COLORADO FLOWER GROWERS ASSOCIATION

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GREENHOUSE RESEARCH IN ENGLAND

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(Note: In August, 1977, the International Society for Horticulture Science sponsored a symposium on "More Profitable Use of Energy in Cultivation" at Alnarp, Sweden. Dr. Goldsberry not only participated in the symposium, but had the opportunity to visit several research centers and growers in England and Europe.)

Many people feel the art of growing plants rests with our friends across the Atlantic, while others with those across the Pacific. I have now had the opportunity to visit both areas and draw my own conclusions. One fact is very apparent, — everyone world-wide, realizes the importance of controlling the greenhouse environment, saving energy, reducing costs and increasing mechanization to get maximum return from a particular crop. Yes, they realize it, but as in America, most growers don't really practice it.

Researchers throughout the world fall into two categories — those that conduct applied research, which often benefits the growers immediately by providing visual results or moreover, the opportunity to put some innovative system to work. The basic researchers may contribute little pieces of information, i.e. why plants react in a certain way to temperature, nutrients, solar energy changes etc. and in turn suggest their results be tried on a larger scale and applied to commercial growing.

The symposium at Alnarp, Sweden indicated that greenhouse energy conservation was the primary applied world-wide research taking place today. The question, "How to reduce greenhouse fuel costs" was paramount in most discussions. The research centers throughout Europe were trying to answer the question, but were also conducting other timely research.

NIAE

The National Institute of Agriculture Engineering (NIAE) Wrest Park, Silsoe, England is located on a 415 acre estate — formerly the home of the deGrey family. The mansion and a portion of the grounds are maintained in English style. Stone walls surrounding several small gardens are covered with numerous species of vines. The rose and formal hedge gardens are immaculate. An 18th century greenhouse — curved glass roof on a brick walled building is used as a lounge.

Several projects are underway involving the glasshouse Department. The modification of a multispan inflated roof greenhouse (fig. 1) patterned after the design of Roberts and Mears (1969) at Rutgers University was almost complete. A 16 month evaluation showed a 43 percent savings in fuel, when compared to a glasshouse. However, the light transmission was reduced up to 4 percent throughout the year. The effect of wind load on the structure, was also being studied.

The mechanization of many greenhouse activities by the use of traveling gantries was also of interest. In most instances rails are placed on the columns supporting the greenhouses. Workers can be carried on self propelled machines to plant, maintain or harvest a crop. One of their first types was used to move bulb trays for the proper forcing conditions and harvesting (fig. 2). England and Holland are probably the world leaders in the development of gantry systems.

Another important facet of research involved the performance of glasshouse air-heating systems. Some of the conclusions in comparing poly ducted systems with piped

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and free air discharge systems were: 1) Poly ducted systems could be as effective as pipe systems and both types were better than the free air method. 2) Poly ducts must be operated at high static pressure and no wrinkling present in the tube surface. The air flow inside the tube is easily influenced. 3) Ducted air provides the most effective heating when the ducts rest on the soil with air discharging below the horizontal. If the ducts must be higher (off the ground)

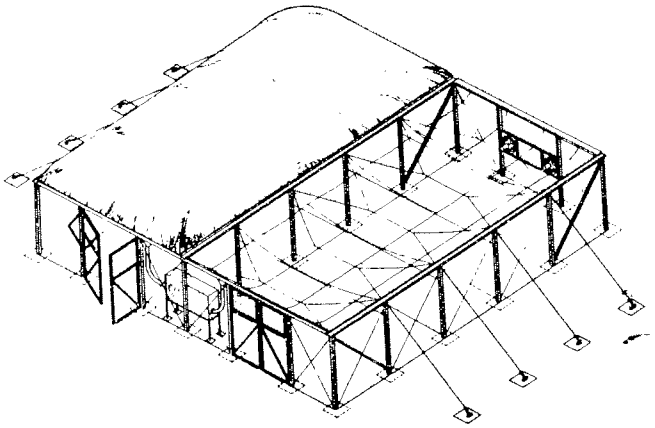

Fig. 1: Cable supported, inflated roof, greenhouse.

then a vertical downward discharge produces the lowest vertical temperature gradient. The discharge should not hit the plants.

