Our standard for peat potting rooted cuttings was revised twice in one week because of an employee's suggestion Daily production was increased by 30%!

In closing I wish to point out that production standards alone are not going to increase productivity The key to productivity is effective personnel management. To be effective we need to practice some very sound principles of personnel relations The people we employ are individuals who have different needs for work Their needs vary with different situations. We must be sensitive to their needs and adapt our management techniques accordingly As managers, we should treat our workers the way we would like to be treated. We need to encourage interest in the job Be receptive to their ideas. Encourage them to do their best Give praise for a job well done. Stand behind these people.

Practice these principles and you will create an atmosphere of good moral, positive attitudes and increased productivity.

PETER VERMEULEN. Do you have problems when you find your standard is too low and you try to raise it? Also have you compared your standards with piece rate?

BLAIR MASTBAUM: Yes, it can be a problem to increase standards. The direct supervisor needs to have a good relationship with his people and be open with his workers He needs to point out to them that if they are achieving above the set standards that there is no need to object because they are doing it already We time at 100% efficiency but expect only about 85%

In regard to your piece rate question, I should point out that I have a factory background and think it is a good idea. I have not, however, been able to initiate a plan when we work with crews producing 12-15,000 units per day and the great amount of interaction that occurs between different jobs. We are working on group standards.

THE PASSIVE SOLAR PROPAGATION STRUCTURE

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The passive solar principle in greenhouse construction is to utilize solar energy in its most economical and efficient form. The basic concept that we used had to be:

1. Of simple construction,
2. Economically feasible for commercial greenhouse production,
3. Reliable and efficient.

Therefore, a system was developed that employed a solar collector, a water storage system, and a simple form of passive energy transport. This system, when compared to an active solar system, is very inexpensive to construct and requires very little maintenance.

CONSTRUCTION DETAILS AND PRINCIPLES

1. The greenhouse is designed and built to become the complete solar collector.
   a. The structure is 100 feet long and 13.6 feet wide.
   b. The whole structure is 32 inches in ground. The foundation consists of 8 inch cement blocks on a 12 inch footing. A complete system of drainage tiles inside and out removes excess water to a sump.
   c. The gable ends and north wall are fully insulated and consist of two-by-four construction, fiberglas insulation, vapour barrier, interior ¼″ plywood and exterior KB board with white masonite siding.
   d. The acrylic skin of the greenhouse is S.D.P. clear plexiglass (an insulated plexiglass). The S.D.P. plexiglass is sandwiched between the 1 × 6 inch bar cap and the 2 × 6 inch cedar rafters with polybutyl sealant. A ¼ inch space is allowed on either side of the 4 × 15 feet sheets of plexiglass for expansion during hot weather. The acrylic skin is all south orientated at a 40° angle for optimum solar absorption.
   e. The height of the structure is 9 feet, 6 inches above grade and 12 feet, 8 inches from floor to roof inside.
   f. All interior walls are painted a flat black.
2. The storage system
   a. Two hundred 25 gallon steel barrels of water (5000 gal. of water total) are located below grade and enclosed in two cement and steel greenhouse benches with plastic drapes on each side for heat retention. The 25 gallon barrels are very reasonable to purchase and can be easily replaced as needed
   b. The passive transport system consists of five thermo generators located in the peak of the house. These generators

pump hot air down and around the barrels during the daytime, thus raising the water temperature in these barrels. During the night colder air is pumped down around the barrels and this forces heat from the barrels up to heat the greenhouse.

c. A row of barrels lies between the north wall and bench. These absorb solar radiation directly.

TEMPERATURE ZONES IN RELATION TO PLANT GROWTH

During cloud-free days the 40° angle of the solar collector will raise the interior temperature very rapidly to extremes. The construction is such that these extremes are located in the peak and, as one proceeds downward, temperature becomes progressively lower until an optimum plant growth temperature is found at approximately grade level. The plant benches with their growing media are located at this level Temperature at this level will vary only ±5° of 70°F at any one time.

We used a thermograph to monitor temperature at the seven foot level and you will note extreme temperature variation at that level, but not in the plant growth area The thermograph could not be lowered last winter because of the very humid conditions at plant growth level. This is due to our automatic misting system, which is located just above the plant-growth area. The greenhouse being a propagation structure requires a bench medium temperature of approximately 70°F and an air temperature from 55 to 75°F These temperatures were easily achieved with the result of an excellent crop of evergreen cuttings, grafts and other liners being produced.

