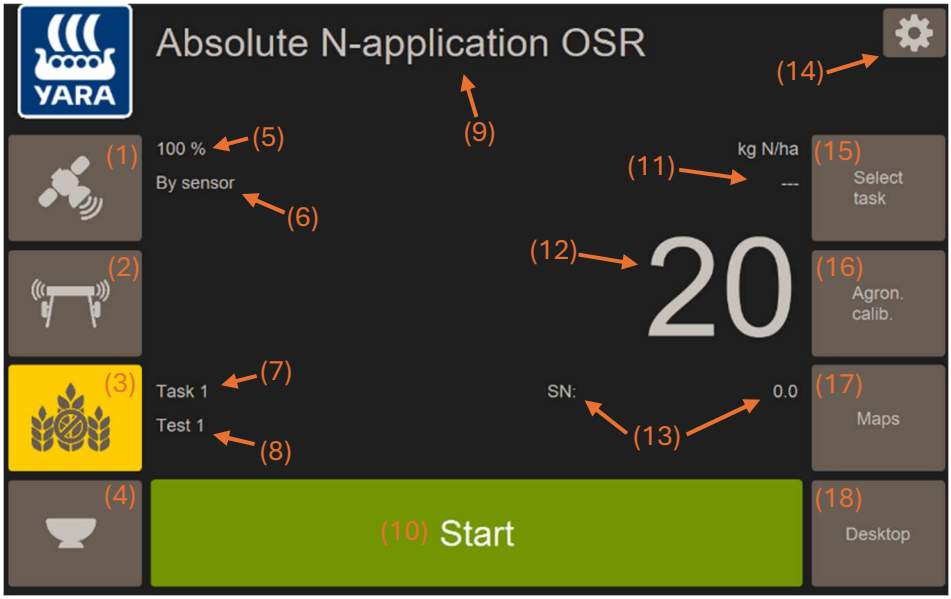
- Select, “Overlay Map”

2. Agronomic Calibration

“Agent Content” and “Map Factor”

- 100%

## Main working page layout




1.) GPS Data

2.) N-Sensor Data

3.) Agronomy / Low Biomass

4.) Variable rate

5.) Percentage alteration

6.) Application by sensor or by map (Base Application Only)

7.) Task Number

8.) Task / Field Name or Number

9.) Current Operational Mode

10.) Start / Stop

11.) As-Applied Rate ( Bidirectional only)

12.) Recommended Rate (Kg N/ha)

13.) SN (Nitrogen Uptake Value)

14.) Settings

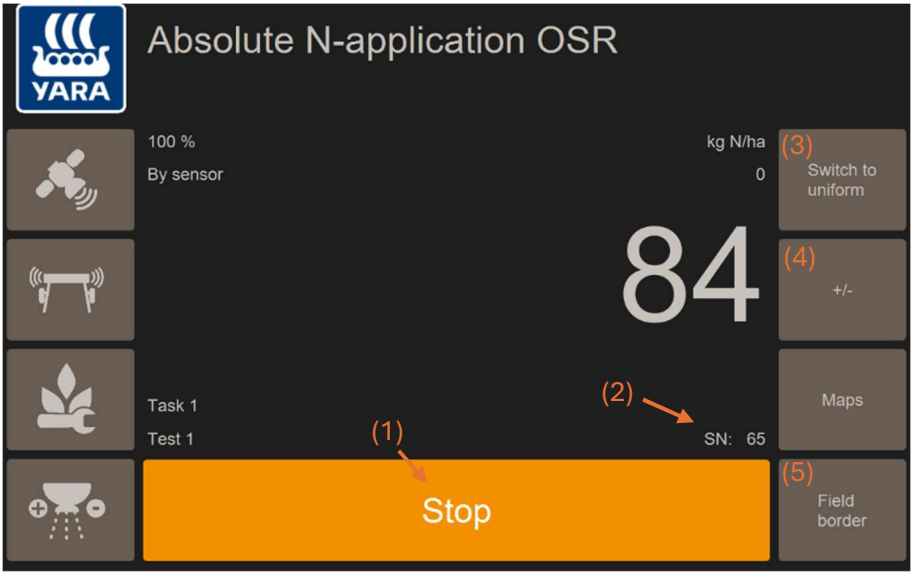
15.) Task Selection

16.) Agronomic Calibration

17.) Maps

18.) Windows Desktop / Additional Programs

## Main working page layout




1.) Stop / Start

2.) SN (Nitrogen Uptake),
In this example the N-Sensor can see 65 Kg N in the canopy

3.) Switch to Uniform (Flat Rate) / Switch to Sensor

4.) Rate Percentage Changer (Kg N/Ha)

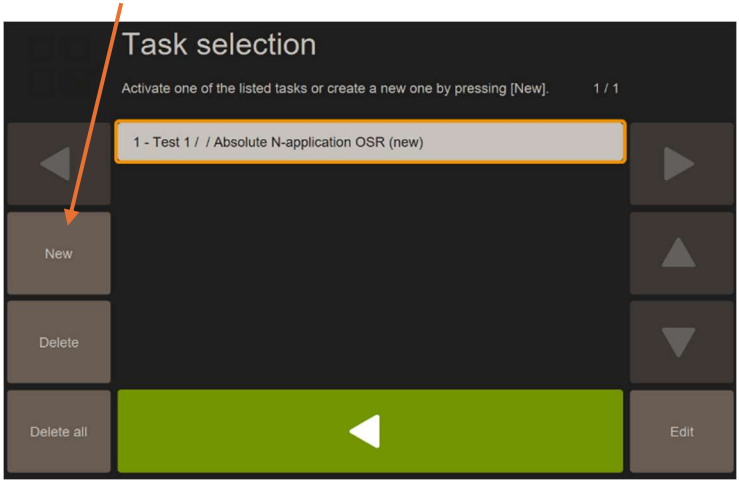
5.) Field Border (ALS-2 Only)
Turn off one head to improve headland accuracy

# Creating a “New Task”

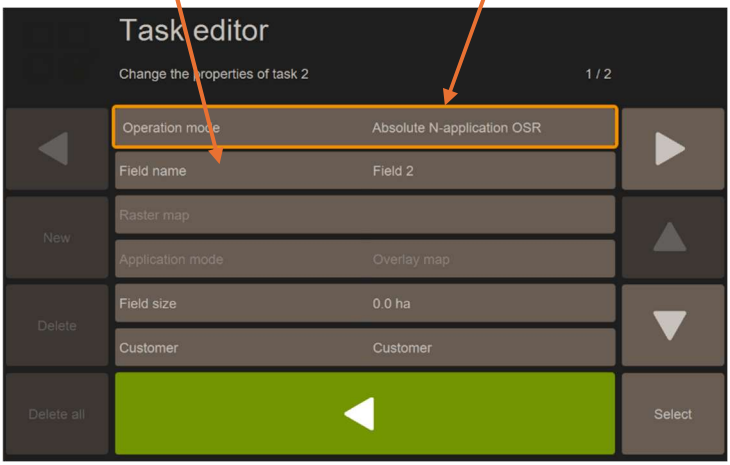
**Every Field** you enter to do an application or scan will need to do an **individual** task, even if you have previously done an application or task before, **always create a new task!**

1. Press the “Select task” option

2. Press “New”

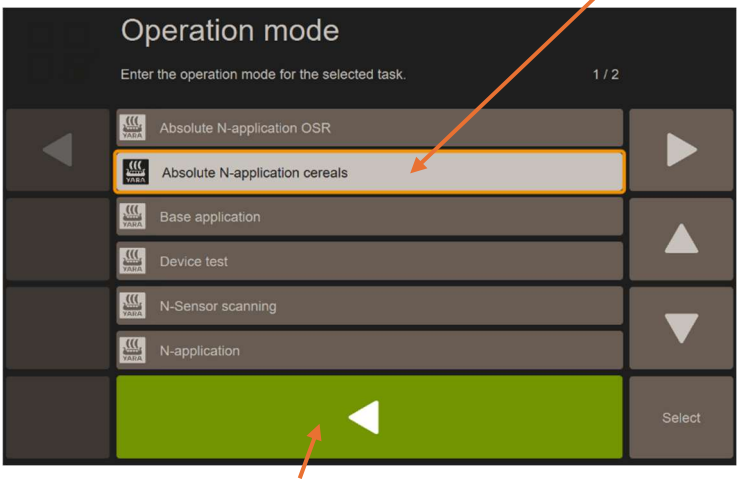


3. You can now add details about the task your about to begin. The most important details are the “Operation mode” and the name of the field you are in.



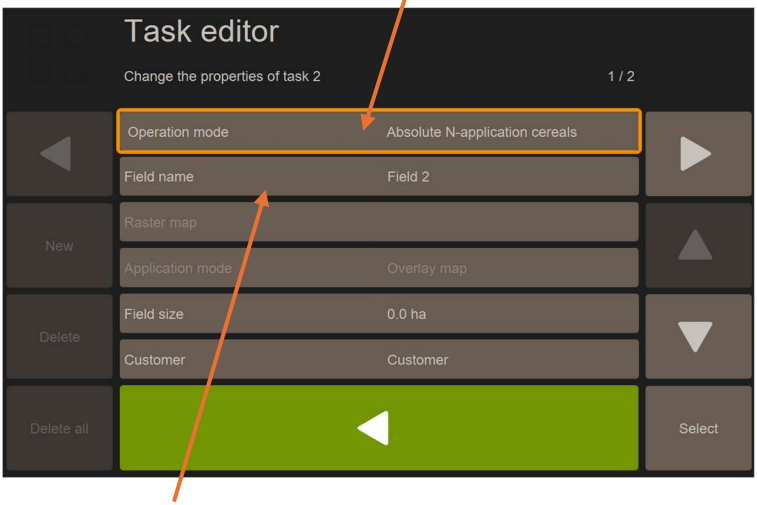

Press “Operation mode” to view and select the correct operational mode. (Please see page 4 for more details on operation mode types)

Press the mode you wish to select until it is highlight in a solid colour, and <u>not just an orange ring around it</u>.




Then Press the Green “Select and Return” button

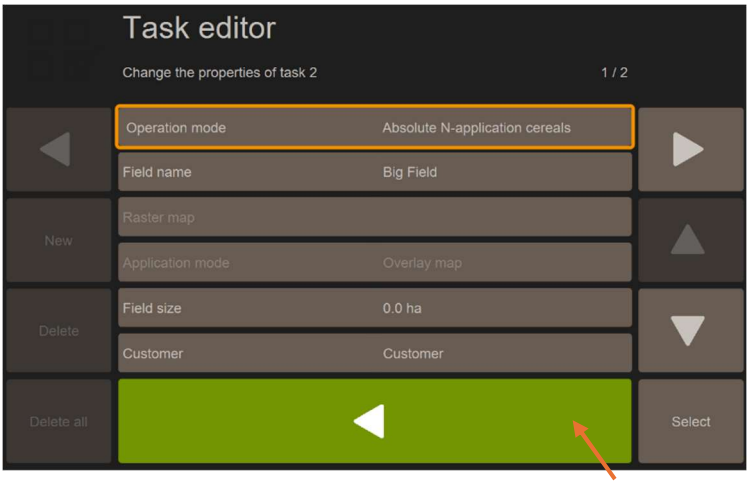
You will then return to the “Task Editor” page. You should now notice the “Operational Mode” has changed to the desired mode




Now Press “Field name” to change the name.

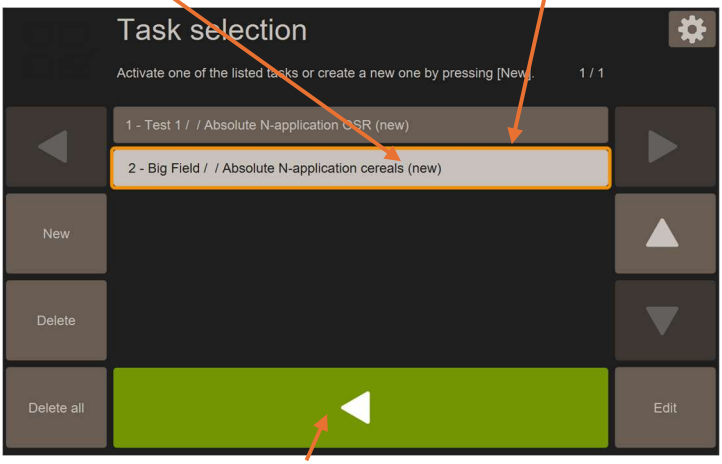
Just start typing and the preset field ID will be removed and replaced with the name of the field/task. Once you are happy with the selection press “OK”

You should now be back on the “Task creation” screen again




When you are happy with the selected options, Press the Green “Select and Return”

You will then go back to the “Task Selection” Page, You should then see the “New task” you have just created and the system will automatically select the task make sure the task is selected with the orange ring around and that the task is highlighted in a different colour, you may also notice the (new) after the task.




Then press the “Select and Return” icon to return back to the main running page.

On the main running page, you should now see 3 changes.

1.) Operation mode has Changed

2.) We are now on a new task, or the task number has changed

3.) The field name entered is now displaying.

All that is left is to check/adjust the crop agronomy (Agronomic Calibration) and you are ready to start using the Yara N-Sensor

Please see individual operational mode guides for help setting up the “Agronomic Calibration”.

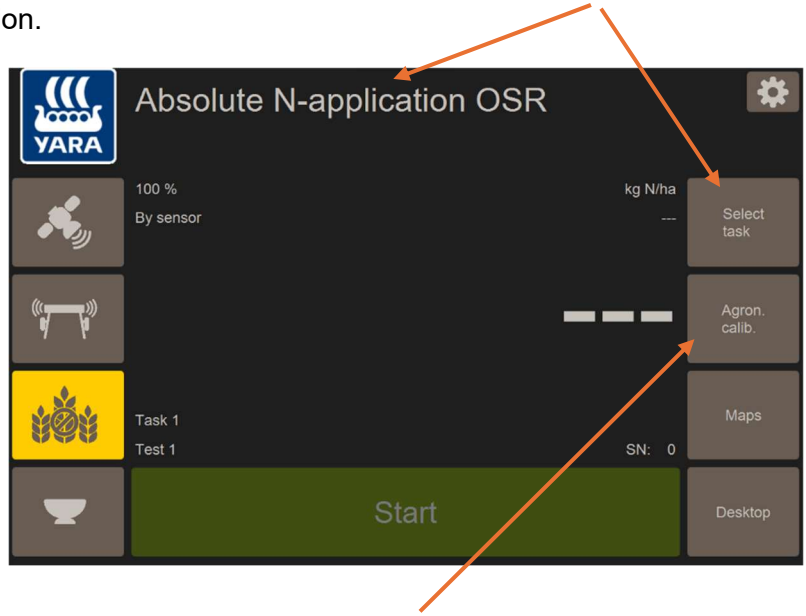

- Absolute N-Application OSR pg. 18
- Absolute N-Application Cereals pg. 30
- Target Rate Application pg. 42
- Target Rate Application (Grassland) pg. 56
- Scanning pg. 70
- N-Application pg. 76
- Base Application pg. 90

# Notes

# Absolute N-Application OSR

1.) Create a new task,

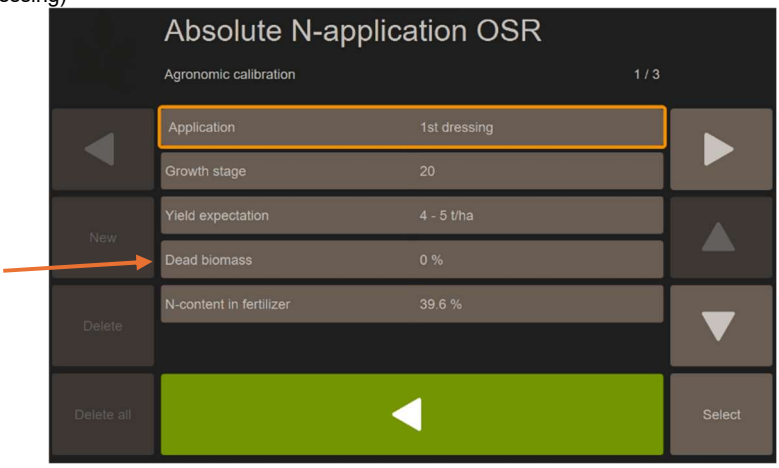
To start you must first create a new task in the task Selection, in Operational Modes make sure to select “Absolute N-Application OSR” for further details on how to do this see the “Creating a New Task” section.




2.) Now select the “Agronomic Calibration”

You will then get 2 different selections depending if this is the 1st Application or the 2nd Application

(1st Dressing)



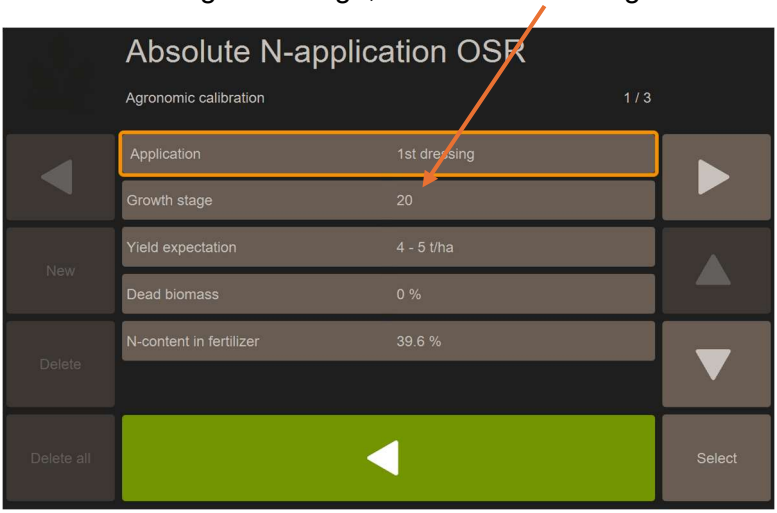

(2nd Dresing)

You will notice the only change between the 2 dressings is the change from Dead Biomass (1st Dressing) to Mineralisation Potential (2nd Dressing)

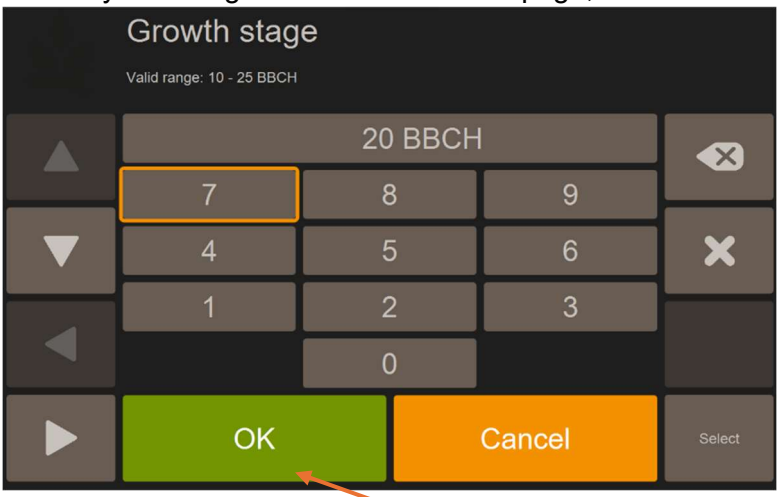
Growth stages

- 1st dressing is between GS10 – GS25
- 2nd dressing is between GS26 – GS39

To select the correct growth stage, hit the “Growth stage” button




This will take you through to the GS selection page,

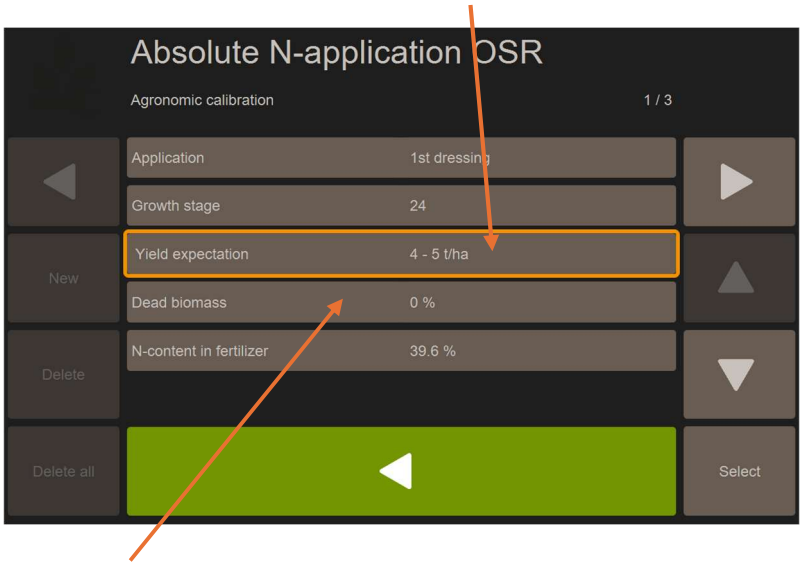



Select the correct Growth stage on press “OK”

You then need to choose the correct yield expectation

- Less than 4T/ha
- Between 4 – 5T/ha
- More than 5T/ha

Simply tap the “Yield expectation” to change/scroll between options.

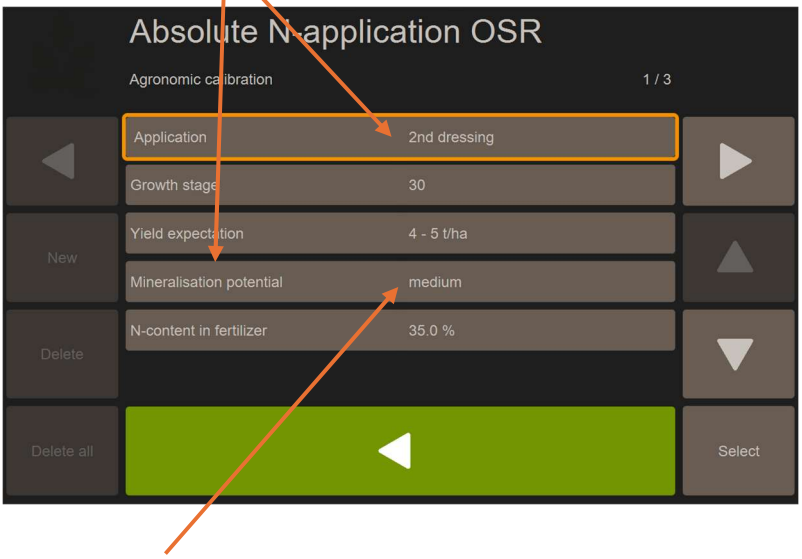



Dead Biomass (1st Dressing only), by increasing the dead biomass or amount of yellow/damaged leaves in the canopy by 10% the N-Sensor will see this as a potential 7± Kg N/Ha return to the soil later for a resupply later in the growing season.

Dead biomass options,

- 0%
- 10%
- 20%
- 30%
- 40%

On the “2nd dressing”, “Dead biomass” will change to “Mineralisation potential”




Selecting the button will change between High, Medium and Low.

High mineralisation potential (**-10±Kg N/Ha**)

- High organic matter soil,
- High soil N core values
- SNS 3+
- Low Rainfall or Drought

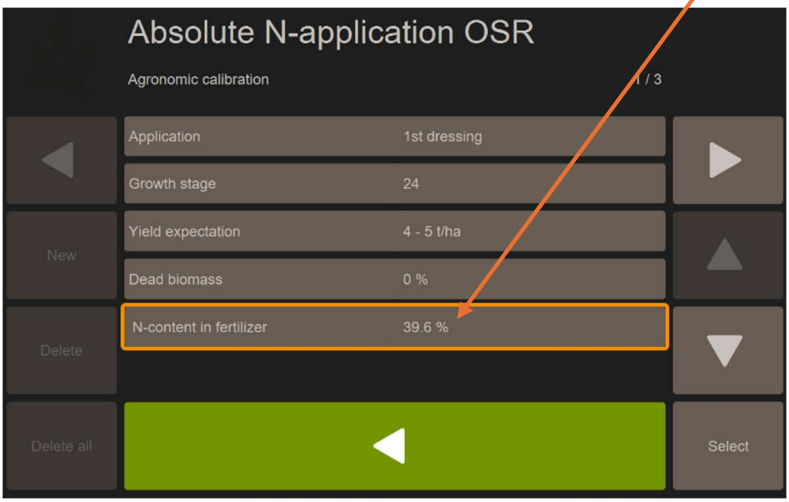
Medium Mineralisation potential (**Standard N-Uptake scale**)

- Medium or mixed Soils
- SNS 1 or 2
- Average / High Rainfall

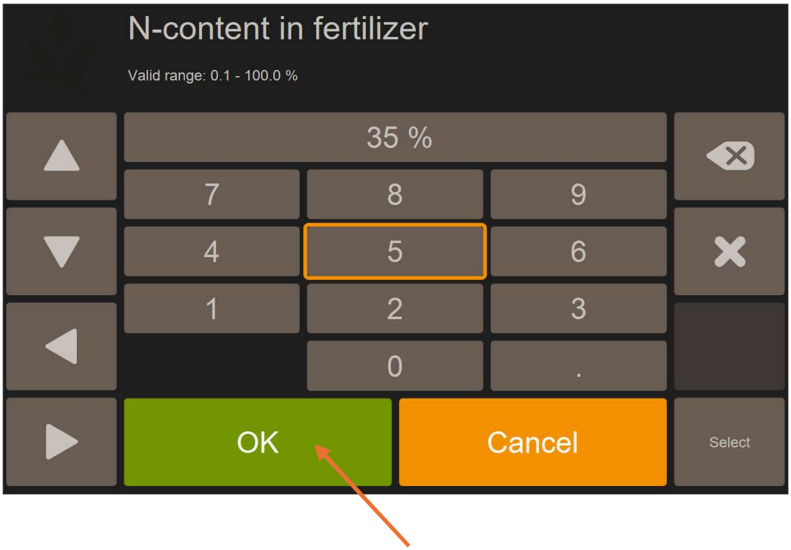
Low Mineralisation potential (**+10±Kg N/Ha**)

- Low Organic Matter soils
- Sandy Soils
- SNS 0

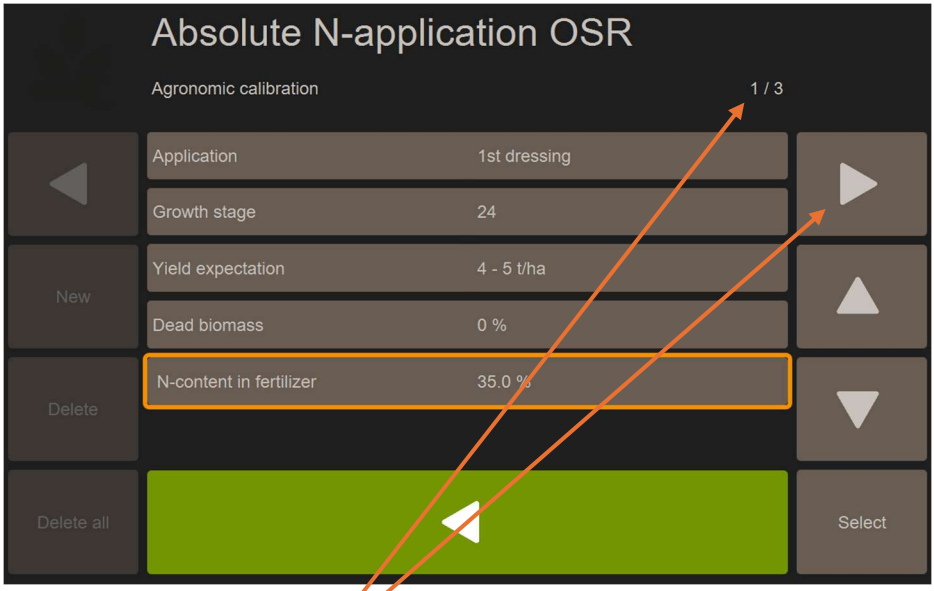
N-Content in fertilizer, to change the N% tap the “N-Content in fertilizer” button




N% valid range from 0.1% to 100%, remember this is N% (**Weight by Volume**), Liquid (Weight by Weight) manufacturers need to be converted, see Rate Calculator for more information.

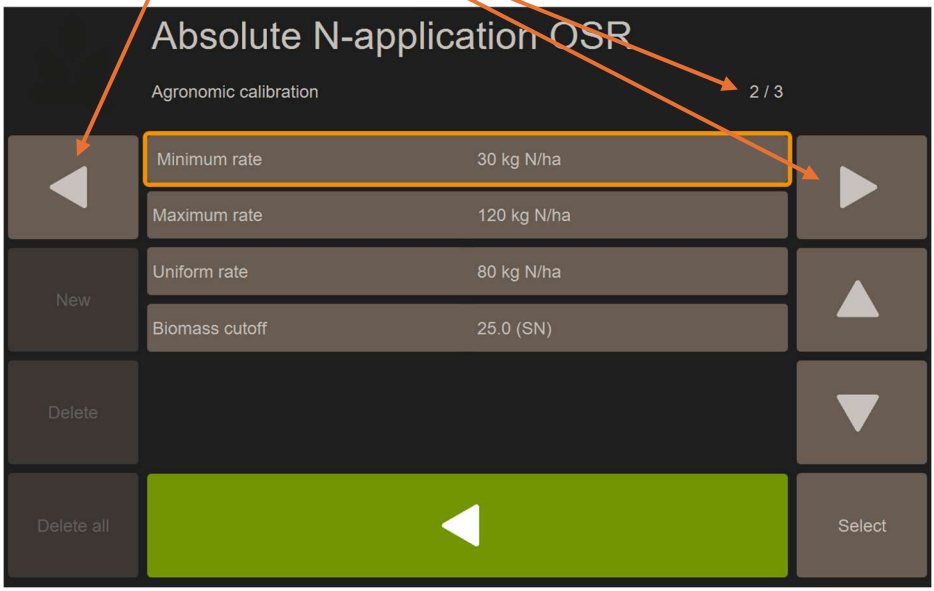



Select the correct N% and press “OK”

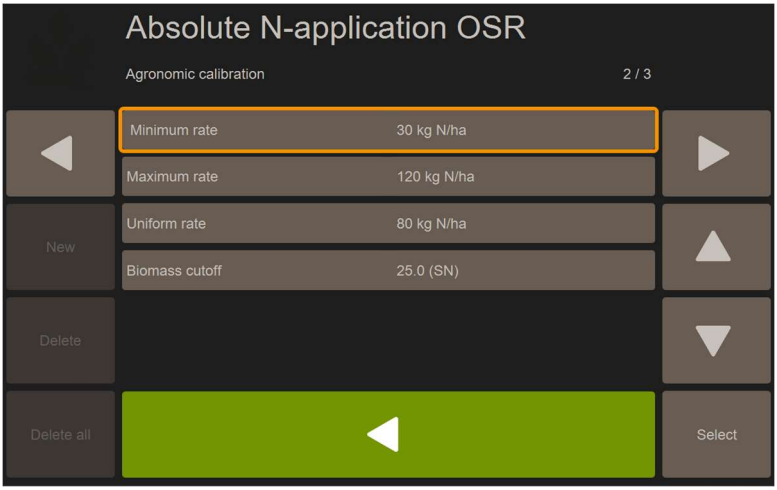



Move to the next page,

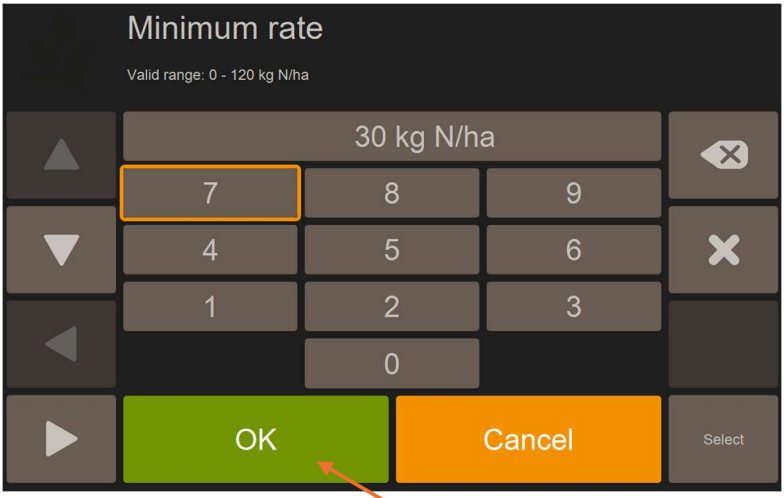
Or back a page.



