Greenhouse Internal Infrastructure Systems

Indigenous Greenhouse Factsheets

Project sponsor: the B.C. Indigenous Advisory Council on Agriculture and Food (IACAF)

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Introduction

Greenhouse structures house several internal systems that work to create optimal growing conditions for your plants. This factsheet provides an overview of these critical components: Irrigation, Ventilation, Temperature Control and Lighting.

Irrigation

Greenhouses commonly have overhead and drip irrigation systems. Drip systems deliver water directly to the plant root zone which reduces waste and helps prevent foliage diseases. Drip irrigation is often considered essential for tomato and cucumber growing. Overhead irrigation systems are often used in nursery settings for seedlings.

Some greenhouses internally locate water tanks to warm the water to the same temperature as the greenhouse. This helps prevent shocking the plants with cold water. Even the most simple irrigation systems can be automated with timers which can help reduce labour needs, and improve consistency.

Figure 1. Overhead irrigation system at Twin Sisters Nursery.

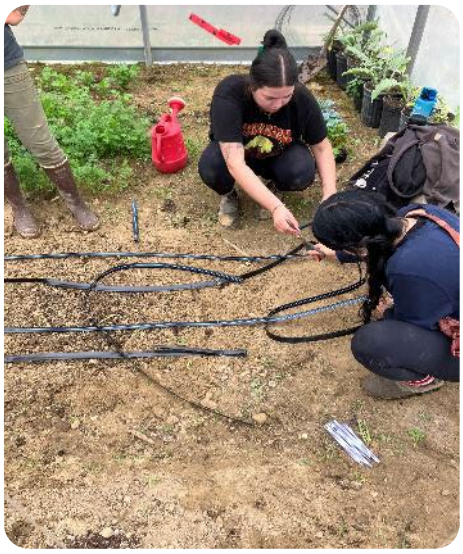

Figure 2. Amisk Farm crew installing drip line irrigation systems.

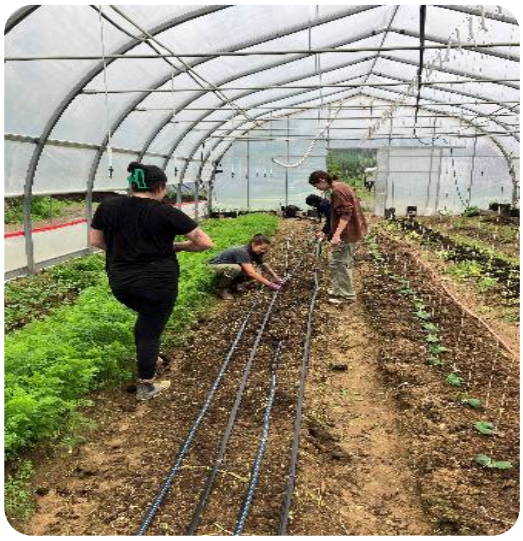

Figure 3. The drip lines are held in place using ground staples prior to being covered with landscape fabric.

Ventilation: Airflow and humidity management

Ventilation in a greenhouse is critical to support airflow and prevent excess humidity and associated plant diseases. The simplest form of greenhouse ventilation is provided by passive airflow through roll-up sides and roof vents (Figure 4). Mechanical ventilation can be integrated in the form of positive pressure fans and horizontal air flow (HAF) fans (Figure 5). These fan systems circulate air efficiently and are great at preventing humidity buildup. You can install automatic vents on the ends of the greenhouse. These vents open and close based on the temperature and humidity settings you choose on the controller. Humidity optimization should also be considered. Heating and ventilation systems can work together to remove excess moisture, preventing fungal diseases. If the greenhouse environment becomes too dry, then a misting system might be necessary.

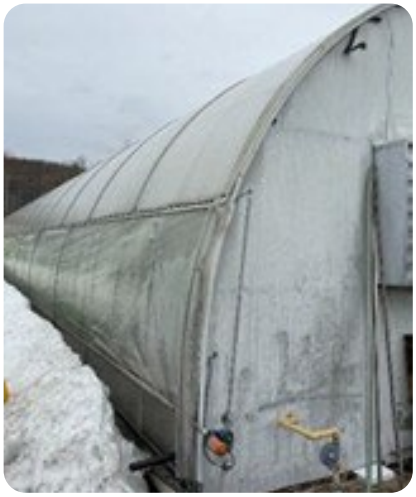

Figure 4. Roll-up sides on motors to allow for automation.