Approximately 35,000 liners were produced in the structure over the 1980-81 winter. This covered about 150 species and cultivars of plant material. This production was achieved with a minimum of energy expense when compared to a conventional glass or polyhouse.

SUPPLEMENT HEATING SYSTEM

A back up system was installed consisting of an oil-fired boiler and radiators running under the benches on either side of the barrels. A thermocouple located in the medium half way down a bench regulated the boiler performance. The boiler was operated from the first of December, 1980 to the first of April, 1981, with an expenditure of approximately $748.00. Some of our coldest days and nights in several years occurred during the latter part of December and early January. During this period, it was not uncommon to record peak temperatures of over 100°F.

MODIFICATIONS OF STRUCTURE

The greenhouse structure could be extended to 20 feet wide by making the roof wider. This would accommodate three growing benches, more water storage barrels and, therefore, more strato-therms The increase in total volume of the greenhouse would store more heat from the collectors and therefore the greenhouse should become more efficient than it is now.

Table 1. Construction costs for the solar greenhouse

S D P covering	$ 4,335 00
Putty	120 00
Cement blocks, 8″	516 00
Cement bench bottoms	400 00
Steel benches	498 00
5 Strato therms	300 00
Fan	298 00
Lights, wiring, sump, etc	216 00
Excavation of footings and hole	120 00
5 yds of concrete, mason cement and sand	250 00
Lumber for construction	1,600 00
Labour for construction	2,500 00
Total Greenhouse Cost	$11,153.00

SUPPLEMENTAL MODIFIED NEARING FRAME AND LATH HOUSE

The north wall of the greenhouse, being a solid wall with white siding, allowed the construction of a modified Nearing frame against this wall. The frame is 18 inches in the ground and 96 feet long by 6 feet wide with redwood sash as a covering. The area immediately adjacent to the greenhouse north wall is totally covered by a 50 × 100 foot lath house. This provides a modification in climate which provides the necessary environment for the culture of small cuttings, seedlings and grafts. The lathhouse also covers the Nearing frame and therefore provides an excellent propagating area for summer and winter rooting of cuttings. This frame is automatically misted all summer.

By using the Nearing frame to root the species that will root cold (no energy expense), either during the summer or winter, we increase our total production by about 10,000 cuttings per year. Under conventional means these species would be rooted with bottom heat in a greenhouse over winter. Therefore, the Nearing frame becomes an intricate part of our total greenhouse system. Windows located in the north wall of the greenhouse provide ventilation in spring and summer and also provide an easy method in which the greenhouse can be emptied of its plant material. The use of rollers and greenhouse flats can be employed here reducing labour considerably. The plant material can then be planted directly into the lathhouse beds or held in flats under the lath for future planting. Overhead watering in the lathhouse provides the necessary modification of environment during the handing-off process

PLANT MATERIAL PRODUCED AND THE PROBLEMS INCURRED

The operation of the structure went very smoothly over the winter of 1980-81. To test its complete propagation feasibilities, a complete cross section of plant materials was placed in the structure. Table 2 lists some of the cultivars produced in this greenhouse during the 1980-81 season.

Table 2. Partial list of plant material propagated in the passive solar propagating structure

GRAFTS	
Acer palmatum	'Crimson Queen'
Cornus florida	'White Cloud'
Juniperus chinensis	'Mountbatten'
Juniperus chinensis	'Pyramidalis'
Juniperus chinensis	'Spartan'
Juniperus procumbens	'Nana'
Juniperus scopulorum	'Blue Heaven'
Juniperus scopulorum	'Gray Gleam'
Juniperus scopulorum	'Hill's Silver'
Juniperus scopulorum	'Wichita Blue'
Juniperus virginiana	'Skyrocket'
Juniperus virginiana	'Springbank'
Picea abies	'Echiniformis'
Picea abies	'Inversa'
Picea abies	'Maxwellii'
Picea abies	'Pendula'
Picea bicolour	'Tigers tail'
Picea omorika	'Nana'
Picea omorika	'Pendula'
Picea pungens	'Globosa'
Picea pungens	'Hoopsii'
Pinus densiflora	'Pygmaea'
Pinus flexilis	'Glauca'
Pinus parviflora	'Megishi'
Psuedotsuga menziesii	'Pendula'
CUTTINGS	
Juniperus chinensis	'Gold Coast'
Juniperus chinensis	'Mint Julep'
Juniperus chinensis	'San Jose'
Juniperus chinensis	'Sea Green'
Juniperus chinensis	'Pfitzeriana Compacta'
Juniperus communis	'Suecica Majour'
Juniperus horizontalis	'Glauca'
Juniperus horizontalis	'Hughes'
Juniperus horizontalis	'Jade Spreader'
Juniperus horizontalis	'Plumosa'