The use of thermal screens (false ceilings and walls) was also being considered. Many "screen" materials had been evaluated. Those made of the aluminized polyester material proved to be the best for reducing heat loss. However, such materials had little mechanical strength. It is felt that the use of thermal screens can be of great value and recommend that all greenhouse growers install them. They have calculated that an overall 42% return on the investment can be expected. An English grower borrowing money at 20% interest can repay his loan out of the money saved for fuel in 2.8 years.

The last point of interest at the NIAE was the work being done to balance nutrient solutions. Nutrient culture studies (hydroponics) were being conducted on greenhouse forcing cucumbers. They were trying to automatically control the various nutrient elements with selective electrodes. If the plants used more or less of an element on a sunny or cloudy day, the solution would be computer controlled to the particular need.

(We appreciate the time taken by Ken Winspar, Chairman of the Glasshouse Department; G.S. Weaving and D. A. Wells to explain and discuss their programs.)

Lee Valley Experiment Station

Several phases of research were of interest and could be of value to the greenhouse industry. A great portion of their research is related to such greenhouse vegetables as, cucumbers, tomatoes, sweet peppers, chinese cabbage, lettuce, egg plant, chicory and celery. The latter three have been evaluated in various types of heated and unheated polyethylene tunnels — the types that range in size from one or two feet off the ground, to those that are large enough to walk in.

After observing the greenhouse vegetable production program on tomatoes in England, it was apparent that American operators were in "left field". Most commercial growers were getting 100 ton/acre. The plants are left in for a complete season (not a fall and late winter planting as in U.S.). A layering method of "letting plants down" (fig. 3) has increased production by 15 ton/acre. Layering has revolutionized the English greenhouse tomato industry by reducing labor. Plants are "dropped" every week to 10 days and trimmed to approximately 48" of leaves. Some clusters of tomatoes may be below the foliage area, but about ready to harvest. One plant had a stem 22 feet long.

The greenhouse forcing cucumber research involved soil heating, NFT growing and biological control of insects. The NFT method of growing (Nutrient film technique) is being

