

DGS 66 Grow System

Owner Manual



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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

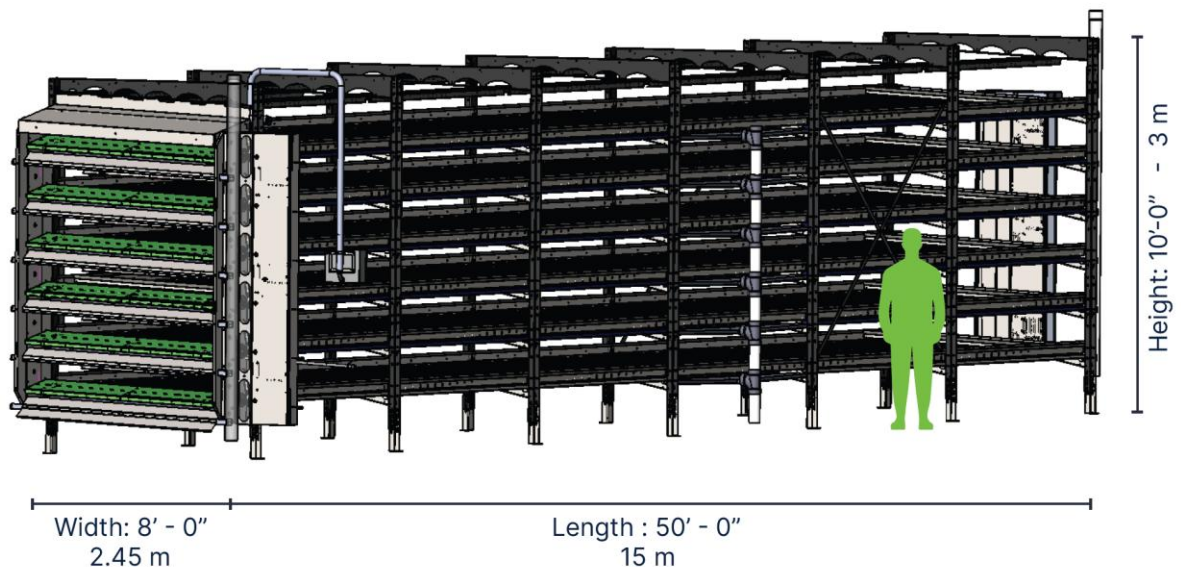
The HydroGreen DGS 66 System consists of 6 levels (vertical) and 6 sections long (horizontal) with an water sizer with remote pump that can service multiple system. All actions performed by the DGS 66 Systems are controlled by a touchscreen computer managed by the owner. These actions include seeding, watering, lighting, harvesting, sizing, and re-seeding to start a new crop.

The intended use of a DGS 66 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 DGS 66 using equipment outside of HydroGreen Standards which can damage equipment.

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

APPROXIMATIVE DGS 66 MODULE DIMENSIONS



Serial Number Plate

The Serial Number Plate for DGS 66 is located on the front of the machine. This manual is for GLS 808 with serial numbers 128000-129000.



Installation

Installation of HydroGreen DGS 66 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 Growing System, please read the owner's manual in its entirety and follow all instructions!

Restrict the use of your HydroGreen system to users who have read, understand and can follow 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 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.
- There are no blades or knives used to size the fodder as the fodder is moved off the grow system tables during harvest.
- Safety guards are located over parts of the system that could be potentially dangerous. Never operate this machine without all 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.

Safety Decals

	<p>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</p>	<p>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</p>
	<p>M004 – Wear Eye Protection Category: Mandatory Action Hazard: Flying Object / Particles</p>	<p>M004 – Use protección ocular Categoría: Acción obligatoria Peligro: Objeto volador / partículas</p>
	<p>M003 – Wear Ear Protection Category: Mandatory Action Hazard: Noise</p>	<p>M003 – Use protección auditva Categoría: Acción obligatoria Peligro: Ruido</p>
	<p>P015 - No Reaching In Category: Prohibition Hazard: Injury to Hands</p>	<p>P015 – Sin llegar Categoría: Prohibición Peligro: Lesiones en las manos</p>
	<p>W001 – General warning sign Category: Warning Hazard: Risk to Specified by the supplementary sign</p>	<p>W001 – Señal de advertencia general Categoría: Advertencia Peligro: Riesgo especificado por la señal complementaria</p>
	<p>W024 – Crushing of Hands Category: Warning Hazard: Closing Mechanical Parts of Equipment</p>	<p>W024 – Aplastamiento de manos Categoría: Advertencia Peligro: Cierre de piezas mecánicas del equipo</p>
	<p>W011 – Slippery Surface Category: Warning Hazard: Slippery Surface</p>	<p>W011 – Superficie Categoría: Advertencia Peligro: Cierre de piezas</p>
	<p>W012 – Electricity Category: Warning Hazard: Taking care to avoid coming</p>	<p>W012 – Pericolo elettricitá Categoría: Advertencia Peligro: Avendo cura di evitare di venire</p>
	<p>W041 – Breathing Hazard Category: Warning Hazard: Taking care to avoid exposure to asphyxiating atmosphere</p>	<p>W041 – Pericolo respiratorio Categoría: Advertencia Peligro: Avendo cura di evitare l'esposizione ad atmosfere asfissianti</p>

Decal Locations

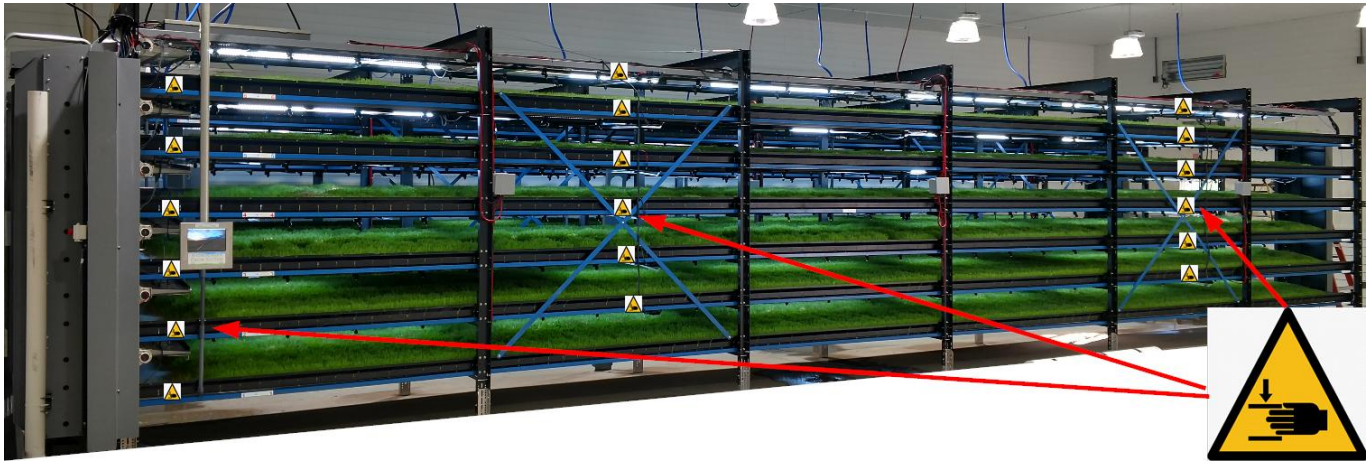
Entry Door



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



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



Mandatory Action: Wear Eye Protection!



Ear Protection – Noise levels are elevated to the 75-80 dB range during harvest.



Mandatory Action: Wear Ear Protection!



High-Pressure Water - The HydroGreen Grow System uses high-pressure water to size the product during harvest. Keep body parts out of the sizing area during harvest!

Pinch Point – As the sizer frame moves side to side it could present a pinch point. Keep body parts out of the sizing area during harvest!



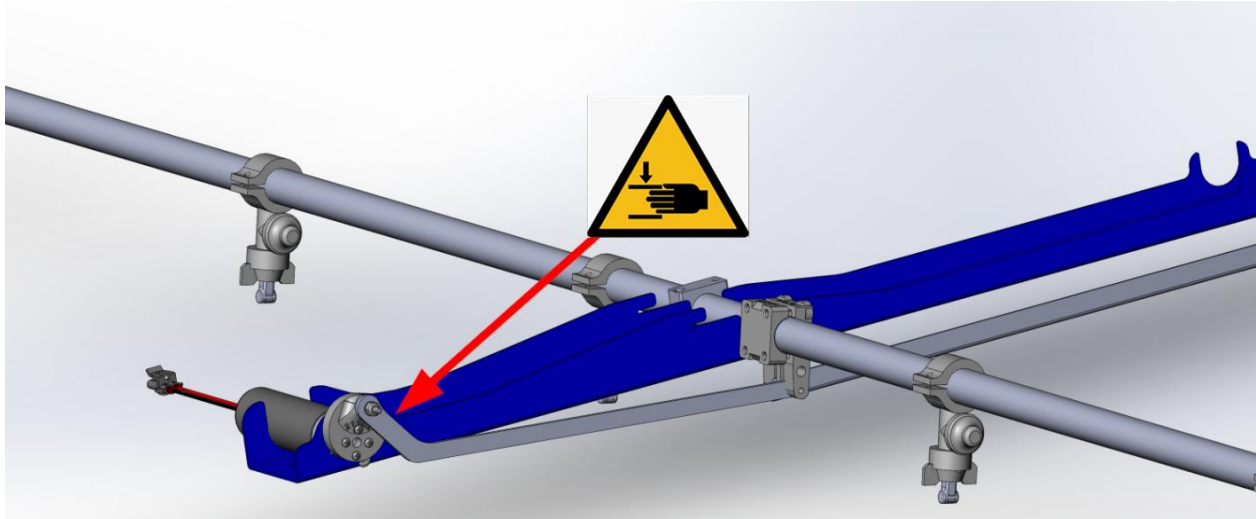
Prohibited: No Reaching In!!