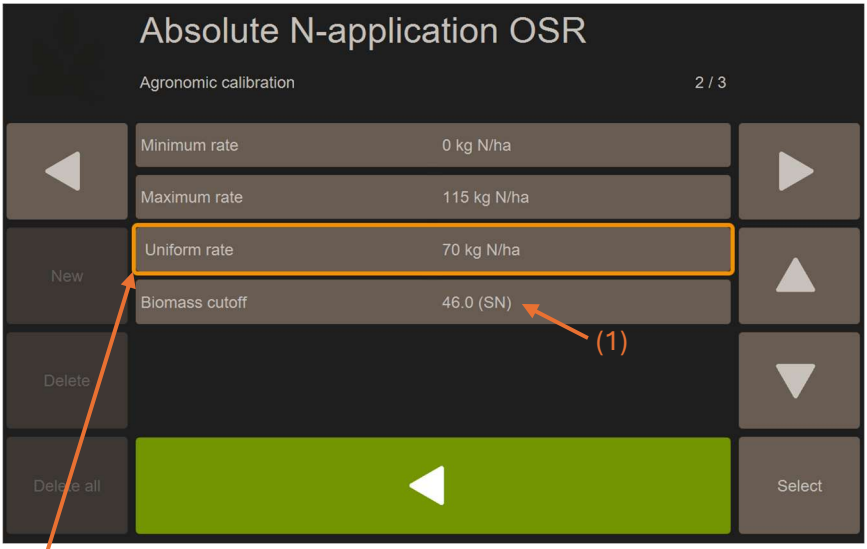
Select either the “Minimum rate” “Maximum rate” and “Uniform Rate” to change the limits. Remember the system works in Kg N/ha not product.




- 1st dressing the minimum & maximum rate is 0-120 Kg N/H
- 2nd dressing the minimum & maximum rate is 0-150 Kg N/Ha




Chose the quantity required then select “OK”,




Uniform Rate

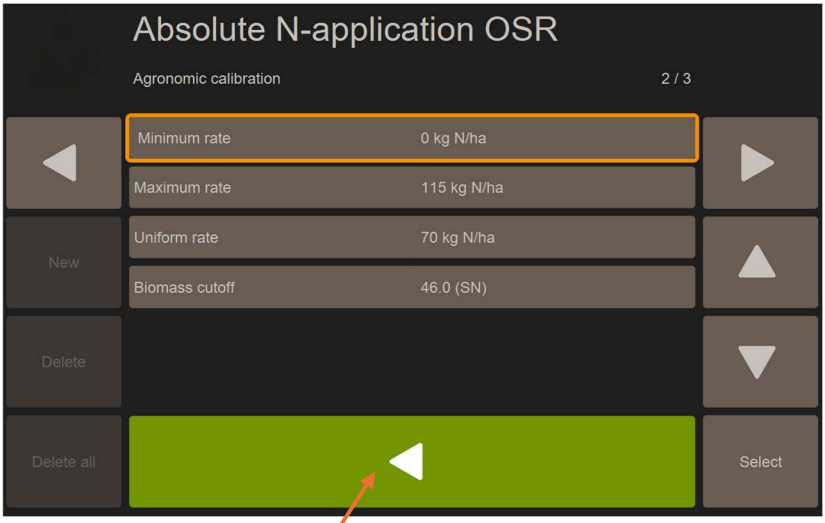
If the N-Sensor failed or malfunctioned the sensor would go into a flat rate or uniform mode, this is the rate you would put on if you were not using the N-Sensor.

Biomass Cutoff (1)

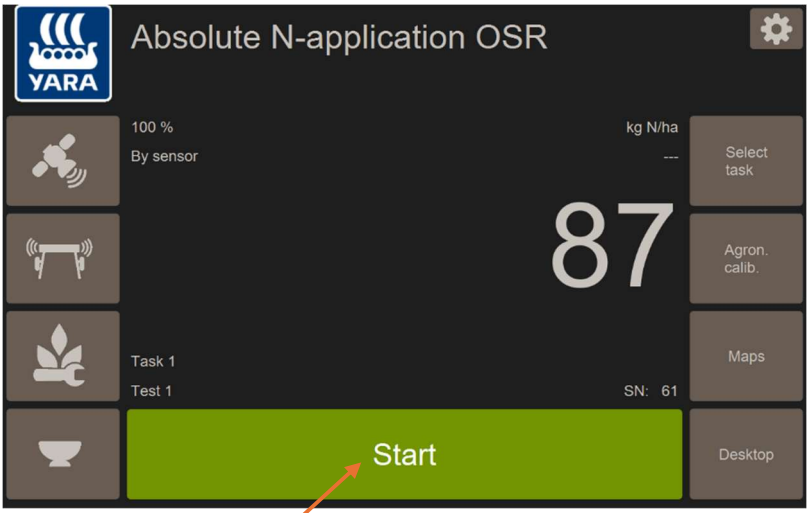
To stop over application on poor areas the N-Sensor includes a biomass cutoff feature, you can tell the N-Sensor when it should cut to the minimum rate to stop the over application. Increasing this figure will make the system cut in sooner, decreasing this figure will make the system cut off to the minimum rate later.

In the Absolute N-Application OSR mode the biomass cutoff works off the actual SN readings (the amount of Nitrogen the N-Sensor can see in the crop). In the Example photo above (1) the Biomass Cutoff has been set to “46”, this means any crop the N-Sensor see under 46Kg of N Uptake in the canopy the rate will start to reduce down to save input costs, rather than increasing. The further the figure is below the cut off value the more severe the rate will cut back by.

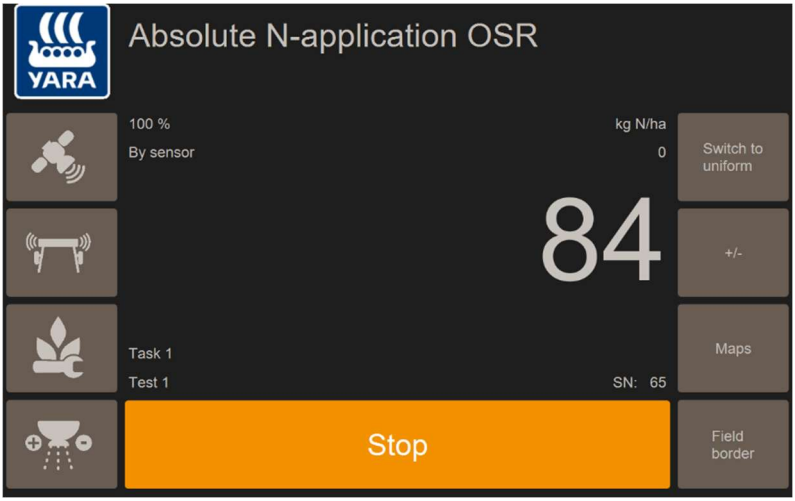
Once you are happy with your selections,




Press the Green “Select and Return Icon”




When ready press “Start” to activate and use the N-Sensor.




If you have not finished the field and need to refill, press “Stop”, Refill and then go back to the same position you were in where you pressed “Stop” and press “Start” again to continue operation.

**It is important to press “Stop” when not in operation**, not pressing “Stop” will cause the recording of improper data and manipulated calibrations.

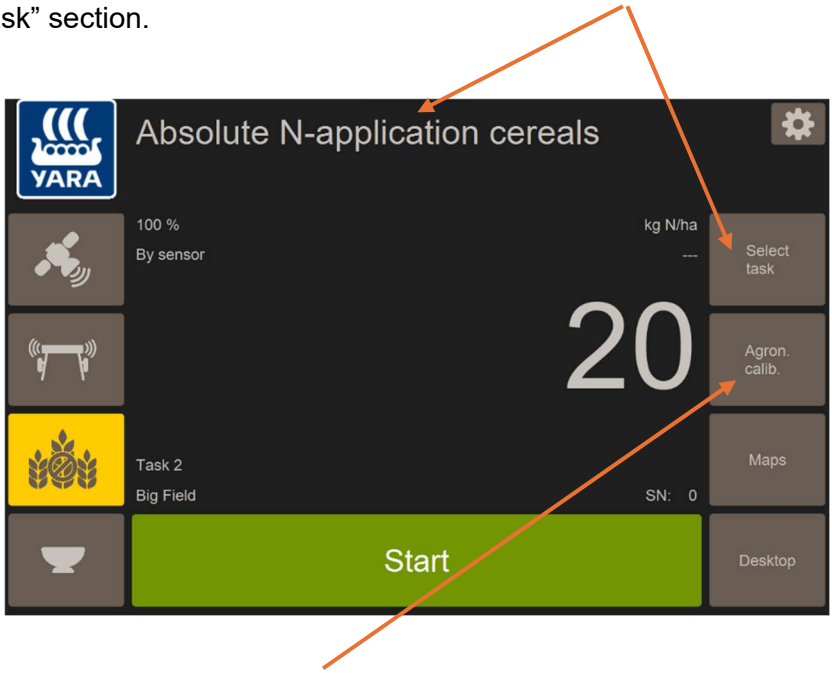
Once you have finished applying to the Task/Field, press “Stop” to complete.

When moving to the next Field, Remember to change “Task” and check the “Agronomic Calibration” before proceeding.

# Notes

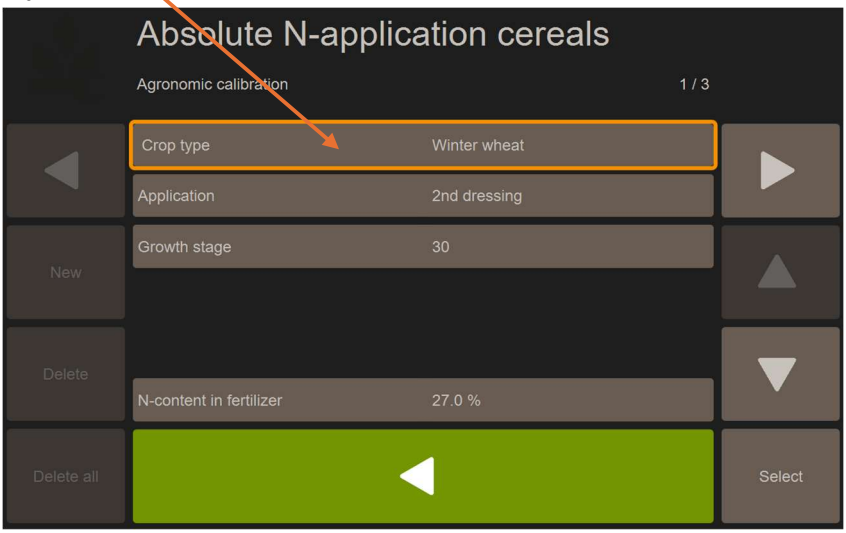
# Absolute N-Application Cereals

To start you must first create a new task in the task Selection, in Operational Modes make sure to select “Absolute N-Application Cereals” for further details on how to do this see the “Creating a New Task” section.

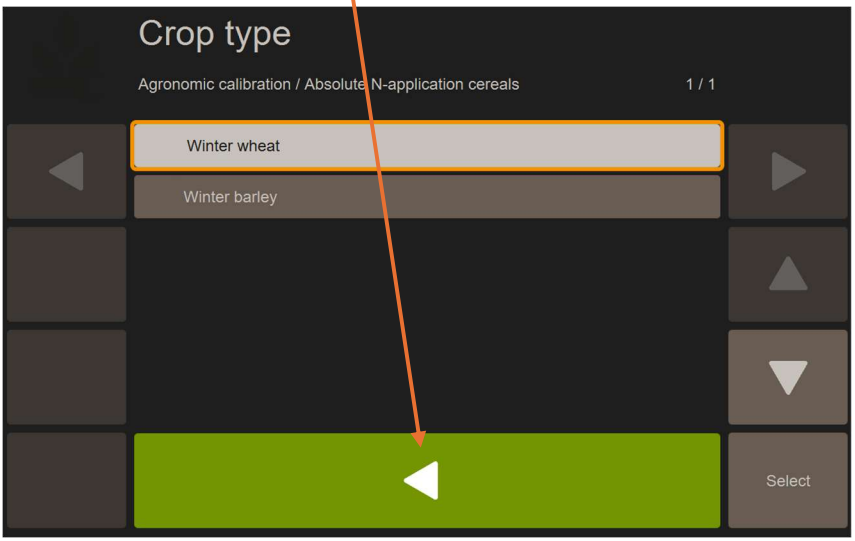



Now select the “Agronomic Calibration”

Select “Crop type” to change between “Winter wheat” and “Winter barley”




Once selected, press “Select & return”

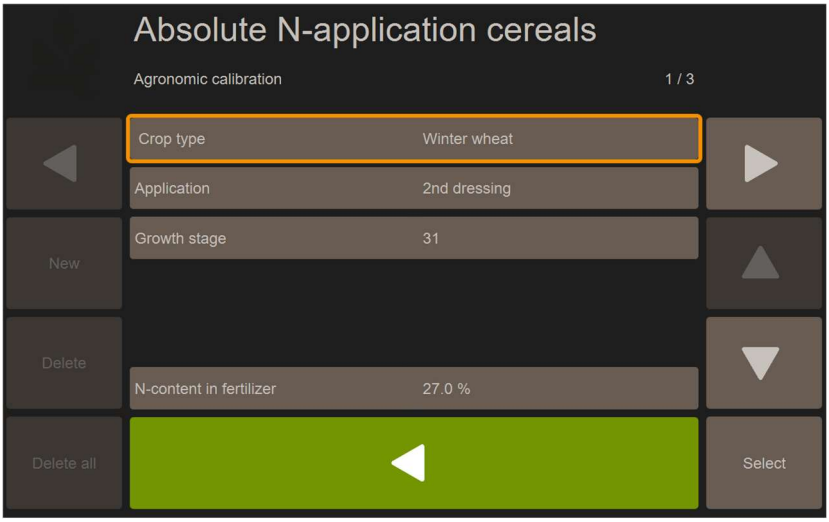


You will also get two different layouts depending on if this is the 2nd N Application or the 3rd N Application.

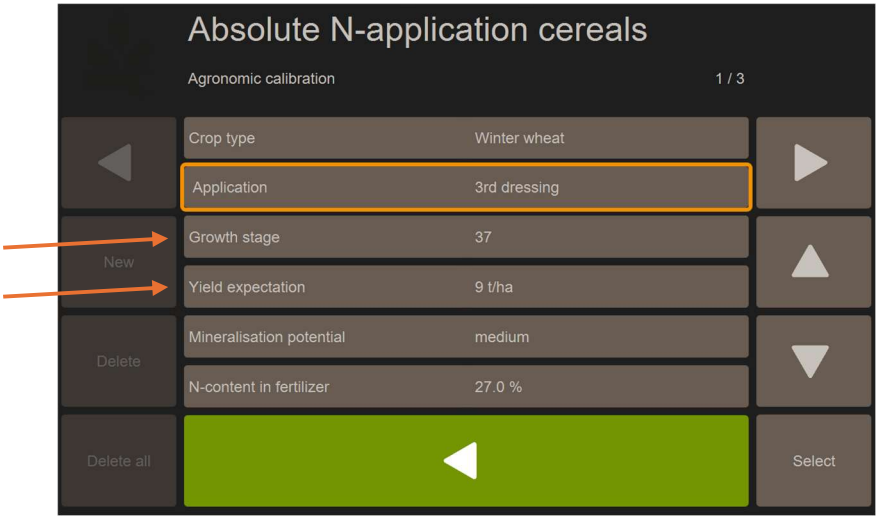
Growth stages

- 1st dressing, Flat Rate (**Not using N-Sensor)**
- 2nd dressing is between GS30 – GS32
- 3rd dressing is between GS37 – GS53

(2nd Dressing)

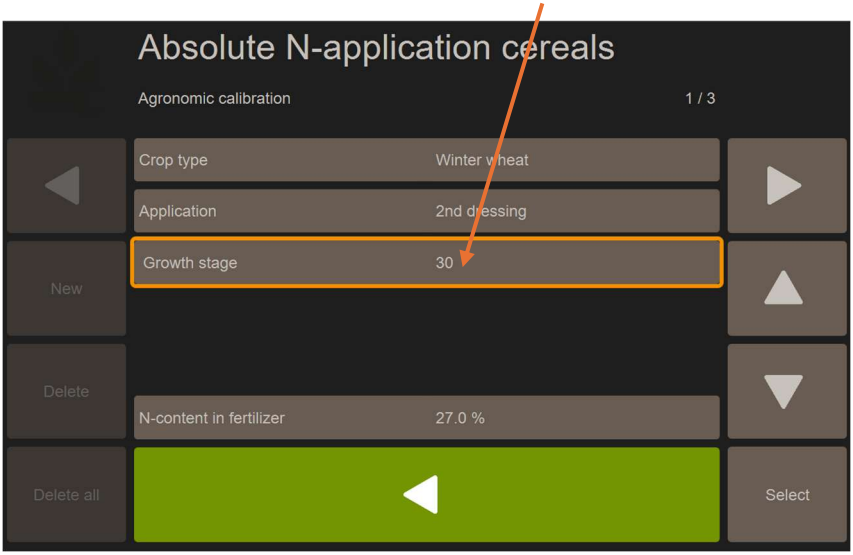



(3rd Dressing)



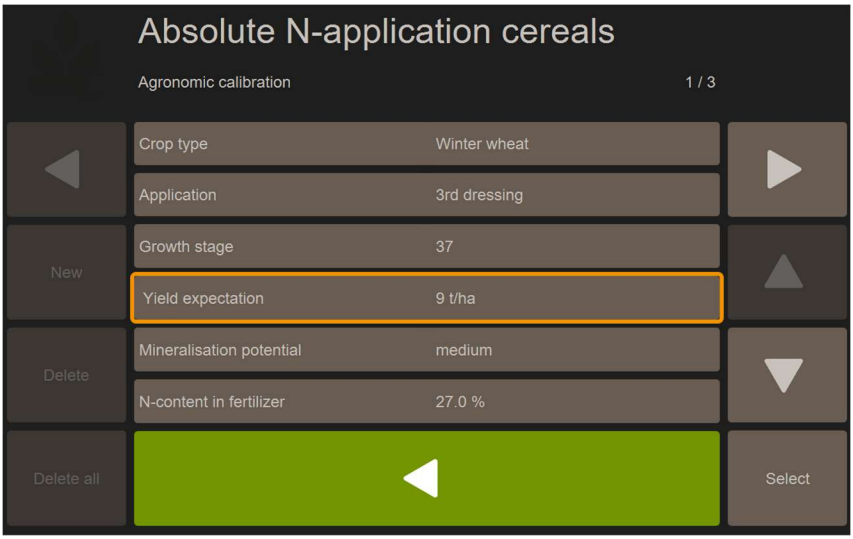
You will notice the only change between the 2 dressings is the additional settings in the “3rd dressing” adding Yield Expectation and Mineralisation Potential

To change the growth stage select the “Growth Stage” button

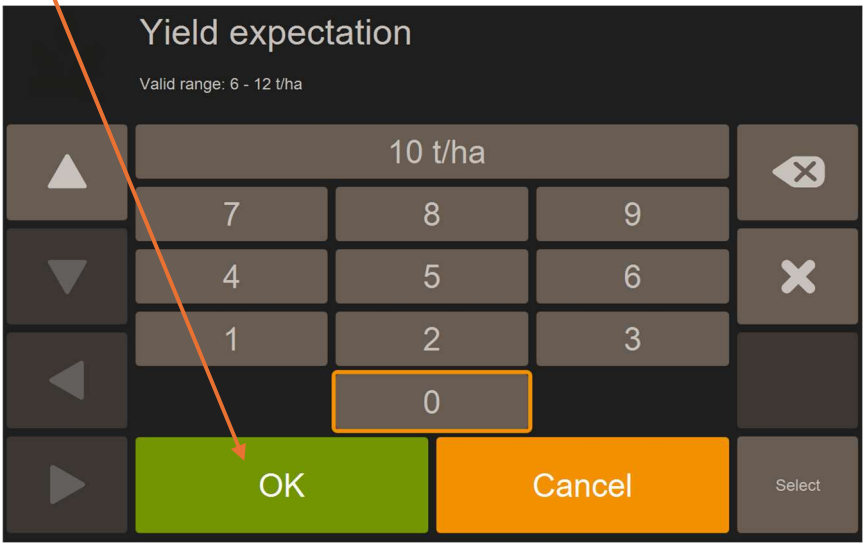



Enter the correct growth stage and then select “OK”

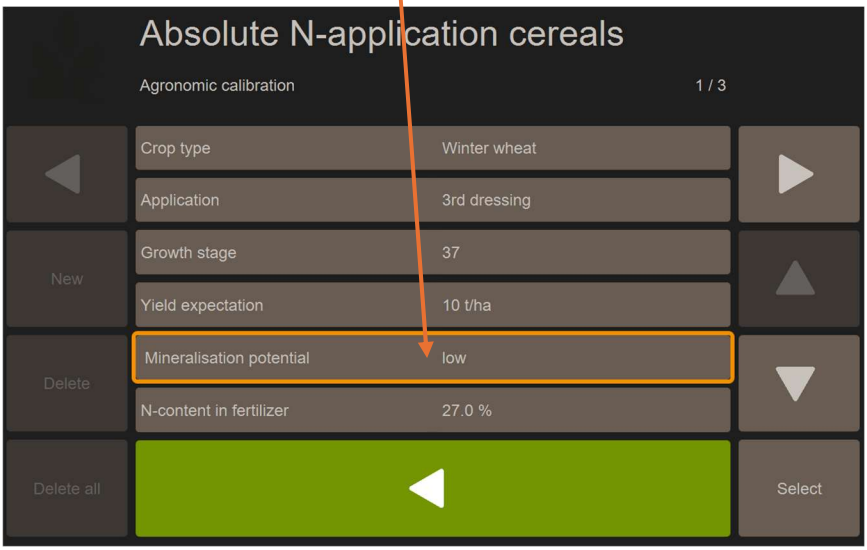
(3rd dressing only), Press “Yield expectation”




Enter a valid and true yield expectation between 6-12T/Ha, and press “OK”



(3rd dressing only), Press “Mineralisation Potential” to change between High, Medium and Low.




High mineralisation potential (**-20±Kg N/Ha**)

- High organic matter soil,
- High soil N core values
- SNS 3+
- Low Rainfall or Drought

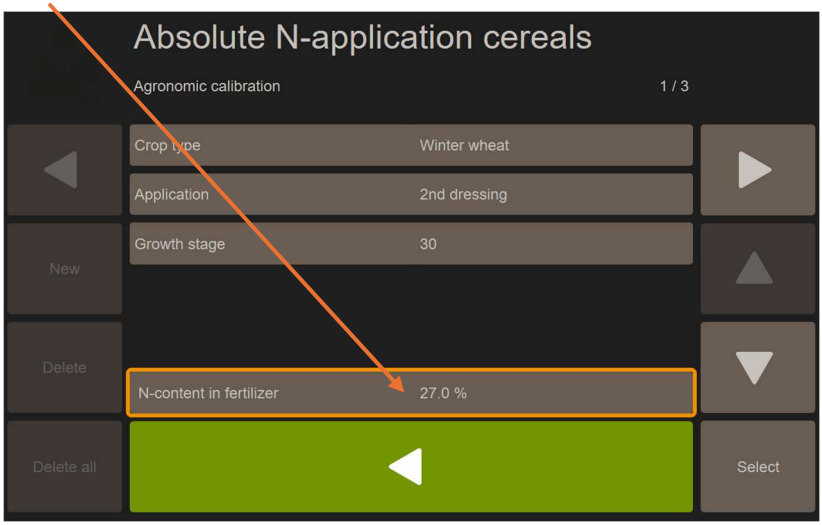
Medium Mineralisation potential (**Standard N-Uptake scale**)

- Medium or mixed Soils
- SNS 1 or 2
- Average / High Rainfall

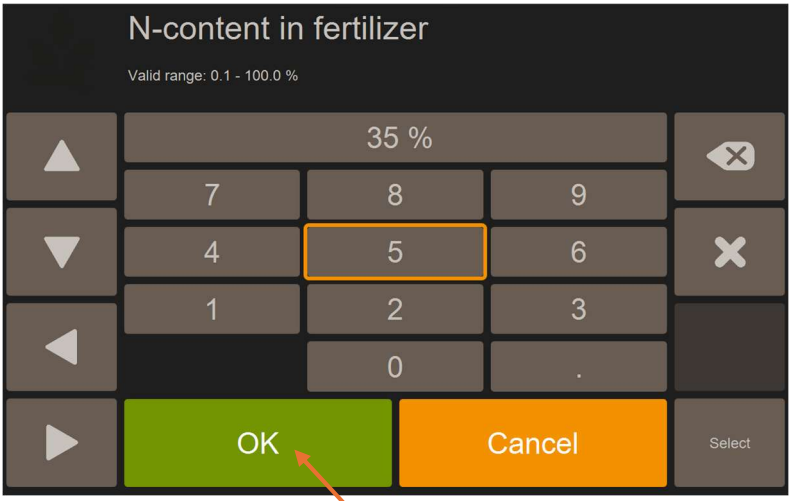
Low Mineralisation potential (**+20±Kg N/Ha**)

- Low Organic Matter soils
- Sandy Soils
- SNS 0

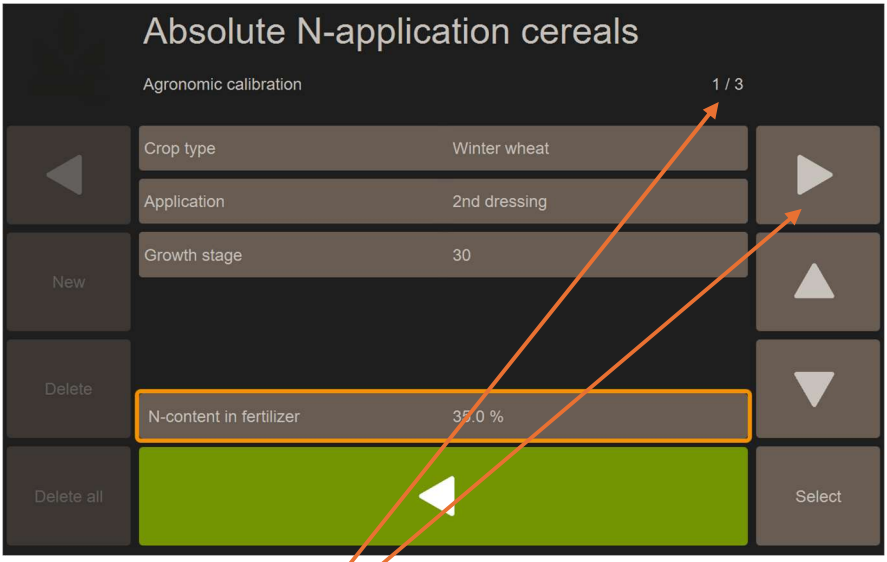
Now select the N-Content in fertilizer, to change the N% tap the “N-Content in fertilizer” button




N% valid range from 0.1% to 100%, remember this is N% (**Weight by Volume**), Liquid (Weight by Weight) manufacturers need to be converted, see Rate Calculator for more information.

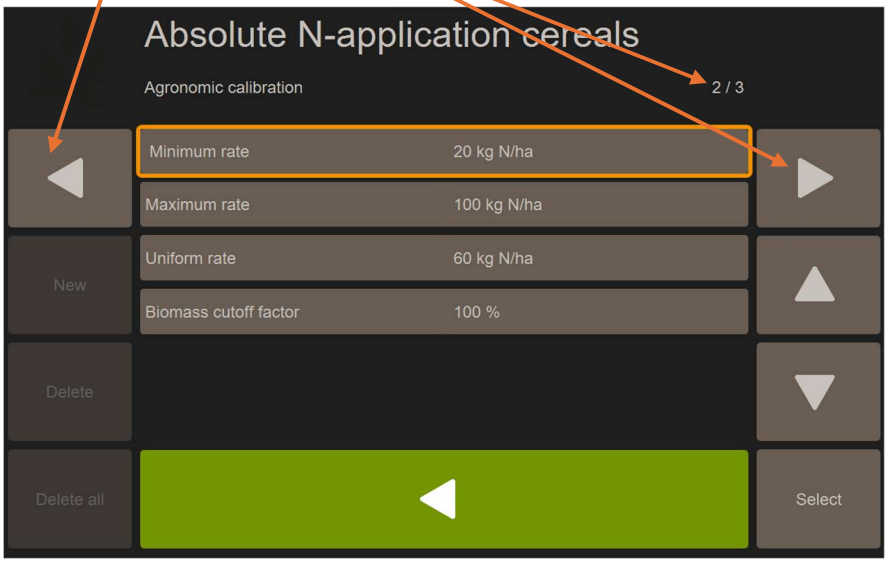



Select the correct N% and press “OK”

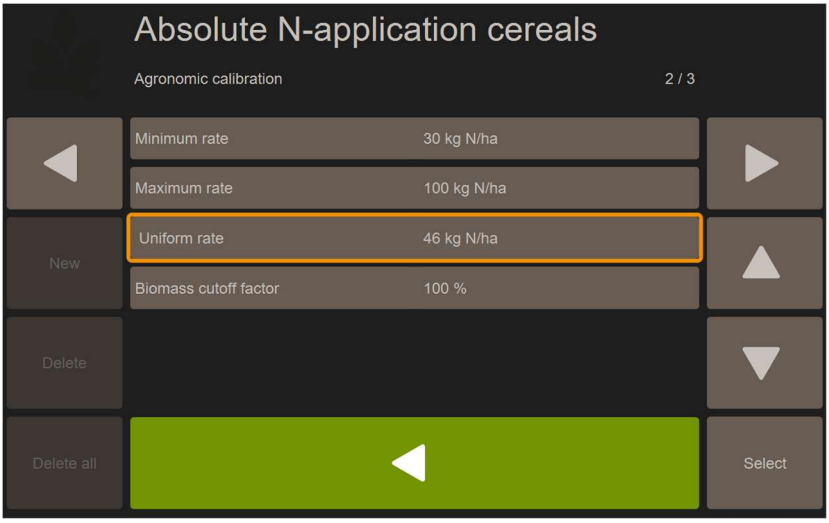



Move to the next page,

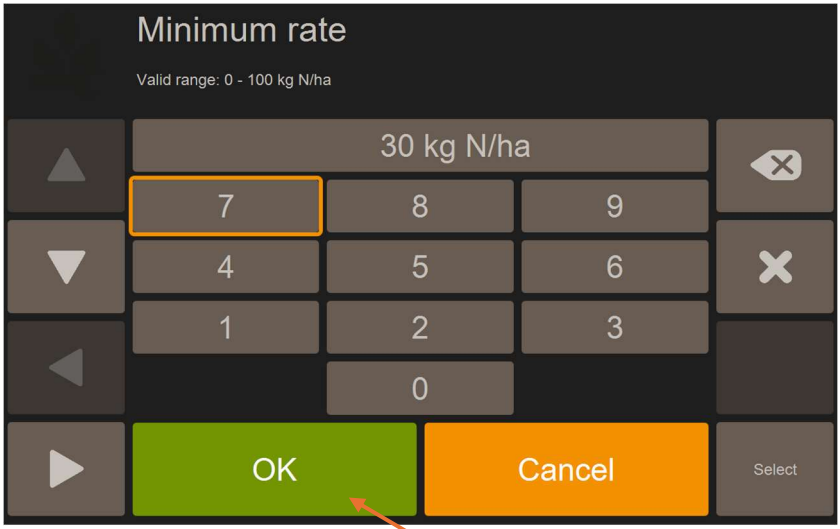
Or back a page,



Select either the “Minimum rate” “Maximum rate” or “Uniform Rate” to change the limits. Remember the system works in Kg N/ha not product.

