hydrogreen
NUTRITION TECHNOLOGY

A DIVISION OF CUBICFARM SYSTEMS CORP.

GLS 808 System

Owner's Manual

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Contents

Introduction

Congratulations on the purchase of your new HydroGreen Grow System! Your new Grow System is an automated system for germinating and sprouting seed into animal feed. HydroGreen grow systems come in a variety of packages to fit the nutrition demands of a wide range of animal feeding operations.

HydroGreen systems employ the science of “hydroponics” to produce animal feed. Seed, water and light are the main ingredients. HydroGreen technology gives the owner complete control over seeding depth, watering schedules and lighting schedules, assuring the efficient use of resources, and optimizing system productivity.

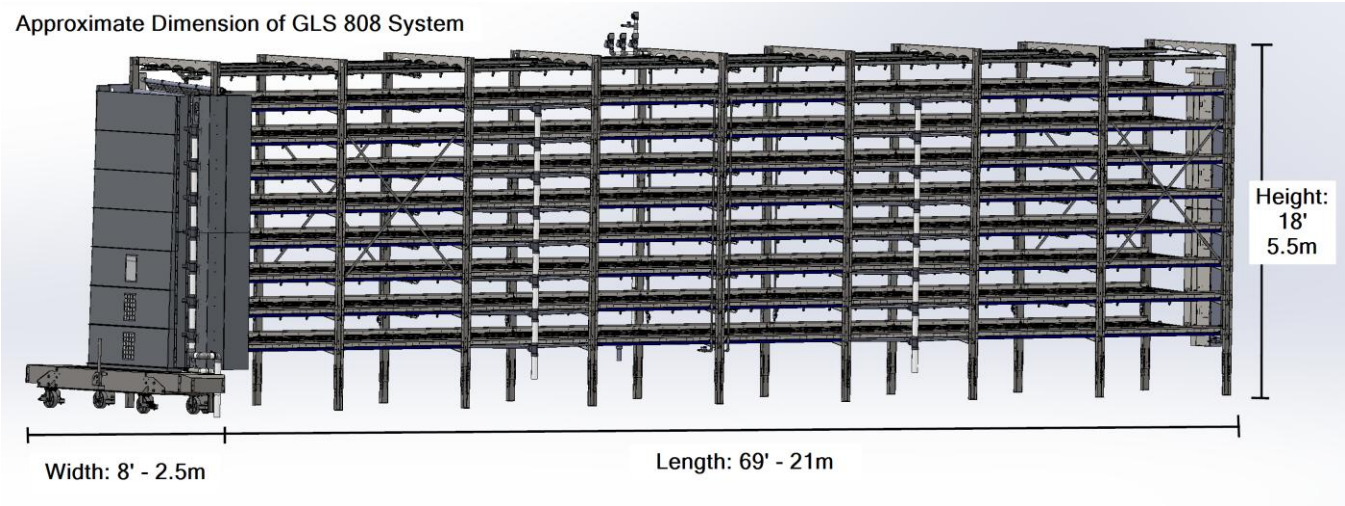
General Description

The HydroGreen GLS 808 System consists of 8 levels (vertical) and 8 sections long (horizontal) with a feed sizer that is capable of servicing multiple GLS 808 systems if inline. All actions performed by the GLS 808 Systems are controlled by a touchscreen computer managed by the owner. These actions include seeding, watering, lighting, harvesting, sizing, and re-seeding to start a new crop.

The intended use of a GLS 808 is to sprout grains to HydroGreen’s standards. For HydroGreen standards on grain, environment, water, water schedule, length of grow, density, etc. refer to HydroGreen Crop Training section of manual.

Misuse of the GLS 808 using equipment outside of HydroGreen Standards which can damage equipment including GLS 808 and Feed Sizer.

HydroGreen’s Standards of Operation are detailed in this manual for intention of use.



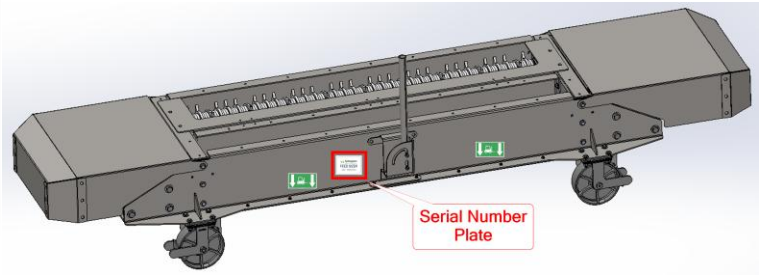
Machine Mass Dry Weight = 21,600 lb. (9,800 kg)

Machine Mass Loaded Weight = 57,600 lb. (26,125 kg)

Serial Number Plate

The Serial Number Plate for GLS 808 is located on the front of the machine. This manual is for GLS 808 with serial numbers 128000-129000

The Serial number for the Feed Sizer in located on the front frame rail.



Installation

Installation of HydroGreen GLS 808 System is overseen and commissioned by a HydroGreen Technician to assure the system is assembled to HydroGreen Global Technologies' specifications. During and immediately following installation, the new owner is provided training regarding the operation and maintenance of the system.

Safety

Before operating your new HydroGreen GLS 808 System, please read the owner's manual in its entirety and follow all instructions!

Restrict the use of your HydroGreen system to trained operators only. In addition, these trained operators must have read, understood, and followed all operating instructions, precautions and safety rules.

HydroGreen Global Technologies is concerned about the safety of the operator and anyone else who could come in contact with the HydroGreen Grow System. The HydroGreen Grow System is designed and manufactured with built-in safety features to protect both operators and service technicians.

- The HydroGreen Grow System is powered completely by low voltage DC electrical power to significantly reduce the risk of electrocution.
- AC electrical power is used to power the low voltage DC electrical system, and AC electrical power will be located according to building codes around the perimeter of the grow room. Use GFCI protected outlets throughout the building for all AC power sources.
- Safety guards are located over parts of the system that could be potentially dangerous. Never operate this machine without all the safety guards in place.

Before starting your system, verify that the warning labels pictured in this manual are in place as indicated, and are both legible and clearly visible. Please contact HydroGreen if replacement labels are needed. Replacement label kit # 53-0220.

Safety Decals

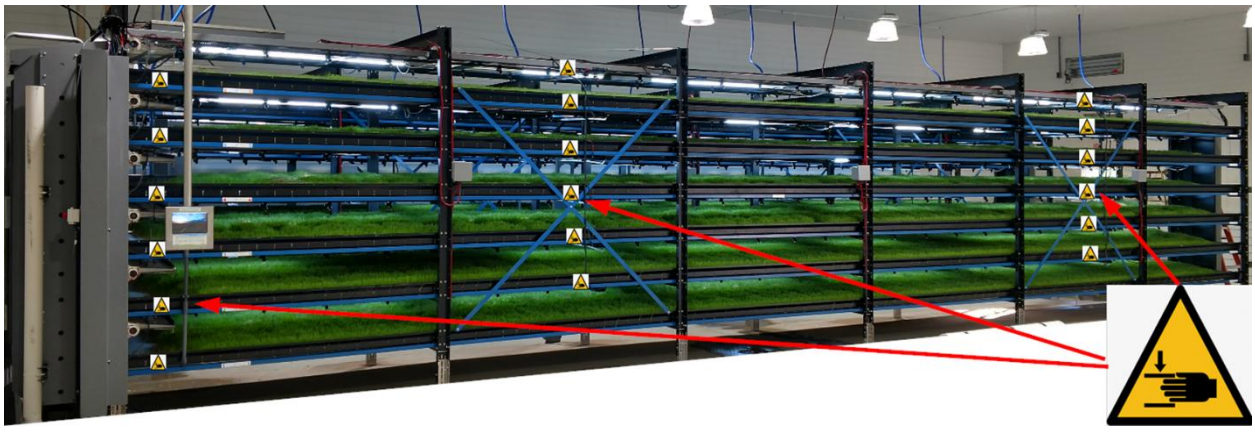
	**M002 – Refer to Instruction Manual/Booklet** **Category:** Mandatory Action **Hazard:** Not reading the instruction manual/booklet before starting work or before operating equipment or machinery	**M002 – Consulte el manual / Folleto de instrucciones** **Categoría:** Acción obligatoria **Peligro:** No leer el manual / folleto de instrucciones antes de comenzar a trabajar o antes de operar equipo o maquinaria
	**M004 – Wear Eye Protection** **Category:** Mandatory Action **Hazard:** Flying Object / Particles	**M004 – Use protección ocular** **Categoría:** Acción obligatoria **Peligro:** Objeto volador / partículas
	**M003 – Wear Ear Protection** **Category:** Mandatory Action **Hazard:** Noise	**M003 – Use protección auditva** **Categoría:** Acción obligatoria **Peligro:** Ruido
	**P015 - No Reaching In** **Category:** Prohibition **Hazard:** Injury to Hands	**P015 – Sin llegar** **Categoría:** Prohibición **Peligro:** Lesiones en las manos
	**W001 – General warning sign** **Category:** Warning **Hazard:** Risk to Specified by the supplementary sign	**W001 – Señal de advertencia general** **Categoría:** Advertencia **Peligro:** Riesgo especificado por la señal complementaria
	**W024 – Crushing of Hands** **Category:** Warning **Hazard:** Closing Mechanical Parts of Equipment	**W024 – Aplastamiento de manos** **Categoría:** Advertencia **Peligro:** Cierre de piezas mecánicas del equipo
	**W011 – Slippery Surface** **Category:** Warning **Hazard:** Slippery Surface	**W011 – Superficie** **Categoría:** Advertencia **Peligro:** Cierre de piezas
	**W012 – Electricity** **Category:** Warning **Hazard:** Taking care to avoid coming	**W012 – Pericolo elettricitá** **Categoría:** Advertencia **Peligro:** Avendo cura di evitare di venire
	**W041 – Breathing Hazard** **Category:** Warning **Hazard:** Taking care to avoid exposure to asphyxiating atmosphere	**W041 – Pericolo respiratorio** **Categoría:** Advertencia **Peligro:** Avendo cura di evitare l'esposizione ad atmosfere asfissianti

Decal Locations

Entry door

Front of Machine

Side of Machine



Hazards

Owner's Manual – Read and Understand the Owner's Manual in its entirety before operating the system.

Mandatory Action: Refer to Instruction Manual/Booklet

Eye Protection – Flying product (fodder) debris could be present during harvest.

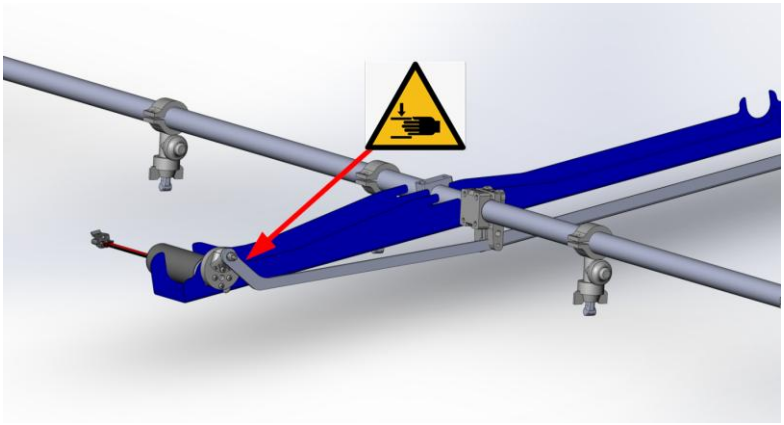
Mandatory Action: Wear Eye Protection!

Ear Protection – Noise levels are elevated in grow chamber. GLS 808 & Sizer during harvest level can reach 75 dB. Other customer supplied equipment such as dust collection system or grain delivery vacs can be louder.

Mandatory Action: Wear Ear Protection!

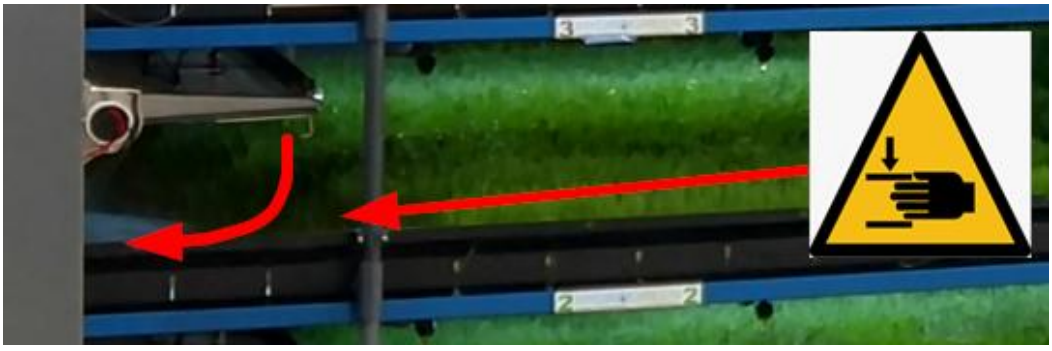
Pinch Point - As the spray boom motor rotates to move the pitman arm for the sprayers, a pinch point could develop. Disable the system before working on this equipment.

Warning: Crushing of Hands!!



Crush Point - As the seeder comes down between the table frames, a crush point could develop. Disable the system before working on this equipment.

Warning: Crushing of Hands!!

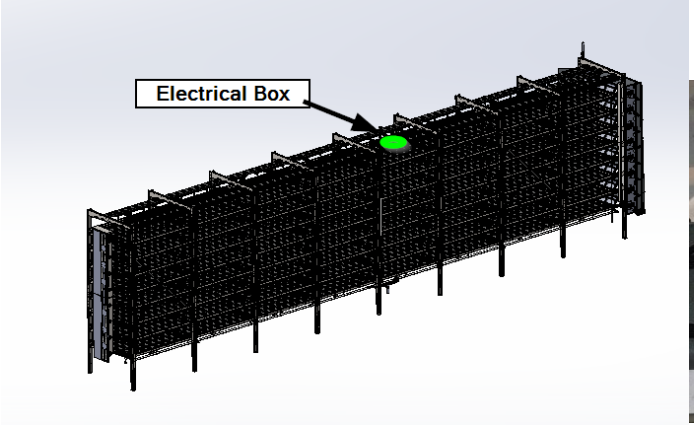


Operate in a well-ventilated area with working CO2 Monitors and Alarms..

Warning: Suffocation Hazard

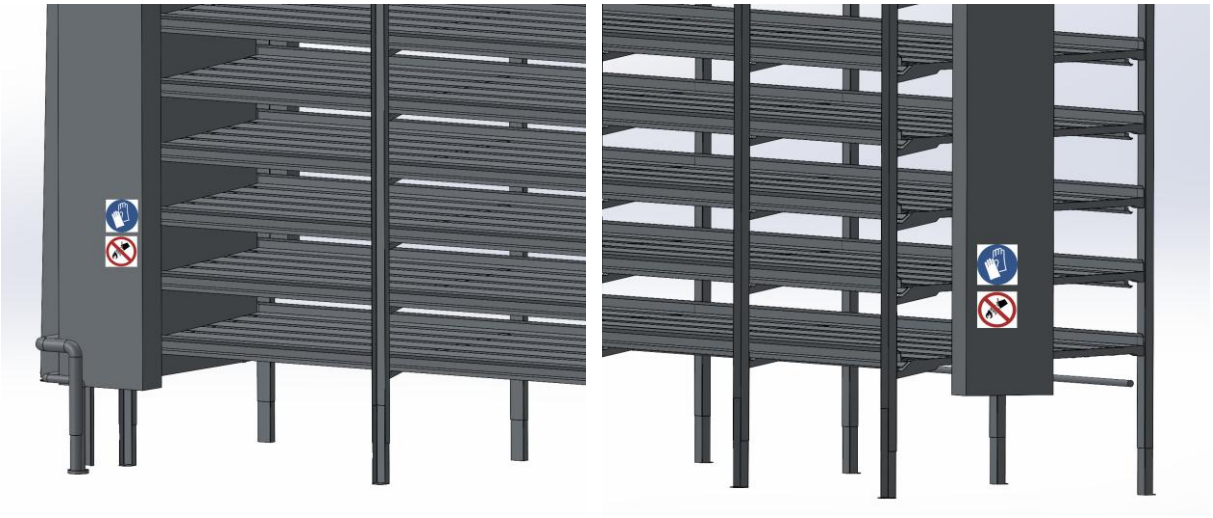
Use extreme caution around electrical components. Disconnect and lockout power before opening electrical compartment.

Warning: Electrical Hazard



Hazard of 24VDC Low Voltage Electrical Wiring

Front and Rear control cabinet



Do not extinguish with water

Wear protective gloves

Before opening any cabinet, cover or shield Lock Out, Tag Out procedure is required.

Safety Features

Lock Out, Tag Out (LOTO)

In the event of any damage or failure of the machine during operation, immediately turn off the power source and follow Lock Out, Tag Out procedures per local building and electrical code regulations.

Prior to adjusting, servicing, or performing maintenance on the machine, shut off the power source and follow Lock Out, Tag out procedures.

Power Interruption Protocol

Background, the HydroGreen Grow System is powered by two 24vdc power converters that are both located in the power supply box. The Low Current (LC) converter provides logic power the ECUs and HMI. The High Current (HC) converter powers all machine outputs through the ECUs.

Loss of power from either converter to any part of the system (any ECU or the HMI) will result in the halting of all harvest/seeding operations. Loss of power to the HMI will result in all outputs being disengaged until power is restored.

To prevent crop damage due to missed watering, a loss of power (HC or LC) to any individual ECU during non-hazardous operations such as lighting and watering shall not affect the operation of the other ECUs. Additionally, restoring power to the affected ECU or the machine HMI will result in growing/watering operations automatically resuming.

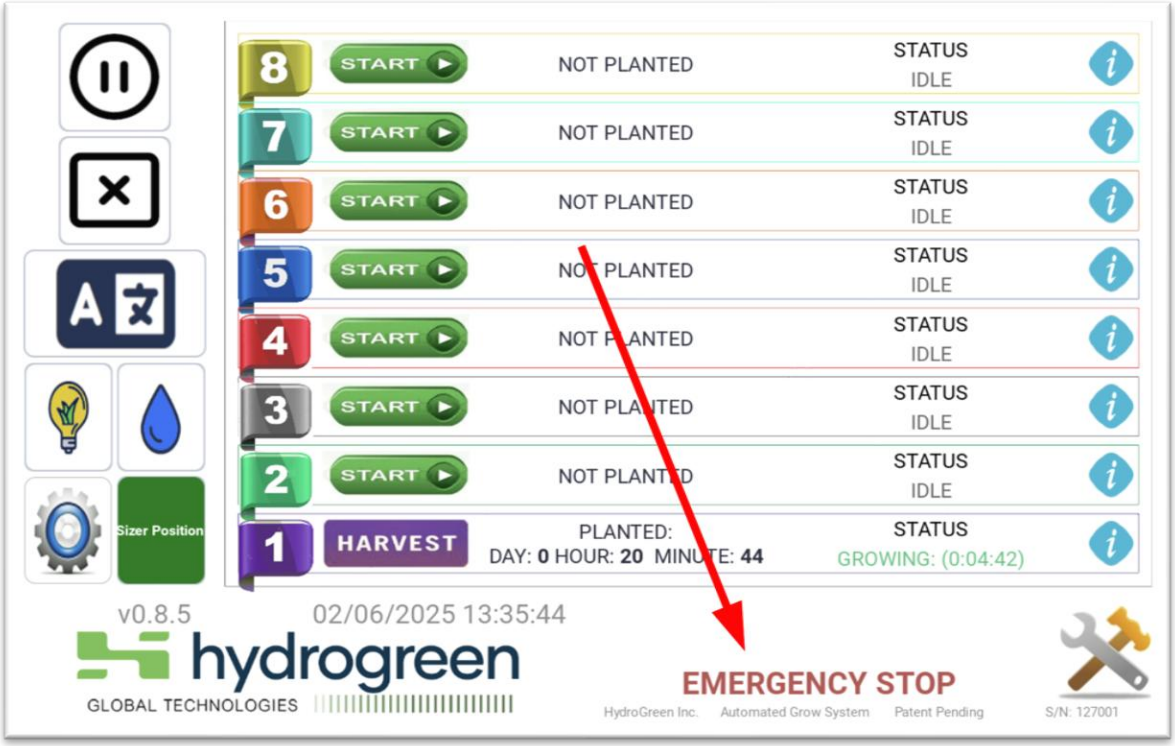
Any power loss (HC or LC) to any part of the system during harvest/seeding operations will result in a general halt of machine operations during which time all outputs are disengaged. Upon restoring power to the machine, input is required from the user at the HMI to resume the harvest/seeding operation.

In general, the machine will attempt to continue watering/lighting in all conditions as long as the user can still control the machine via the HMI. However, loss of power during the operation of potentially hazardous machine outputs will result in a total shutoff that persists until power is restored and input is received at the HMI.

