scribes these studies. There has been really a tremendous amount of work done by the plant pathologists, and 140°F for 30 minutes is the point arrived at which kills most pathogenic organisms but not most beneficial ones.

HOWARD BROWN: Bruce, I don't have a question but I thought it would be appropriate to elaborate on what Tok Furuta brought out here in regard to nitrogen fertilizer from natural gas. We face a real problem in the state of California now. Natural gas is the main heat source for the production of ammonia, to result in nitrogen fertilizer. Two years ago we had eight major companies manufacturing nitrogen fertilizers. Because of the rapid increase in the price of natural gas, all but two of those companies have gone out of business. Mexico and U.S.S.R. are making a great deal of nitrogen fertilizer now, selling it in the state of California and, I imagine, in the rest of the United States, for much less than our local people can manufacture it for. The California State Board of Agriculture recently passed a resolution sent to the Public Utilities Commission, and other governmental agencies, recommending that the price of natural gas be frozen for at least one year for the manufacturers of nitrogen fertilizers — Union Chemical Company and Valley Nitrogen — so that they can continue to make nitrogen fertilizer domestically. What would happen if we got to the point where we were depending upon an OPEC type of arrangement for purchase of nitrogen fertilizers?

PLANT PROPAGATION IN VIRGINIA

CHARLES PARKERSON

Lancaster Farms
Suffolk, Virginia 23435

Lancaster Farms is a small wholesale container nursery located in the southeastern tip of coastal Virginia (zone 8b on the U.S.D.A. Plant Hardiness Zone Map). Production is centered around twenty genera of broadleaf evergreens and ten genera of coniferous evergreen plants. Propagation is mainly by cuttings using three different time schedules. Coniferous evergreens are propagated between January 1 and February 15. Broadleaf evergreens for 1 gallon production are made during December, and broadleafs for 2 and 3 gallon production are made between June 15 and September 15. A few items are propagated by seeds or division.

Propagation Decisions. A propagation system starts with a basic decision as to the type of production that works best for

one's business and climate. Since the bulk of our efforts are directed to plants for 2 and 3 gallon production, this paper will concentrate on this system. For many years cuttings were rooted into 2¼" rose pots during the summer and carried over in plastic houses, being transplanted into 1 gallon containers the following spring. These plants were grown until fall or the following summer when they would be shifted into 3 gallon pots, being ready for sale the following spring after a flush of growth. During the winter of 1977, we suffered severe plant losses due to winter freeze damage. This caused us to take a hard look at our production cycle. Plants, in general, were in our system for one winter as a 1 gallon plant and two winters as a 3 gallon plant. We were forced to reduce this winter exposure; consequently, for the spring 1977 planting season, we took 2¼" pots and planted directly into 3 gallon pots. At the time we thought this was a bold move. Well, it worked and we found a way to eliminate one winter exposure. After reading an article by Sidney Meadows (3) in THE PLANT PROPAGATOR, we shifted production from 2¼" pots to larger 3" pots and began to use multiple cuttings per pot to ensure that a big liner was produced.

Propagation Structures. Our basic propagation structure is a simple poly pipe house 30 ft. wide by 96 or 144 ft. in length. Benches are not used. Pots are set on a base of #5 crushed stone 3 inches deep. A high quality city water used in the propagation area eliminated the need for special high pressure pumps, boosters, back-ups, etc. A Buckner #1124-4 Midget rotary nozzle delivers 0.78 GPM at 40 PSI to provide both misting during rooting and watering of the plants once rooting has occurred. The nozzles are spaced 16 ft. between lines and 9 ft. between nozzles. A 100 mesh in-line filter is installed in each house to ensure that small particles in the water do not clog the nozzles. These rotary nozzles are not perfect — a little too much water during the propagation phase and a little too little during the growth of the liner — but they provide a happy medium that we can manage. Fertility is supplied by injectors into the water lines after rooting.

Houses are covered with a 4-mil co-polymer film in the fall. We expect to get one full year's service from this one cover.

Preparation. All houses are clean and ready to start the propagation process around the middle of May. Houses are filled with 3" pint plastic pots and the growing medium is dumped on top of the pots and struck off with a board and broom. The medium used is ground pine bark and sand to which the following has been added per yard: 12 lbs dolomite lime, 3 lbs 20% superphosphate, 3 lbs gypsum, and ½ lb fritted

minor elements. Every effort is made to have the air pore space at least 25% by volume (4). Once the rooting medium has been added to a house we do not allow the material to dry out but keep it moist. Depending on the crop of cuttings to be made, shade cloth (either 63% or 78%) is applied over the poly.

Making and Sticking Cuttings. We are so thankful for the Plant Propagators Society for giving us the opportunity to see what other nurseries are doing. In 1974 the Eastern Region toured Greenleaf Nursery in Oklahoma. They have a system of making cuttings that we have adopted. This procedure for making cuttings is explained in detail by Kenyon (1) in a talk presented to this group during 1974. Briefly, this is what the system includes: Each employee is issued the following: carpenter's nail apron, an adequate supply of #12 rubber bands, color coded labels (Economy slip on type 5″ in length), and a pair of Snap-Cut #118 hand snippers. The rubber bands are placed into one pocket of the apron and the coded labels in the other. All production is on a piece-work basis. The worker makes cuttings in the field preparing them by cutting to size (in most cases 5″ — the same length as the label), removing the lower leaves, and placing into packs of 25 along with his color coded label. The base of the pack of 25 cuttings is held with the rubber band. The bundles are stored in an ice chest until picked up from the field and transported to the greenhouse for sticking.