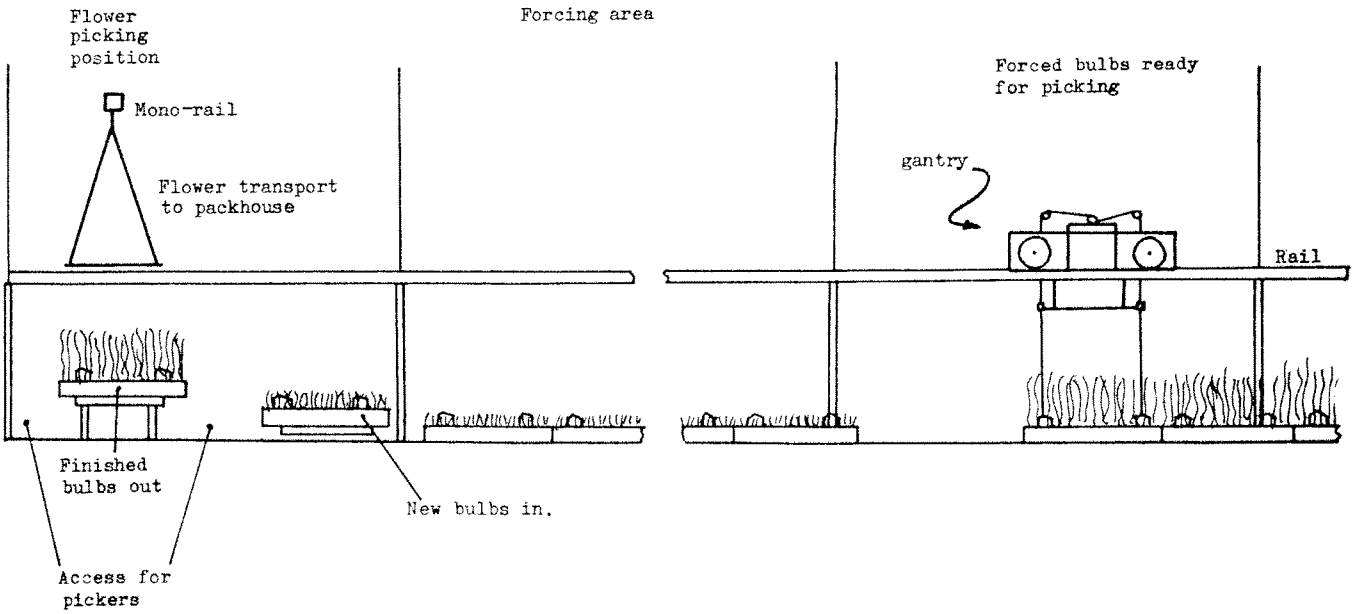

Fig. 2: Gantry used in a bulb forcing program.

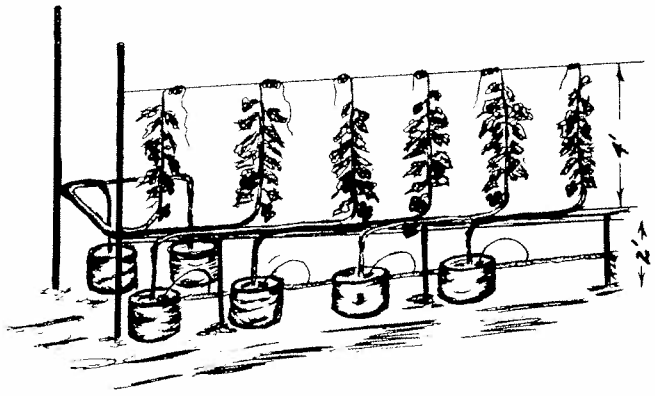

Fig. 3: Tomato production using drip irrigation and layering method of "letting plants down".

evaluated throughout Europe for many vegetable and flower crops. The system is really "hydroponics" but is somewhat unique. Plants are placed in a trough of opaque film plastic, (fig. 4). The film, white on the exterior side and black on the inside, is placed on a gently sloping plane so the nutrient solution will flow from one end of the row to the other. Plants are placed in the trough and the nutrient solution circulated continuously. The secret — maintain the solution approximately 1 mm deep (a film). If the solution is too deep, the roots turn a yellow brown and sluff off. An active root system is very white. The English forcing cucumber varieties produces approximately 105 ton/acre/year — the NFT System reduces the overhead. One drawback still persists with any hydroponic type system — the contamination of the solution and spread of disease.

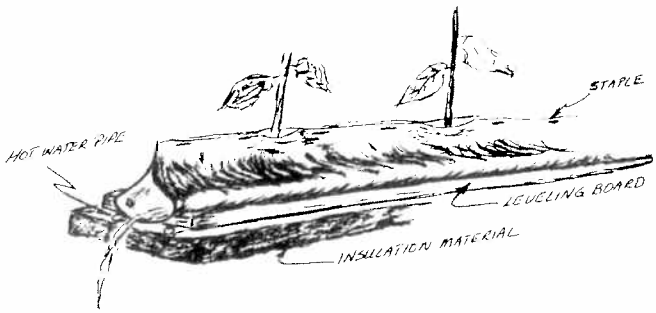

Fig. 4: Plastic film trough system for growing plants with the NFT method.

Several projects were also underway on floriculture crops. The most timely project was on the control of Fusarium in carnations. The carnation industry in England is presently being invaded with the disease, with little success in controlling it. The strain F. oxysporium (the common culprit in the U.S.) is not the big problem — F. redelins has taken over. They feel the latest strains have been brought in from the Mediterranean area or possibly from flower shipments out of South America.

To control the problem, they are experimenting with film plastic lined benches, use of media filled plastic bags and resistant varieties through breeding programs. Vapam and steam have not controlled fusarium for the English.

A foliar feeding program on cut mums was conducted for several months. The basis for the study was to see if poor root action obtained during low light periods could be overcome. There was no apparent benefit. Commercial growers are tending to mix more of the plants needs in the growing medium and less use of the liquid feed . . . this too is being studied. A "once-over" harvesting technique of mums is also included. Mums are cut at all stages and bud-opening solutions used to open the tight ones.