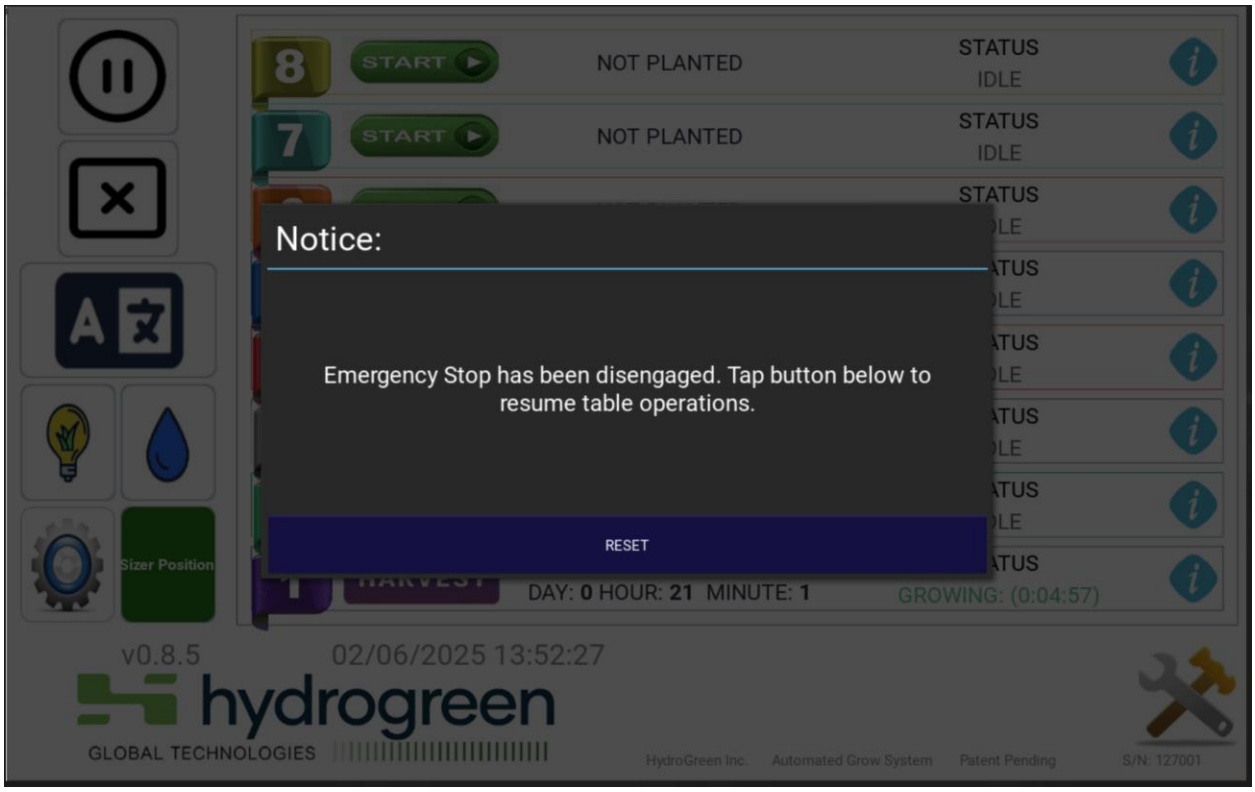
E-Stop

The Emergency Stop Button (E-Stop) is located on the front of the machine and can be pressed at any time to stop the machine. Engaging the emergency stop causes the high current power supply to enter an OFF state via a hardware interlock circuit. This prevents all machine outputs from being energized. Additionally, this state is detected by the machine control system which will pause all operations and issue a command to disengage all outputs.

Position of the E-Stop is display on the HMI



To Reset, twist E-Stop button according to arrows and press Resume on the HMI.



Note: All table operations (including lighting and watering) are halted until the E-Stop Button is reset **AND** Resume is pressed at the HMI. A failure to operate either resume function can result in crop damage due to missed watering.

Sizer in Position – Safety Interlock Switch

To eliminate or reduce risks of injury the feed sizer with a RFID safety position switch. Do not tamper with this switch. Doing so can result in damage to equipment and the possibility of injury.

The **SIZER IN POSITION** indicator shows when the product sizer RFID sensor detects the product sizer.

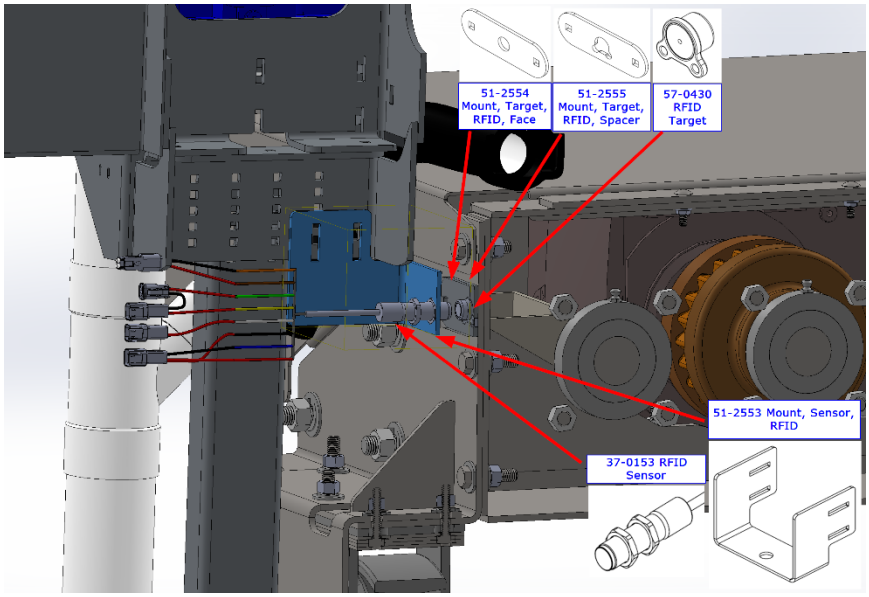
The switch is a IDEM BMF-M0414001 Non-Contact Master Coded RFID Switch Set.

The switch is programmed to the target on the sizer and will not energize the sizer unless target is within 5mm(0.20”)

Standards
ISO 14119, EN 60947-5-3, EN 60204-1, ISO 13849-1, EN 62061, UL 508

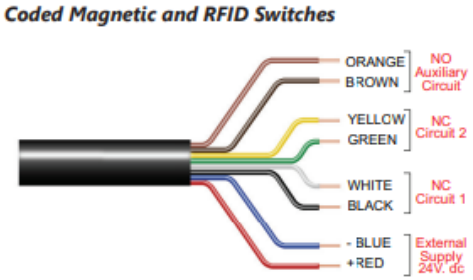
Sizer Safety Switch Details

To prevent engagement of the GLS product sizer when not safely in position under the product chute, each machine is equipped with an IDEM BPF/BMF Series Non-Contact RFID Coded Safety Switch. The RFID sensor mounted to the front of the machine can detect the presence of the RFID target which is mounted to the product sizer.



RFID Safety Switch Location

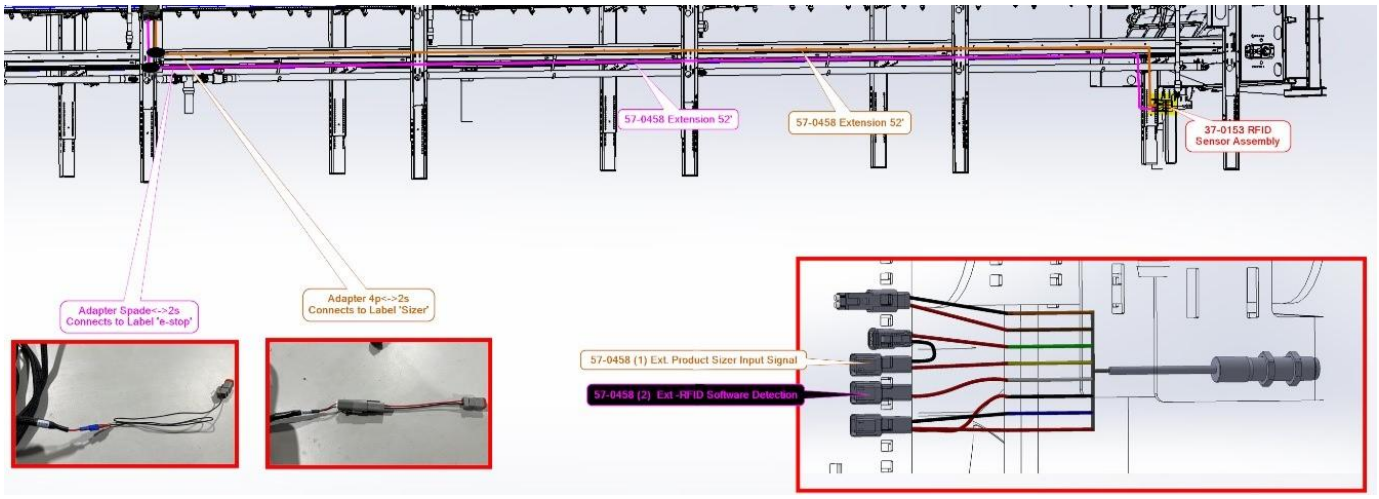
The product sizer is engaged via a 24V signal originating from the bottom-most Electronic Control Unit (ECU) terminating at the VFD control block. The RFID Sensor acts as a hardware interlock preventing this signal from reaching the VFD – thereby preventing operation of the sizer -- when the sizer is not detected in position under the product chute. This is achieved by routing the signal through NC Circuit 2 of the RFID sensor which is open when the target is not detected in front of the sensor.



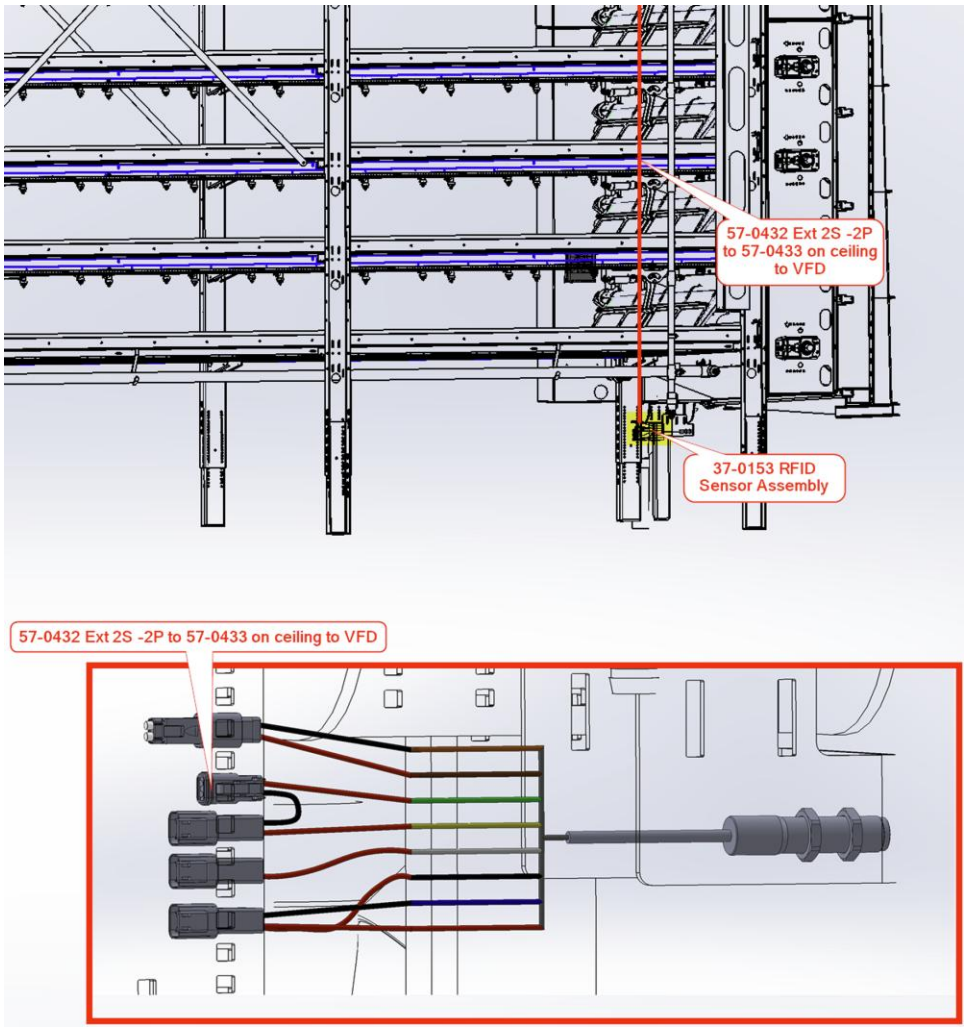
Coded Magnetic Switches - Electrical Connections

Quick Disconnect Connector Pin Out	Lead Color	Type of Circuit (Actuator Present)	Output Types (Solid State)
8	Orange	Auxiliary (NO)	200 mA max. 24 VDC
5	Brown	Auxiliary (NO)	
4	Yellow	NC2 +	200 mA max. 24 VDC (Optocoupler)
6	Green	NC2 -	
7	Black	NC1 +	200 mA max. 24 VDC (Optocoupler)
1	White	NC1 -	
2	Red	Supply +24 VDC	Supply 24 VDC +10% / -15%
3	Blue	Supply 0VDC	

Safety Switch Electrical Connections



Direct Product Sizer Signal and Software Detection Wiring



Interlocked Signal Wiring

Additionally, the sensor state is read by an Electronic Control Unit (ECU). This state is read by the automation control system and used to halt operations should the product sizer move out from under the chute during operation.

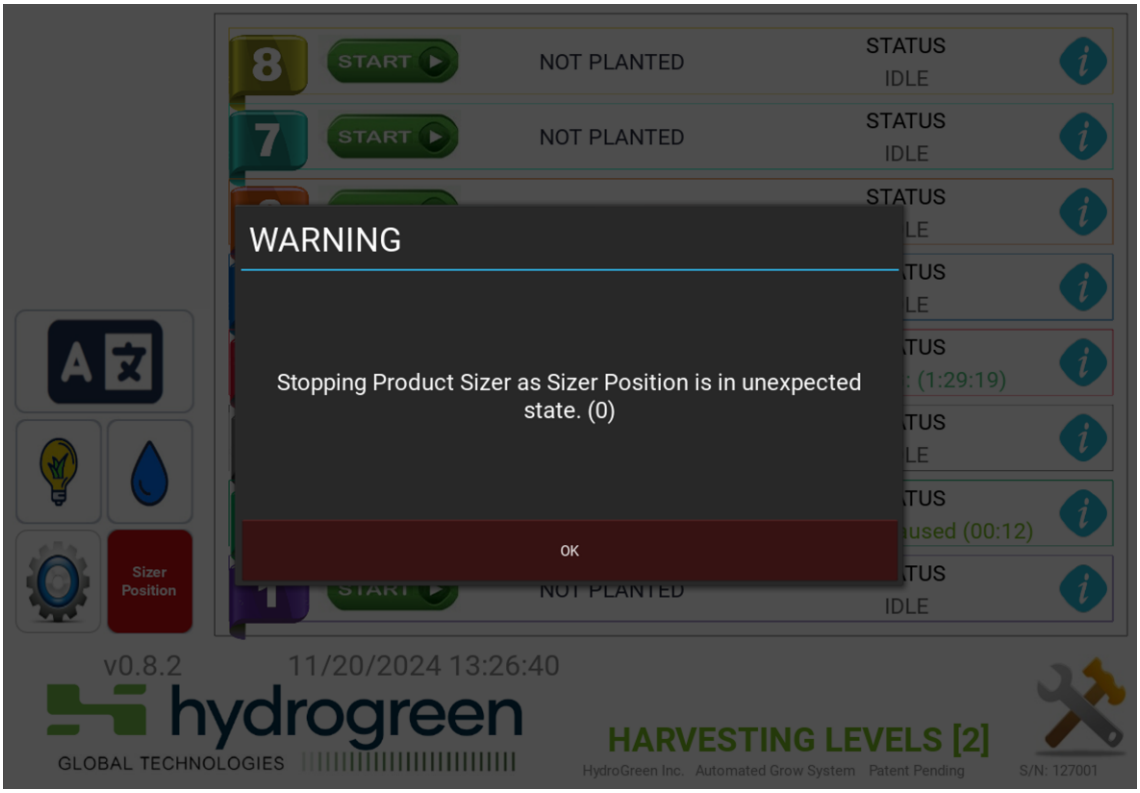


Figure 4: Software Halting RFID Connection is Lost

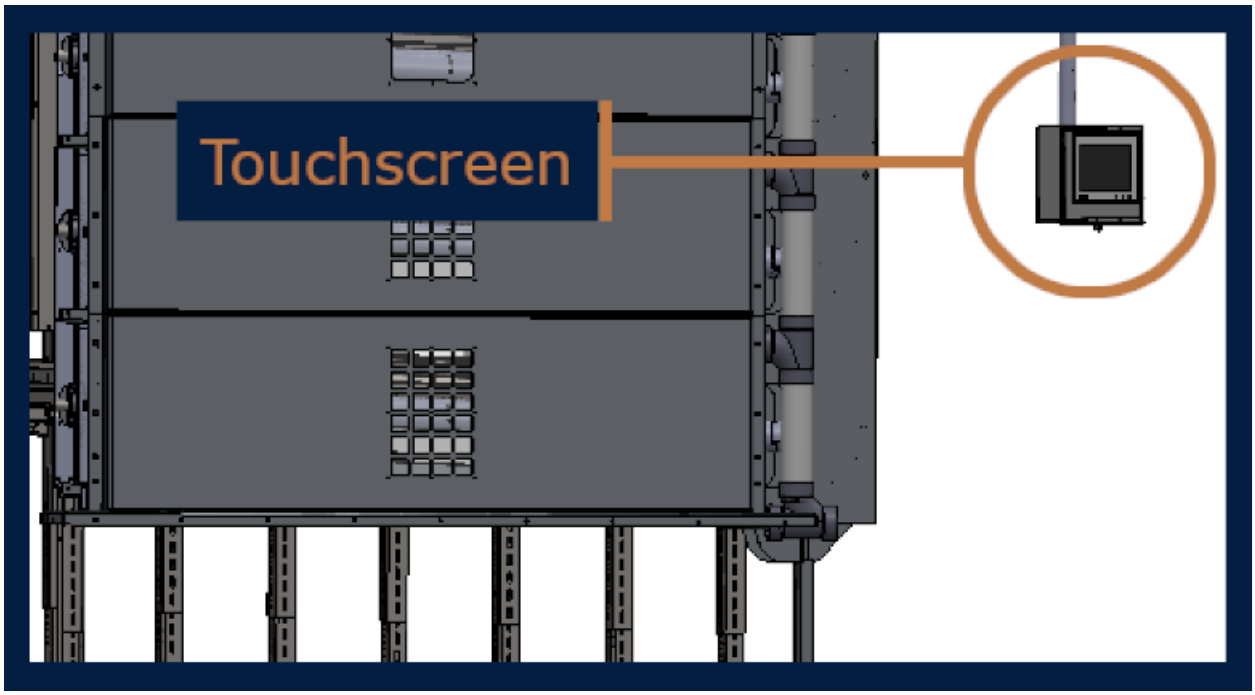
The interlocked signals of multiple machines are ran in parallel to the VFD, however, the sizer must be in position under a machine for any signal to reach the VFD. An RFID solution (rather than a simpler magnetic switch) was selected in order to mitigate attempts to bypass this interlock systems by placing magnets in front of the exposed sensors on additional tables.

It is prohibited to tamper with or remove this device.

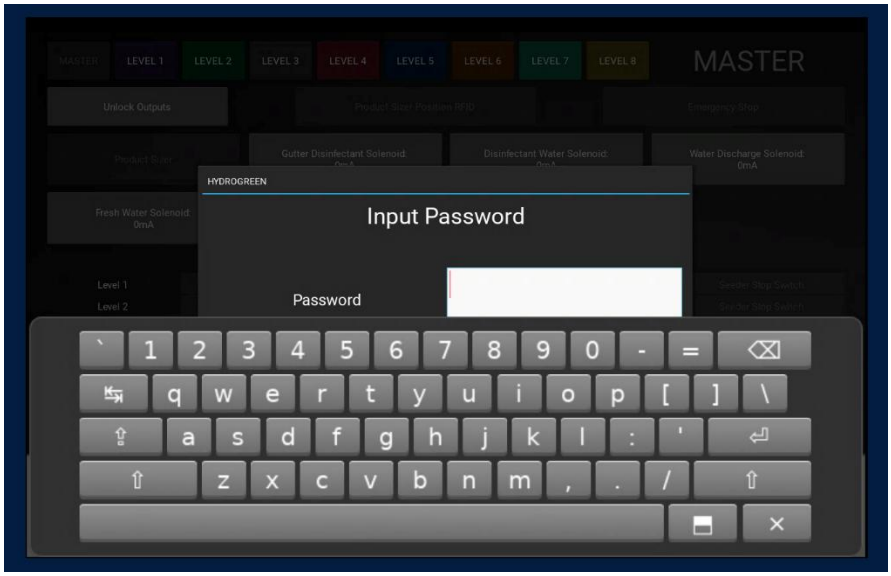
Also, Lock Out, Tag Out equipment before performing any maintenance.

Machine Controls

Your HydroGreen System is controlled by a touch screen located at the front of the machine.



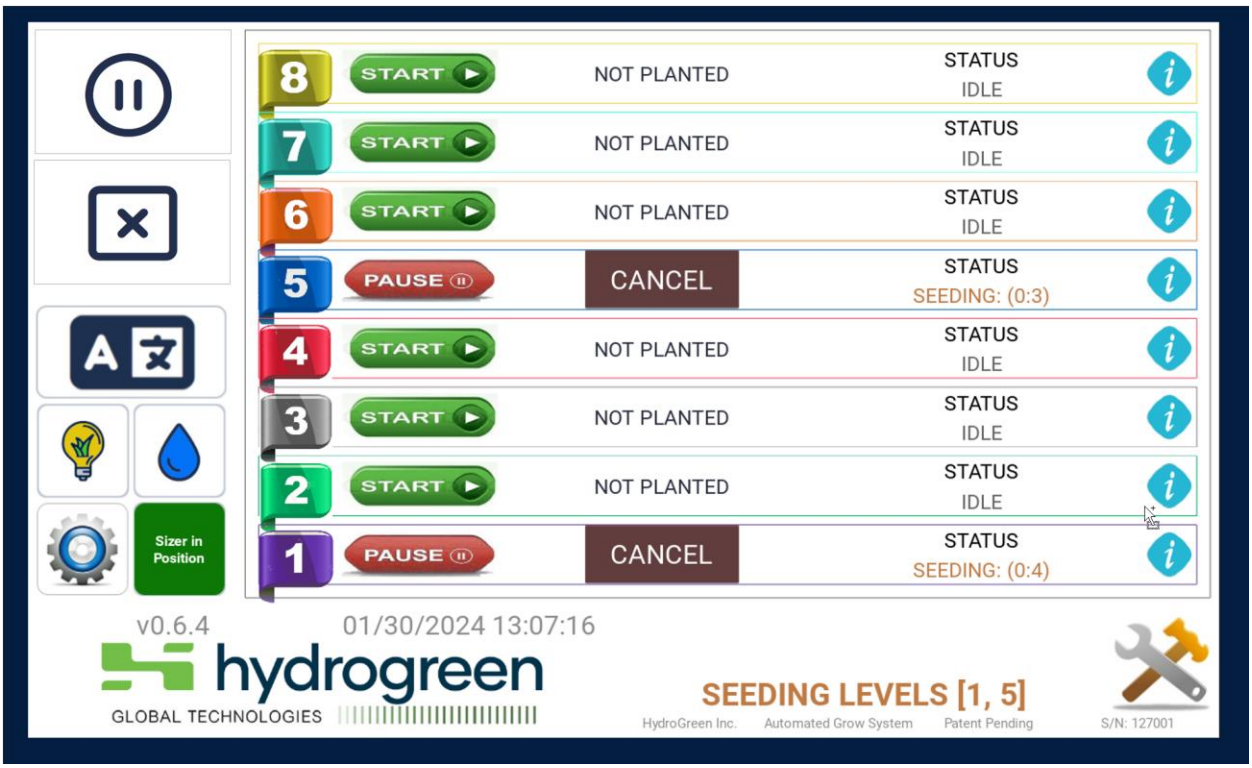
Operator input and screen navigation are all accomplished by tapping buttons, text boxes, and other controls such as the onscreen keyboard shown below.