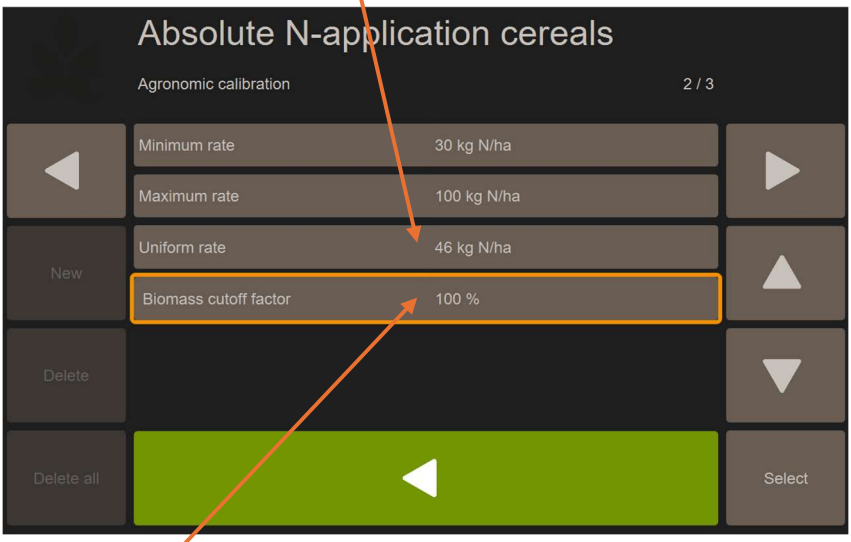



- 2nd and 3rd dressing the minimum & maximum range is 0-100 Kg N/Ha




Chose the quantity required then select “OK”,

Uniform rate, If the N-Sensor failed or malfunctioned the sensor would go into a flat rate or uniform mode, this is the rate you would put on if you were not using the N-Sensor.

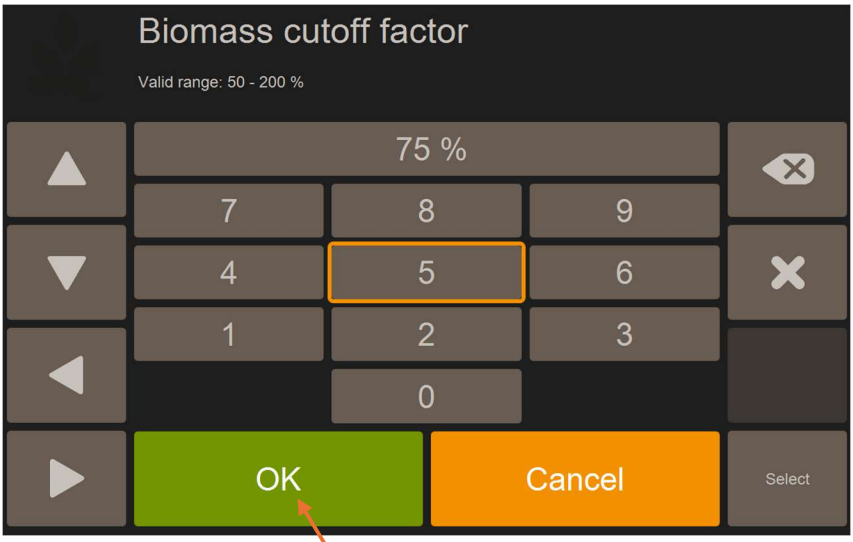



“Biomass cutoff factor”, To stop over application on poor areas the N-Sensor includes a biomass cutoff feature, you can tell the N-Sensor when it should cut to the minimum rate to stop the over application. Increasing this figure will make the system cut in sooner, decreasing this figure will make the system cut off to the minimum rate later.

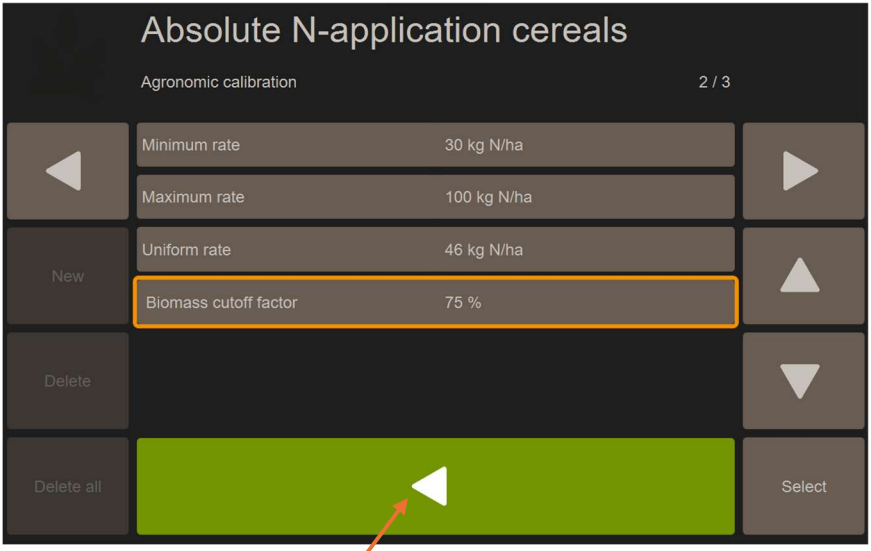
In the Absolute N-Application Cereals mode the biomass cutoff works off a pre-prescribed N-uptake value, which increases and decreases per growth stage.

The predetermined value can be adjusted to the user own preference, a value of 100% can be adjusted from 50% to 200%.

Press “Biomass cutoff factor” to change the value

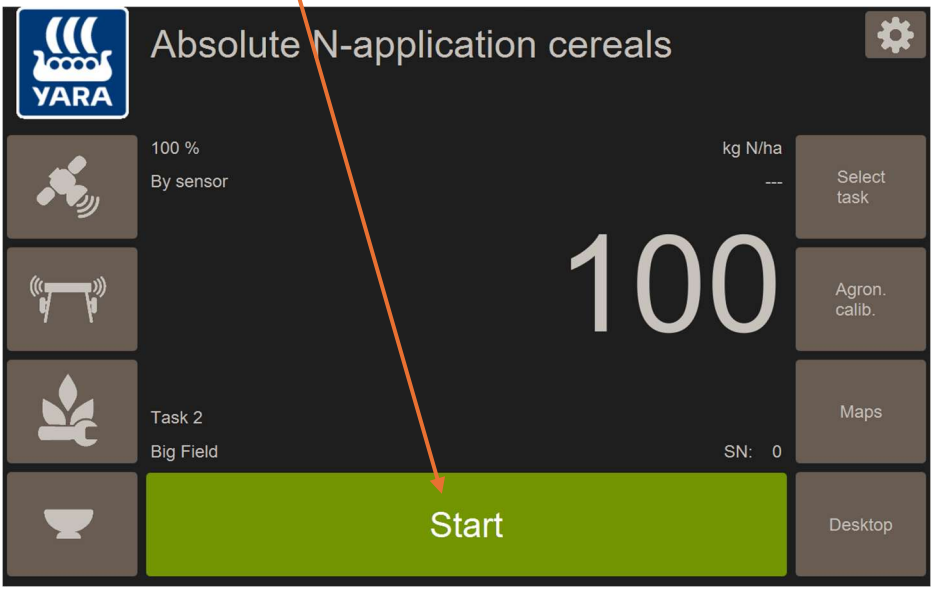



Select the value and press “OK”




If you are happy with the selected values on both pages press the “Select and return” button.

When ready press “Start” to activate and use the N-Sensor,




If you have not finished the field and need to refill, press “Stop”, Refill and then go back to the same position you were in where you pressed “Stop” and press “Start” again to continue operation.

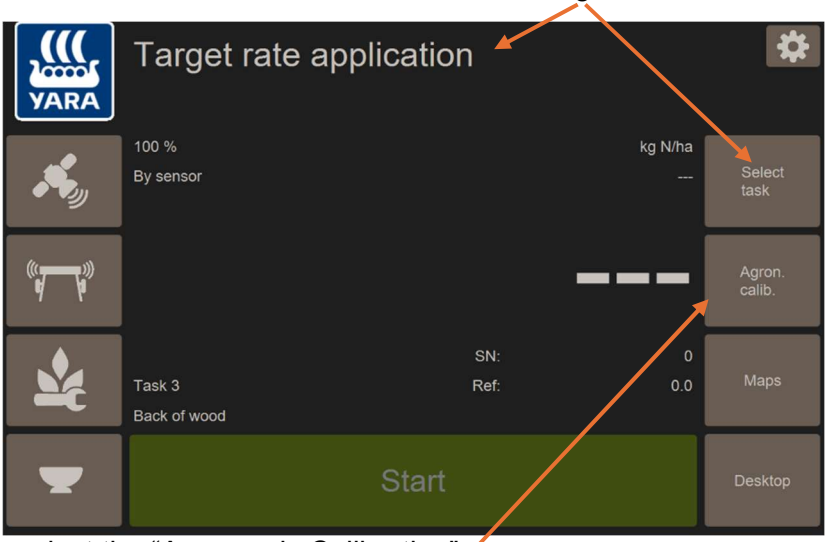
**It is important to press “Stop” when not in operation**, not pressing “Stop” will cause the recording of improper data and manipulated calibrations.

Once you have finished applying to the Task/Field, press “Stop” to complete.

When moving to the next Field, Remember to change “Task” and check the “Agronomic Calibration” before proceeding.

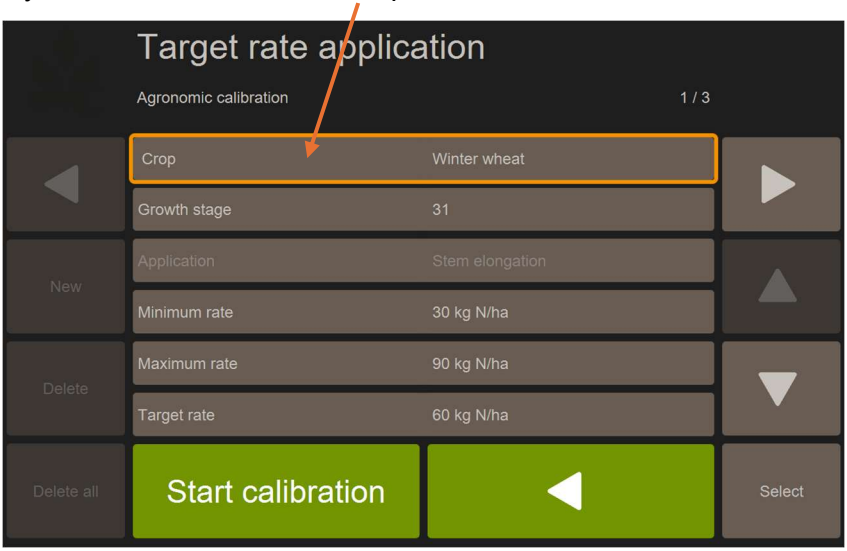
# Target Rate Application

To start you must first create a new task in the task Selection, in Operational Modes make sure to select “Target Rate Application” for further details on how to do this see the “Creating a New Task” section.

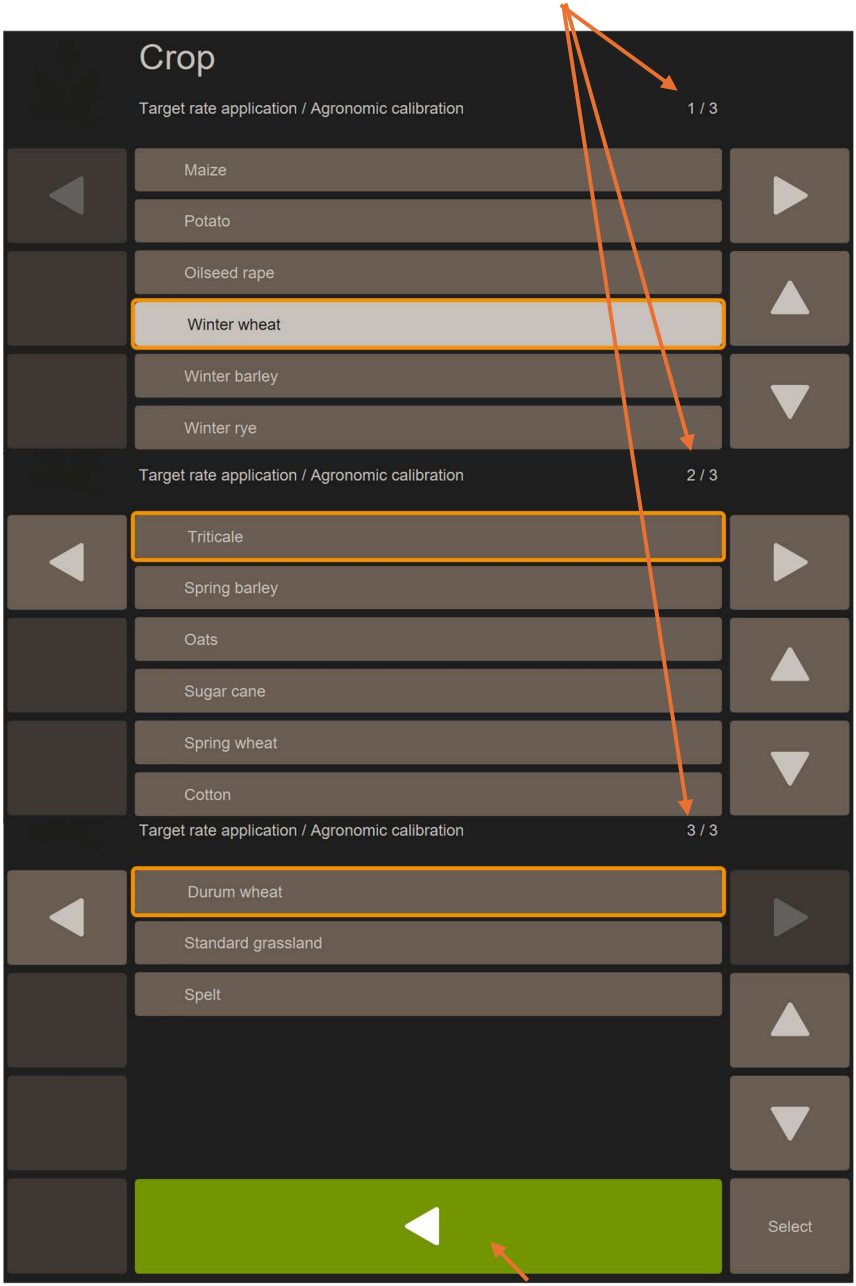



Now select the “Agronomic Calibration”

Firstly, we need to choose a “Crop”

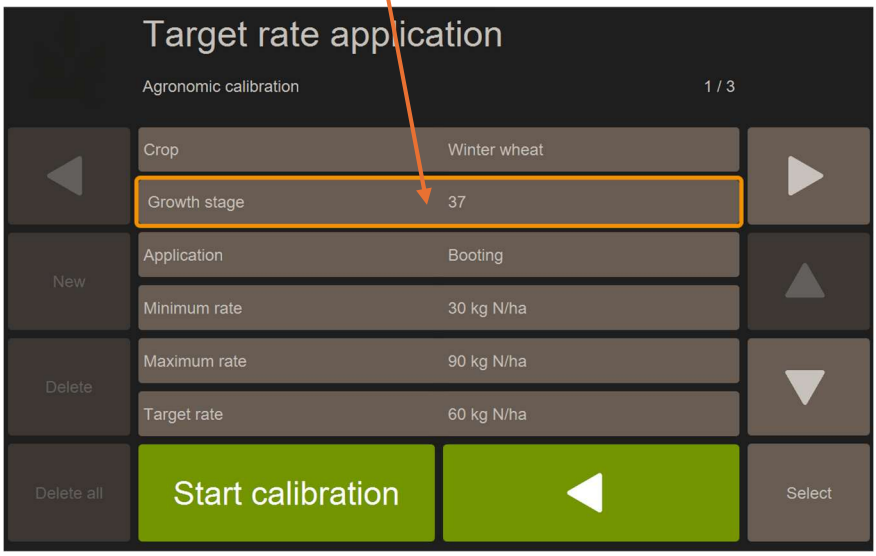


Choose the required crop. There are more choices on the next page.

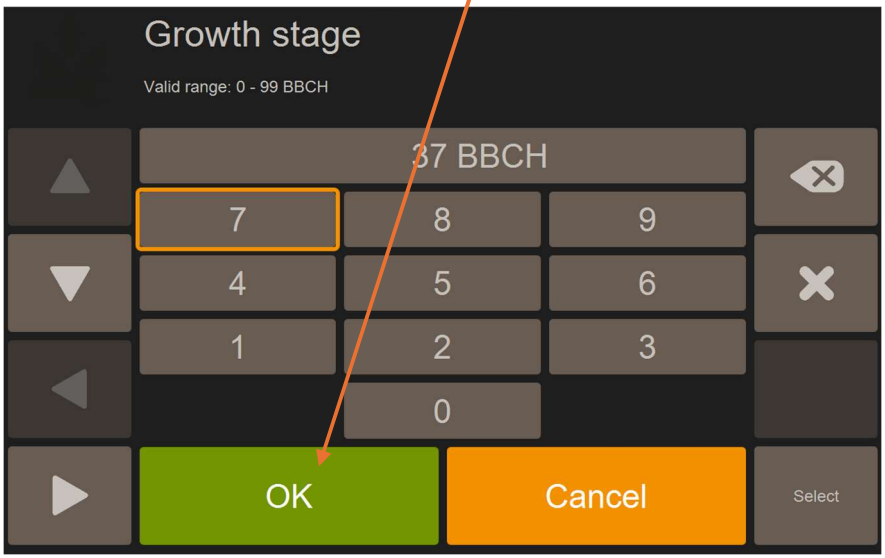



Once the required crop is chosen, press “OK”

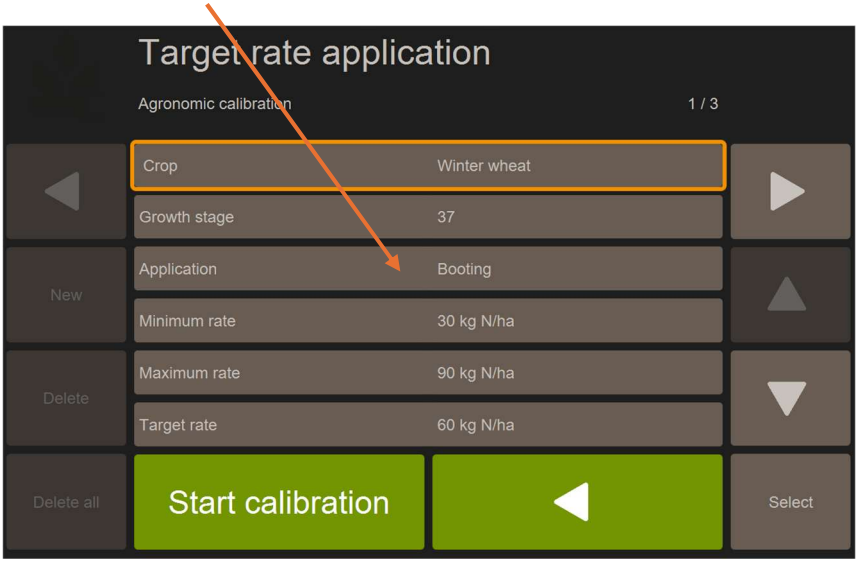
Now choose a the correct “Growth Stage” for the crop




Type in the growth stage and press “OK”



In cereal and brassica crops you get additional settings. The "Application" description will appear below the growth stage, between GS20 - GS36 this value is locked, between GS37 – GS49 this value can be changed between "Booting" & "Protein dressing"



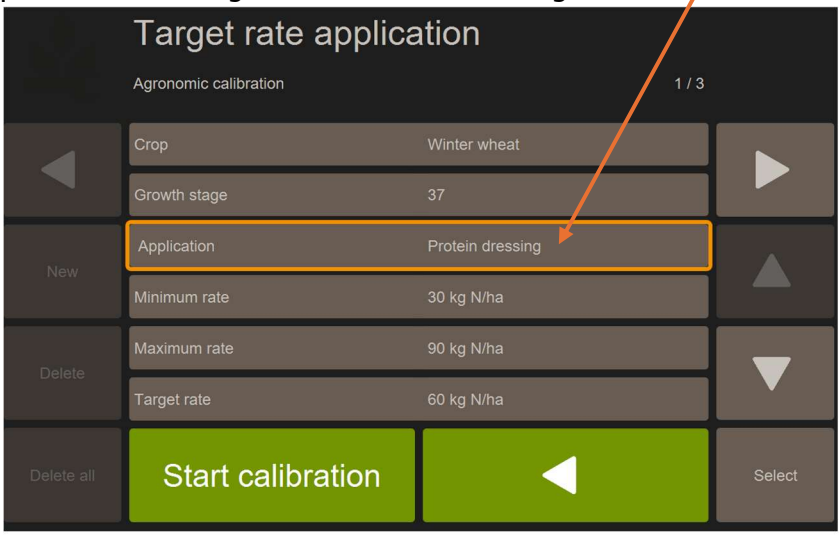

"OSR" will also allow you to change between 1st and 2nd dressing.

Cereals crop's that have additional applications like, Tillering, Steam elongation, Booting & Protein dressing:-

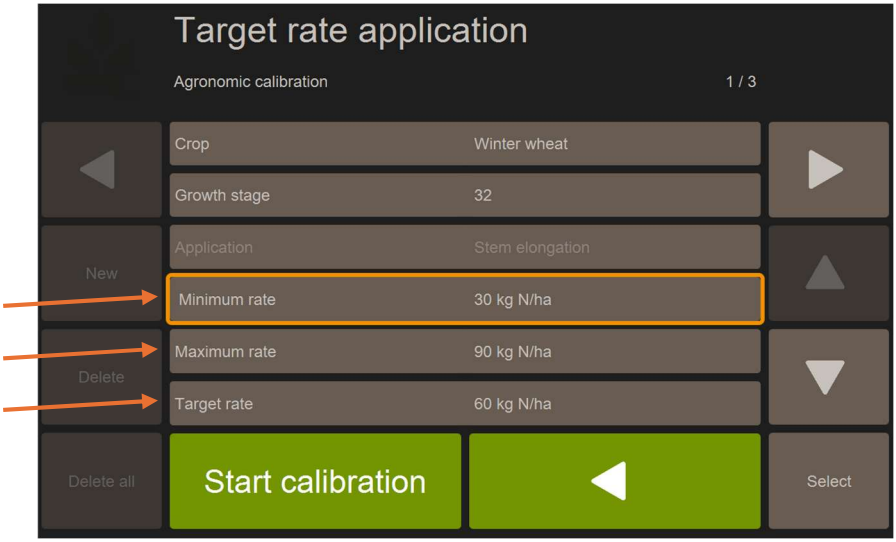
- Winter Wheat
- Winter Wheat
- Winter Rye
- Triticale
- Spring Wheat
- Spelt
- Durum Wheat

The "Protein Dressing" mode will invert what the N-Sensor would do normally, so higher biomass and N-uptake areas will get a higher rate and lower Biomass and N-uptake areas will receive less.

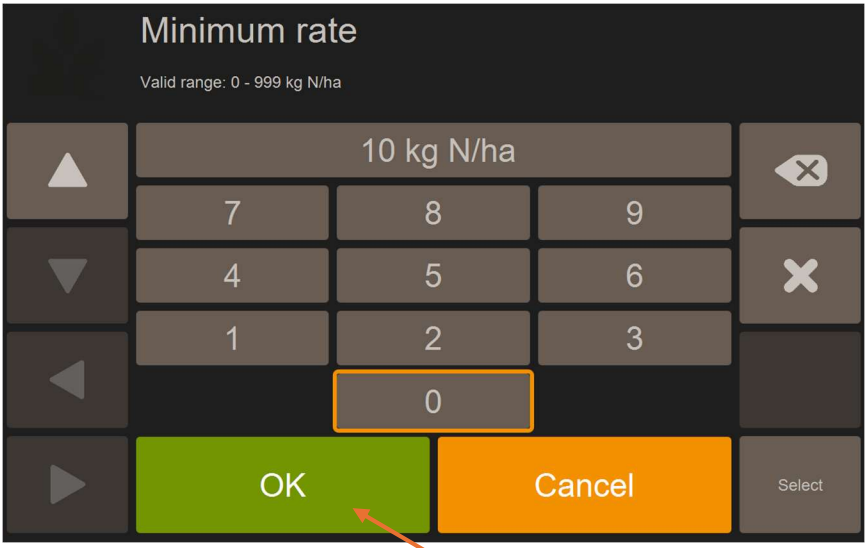
When selecting between GS37 - GS49, the "Application" "Booting" can be pressed and changed to a "Protein Dressing" mode



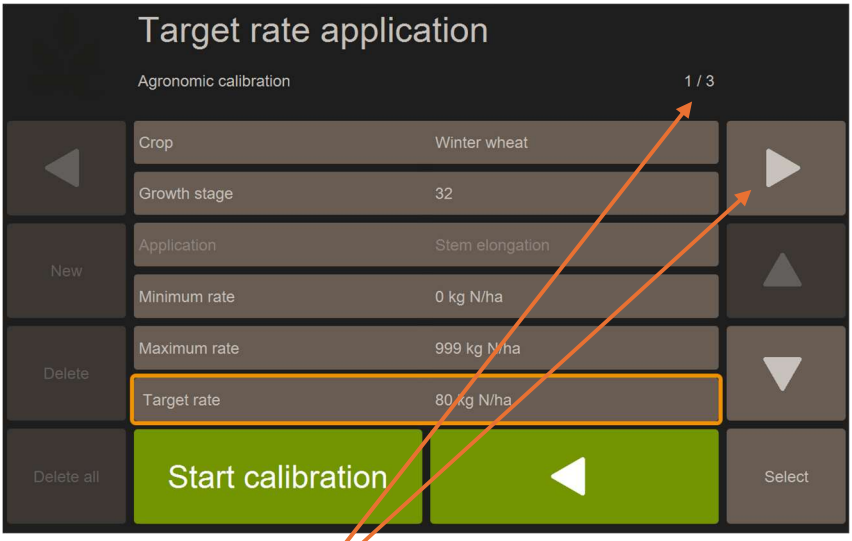

Next select the "Minimum rate" "Maximum rate" & "Target Rate" to set the target rate (Kg N/Ha) & change the upper and lower limits.




- The minimum & maximum range is 0-999 Kg N/Ha

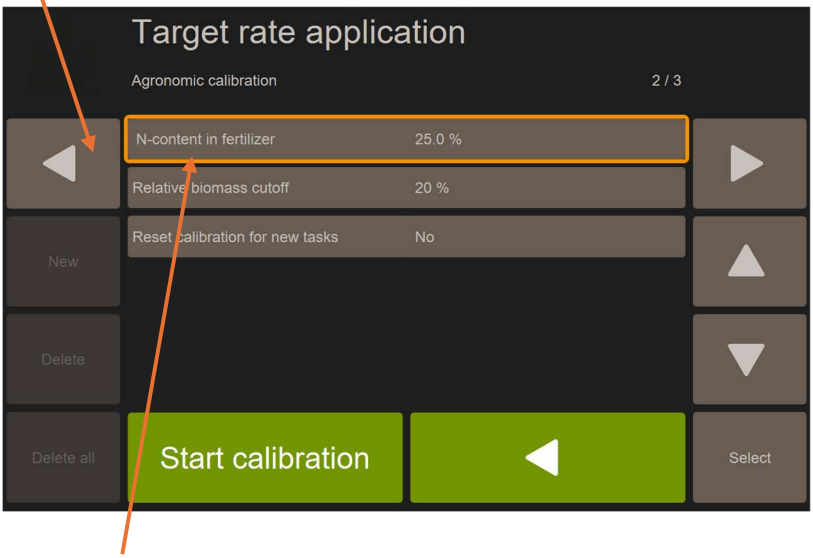



Chose the quantity required then select “OK”,



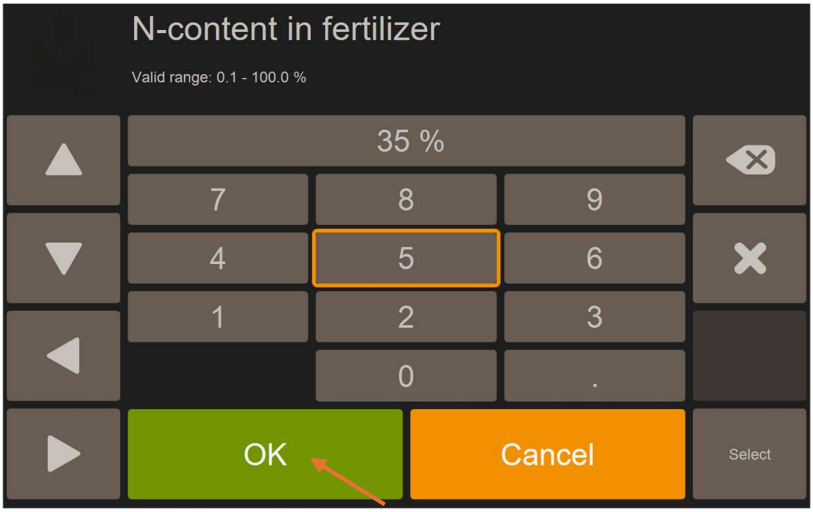

Switch to the next page,

You can also go back and check previous setting by hitting the back arrow.




Select “N-content in fertilizer” to change the N%

N% valid range from 0.1% to 100%, remember this is N% (**Weight by Volume**), Liquid (Weight by Weight) manufacturers need to be converted, see Rate Calculator for more information.

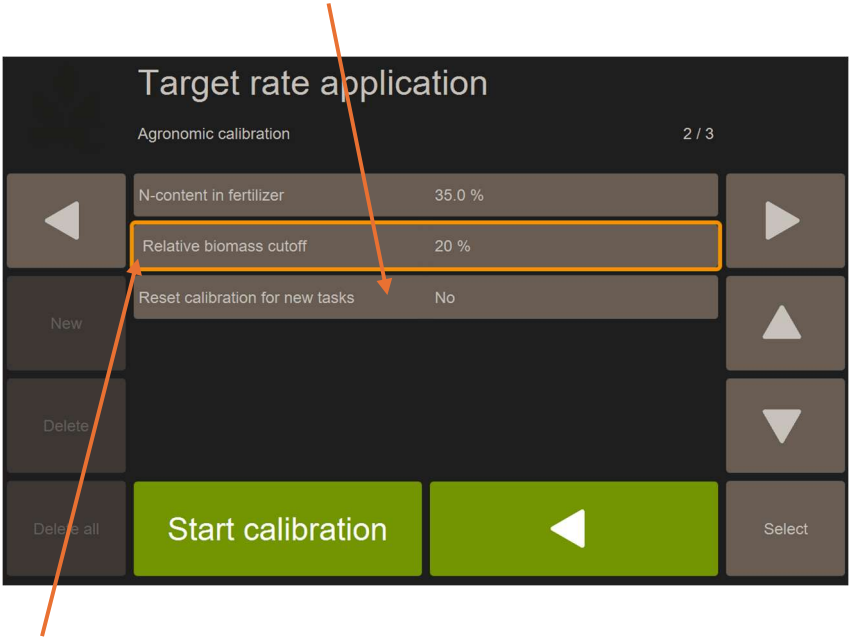



Select the correct N% and press “OK”

“Reset calibration for new task”, Once you have completed a task and are looking to move onto the next task, this feature allows you to either keep or delete the calibration when moving to the next task.