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!!



Moving Parts – During the seeding, harvesting and re-seeding processes, the belt on each table moves back and forth. Although not particularly dangerous, caution around the belt during those times is recommended.



Warning: General Warning!!



Slippery Surface – During the harvest and cleaning process, the floor of the grow room could become wet and slippery. Take caution while walking, clean and dry the floor, and when using a floor cleaner, employ an anti-slip cleaner.



CAUTION: Slippery Surface!



Safety Features

Lock Out Tag Out (LOTO)

The Lock Out Tag Out procedure is to turn off Main Power switch, which is located on the front of the machine, and place a LOTO lock on the switch.



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.

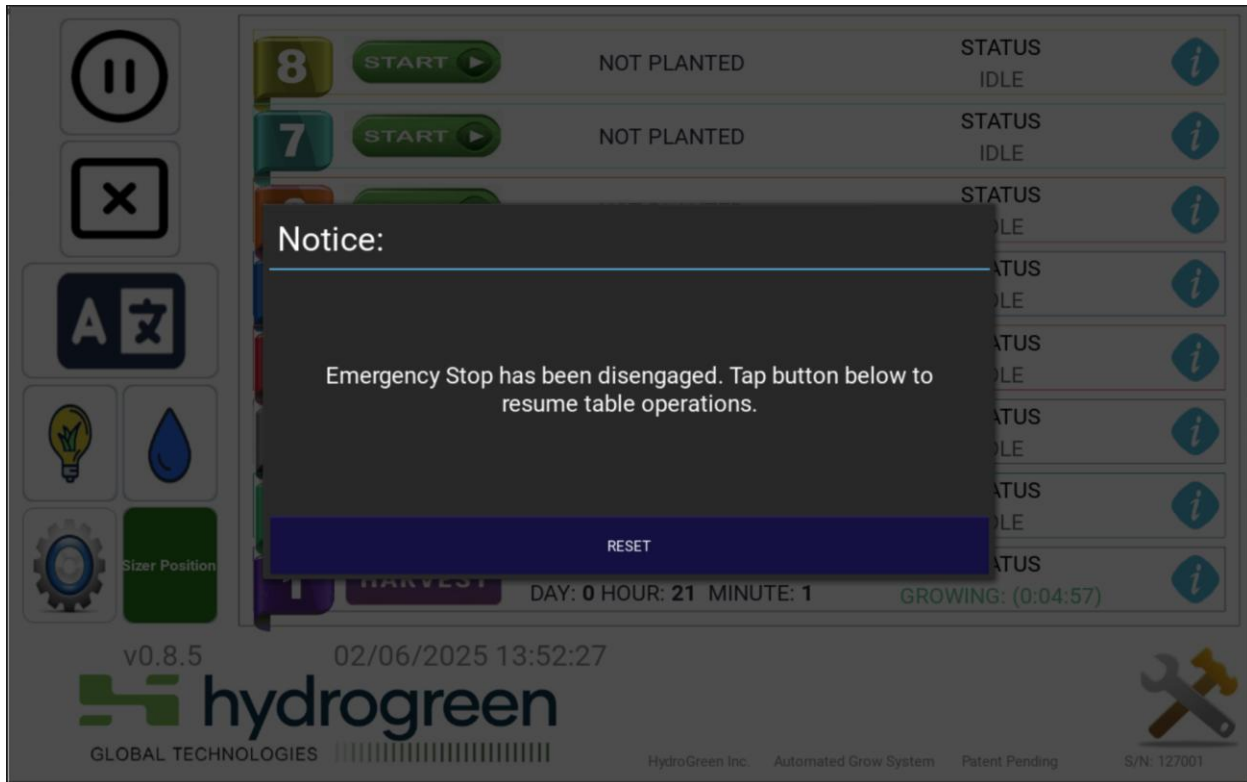
In general, the machine will attempt to continue watering/lighting in all conditions as long as the user can still control the machine via the HMI. However, loss of power during the operation of potentially hazardous machine outputs will result in a total shutoff that persists until power is restored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

Emergency 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.



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.

Workstation

The workstation (floor area where the operator will stand while managing the computer control panel) can be designated to one of two locations, depending on the particular machine configuration in the grow room.

The first picture shows the workstation at the front of the machine, while the second picture shows the workstation at the side of the machine.



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 screenshot displays the main control interface for the HydroGreen system. On the left is a sidebar with control icons: a pause button, a close button, a language selector (English), a lightbulb icon, a water drop icon, and a gear icon. The main area features a table with 6 levels, each with a 'HARVEST' button and status information. At the bottom, the version (v0.8.9), date/time (04/01/2025 10:16:04), HydroGreen logo, and system details are shown.

Level	Harvest Button	Planted Time	Status
6	HARVEST	DAY: 5 HOUR: 18 MINUTE: 21	GROWING: (2:41:37)
5	HARVEST	DAY: 4 HOUR: 19 MINUTE: 48	GROWING: (2:41:37)
4	HARVEST	DAY: 3 HOUR: 19 MINUTE: 20	GROWING: (2:21:37)
3	HARVEST	DAY: 2 HOUR: 18 MINUTE: 43	GROWING: (2:21:37)
2	HARVEST	DAY: 1 HOUR: 20 MINUTE: 40	GROWING: (2:21:37)
1	HARVEST	DAY: 0 HOUR: 19 MINUTE: 28	SPRAYING: (0:01:01)

v0.8.9 04/01/2025 10:16:04
hydrogreen
 GLOBAL TECHNOLOGIES

HydroGreen Inc. Automated Grow System Patent Pending S/N: 127004

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.

Advanced Settings

Advanced

ECUs

Advanced Settings

Reverse Harvest Motors	<input checked="" type="checkbox"/> ON <input type="checkbox"/> OFF	Reverse Seeding Motors	<input type="checkbox"/> ON <input checked="" type="checkbox"/> OFF
Gutter Spray Duration (sec)	30	Gutter Spray Frequency (hr)	1
Split Level Watering	<input checked="" type="checkbox"/> ON <input type="checkbox"/> OFF	Seeding Start Delay (sec)	30
Disinfectant Start Delay (sec)	150	Seed Soak Time (sec)	180
Harvest Speed Slope (0-2)	1.25	Cutter Start Delay (sec)	100
Max Levels Watering (1-3)	1	Engage Disinfectant Boom While Rolling Belt Out	<input type="checkbox"/> ON <input checked="" type="checkbox"/> OFF

BACK

APPLY

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.

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.

Split Level Watering

The split level watering option is for systems with low water pressure. It enables the system to water half of a level at a time. (front/rear)

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.

Disinfectant Start Delay

This time delays the seed disinfectant spray boom until the belt is under the boom.

Seed Soak Time

This time delays the water schedule allowing a time for the disinfection treatment of the grain.

Harvest Speed Slope

The harvest speed slope controls the rpm of the harvest motor to maintain a consistent wedge size during harvest. The higher the number, the smaller the wedges.

Cutter Start Delay

This time delays the start of the sizer high pressure water pump until the product is over the sizer.