Control Screens

Related grow system controls are grouped together on separate screens and tabs to focus on information relevant to the function at hand.

Main Screen and Functions



The main screen is displayed upon start-up. Harvesting and seeding operations begin here. This screen also presents general status information related to the table and levels.

System Information and Diagnostics

Table Level

The table level icons display which row and action button the controls are associated with from left to right across the screen.

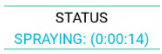
Planted Status

This column on the main screen displays the planted status and age of the crop on the associated level if planted.

Table Status

This label displays information about the current table status.

Level Status



The level status column shows the current state of a level as well as a timer either displaying the duration of the current state or counting down to a scheduled state change.

Version / Date

This label displays the software version running on the system and includes the current date and time.

Information


The information icon for each level on the main screen is a button that opens the information screen for that specific level.

Maintenance


This button opens the maintenance screen for diagnostic information and manual control of the system.

General Controls

Table Pause

 The **TABLE PAUSE** button temporarily stops operations taking place on the system. Press Resume to restart operations.

Table Cancel

 The **TABLE CANCEL** button cancels all harvest or seeding operations taking place on the table. This button does not cancel growing or watering operations. Operations are paused initially upon pressing this button and cancelled once the user confirms the operation via the confirm-cancel popup.

Level Operation Buttons

Operation buttons open the harvest or seed pop-up menus for production operations. Each operation button controls an associated table level. During operation, these buttons are replaced with level pause / resume buttons.

Level Operation Interrupts

Level Cancel

During operation, the planted status label is replaced with a level cancel / continue button. Canceling will cause operation to pause temporarily until the user confirms the cancellation, at which point the process will be fully cancelled.

Level Continue

The continue button appears when the level is waiting on a timer before moving on to the next step of operation and the user can safely override this waiting period. Pressing the continue button will move on to the next operation step.

Example: When a level finishes harvesting to the front limit switch, the product sizer will remain engaged for a period to process any product remaining in the drop chute. If the operator confirms that the drop chute is cleared of material, they may skip the remaining waiting period by tapping the level continue button.

System Settings

System Language Mode

 The **LANGUAGE MODE** button opens a dropdown that allows the user to select the language to be used for on-screen text.

Settings

 The **SETTINGS** button opens the system settings screen.

Water Schedule

 The **WATER SCHEDULE** button opens the water schedule screen.

Lighting Schedule

 The **LIGHTING SCHEDULE** button opens the lighting schedule screen.

Sizer in Position

The **SIZER IN POSITION** indicator shows when the product sizer RFID sensor detects the product sizer.

System Settings Screens

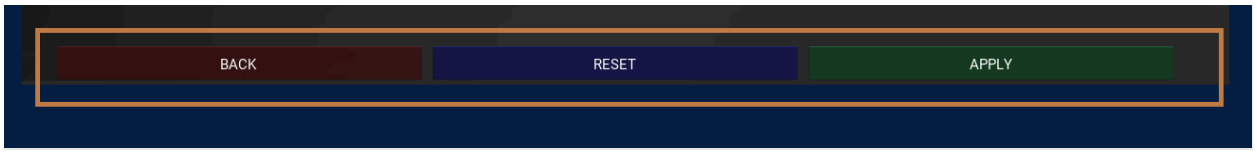
The grow system setup screens are used to configure the system settings and variables to help you get the best results out of your grow system.

A Note About Navigation & User Input

Screens with multiple tabs of information have navigation buttons across the top that are used to move from tab to tab.

Figure 1 - Navigation Buttons / Information Tabs

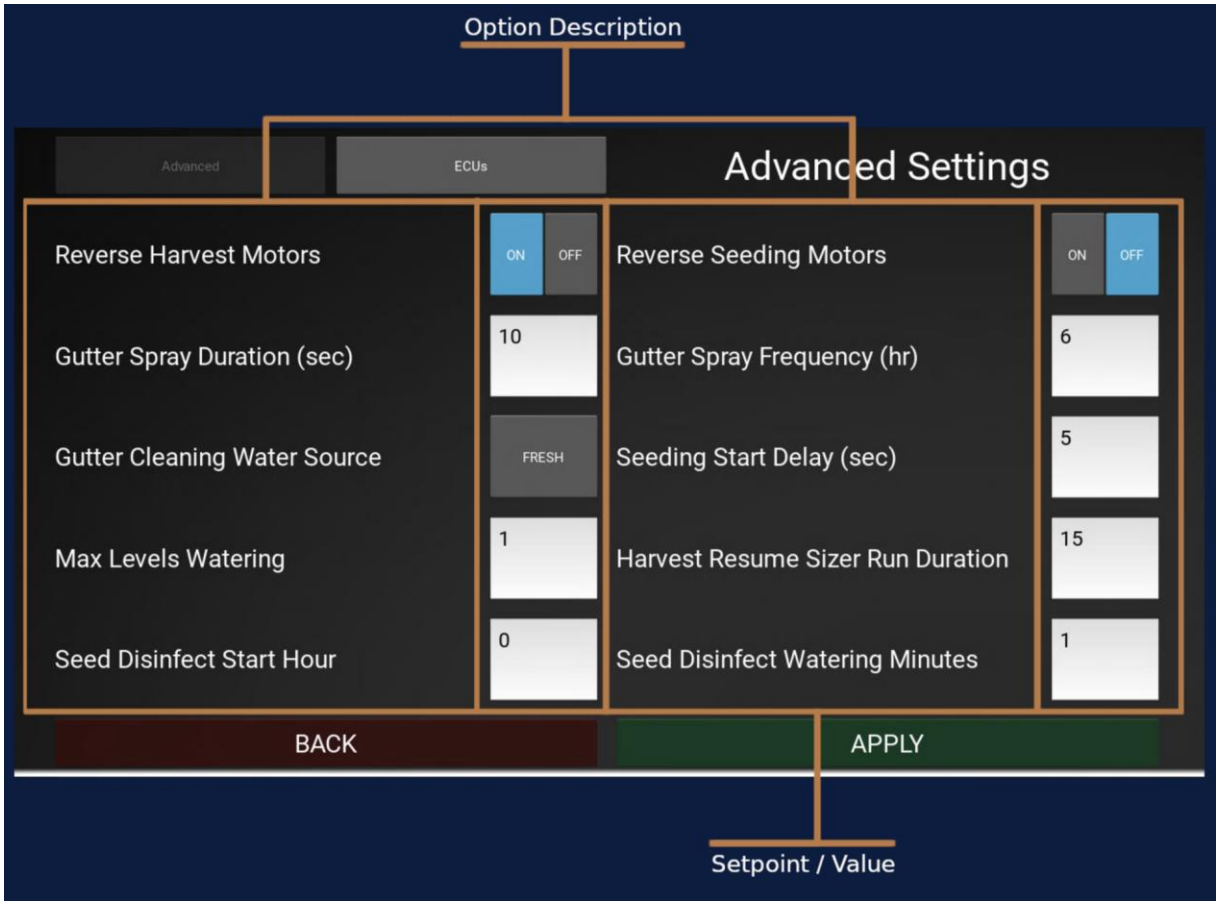
Action buttons are found at the bottom of some screens and often repeat from screen to screen. The action result is always the same for each button type regardless of which screen it is on.



The following table lists the different action button types including the purpose of each.

Action Buttons	
BUTTON TEXT	**BUTTON ACTION**
BACK	Return to the main screen
RESET	Reset values to the default settings
APPLY	Save updated values (user input)
OK	Accept and close pop-up screen
CANCEL	Cancel and close pop-up screen

Advanced Settings



The advanced settings screen is used to set configuration setpoints pertaining to table operations. The appropriate values of these values are often determined by the parameters of the physical table installation and are therefore only rarely adjusted after installation.

Option Description

This is a description of the variables and settings that can be adjusted on this screen.

Setpoint / Value

This section displays the current values and settings in use by the grow system.

Settings Breakdown

Reverse Harvest / Seeding Motors

Use this setting to change the direction belt motors spin (clockwise vs counterclockwise).

Explanation: The belt motors can be installed with the drive shaft pointing towards the table's high or low side. Depending on the installation, the motors will have to spin either clockwise or counterclockwise to pull the belt.

Gutter Spray Duration / Frequency

Use these settings to adjust the duration and frequency of gutter cleaning cycles.

Gutter Cleaning Water Source

Use this dropdown to select the desired water source used during gutter cleaning cycles.

Seeding Start Delay

Use this setting to adjust where the seed chamber drops relative to the push-off bar at the beginning of seeding operations. Higher values will cause the chamber to drop further from the push-off bar.

Explanation: After positioning the belt at the front stop switch, the table will roll the belt out for a number of seconds programmed by this setting before dropping the seed chamber and dispensing seed.

Max Levels Watering

Use this setting to change the number of levels between 1-3 on this table allowed to water simultaneously.

Explanation: Allowing more levels to water simultaneously causes them to more closely adhere to the programmed water schedule as they spend less time waiting for water. However, each installation will only be able to provide a limited water flow rate.

Harvest Resume Sizer Run Duration

Use this setting to configure the number of seconds the table should allow the product sizer to run on harvest resume prior to moving the belt. This allows the product sizer to reach operational speed before more product is fed in.

Seed Disinfect Start Hour

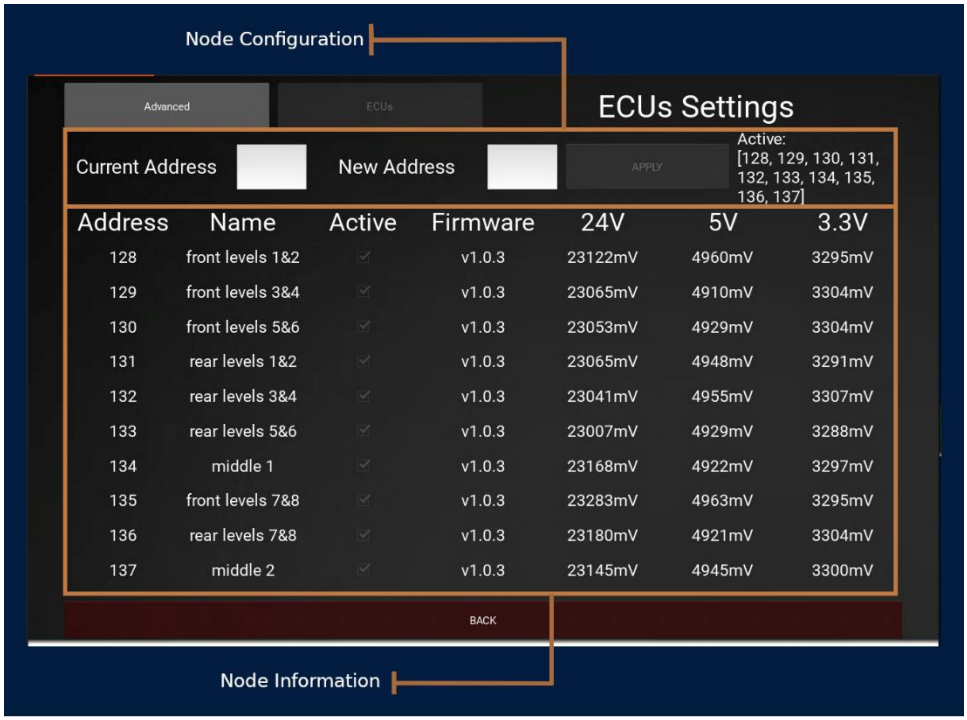
Use this setting to configure what hour of the water schedule the table should use the DISINFECTANT water source during watering. This setting overrides the configured water source from the water schedule.

Seed Disinfect Watering Minutes

Use this setting to limit the number of watering minutes the table uses the DISINFECTANT water source.

Explanation: It is often undesirable to water using the DISINFECTANT source for an entire 6-hour water schedule block. This setting causes the table to revert from DISINFECTANT to the normally scheduled water source after the configured number of watering minutes.

ECU Settings



This screen displays information related to and allows for limited configuration of the system Electronic Control Units (ECUs) - also referred to as Nodes.

Node Configuration

This section of the ECU Settings screen is used to add new nodes to the system or re-assign nodes to target specific areas of control. Each address corresponds to a specific control region on the table as seen in the Node Information Section.

Node Information

This section displays diagnostic data regarding ECUs detected by the system.

Water Schedule Screen

Level Selection

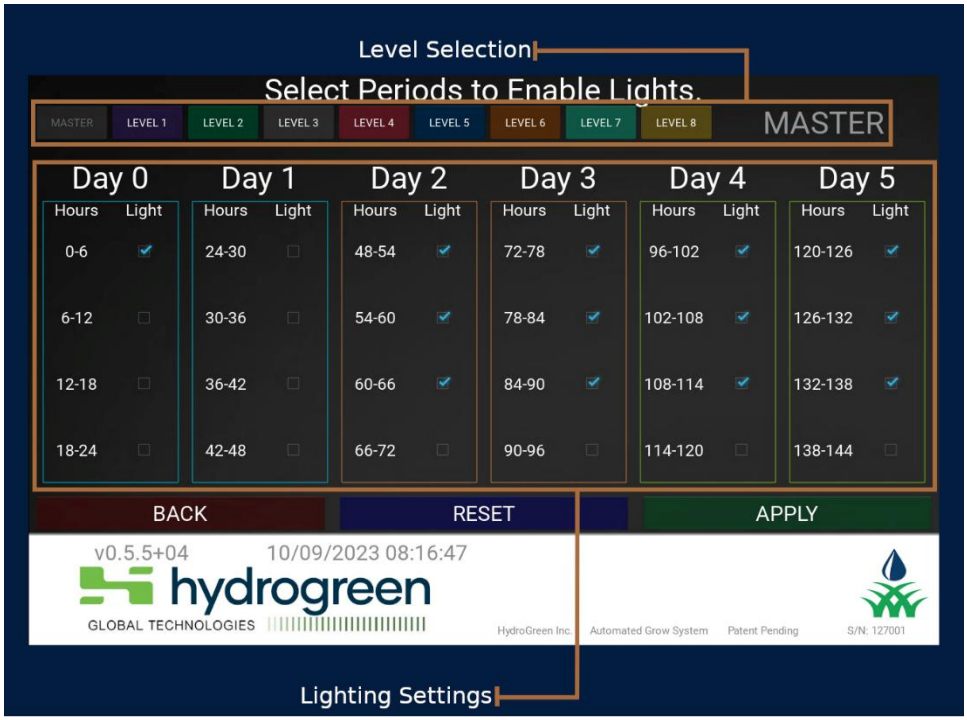
This section contains a tab for each level schedule and an additional tab for the **MASTER** schedule. The Master tab contains settings common to all levels while the remaining tabs each correspond to one specific level on the grow system.

Column Purpose

Each column of the Water schedule determines a different configuration for how the water schedule affects table watering. These settings affect the spacing and duration of watering periods (in minutes), and (if selection solenoids are installed) what water source and/or destination to activate during the period. Each block of 6 hours can be configured independently with different watering schedule settings. The **ADVANCED** button will open a popup where the first 6 hours of watering can be adjusted individually.

Specific sprayer and dripper start/stop times are managed by the system.

Lighting Schedule Screen



This screen allows the user to configure when the system lights should be enabled during crop growth.

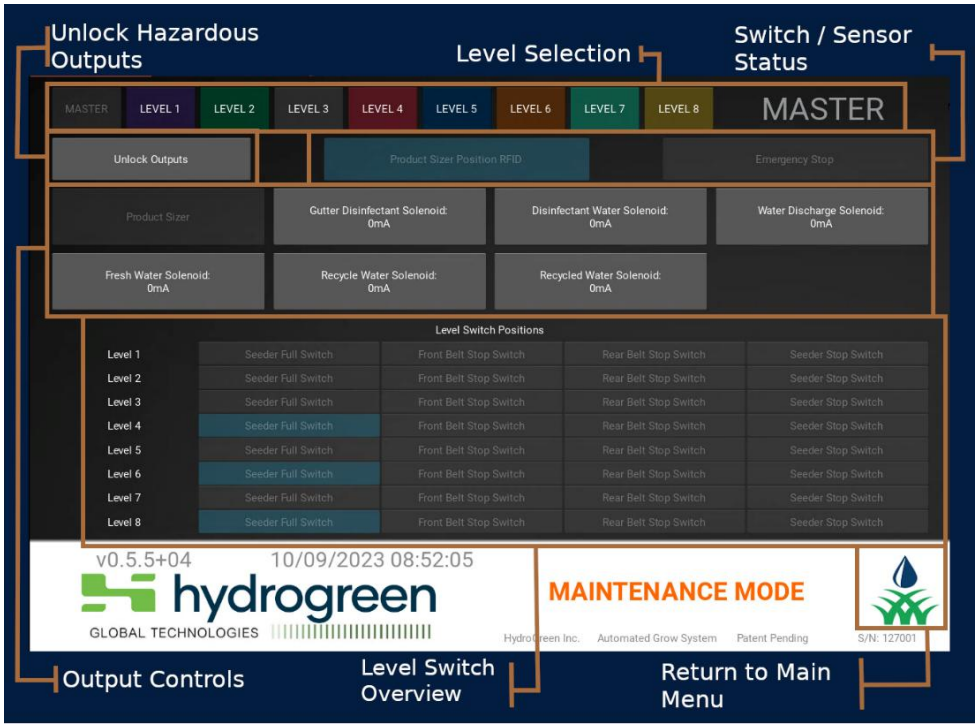
Level Selection

These tabs navigate between schedule screens that control each level and the Master schedule which sets all levels.

Lighting Settings

This section allows the user to configure the lighting settings for each 6-hour period of crop growth. A checked box indicates that lights will be enabled.

Maintenance Screen – General



The maintenance screen allows the user to manually control outputs across the table as well as overview the current states of switches and sensors.

Level Selection

This section contains nine tabs. The **MASTER** tab contains settings common to all levels while the remaining tabs correspond to one specific level on the grow system.

Switch / Sensor Status

These toggles show the current state of mechanical switches or digital sensors.

Unlock Outputs

By default, potentially hazardous outputs are not toggleable. Tapping the **Unlock Outputs** button will raise a password input popup. The user can then enter a technician password to unlock these outputs.

Note: These outputs should only be controlled by trained and experienced technicians.

Output Controls

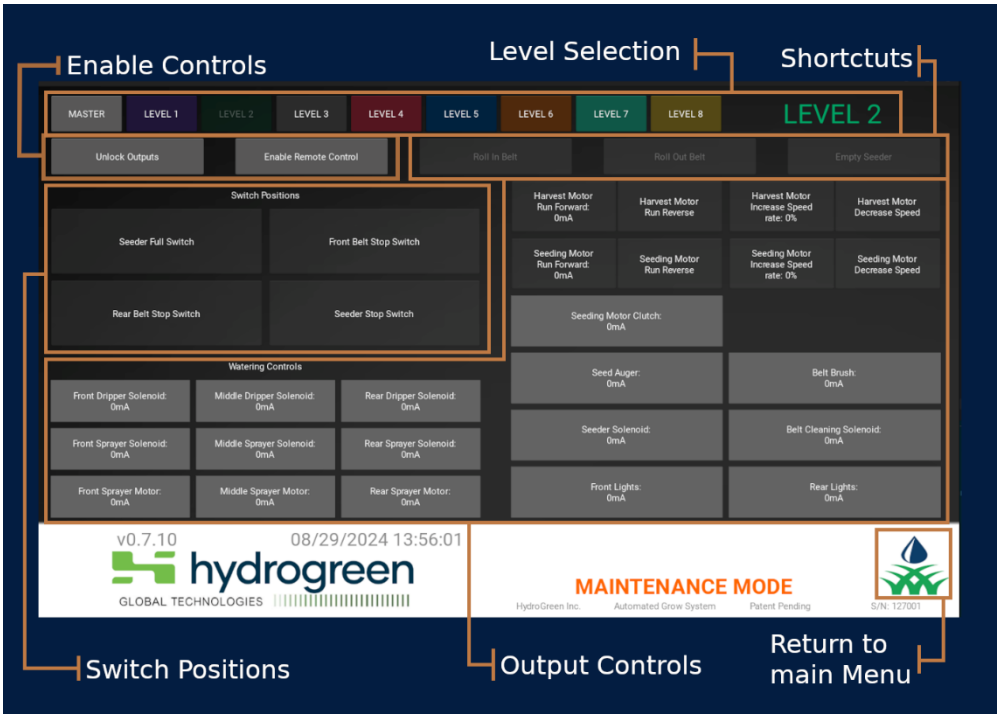
These Buttons allow the user to manually set the output state of general table components.

Level Switch Overview

This is a diagnostic area that displays the status of all the belt position switches on the grow system.

Note: This is useful when troubleshooting a faulty switch, cable connection, or node.

Maintenance Screen – Level Specific



Level Selection

This section contains nine tabs. The **MASTER** tab contains settings common to all levels while the remaining tabs each correspond to one specific level on the grow system as labeled.

Enable Controls

Some maintenance operations or disabled when you enter maintenance mode and require an additional confirmation to enable.

Unlock Outputs

By default, potentially hazardous outputs are not toggleable. Tapping the **Unlock Outputs** button will raise a password input popup. The user can then enter a technician password to unlock these outputs.

Note: These outputs should only be controlled by trained and experienced technicians.

Enable Remote Control

If your installation is equipped with an Edge Server to host additional utilities, tapping this button will unlock some outputs to be remotely controlled via the companion web application. A QR code will display on screen to navigate to the appropriate webpage.

Operation Shortcuts

These buttons prompt the system to automatically engage in common maintenance operations.