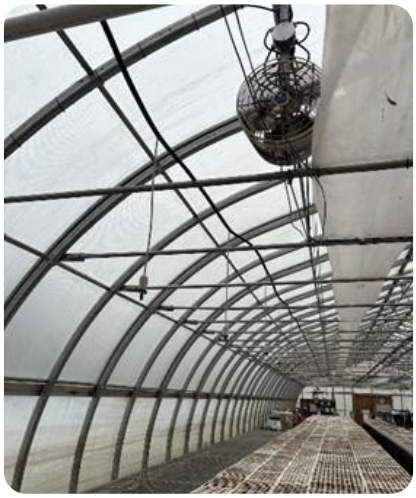

Figure 5. HAF fan provides air flow inside the greenhouse. This helps mix warm and cool air in the greenhouse and lowers the chance of fungal diseases.

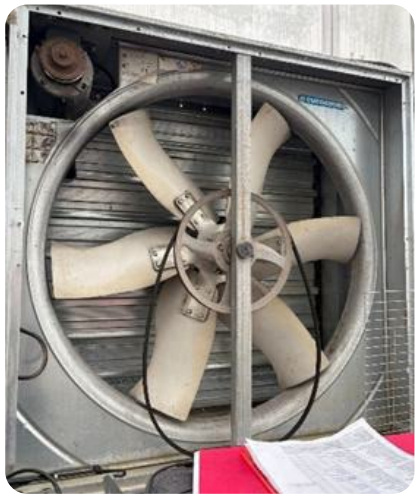

Figure 6. A large exhaust fan. These are important for growing in heated greenhouses during winter because they help control temperature and humidity without needing to open roof or wall vents.

Heating and cooling

Temperature management systems in greenhouses extend growing seasons and improve yields. Propane and natural gas are the most common energy sources for greenhouse heating systems and can be cost-effective and reliable. However, external boilers are also common and can include a diversity of fuel sources such as wood, pellets, or even waste oil. Some greenhouses also use geothermal and thermal mass systems as part of their heating setup.

No matter what system you use, if it has fans that blow warm air into the greenhouse, you'll need heating tubes to spread the heat evenly and keep the temperature the same throughout the space. These are simply perforated poly tubes that are connected to heating system blower fans and run across the length of the greenhouse. You can run the heat tubes along the crossbars, but bringing them down to ground level before running them the length of the greenhouse spreads the heat more evenly to the plants. If the heating system is distributed through radiant waterlines, food grade glycol is recommended to avoid issues with freezing.

Cooling greenhouses can be required during the warmest parts of summer. Shade cloths can be placed directly over the top of the greenhouse or installed inside on rollers that stretch across the bottom of the roof supports. Alternatively, there are greenhouse-specific paints available that still emit various types of light.

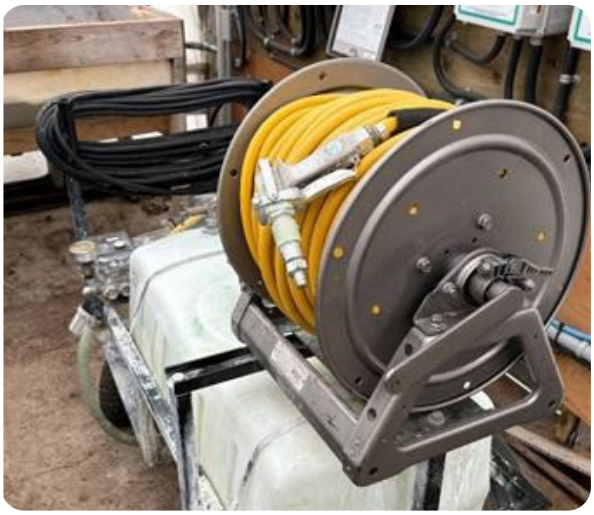

Figure 7. Large sprayer used to paint the exterior of Twin Sisters Native Plant Nursery greenhouses to reduce temperatures during summer.

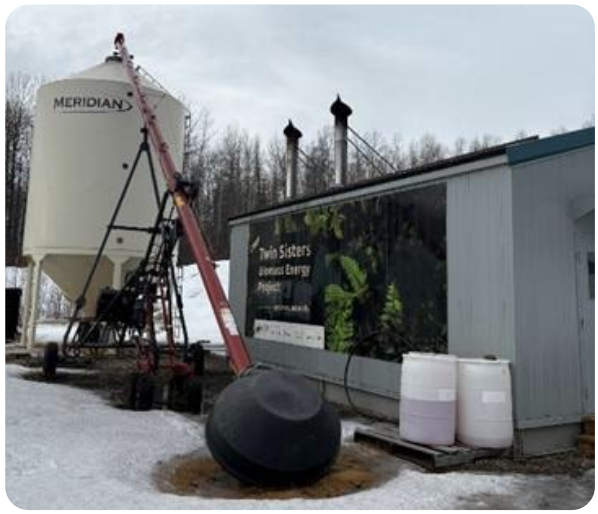

Figure 8. A perforated poly tube used to spread warm air from a large blower fan connected to a propane furnace.