Max Levels Watering

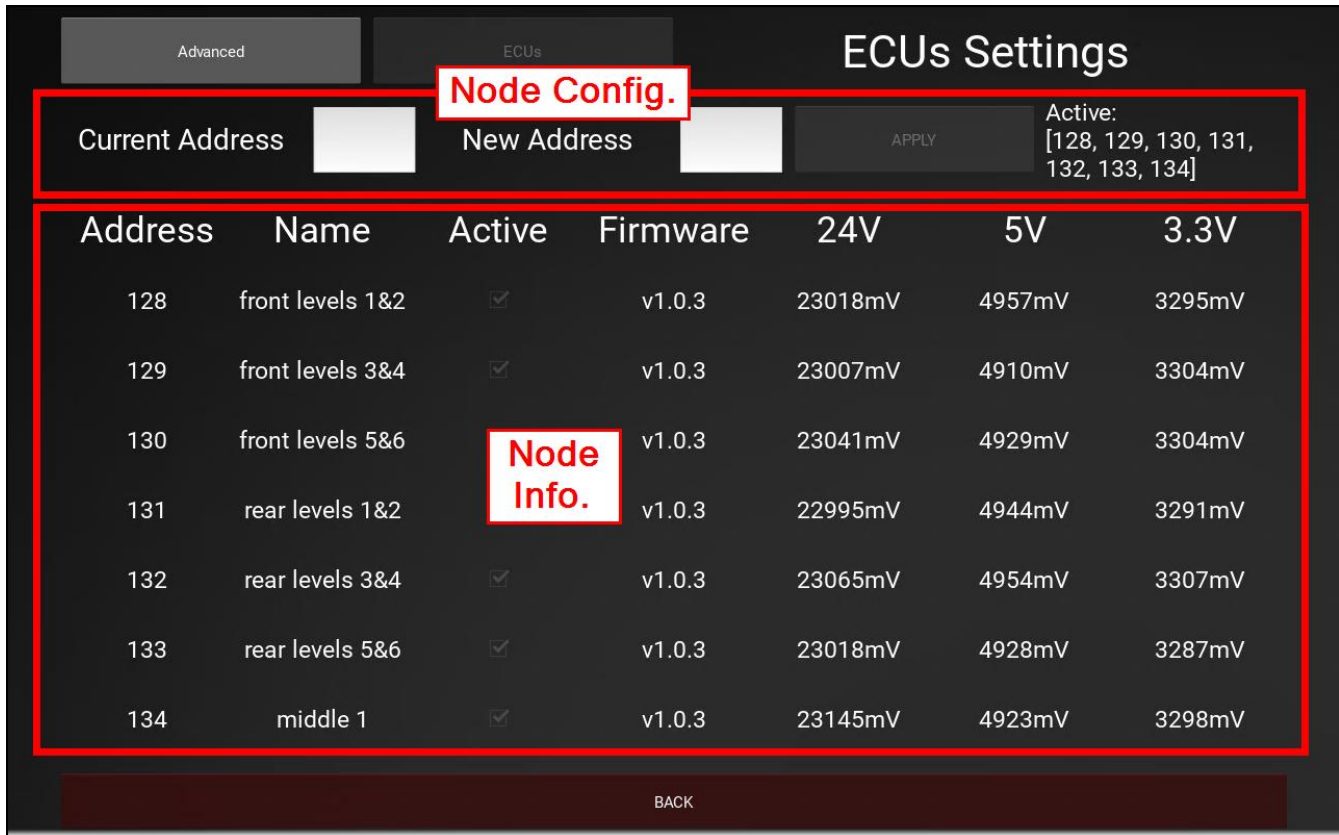
Use this setting to change the number of levels between 1-3 on this table allowed to water simultaneously.

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.

Engage Disinfectant Boom While Rolling Belt Out

This option is only available while **Harvest Then Roll Out Belt** to apply disinfectant water on to belt.

ECU Settings



Advanced ECU's ECU's Settings

Node Config.

Current Address New Address APPLY Active: [128, 129, 130, 131, 132, 133, 134]

Address	Name	Active	Firmware	24V	5V	3.3V
128	front levels 1&2	<input checked="" type="checkbox"/>	v1.0.3	23018mV	4957mV	3295mV
129	front levels 3&4	<input checked="" type="checkbox"/>	v1.0.3	23007mV	4910mV	3304mV
130	front levels 5&6	<input checked="" type="checkbox"/>	v1.0.3	23041mV	4929mV	3304mV
131	rear levels 1&2	<input checked="" type="checkbox"/>	v1.0.3	22995mV	4944mV	3291mV
132	rear levels 3&4	<input checked="" type="checkbox"/>	v1.0.3	23065mV	4954mV	3307mV
133	rear levels 5&6	<input checked="" type="checkbox"/>	v1.0.3	23018mV	4928mV	3287mV
134	middle 1	<input checked="" type="checkbox"/>	v1.0.3	23145mV	4923mV	3298mV

Node Info.

BACK

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

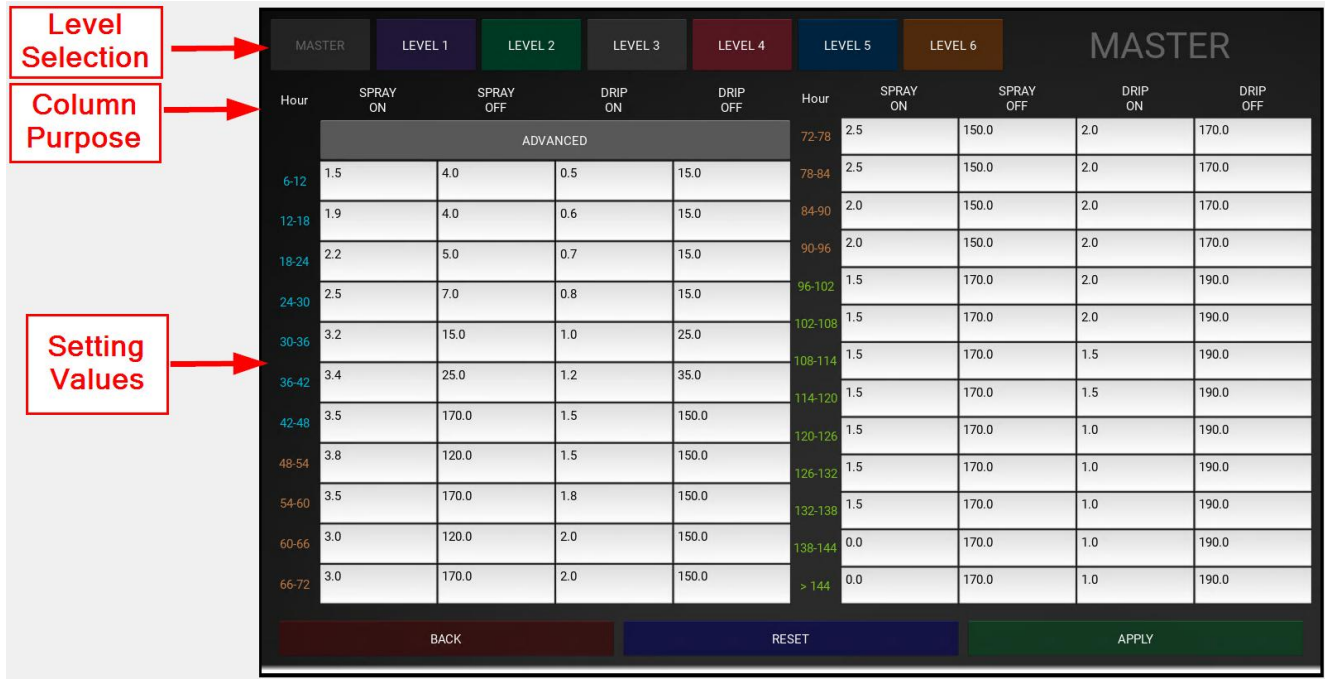
Node Configuration

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



The screenshot shows a water schedule interface with tabs for MASTER, LEVEL 1, LEVEL 2, LEVEL 3, LEVEL 4, LEVEL 5, and LEVEL 6. The MASTER tab is selected. The interface displays a table of watering settings for various 6-hour blocks. The columns are labeled: Hour, SPRAY ON, SPRAY OFF, DRIP ON, and DRIP OFF. The rows represent 6-hour intervals from 6-12 to > 144. A 'BACK' button is at the bottom left, 'RESET' is in the center, and 'APPLY' is at the bottom right.

Hour	SPRAY ON	SPRAY OFF	DRIP ON	DRIP OFF
ADVANCED				
6-12	1.5	4.0	0.5	15.0
12-18	1.9	4.0	0.6	15.0
18-24	2.2	5.0	0.7	15.0
24-30	2.5	7.0	0.8	15.0
30-36	3.2	15.0	1.0	25.0
36-42	3.4	25.0	1.2	35.0
42-48	3.5	170.0	1.5	150.0
48-54	3.8	120.0	1.5	150.0
54-60	3.5	170.0	1.8	150.0
60-66	3.0	120.0	2.0	150.0
66-72	3.0	170.0	2.0	150.0

Level Selection

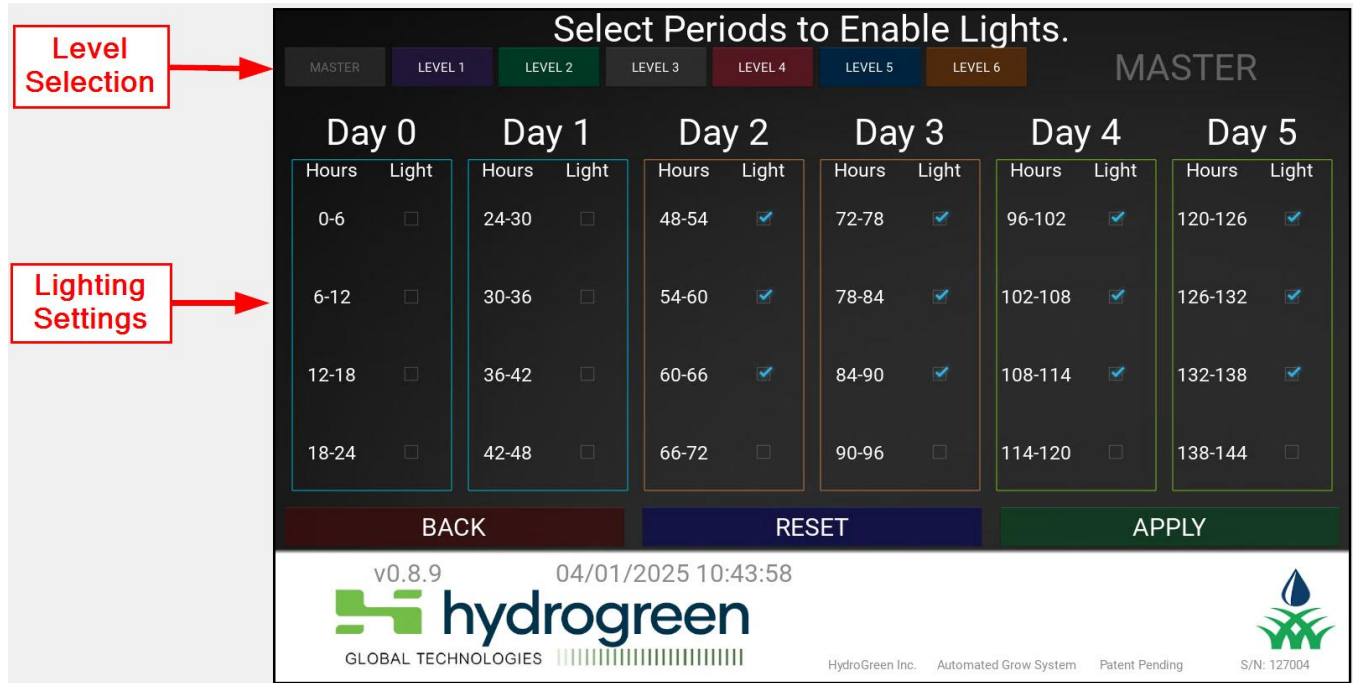
This section contains a tab for each level schedule and an additional tab for the **MASTER** schedule. The Master tab contains settings common to all levels while the remaining tabs each correspond to one specific level on the grow system.