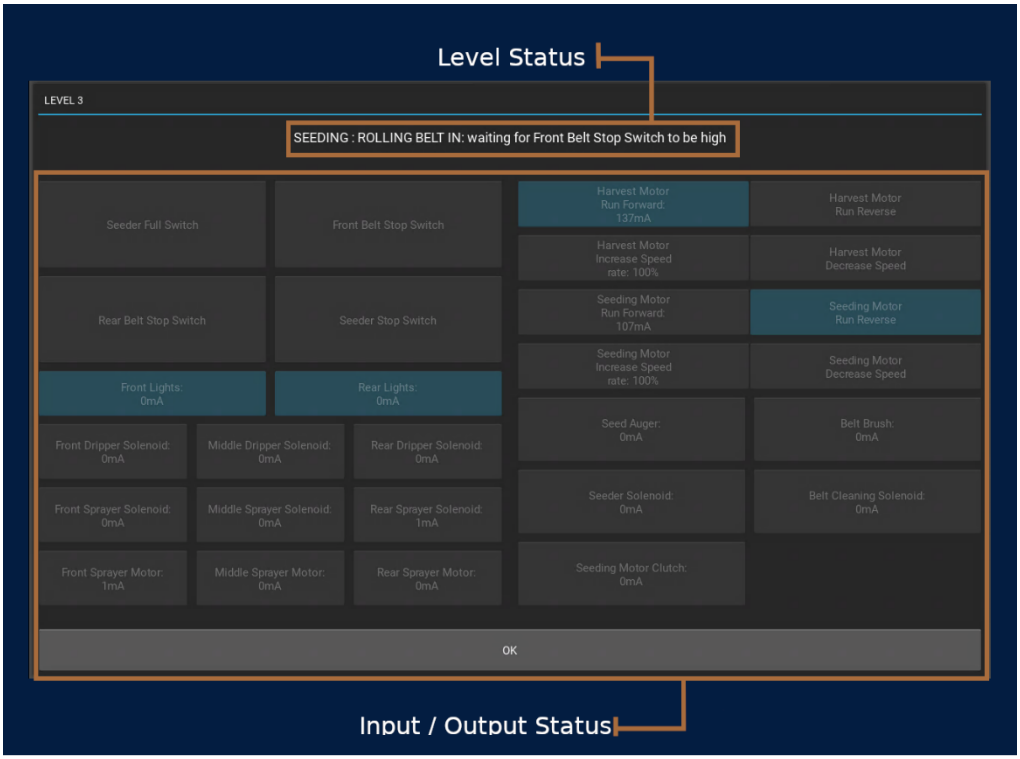
Switch Positions

This section provides an overview of the current state of level mechanical switch positions.

Output Controls

This section allows the user to manually engage the outputs present on the selected level.

Information Popup Screens



Input / Output Status

Each level on the grow system has an information screen that displays the status of all mechanical switches, lighting, solenoids, and motors while monitoring the electrical currents through each device.

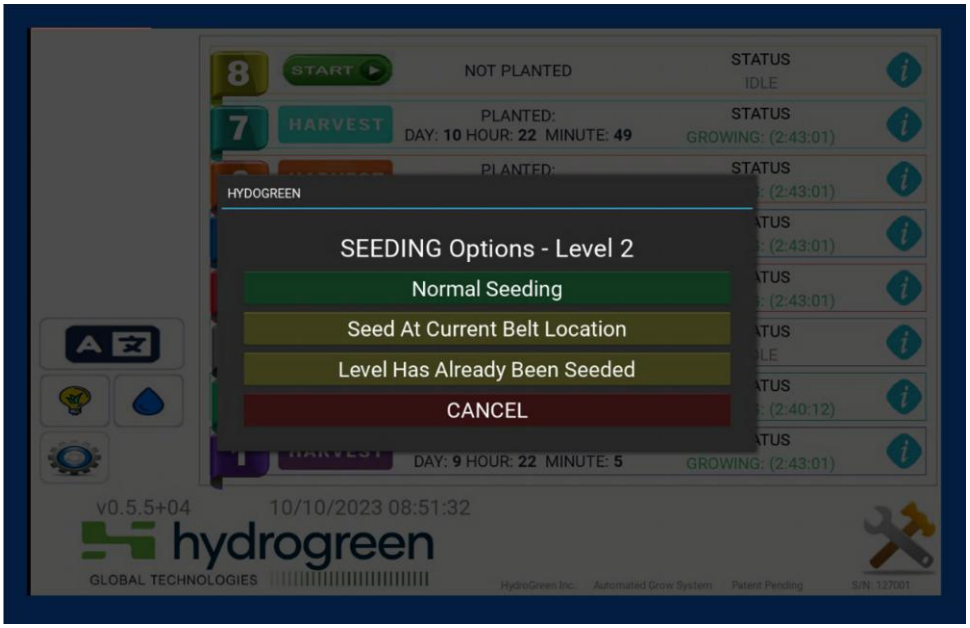
Level Status

The level info header displays the status of the level including ongoing operations, the active step of the operation, and what the level is looking for to trigger the next step.

Action Button Popup Screens

Action buttons on the main screen change according to the current state of the grow level.

Seeding Options Popup



Normal Seeding

This option will roll up the belt and begin seeding the full level.

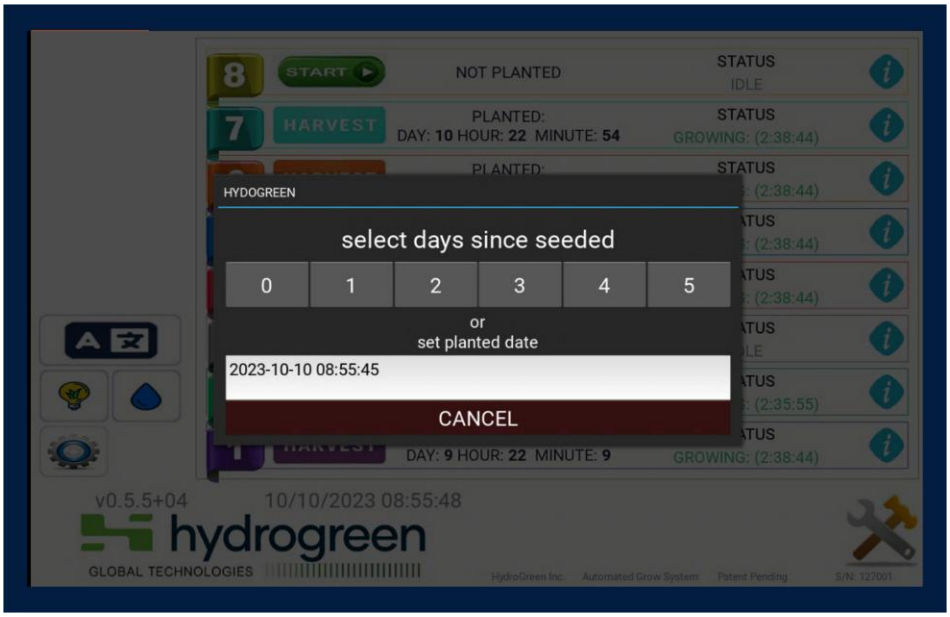
Seed at Current Belt Location

This option begins the seeding operation from the current belt location.

Level Has Already Been Seeded

This tells the grow system that the belt already has seed and is ready to begin the growing cycle at the day of growth selected in the watering day pop-up screen shown below.

Set Planted Date Popup

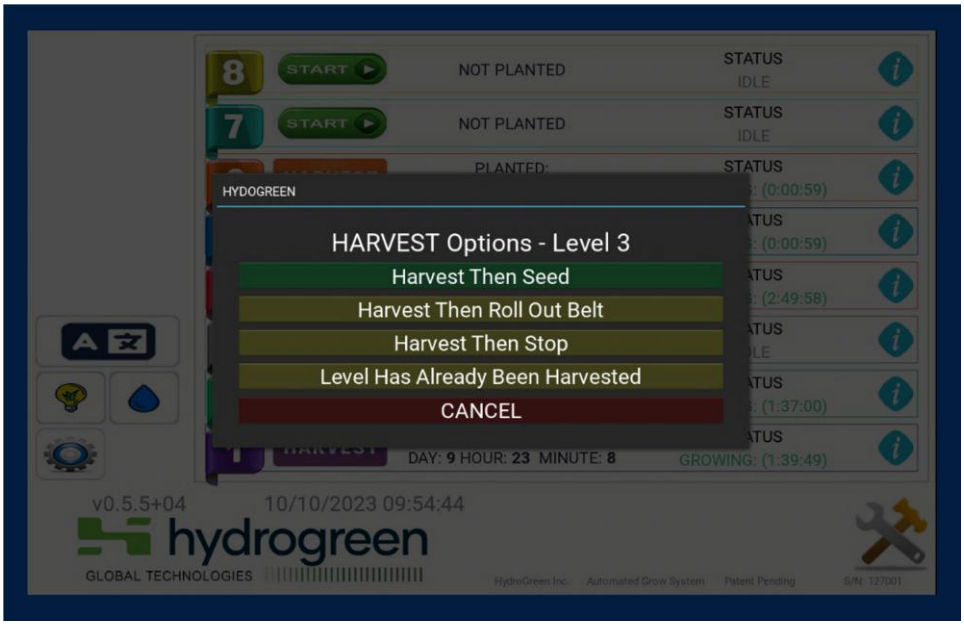


Selecting **level has already been seeded** from the Seeding Options popup screen launches the Planted Date pop-up screen.

This screen allows for inserting an offset into the grow cycle that is desired for the crop. The table will begin scheduled operations (including watering and lighting) on the level at the beginning of “day 0” unless otherwise specified with an offset.

Note: Entered dates must follow the pattern of **YYYY-MM-DD HH:MM:SS** (Example: 2023-10-10 08:55:45).

Harvest Options Popup



Harvest Then Seed

This option starts the harvest cycle and then seeds out the level when harvest is finished.

Harvest Then Roll Out Belt

This option starts the harvest cycle and then rolls out the belt without seed.

Harvest at Current Location Then Stop

This option starts the harvest cycle and leaves the belt rolled up when finished.

Level Has Already Been Harvested

Choosing this option tells the grow system that the belt is currently empty and is ready for seed.

Once Harvest is selected, a password will have to be entered to start the operation

Before Growing

Minimum Requirements

Grow System Minimum Requirements	
ITEM	**VALUE / RANGE**
Water Pressure	>55 PSI
Air Pressure	>60 PSI

I/O Check

The grow system should have been fully tested for proper operation to finish the installation. Refer to the following steps if this hasn't been completed or if you are unsure if the I/O check has been completed:

1. Turn on a device (solenoid, motor, lights, etc).
2. Verify the intended device energizes.
3. Verify current readings (amperage) or device status (on/off) updates on the screen.
4. Repeat the process with the next device until everything on the grow system has been verified to energize with the correct button on the screen and the status of the device updates.

Lubrication

Slide clutches and bearings should have been lubricated during installation but do require periodic service.

Specific details regarding table lubrication are covered later in the *Maintenance & Adjustments* section of this manual below.

Operating the Grow System

First Steps

Do Not Operate this machine unless you have completed training.

Operator Job

The operator's job during Seeding or Harvesting is to:

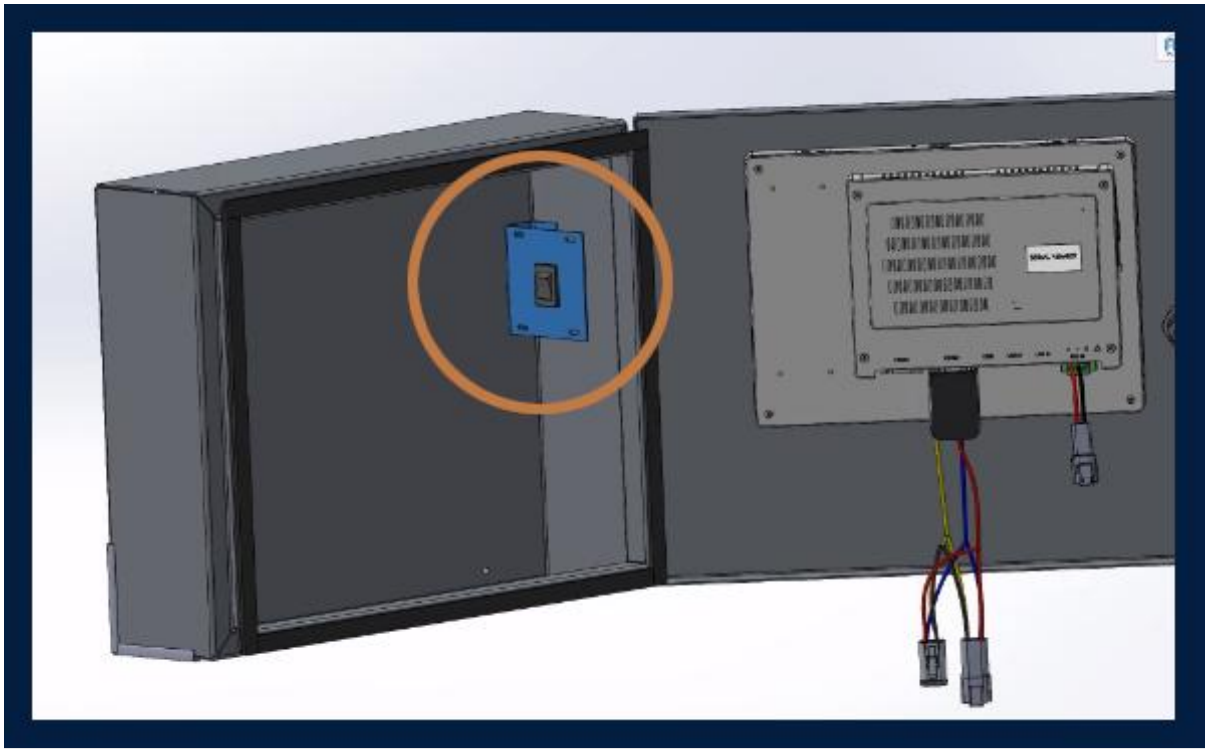
- Verify everyone is clear of the equipment
- Verify that the HydroGreen Growing System is in proper working condition
- Verify that support equipment is in proper working condition

Turn on the main power source feeding the growing system if it is not already energized.

Note: Commercial equipment is typically powered from a main electrical distribution panel, switch gear, sub-panel, or bus bar.

Power Up the Grow System

Flip the power switch inside the grow system control box and wait for the touchscreen to boot.



Water Schedule

Your HydroGreen Grow System comes equipped with a default water schedule. Modifying this schedule to align with your region and environment is important for yield and consistency.

Seeding & Harvesting

- ✓ Minimum requirements are met (see above)
- ✓ Rear clutch lubrication is applied
- ✓ Grow system is powered up
- ✓ Initial configuration is ready
- ✓ Water schedule is acceptable

Once the items listed above are completed, you're ready to put seed on the table.

Note: Refer to the Troubleshooting chapter on Crop Quality in this manual for watering tips.

Seed The Table

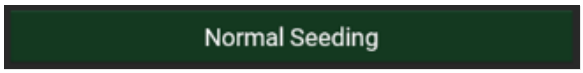
Single Level Seeding

1. Tap the **START** buttton next to the level you want to seed.

   Note: This will launch the **Seeding Options** pop-up screen.

2. Tap **Normal Seeding** or other option that best suits your need.

3. Input Password

   Note: The system will flash the grow lights in a distinct pattern to warn bystanders prior to any harvest action.

   - ✓ You should hear the harvest clutch clicking slowly as it turns in reverse.

Multi-level Seeding

The system is capable of simultaneously seeding levels that are controlled by separate ECUs. For example, levels 1 and 2 are controlled by the same front/rear node, so level 1 cannot be seeded at the same time as level 2, but level 1 can be seeded at the same time as any other level. The same applies to levels 3&4, 5&6, and 7&8.

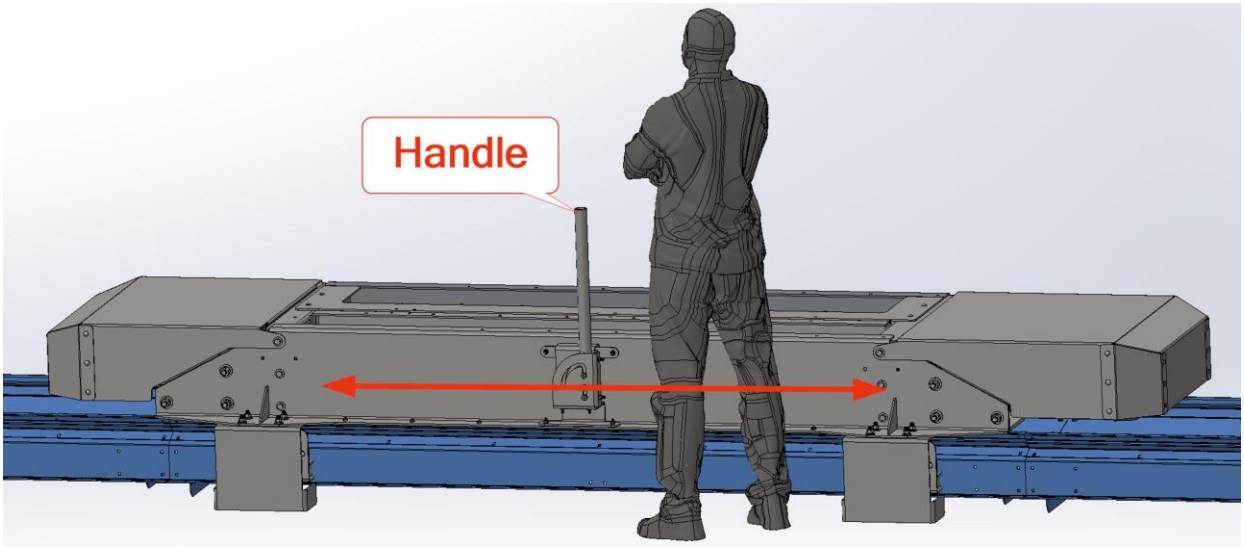
1. Follow the procedure for a single level seeding on each level you want to seed.

Note: The entire table can be seeded in two steps. First seed levels 1, 3, 5, and 7 then seed levels 2, 4, 6, and 8.

Harvest The Table

Setup The Sizer for Harvest

1. Place sizer under the grow system being harvested.
    a. Before moving the sizer verify the floors are dry and clear of debris.
    b. Using the handle the sizer should move freely from machine to machine guided by the conveyor.



✓ Observe the **Sizer in Position** 

indicator to verify the sizer RFID tag is lined up with the RFID sensor. A green background indicates that the sizer is in position.

2. Engage wheel locks.

Harvest

3. Tap the **HARVEST** button for the level that you want to harvest.

Note: This will launch the Harvest Options pop-up screen.

4. Tap **Harvest then seed** or other option that best suits your need.

5. Input Password

Note: The system will flash the grow lights in a distinct pattern to warn bystanders prior to any harvest action.

Hold Belt Position

button can be used during a harvest to stop the belt while leaving the sizer engaged. This option was designed to be used to allow the sizer to process any product that is in the chute prior to a shutdown or resume of the harvest.

Once 

is pressed a timer 

will appear before it can be reengaged.

Press 

to continue harvest or 

to stop harvest.

Maintenance & Adjustments

PPE

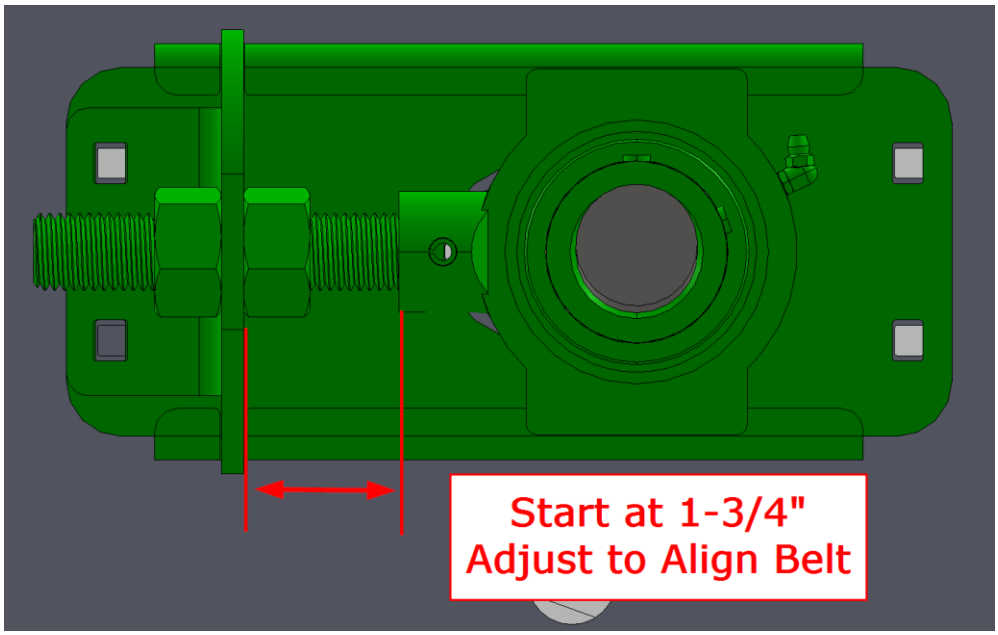
While performing any maintenance or cleaning on the system, eye protection and gloves are required.

Belts

Belt installation instructions are included in the GLS 808 System Assembly Manual.

Belt Tracking Adjustments

Belt tracking adjustments take place on the front low side of the grow system by adjusting the slide bearing that the harvest belt mounts to.



Note: Belt tracking is best performed during harvest while the belt is carrying the heaviest load.

Belts that are riding too high during harvest need to have the bearing moved to the front. This will tighten the high side and cause the belt to push lower.

Belts that are riding too low during harvest need to have the bearing moved to the rear. This will loosen the high side and cause the belt to climb higher.

Small adjustments are better than big ones. Especially when getting the belt close to where it needs to ride as it is wound up during harvest.

The goal is to have the level harvest a full load while winding the belt up on the drive shaft evenly without walking up or down the drive shaft.

Consistent growing environments, water schedules, and seed depths all contribute to belt tracking because they can change the overall crop weight coming off the table from load to load.