Figure 9. Exterior of Twin Sisters Native Plant nursery pellet boiler. The auger is used to fill up the hopper with wood pellets. These systems depend on stable and affordable access to wood pellets.

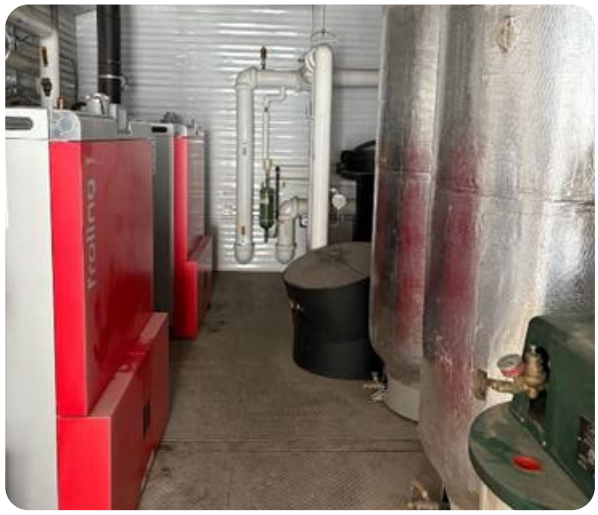

Figure 10. Aninside view of the wood pellet boiler system.

Lighting

Lighting is a critical component of greenhouse production, especially in regions with limited daylight during late fall and winter months or for crops that require extended photoperiods. Proper lighting ensures consistent plant growth, improves yields, and allows for year-round production.

Key Consideration for Greenhouse Lighting:

1. **Light Intensity:** Measured in PAR (Photosynthetically Active Radiation), which is the range of light wavelengths (400-700 nm) that plants use for photosynthesis. Ensure lighting systems provide adequate PAR for your crops.
2. **Photoperiod:** The duration of light exposure plants receive each day. Some crops require long days (e.g., 14-16 hours of light) to trigger flowering or fruiting.
3. **Energy Efficiency:** Choose lighting systems that balance energy consumption with light output to minimize operational costs.
4. **Heat Output:** Some lighting systems generate significant heat, which can affect greenhouse temperature and humidity. Proper ventilation is essential to manage heat buildup.

Common types of greenhouse lighting

1. **High-Intensity Discharge (HID) Lights:** Includes Metal Halide (MH) and High-Pressure Sodium (HPS) lights.
    a. **Pros:** HPS lights are highly efficient and provide a broad spectrum of light, ideal for flowering and fruiting crops. MH lights emit a bluer light spectrum, suitable for vegetative growth.
    b. **Cons:** High energy consumption and heat output; requires proper ventilation and cooling systems.
    c. **Suitable for:** Large-scale greenhouses with high-value crops like tomatoes, peppers, and cucumbers.

2. **Light-Emitting Diodes (LEDs):**
    a. **Pros:** Energy-efficient with a long lifespan (50,000-100,000 hours). Customizable light spectra (e.g., red, blue, or full spectrum) to optimize growth for specific crops. Low heat output, reducing the need for additional cooling.
    b. **Cons:** Higher upfront cost compared to HID lights.
    c. **Suitable for:** Small to medium-scale greenhouses, propagation, and supplemental lighting for high-value crops.
3. **Fluorescent Lights:** Includes TS and TS fluorescent tubes.
    a. **Pros:** Low heat output, making them ideal for seedlings and young plants. Affordable and easy to install.
    b. **Cons:** Lower light intensity compared to HID and LED systems; less efficient for large-scale production.
    c. **Suitable for:** Seed starting, propagation, and low-light crops like leafy greens.
4. **Induction Lights:**
    a. **Pros:** Long lifespan (up to 100,000 hours) and energy efficiency. Low heat output and minimal maintenance.
    b. **Cons:** Higher initial cost and less common in commercial greenhouses.
    c. **Suitable for:** Supplemental lighting in small to medium-scale operations.

Lighting system management tips

- **Light distribution:** Ensure even light distribution across all plants by positioning lights at appropriate heights and angles.
- **Lighting schedule:** Use timers or automated systems to control photoperiods and ensure consistent light exposure.
- **Energy savings:** Combine natural sunlight with supplemental lighting to reduce energy costs.