There is also a constant program to evaluate mum varieties for the geographical area of Lee Valley. They are looking at 10 week varieties to overcome some of the low light problems. One cannot imagine the light available in England during the winter. Light in England in December is from ⅛ to ½ of what we got for that month. And our total light in December is better than what they get in June.

The production of greenhouse roses in England has dropped from 120 to 40 acres in the past few years. Competition from adjacent countries, plus increased costs of fuel has contributed to the decrease. They are presently testing 13 newer varieties of roses of which most are propagated on their "own" roots. They have found that their program of giving plants a winter rest (minimum heat, 40°F ± from December 23 to January or February) works best on "own root" roses when compared to those grafted to *manetti* or *indica* root stocks.

One of the major problems involving roses is the fact that red spider mites are becoming resistant to their miticide programs. Temik is not doing the job and resistance has been shown with the use of morestan. Plictran organic T is the major miticide presently being used. Pentac is illegal in England — "it had been suggested that one can become impotent by handling the material and the ole Englishman doesn't want to take the chance."

One of the most interesting aspects of greenhouse culture at the station was the conversion of a quonset type structure for mushroom production. It was covered with a double air inflated layer of black plastic with four inches of fiberglass insulation in between. Trays for producing mushrooms were portable and could be moved in and out of the building for harvesting and sterilization.

Two last items of interest: 1) they were painting greenhouses and a small amount of red lead was put into the undercoat, so they could see where the second coat was being added. 2) Biological control of diseases and insects is being accomplished. Preditors and parasites are used through contract control. It costs about $250 per acre and 450 acres are under contract in England at this time.

(Appreciation is expressed to P. G. Allen, Director of the Lee Valley Experiment Station for taking his time to tour the facilities and explain their programs.)

Glasshouse Crops Research Institute (GCRI)

GCRI was founded in 1953 and is located on the south shore of England near Littlehampton, in the heart of the important west Sussex glasshouse and mushroom area. It occupies 100 acres of land and approximately three acres of glasshouses. Their research program involves lettuce, tomatoes, carnations, chrysanthemums, pot plants and mushroom crops.

This is the home of the nutrient film technique (NFT) of growing plants. One of the finest crops of greenhouse

cucumbers ever observed were being grown by the NFT method. In fact, several plants of a number of plant species were being grown in the NFT method. Juniper and cedar trees, roses, carnations and several woody ornamental materials were all being grown in the same nutrient solution and growing relatively well. One possible problem was, however, had the solution become contaminated and was disease being spread into the carnations?

Because of the low light and short winter day conditions in England, research using supplementary lighting is of paramount interest. Several aspects of lighting carnations were being considered. In one experiment carnations were planted each month of the year under full and reduced light. All the treatments had an eight hour natural day and extended to 12, 16, 20 and 24 hours with tungsten lamps from the planting date. The maximum number of buds were achieved growing under tungsten, but the quality of the plants were poor.

The development of laterals on carnations was also observed using fluorescent and tungsten lamps. Fluorescent was effective, but not like tungsten. In another experiment, the red and far red light was filtered out of the fluorescent and tungsten light sources. They found that the presence of far red and red light was detrimental of lateral development. Another question still unanswered — was the supression of carnation lateral development due to bud initiation or strictly to a light effect? There are indications that flower initiation delay is due to high density planting.

The major program with carnations, involved the interaction of radiation, temperature and carbon dioxide on production. As in America, the individual factors have been used as "cultural practices" but never combined for optimum production.

Studies on the supply of phosphorus to plants in "loamless" substrates, are also underway. They are incorporating slow release forms of phosphatic fertilizers and adding phosphorus forms in the liquid feeding programs.

Two problems involving pot plants are being studied. The propagation of Rieger begonias and the factors controlling the flowering of regal pelargoniums. The pelargoniums variety, 'Grand Slam' was being evaluated for response to temperatures. When forced under high temperatures, the flowers aborted. There is a paper in *Scientific Horticulture* on previous work.