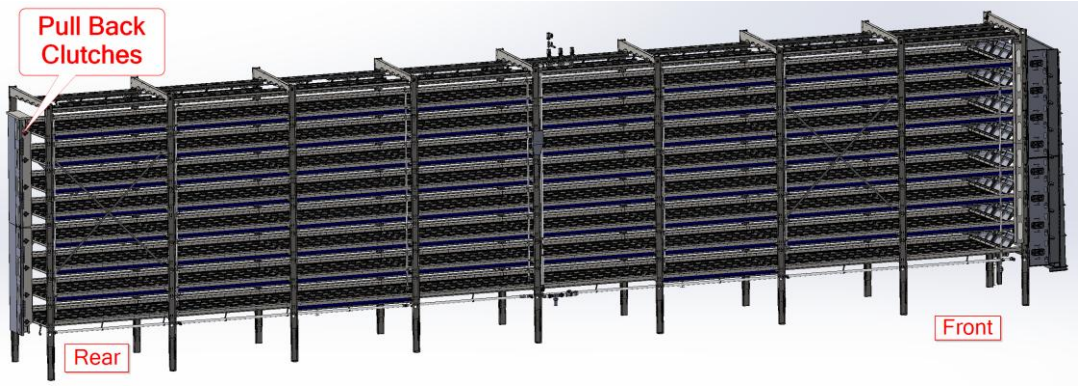
More weight will drag the belt lower, and less weight will cause the belt to ride higher.

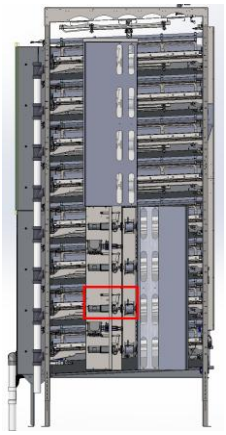
Lubrication

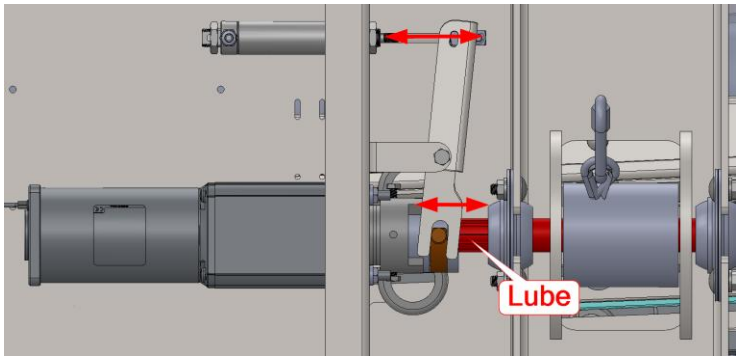
Why – Sliding clutches should be spray lubricated with lite oil for proper actuation. Shaft bearings should be greased to keep out contaminates.

What – Slide clutches: see table below for recommendations. Bearings: food grade axle grease.

Where – Rear clutch slides, pull-back spool bearings, and front axle bearings.







When – Spray clutch slides once per month. Grease bearings once per year (remove any excess). This is a rough guideline and sections of your GLS 8 may require more frequent lubrication depending on the environment inside your grow facility.

How – Grease and lubricate the machine during times when the machine is idle (not during harvest of seeding). A short spray of lite oil on the clutch slides and 1 pump of grease for each bearing should suffice.

Recommended Lite Oil Lubricants

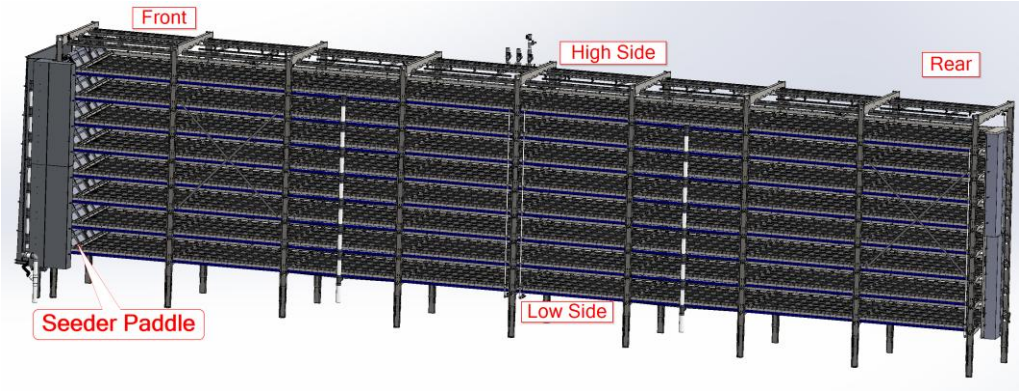
- Rem Oil
- 3 in 1 Oil
- Fishing Reel Oil

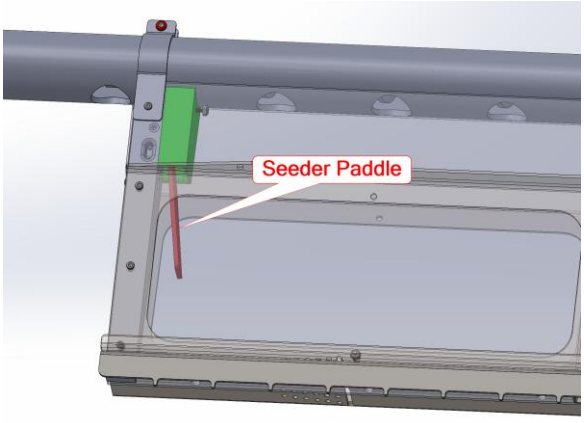
Clean & Clear

Why – To allow Seed Paddle to move freely as chamber fills with grain.

What – Seeder Paddle indicates grain level in seeder.

Where – Low side of the machine behind the harvest chute





When – Before each seeding

How – With small parts cleaning brush

Spray Booms

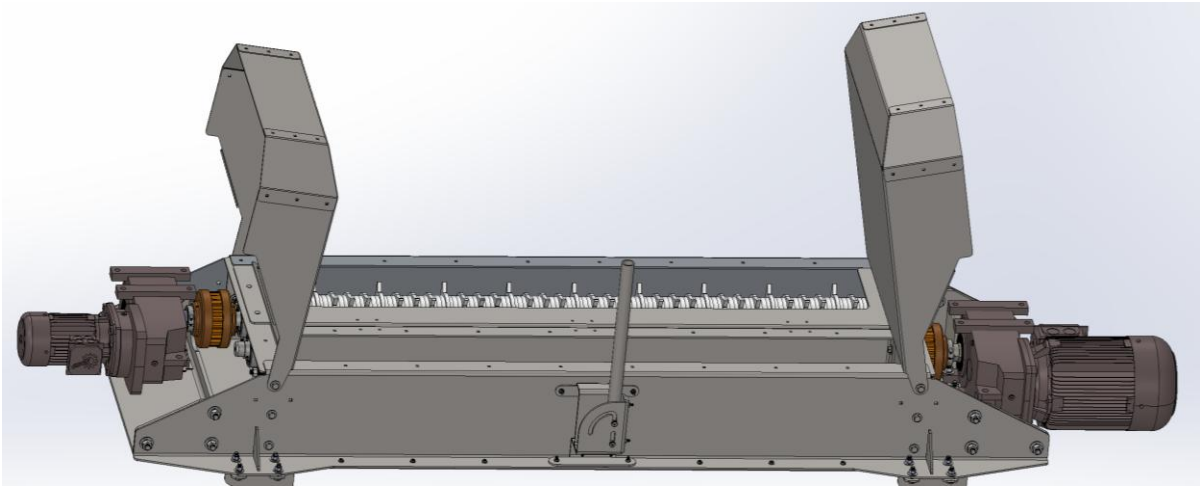
Spray boom nozzles need to spray a clean pattern with full coverage.

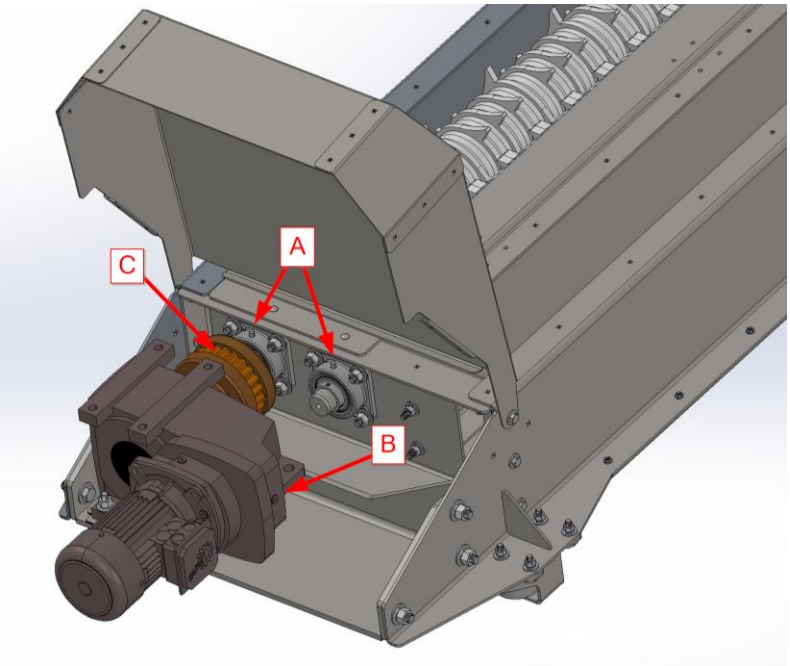
If NOT,

- Check screen
- Check nozzle

Sizer Maintenance

Before performing any maintenance on the sizer follow Lock Out, Tag Out procedure to ensure it cannot be energized.





A. Bearing
    1. What – Grease Bearing
    2. When – 50 Hours
    3. With – Multi-Purpose Grease – NLGI Grade 2
    4. Why – Lubricate Bearing
B. Gearbox
    1. Check Oil
        i. What – Verify Oil Level
        ii. When – 50 Hours
        iii. With – Standard Oil – ISO VG220
        iv. Why – Lubricate Gears
    2. Change Oil
        i. What – Remove and Replace Oil
        ii. When – 10,000 Hours
        iii. With – Standard Oil – ISO VG220
        iv. Why – Lubricate Gears
C. Coupling
    1. What – Visual Inspection of wear
    2. When – 50 Hours
    3. With – Visual, Replacement Part Numbers 53-0250
    4. Why – Identify Premature Failure

Product Plugged in Chute

Stop Harvest

Push the Emergency Stop Switch.

OR any of the Display / buttons.

Follow Lock Out, Tag Out procedures.

Remove panel(s) as necessary to gain access to plugged material. Remove material.

Reattach all panel(s) prior to machine start up.

Follow Lock Out, Tag Out procedures before re-starting harvest process.

Troubleshooting

Sights & Sounds

Observation and experience are two factors that impact the time it takes to diagnose and repair equipment issues. The following list are things to keep an eye or ear on while the grow system is in use:

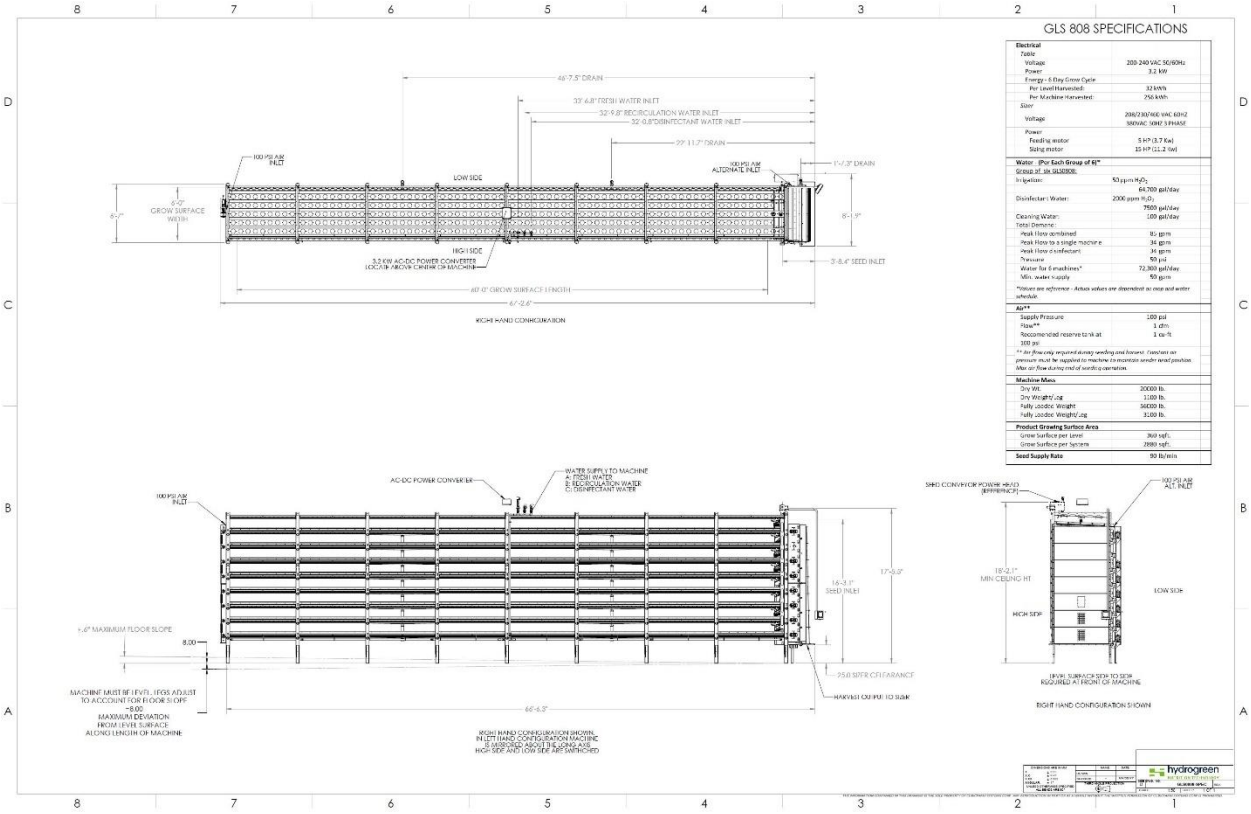
- **Sight**: Corrosion on or around electrical connections.
- **Sight**: Moisture inside the lights or dripping on electrical connections.
- **Sound**: Harvest clutch should be clicks when running in reverse (seeding).

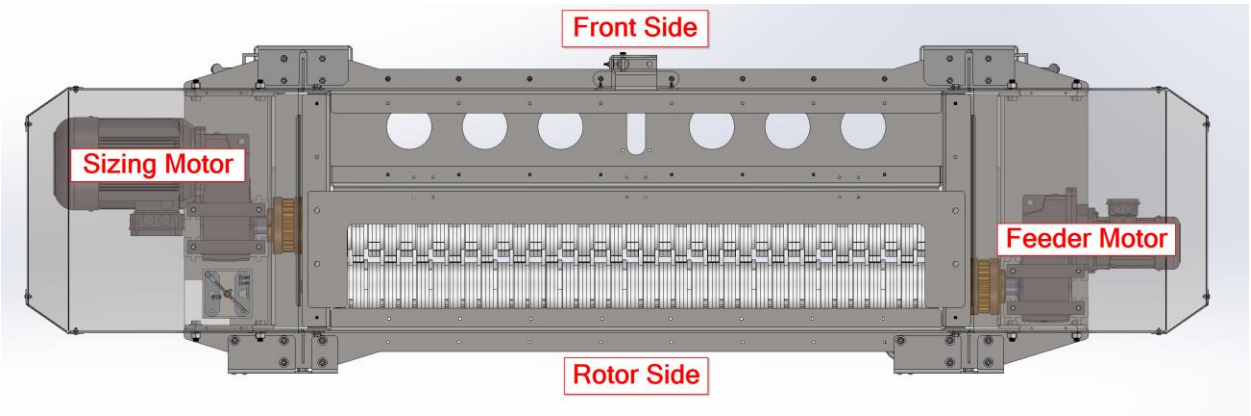
Grow System

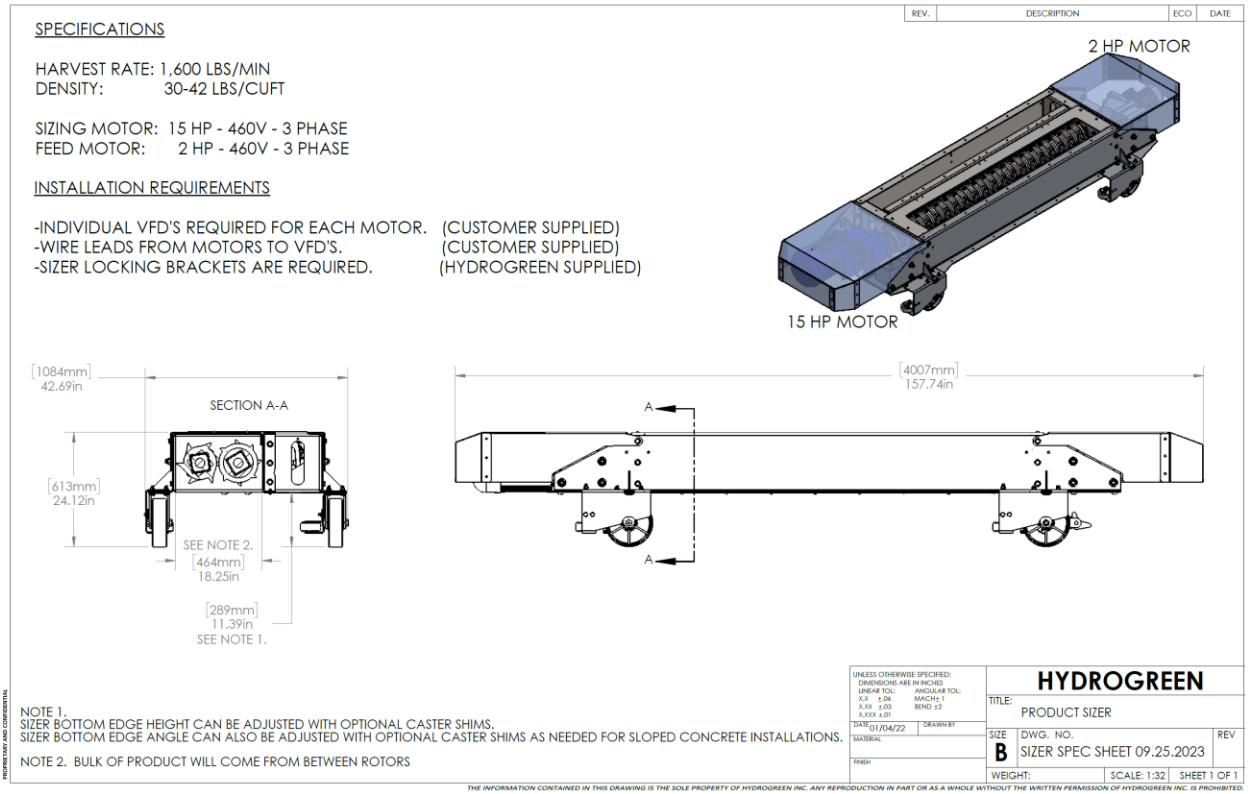
Symptoms & Solutions		
PROBLEM	**PROBABLE CAUSE**	**POSSIBLE REMEDIES**
No power at table	Breaker off	Reset breaker
	Large 24VDC power converter overheating	Replace case fan if broken
	Large 24VDC power converter failure	Replace power converter
	E-stop pressed	Release e-stop
No power at screen	Power switch may be off behind the touchscreen	Switch on inside the touchscreen panel.
	Small 24VDC power converter failure	Replace power converter
	Terminal/screen failure	Replace terminal
No power at section	Node to harness connection loose	Check connections
	Loss of communication to node	Check diagnostic screens
	Node failure	Replace node
Device failure	Voltage present when on	Replace device
	Voltage missing when on	Check harness / node connections
No water at table	Supply valve shut off	Find and open closed supply valve
	Main solenoid off/faulty	Repair/replace supply solenoid
	Section valves off	Open table section water valve
No water at section	Section solenoid off/faulty	Repair/replace section solenoid
	Table water supply off	See “No water at table” above
No water at sprayer	Screen/tip plugged	Clean/replace screen/tip
	Table section supply off	See “No water at section” above

Specifications

Table	
DESCRIPTION	**VALUE**
Model	GLS 808
Length	67’-2.6”
Width	8’-1.9”
Height	18’-2.1”
Weight	Dry Weight = 20,000 lb. Fully Loaded Weight = 56,000 lb.