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



The screenshot shows the 'Select Periods to Enable Lights.' screen. At the top, there are tabs for 'MASTER', 'LEVEL 1', 'LEVEL 2', 'LEVEL 3', 'LEVEL 4', 'LEVEL 5', and 'LEVEL 6'. The 'MASTER' tab is selected. Below the tabs, there are six columns representing 'Day 0' through 'Day 5'. Each column has two sub-columns: 'Hours' and 'Light'. The 'Light' column contains a checkbox. The 'Light' checkboxes are checked for the following periods: Day 2 (48-54, 54-60, 60-66), Day 3 (72-78, 78-84, 84-90), Day 4 (96-102, 102-108, 108-114), and Day 5 (120-126, 126-132, 132-138). At the bottom, there are three buttons: 'BACK', 'RESET', and 'APPLY'. The footer contains the version 'v0.8.9', the date and time '04/01/2025 10:43:58', the hydrogreen logo, 'GLOBAL TECHNOLOGIES', and the text 'HydroGreen Inc. Automated Grow System Patent Pending S/N: 127004'.

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

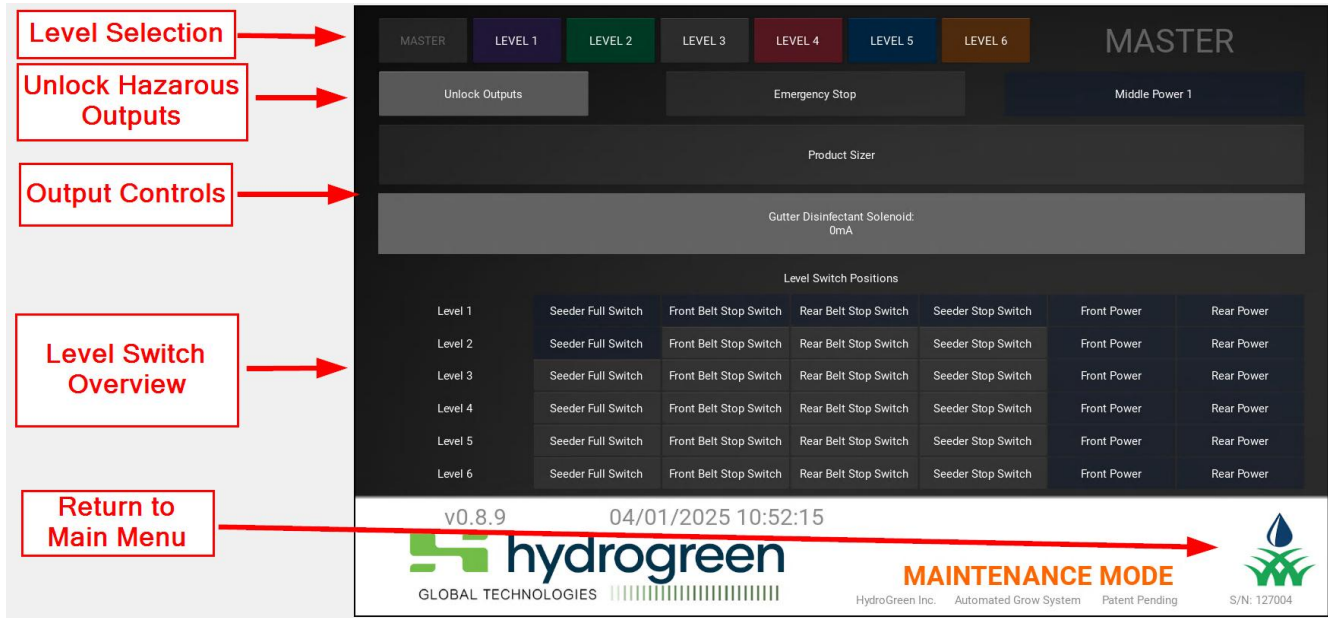
Level Selection

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

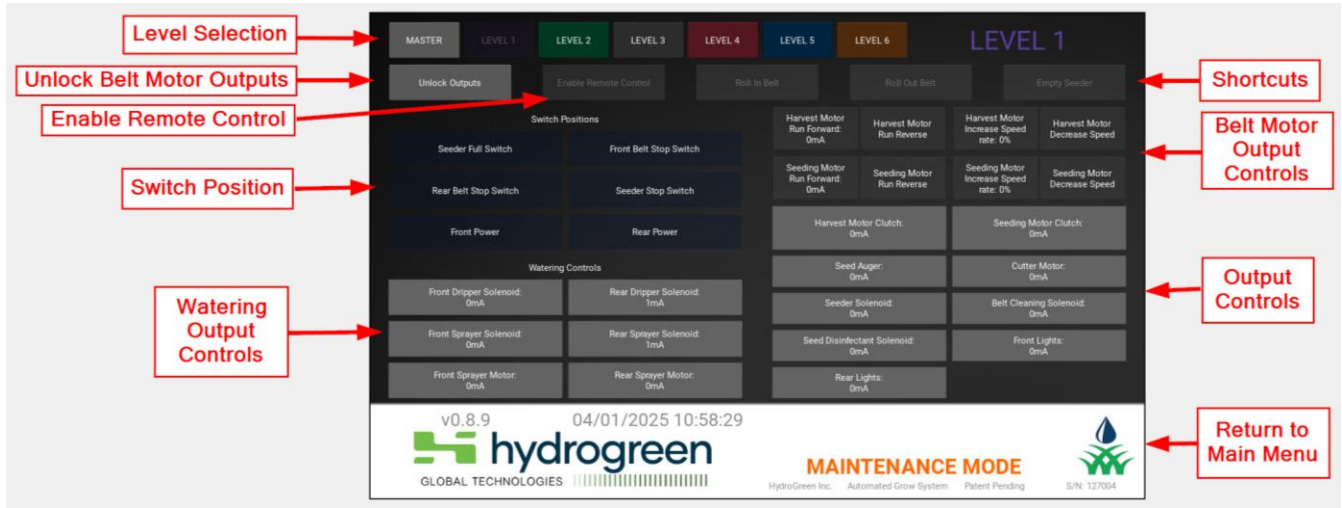
These Buttons allow the user to manually set the output state of general table components.

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.

Unlock Belt Motor 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.

Belt Motor Output Controls

These controls are locked by default and should only be used by HydroGreen train personnel. These controls turn on/off the motor that move the belts.

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.

Water Output Controls

These controls will turn on/off water solenoids and spray boom motors.

Output Controls

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

Information Popup Screens

Level

Level State

LEVEL 1

DRIPPING : DRIPPING REAR

Seeder Full Switch	Front Belt Stop Switch	Harvest Motor Run Forward: 0mA	Harvest Motor Run Reverse
Rear Belt Stop Switch	Seeder Stop Switch	Harvest Motor Increase Speed rate: 0%	Harvest Motor Decrease Speed
Front Power	Rear Power	Seeding Motor Run Forward: 0mA	Seeding Motor Run Reverse
Front Lights: 0mA	Rear Lights: 0mA	Seeding Motor Increase Speed rate: 0%	Seeding Motor Decrease Speed
Gutter Disinfectant Solenoid: 0mA	Emergency Stop	Cutter Motor: 0mA	Harvest Motor Clutch: 0mA
Middle Power 1	Product Sizer	Seed Disinfectant Solenoid: 0mA	Seeder Solenoid: 0mA
		Belt Cleaning Solenoid: 0mA	Seeding Motor Clutch: 0mA
		Front Dripper Solenoid: 0mA	Rear Dripper Solenoid: 2mA
		Front Sprayer Solenoid: 0mA	Rear Sprayer Solenoid: 2mA
		Front Sprayer Motor: 0mA	Rear Sprayer Motor: 0mA

OK

Inputs / Outputs Status

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.