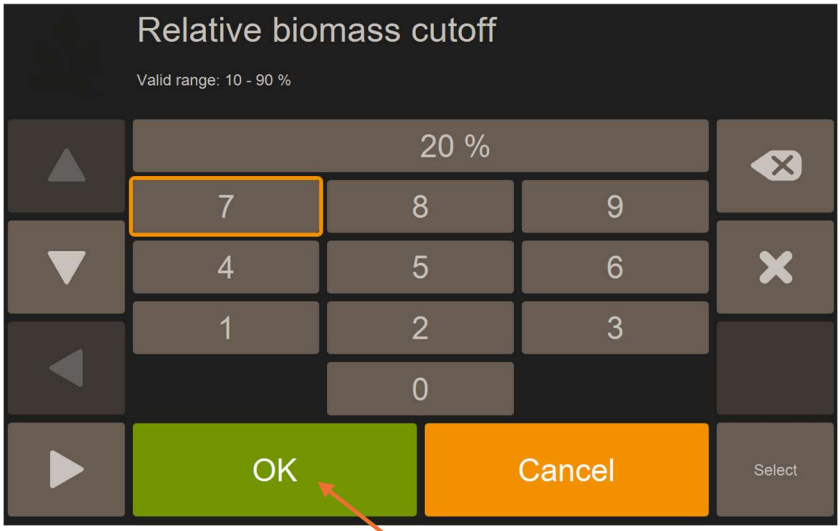
The options :-

- No – This will keep the calibration value when moving to the next task
- Yes – This will delete the calibration value when moving to the next task
- Always Ask – Once a new task is created a pop-up option will ask If you wish to keep the calibration value or delete it.

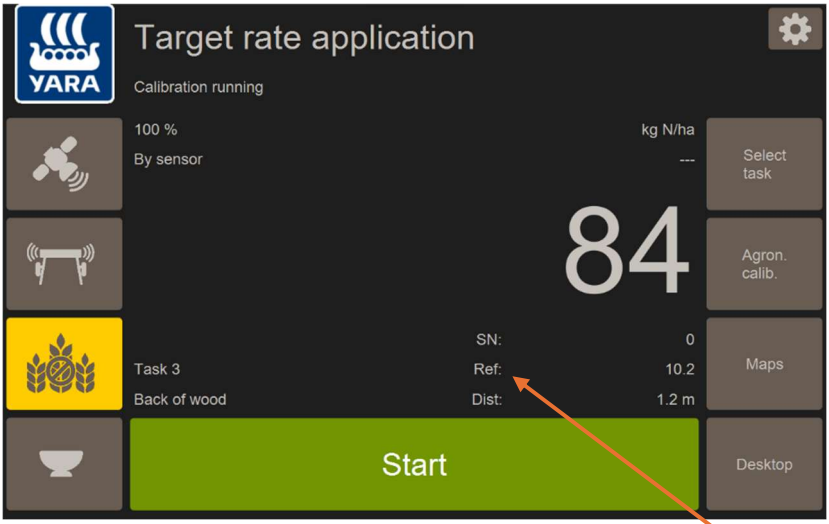



“Biomass cutoff factor”, To stop over application on poor areas the N-Sensor includes a biomass cutoff feature, you can tell the N-Sensor when it should cut to the minimum rate to stop the over application. Increasing this figure will make the system cut in sooner, decreasing this figure will make the system cut off to the minimum rate later.

In “Target Rate Application” the biomass cutoff is determined by a percentage (10%-90%) of the “Ref” value.




Select the desired value and press “OK”

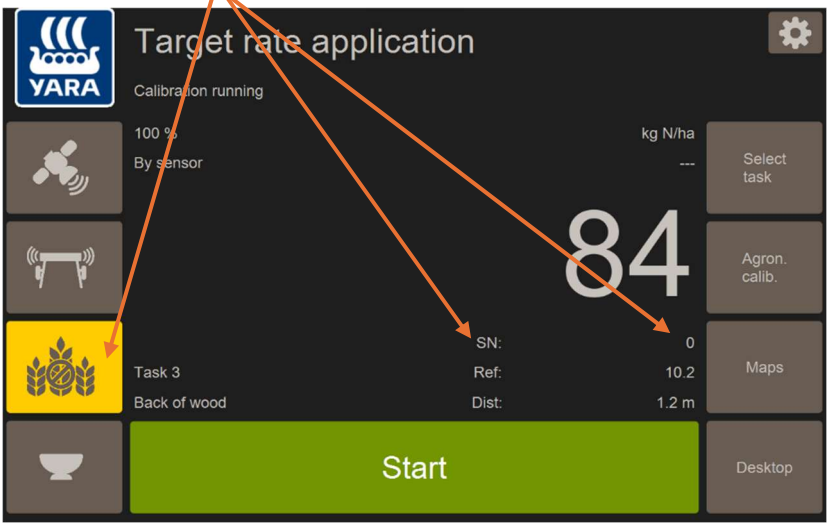



In the example above & below, the N-Sensor has seen and average (Ref) N-Uptake (SN) of 10.2.

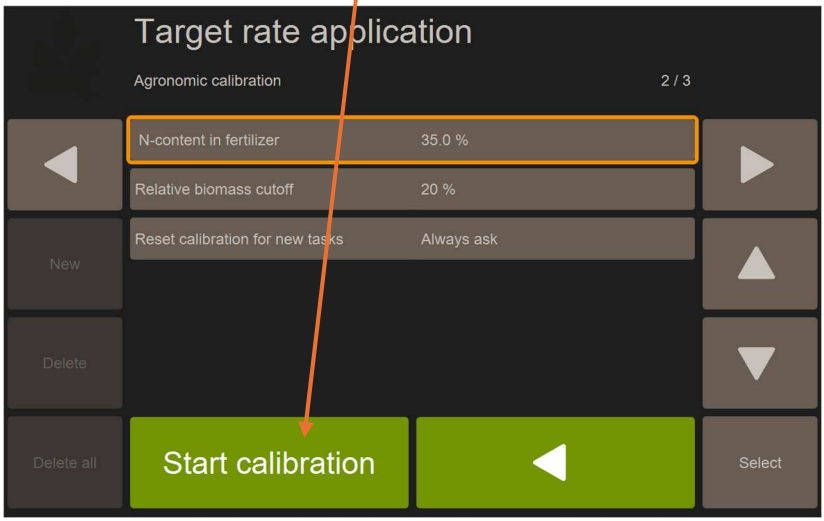
With the biomass cutoff set at 20% this means below 20% of the Average (10.2 SN) the rate will start to reduce to the minimum.

10.2(SN) ÷ 20% = 2.04 or 2 SN.

SN values under 2 SN will cause the biomass cutoff factor to kick in




You are now ready to start the calibration process, Press “Start Calibration” to continue



There are 2 ways in which to use “Target Rate Application”, Calibration Running & Calibration Stopped.

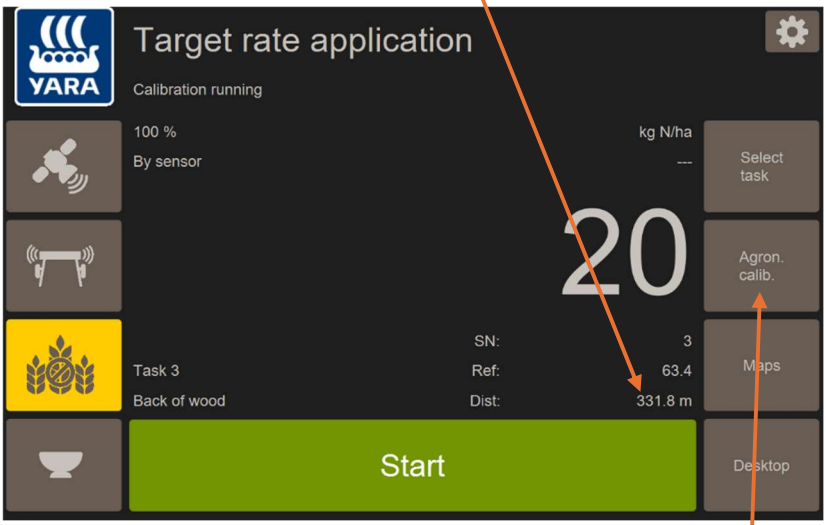
Calibration Running

Once you press “Start” the calibration and application will start, this will continue to run until reset! This means you can keep the calibration continuously through different task’s.

Leaving the Calibration running can mean the “Ref” or average SN value will continuously keep changing and moving, once an application is complete you will see that the average overall rate will be closer to the “Target Rate”.

Calibration Stopped

When “Start” is pressed a distance or “Dist” will start to increase and calculate the “Ref”

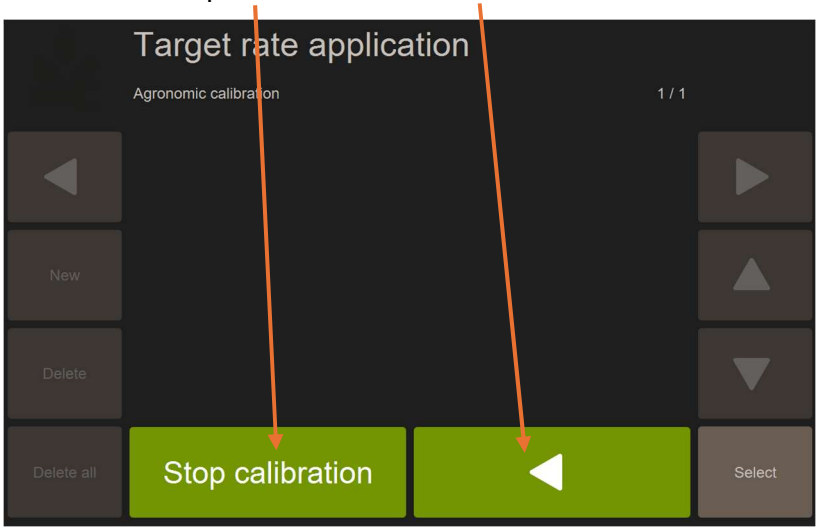



After 100M of “Dist” you now have the ability to stop or lock in the calibration which is altering the “Ref” or average value.

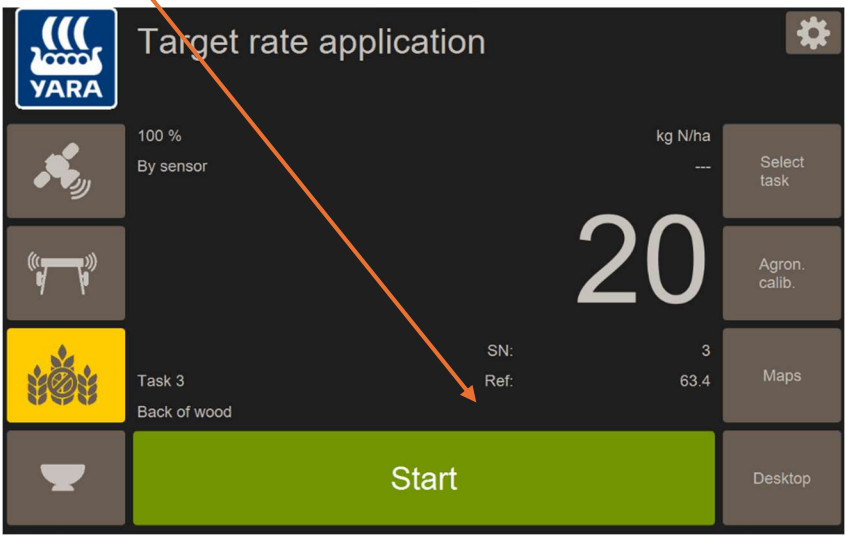
To do so first press “Stop” and then hit “Agronomic Calibration”

You will notice, no agronomy options are available.

You can either “Stop Calibration” or “Return”

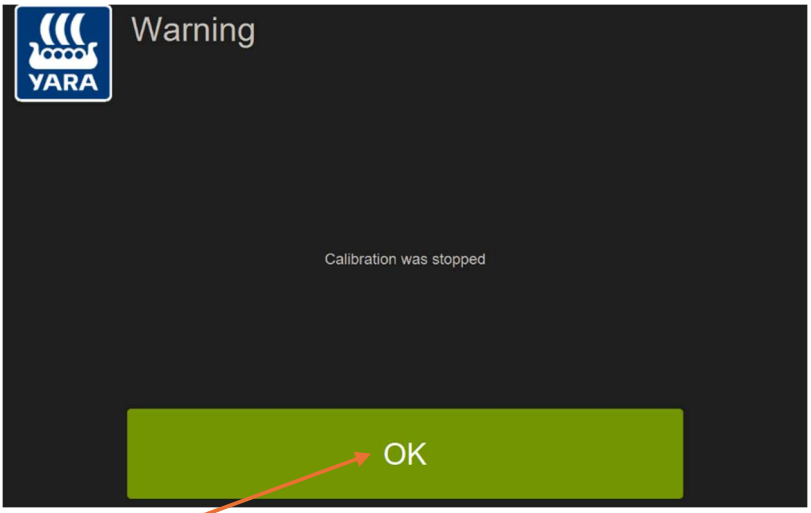



Return will take you back to the main working page, “Stop Calibration” will also return you to the main working page, however will notice “Dist” is now gone.

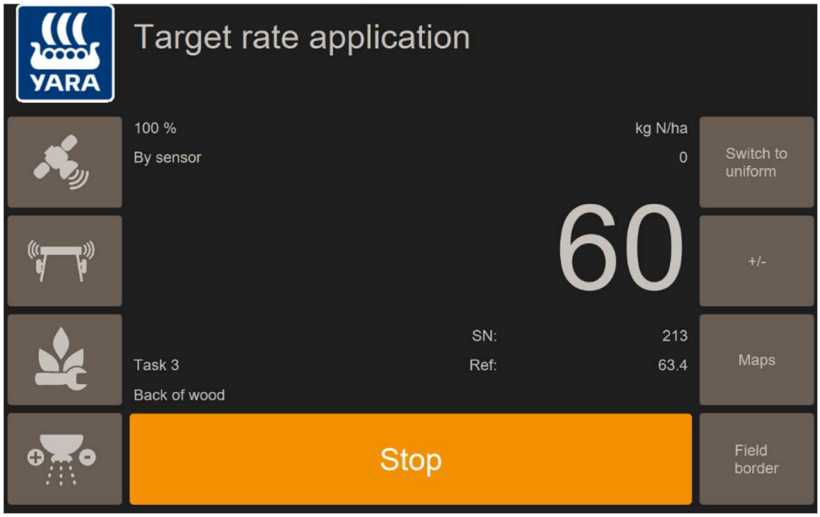


This means the calibration and “Ref” or Average is now locked. This will make the Sensor more accurate across the field/task. It can however cause the Average N-Applied to move away from the intended “Target Rate”

When you next press “Start”, a warning will appear to say the calibration was stopped.

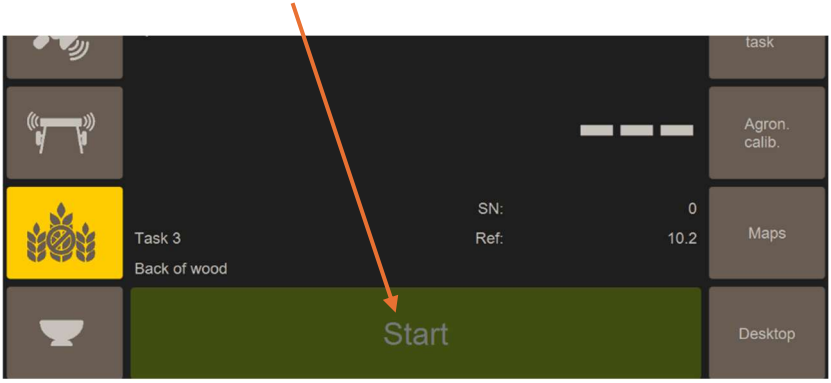



Select “OK” and continue.



You are now ready to press “Start” and use the “Target Rate Application Mode”

You may notice the start bar is a bright colour in the previous images, If the “Start” bar is faded out like below, you must go back into “Agronomic Calibration” and Press “Start Calibration”




In “Target Rate Application” you have the ability reset the calibration throughout the field/task.

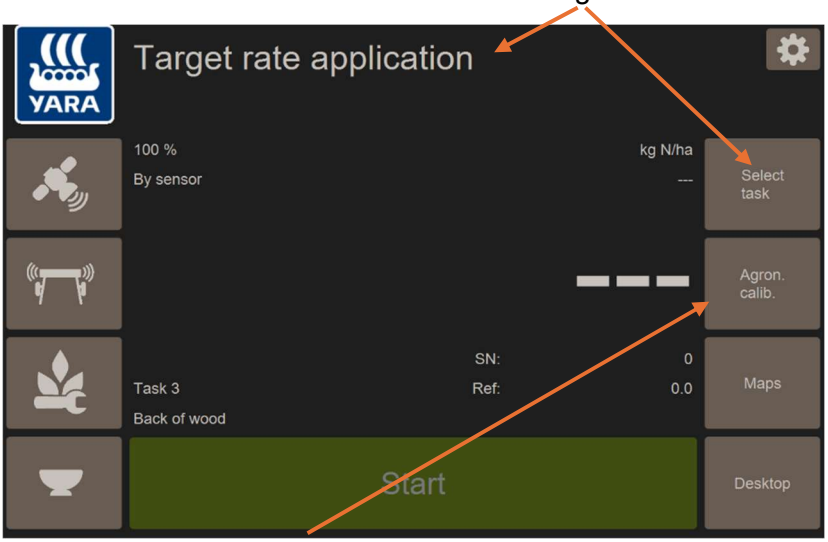
To do so follow the below.

1. Press “Stop”
2. Press “Agronomic Calibration”
3. Press “Stop Calibration”
4. Press “Agronomic Calibration”
5. Press “Start Calibration”

This process will reset the “Ref” and “Dist” back to 0 ready for a new calibration without distorting previous data captured.

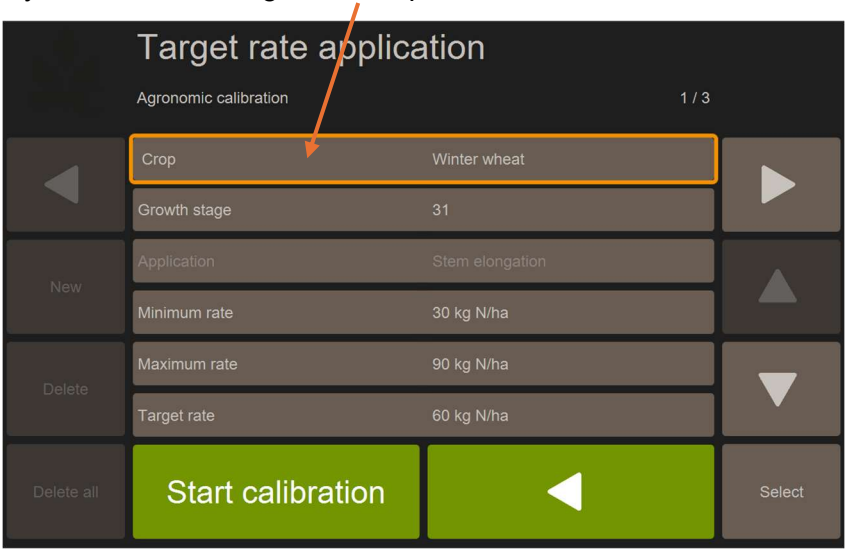
# Target Rate Application (Grassland)

To start you must first create a new task in the task Selection, in Operational Modes make sure to select “Target Rate Application” for further details on how to do this see the “Creating a New Task” section.

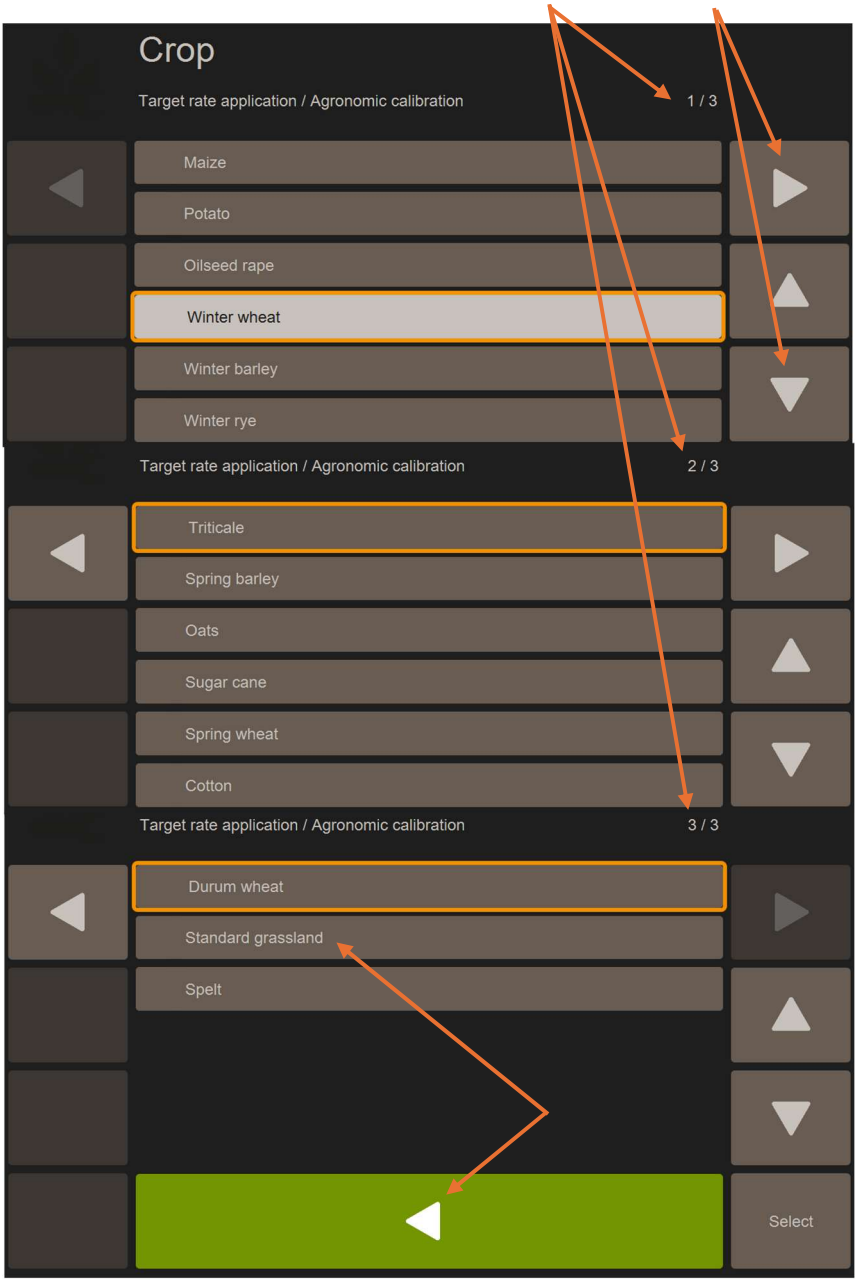



Now select the “Agronomic Calibration”

Firstly we need to change the “Crop” to “Standard Grassland”

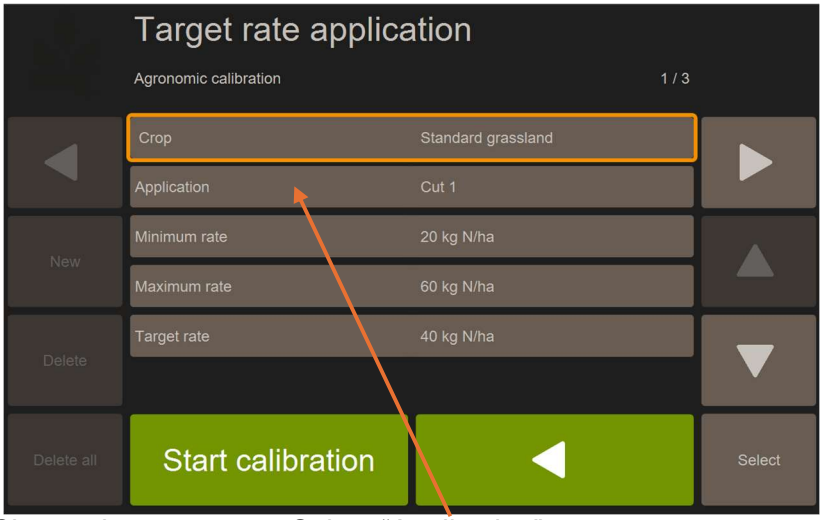


Use the “Down” button or “Next Page” button to move across pages and find “Standard Grassland”, once found select and press “OK”

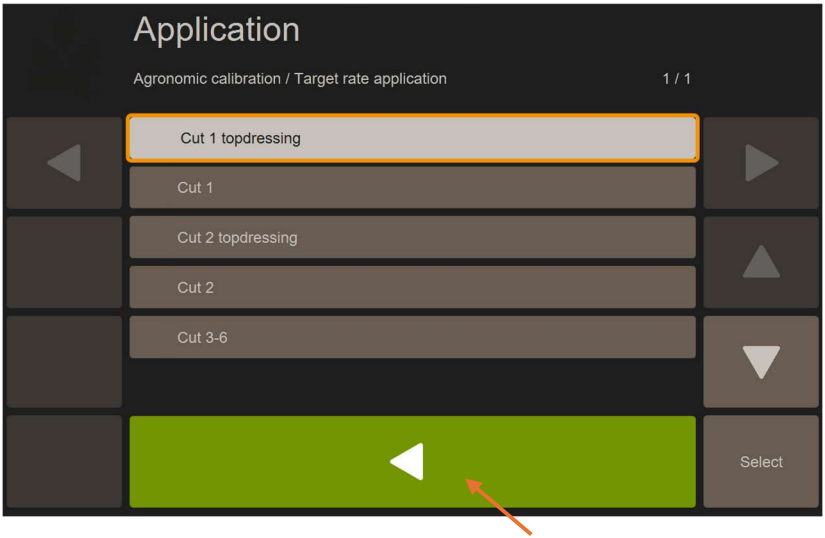


The Grassland module in “Target Rate Application” works under the same principles however instead of growth stages we have changes in “Cuts”

“Cut 1 Top Dressing”, “Cut 2 Top Dressing” – Applications 10+ Days prior to Mowing (Recommended). “Cut 1”, “Cut 2”, ”Cut 3-6” – Applications within 2 Days prior to mowing date.

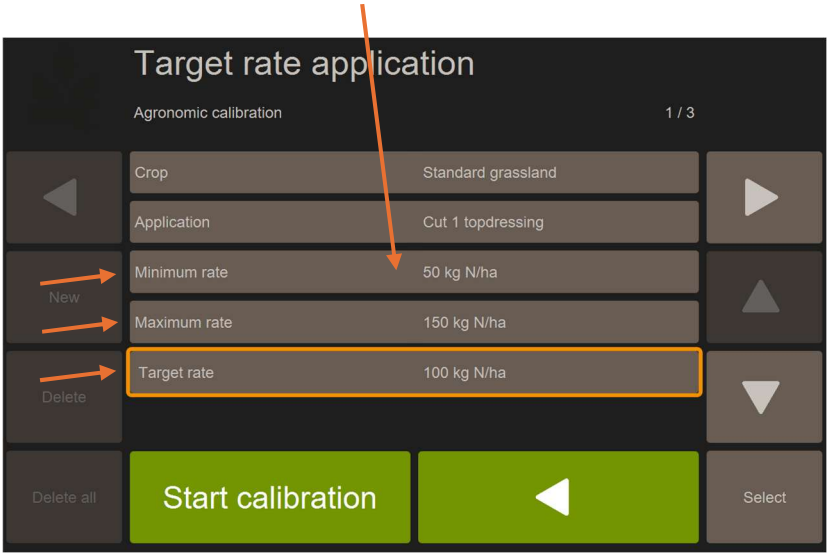


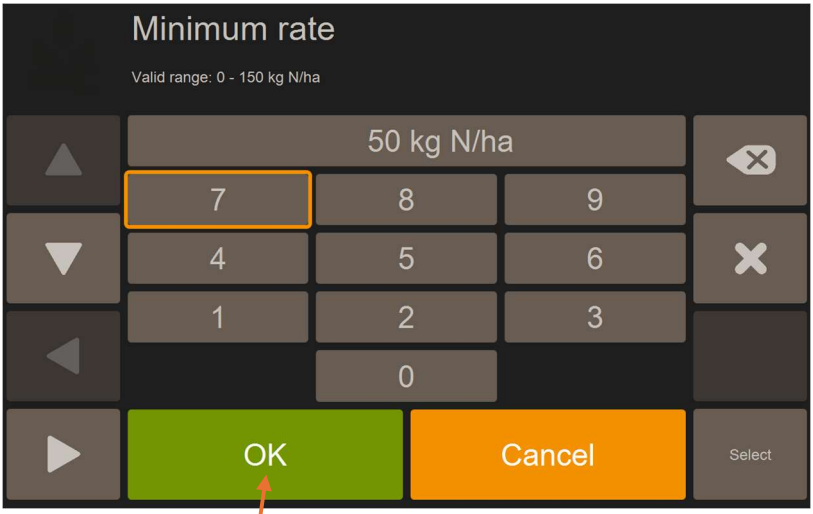

To Change between cuts, Select “Application”




Select the appropriate cut and press “Select & Return”

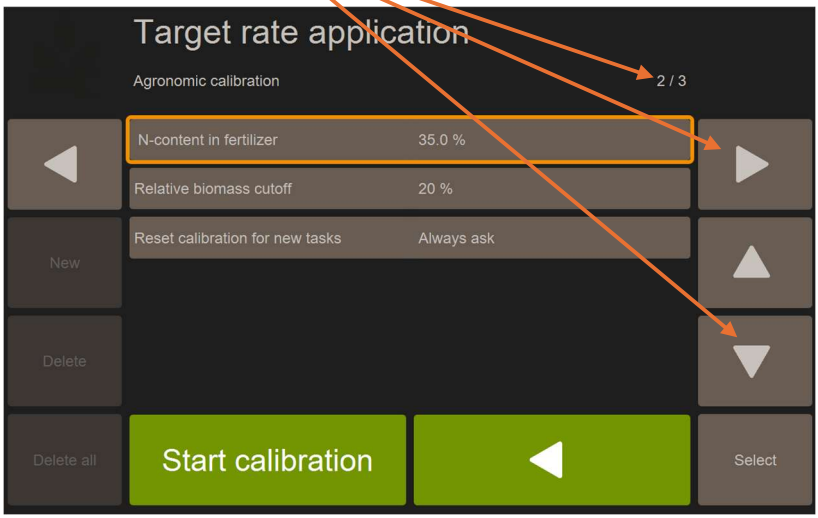
Change the “Minimum rate”, Maximum rate” & “Target rate” to the correct rates. To do so, tap the rate button



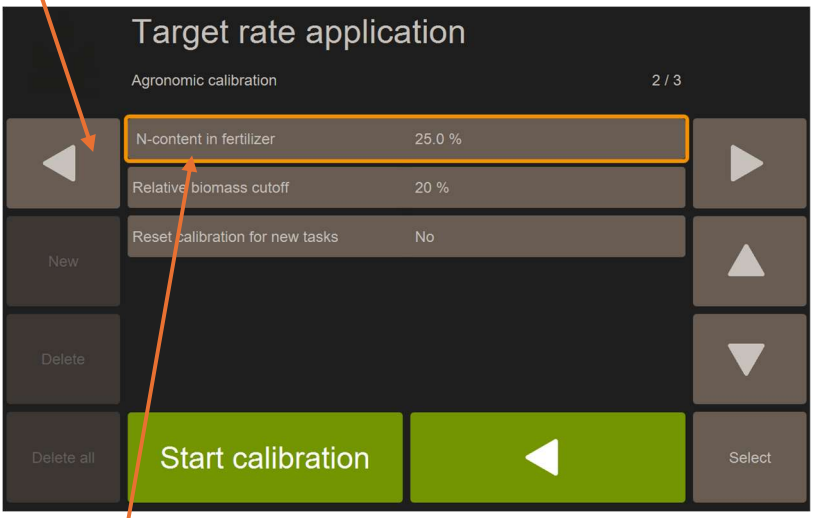




Once selected, Press “OK”

Move to the next Page

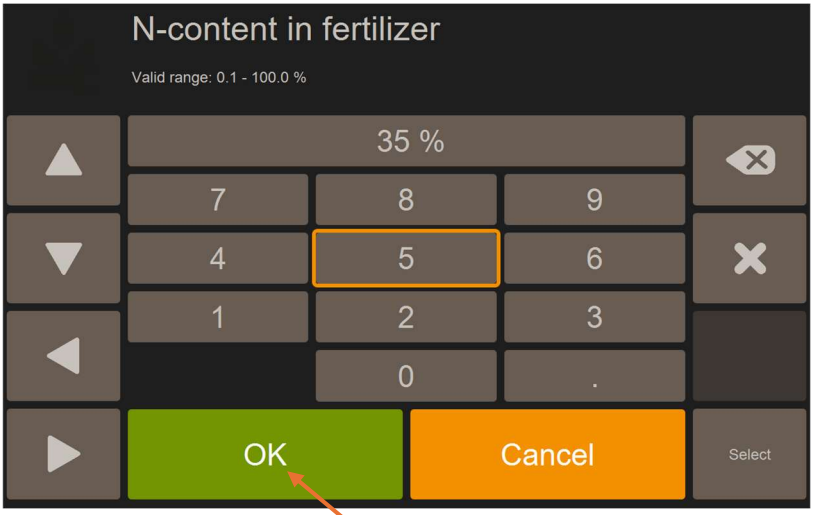



You can also go back and check previous setting by hitting the back arrow.