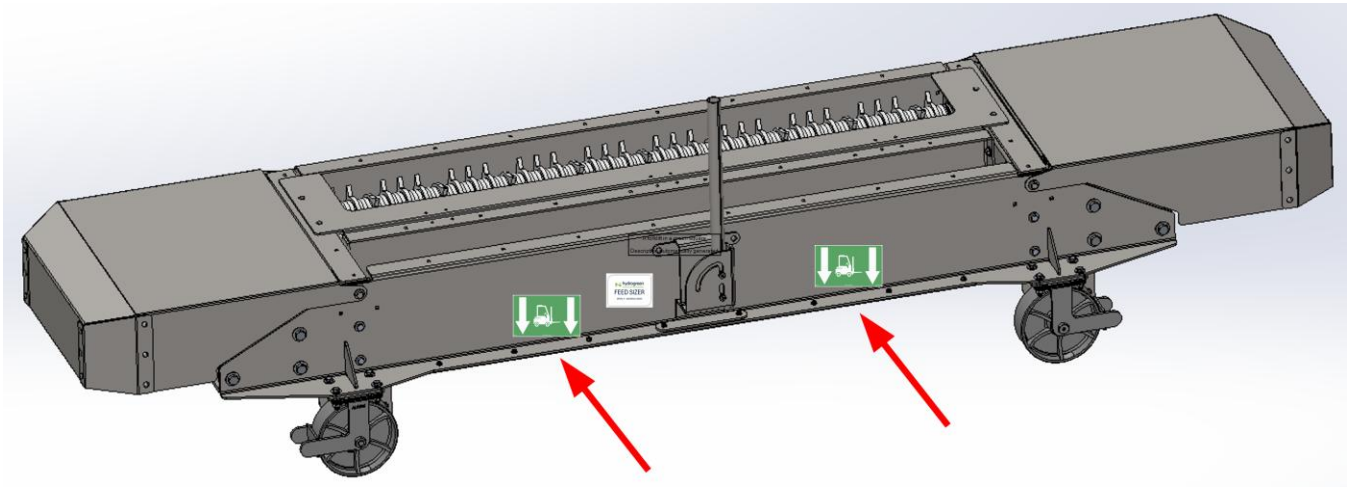


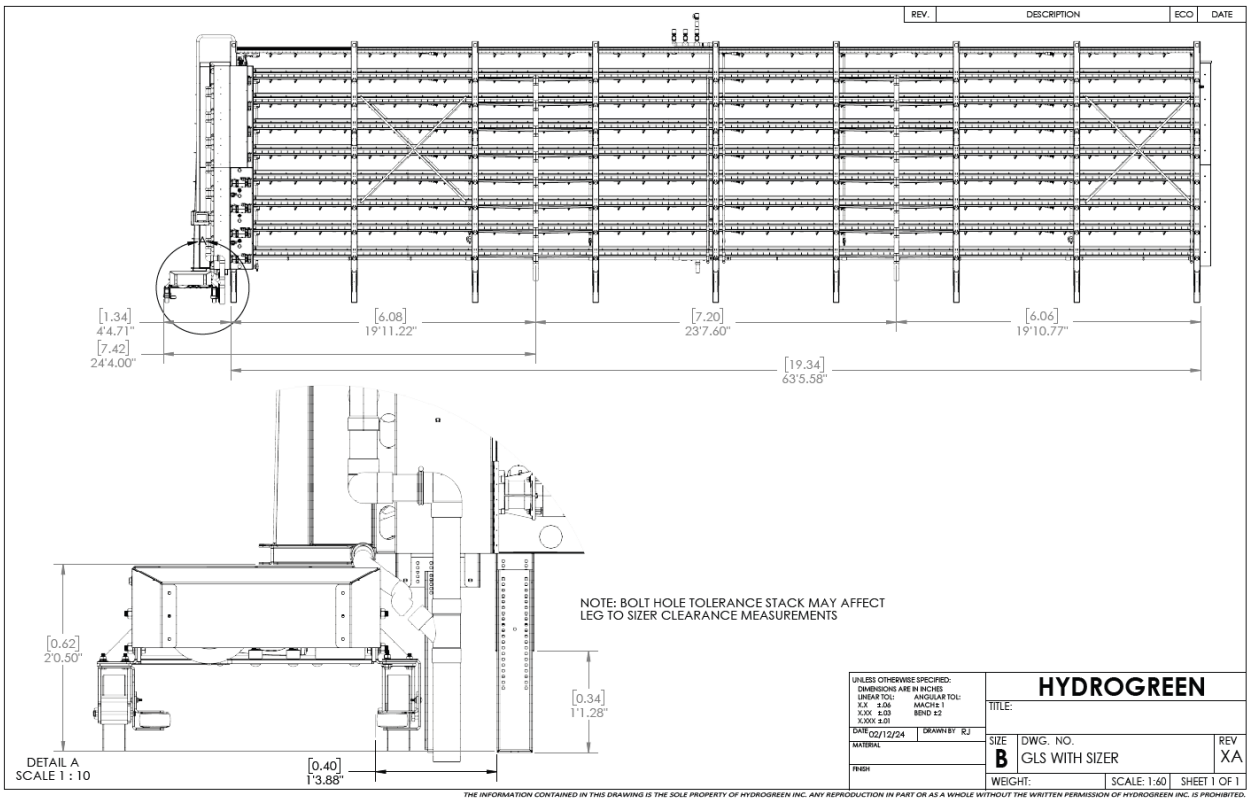


Lifting and Transporting

GLS 808 is designed to build and anchored in place. To move or transport the system I will need to be disassembled.

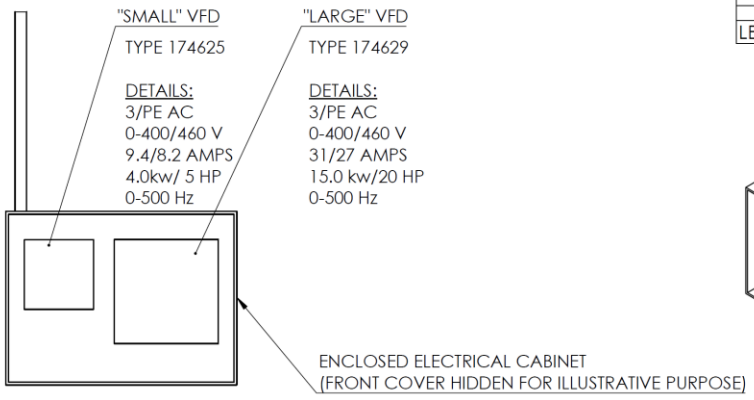
To move they feed sizer lift under the frame where decals are present with forks or straps rated for loads greater than 1,600 lb. (726 kg)

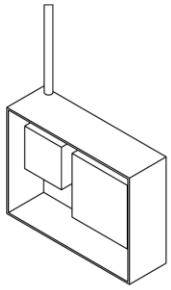




3/24/2025

APROVED MODELS	
MFG	MODEL
LEESON (LENZE)	SMV Vector





NOTES

1. 24 VOLT SIGNAL FROM HYDROGREEN TABLE
2. SMALL VFD
   - A. RECOMMENDED FREQUENCY
     - I. NORTH AMERICAN: 42Hz.
     - II. INTERNATIONAL: 35HZ.
   - B. RAMP TIME
     - I. UP: 20 SECONDS
     - II. DOWN: 5 SECONDS
3. LARGE VFD
   - A. RECOMMENDED FREQUENCY
     - I. NORTH AMERICAN: 90Hz.
     - II. INTERNATIONAL: 90HZ.
   - B. B. RAMP TIME
     - I. UP: 5 SECONDS
     - II. DOWN: 20 SECONDS

hydrogreen
NUTRITION TECHNOLOGY
A DIVISION OF CUBICFARM SYSTEMS CORP.

VFD SPEC SHEET 1.1

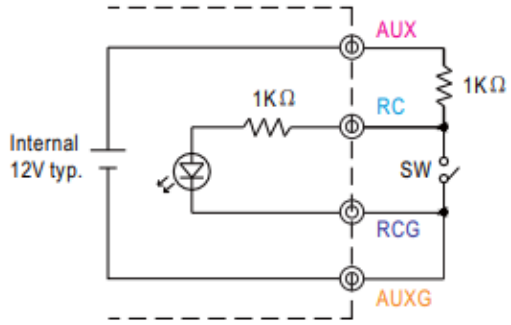
E-Stop

The Emergency Stop control utilizes the Remote ON-OFF functionality of the Meanwell RSP-3000 Power supply.

https://www.meanwell.com/Upload/PDF/RSP-3000/RSP-3000-SPEC.PDF

The Emergency Stop button takes the place of switch ‘SW’ in the following diagram:

Example 3.2(C): Using internal 12V auxiliary output



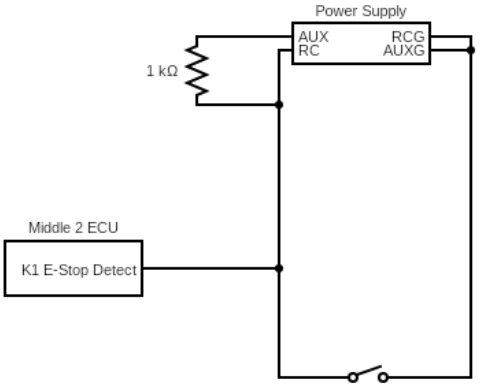
◎ Connection Method

		Example 3.2(A)	Example 3.2(B)	Example 3.2(C)
SW Logic	Power supply output ON	SW Open	SW Open	SW Close
	Power supply output OFF	SW Close	SW Close	SW Open

Engaging the Emergency Stop causes the power supply to enter an OFF state during which all power to drive machine output is removed.

To prevent the machine from restarting upon disengaging the emergency stop, the 12V signal provided by the power supply when the switch is open (emergency stop engaged) is detected by an Electronic Control Unit (ECU) which causes the machine to pause all harvest and/or seeding operations until an additional input is made to resume at the HMI.

Including this connection in the wiring schematic yields:



CE Declaration

EU Declaration of Conformity

HYDROGREEN
GLOBAL TECHNOLOGIES

Company: HydroGreen Global Technologies, LLC
47168 Haylie Street
Sioux Falls SD 57107 USA
+1-605-277-7271

Represented in the European Community by:
Authorised Representative Service
77 Camden Street Lower
Dublin, D02 XE80, Ireland
+353 19036214
Ar.info@doceupoint.com

Description: HydroGreen GLS 808 System
Serial Numbers: 128XXX – 129XXX

This declaration of conformity is issued under the sole responsibility of the manufacturer and is in conformity with relevant European Union harmonization legislation.

A sample of this product has been assessed against Essential Health and Safety Requirements of the Machinery, EMC, Low Voltage and RoHS Directives. Based on conformity with these directives, the above product is deemed in compliance with:

- Machinery Directive: 2006/42/EC (EN 60204-1)
- EMC Directive: 2014/30/EU;
  EN 61000-6-2:2005
  EN 61000-6-4:2007 (EN 55011:2016, Group 1, Class A)
- Low Voltage Directive: 2014/35/EU
- Restriction of Hazardous Substances (RoHS): 2014/65/EU

Ryan Joens

(Signed for and on behalf of)

Sioux Falls, SD, USA 4 Dec. 2024
(place and date of issue)

Spare Parts

Contact HydroGreen direct to ensure the accuracy of the replacement part.

Main Office

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Sioux Falls, SD 57107
United States

Email: HGinfo@hydrogreenglobal.com

Phone: +1 605-277-7271

Crop Training and Grow Specifications

The Goal

The HydroGreen systems are designed specifically around small grains. The grain density, nutritional value, consistent performance, ease of use and availability are highest with wheat and barley. The goal of HydroGreen Feed producers is to grow a fresh healthy crop that meets production requirements while being nutrient dense and free from disease or problems.

Expectations for HydroGreen Feed		
Item	Wheat	Barley
Seed to Feed Ratio	1:4	1:5
Dry Matter Percentage	22%	19%
Total Sugars	>28	>25

We can find success in this goal by making educated decisions in key focus areas.

The key areas of focus are:
1. Grain Selection
2. Grain Density
3. Environmental Conditions
4. Water Schedule
5. Crop Troubleshooting

As you go through this manual you will learn how to grow a high quality HydroGreen feed that meets your requirements. Please contact HydroGreen Support Staff if you have any questions or if you need any further assistance with your crop.

Grain Selection

As mentioned previously, wheat and barley are the recommended grain types for use on HydroGreen systems. Both grain types absorb water quickly, have a high density on a square foot basis, and are readily available where systems are installed.

Discovery

Grain selection for use in HydroGreen systems is based on several factors. Daily grain quantity requirements must be determined first. HydroGreen will then provide producers with a list of top performing varieties. Afterwards, the producer and HydroGreen team should determine what grain is readily available to assess the economics of the grain purchase and logistics of obtaining it. It is recommended that 2-3 readily available, grain varieties are found. Once found, the Variety Screening process will begin.

Variety Screening Steps:

1. Obtain a sample of each variety, 6 lbs minimum.
2. Fill out a Sample Submission Form (see appendix) for each variety.
3. Seal each seed sample, with its submission form, in a zip locked bag.
4. Place samples and the submission forms in a box.
5. Send package to the following address:

HydroGreen Research
47172 Haylie Street
Sioux Falls, SD 57107

The HydroGreen R&D Team will then test each sample for germination percentage, vigor, and performance. This process will take approximately one week from the date of delivery. At the completion of these tests, results and a complete nutritional analysis of each variety will be returned to the producer via email.

It is recommended that grain is tested at least a month in advance of start-up or switching grain varieties. This way we can ensure peak system performance.

Continued Support

After systems have been installed and are functioning, producers must provide regular communication on crop performance and system operations to receive full HydroGreen support. HydroGreen customer support staff will provide regular support to evaluate crop production, system performance, and continued customer education/training. As grain variety availability changes, producers must collaborate with grain suppliers and HydroGreen R&D Team to review alternative options and evaluate new varieties.

Key Performance Factors

Germination Percentage

Grain with germination percentage less than 95% will still absorb water but will not sprout. This leads to soaked, rotting grain, poor crop performance and feed quality.

Purity

Grain with purity less than 97% will have reduced feed nutrition values and inconsistent crop performance.

Foreign Material

Any Foreign Material (FM) in sourced grain will have a negative impact on crop performance and system cleanliness. FM includes weed seed, chaff, stems, dirt, stones, and other seeds. Having excessive FM on the DGS or GLS system will lead to decreased total grain density per square foot, plug drains, contaminated water, mold growth, and increased insect pressure. This ultimately leads to poor crop growth.

Disease and Insects

Disease and insect issues from field production can carry over to HydroGreen crop production and negatively impact feed quality. Insect damaged grain will likely have poor or no germination as well as disease issues. Disease issues in field produced grain can potentially lead to dangerous levels of vomitoxin if fed in high quantities to livestock. Cleaning grain will help reduce the levels of both insect and disease damage.

Grain Cleanliness

Cleaning grain prior to adding it to a system will add to the crop quality and performance. Commercial grade grain cleaners improve quality by grading the grain to a specific size, removing most FM, disease/insect damaged kernels and dust.
Commercial grain cleaners that accompany most systems have 3 levels of cleaning screens as well as dust collection. The top scalping screen typically removes larger material from the grain including hulls, sticks/stems, oversized FM. Level 2 and 3 have sizing screens that grade off light material (FM), smaller kernels, damaged and diseased kernels, dust, and insects. Screen sizes can be changed out based on the size of the grain being graded. Customers must work with HydroGreen R&D on proper grain grading and screen selections.

Customer and HydroGreen personnel should complete a new form and collect a representative sample of the grain that will be sourced and/or used in the system. Failure to collect samples, complete sample form and submit to HydroGreen R&D for testing prior to grain purchase and delivery to customer site may result in unsatisfactory crop production and lowered expectations due to multiple unknown variables previously mentioned.

Grain Density

The goal for HydroGreen producers is to maximize the conversion of complex sugars to simple and the value of how that specific product delivers to the ruminant fermentation processes. By maximizing the mobilization of carbohydrates and minimizing stress, we reach unique glucose and sugar levels. This enables HydroGreen producers to maximize dry matter yield, and the application in the ruminant fermentation process. The glucose yield per square foot for wheat and barley increases until ~2.5 lbs/ft2 and quickly decreases thereafter.

Grain Densities				
Variety	**Unit**	**Minimum**	**Maximum**	**Recommended**
Wheat Grain Density	lbs/ft^2	1.5	2.7	2.5
Barley Grain Density	lbs/ft^2	1.3	2.6	2.4
Wheat Grain Density	g/ft^2	680	1225	1150
Barley Grain Density	g/ft^2	630	1175	1100

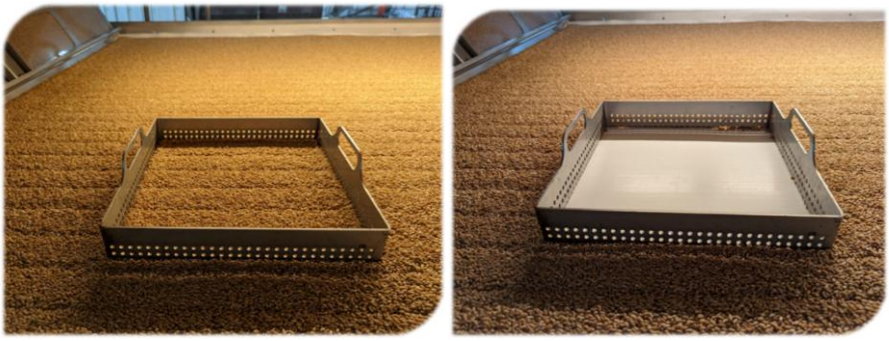
This grain density allows for successful hydration of the grain early on and minimizes heat accumulation and stress. What's unique is the correlation to dry matter yields. Most would think that putting more grain on the system will result in more of the HydroGreen Product. That’s simply not the case, the highest dry matter yields are correlated to producing the most glucose per square foot. Putting more dry matter (grain) on the table does not increase dry matter output.

For example, at 3 lbs/ft2, there will be dry matter loss of about 5-10%. At 2.5 lbs/ft2 we’ll see gains of 10-15%. That's just from a pure dry matter perspective. The value of those crops is also very correlated to these types of changes. It is critically important that we do not over or under apply grain on the system. This will help in our goal to maximize glucose production per square foot.

Measuring Grain Density

Check grain density often, especially with a new load of grain, a change in grain variety, or a significant change in outside temperature or humidity. These scenarios will change the grain density on your HydroGreen system.

To measure grain density, you need a square-foot tool. If you do not have one of these tools, please contact us and we can send you one. It is important to replicate these steps on the high and low side of the table.

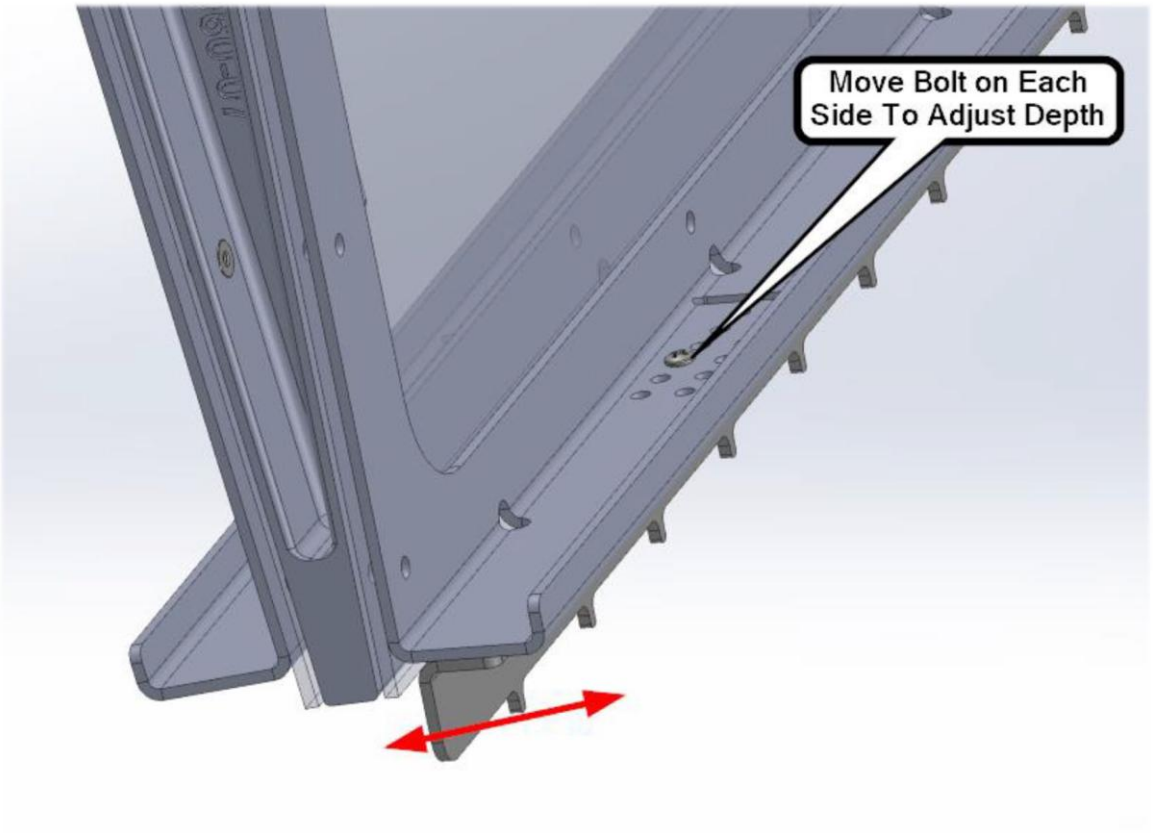


1. Seed out the table as normal and pause it after 3 feet or so.
2. Place the square-foot tool on the seeded-out portion of the table.
3. Vacuum out the entire contents of the square-foot tool.
4. Weigh the contents.
5. Do this on the high and low side of the table.
6. Adjust the seeder as needed. (See below)
7. Repeat steps 1-6 until you get the desired seed density evenly across the table

Adjusting Grain Density

The HydroGreen seeder is designed to give the operator complete control over grain density. This is done by adjusting the seeder to increase or decrease grain depth. Grain depth adjustments will either increase or decrease the amount of HydroGreen ultimately harvested. HydroGreen recommends setting the seeder to place seed on the belt at depths between ½-¾ inches as a starting point and then measuring the grain density as described above and adjusting as needed to achieve a grain density of 2.5 lbs/ft2 or 1150 g/ft2 for wheat or of 2.4 lbs/ft2 or 1100 g/ft2 for barley.

The seeder can be adjusted by moving the seed rake forward or back and securing the desired position with a bolt on each side through aligning holes. If you cannot achieve the desired adjustment, flipping the rake is a possible solution. See the illustration below.



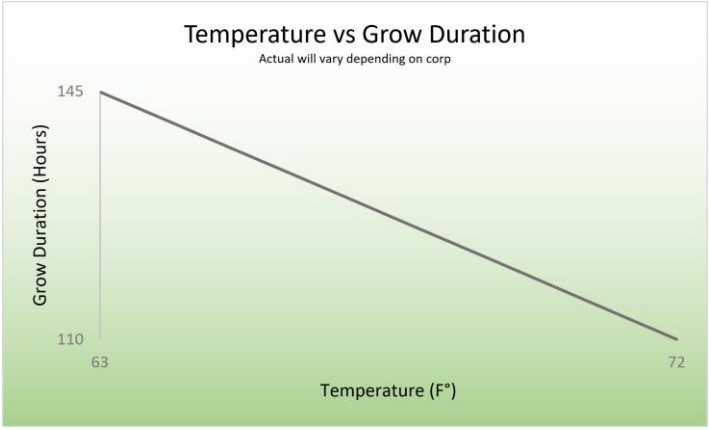
Environmental Standards

The ideal HydroGreen Crop begins with the right grow room environment. It is essential for key variables, such as temperature, air movement, water schedule, and humidity, to meet the ideal growing conditions for small grains. Small changes in these key variables can have noticeable changes in physical appearance and nutrient composition during the grow cycle. If not managed properly, these key variables, general machine maintenance, and cleaning, can result in poor crop performance. These factors can be connected and could lead to independent concerns, but when trying to troubleshoot problems remember to review all environmental aspects that it may be related to.