- **Monitoring:** Regularly measure light levels (using a PAR meter) to ensure crops receive optimal light for growth.

Automation of greenhouse systems

Automation systems are amazing time and labor- saving upgrades that can improve the overall growing conditions within a greenhouse. A climate controller can be used to automate heating, ventilation, and dehumidification based upon sensor data. An external sensor can also be installed that monitor weather systems and preemptively adjusts greenhouse conditions.

Another benefit of these modern automation systems is that many are smartphone-compatible and allow for remote monitoring and adjustments.

Figure 11. A weather station was installed on the greenhouse ridge. These systems can be used to control automation within the greenhouse.

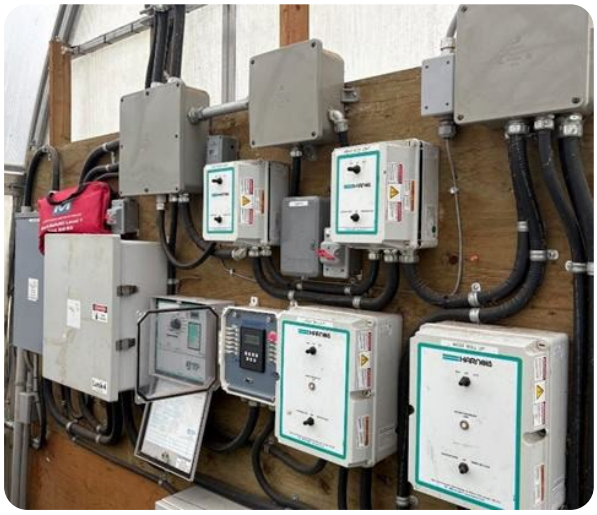

Figure 12. Electrical panel and automation system at Twin Sisters Native Plant Nursery.

Additional infrastructure

It is important to consider any other additional infrastructure that your greenhouse project might require. For example, a lack of proper storage can cause the loss of expensive greenhouse inputs. A well set up cleaning and packing station near your greenhouse is extremely valuable. Additionally, having cold storage on, or near your greenhouse site can maximize produce quality and shelf life by enabling you to get it to refrigerated temperatures as soon as possible. Factor the cost of these infrastructure pieces from the beginning: storage, staff area, office space, potting shed, walk-in cooler, shop space, vegetable wash stations, etc

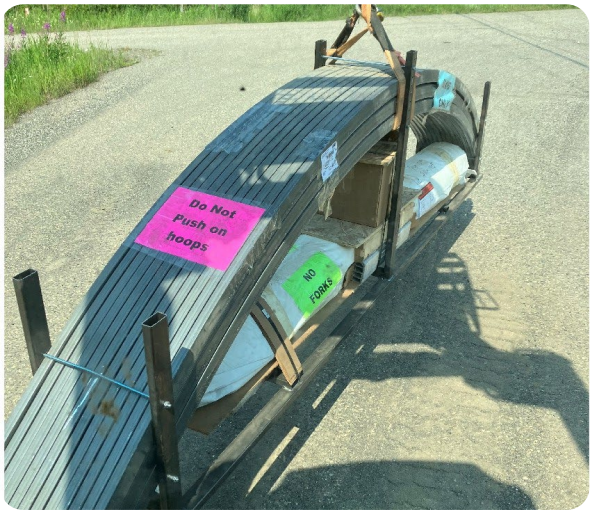

Figure 13. Uploading 80 ft hoophouse

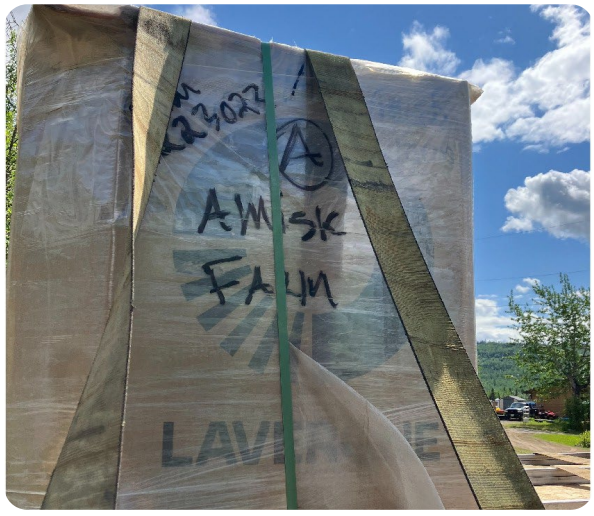

Figure 14. Shipping an 80 ft double walled greenhouse required an entire lowbed truck

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