An area of great interest in all of England is the biological control of pests on greenhouse crops. The treatment of seven potential pests have been considered . . . however, space does not permit comments on all of them.

Red spider predator - *Phytoseiulus persimilis* is a fast moving, orange-brown mite, larger than the red spider mite. In warm temperatures, each female lays 50-60 eggs at a rate of three or four per day, which hatch in two to three days. Its life cycle is twice as fast as its prey. It is very efficient at searching out its prey and each female will devour up to five adult or 20 young spider mites per day. It does not feed on plant material and its survival is entirely dependent on a low level spider mite population.

Whitefly parasite - the small chalud wasp, *Encarsia formosa*, lays about 60 eggs during its 12 day adult life. Each egg is inserted into a mature whitefly scale and it dies. The parasite also stings the young whitefly nymphs killing them. It is known that *Encarsia* can detect white fly infested plants at some distance - presumably by responding to volatiles produced by the pest.

The Overview

How can our growers benefit from this review? Consider the following:

1. A crop of greenhouse forcing cucumbers following bedding plants — use free summer heat.
2. A simple air inflated house with cable supports for spring use.
3. Can poly tubes be more effective on the ground?
4. Thermal screens do work and save up to 20-30% in winter heating bills.
5. Where can the NFT system be used?
6. If you're considering tomato production - look at the new methods.
7. What are our sources of carnation flowers and cuttings? Will new diseases be introduced?
8. There is a need to evaluate and select carnation and rose varieties for the Colorado area.
9. The type of light used to develop carnation laterals is important.
10. Biological control of greenhouse pests — it isn't being evaluated in Colorado.

Yes, it would be nice to return to England and look some more. We're not necessarily behind or ahead - but we get things into perspective and who knows, we might inspire a grower to try something he felt would work, but not tried in our area.

Reference

1. Roberts, W. J. and D. R. Mears 1969. Double covering a film greenhouse using air to separate the layers. Transactions of the ASAE (1):32-33, 38.

Energy Conservation Program Guide for Industry and Commerce - NBS Handbook 115 September 1974. Flue Gas Analysis as a Maintenance Tool

EXAMPLE

Improved maintenance procedures, including regular determination of oxygen and combustibles in furnace flue gas, eliminated a fuel loss of over $12,000 per month. This experience occurred in a small chemical plant, where for a period of two months it had not been possible to get more than 80% of rated output from a boiler rated at 120,000 pounds of steam per hour. The boiler had complete flow metering and combustion control equipment but steam flow could not be brought to more than 100,000 lb per hour.

A service engineer from the manufacturer was called to test the combustion controls and found that the flue gas contained no excess oxygen and approximately 4% combustible gas. The ratio of combustion air to fuel was increased until the flue gas contained zero percent combustible gas and steam flow increased to the full 120,000 lb per hour capacity.

In determining the cause of the combustion control malfunction, it was found that moisture from the products of combustion had condensed in the piping to the combustion air flow controller causing an erroneous action.

To eliminate this and similar types of fuel loss in the future, an oxygen and combustibles recorder was installed and a regular maintenance contract was set up with combustion control manufacturer.

For the two months of operation at 20% below rated output, the boiler was using gaseous fuel at the full rate of 150,000 scf/h. Heating value of the gas was 1000 Btu/cf.

Fuel lost in kcf
= 0.2 × 150 kcf/h × 24 h/d × 60 d
= 43,200 kcf

Fuel lost in MBtu
= 43,200 kcf × 1000 Btu/cf
= 43,200 MBtu in two months

At a gas cost of $0.60 per MBtu
Cost of lost gas
= 43,200 MBtu × 0.60 $/MBtu
= $25,900 in two months

Estimated cost of monitoring equipment:	
Oxygen and combustibles recorder	$4500
Installation	2000
Total Installed Cost	$6500

Cost of a maintenance and tune-up contract providing for two combustion tests and two tune-ups was estimated at $1000/year.

Suggested Action

Consider the monitoring of oxygen and combustibles as a possible method for assuring that combustion processes are kept in control. Discuss the use of this tool with an instrument and controls manufacturer's representative.

