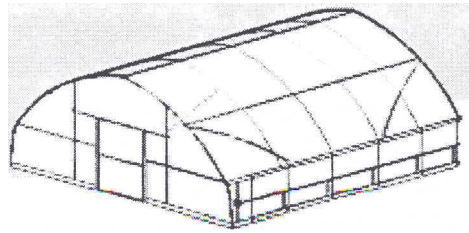


Choosing a Greenhouse



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How Do You Choose a Greenhouse?

Greenhouse Design and Construction

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Changes in the greenhouse industry during the past 10-15 years have made greenhouse facilities much more expensive. This makes it necessary to plan the overall design of the facilities with extreme care in order to avoid costly retrofits at a later stage. A comprehensive master plan is required which reflects how the owner/operator intends the completed facility to look. A key component of the plan is the integration of all the systems and buildings comprising the entire greenhouse system.

For financial reasons, it is usually not possible to include all the desired systems and installations in the initial design of the facility. However, the overall plan should provide that these systems and installations are included and that they can be added at a later date without trouble or high costs.

It is always a good idea to establish priorities and not to compromise in the plan. The priorities and systems selected and included in the first installation should always be options that provide the greatest returns. The 'luxury items' can be added at a later date.

There are many items to consider in formulating a facilities master plan because it is only part of an organizational master plan. It is always easier to add a greenhouse than to develop an overall goal and a plan to achieve it. Both technical and business management skills are required in any organization. Excellence in only one area cannot guarantee business and operational success.

Greenhouse Design

There are many items to consider when contemplating the location and design of a greenhouse. These include the following:

- Site selection
- Orientation for optimum light utilization
- Strength to handle environmental conditions of wind and snow
- Suitable glazing materials
- Energy conservation considerations
- Environmental control systems, heating and ventilation
- Watering system supply and irrigation systems
- Availability of services, water, electricity, fuel transportation
- Plant production systems, inputs, outputs
- Materials handling systems and labor availability

Requirements for a Greenhouse Production System

There are many pieces to a greenhouse production system puzzle. The diagram in Figure 1 graphically portrays some of the inputs and outputs that need to be considered when planning an expansion to a greenhouse production system. Each of the items mentioned needs to be considered. Some items such as heat have arrows going in both directions. Residue is an item often forgotten. Some items are easier to handle than others because they flow, such as water and air. Others require manual labor and storage facilities. Deciding upon a growing system will determine how the materials are required to move and be moved throughout the greenhouse. Cost effectiveness, that is labor versus initial capital expenses, of the system may help make the final decision. Thinking of the greenhouse as a system, that is planning how each item moves, can help forestall subsequent problems.

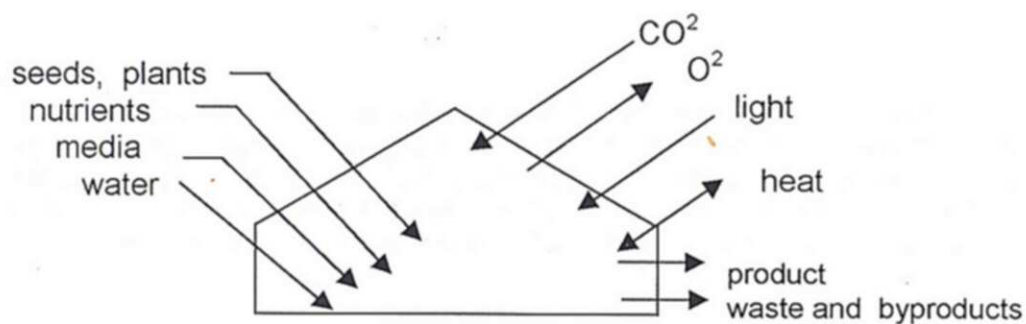


Figure 1 Parameters required for a greenhouse production

Figure 1. Parameters Required for Greenhouse Production System

Key Components for Greenhouse Facilities

The Foundation

With new environmental regulations limiting run-off from greenhouses it is becoming increasingly beneficial to construct a solid concrete foundation for the greenhouse. The walls must extend below frost-line and should be 8" wide. Interior walkways should be 4" thick and at least 10 feet wide for vehicle travel.

The Structure

The type of structure should be based upon the growing system, the level of automation, the crops to be grown and the overall physical arrangement possible on the site. These choices determine bay width and length, gutter height, glazing, and type of ventilation. Hanging baskets can determine gutter height and irrigation booms can require special clearances.

Ventilation and Cooling System

Ventilation systems can be either mechanical or natural with natural being determined mostly by site because of wind considerations. Natural ventilation through side walls is becoming a popular choice but its appropriateness depends on crops being grown, location, and automation potential. Performance for cooling is outstanding in the new innovative Open roof greenhouses.

Heating System

The heating system should be selected based on personal choice and the crop being grown. The initial cost is important but may not be the most important consideration. A uniform crop is a necessity for some growing systems, and the heating and ventilation systems are major players in producing a uniform crop. Heating systems that give good temperature uniformity are preferred.