There is a separate crew for making and sticking cuttings. This summer (1979) the rate for most broadleaf plants was $9.00 per 1000 for making the cuttings and $2.00 per 1000 for sticking. Depending on the cultivar and condition of the cutting wood, IBA quick-dip hormone treatment is used. We make up the IBA solution using crystalline IBA and alcohol, as described by Machen (2). Cuttings are stuck to a depth of 1 to 2 inches and watered well. Mist applications are regulated by a series of time clocks and electric timers.

The house is placed under a regular preventive spray schedule. Shade cloth is removed in October. Fertility is supplied in liquid form until a tissue level of 2.0% nitrogen is reached. The houses are left unheated until late February at which time unit heaters are installed to prevent freezing until planting in the field. Planting in 2 and 3 gallon pots starts after the first full moon in April, which is the last frost date in our area. By this time, we have had one flush of growth and have started building the nitrogen level in the plants for the next flush. By September many of these plants are ready for sale in the smaller sizes that we offer. They are, for example, *Ligustrum lucidum*, $^{15}/_{18}$″; *Euonymus kiautschouica* 'Manhattan' $^{18}/_{24}$″; *Ilex crenata* 'Rotudifolia' $^{12}/_{15}$″. However, the bulk of the crop is

ready for sale after a flush of growth the following spring.

Broadleaf Propagation for 1 Gallon Production. Cutting and media preparation are the same as above. Cuttings are made during December, stuck into deep flats, and placed into a poly house with hot water pipes in the floor. The cuttings are spaced about 2 inches apart. Humidity in the house is maintained by a light mist and by hand sprinkling of the leaves and floor surface during the heat of the day, and at night by mist until the plants are rooted. When roots begin to form (usually by early January), feeding begins. A nice sized bare-root liner is ready for the gallon can by early April. These bare-root liners grow vigorously. I have often called this the 60 mile-per-hour theory.

The summer-rooted liner develops roots, makes a flush of fall growth, and then is stopped by winter cold. It takes this plant forever to get started growing again in the spring, for it starts at zero speed. On the other hand, a cutting made in the early winter produces roots easily. It is then left unchecked and hits the field at planting time already going 60 m.p.h., making flush after flush of growth. This rooted cutting makes a nice plant for sale in September.

Coniferous Evergreen Propagation: The propagation of junipers and other coniferous evergreens is done during the months of January and early February. Cuttings are prepared as described except that all receive an IBA quick-dip. The cuttings are stuck into the same medium that has been described, inserted 1½ by 1½ inches apart into 3 gallon pots, and placed into an unheated poly house. You might ask — why 3 gallon pots . . . why not beds or liner pots? Well, in our system it is what works best. In the past we used ground beds but sanitation was a problem. It is easy to become locked in on a greenhouse for a particular crop with these beds. Flats work very poorly for us because we seem to need additional depth to promote good rooting. Shade is applied to the house in March to reduce heat and plastic is removed in mid-April. All plants are rooted by early June and the pots are moved out of the hosue if the space is needed for another crop of cuttings. The rooted cuttings are planted into 2-gallon containers during July and placed in the field can-to-can. In the late fall, after winterizing of the broadleaf crop, these 2-gallon plants are spaced then are ready for sale the next summer.

LITERATURE CITED

1. Kenyon, Austin F., 1974. Plant propagation in Oklahoma. *Proc. Inter. Plant Prop. Soc.* 24:64-67.
2. Machen, John L. 1977. Mixing rooting hormones. *Proc. Inter. Plant Prop. Soc.* 27:259-263.

3. Meadows, Sidney B. 1973. Direct rooting. *The Plant Propagator*, 19(3).
4. Self, R.F. 1974. Air capacity studies. *So. Nurs. Research Conf. Proc.* 19:7-9.

NURSERY PRODUCTION IN ENGLAND

TOM WOOD

Oakover Nurseries Ltd., Potters Corner, Ashford, Kent, England

INTRODUCTION

Among United Kingdom nurserymen there is an increasing awareness in the need for specialization in the containerized market for Garden Centres, which is particularly attractive to marketing groups, and the awareness of the need for purpose-grown stock particularly smaller feathered trees, potted shrubs, and herbaceous plants.

Specialist producers are now concentrating either on landscaping and its plant requirements, high quality choice or up-market plants for the plant enthusiast, heavy standards and larger specimens for local authorities and, in particular, indigenous trees and shrubs which are used in considerable quantities for conservation and the landscaping of industrial developments and roadworks. It is in this last specialist need that we have developed our production technique and it is by relating our own experiences to meet this need that I hope to convey something of our own particular part in nursery production in England. Our development is very closely linked to our participation in the International Plant Propagators Society, with considerable involvement and exchange of ideas and I hope to demonstrate this as we go along. I would, therefore, like to introduce Oakover Nurseries. We are some 80 acres in extent, primarily on greensand which is ideally suited to the production of nursery stock and forest trees. We were formerly a forest nursery and developed seedbed and transplant techniques based on forestry systems. This involved standardization of equipment and the development on the tractor bed system commonly used by the Forestry Commission and commercial forestry producers (1).

THE NEED — BRITISH GROWN NURSERY STOCK

Some ten years ago we started to collect indigenous seeds to meet the demand for this type of material; this need had been created by a greater public awareness of our diminishing tree and hedgerow population due to modern methods of agriculture and to industrial development.