EARLY EXPERIENCES WITH A FOGGING UNIT: AGRITECH

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The modification of relative humidity to a point where "fog" is produced is not new. "Humidifiers" and fine droplet sprays have been used for many years to ameliorate the effect of high temperatures under various structures during daytime, for frost protection at night and the control of relative humidity in cold storage. All of these practices rely on the fact that a large amount of latent heat is required to change water from either the solid to liquid or liquid to the gaseous state; the spin-off being a change in temperature.

Most of the equipment was very large, often expensive, and in many cases used only on a large scale and was, therefore, not seriously considered by propagators, particularly those with comparatively small facilities. Recent developments in the range of equipment available have changed all this.

Now we have not only the ongoing fog versus mist debate, which in itself is not new, (over 20 years ago Warner (2) recognised this in his paper to the IPPS Eastern Region Conference of 1966 at Newport, Rhode Island), but have extended the argument to include types of fog. We consider whether the product is 'dry' or 'wet', whether ventilated or non-ventilated, whether closed or open (i.e. under polythene or in an open house) and proceed to compute in combinations of this new propagators' jargon.

There is a danger that the basic principles of simple systems such as closed cases and the use of polythene sheeting are overlooked in the rush to greater and more involved technology.

The difference between fog and mist. Fog is minute droplets of water, so fine that they remain suspended in the air (as opposed to mist where the larger droplets precipitate out very rapidly falling on to the surface of whatever subject is being misted). This is the fog that we can see. There is also the effect of a near-saturated atmosphere where the fog has raised the relative humidity but because of the temperature the droplets cannot be seen. The important thing is that fog being in suspension moves with the air around the whole surface of the plant and, very importantly, underneath the leaves of our cuttings where the majority of the stomata are to be found. It is this important factor that provides the basic difference between a fogging system and a damping down or misting system which can only reach the upper surfaces.

The performance of the cutting will be influenced by its ability to photosynthesise during the rooting period, enabling the rapid developments of both shoot and root throughout the propagation period to the enhancement of the size and quality of the rooted plantlet. Actively photosynthesising plants can utilize any nutrients that may be available in the rooting medium, thus opening up a wide range of possibilities for enhanced propagation techniques. This factor is particularly important during the 'high-light' summer propagating season and the use of fog in winter under 'low-light' conditions does not utilize these factors and may be fraught with additional problems.

Why use fog? My own interest in the technique developed as a result of attending the I.P.P.S. Southern Region Conference in 1980 where the equipment which came to be known as 'Agri-Tech' was discussed and described by Dan Milbocker (1). It was comparatively cheap and could be used in relatively small areas, a single fogging machine being capable of covering an area of 90 sq m. This was just what I needed. Our 15-year-old mist unit which—because we were in a hard water area—relied on collected rain water, which was then pressurised in order to function, needed replacing. The pump and pressure unit alone would have cost more than the 'Agri-Tech' fogger and recent experiences with the idiosyncrasies of the system made the choice very easy. However, things were not quite so simple: voltages and cycles are different in the USA where the 'Agri-Tech' came from and the equipment had to be modified. This proved to be quite costly and time-consuming. However, the end product worked just as Dan had predicted and I have had no reason to regret my decision to change to fog. I would have been happier if the Mark I model I obtained had been more robust and more durable, but I understand there are now improved models with more certain performance. One thing I have learned is that a back-up system is essential because it is a certainty that the machine is bound to fail on the hottest day of the year just after taking a batch of one's choicest, most difficult material. I find no great pleasure in attempting to change electric motors when the temperature is running up and all around are desperate wilting plants. We have come to terms with this and now have a simple emergency system as an insurance against rapid crop loss.

Our objectives. Our first objective was initial cost saving on the equipment which, in spite of the problems, was not extortionately high (in 1980 the dollar was 2.40 to the British pound) and our whole installation, including shipping, electrical work and the rewiring of one motor came to under £600. More important is the saving on running costs. Much of the energy that goes into undersoil heating is used to evaporate the surplus water in the compost in order to maintain the necessary bottom heat. This is particularly so where mist equipment is used to maintain cuttings in a turgid condition, often in high air temperatures which require considerable amounts of water to be used. Much of this surplus saturates the medium reducing its temperature and absorbing high quantities of energy due to the latent heat consumed in evaporation. This is not a problem where fog remains in suspension and it is possible to maintain high air porosity within the medium while the surrounding atmosphere is controlled even at very high temperatures. In fact, in high temperatures the rooting medium may well tend to dry out. Cost savings on under-heating in our first year were at least 50 per cent.