Thermal Screens or Curtain Systems

A thermal screen that doubles for summer shading is one of the best investments a grower can make. The greenhouse structure must be able to accommodate a thermal screen. If the installation cannot be made at the beginning of the project, the design must include the provisions for it to be added without expensive modification or alteration to the greenhouse at a later date.

Growing Systems

Efficient use of greenhouse space and the cost and energy savings realized are major considerations for growers. Being able to fill and empty the greenhouse efficiently and quickly is an important consideration. The bedding plant industry is a good example of how mechanization has developed and how each piece of required equipment works within a system to achieve the desired goal of efficient movement and reduced time, effort, and cost.

Environmental Control System

Quality analog and computer systems are available that accurately sense and control both aerial and soil temperatures. Computer systems have the advantage of recording data for subsequent use in evaluating plant performance or identifying problems with the growing system.

Adequate Water Supply

In siting the greenhouse, consideration must be given to the water supply. Is there an adequate water supply? Water availability via certification should be determined prior to the site purchase and/or greenhouse construction or the grower will risk not obtaining a water certification for the volume of water needed.

Irrigation Systems

Irrigation systems vary in design and layout. Automation is a major consideration; a greenhouse design should be chosen that allows for future installations of automatic control and equipment. The fertilizer injection system must be compatible with the installed irrigation system and must be understood by the operator so that expectations of its performance are realized.

Utilities Installations

The installation and availability of utilities (water, fuel and electricity) is of utmost importance, particularly when thinking about capacity for future expansion. The use of

appropriate electrical installation practices within the greenhouse can forestall future safety and operational problems as well as maintenance and breakdown situations. Each installation should have provisions for an emergency generation system, preferably to be installed when the greenhouse is constructed.

Selecting a greenhouse requires much thought and a good master plan composed of many components. Considerable thought and evaluation has to be made before the plan is completed and before the intended program of growth or expansion is undertaken. The important issues include a business plan, a site evaluation, an evaluation of the type of growing structures, equipment desired and required, and the impact the expansion might have on the community at large. The listed references contain information helpful in preparing a master plan for the grower who would like to erect new facilities or enlarge current ones.

My former co-worker gave me good advice when he said to me, **"Don't sew a shirt to a button."** Growers who are the most unhappy after a change are those who altered existing facilities, tried to make them work, and ended up spending as much money as if they had built new, without the benefit of a new facility. Make mistakes on paper. Think, plan and consult with those who can help you make an admirable facility which will be a joy to operate.

References

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2. Brumfield, Robin. "Greenhouse Systems Costs." NRAES 72 Greenhouse Systems, Automation, Culture and Environment, Proceedings of International Conference, ACE-SYS New Brunswick, NJ, July 1994.
3. Roberts, William J. "Greenhouse Structures for Controlled Environment" *Bedding Plant IV*, Chapter 17, page 215, 1. Holcomb, Editor.
4. Roberts, William J. "Creating a Master Plan for Greenhouse Operations." Rutgers Cooperative Extension Publication E221, 1998.

Greenhouse Check List

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Permits

Site Preparation

Leveling
Drainage

Greenhouse Foundation Perimeter knee wall

Walk ways
Concrete floors
Splash ways for roof runoff
soil bearing capacity
Interior post design

Utility Provisions

Electricity
Potable Water
Irrigation water
Telephone
Natural Gas
LP Gas storage tank
Fuel oil storage tank
Sewage system

Greenhouse Structure

Roof Glazing
Side wall glazing
End wall glazing

Ventilation and Cooling Systems

Gable ventilation system
Exhaust fans
Pad system
Roof ventilation system
Natural ventilation system
Open Roof Design
Horizontal air flow fans
Fog cooling system

Curtain Systems

Energy retention systems thermal screens
Inside shade system
External shade system
Gable shade system
Black out system/day length control

Environmental Control Units

Analog controllers
Computer based controllers
Alarm systems

*Courtesy John Hoogeboom, CEO
Agronomico International
Hendersonville, NC*

Electrical Installations

Service Entrance equipment
Stand-by power generator
Interface panels
Main and low voltage cables and boxes
Distribution Boards

Heating Systems

Gas fired unit heater
Oil fired unit heater
Hot water unit heater
Hot water boiler unit
Perimeter piped hot water system
Overhead piped hot water system
Under-bench system piped hot water
In-floor system piped hot water
Pipe/rail heating system

Irrigation Systems

Hand watering
Overhead spray nozzle
Floor sprinkler
Irrigation boom (movable)
Low level spray nozzle
Flooded floor
Drip irrigation

Fertilizer Injection Equipment

Proportioners
Injection units
Liquid fertilizer injection system

CO2 Injection units

Pure CO2 distribution system
CO2 burners
Flue gas CO2 extraction system

Greenhouse Lighting

Supplementary lighting system
Cyclic lighting system
Walk-way and security lighting
Day-length control

Growing Systems

Greenhouse floor
Flooded greenhouse floor Fixed tables or benches Rolling tables
Mobile or transportable tables Hanging basket systems Vegetable growing system

Misc. Installations Equipment

Site Finishing