PROTECTED CROPPING

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There has been a big increase in crop protection over the past few years on nurseries all over the country for both propagating and growing-on purposes. In most cases, the protection has been provided by comparatively cheap polythene clad tunnels, although many growers express a preference for glass if they could afford it. The main benefits are produced by the ability to gain better control of growth under protected conditions.

Shelter is provided to protect the plants against excesses of cold, heat, wetness, desiccation, and to a lesser extent, light. It is obvious that these factors interact; light, for instance, when provided by sunshine is normally associated with an increase in temperature but there are occasions when absence of light might be beneficial.

PROPAGATION

By giving stock plants protection there is an opportunity to obtain earlier growth, more material and an improvement in quality.

Earlier Growth. The earlier propagation can be started, the longer the growing season in the first year. This increases the chance of successful overwintering, particularly with deciduous plants such as Japanese maples, magnolias and deciduous azaleas. Such high value plants are better able to carry the cost of providing protection. An early start with propagation is not always a virtue as size and age of a cutting is also important. Work at Kinsealy proved that larger cuttings of pyracantha taken in September, ended up the following autumn bigger and better than cuttings struck in early summer. The material taken in September also flowered and berried.

More Material. Rapid growth can lead to the production of more cuttings from a mother plant but there is a risk in extending the propagating season beyond the point which allows good plants establishment before the onset of winter. Providing lighting to extend the daylength is sometimes used to prevent this problem arising.

Speeding up growth early in the year is not without risk. Soft growth is subject to frost damage and some simple form of heating might be necessary as an insurance policy. Sufficient heat to keep out frost is all that is needed. To maintain a temperature of 7°C (45°F) would use about 3½ times the amount of

fuel required to achieve 4 to 5°C (40°F) in the West Midlands from February to May.

Improvement in Quality. This does not follow automatically once protection has been provided; it can only be achieved by good management.

The climate within a structure is largely dependent on the type of cladding; growth under polythene is softer than under netting. High humidity favours development of certain diseases such as *Botrytis* and *Pestalotiopsis*. The shelter also favours rapid build up of pests like aphids and red spider. Such problems can spread rapidly within closely spaced stock plants.

Consideration must be given to the method of growing the stock. If planted permanently on the site, the area is occupied continuously and thus production costs are increased, unless the protection is mobile or temporary. There are also difficulties with plant spacing. After a year or two, more room is required for each. This can be achieved by planting fairly thickly initially and thinning as required or by planting to allow room for future development and filling in spaces with container-grown stock plants in the early years. It is more economical to grow the stock plants in containers and to provide protection only during the cutting production season than to occupy the tunnel throughout the year. Permanent and accurate labelling is essential. Growth of some subjects is rapid so adjacent cultivars should have different leaf characteristics to avoid errors when collecting propagating material.

Pruning is an important factor in maintaining health and quality. The aim should be to produce well balanced growth for propagation but to leave sufficient reserves to build up the stock for production next season. Surplus cuttings should be removed to avoid a build-up of hard straggling growths with lower production potential. When a cut is made the welfare of the stock plant should be considered. Pruning snags on stock plants are frequently the cause of die-back and other problems. Any wound makes entry of certain pathogens much easier. Routine spraying with a range of materials is necessary to avoid build-up of disease.

Good ventilation is necessary on most occasions and spring can be a difficult period. Temperatures rise rapidly when the sun shines; ventilation helps to produce more balanced growth, able to withstand low night temperatures. Shading may be needed to avoid leaf scorch. Once the crop of cuttings has been taken, steady growth should be encouraged so that the stock plants enter the winter rest period in a suitably mature state.

To provide protection is not cheap so a good yield of high

quality material is essential. The best way to deal with bread and butter lines is to have sufficient outdoor stock plants to allow large batches of selected material to be removed at the correct time. This will lead to greater crop uniformity.

New introductions to the nursery and difficult or high value plants can stand the extra costs that protection imposes. On certain sites, climbing plants respond favourably by producing earlier and more cuttings when protected from wind. They can be intensively housed and need not occupy the area for long.

By difficult plants we usually mean difficult to root or difficult to establish and grow satisfactorily on their own roots. Protection of stock plants could well be helpful in increasing the percentage rooting obtainable from cuttings. The propagator has greater control over growth but what is probably more important still are the changes that occur in the plant itself when given certain types of protection. The studies at East Malling of preetiolation leading to improved rooting of difficult fruit and ornamental plants have been noted with interest and are being followed up at various centres in collaboration with Dr. Howard. The technique of covering pruned stock plants in early spring with a framework covered in black polythene was originally tried on apple rootstock M9. When the etiolated shoots were about 50 mm long, the polythene on the north side was opened to prevent scorching. After allowing the shoots to green up they were taken as basal softwood cuttings and rooted very successfully.

With *Tilia platyphyllos* the results were not so clear cut. The system is clearly worth investigating further and a wider range of ornamental plants is being screened.

GROWING ON

There has been a large increase in the use of protection for the production of pot liners and container grown plants. Polythene clad structures have not always produced the results that were anticipated, particularly where cultural methods were not modified to suit this system. The main benefits to be obtained are fewer plant losses and faster growth.

Plant Losses. The influence of protection on pathogens has already been mentioned. Intensive production, higher temperatures and frequent irrigation, favour many pests and diseases but most plant losses are caused by other factors. Even if propagation and potting are carried out at a reasonable time, plant establishment and overwintering are not always satisfactory. The main reasons for this are temperature and water relations.