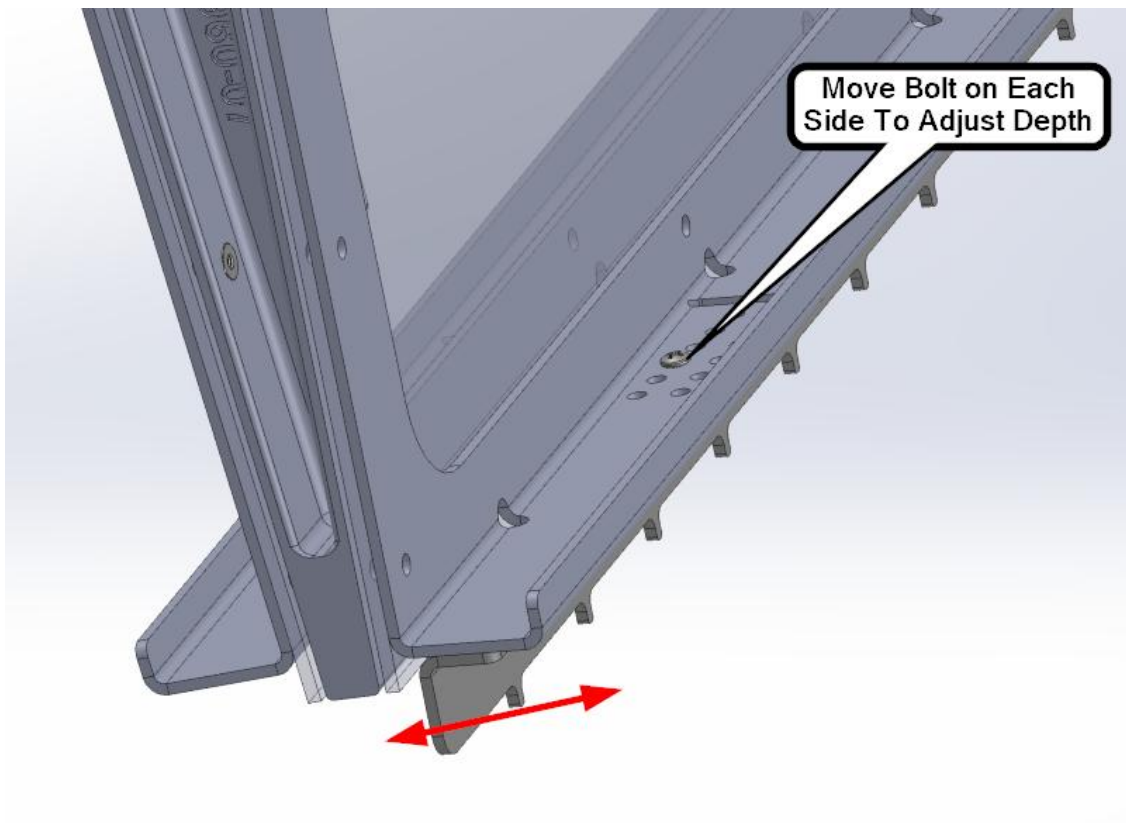
Level Status

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.

Adjusting Seed Depth

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 $\frac{1}{2}$ - $\frac{3}{4}$ 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.



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:

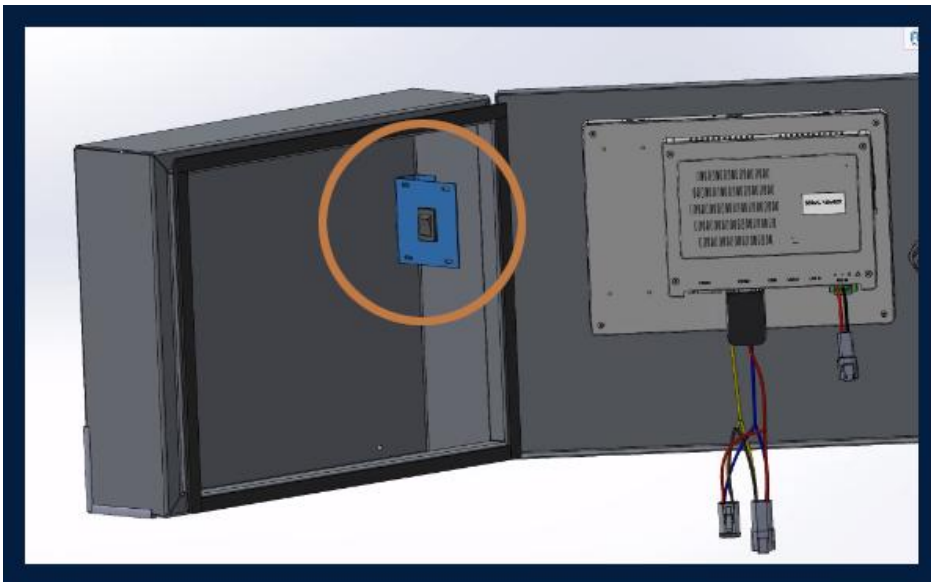
- Verify everyone is clear of the equipment
- Verify that the HydroGreen Growing System is in proper working condition
- Verify that support equipment is in proper working condition

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.



Seeding & Harvesting

- ✓ Minimum requirements are met (see above)
- ✓ 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.

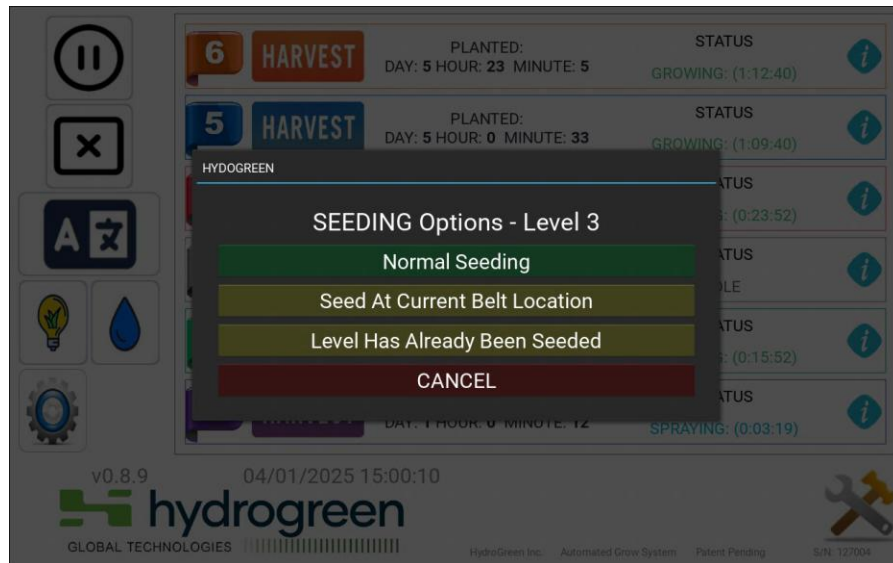
Seed The Table

Single Level Seeding

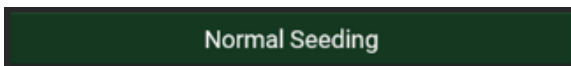
1. Tap the **START** button next to the level you want to seed.



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

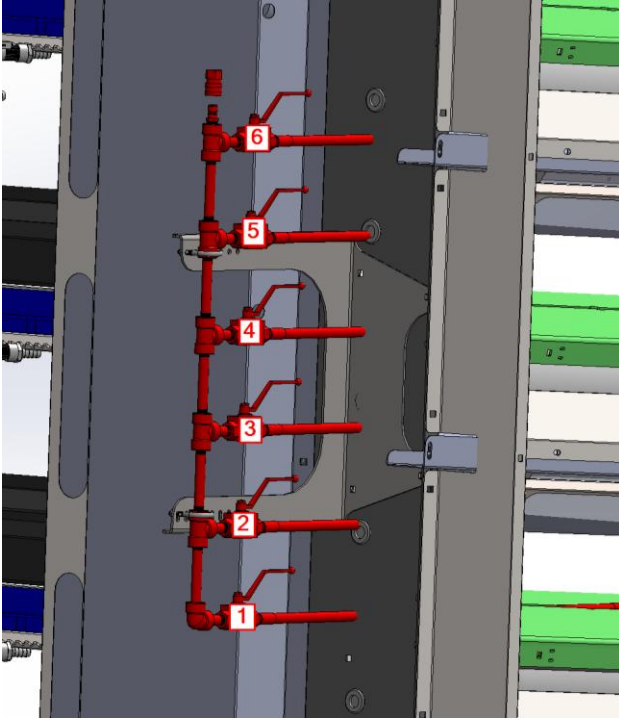
Note: The system will flash the grow lights in a distinct pattern to warn bystanders prior to any harvest action.