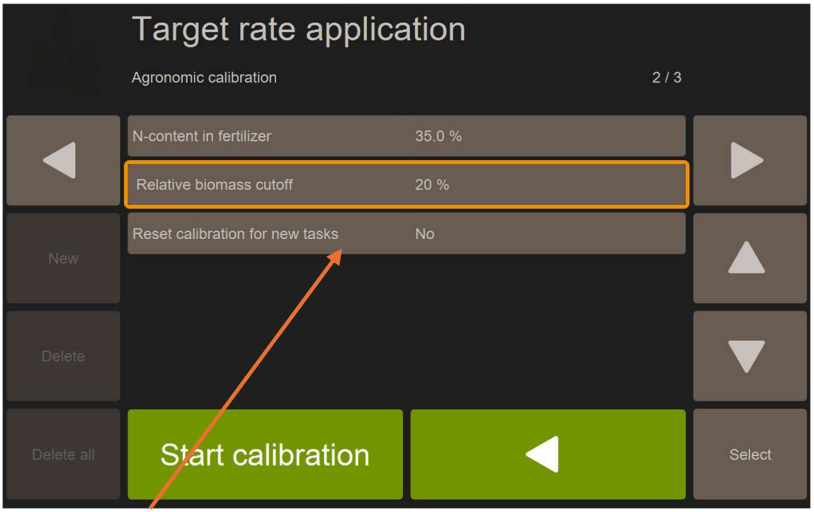



Select “N-content in fertilizer” to change the N%

N% valid range from 0.1% to 100%, remember this is N% (**Weight by Volume**), Liquid (Weight by Weight) manufacturers need to be converted, see Rate Calculator for more information.




Select the correct N% and press “OK”

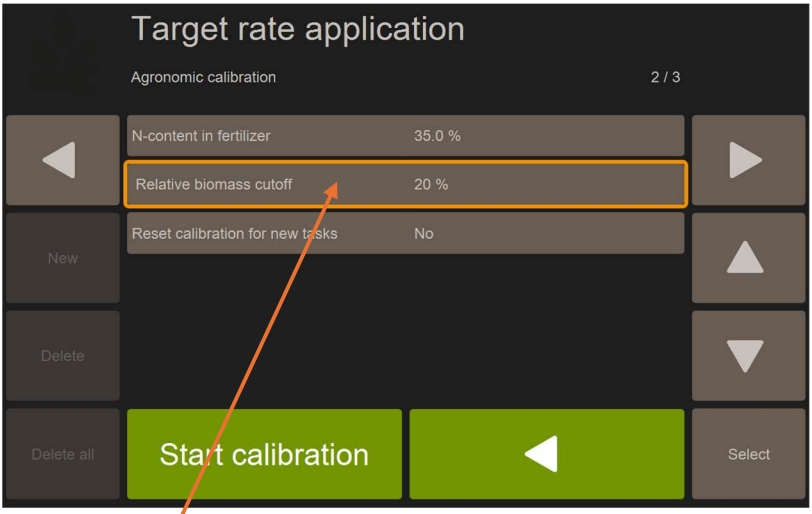



“Reset calibration for new task”, Once you have completed a task and are looking to move onto the next task,

this feature allows you to either keep or delete the calibration when moving to the next task.

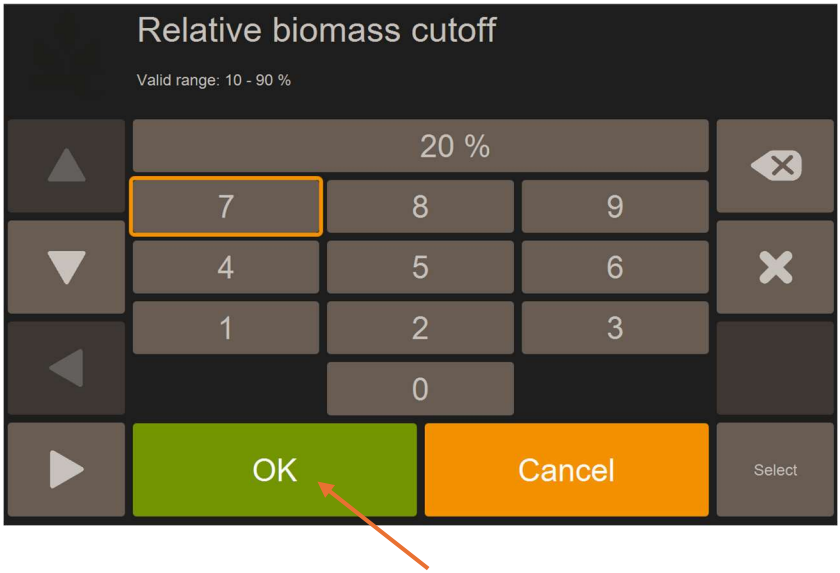
The options :-

- No – This will keep the calibration value when moving to the next task
- Yes – This will delete the calibration value when moving to the next task
- Always Ask – Once a new task is created a pop-up option will ask If you wish to keep the calibration value or delete it.

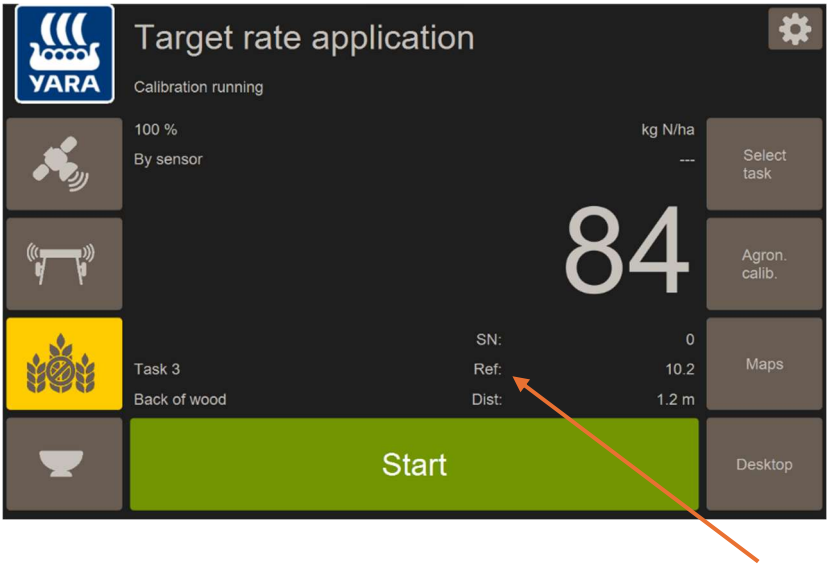



"Biomass cutoff factor", To stop over application on poor areas the N-Sensor includes a biomass cutoff feature, you can tell the N-Sensor when it should cut to the minimum rate to stop the over application. Increasing this figure will make the system cut in sooner, decreasing this figure will make the system cut off to the minimum rate later.

In “Target Rate Application” the biomass cutoff is determined by a percentage (10%-90%) of the “Ref” value.




Select the desired value and press “OK”

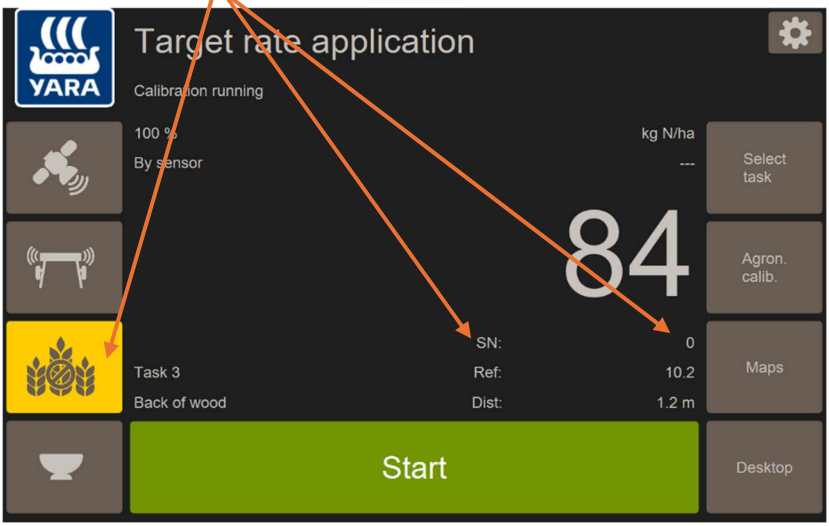



In the example above & below, the N-Sensor has seen and average (Ref) N-Uptake (SN) of 10.2.

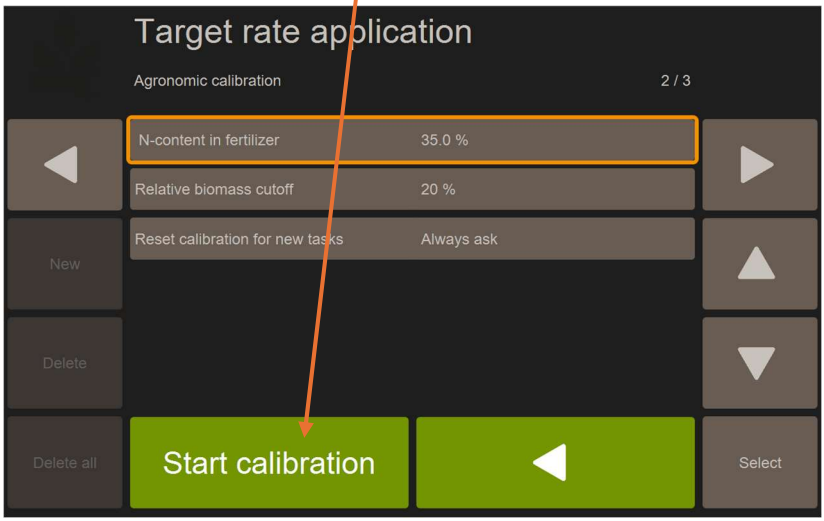
With the biomass cutoff set at 20% this means below 20% of the Average (10.2 SN) the rate will start to reduce to the minimum.

10.2(SN) ÷ 20% = 2.04 or 2 SN.

SN values under 2 SN will cause the biomass cutoff factor to kick in




You are now ready to start the calibration process, Press “Start Calibration” to continue



There are 2 ways in which to use “Target Rate Application”, Calibration Running & Calibration Stopped.

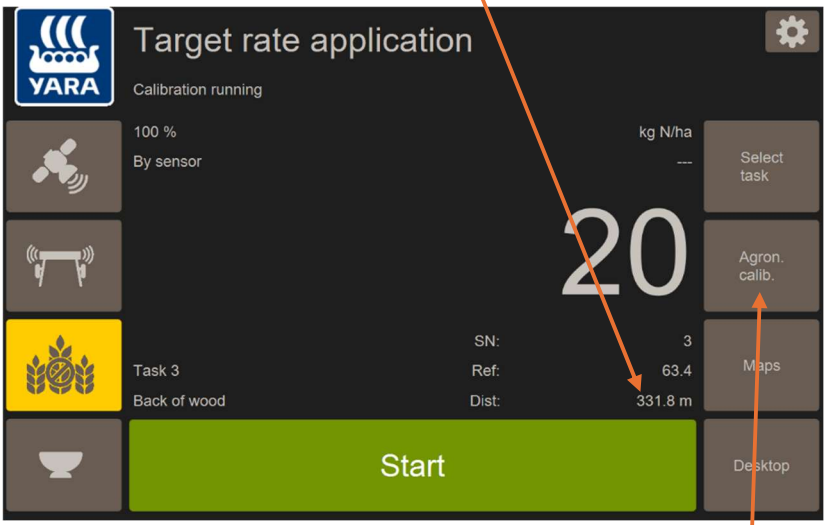
Calibration Running

Once you press “Start” the calibration and application will start, this will continue to run until reset! This means you can keep the calibration continuously through different “Task”.

Leaving the Calibration running can mean the “Ref” or average SN value will continuously keep changing and moving, once an application is complete you will see that the average overall rate will be closer to the “Target Rate”.

Calibration Stopped

When “Start” is pressed a distance or “Dist” will start to increase and calculate the “Ref”

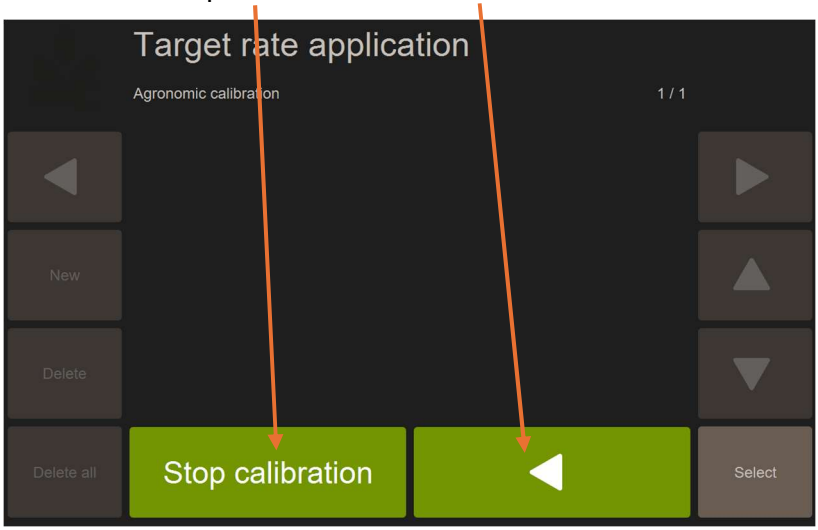



After 100M of “Dist” you now have the ability to stop or lock in the calibration which is altering the “Ref” or average value.

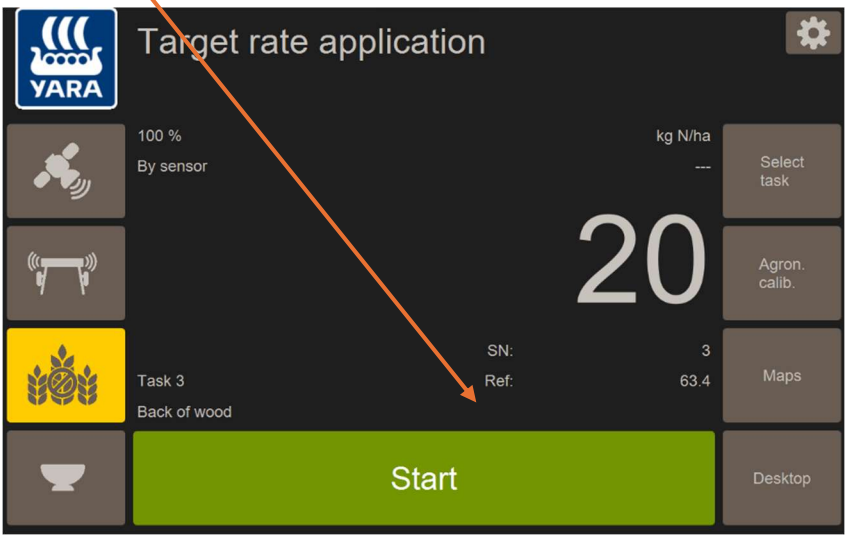
To do so first press “Stop” and then hit “Agronomic Calibration”

You will notice, no agronomy options are available.

You can either “Stop Calibration” or “Return”

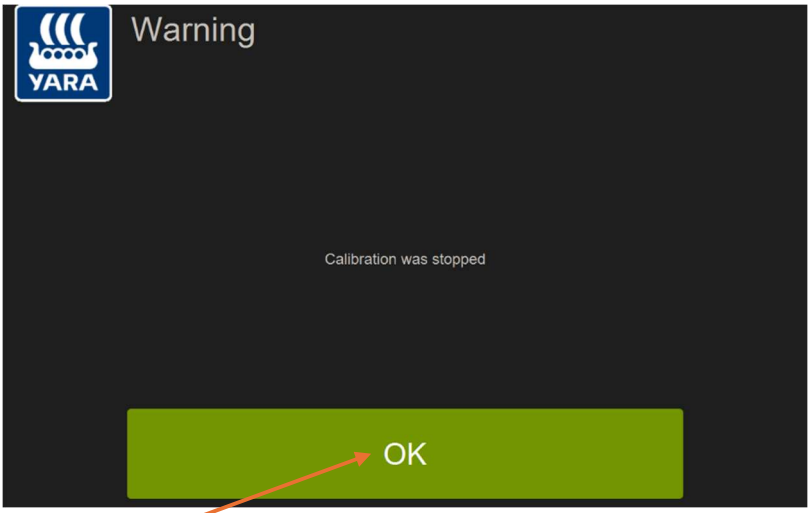



Return will take you back to the main working page, “Stop Calibration” will also return you to the main working page, however will notice “Dist” is now gone.

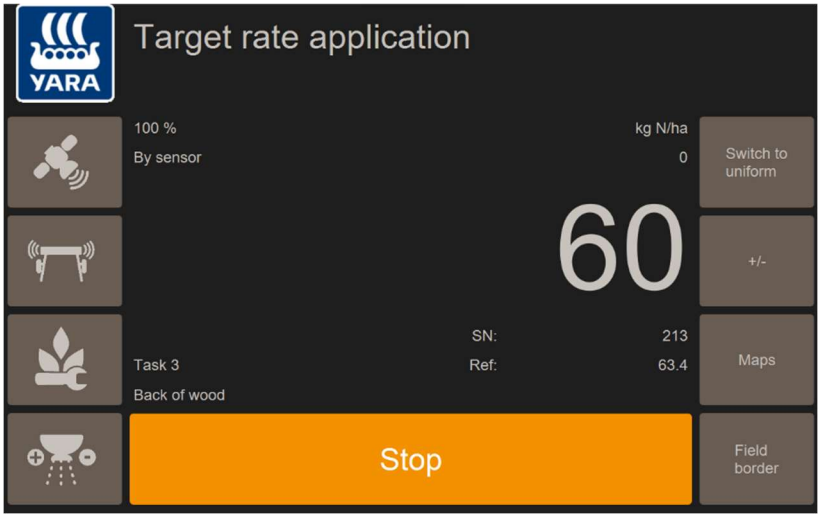


This means the calibration and “Ref” or Average SN is now locked. This will make the Sensor more accurate across the field/task. It can however cause the Average N-Applied to move away from the intended “Target Rate”

When you next press “Start”, a warning will appear to say the calibration was stopped.

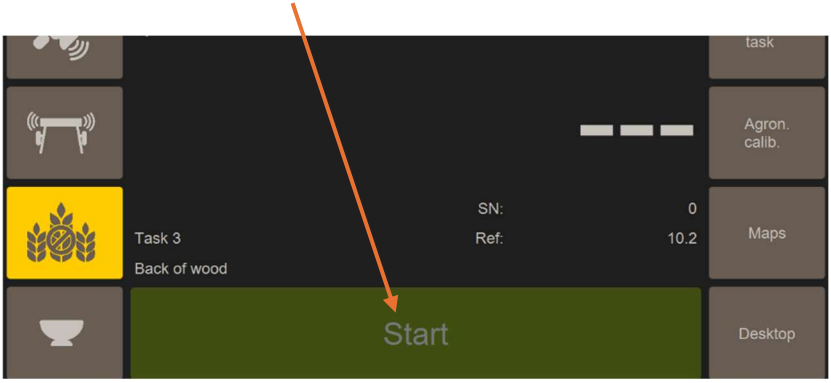



Select “OK” and continue.



You are now ready to press “Start” and use the “Target Rate Application Mode”

You may notice the start bar is a bright colour in the previous images, If the “Start” bar is faded out like below, you must go back into “Agronomic Calibration” and Press “Start Calibration”




In “Target Rate Application” you have the ability reset the calibration throughout the field/task.

To do so follow the below.

6. Press “Stop”
7. Press “Agronomic Calibration”
8. Press “Stop Calibration”
9. Press “Agronomic Calibration”
10. Press “Start Calibration”

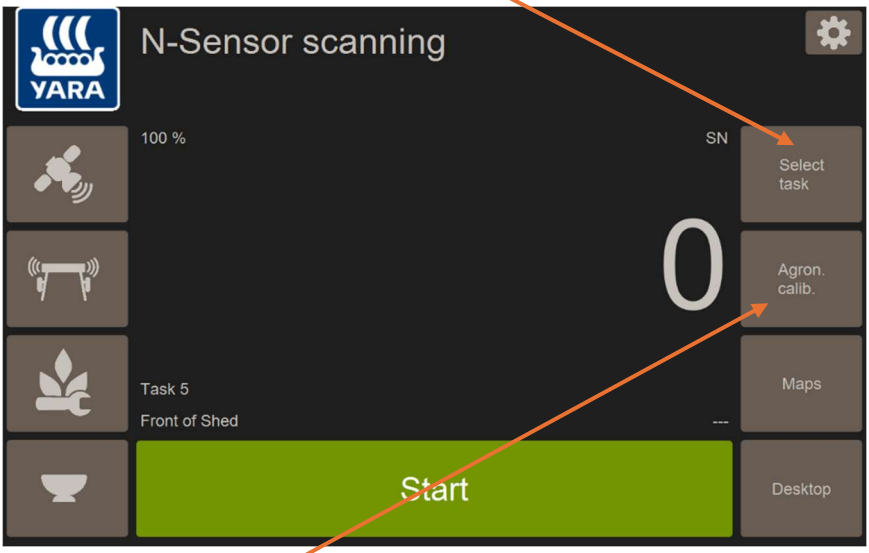
This process will reset the “Ref” and “Dist” back to 0 ready for a new calibration without distorting previous data captured.

# Notes

# Scanning

The Scanning mode allows you to scan a crop and take a biomass reading without application. Simply tell the N-Sensor the Crop and the implement width on the vehicle and record.

To start you must first create a new task in the task Selection, in Operational Modes make sure to select “Scanning” for further details on how to do this see the “Creating a New Task” section



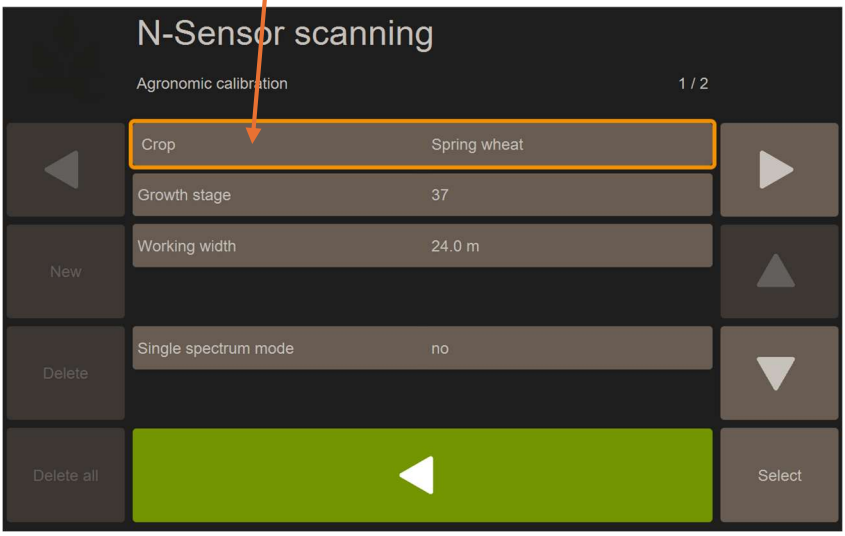

Now select “Agronomic calibration”

There are only 4 Options to choose from when scanning,

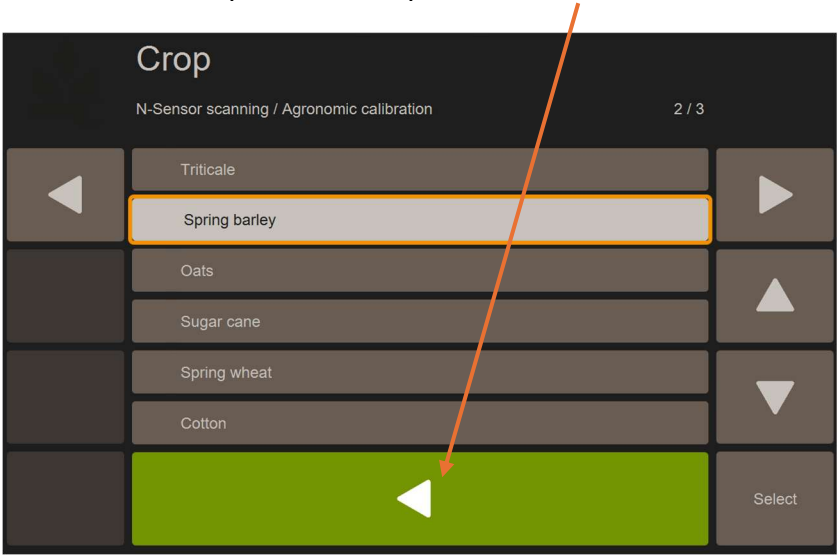
- Crops
- Growth stage or Cut (Grassland Only)
- Working width
- Single Spectrum mode

First choose the correct “Crop” to scan, “Crops” available to scan are:

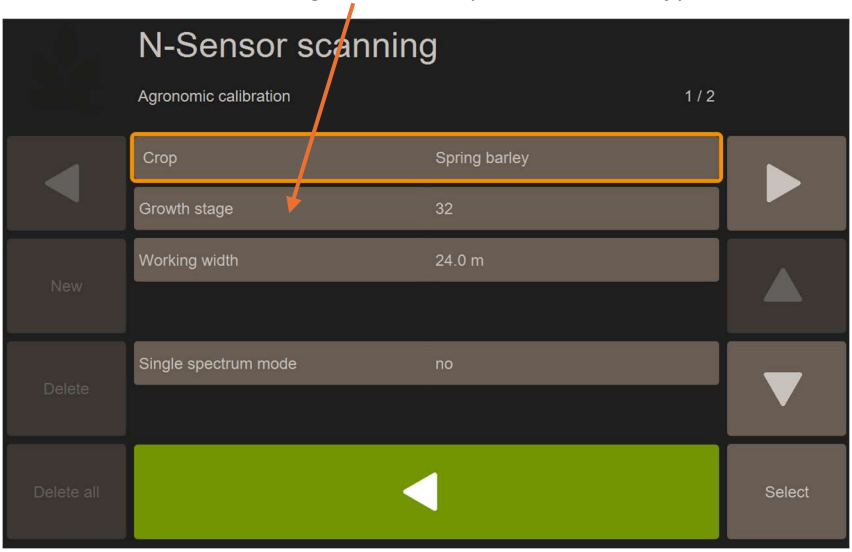
- Maize
- Potato’s
- Oilseed Rape
- Winter Wheat
- Winter Barley
- Winter Rye
- Triticale
- Spring Barley
- Oats
- Sugar Cane
- Spring Wheat
- Cotton
- Durum wheat
- Standard Grassland
- Spelt



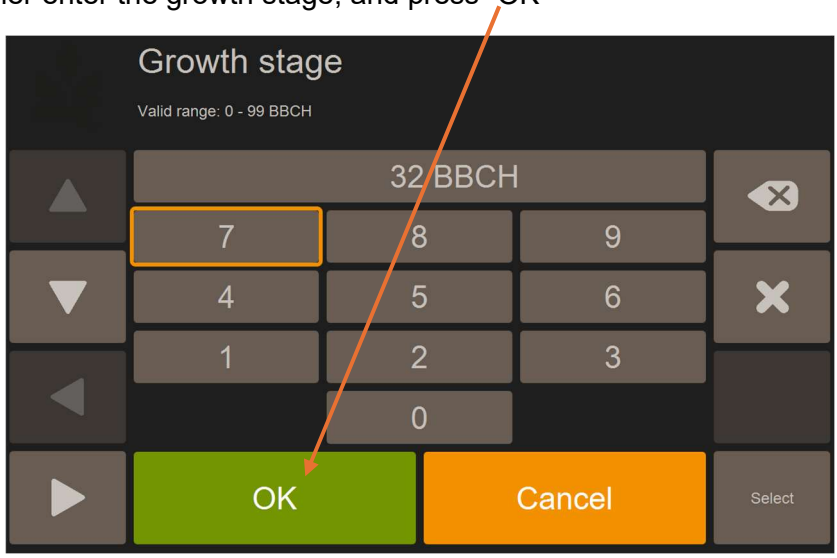
When the correct crop is selected, press “Select & Return”



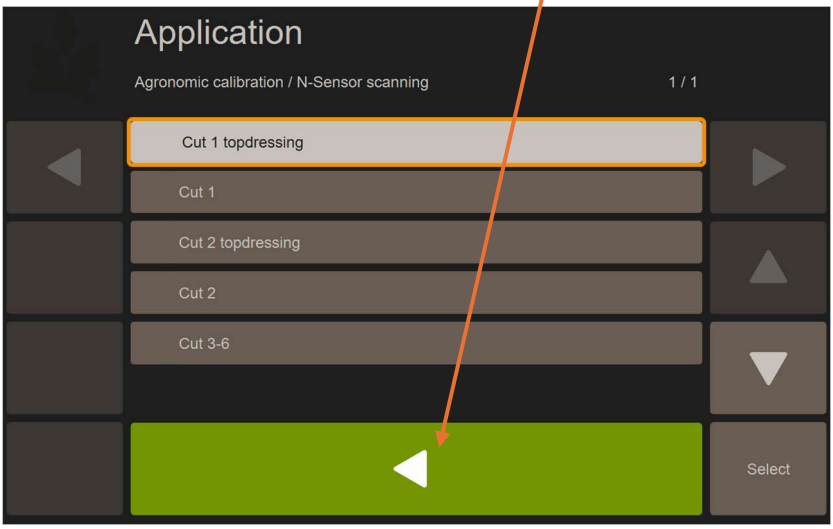

Next enter the “Growth stage” or “Cut” (Grassland Only)



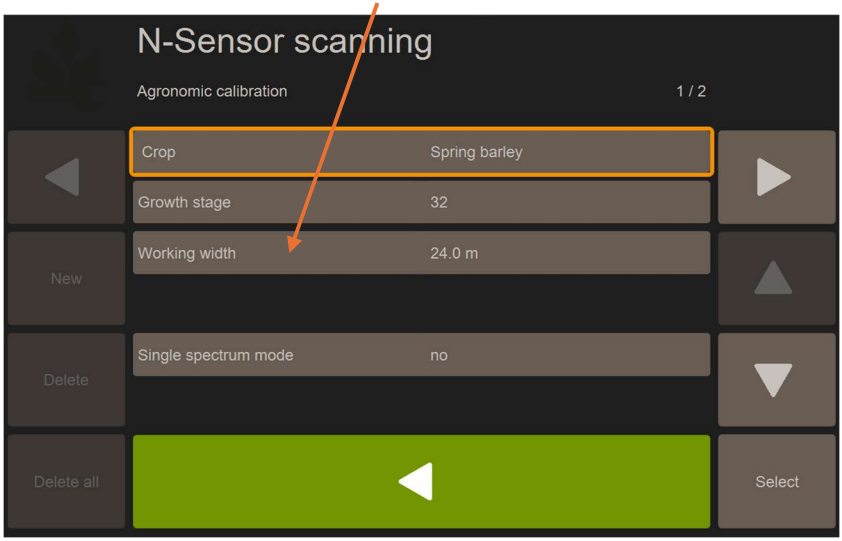
Either enter the growth stage, and press “OK”