Temperature

Temperature is an important factor to manage as it has a great effect on the products' growth and nutritional value.

Maintaining the environment at a lower end specified temperature range for a longer end of specified grow duration range will allow the grain to optimize its nutritional value and genetic potential. If the temperature is too high, the nutritional value of the fodder will decrease. Along with providing a growing environment to support optimum development, care should be taken to avoid product heating at the end of the growth cycle.



Air movement

Managing air movement can help your growth as well. It is important for air movement to be as uniform as possible within the grow room and along the tables. Air movement helps regulate the temperature of the sprouted grains and helps create a uniform crop across the table. Sufficient airflow throughout the grow room is needed to ensure that the micro-environment surrounding the plant is approximately equal to the entire grow room environment. Use an anemometer to measure air flow.

Humidity

Humidity is needed to support proper uptake of water early during development but can be a hindrance to more developed sprouted grain. Maintaining humidity as specified below ensures proper development while avoiding product heating concerns.

Hydrogen Peroxide (H2O2)

It is important to use the correct concentration of hydrogen peroxide. Hydrogen peroxide helps prevent mold and bacteria buildup that will create issues with crop performance and water drainage. If the concentration is too high, it can stunt the crops' growth.

Cleanliness

Keeping your grow room and grow systems clean is an important key to success. Refer to the Grow Room Cleaning Checklist included in appendix of this booklet.

Key areas include:

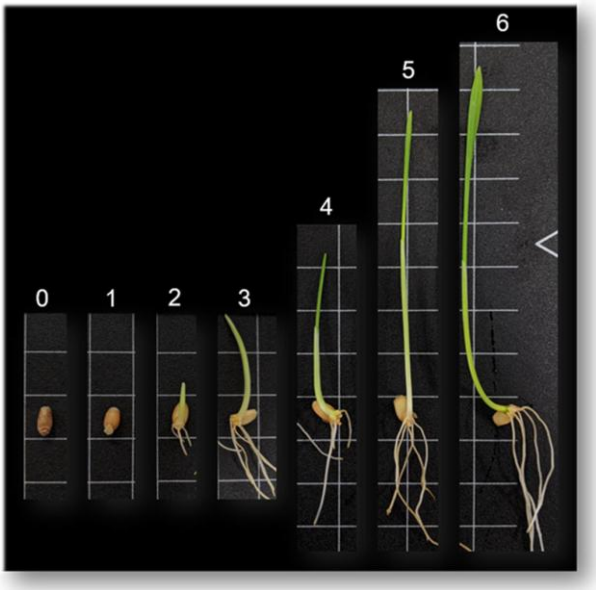
- Harvest Area
- Belts and Conveyors
- Gutters
- Moving Parts
- Floors

Growing Conditions RANGES WILL VARY BASED ON YOUR SPECIFIC GRAIN VARIETY AND LOCATION				
Variable	**Unit**	**Min**	**Max**	**Recommended**
Environment				
Air Temperature	°F	63	72	65
Crop Temperature	°F	68	74	71
Humidity	%	40	75	65
Air Movement	CFM	50	200	100
Carbon Dioxide	ppm	0	1000	800
Light Duration	hours/day	12	24	18
Water				
Water Temperature	°F	55	85	65
pH	pH	5.8	7.8	6.8
H_2O_2 – Maintenance	ppm	50	180	80
H_2O_2 – Disinfectant	ppm	1000	3000	2000
Salinity	ppt	0	1000	500
Nitrate	ppm	NA	NA	<200
TDS	ppm	0	1000	500
TSS	mg/L	NA	NA	<5
TOC	mg/L	NA	NA	<25
Grain				
Grain Density – WHEAT	lbs/ft^2	1.5	2.7	2.5
Grain Density – BARLEY	lbs/ft^2	1.3	2.6	2.4
Grain Density – WHEAT	g/ft^2	680	1225	1150
Grain Density – BARLEY	g/ft^2	630	1175	1100
Growth				
5-day Grow Duration	hours	110	120	116
6-day Grow Duration	hours	135	145	140

Stages of Growth

1. Hydration

- The grain absorbs water which causes it to swell.
- This process is affected by factors such as temperature, humidity, and the seed's physical and chemical properties.
- The absorption of water is a critical initial step to proper sprout development.



2. Metabolic Activation

- After proper hydration metabolism begins, the seed comes out of dormancy.
- This triggers the production of enzymes that break down stored starch into smaller and easily digestible molecules that are needed for respiration in the cells.
- These molecules are then transported to the embryo for further use.

3. Germination

- The emergence of the radicle through the seed coat is the sign germination has begun.
- The coleoptile (protective covering of the stem) and lateral roots emerge next.
- This process also triggers the metabolism and breakdown of stored molecules to rapidly increase.

4. Seedling Development

- As the plant grows, it breaks down stored molecules which provide energy for the rapid growth of both stem and roots.
- Once the plant has true leaves, it will produce more pigments for photosynthesis, which helps it to make more food for itself.

5. Harvest

- The goal is to harvest the most nutritious sprouts possible, as soon as possible.
- This means that we want to encourage water absorption and metabolic activity.
- However, we want to harvest the sprouts prior to the start of photosynthesis.
- Photosynthesis will reduce the nutrient availability of the sprouts.

Water Schedule

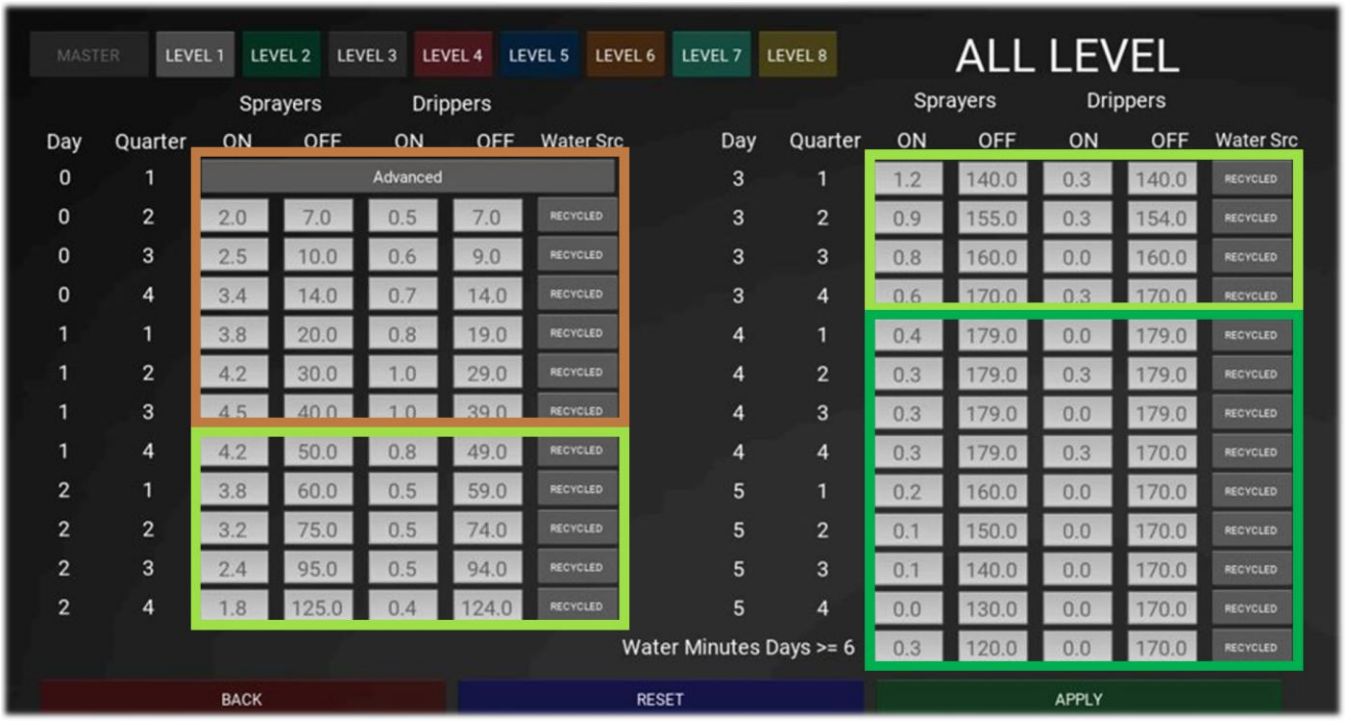
Water management is critical to the success of a HydroGreen system. Manage this using the system's control panel. The schedule will differ based on the variety of grain used and is simplified into three different phases. The key is to adjust the watering schedule according to each of these phases and their individual objectives.

The three phases of the water schedule are:

Phase 1 - Hydrate the seed as rapidly and as uniformly as possible.

Phase 2 - Avoid stress by providing the minimum amount of water and allowing for complete, efficient, and thorough drainage.

Phase 3 - Avoid secondary fermentation and accumulation of heat on the belt.



Phase 1 (0-36 hours)

The objective in phase 1 is to hydrate the grain rapidly and uniformly. The grain should be checked at the 24-hour mark for uniform radical protrusion. Using a straight edge on the high side of the table pull back and evaluate the grain from top to bottom. If any grain is not hydrated, the watering duration should be increased. Do this in increments of 1/10 of a minute. For instance, if the sprayers are on for 2 minutes every 7 minutes, increase the duration to 2.1-2.3 minutes every 7 minutes. Conversely, if erosion is occurring, reduce the duration to 1.8-1.9 minutes every 7 minutes. Adjust and evaluate until the grain is thoroughly saturated without erosion.

Phase 2 (36-75 hours)

The objective in phase 2 is to avoid stress by providing the minimum amount of water needed and allowing for complete, efficient, and thorough drainage. Apply water just so it reaches approximately 60-70% relative moisture content in the middle of the grain bed. The product should feel slightly damp when touched. If your fingers feel very wet, reduce the water. If water is seen on the bottom of the belting, cut back water rapidly. If there is worry that not enough water is being applied, as long as brown discolorations on the roots are not seen, everything is fine. This promotes root development and most importantly, mitigates stress.

Phase 3 (75-140 hours)

The objective in phase 3 is to avoid secondary fermentation and accumulation of heat on the belt. Temperatures should not reach 80°F anywhere, at any stage of development. 68-74°F, should be the target. If temperatures do surpass 80°F, measures need to be taken to manipulate control factors to reduce heat accumulation as these conditions may lead to mold development. In terms of the water schedule, in this phase a very slight spritz is all that is needed, about 6-12 seconds every two to three hours. Then allow low humidity and air movement perform as an evaporative cooler and wick the heat away. If that does not work, try decreasing grow room temperature and humidity, and/or adjusting air movement.

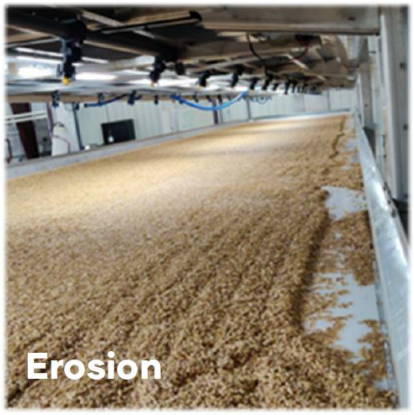
Water Quality

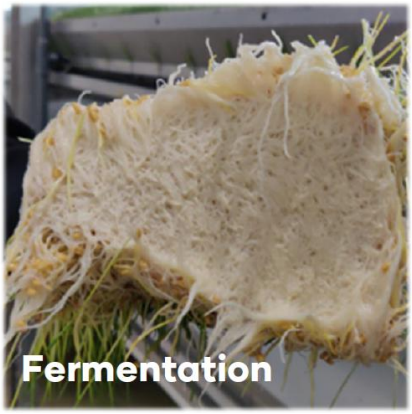
Hydrogen peroxide is essential to the system. It acts as a plant signaling compound and a disinfecting agent. If you're not applying hydrogen peroxide on the system, you're not capturing the full value of the system. Ensure you are always at about 80 ppm. If you're having a difficult time, and the sprouted grain is under stressful conditions, increase this to 100-180 ppm.

Feed Troubleshooting

Crop growth troubleshooting should begin with inspecting your grow room environment to ensure temperature, humidity, and other key variables are meeting the ideal growing conditions for small grains (see table on page 8). Small changes in temperature and humidity can have noticeable changes in physical appearance and nutrient composition over a six day grow cycle.
HydroGreen crop performance is affected by each of these factors including as well as machine maintenance, and cleaning. Troubleshooting any suboptimal crop should involve reviewing all environmental aspects connected to the issue. HydroGreen support staff should be consulted for optimum system and crop production support, as each DGS or GLS system is unique and requires independent management

The main crop performance issues are:



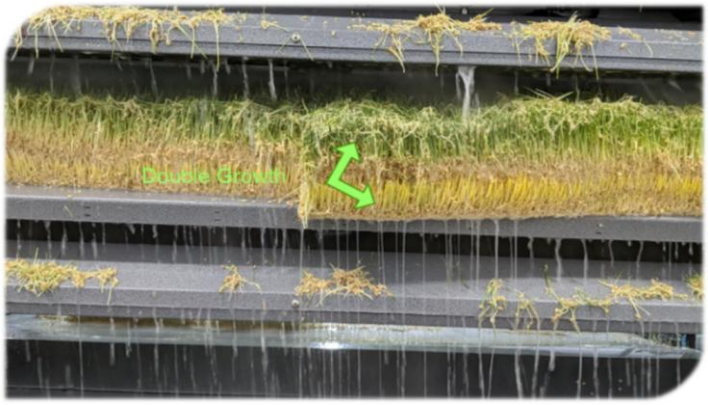


Double Growth

Double growth is two layers or separation of growth, one on top of the other. This can lead to difficulty harvesting and inconsistency in growth and nutritional value.

Causes:

- Double Growth occurs when the grain fails to be uniformly hydrated due to inadequate water delivery during the first 36 hours of growth.
- As seen in the photo the top growth was at a harvestable stage on day six while the double growth on the bottom started 1-2 days after initial seed out. Feed quality and consistency will suffer due to the delayed secondary growth.



Prevention:

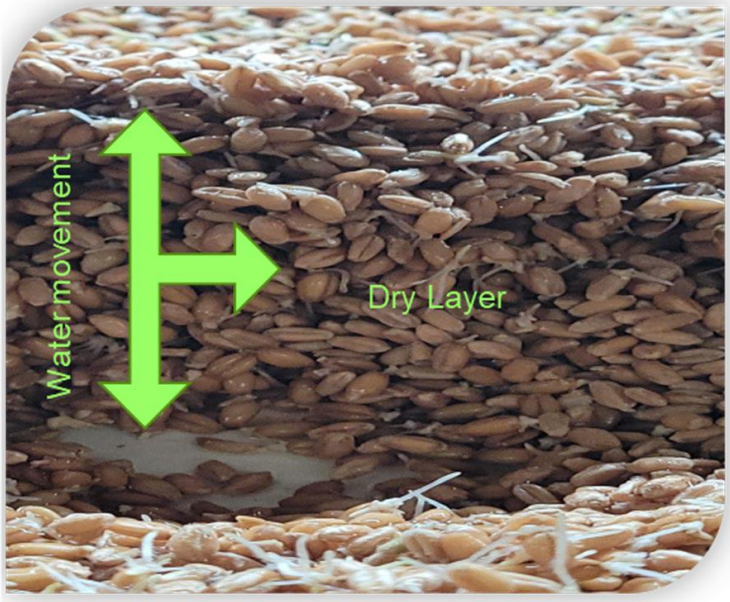
Properly adjusting the system's water schedule will help prevent this issue. Grain hydration should be reviewed after the first 24 hours. Beyond the first 36 hours improper or shallow watering could result in double growth and/or dry pockets of grain.

To inspect grain imbibition after 24 hours of growth:

- Separate the grain bed layer on the high side of the table and inspect for uniform grain hydration.
- If the bottom layer of grain is dry, adjust the water schedule accordingly.
- Remember, the water schedule can vary on different types of grain varieties.

For proper grain hydration, it is important to ensure that the grain is uniformly wet within the first 24 hours. If the top portion of the grain bed takes up water before the bottom, or if the middle portion remains dry, it indicates uneven water distribution. To achieve uniform hydration, adjust the water schedule to increase water throughout the grain bed.

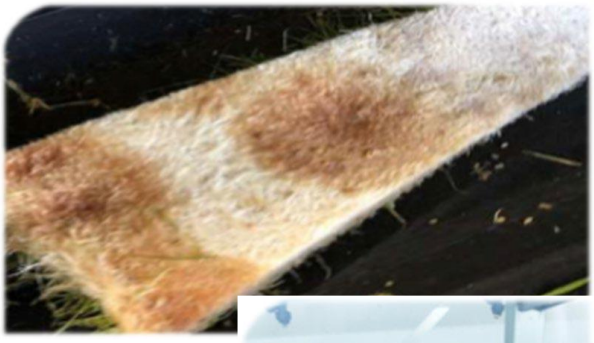
As you will see in the photo, the middle layer of grain is still dry due to poor water schedule settings as well as excessive grain density. In this situation the grain density should be reduced, and the water schedule should be adjusted for both the sprayers and drippers. The water will eventually meet in the middle as it soaks down from the top and up from the bottom. Remember the water schedule will vary with different types of grain such as barley, hard red wheat, and soft wheat.



Heating

Heating is considered an issue when the temperature of the mat of sprouted grains is between 85-90°F. Excessive heat will lead to other issues including hot spots, mold, fermentation, and bacterial growth.

Causes:



- Water schedule may be too aggressive towards the end of the growth cycle.
- The environmental temperature is too high.
- Inadequate airflow is creating microclimates.

Prevention:

Monitor the temperature of the sprouted grains during the third quarter of growth.

- Check by pulling back a part of the leaves to expose the surface of the roots.
- Use an infrared temperature reader to check the temperature. (68-74°F is recommended)
- Check bottom of developed crop/root growth for “hot spots.”
- If heating is found, adjust the water schedule in the last few quarters of the growth cycle as well as the temperature of the room. Check different areas of each table to verify uniformity.

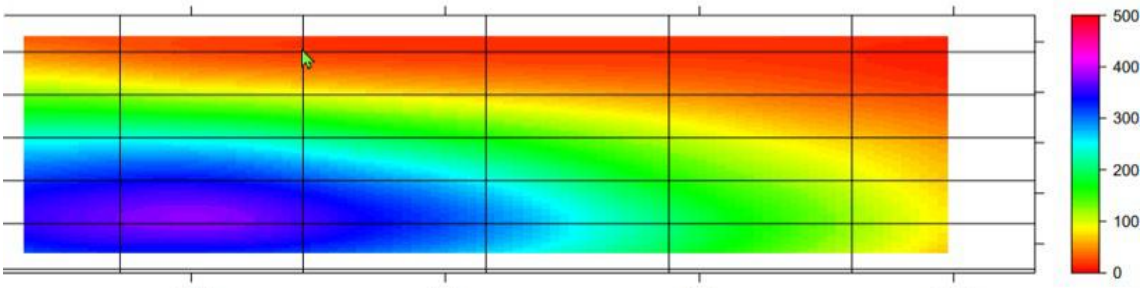
Monitor the airflow of the crop throughout the entire growing cycle.

- Use an anemometer to check different areas on each level to determine airflow and dead spots. (75-125 CFM is recommended)
- Adjust fan location to move airflow across all levels.
- Add fans if needed to improve overall airflow.

Crop Heating, mold, fermentation, bacterial growth, and hot spots can occur with a high room temperature, poor air flow, and an aggressive late watering schedule. When the crop is near harvest, any excessive water and other microclimate issues combined will increase the heating problem. Any irrigation in the last 36 hours should only be used to keep the crop cool until harvest. Drippers should be used minimally to avoid root heating.

Ensure that the system is free of stagnant air as this could cause heating due to crop growth and inadequate airflow. Microclimates will develop and increase the air and crop temperatures.

As seen in the chart below, too much airflow at the bottom of the system (blue), while keeping the crop cool, will have a negative impact. Areas in red show stagnate airflow and potential areas for development of hot microclimates. The ideal areas in green show proper airflow which will aid in the proper crop production. If necessary, adjust or add fans to improve airflow across all tables.



Erosion

Erosion is when the mat of grain shifts or flows towards the low side of the table. Erosion of grain on the system can lead to uneven poor crop growth, no growth, clogged drains, and flooding.

Causes:

- An aggressive water schedule in the beginning of the grow cycle.
- High water pressure.
- Grain density is too low.

Prevention:

- Check the grain depth, water schedule, and/or water pressure.
- Verify that everything is within tolerance for the specific grain being used and adjust accordingly.
- Observe the sprayers early in the growth cycle to determine if the pressure is excessive and adjust
- where needed.
- Check drains to ensure that openings are not clogged which can cause flooding further into the growth cycle.
- Remember, these factors can vary depending on the variety of small grain being used.
- As a temporary solution, move along the table using your hand to remove grain from blocking the drains.

Flooding

Flooding occurs when water is not able to leave the table due to plugged drains from grain, bacteria/fungus buildup, or improper belt position on the low side of the table. When this occurs, crop production is poor and may lead to harvest issues especially if the belt is riding up on the low side. Any bacterial/fungal growth in the drains can expand into crop production if not properly managed. It is important to monitor the tables to determine the cause of flooding.

Causes:

- Erosion – causing clogged drains.
- Belt Blocking – belt riding up on the low side of the belt blocking the drains.
- Bacteria – bacteria or fungus in the drains will clog them.

Prevention:

- Erosion: when erosion has occurred resulting in clogged drains, as a temporary solution, use your hand to move the grain away from the drain holes to allow water to properly flow out. After
- harvesting, adjust the water schedule and/or grain depth.
- Belt Blocking: If the belt is riding up the low side as the machine is being seeded out, reposition the belt to ride true. If you are usure of how to do this, please call HydroGreen Customer Support.
- Bacteria: If bacteria or fungus is plugging drain holes and gutters, use a scrub brush and chlorine solution along with water to remove all foreign material and disinfect the drains and gutters. Repeat this cleaning process on a regular schedule to prevent buildup of unwanted bacterial growth.

Fermentation

Crop Fermentation can occur during the late stages of growth, prior to harvest, due to excessive watering during the last hours. The roots of the crop will be extremely wet or saturated and will have an acidic or vinegar type order. Once the crop has reached this point it will be difficult to harvest and crop heating may occur. Crop quality is likely to be reduced due to these conditions.