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

Harvest The Table

Setup The Sizer for Harvest

1. Identify the level you would like to harvest and locate correlating sizing water valve and open.

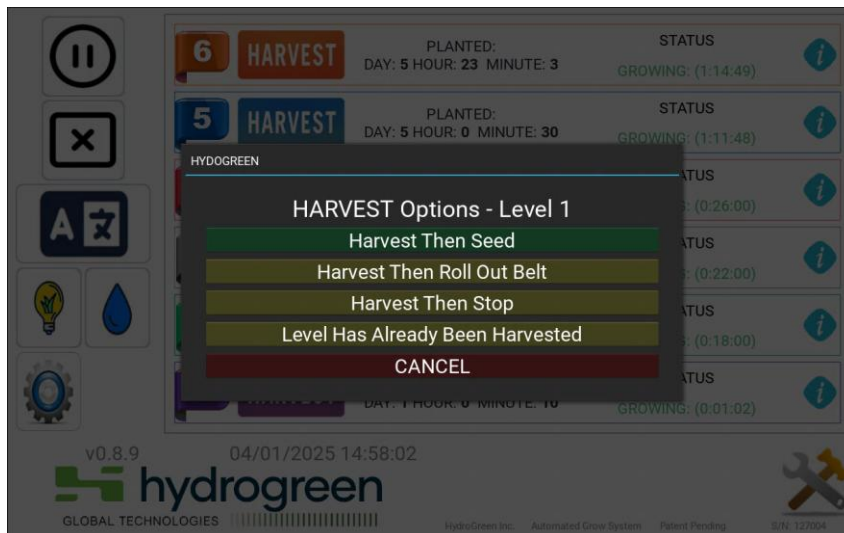


Harvest

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



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



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



4. 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.

Clearing a Product Jam During Harvest

Rarely during harvest, over-grown or irregularly shaped fodder can become jammed in the sizing chute. If such a jam occurs, immediately press one of the “E-Stop” buttons, followed by turning off the high pressure valve. This will stop all energy sources coming to the machine. With the systems energy sources off, use a rake to clear the blockage.



Do Not React In With Any Body Parts



At any point you cannot clean the jam with a rake or other tool, Lock Out Tag Out procedure is required before removal of any parts or any part of your body needs to enter the system.

Maintenance

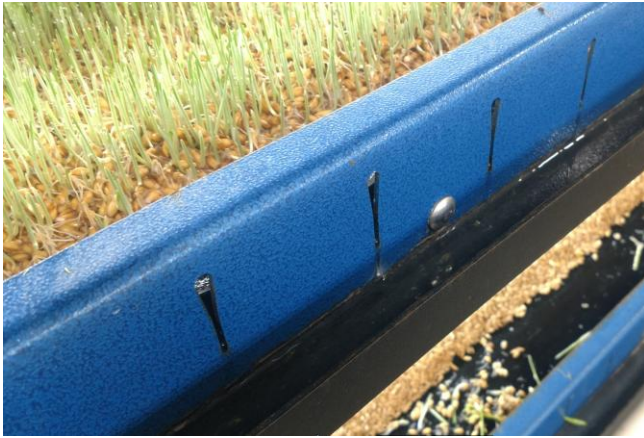
PPE



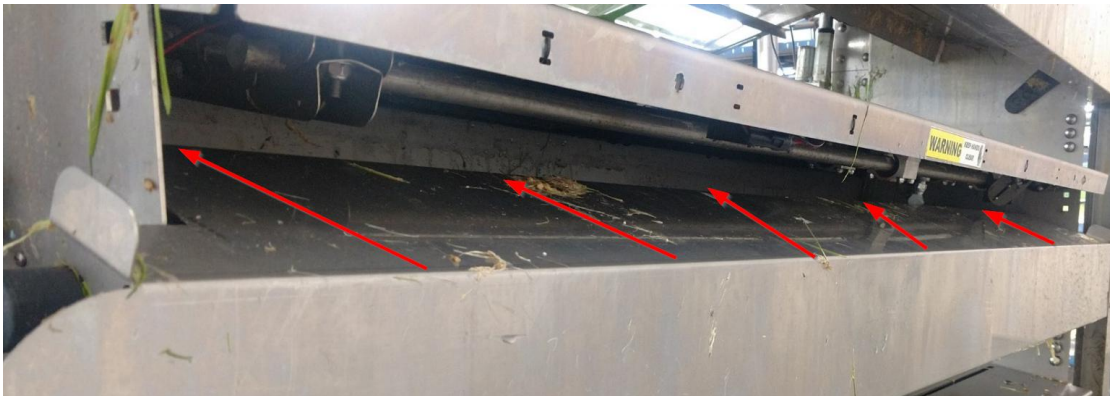
While performing any maintenance or cleaning on the system, eye protection and gloves are required.

Cleaning

Gutters at the outer edges of each level require cleaning at least once a week. A larger brush and a garden hose with nozzles have been found to be effective tools.



Belt Cleaning Shield requires cleaning at least once a week. A garden hose with a nozzle has been found to be an effective tool. Spray in water between the material sizer and gutter. Also, spray in from the open end of the gutter.



Pull Back Bars require cleaning at least once a week. Remove any debris, brush down and rinse clean. A larger brush and a garden hose with nozzles have been found to be effective tools.



Visual Inspections of Key System Components

Belts - Visual inspection of the belts is required daily for the level harvested and re-seeded on that day. Check for any tears or wear that could affect the performance of the system.

Nylon Rope - Visual inspection of the nylon rope is required daily for the level harvested and re-seeded on that day. Check for any fraying or wear that could affect the performance of the system.

Spray Nozzles - Visual inspection of the spray nozzles is required daily for all levels. Check for any plugged tips or un-uniform spray patterns that could affect the performance of the system.

Spray Boom - Visual inspection of the spray boom is required daily for all levels. Check for any of the booms that are not rotating properly, or any spray patterns not centered on the table that could affect the performance of the system.

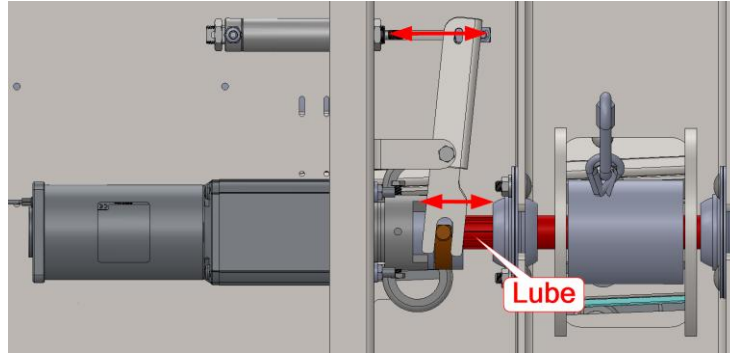
Sizing Nozzles - Visual inspection of the sizing nozzles is required daily for the level that is being harvested. Check for any plugged tips or pieces that are not completely sizing that could affect the performance of the system.

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, front 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



Pressure Pump

After the first 50 hours change out the break-in oil.

Change oil every 500 hours or annual, whichever comes first.

Recommended Oil HG 100 Series Pump Oil.

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

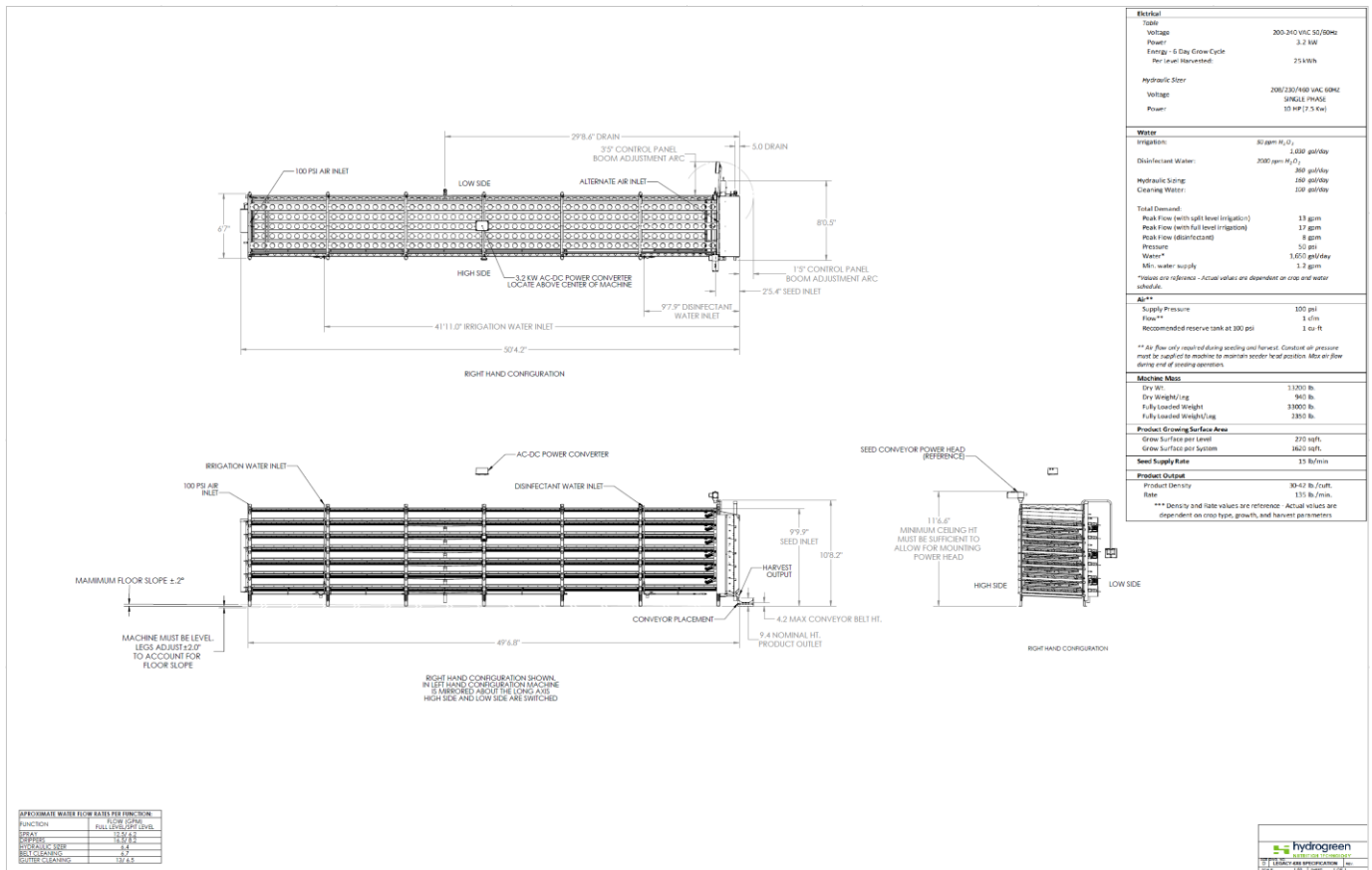
Symptoms & Solutions		
PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDIES
No power at table	Breaker off	Reset breaker
	Large 24VDC power converter overheating	Replace case fan if broken
	Large 24VDC power converter failure	Replace power converter
	E-stop pressed	Release e-stop
No power at screen	Power switch may 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