Juniperus horizontalis	'Wiltonii'
Juniperus chinensis	'Hetzii' *for understock*
Juniperus sabina	'Broadmoore'
Juniperus sabina	'Buffalo'
Juniperus sabina	'Hicksii'
Juniperus scopulorum	'Table Top Blue'
Juniperus squamata	'Meyeri'
Rhododendron	25 cultivars
Platycladus orientalis	'Raffles'
Thuja occidentalis	'Ellwangerana Aurea'
Thuja occidentalis	'Holmstrup'
Thuja occidentalis	'Lutea Nana'
Thuja occidentalis	'Nigra'
Thuja occidentalis	'Pendula'
Thuja occidentalis	'Techny'

MISCELLANEOUS

Buxus cultivars
Chamaeyparis lawsoniana 'Ellwoodii'
Chamaeyparis nootkatensis 'Aurea'
Chamaeyparis obtusa 'Nana Gracilis'
Crytomeria japonica 'Pygmea'
Euonymus cultivars
Ilex cultivars
Prunus 'St Julien X' (softwood)
Taxus cuspidata 'Brownii'
Taxus cuspidata var *nana*
Vitis cultivars (softwood)

The structure proved to be too efficient during the latter part of February and March, with excessive sunlight and high interior temperatures, especially against the back wall of the house. Here we tried rooting cuttings in flats on top of the water barrels which are against the back wall; this proved only about 50% reliable because:

1. Our flats were too shallow,
2. Increase amount of water need, due to high sunlight,
3. Inaccessibility (24 inches higher than the benches).

Shading had to be applied over one half of the lower section of the house and ventilation had to be provided daily during this period. We experienced some burning on new grafts with the open bench method of callusing but none with the polytent method. All cutting material rooted quite well with the exception of some very slow to root cultivars such as *Chamaecyparis obtusa* 'Nana Gracilis', *Thuja occidentalis* 'Pendula' and *Crytomeria*. Grafts were within the range of 90% for most cultivars while others ranged from 25% to 50%. Excessive sunlight during the callusing period is a problem with this structure and we hope to experiment more with this problem this winter by using several different callusing areas within the greenhouse. This way we should find an optimum area for our callusing procedure. After the structure was emptied about May 10, 1981, 100,000 grapevine grafts were placed in the house for callusing (callusing boxes). Here excessive temperatures played an important part in the callusing procedure. Callusing temperatures must be maintained at 86°F. (or 30°C.) day and night over a period of 3 to 4 days or until the interior of all the callusing boxes reaches the above temperatures This was accomplished by completely sealing the greenhouse for 3 days and then ventilating on the 4th day to lower the interior temperature gradually to 72°F. More shading had to be applied during this period for fear of burning the new developing vine growths

CONCLUSIONS

The structure overall proved to be very efficient for propagation. A few problems have to be worked out but these are minor when compared to the amount of fuel savings over the year. According to last winter's fuel savings, we estimate that the structure will pay for itself in fuel savings alone in about four years.

JACK ALEXANDER: Could you give us heating cost figures?

ARTHUR OSLACH. It costs us $758 in back-up fuel for last year. This same boiler was in a similar nonsolar glass structure 3 years ago and it cost $4,000 to operate. December and January are the worst months.

DAVE EMMONS. Why not use double poly which is cheaper?

ARTHUR OSLACH: I wanted something that was more permanent for propagation and also had a high R-factor to it.

EXPERIENCES IN BREEDING AZALEAS AND RHODODENDRONS

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My goal in breeding ornamental plants has been to produce hybrids which can make it commercially Some hybridizers make crosses for their own satisfaction; some do it as a joint activity with other hobbyists. But mine is a full-time occupation and I have hoped to produce new rhododendrons for very cold climates that would be profitable for commercial growers and present no problems in production. The records