Our second objective was to provide a controlled environment for the weaning of propagules from micropropagation laboratories. At that time micropropagators were experiencing serious difficulties in the transition of material from the closed conditions of the laboratory to the outside world. Losses were extremely high and it was felt that an intermediate stage was needed either as a service to the producing laboratory or as a buffer for the growing-on operation. Fog has much to recommend it in this situation. However, the production laboratories have recognised this weakness and are now taking their material through this stage and offering the weaned and established plantlet or liner.

Our experience over the last six years has pointed to one factor that initially we had been slow to recognise and that is the superior quality of the rooted cutting or liner that we are producing.

Many of our plants now root rapidly and produce stronger, more vigorous liners which most certainly influence the quality of the final product. This cannot be attributed solely to the use of fog but in combination with improved open media (bark and perlite plus peat mixtures) and a modification in the type of cutting material used, particularly in the soft summer season. These factors have produced a throughput far in excess of that previously regarded as acceptable under mist and polythene. Even simple subjects such as fuchsias and hydrangeas can be improved upon, produced quickly and cheaply and, most important of all, with a greater efficiency of operation.

The range of subjects that we have rooted to acceptable economic levels include soft spring cuttings of *Acer* and *Betula*, deciduous azaleas (using pre-treated or forced material), *Cotinus*, *Corylopsis*, and our main evergreen azalea crop, together with *Liriodendron*, *Buddleia* and *Prunus* during midsummer. We have also rooted semi-ripe cuttings of *Parrotia*, *Pieris*, and *Rhododendron*, both dwarf species and hardy hybrids, and a wide range of high-value evergreens, including *Mahonia*, *Eleagnus*, *Kalmia*, and *Camellia*.

We have found that conifer cuttings in general do not root well, particularly when taken during the winter months. However, it is not difficult to use the facility without the fog switched on or to control it on a purely manual basis during warmer or brighter periods.

CONCLUSIONS

Always remember your objective. If you have a system that is working well do not change to fog just because fog is there. Remember also the basic principles. No quantity of highly developed electronic equipment can replace good propagation practice. It is essential to have good propagation material at the correct time of the year, to use a well-balanced medium and accurate temperature controls, both of the medium and the atmosphere above and, above all, to practice good hygiene standards; diseases or pests will move very rapidly through a fogging area particularly in warm summer conditions when there is considerable air movement. Observe these basic principles and your fog system will work very well. You will be amazed at the speed of throughput and the quality of the resultant product.

LITERATURE CITED

1. Milbocker, D. C. 1980. Ventilated high humidity propagation. *Proc. Inter. Plant. Prop. Soc.* 30:480–481.
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PROPAGATING SITKA SPRUCE UNDER INTERMITTENT MIST AND OTHER SYSTEMS

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Abstract. The reasons for the recent interest in using stem cuttings of tree species to produce rooted cuttings for forest use are reviewed. In Britain, commercial developments are currently confined to Sitka spruce (*Picea sitchensis* Bong. (Carr.)). A prototype facility for rooting conifer cuttings is described. Results indicate that high rooting can be obtained in a wide range of media and under different propagation systems. Correct feeding of the mother plant is shown to be important in obtaining high quality cuttings. Future developments are reviewed.

INTRODUCTION

Plants of tree species used in commercial forestry have traditionally been raised from seed. Only poplars and willows have normally been propagated using stem cuttings and in Britain these are a very small percentage of the number of plants produced. However, in the last 15 years, there has been increasing interest worldwide in the vegetative propagation of a wide range of other tree species (8). This has occurred for 3 reasons. Firstly, tree breeders have begun to identify high yielding genotypes with appreciable gains over unimproved stock. Such genotypes are generally