Lifting and Transporting

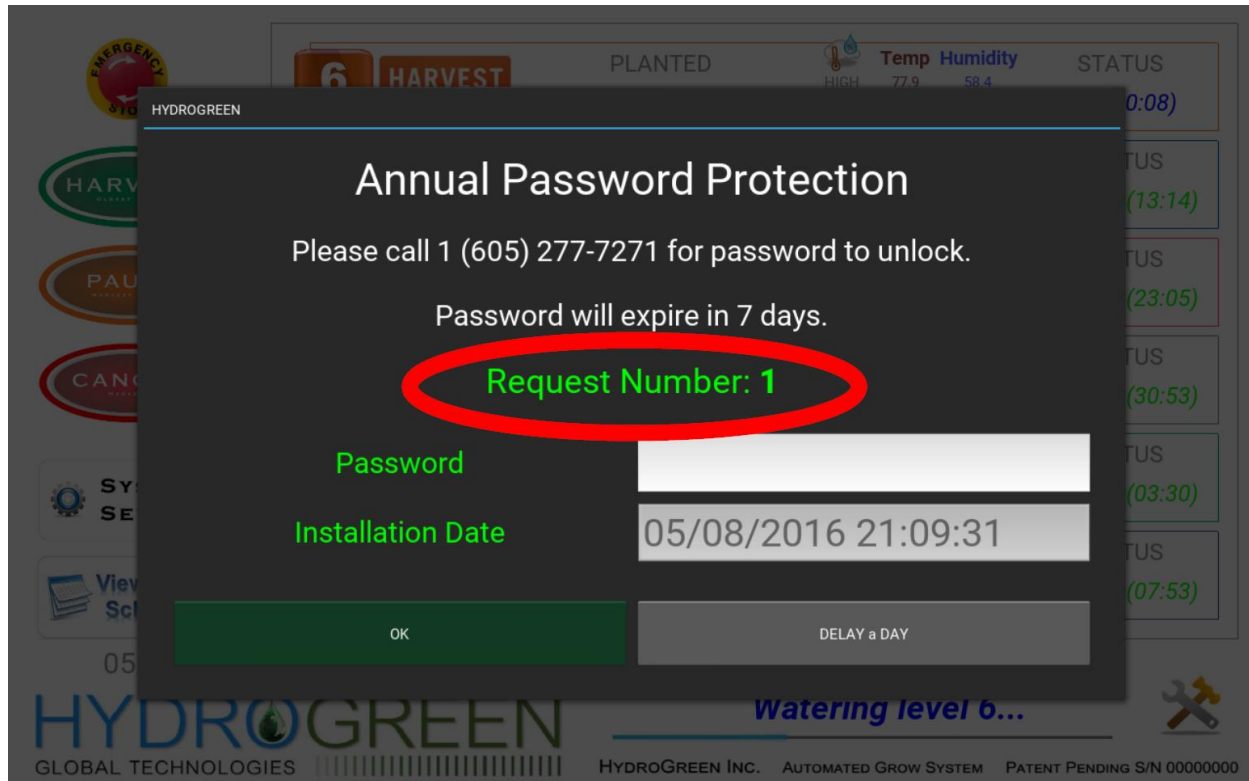
GLS 808 is designed to build and anchored in place. To move or transport the system I will need to be disassembled.

Specifications

Table	
DESCRIPTION	VALUE
Model	DGS 66
Length	50'-4.2"
Width	8'-0.5"
Height	10'-8.2"
Weight	Dry Weight = 13,200 lb. Fully Loaded Weight = 33,000 lb.



Password



Once a year, the Annual Protection Password pop-up will appear. The first time you see this screen you will have 7 days to call the HydroGreen Offices for the password. Note: You will need to give the HydroGreen Team member the Request Number to get the correct password.

HydroGreen Offices: (605) 277-7271

Spare Parts

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

Main Office

HydroGreen
47168 Haylie Street
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

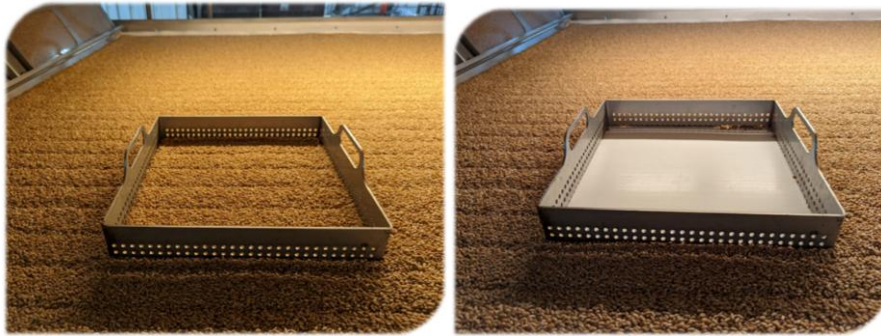
This grain density allows for successful hydration of the grain early on and minimizes heat accumulation and stress. What's unique is the correlation to dry matter yields. Most would think that putting more grain on the system will result in more of the HydroGreen Product. That's simply not the case, 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

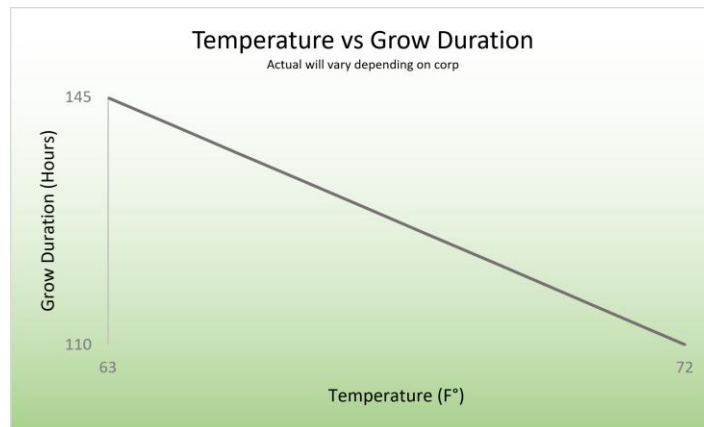
Environmental Standards

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 ₂ O ₂ – Maintenance	ppm	50	180	80
H ₂ O 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

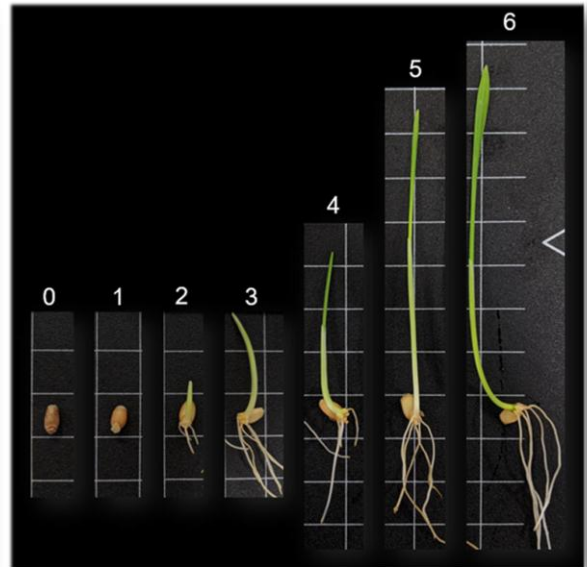
Stages of Growth

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.