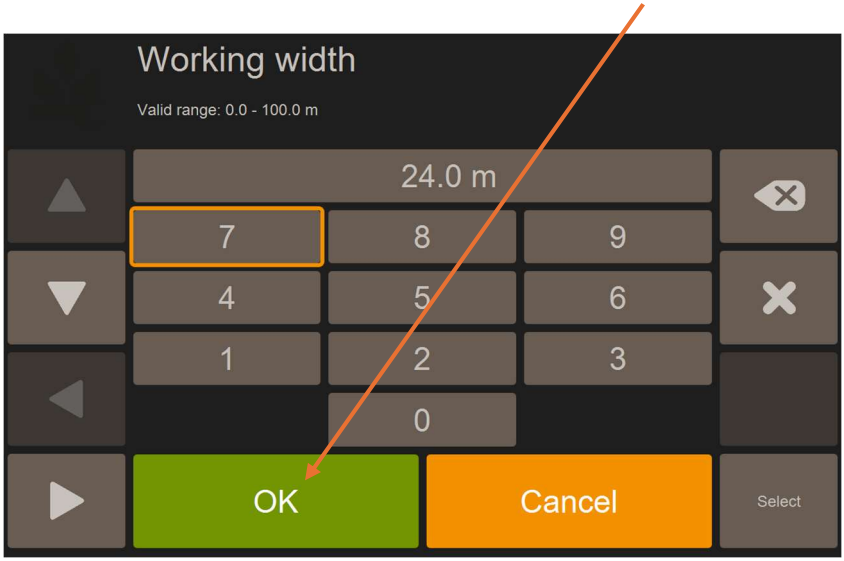

Or enter Application / Cut, and press “Select & Return” (Grassland Only)



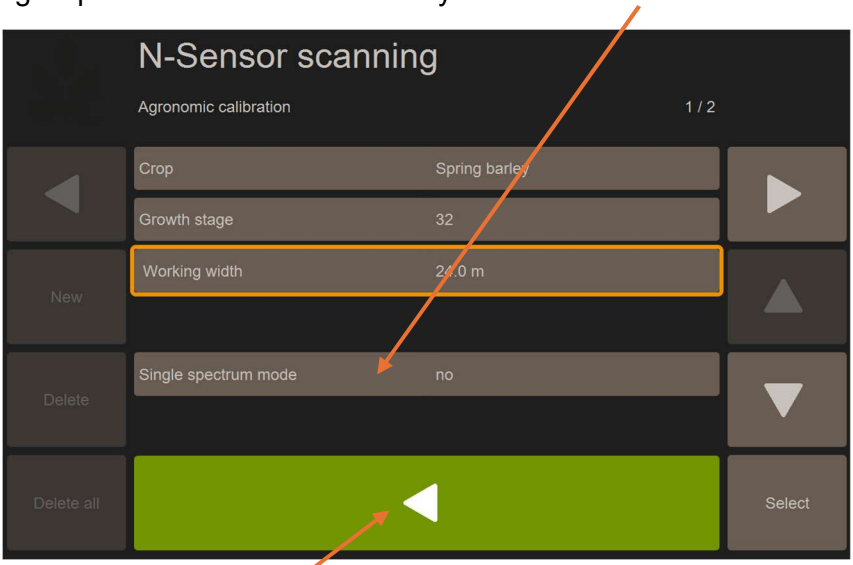
Next type in the correct “Working width”




Once the correct working width has been set, press “OK”

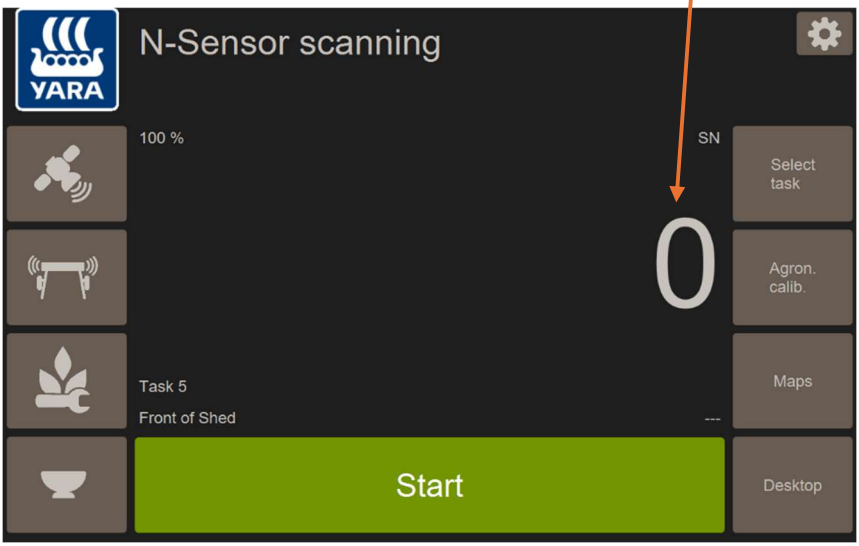


“Single spectrum mode” should always remain as “no”



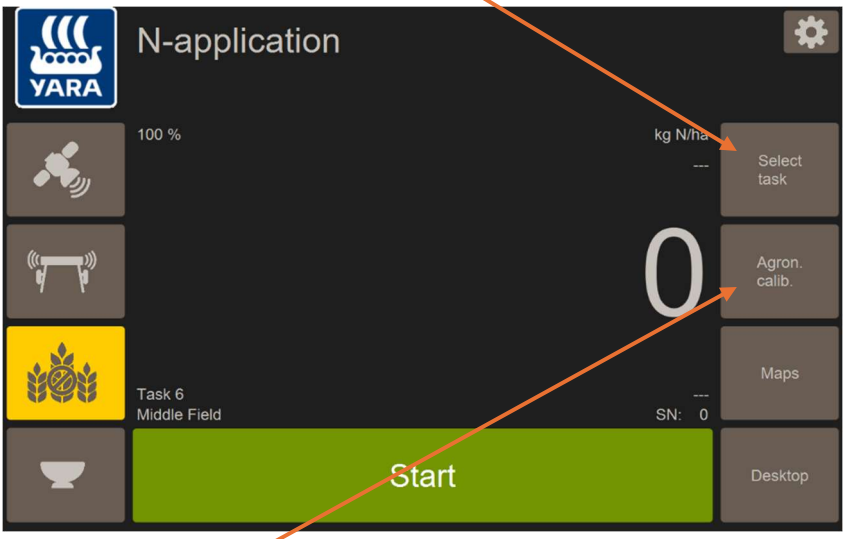

Press “Select & Return”,

You are now ready to press “Start”, the only difference between the “Scanning Mode” and other modes is that no rate is provided, which means the large figure in the middle, usually Kg N/Ha is now SN (Nitrogen Uptake) instead.



# N-Application

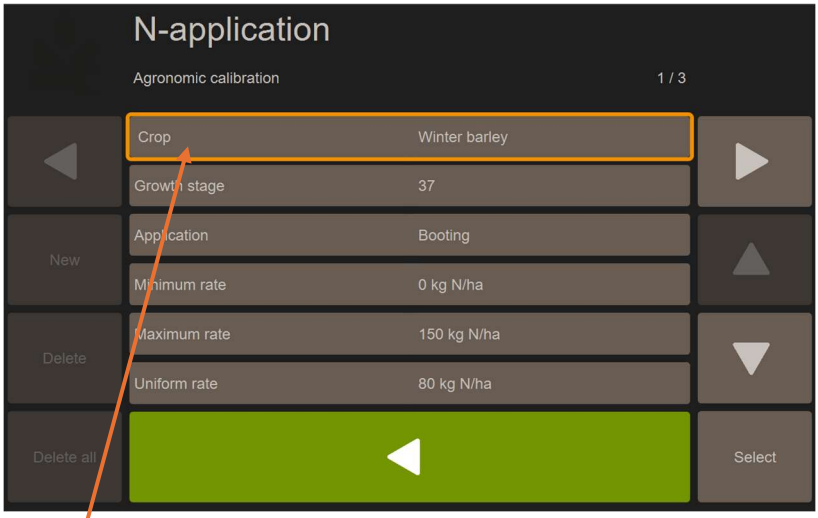
To start you must first create a new task in the task Selection, in Operational Modes make sure to select "N-Application" for further details on how to do this see the "Creating a New Task" section




Now Select "Agronomic calibration"

Firstly select a "Crop", Available crops include

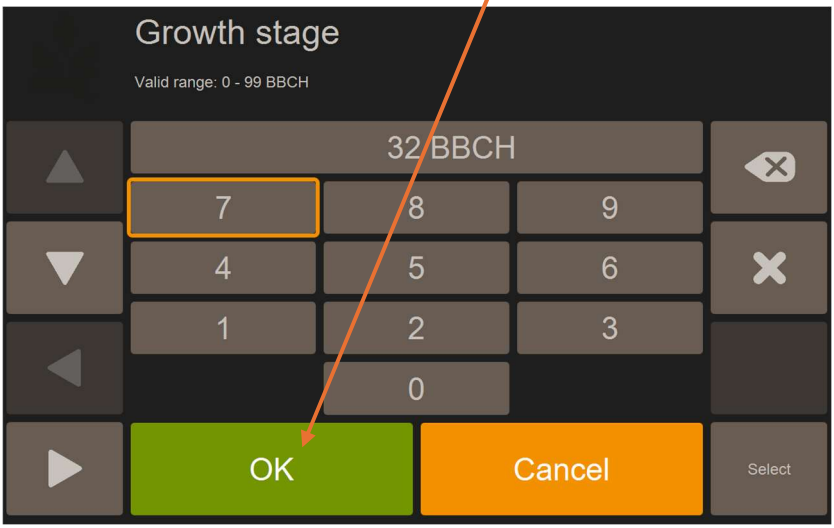
- Cotton
- Durum wheat
- Maize
- Oats
- Oilseed Rape
- Potatoes
- Spelt
- Spring wheat
- Spring barley
- Standard grassland
- Sugar cane
- Triticale
- Winter Barley
- Winter Rye
- Winter Wheat



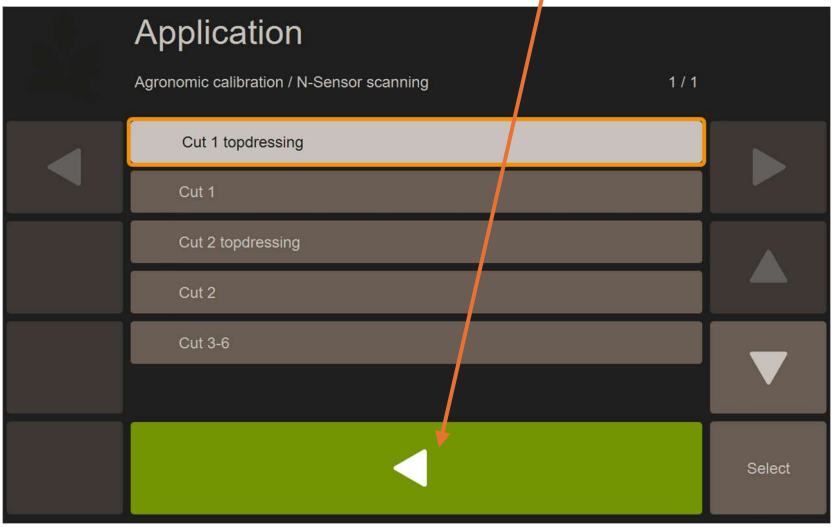

Select "Crop" to change crop type

Next Select the "Growth stage" or "Cut" (Grassland Only)

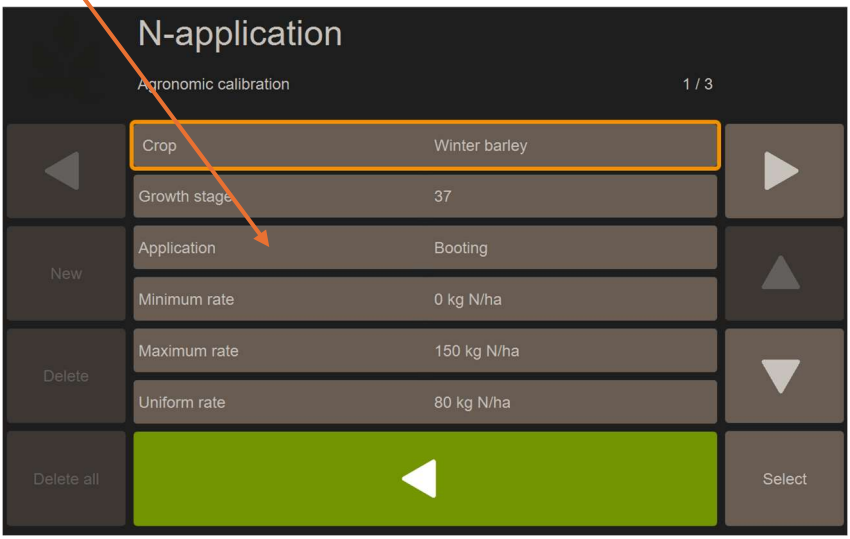
Either enter the growth stage, and press "OK"




Or enter Application / Cut, and press "Select & Return" (Grassland Only)



In cereal and brassica crops you get additional settings. The "Application" description will appear below the growth stage, between




GS20 - GS36 this value is locked, between GS37 – GS49 this value can be changed between "Booting" & "Protein dressing"

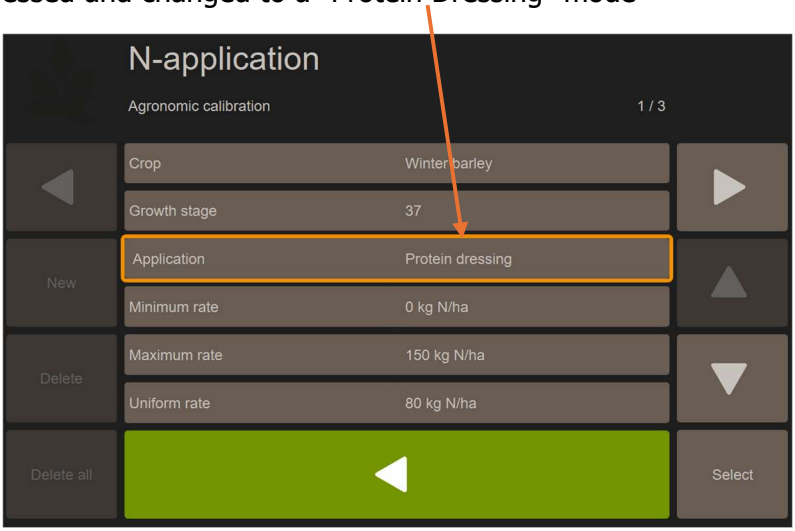
"OSR" will also allow you to change between 1st and 2nd dressing.

Cereals crop's that have additional applications like, Tillering, Steam elongation, Booting & Protein dressing:-

- Winter Wheat
- Winter Wheat
- Winter Rye
- Triticale
- Spring Wheat
- Spelt
- Durum Wheat

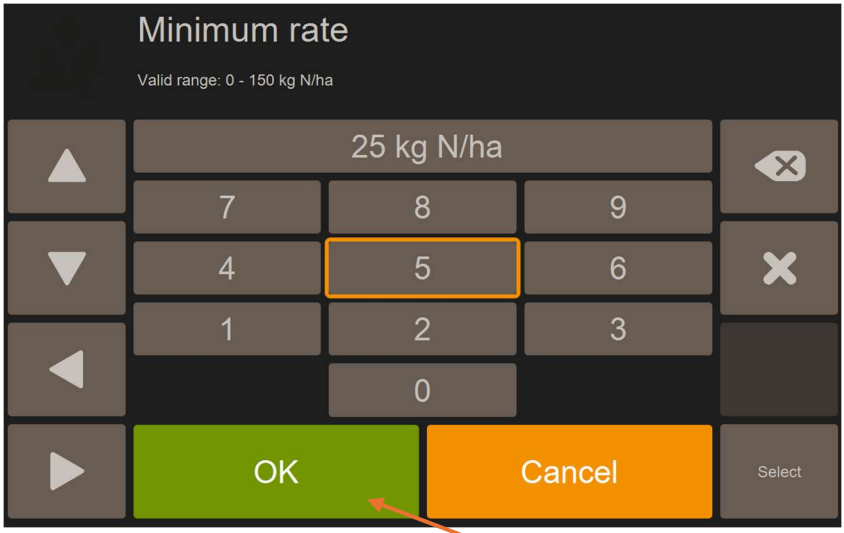
The "Protein Dressing" mode will invert what the N-Sensor would do normally, so higher biomass and N-uptake areas will get a higher rate and lower Biomass and N-uptake areas will receive less.

When selecting between GS37 - GS49, the "Application" "Booting" can be pressed and changed to a "Protein Dressing" mode



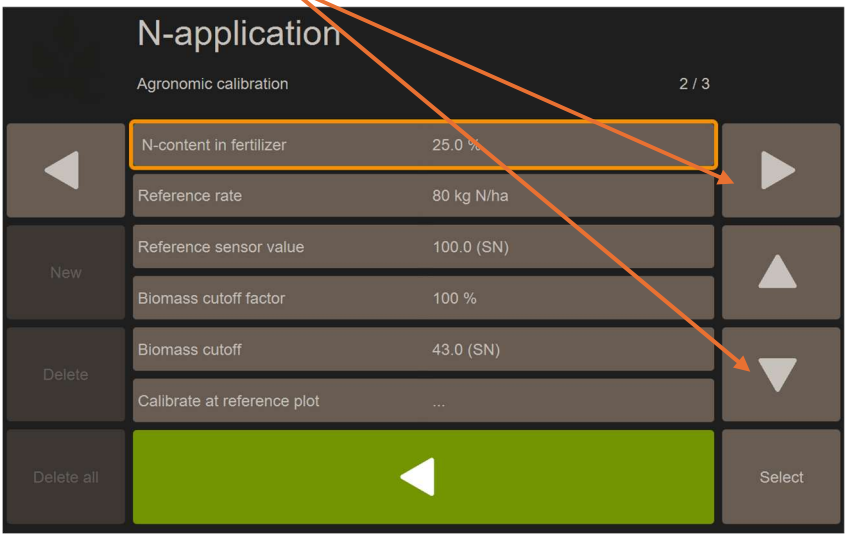

Next select the "Minimum rate" "Maximum rate" & "Uniform rate"" to set the upper & lower rate limits. (Kg N/Ha)

If the system fails or has a hardware failure "Uniform rate" is the flat rate then applied as a fail-safe.

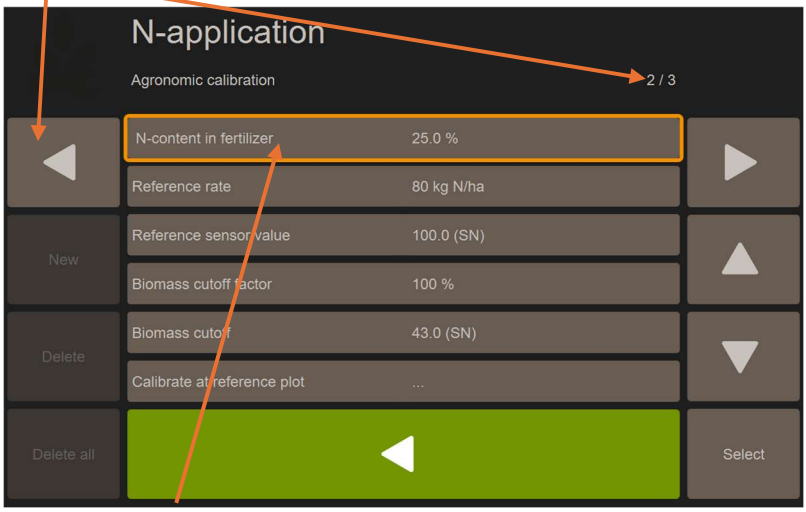



Select the limitations and uniform rate then, Press "OK"

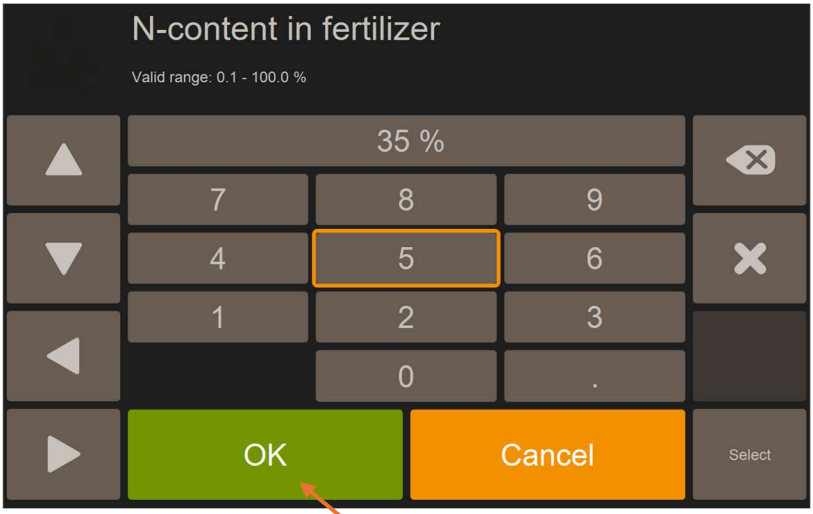
Move to the next Page



You can also go back and check previous setting by hitting the back arrow.




Select "N-content in fertilizer" to change the N% choose a valid range from 0.1% to 100%, remember this is N% (**Weight by Volume**), Liquid Weight by Weight) manufacturers need to be converted, see Rate Calculator for more information.

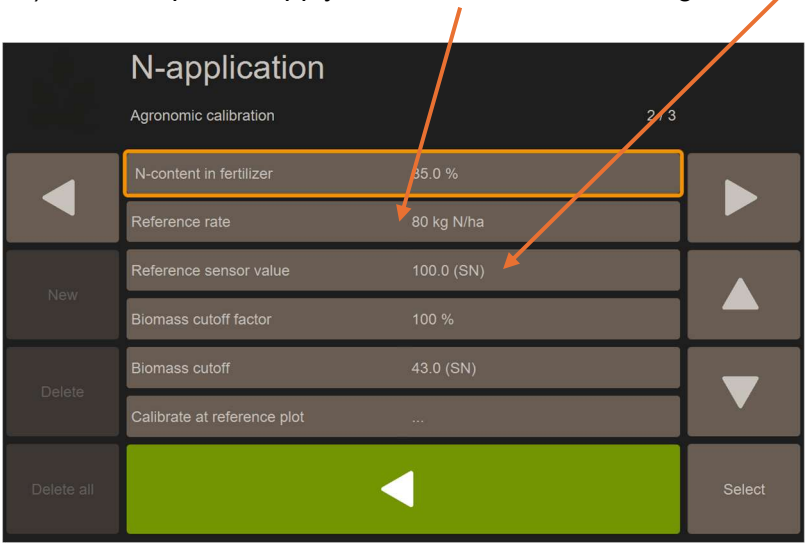



Select the correct N% and press "OK"

N-Application works upon an adjustable reference rate either set by the user or by a “Calibration at reference plot” (N-Sensor self-calibration).

That then sets the “Reference sensor value”, whatever SN (Nitrogen Uptake) value then N-Sensor collects or the user chooses the N-Sensor then works with this value for the “Reference rate”

Is the example below, every time the N-Sensor see’s 100 SN (Nitrogen Uptake) in the crop it will apply the “Reference rate” 80 Kg N/Ha.



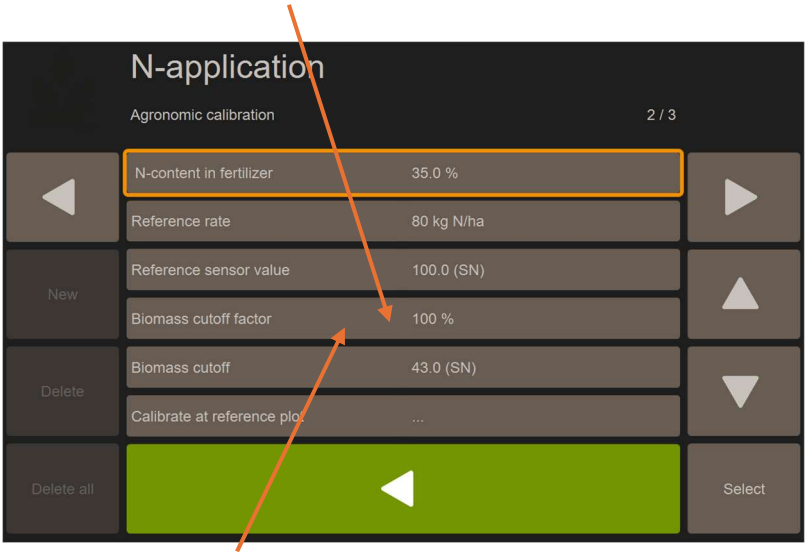

With individual crop algorithm’s, the SN values increasing and decreasing this will then adjust the application rate depending on severity of difference to the “Reference Sensor Value”.

“Biomass cutoff” is now applied in 2 factors

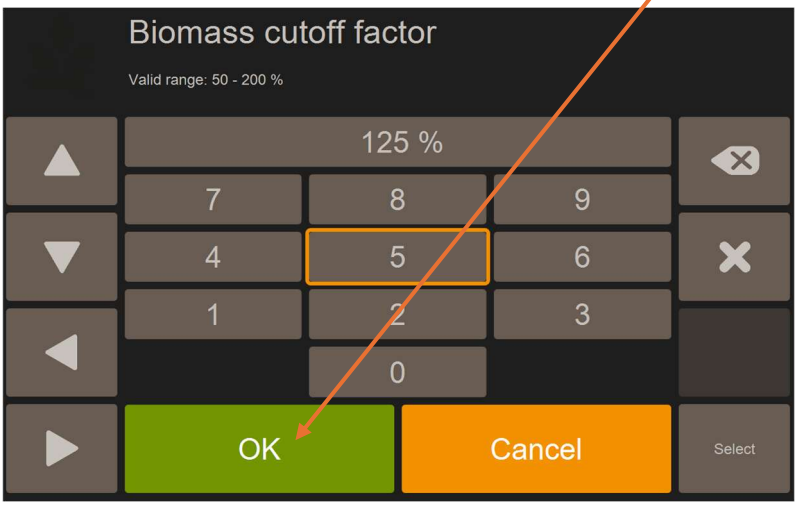
- When to engage and start decreasing N rates,
- How quickly & strongly the “Biomass cutoff” engages to decrease the rate.

The “Biomass cutoff factor” can be adjusted from 50% - 200%, 100% is standard.

If the system isn’t cutting off quick enough increasing the 100% to 200% will make the system drop or respond the SN value below the “Biomass Cutoff” twice as fast. Decreasing this value to 50% will slow the system down in its response to values below the “Biomass cutoff”.

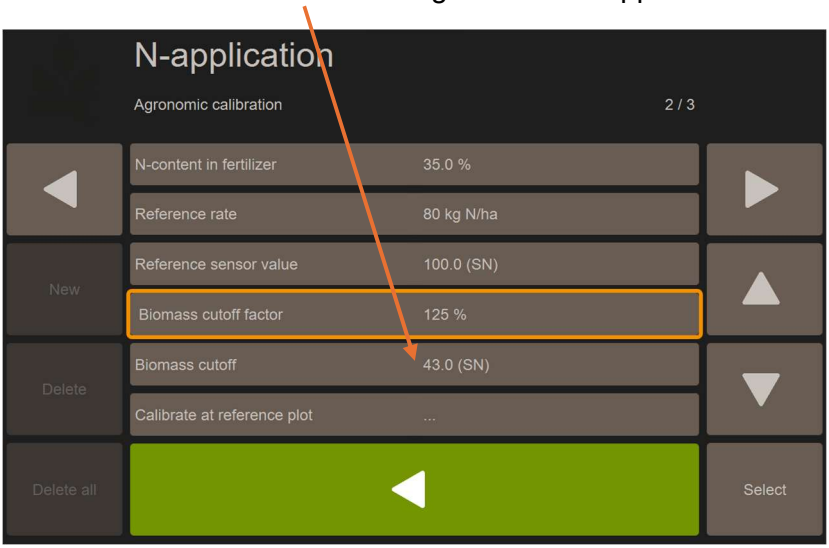



Select the “Biomass cutoff value” to adjust, then press “OK”

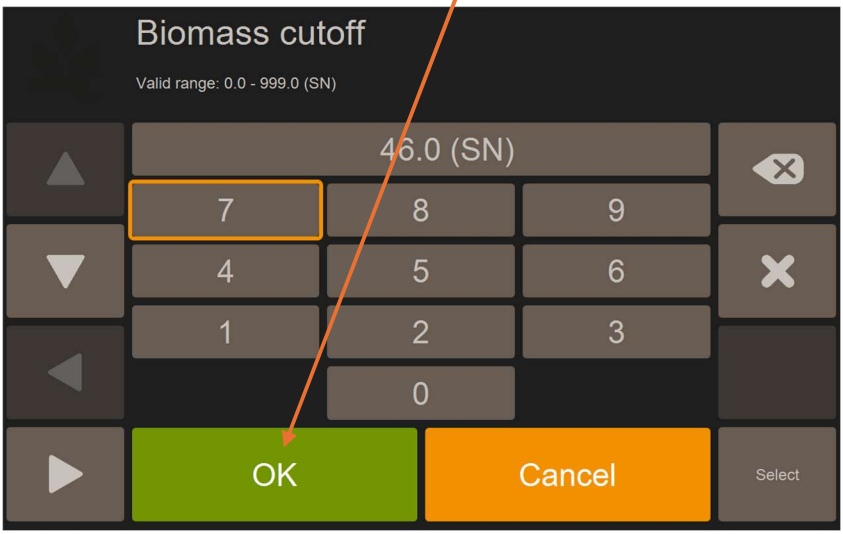


Now press “Biomass cutoff”

For “Biomass cutoff” select the SN (Nitrogen Uptake) value in which you wish the N-Sensor to start cutting back the N application.

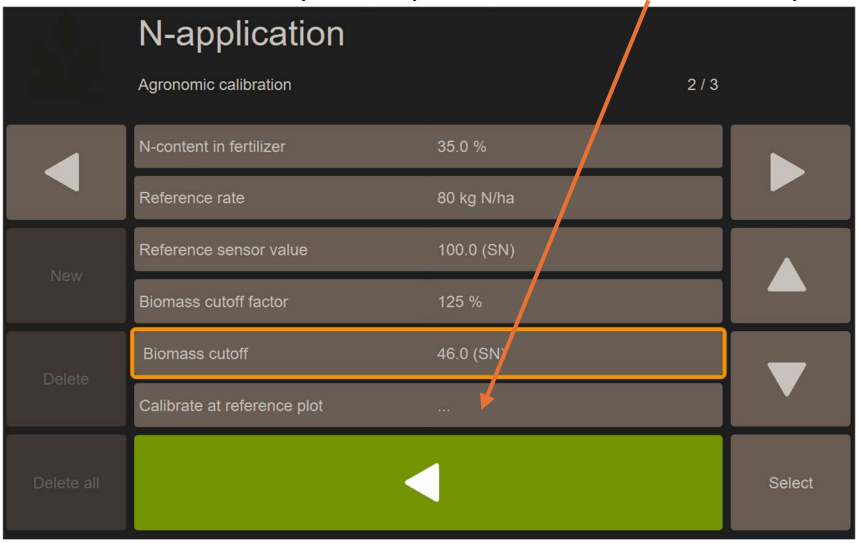


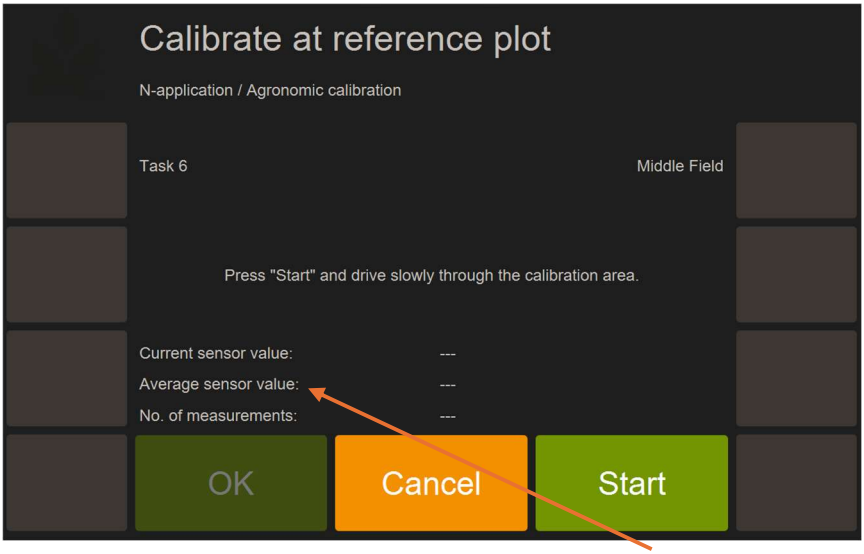

Select the SN cutoff value and press “OK”,



The Agronomy is now set up, however as previously mentioned, the “Reference sensor rate” can either be set manually or set by scanning an area of crop to create an average SN value.