Causes:

- Too much water is administered towards the end of the growth cycle.
- As the sprouted grains grow, they will hold onto the water which can lead to fermentation, heating, and underdeveloped grain.

Prevention:

- Adjust the water schedule during the last quarter of the growth cycle.
- Cut a few small squares in different areas and observe the root structure, its moisture content, and any unusual order. Roots should be damp and firm, not saturated and mushy. You should be able to see the root structure if it is ideal. Fermented roots will be a solid mat of mush.

Uneven Growth

Uneven Growth is random patches of underdeveloped grain or “hills” along the mat of sprouted grain. When this occurs crop production suffers, processing efficiency is reduced, and system economics are negatively impacted.

Causes:

- Underdeveloped Grain: o High Side: Waves in the belt or uneven water distribution of the drippers.
  - Middle: Poor water distribution of the sprayers.
  - Low Side: Drain blockage and flooding.
- “Hills” along the mat:
  - Possibly “Double Growth”
  - Rippled belt

Prevention:

- Underdeveloped Grain: o Evaluate sprayers and drippers regularly for uniform performance.
  - If flooding occurs, remove any grain from the drains. After harvest, adjust the water schedule and grain depth.
  - After every harvest, drains and gutters should be cleaned and free of any grains or bacterial growth.
- “Hills” along the mat:
  - To determine if the hill is caused by Double Growth, cut out a sample in that area. If found, adjust grain depth and water schedule accordingly.
  - In the ripples of a belt, the grain cannot be properly wetted, resulting in inconsistent germination or undeveloped grain. Once the belt develops ripples, it is nearly impossible to produce a consistent crop. The belt will need to be replaced to eliminate this issue.

When determining the reasons for uneven growth, collect as much data as possible relating to belt condition, sprayer or dripper performance, flooding, dry pockets, grain hydration, grain quality, grain density, and water schedule. Review all potential causes and consult with HydroGreen customer service support staff to troubleshoot.

Ungerminated Grain

Ungerminated Grain is grain that has not sprouted. Usually found underneath or within the mat of sprouted grain. In the top photo, the grain depth is excessive. Water will not uniformly move through the grain profile. This causes a dry midsection that results in double growth and/or dry pockets at harvest. The other photo shows ungerminated seed at the bottom of the root mat. Again, this is due to a lack of adequate watering at the beginning of the cycle.

Causes:

- Grain germination may be poor.
- Grain depth/density is too deep.
- Watering at the beginning of the grow cycle is inadequate.

Prevention:

Preventing ungerminated grain is easily managed.

- Adjust the water schedule and/or seeding depth.
- Be sure to adjust just enough to provide enough water to all layers but prevent erosion.
- Check grain depth as described below.
- Verify your grain density is within HydroGreen recommendations.
- Verify grain germination and nutritional performance by submitting a sample to the HydroGreen Research Team for testing.

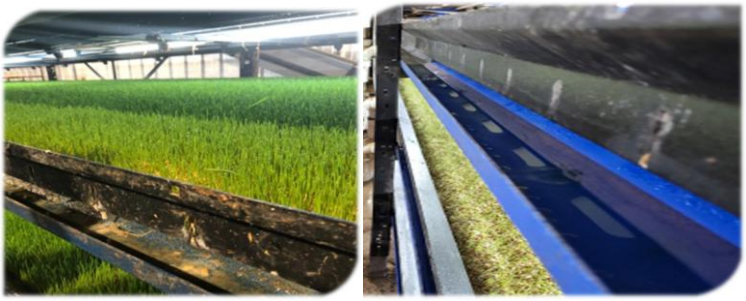
Evaluate grain depth for proper hydration in the first 24 hours of the growth cycle. To do this take a knife or straight edge and push down into the grain to the table, then pull towards you, exposing the grain profile. If the grain is dry in the middle or bottom, adjust your sprayers and drippers to increase output.
When evaluating crop production during the mid and late growing cycles, take a knife and cut a small square to view the rotting structure. And note any double growth or ungerminated grain. If the crop has either of these, adjust your sprayers and drippers to increase output and thoroughly wet out the grain at the early end of the growing cycle.

Bacteria Buildup

Bacterial buildup can create issues not only with drainage and crop performance, but also with water that is recycled. Any water that sits for a period will allow the bacterial growth to begin. When this occurs, table drains begin backing up, causing flooding issues and poor crop performance. Cleaning and general housekeeping procedures should be used on a regular basis to prevent bacterial growth from occurring.

Causes:

- Little to no cleaning of the drains and belt.
- Little to no H2O2 or bleach is applied to the water for cleaning.



Prevention:

- Use a scrub brush and hose to clean the bacteria out of the drains and gutters.
- Spray a bleach/water solution to kill off any remaining bacteria.
- A clean system is a happy system!

Mold

Mold: Fungus that grows within and between the roots and shoots can be a white or dark color. Poor growing conditions favor fungus growth, water quality, system cleanliness, environmental conditions, and

grain quality can all impact the potential growth of mold. Multiple areas need to be managed to prevent mold development on a growing crop.

Causes:

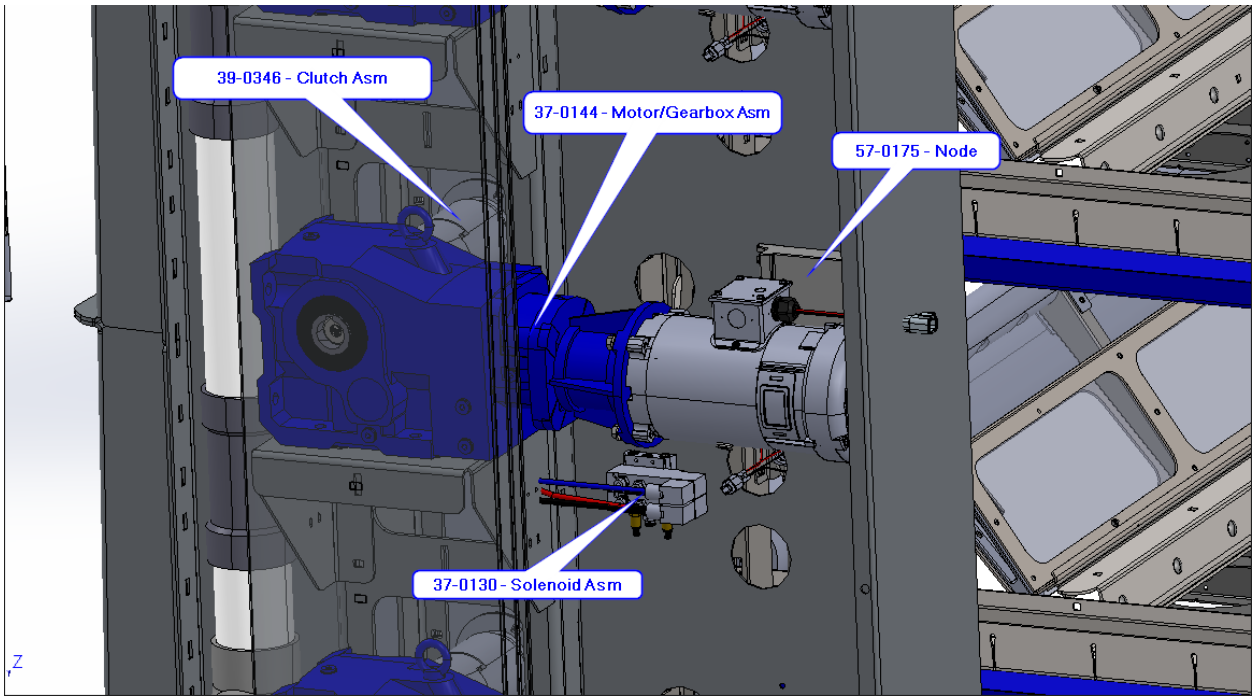
- Unclean/unfiltered water.
- Little to no H2O2 concentration. Hydrogen peroxide helps disinfect pipes, lines, tables and reduce any spores that may be attached to the seed.
- Grow system is unclean, this will almost always guarantee mold growth and poor production.
- Environmental temperature is too high.
- Poor airflow on table.
- Dirty diseased grain.
- Product fermentation.

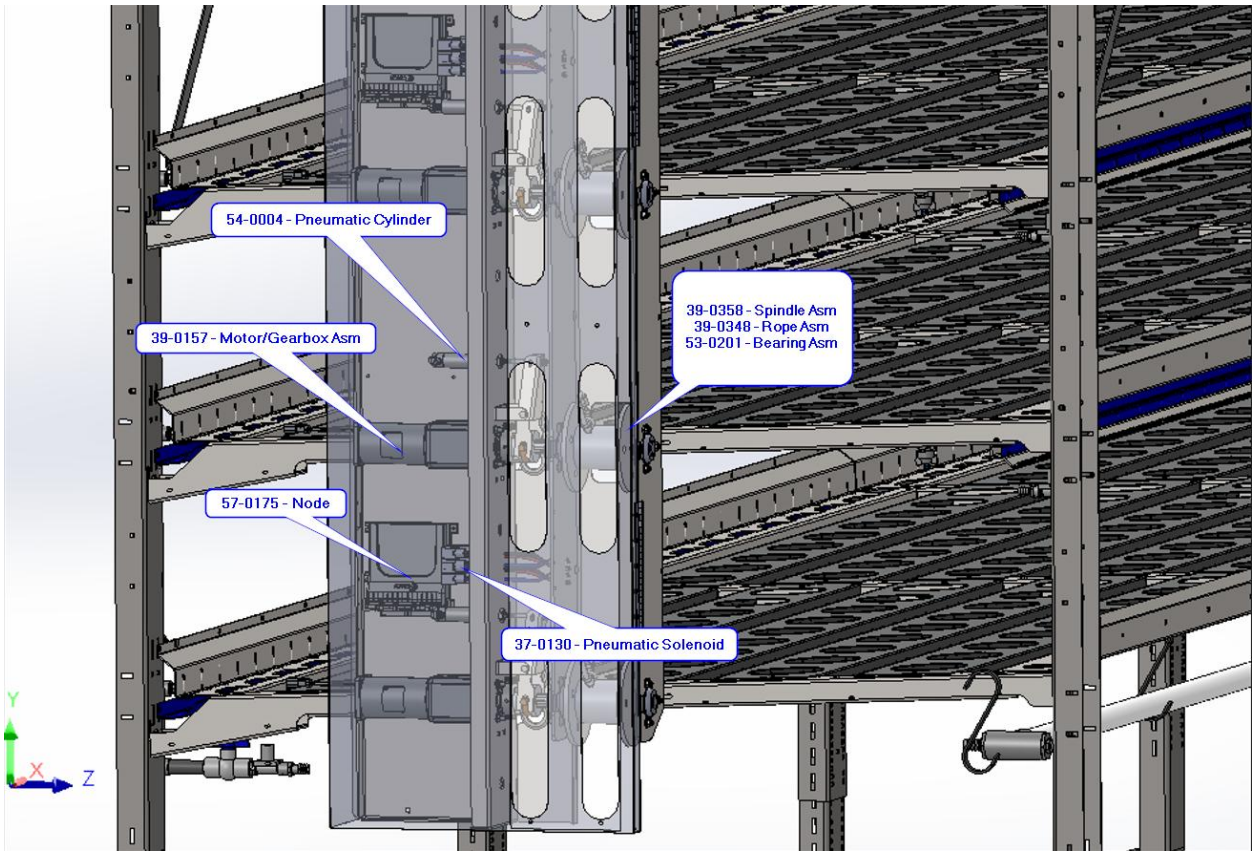
Prevention:

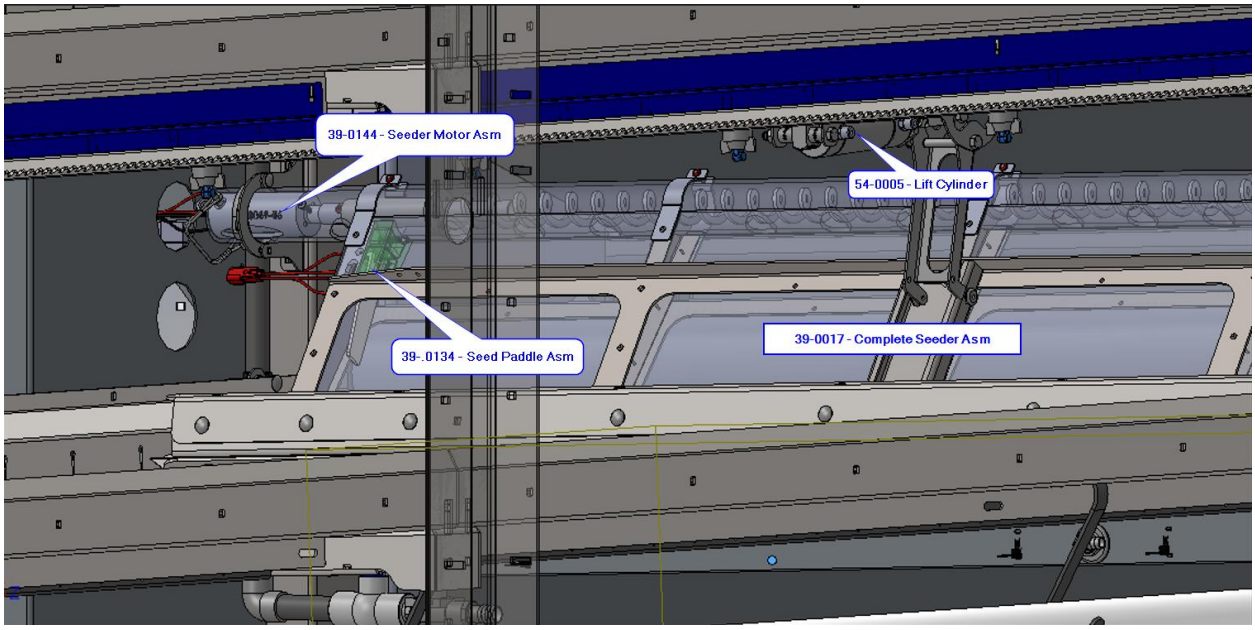
- Check H2O2 levels every day to prevent bacterial growth. If bacteria are found, check H2O2 levels and increase accordingly.
- Make sure to clean the belts, drains, and gutters.
- Use cleaned high quality grain.
- Have green tested for germination.
- Always follow environmental guidelines provided by HydroGreen to reduce any potential issues tied to mold growth.
- Ensure air temp, humidity, and airflow are at recommended levels.
- Make sure to incorporate hydrogen peroxide and maintain levels every day to prevent bacterial growth. Regularly clean belts, drains and gutters. Use disinfectants such as bleach and gutters and drains to sanitize and prevent buildup. Use cleaned, high quality grain from a reliable source.

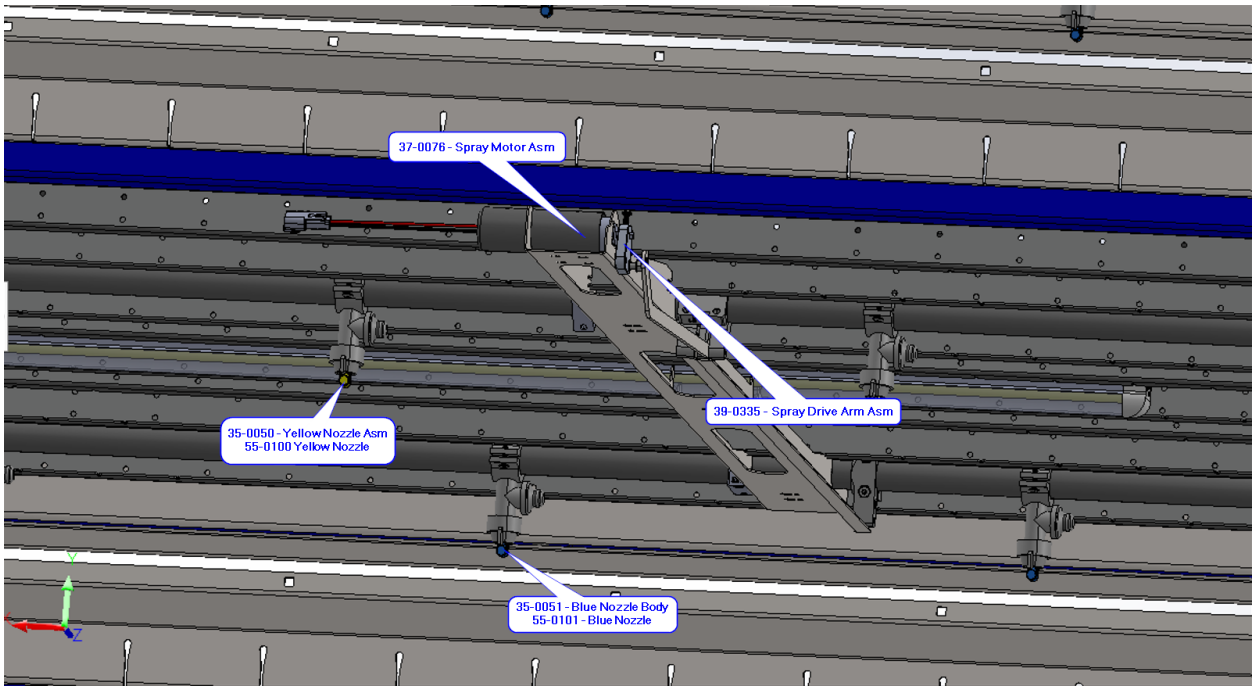
Summary

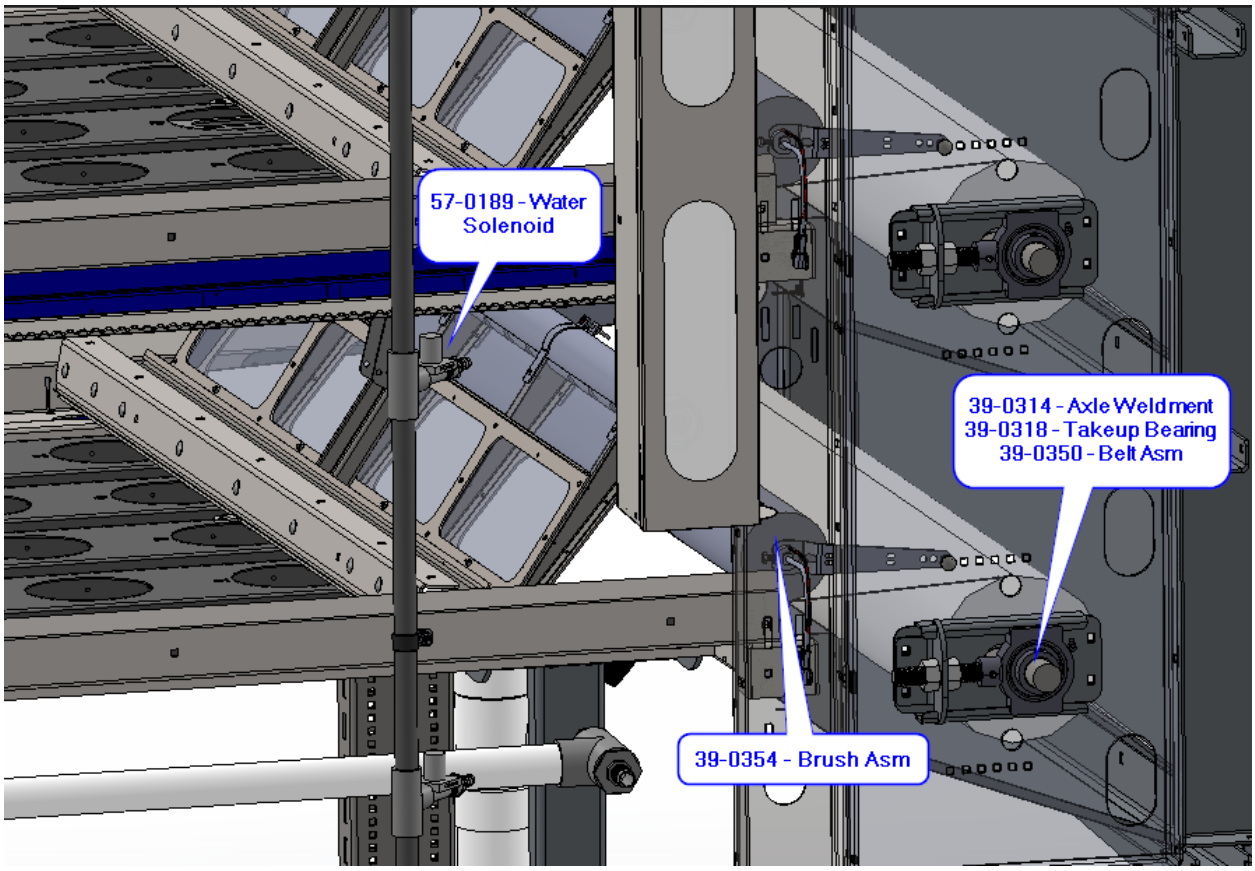
In summary, one production problem can be a result of a single issue or a multitude of issues. As a system operator, you must be willing to investigate every potential avenue to find the root cause of every problem. Simply addressing one potential cause may create other problems later. Thoroughly think through the whole process and ask questions. Take pictures, videos, notes, and anything that would assist in troubleshooting the issue or issues. As always, consult with HydroGreen customer support staff to troubleshoot problems that are occurring.


39-0346 - Clutch Asm
37-0144 - Motor/Gearbox Asm
57-0175 - Node
37-0130 - Solenoid Asm
Z


54-0004 - Pneumatic Cylinder
39-0157 - Motor/Gearbox Asm
39-0358 - Spindle Asm
39-0348 - Rope Asm
53-0201 - Bearing Asm
57-0175 - Node
37-0130 - Pneumatic Solenoid
Y
X
Z


39-0144 - Seeder Motor Asm
54-0005 - Lift Cylinder
39-0017 - Complete Seeder Asm
39-0134 - Seed Paddle Asm


37-0076 - Spray Motor Asm
39-0335 - Spray Drive Arm Asm
35-0050 - Yellow Nozzle Asm
55-0100 Yellow Nozzle
35-0051 - Blue Nozzle Body
55-0101 - Blue Nozzle


57-0189 - Water Solenoid
39-0314 - Axle Weldment
39-0318 - Takeup Bearing
39-0350 - Belt Asm
39-0354 - Brush Asm