MASTER						LEVEL 1						LEVEL 2						LEVEL 3						LEVEL 4						LEVEL 5						LEVEL 6						LEVEL 7						LEVEL 8						ALL LEVEL											
Sprayers												Drippers												Sprayers												Drippers																													
Day	Quarter	ON	OFF	ON	OFF	Water Src	Day	Quarter	ON	OFF	ON	OFF	Water Src	Day	Quarter	ON	OFF	ON	OFF	Water Src	Day	Quarter	ON	OFF	ON	OFF	Water Src	Day	Quarter	ON	OFF	ON	OFF	Water Src																															
Advanced						3	1	1.2	140.0	0.3	140.0	RECYCLED	3	2	0.9	155.0	0.3	154.0	RECYCLED	3	3	0.8	160.0	0.0	160.0	RECYCLED	3	4	0.6	170.0	0.3	170.0	RECYCLED																																
0	1						4	1	0.4	179.0	0.0	179.0	RECYCLED	4	2	0.3	179.0	0.3	179.0	RECYCLED	4	3	0.3	179.0	0.0	179.0	RECYCLED	4	4	0.3	179.0	0.3	170.0	RECYCLED																															
0	2	2.0	7.0	0.5	7.0	RECYCLED	4	5	0.2	160.0	0.0	170.0	RECYCLED	5	1	0.1	150.0	0.0	170.0	RECYCLED	5	2	0.1	140.0	0.0	170.0	RECYCLED	5	3	0.1	140.0	0.0	170.0	RECYCLED																															
0	3	2.5	10.0	0.6	9.0	RECYCLED	5	4	0.0	130.0	0.0	170.0	RECYCLED	5	5	0.0	130.0	0.0	170.0	RECYCLED	5	4	0.3	120.0	0.0	170.0	RECYCLED																																						
0	4	3.4	14.0	0.7	14.0	RECYCLED	Water Minutes Days >= 6																																																										
1	1	3.8	20.0	0.8	19.0	RECYCLED																																																											
1	2	4.2	30.0	1.0	29.0	RECYCLED																																																											
1	3	4.5	40.0	1.0	39.0	RECYCLED																																																											
1	4	4.2	50.0	0.8	49.0	RECYCLED																																																											
2	1	3.8	60.0	0.5	59.0	RECYCLED																																																											
2	2	3.2	75.0	0.5	74.0	RECYCLED																																																											
2	3	2.4	95.0	0.5	94.0	RECYCLED																																																											
2	4	1.8	125.0	0.4	124.0	RECYCLED																																																											

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

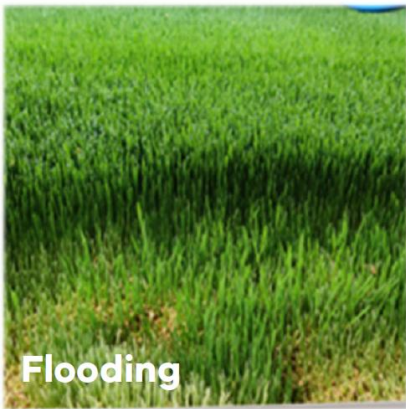
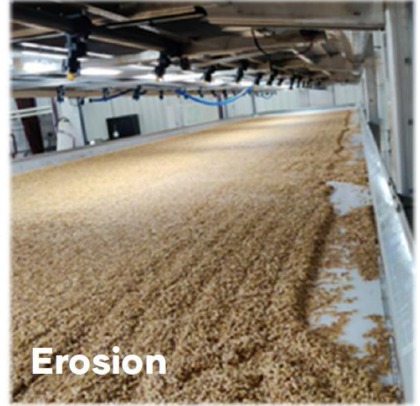
Hydrogen peroxide is essential to the system. It acts as a plant signaling compound and a disinfecting agent. If you're not applying hydrogen peroxide on the system, you're not capturing the full value of the system. Ensure you are always at about 80 ppm. If you're having a difficult time, and the sprouted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

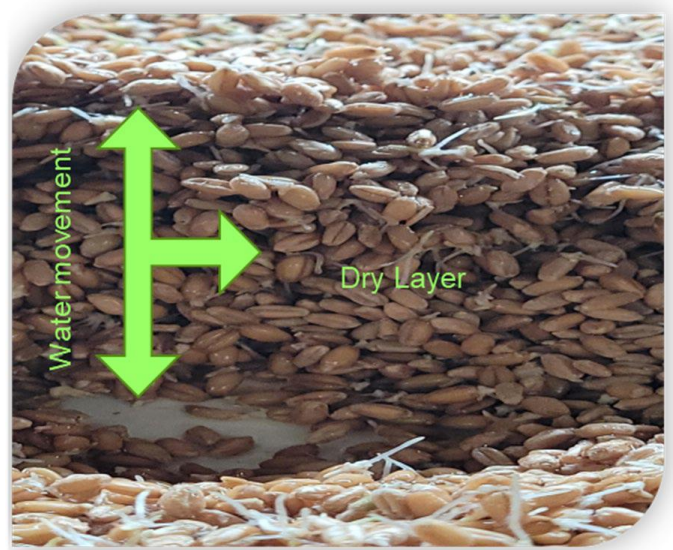
Properly adjusting the system's water schedule will help prevent this issue. Grain hydration should be reviewed after the first 24 hours. Beyond the first 36 hours improper or shallow watering could result in double growth and/or dry pockets of grain.

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.



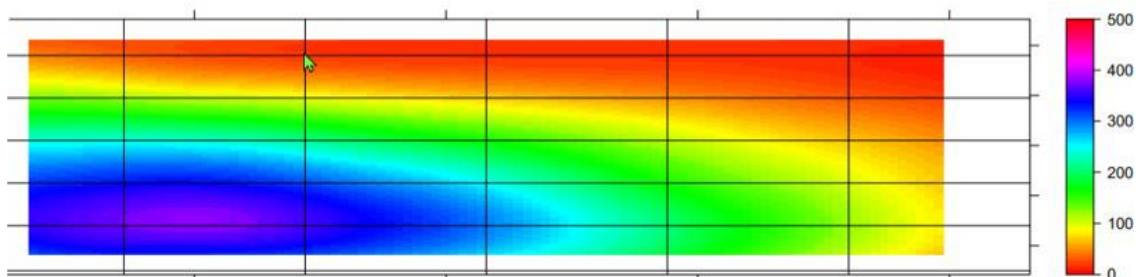
Monitor the airflow of the crop throughout the entire growing cycle.

- 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 unsure 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

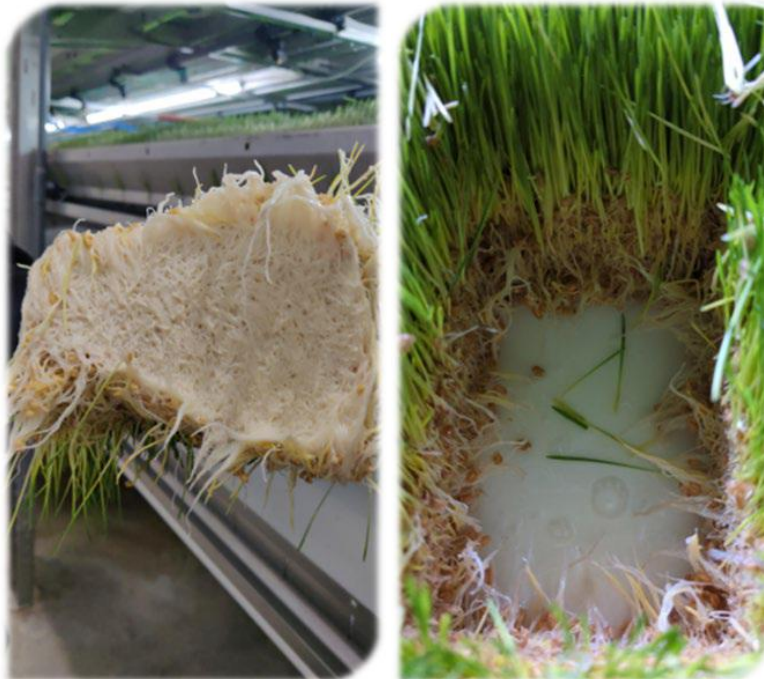
Crop Fermentation can occur during the late stages of growth, prior to harvest, due to excessive watering during the last hours. The roots of the crop will be extremely wet or saturated and will have an acidic or vinegar type odor. Once the crop has reached this point it will be difficult to harvest 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 odor. 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:
 - 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:
 - 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

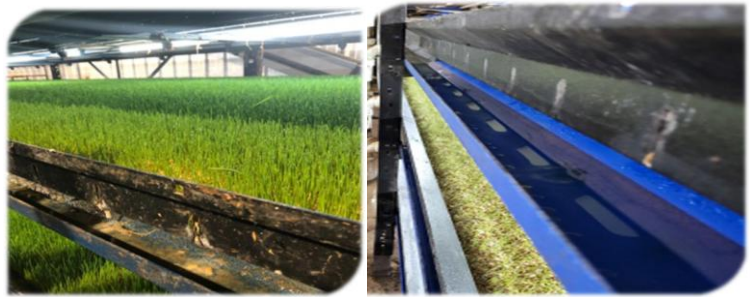
Bacterial buildup can create issues not only with drainage and crop performance, but also with water that is recycled. Any water that sits for a period will allow the bacterial growth to begin. When this occurs, table drains begin backing up, causing flooding issues and poor crop performance. Cleaning 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.