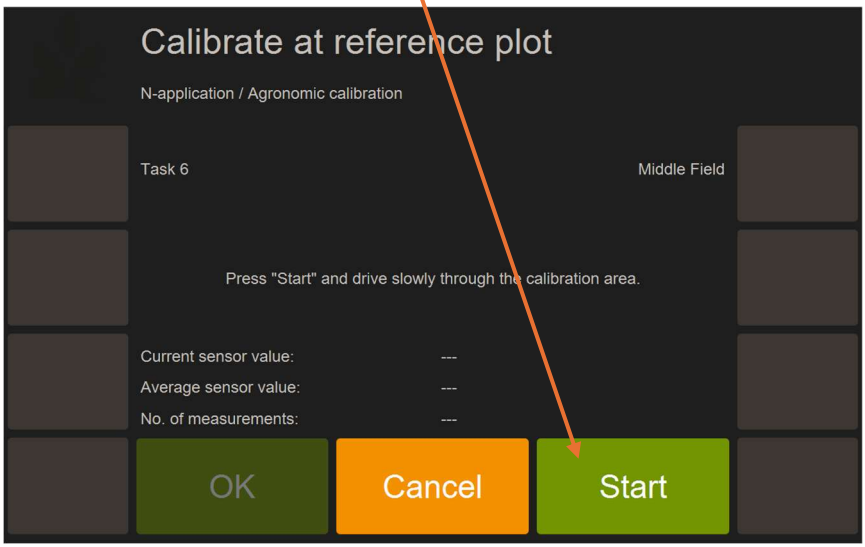
To do this self-calibration process press “Calibrate at reference plot”



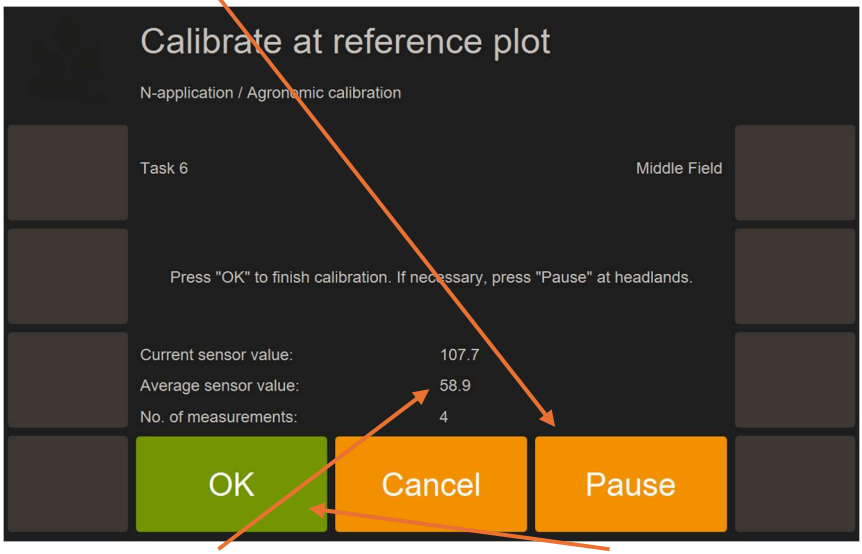




This will now need to create over 1 measurement an “Average Sensor Value” in order to use as a “Reference Sensor value”

Press “Start”, to start creating an average value for the “Reference sensor value”

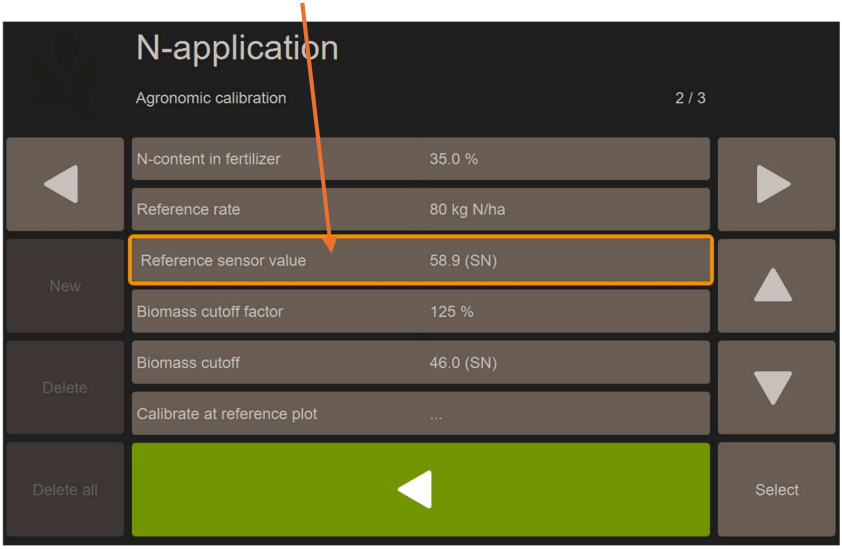



When your happy with the amount of measurements have been collected press “Pause”

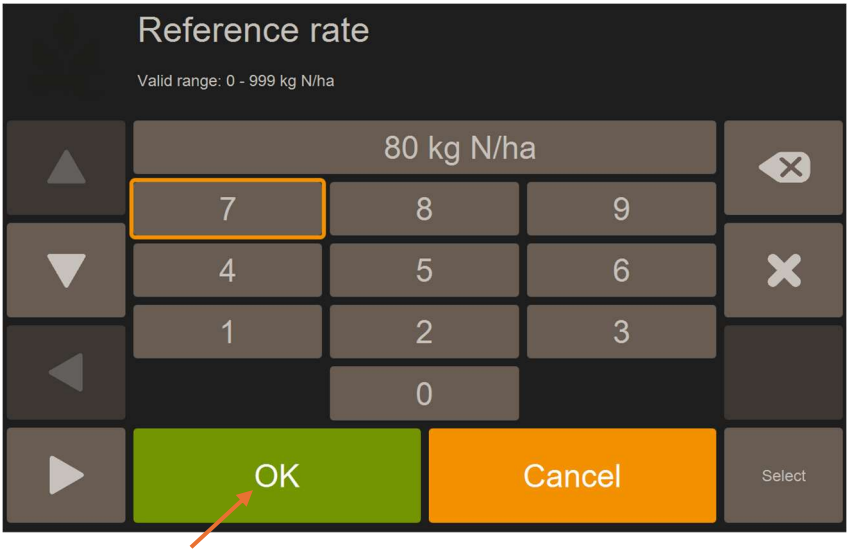



Note the “Average sensor value”, Then Press “OK”,

(You have to go back into “Agronomic calibration” to check) The “Average sensor value” (58.9 SN) has now come through.

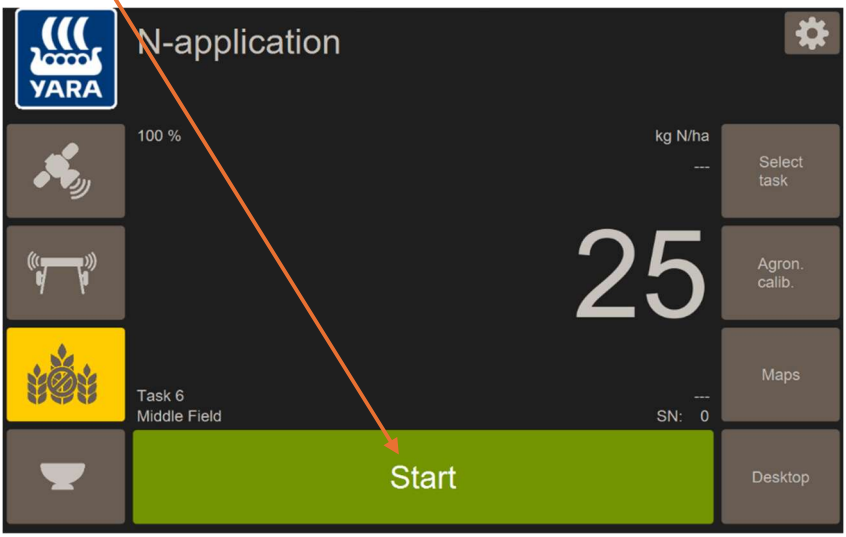



After pressing “OK” in the “Calibrate at reference plot” page, the application will then present the “Reference rate” to Check.




After selecting “OK” you will automatically complete the “Agronomic calibration” and go through to the main working page.

Press “Start” to start the application



# Base Application

Base Application can be used with the following prescription maps

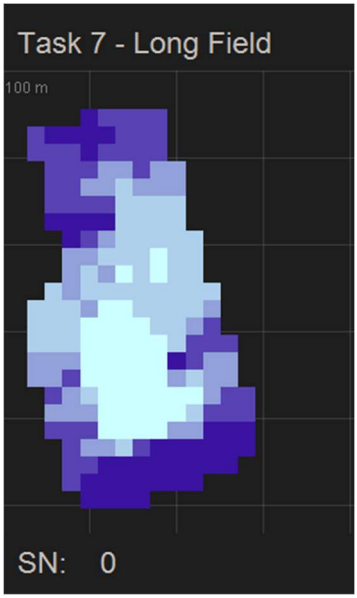
- .rst - Raster Maps
- .grd – Grid File
- .shp – Shape File (file must include .shp + .dbf + .shx)

.rst & .grd files also have the ability to be interpolated,

Interpolated uses data points nearby to mix data to increase accuracy.

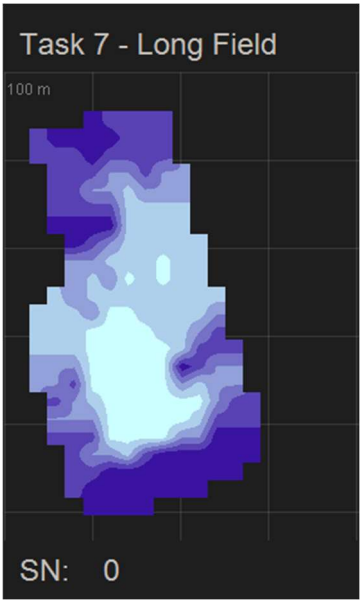
.rst not Interpolated

(Example)



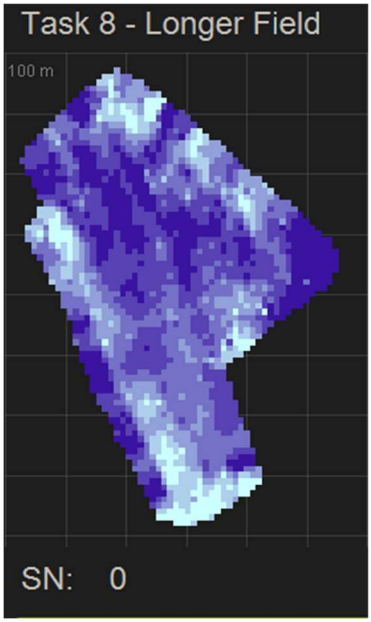

.rst Interpolated

(Example)



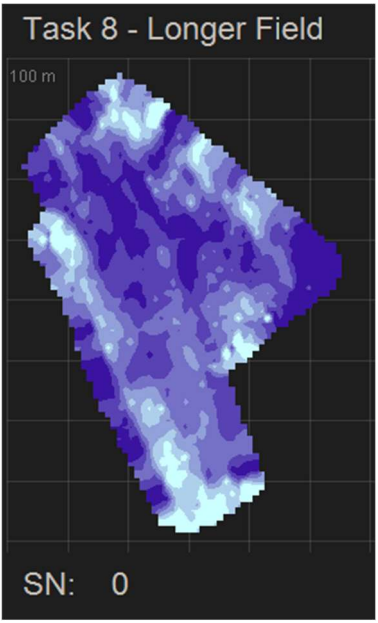
.grd not interpolated

(Example)

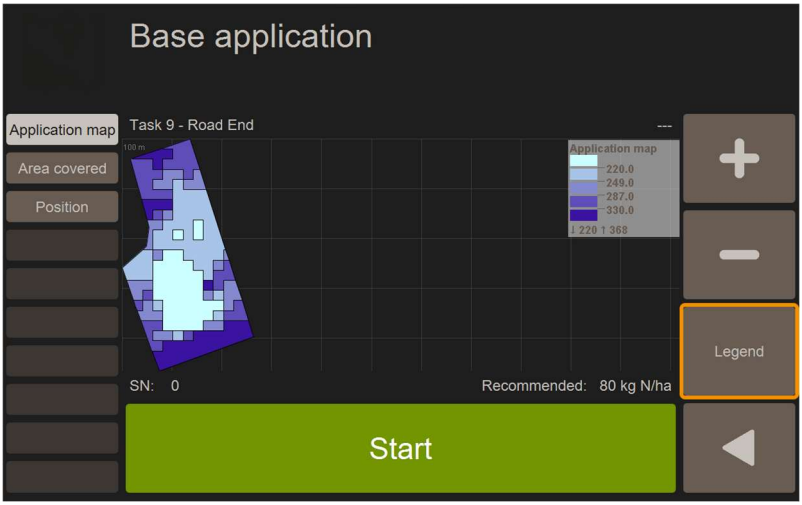



.grd interpolated

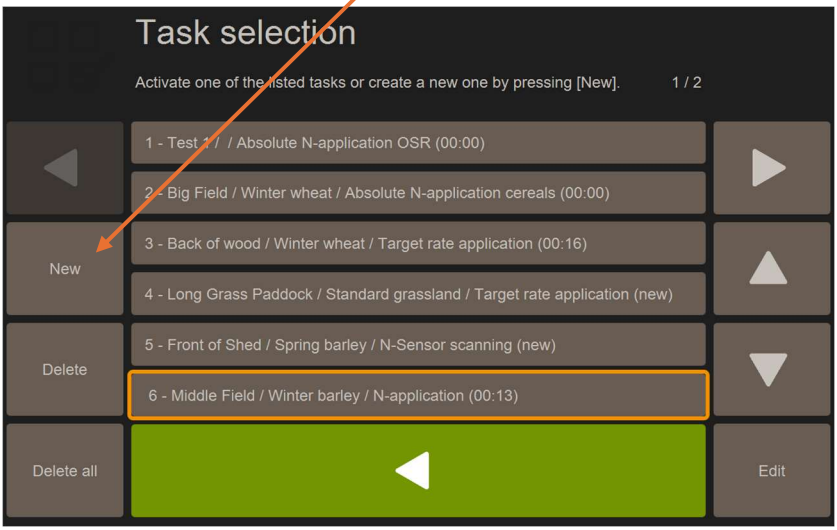
(Example)



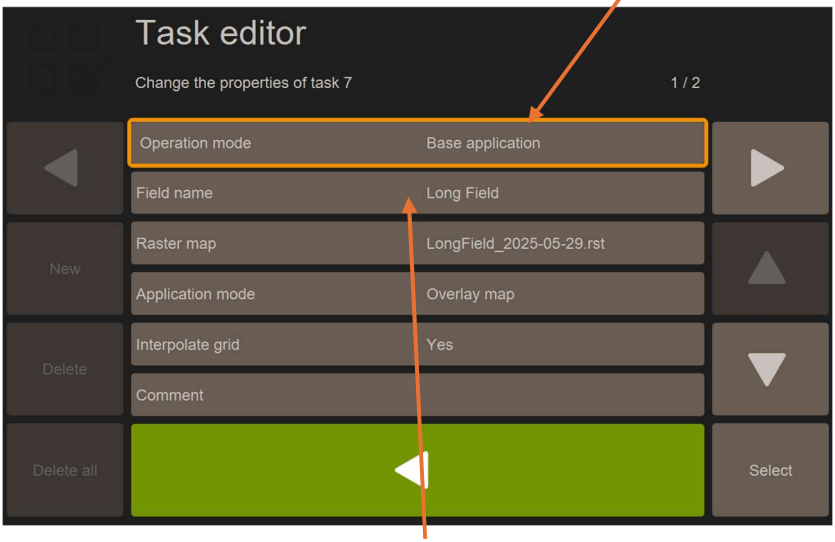

.shp (Example)



To start you must first create a "New" task in the task selection,

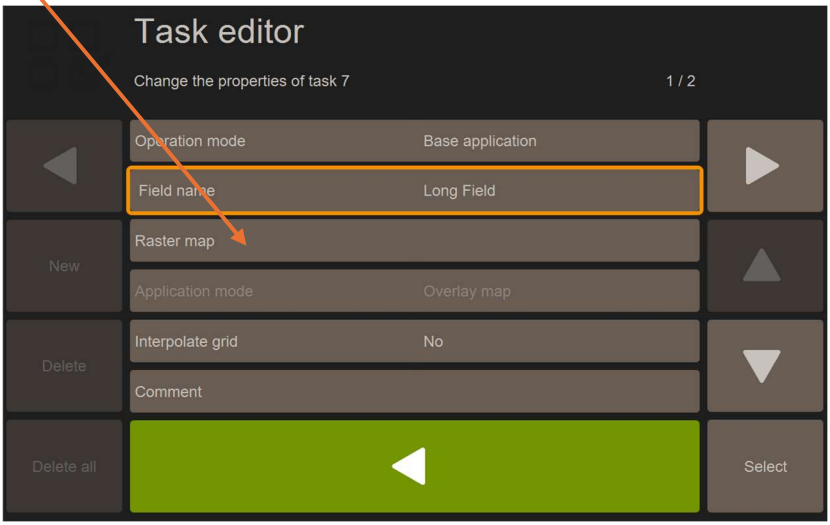



in "Operational Modes" make sure to select "Base application".

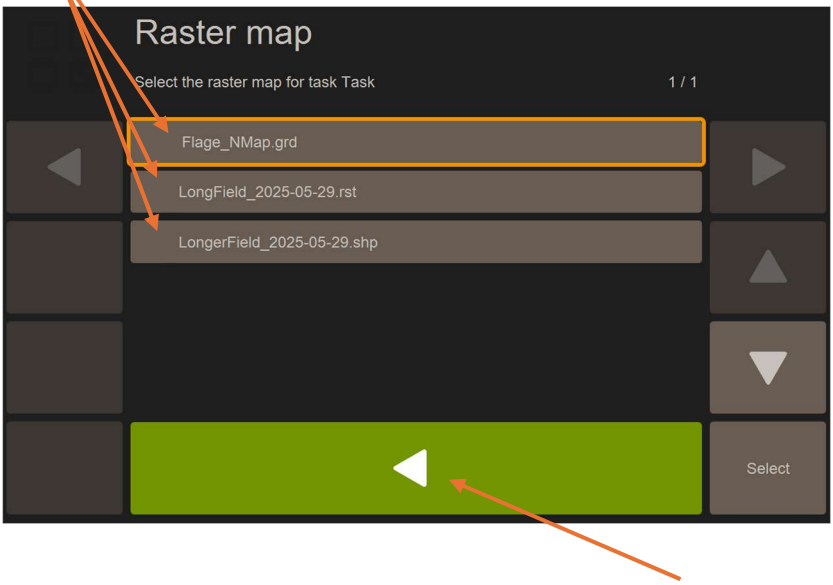



For recording purposes add a "Field name"

You must now select the correct prescription map, to do so select "Raster map"

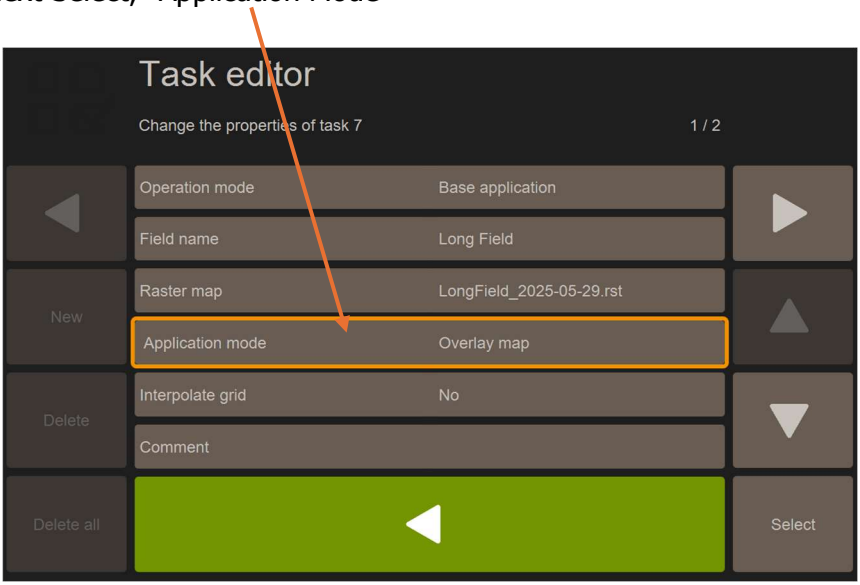



With the correct data format in the correct directory, you should see the prescription maps.



Once you select the correct prescription map, press "Select & return"

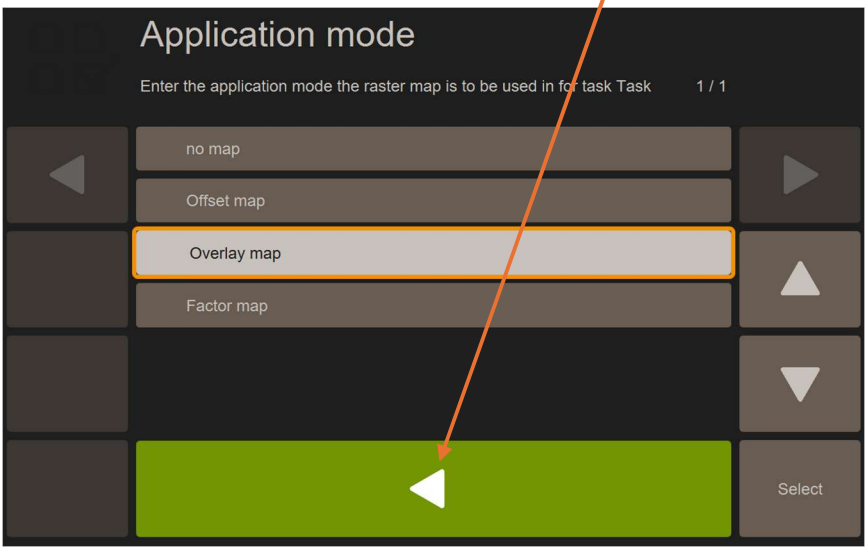
Next Select, "Application Mode"



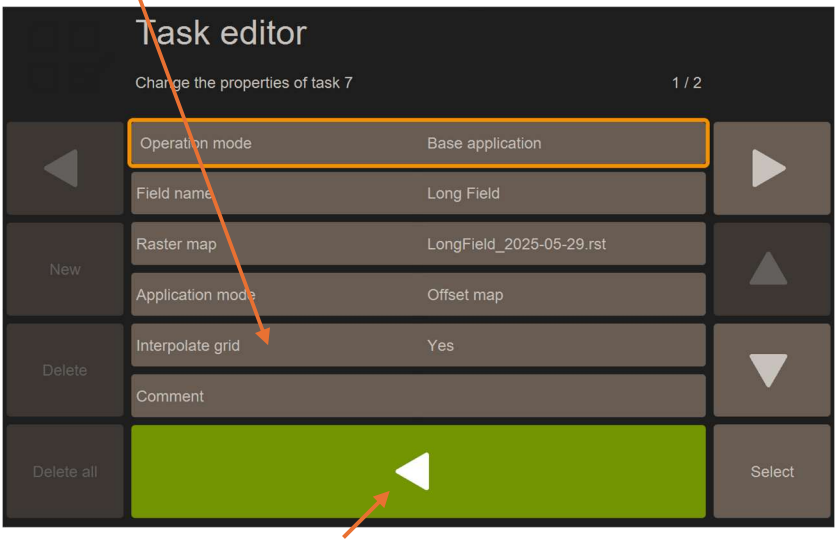

"Overlay map" is chosen as standard, other options Include :

- No map - Prescription maps are not used at all. The application rate is solely based on the N-Sensor reading.
- Overlay map - The final application rate is determined solely by the prescription map. (Recommended)
- Offset map - The final application rate is calculated as the sum of the N-Sensor recommendation and the rate from the offset map. Note that in this case the offset map may contain positive as well as negative rates.
- Factor map - The final application rate is the N-Sensor recommendation multiplied by the value from the prescription map. i.e. 1.2 (+20%) or 0.6 (-40%)

Select the appropriate mode, then press “Select & Return”

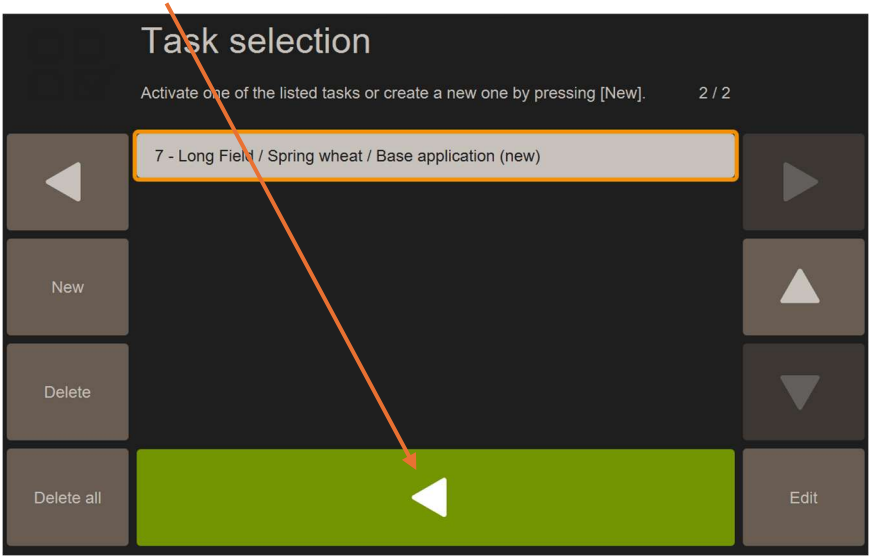



“Interpolate grid” can either be pressed and changed from “Yes” or “No”

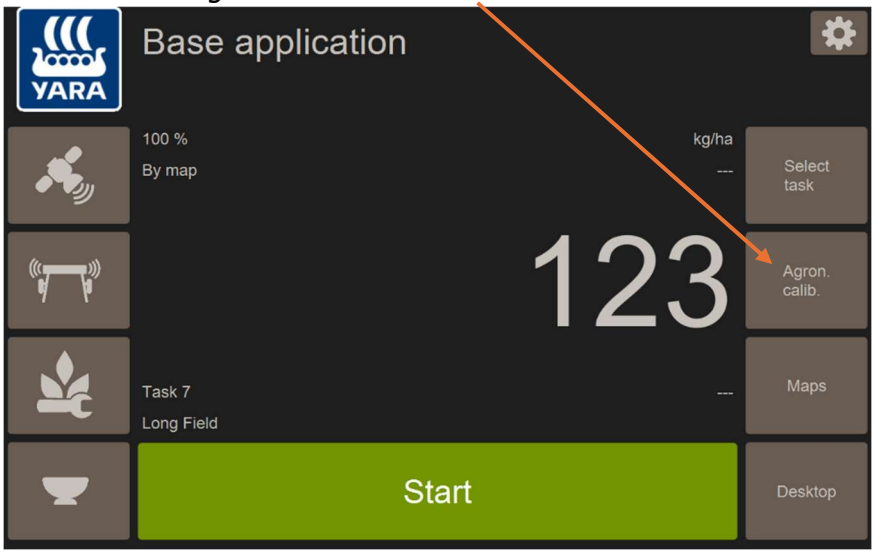



Once selected press “Select & Return”

Press "Select & Return" with the new task selected,

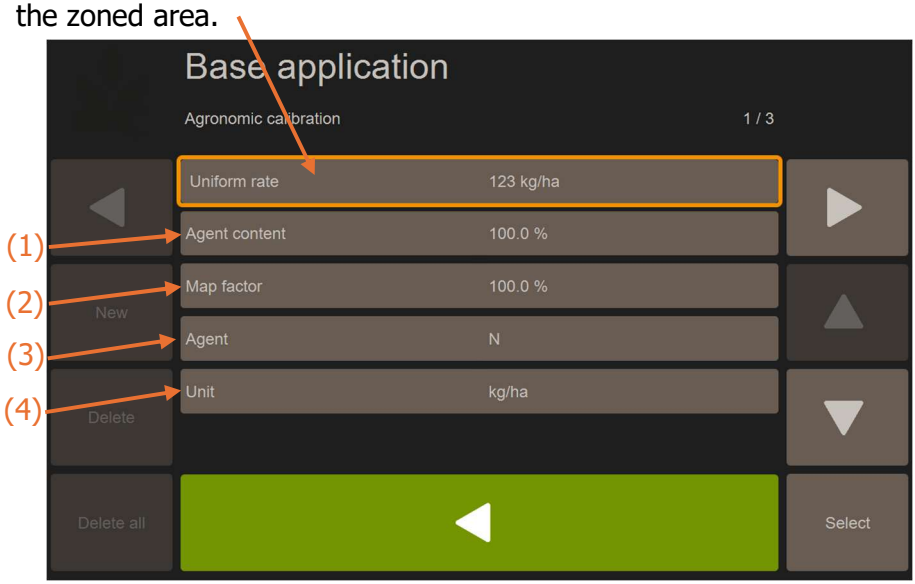



Next check the "Agronomic Calibration"




In "Base Application" the N-Sensor will use the prescription map from the application map to supply the rate (Kg/Ha).

However, outside the grid file, shape file or raster map the system will apply the uniform rate, to stop applications outside these maps change the uniform rate to 0 kg/ha unless part of the map is missing, then set the uniform rate the standard application rate to apply this when out the zoned area.




- When applying a prescription map that has been given in the full Product Application or Total Kg/Ha, "Agent content" (1) should be set to 100% and Unit set to "Kg/ha" (4) (Recommended)

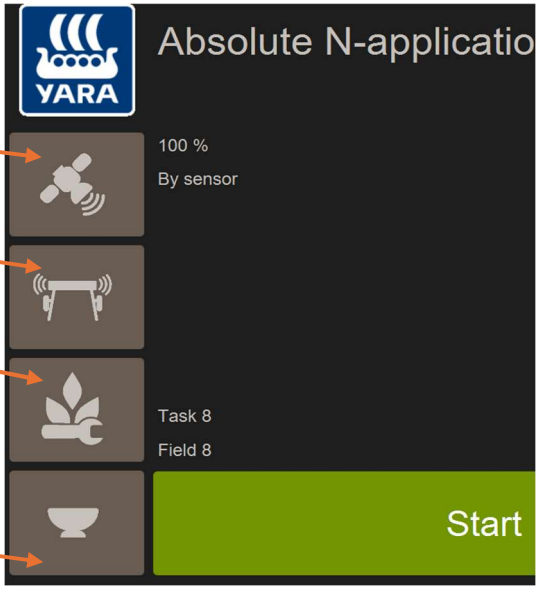
- If the Prescription map has been sent as a total nutrient application i.e. (Kg N/Ha or Kg SO3/Ha), "Agent content" (1) must be set to the nutrient content percentage and "Units" (4) must be set to Kg N/Ha and the "Agent" (3) must be changed to the correct nutrient. Remember to check

- "Map Factor" (2) will multiply the total prescription by the % chosen, i.e. if the prescription total 100 Kg/Ha, "Map factor" (2) set at 50% will reduce the total Applied to 50Kg/Ha. (100% is Recommended)

# Warning Symbols

You can press the symbols on the right to give you more information about the symbol.