SOURCE An equipment manufacturer.

Canadian Florist. 72(22):7. November 5, 1977
To Market to Market

The United Flower Growers Cooperative in Vancouver is moving to larger premises because of increased sales. The recent Ontario Flower Growers' Cooperative's annual meeting produced a very favourable financial report on the previous year's business. Interprovincial Flower Market Ltd. in Montreal has acquired a full time manager and spent $14,000 on renovations.

All three operations have experienced growing pains but now appear to have solidly established the "Dutch Clock Auction" concept, in the Canadian floral industry. Each week sees more and more growers and buyers meeting on the common ground of the flower auction.

Floral products at current market prices - the opportunity to inspect for variety, freshness and quality prior to purchase - these are a few of the important reasons for the apparent success, but a closer look will reveal other reasons. These early risers are experiencing a fellowship amongst themselves which is proving to be as profitable as the economics of the auction. Growers are meeting at the Clock and discussing their mutual problems such as energy, production scheduling, growing techniques, etc. Many a situation has been resolved through these conversations during post auction coffee. The grower is communicating with his customer, the retail florist. He is being advised of current trends and consumer preference, allowing him to produce the product in demand. Communication between the two segments is bound to establish a much better understanding of their respective problems.

A retailer stated during a recent auction, "If we don't start paying better prices, the product won't be here next year".

Many buyers find the morning auction to be the most exciting part of their day. The challenge of pressing the button at the right time brings out their gambling instinct and to a degree becomes reaction rather than work. Another interesting situation occurs when a retailer can't resist good product and consequently overbuys. He returns to his shop and is forced to make an extra effort to sell the excess stock. The "Special" possibly placed outside the front door produces profitable sales and he finds himself back at the auction looking for more product.

There is another significant trend directly connected to these flower auctions. A few floral wholesalers have relocated their business in the immediate area of the auction offering the buyer what amounts to one-stop shopping. Many more are seriously considering making a similar move. The concept is working in Boston, St. Louis and Los Angeles, each having a flower market consisting of a concentration of wholesale florists in a given area. The Toronto group have already dubbed the 401/Dixie Rd. area as the Ontario Flower Terminal, hoping to attract more floral wholesalers.

It would appear that history is repeating itself and the retailer will again find it necessary to go "To Market" each morning to buy product.

Energy Conservation Program Guide for Industry and Commerce - NBS Handbook 115, December 1975.
Upgrade Efficiency of Incandescent Light Sources

Energy savings of 10% to more than 30% may be possible in a conventional incandescent lighting system by merely replacing old bulbs with more efficient ones.

Example

(1) Standard bulbs filled with krypton gas instead of the conventional argon are available which yield the same lumen output and bulb life at 10% less power input.

POWER RATING
(at same light output)

Conventional	Krypton Filled
60	54
100	90
150	135

(2) In an installation using reflector type flood lamps the older R type lamps can be replaced with the newer PAR types which are much more efficient.

Comparison of "R" vs "PAR" Reflector Bulbs

R-40 Floods		PAR-38 Floods	
	Beam Candle		Beam Candle
Wattage	Power	Wattage	Power
100	800	75	1300
150	1200	100	2230
200	1600	150	3450
300	2450	200	4560
500	3600	250	5850

The replacement of a 500 watt R-40 bulb with a 250 watt PAR-38 constitutes a 50% saving in electrical power demand, and a definite cost saving.

Assuming operation for 4000 hours per year, and 2.5¢ per kWh,

Annual Cost Savings
= (500 - 250)W × 1 kW/1000 W
× 400 h/yr × 0.025 $/kWh
= $25 per year for each bulb replaced

Suggested Action

If your lighting system uses incandescent bulbs, consider the use of more efficient bulbs for replacement purposes.

Consultation with your lamp supplier, or a lighting consultant, may help determine the most efficient replacement for your particular system. The examples listed above are not an exhaustive list.

Source: Herbert Anderson, "An Efficient Selection of Modern Energy-Saving Light Sources Can Mean Savings of 10% to 30% in Power Consumption," *Electrical Consultant*, April, 1974, p. 32-33.

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