High temperatures increase the release rate of nutrients from slow-release fertilizers. A newly developing root system is unable to cope. Under conditions of protective cover no more than half

the normal rate of fertilizer should be used. Rain is excluded, therefore leaching does not occur. Late potting does not encourage active root and plant growth. A warm autumn day or two causes too high a soluble salt concentration with consequent root damage. Problems can also occur in late winter and early spring with a quick rise in daytime air temperature. The roots are not active enough in a cold ball of compost to cope with a sudden demand for water from developing shoots. Adequate ventilation will do much to prevent problems of this nature.

The unheated type of protection we are considering will not have much effect in keeping out hard frost. It will reduce considerably desiccation by cold winds. Desiccation occurs when water loss from plants is more rapid than water uptake. If it happens when leaves are present, scorched foliage results. It is an indication of localised drought conditions even though the compost may contain adequate moisture. Shading applied in time to prevent high water loss and good culture conditions to promote good root activity will prevent such occurences.

Rapid and sustained shoot growth cannot be obtained with a poor root system. If the nutrient status is right, the most frequent cause of a sluggish root system is poor aeration of compost. Efficient drainage of compost and standing ground is essential.

Faster Growth Rate. Protection will encourage this provided other conditions are satisfactory. Loss of quality will occur unless careful consideration is given to cultural details. Adequate space must be allowed for balanced growth and some trimming will be needed to produce plants of good shape. The overall picture in structures and tunnels usually looks good, but often when individual plants are taken out, the drawn, soft growth proves disappointing.

TYPES OF PROTECTION

On many sites, simple protection against wind will bring about an improvement in growth rate and quality. The addition of a roof enables protection against excessive sunshine or moisture.

The most commonly used cladding is polythene film followed by netting. Both have drawbacks but perfection cannot be achieved with a low cost tunnel.

Propagation. Many low tunnels clad with milky-polythene are in use for propagation by cuttings during the summer months. Some walk-in high tunnels are also used for year-round propagation but in this case clear polythene is preferred because of the better light transmission during autumn and winter.

Efford Experimental Horticulture Station has successfully

employed ground-level propagation beds in a double skinned polythene tunnel, the two layers of film being held apart by a low pressure air current. Bottom heat was provided to the insulated beds by electric cables. When the outside temperature fell to 1.5°C (35.5°F) the inside temperature was recorded as 8.2°C (46.8°F). The comparative minimum temperatures in structures without bottom-heat provision were 2.8°C, 3.2°C and 3.5°C, respectively, for tunnels clad with Rokolene 1728, Nicofence 31, and one with a milky white polythene roof and netting sides. The light transmission for the first three months of 1980 averaged 47.1% whilst that for tunnels clad with different nettings ranged from 47.5 to 48.3% compared with outside light intensity.

Growing Crops. Whilst the high humidity attainable under polythene film can be useful in propagation, it can create problems in rapidly growing crops, particularly during the summer months. Temperatures, too, can be uncomfortably high unless adequate ventilation and shade are provided.

Netting has certain advantages particularly under summer conditions; growth generally is more gradual and hardier. In rainy periods however, excessive wet can lead to problems. The cost of netting is between 3 and 4½ times that of a single polythene film covering. Netting is however more durable.

For protection of plants requiring shaded conditions, e.g. camellias, rhododendrons and azaleas, structures carrying netting or other windbreak materials such as plastic webbing have proved highly successful.

Young nursery stock generally requires more protection from winter rains than is given by webbing or netting. Polythene often leads to precocious growth in the spring so a compromise is needed. This is best provided by a polythene roof coming sufficiently low down the roof curve to divert the water away from netting sides. If the structure is made from metal, a wooden batten running at the correct height can be used to form a junction where polythene and netting meet. In cold or windy areas polythene "blinds" can be provided to cover the netting during adverse weather conditions. This type of structure is likely to give the grower better control of climatic conditions than any other at a reasonable price.

A reduction in plant losses and an improvement in crop quality will do much to combat increases in cost of production. Protected cropping is one way of achieving this.

J. EDMONDS: We have been using double polythene for four years now and we are getting a lift of some 7 to 8°F. In other words, if there are 7 to 8° of frost, it is frost-free inside. There are just wooden ends which we seal fairly simply by tack

hammering the polythene together.

A. CARTER: I think, John, you are drawing air in from outside. At Efford we are using inside air. I think if you draw air in from outside you are virtually creating a wind all the time at outside temperatures. We are interested in looking at it the other way — putting in the warmer air from the house. It was suggested that if we did that we might get condensation problems, in which case we would go in for fish farming between the two layers, but that hasn't happened and there have been no condensation problems.

J. EDMONDS: We drew in air from the outside because we were wary of the condensation problems but we are heating those tunnels, which is different from what you are doing.

CLONAL SELECTION IN NURSERY STOCK

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Much has been done to improve the health and quality of planting material of many horticultural crops, especially fruit and vegetables. However, much less has been done to improve the health of the wide range of trees and shrubs widely grown as ornamentals in this country. In Europe efforts made to monitor the health standard of several species have improved their quality. Nevertheless some of the stocks imported to the U.K. have been virus infected. The best known example is strawberry latent ringspot virus in *Rosa rugosa* rootstocks. Although the growth of the stock was often unaffected by the virus and showed no symptoms, many hybrid tea rose cultivars either died or produced stunted growth when budded onto infected rootstocks.

In fruit trees the importance of each virus complex differs considerably, depending on the sensitivity of the scions and the rootstocks, the severity of each strain and the number of viruses involved. The same virus can be present in a range of fruit trees but the symptoms and effects may be different in each. For example, chlorotic leaf spot virus does not cause any symptoms on apple cultivars or clonal rootstocks but it can kill many ornamental crabapples. The same virus causes ring and line patterns on pear leaves and reduces the crop, yet when it is present in hawthorn it seldom shows symptoms.

The main method for spread of viruses among crops of woody plants is by using infected propagating material. Eelworms, aphids and other vectors play a part in the spread of