- GPS
- N-Sensor
- Agronomy / Agronomic Calibration
- Rate Controller




For the operation of the N-Sensor to work in the best manner all 4 boxes should be Grey. The only exception is for the Agronomy to go "Yellow" which is warning you of low biomass/N-Uptake (SN).

- Grey Is Good,
- Yellow Indicates an issue, rather than a communication issue.
- Red indicates a Fault or communication issue.

## GPS

- The GPS has communication and good signal/quality

- GPS Has Communication but not good enough signal/quality

- No GPS data

## N-Sensor

- The N-Sensor is ready/active

- SVC Mode (ALS-2 Only), The N-Sensor has detected a fault or the lense could be dirty.

- Not enough daylight (Passive Sensor Only)

- Data  received from N-Sensor is invalid

- Not enough light (Passive Sensor Only)

- Too much Reflectance

- No Data is being received from the N-Sensor

- N-Sensor Simulation mode is Active

- Working below Solar Elevation, (25 °, Passive Sensor Only)

## Agronomy / Agronomic Calibration

- Agronomy is valid and working

- No Crop / Biomass Cutoff threshold met

- N-Sensor module locked, (contact Taylored-Agri)

## Rate Controller

- VRA to the rate controller ready

- Active rate and variably applying

- VRA / N-Sensor is in Uniform rate mode

- No communication to the rate controller

# Windows Tablet

There are 3 different tablets distributed with the N-Sensor since 2017. Some feature displayed below may not be a true representation, however most features are in the exact position or laid out slightly differently.

The locking collar prevents the tablet from slipping out the cradle, to remove the tablet from the cradle lift the locking collar up and slide the tablet forward.

(1) Function button (not used)

(2) Windows Menu

(3) Volume Up

(4) Volume Down

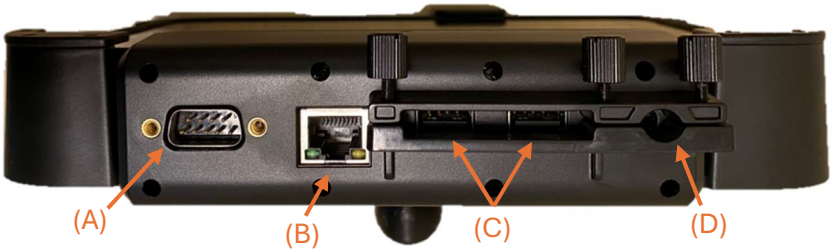
(5) Power

(6) Power to the Cradle

(7) "Blue" Tablet tuned on

(8) "Green" – Tablet Charged
"Red" – Tablet Charging

At the bottom of the cradle you will find the connections




(A) – RS232

(B) – RJ45

(C) – 2x USB

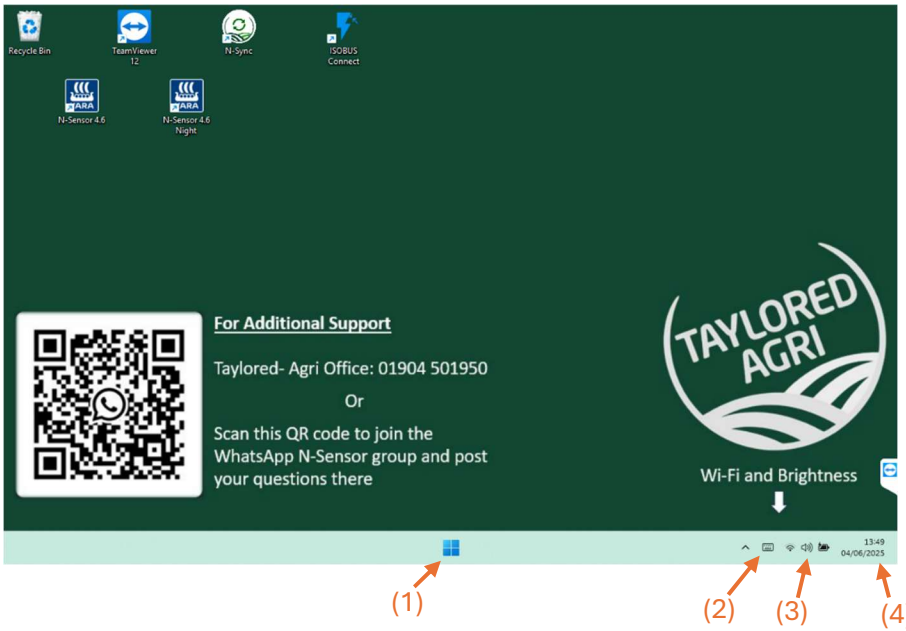
(D) – Power

## Windows Terminal Page

On the windows terminal page you will find shortcuts to programs,

These programs include:

- N-Sensor 4.6
- N-Sensor 4.6 Night
- TeamViewer
- N-Sync
- ISOBUS Connect (If Applicable)



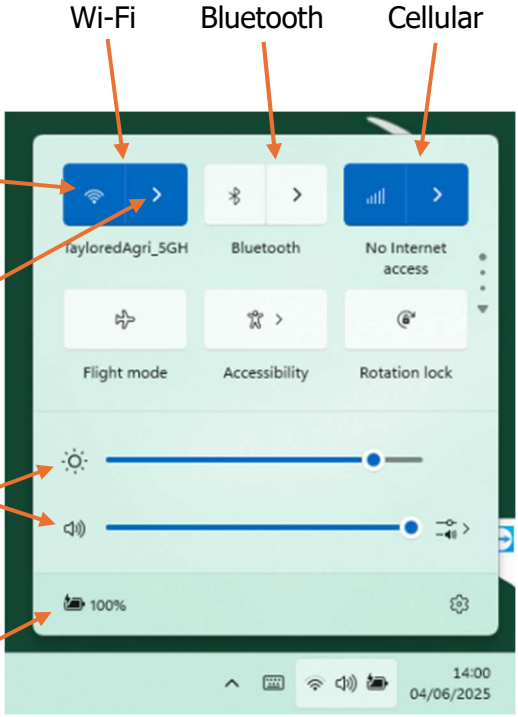

(1) Windows Menu

(2) Keyboard

(3) Wi-Fi, Cellular, Brightness, Volume

(4) Time / Date

By pressing the Wi-Fi, Cellular, Brightness, Volume (3) button, a further menu will appear.




Turning the icons to Blue will activate them, press again to turn off and to Grey

Pressing the little > arrow will give you more options.

Sliding the bars will increase Brightness / Volume

Battery level is also Displayed

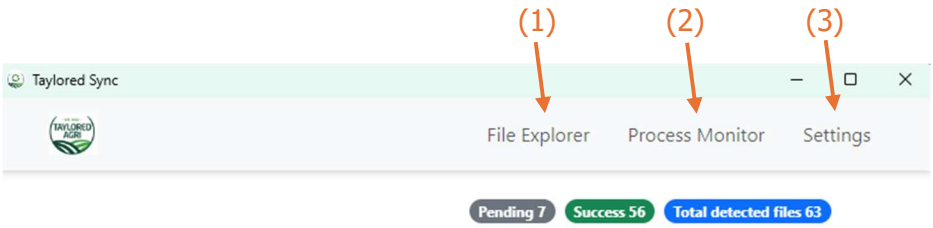
# N-Sync

N-Sync is a program designed to automatically upload N-Sensor data to the Taylored-Agri server, it sync's your data every 2 minutes with an internet connection.

If you wish to opt out, please make a member of Taylored-Agri aware.

N-Sync should automatically open with the tablet. There are 3 tabs to consider when using the program.

- File explorer – (1) Lets you view all the folders and files that the program can see, it also allows you to see individually if the file has been uploaded or not. It will also allow you force an upload of the individual file.
- Process Monitor – (2) This allows you to see the most recent uploads/updates, the last time the program uploaded and how many tasks have been found, how many have been uploaded & how many task are waiting to be uploaded. (first screen shown)
- Settings – (3) Taylored-Agri Use only

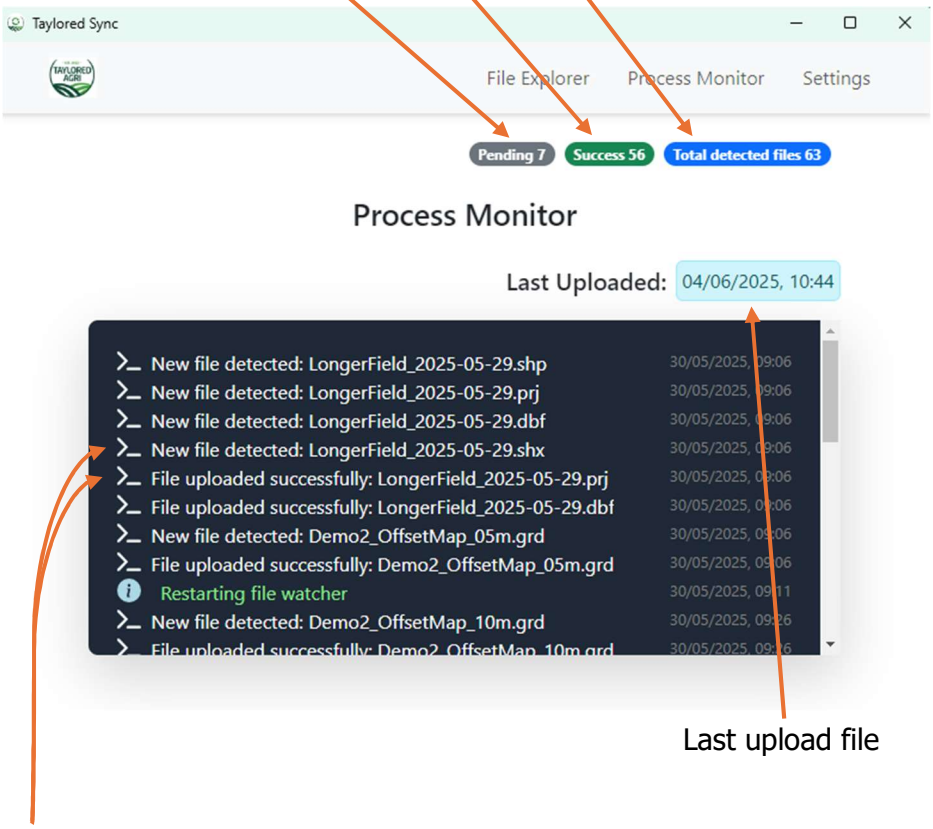


# Process Monitor

Total Files detected on the system

Files successfully uploaded

Files pending upload



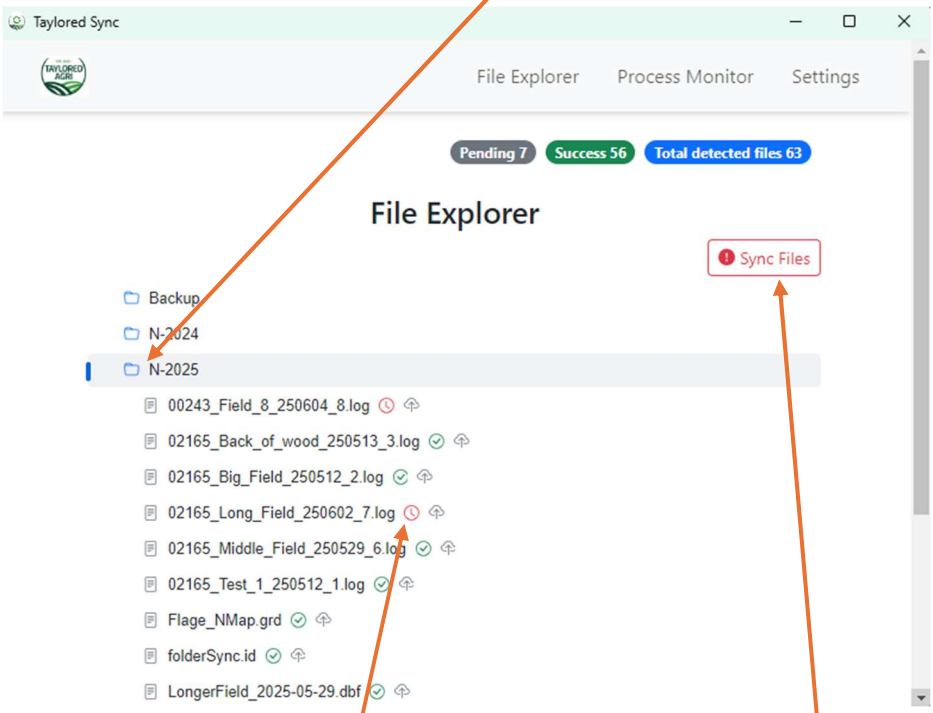

The system will also inform you what the last file found was, and if it was successfully uploaded.

It multiple files are pending, check your internet connection and then move to the "File explorer" page

# File Explorer

View file's and check if file's have or haven't been uploaded, you can also request the file to be uploaded again.

Selecting the folder icon will open the folder.



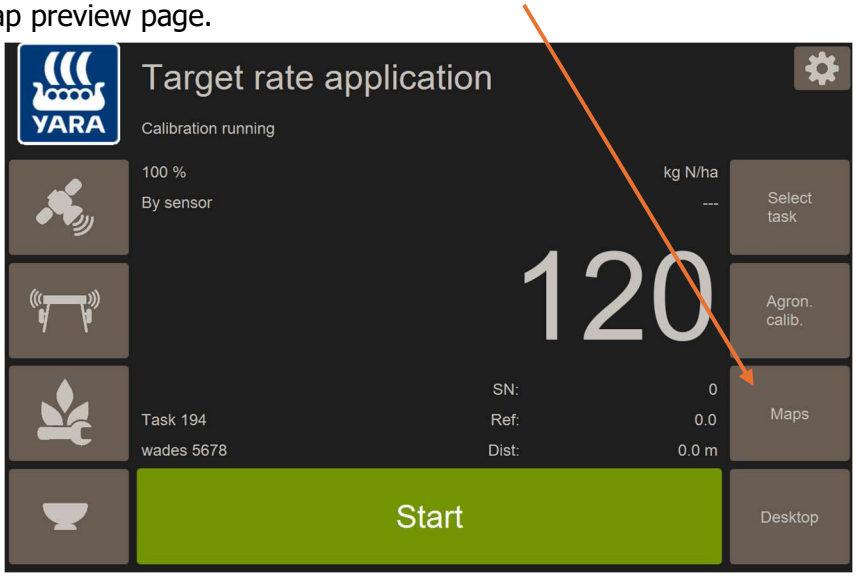

- Files that haven't uploaded are marked with
- Files with a have been successfully uploaded.
- Pressing the button, to upload individual files.
- Press the Sync Files button, and the whole system will be checked again.

# Notes

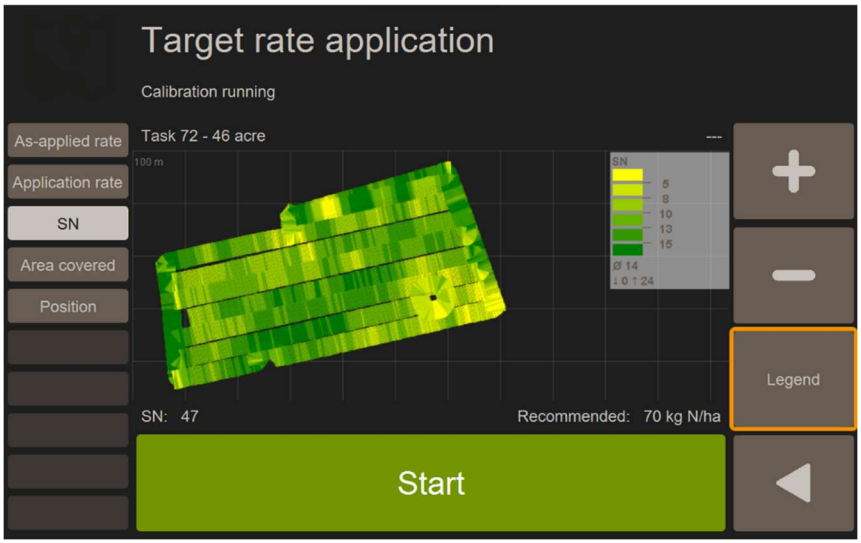
# Maps

## Maps on N-Sensor

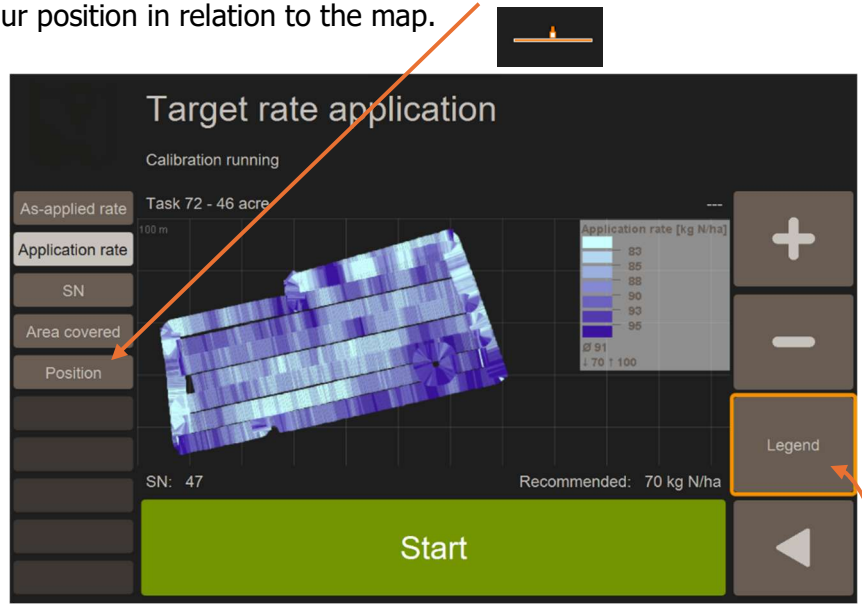
Once a task is completed, selecting the "Maps" icon will take you to a map preview page.




On the left you have multiple options / maps to view.



Only have 1 map selected at a time as maps can't overlay on top of each other. You can however have "Position" selected, this will show your position in relation to the map.




- As-Applied Map – These will give you the actual rate applied by the spreader or sprayer
- Application Rate – This is the rate that was recommended by the N-Sensor Program
- SN – (Nitrogen Uptake) this is a biomass map
- Area covered – This shows the area in which the N-Sensor program was active

Selecting Legend, will also bring out more information about the figures captured by the N-Sensor, including Average, Minimum and Maximum.

# Growth Stages

# Cereals (BBCH)

(Too small for use with the N-Sensor)

## Seeding Growth GS 11-19

GS 11 – First leaf unfolded

GS13 – 3 leaves unfolded

GS15 – 5 leaves unfolded

GS 19 – 9+ leaves unfolded

## Tillering GS 21 - 29

GS 21 – Main shoot + 1 Tiller

GS 23 – Main shoot + 3 Tiller

GS 25 – Main shoot + 5 Tiller

GS 29 – Main shoot + 9 Tiller

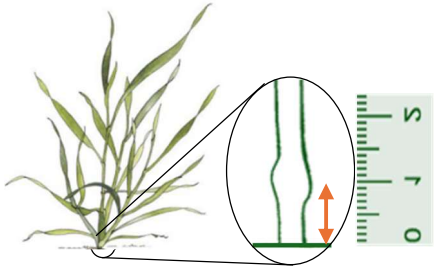
## Stem Extension GS 30

GS 30 – Ear at 1cm, Node at base

GS 07 GS 13 GS 21 GS 23 GS 30

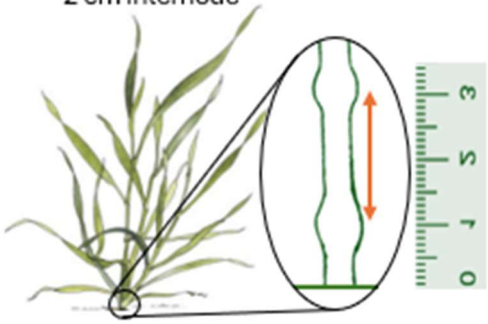
# Cereals (BBCH)

GS 31 – First node detectable
1+ cm height



GS 31

GS 32 – 2nd node detected +
2 cm internode



GS 32

GS 39

## Booting + Ear Emergence
## GS 40 - 59

GS 41 – Flag leaf sheath extending

GS 47 – Flag leaf Sheaf opening

GS 49 – First awns visible

GS 51 – Ear visible above flag leaf ligule

GS 55 – Ear half-way emerged

GS 59 – Ear emerged

GS 49

GS 59

GS 33 – 3nd node detected

GS37 – Flag Leaf just visible

GS39 – Flag Leaf blade fully visible

# Oilseed Rape (BBCH)

## Leaf Development
### GS 10 - 19

GS 10 – Cotyledons unfolded
GS 11 – First leaf unfolded
GS 12 – Second leaf unfolded
GS 19 – Nine+ leaves unfolded

GS 10 GS 12 GS 13 GS 16

## Side-shoot formation
### GS 21 - 29

GS 21 GS 23 GS 25

GS 21 – First side-shoot detectable
GS 22 – Second side shoot detectable
GS 29 – Nine+ side-shoots detectable

## Steam Elongation
### GS 30 - 39

GS 30 – Rosette, No internode
GS 31 – First internode
GS 32 – Second internode
GS 39 – Nine+ internodes

GS 32

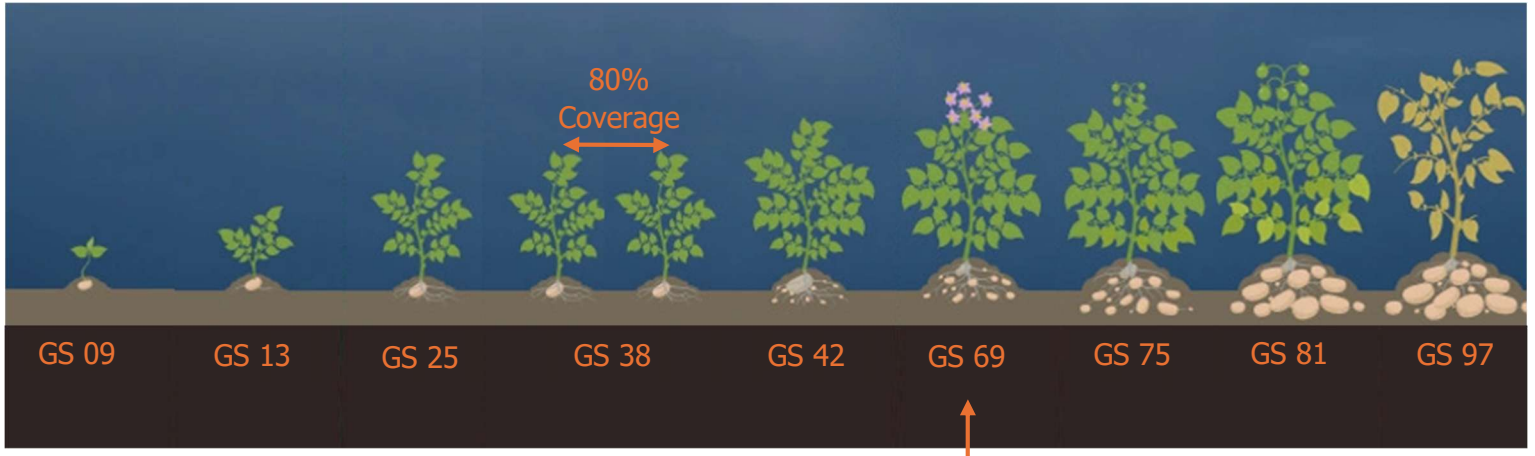
## Inflorescence / Flower-bud emergence
### GS 50 - 59

GS 51 – Green buds visible in canopy from above
GS 53 – Green buds raised above leaves
GS 59 – First petals visible

GS 51 GS 53 GS 59

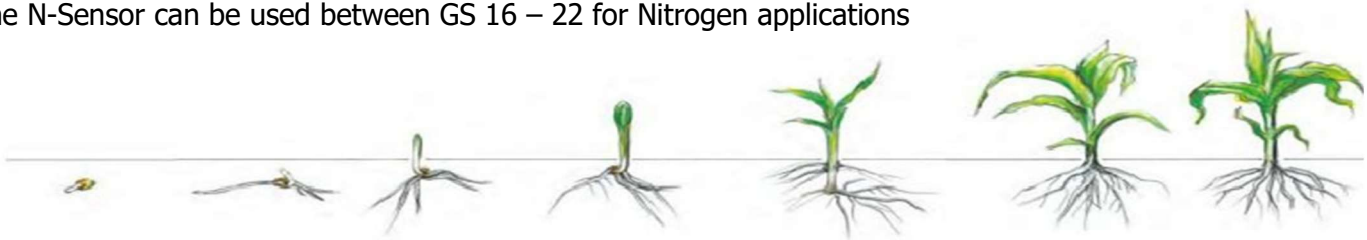
# Potatoes (BBCH)

The N-Sensor can be used between GS 10 – 39 for Nitrogen Applications
It can also be used at GS 69 for Haulm Desiccation

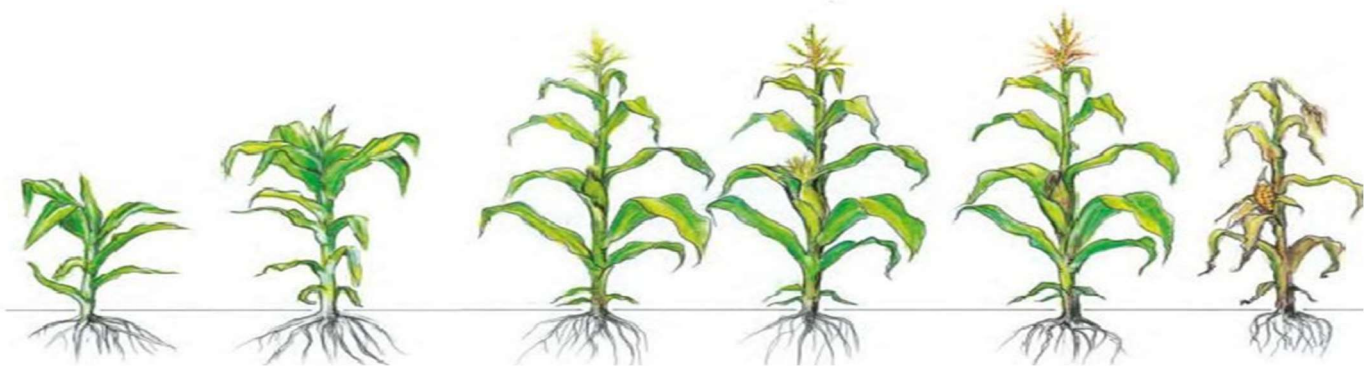


# Maize (BBCH)

The N-Sensor can be used between GS 16 – 22 for Nitrogen applications



GS 00 GS 05 GS 10 GS 11 GS 16 GS 19 GS 32



GS 39 GS 51 GS 63 GS 69 GS 79 GS 89

# Rate Calculator

**The Yara N-Sensor works in a "W/V" metric.**

## Weight by Weight (W/W) to Weight by Volume (W/V)

All solid fertiliser is supplied as "W/V" metric, Yara also supplies liquid fertiliser in a "W/V" metric.

Some manufacturers supply their Liquid Nitrogen in a W/W metric and so this needs to be converted.

To get to the right N% for a "W/V" metric, simply multiply the Nitrogen Content (N%) by the Specific Gravity (SG)

i.e. 28% N (W/W) x 1.28 SG = 35.84%N

These recalculated figures should be rounded up or down to their nearest 0.1 decimal point i.e. 35.8%N (W/V)

Manufacturer Examples:

OMEX

| Manufacturer N% | SG | N% (W/V) |
|---|---|---|
| 30N | 1.30 | 39% |
| 26N + 5S | 1.28 | 33.3% |
| 24N + 7.5S | 1.27 | 30.5% |

frontier

| Manufacturer N% | SG | N% (W/V) |
|---|---|---|
| 30N | 1.30 | 39% |
| 28N + 2.5S | 1.29 | 36.1% |
| 26N + 5S | 1.28 | 33.3% |

Nitrasol
Sunshine in every drop

| Manufacturer N% | SG | N% (W/V) |
|---|---|---|
| 30N | 1.29 | 38.7% |
| 30N +6s | 1.315 | 39.5% |
| 28N | 1.28 | 35.8% |

# Fertiliser Conversion Chart

| | | N % in Fertiliser (Weight by Volume) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Units / Ac** | **KgN / Ha** | **19** | **24** | **27** | **30** | **33.3** | **34.5** | **35** | **39** | **46** |
| **16** | **20** | 105 | 83 | 74 | 67 | 60 | 58 | 57 | 51 | 43 |
| **20** | **25** | 132 | 104 | 93 | 83 | 75 | 72 | 71 | 64 | 54 |
| **24** | **30** | 158 | 125 | 111 | 100 | 90 | 87 | 86 | 77 | 65 |
| **28** | **35** | 184 | 146 | 130 | 117 | 105 | 101 | 100 | 90 | 76 |
| **32** | **40** | 211 | 167 | 148 | 133 | 120 | 116 | 114 | 103 | 87 |
| **36** | **45** | 237 | 188 | 167 | 150 | 135 | 130 | 129 | 115 | 98 |
| **40** | **50** | 263 | 208 | 185 | 167 | 150 | 145 | 143 | 128 | 109 |
| **44** | **55** | 289 | 229 | 204 | 183 | 165 | 159 | 157 | 141 | 120 |
| **48** | **60** | 316 | 250 | 222 | 200 | 180 | 174 | 171 | 154 | 130 |
| **52** | **65** | 342 | 271 | 241 | 217 | 195 | 188 | 186 | 167 | 141 |
| **56** | **70** | 368 | 292 | 259 | 233 | 210 | 203 | 200 | 179 | 152 |
| **60** | **75** | 395 | 313 | 278 | 250 | 225 | 217 | 214 | 192 | 163 |
| **64** | **80** | 421 | 333 | 296 | 267 | 240 | 232 | 229 | 205 | 174 |
| **68** | **85** | 447 | 354 | 315 | 283 | 255 | 246 | 243 | 218 | 185 |
| **72** | **90** | 474 | 375 | 333 | 300 | 270 | 261 | 257 | 231 | 196 |
| **76** | **95** | 500 | 396 | 352 | 317 | 285 | 275 | 271 | 244 | 207 |
| **80** | **100** | 526 | 417 | 370 | 333 | 300 | 290 | 286 | 256 | 217 |
| **84** | **105** | 553 | 438 | 389 | 350 | 315 | 304 | 300 | 269 | 228 |
| **88** | **110** | 579 | 458 | 407 | 367 | 330 | 319 | 314 | 282 | 239 |
| **92** | **115** | 605 | 479 | 426 | 383 | 345 | 333 | 329 | 295 | 250 |
| **96** | **120** | 632 | 500 | 444 | 400 | 360 | 348 | 343 | 308 | 261 |
| **100** | **125** | 658 | 521 | 463 | 417 | 375 | 362 | 357 | 321 | 272 |
| **104** | **130** | 684 | 542 | 481 | 433 | 390 | 377 | 371 | 333 | 283 |
| **108** | **135** | 711 | 563 | 500 | 450 | 405 | 391 | 386 | 346 | 293 |
| **112** | **140** | 737 | 583 | 519 | 467 | 420 | 406 | 400 | 359 | 304 |
| **116** | **145** | 763 | 604 | 537 | 483 | 435 | 420 | 414 | 372 | 315 |
| **120** | **150** | 789 | 625 | 556 | 500 | 450 | 435 | 429 | 385 | 326 |

# Unit conversions

Units/acre to Kg/Ha = Divide by 0.8

Kg/Ha to Units/acre = Multiply by 0.8

1 Bag per acre = 123.46 Kg/Ha

1 CWT/acre (hundred-weight) = 125.63Kg/Ha

1 lb/acre = 1.12 Kg/Ha

# Notes