

testing the seed, the germination percentage, and emergence time must fall within a given specification. When the seed is received it is graded by either size, density, shape, weight, or colour.

A chemical treatment is then applied to the seed to enhance the vigour of emergence. The batch is then subjected to compost emergence tests to check the uniformity and vigour, after which, by use of a simple formula, we calculate the number of seeds to put into a packet to provide a predictable amount of uniform seedlings.

System Seed is used for plug production by our seedling and plant department. It saves time and money so growers can benefit by cutting their production costs, but still produce a quality bedding plant.

At present the number of plant genera, species, and cultivars is limited to:

<i>Ageratum houstonianum</i>	pansy 'Universal'
'Blue Champion'	pansy 'Lyric' × hybrida
<i>Cineraria maritima</i>	<i>Petunia</i> Express Series
'Silver Dust'	and Cloud Series
<i>C.</i> 'Cindy'	<i>Salvia splendens</i> 'Fury'
<i>Dianthus</i> Princess Series	<i>Verbena</i> × hybrida 'Garden Party'
<i>Geranium</i> Century Series	<i>Zinnia</i> 'Peter Pan'
<i>Impatiens</i> 'Accent'	
marigold 'Perfection'	

but further developments are underway.

## LARGE SCALE APPROACH TO CROP PROTECTION

JOHN ADLAM

*Blooms Nurseries Ltd, Bressingham, Diss, Norfolk*

I look at the job of a grower as one of eliminating the variables of the environment. I see these variables as follows:

- 1) Moisture levels
- 2) Nutrient levels
- 3) Gaseous levels
- 4) Temperature levels
- 5) Pest and disease levels

Many of the so-called crop protection duties are a result of an imbalance of one or more of these variables, not just pest or disease factors. Crop protection is not, therefore, just the appli-

cation of chemicals but the paying attention to all 5 items with equal credence. I firmly subscribe to the approach of prevention rather than cure and have proved that preventing an imbalance of these variables goes a long way toward protecting the crop. I am not an advocate of organic growing, but know that the best crops are grown by working with nature not propping it up.

**Light on our toes.** When it comes to doing the job, our motto is "light on our toes". Large organisations are notorious for being lumbering animals, but our approach is to be quick in response to a crop's need or the weather. As a large company we divide up into departments that specialise. Crop protection is one of the specialised departments. We aim to provide the growing departments with a service covering spraying operations, nutrient requirements, a laboratory service for analysis and P & D identification, compost quality control, and supplies.

My team consists of a crop protection officer, technician, supervisor, and up to 4 spray operators. The team members are very flexible in the times they work and are willing to come in at 5:30 a.m. or stay as late as 9:30 p.m. to get the job done. A sense of concern and urgency is felt by all if conditions are right or the need great.

**In the know.** One of the important aspects of modern day growing is knowing what is happening. Crop protection in the propagation beds is often influenced by what you know about the crop at any given time. We are constantly looking for ways of improving what we know NOW.

Bed temperatures are controlled by electronic controllers. These can maintain the beds at a far closer tolerance than rod thermostats, as well as monitoring the temperature in the rooting medium within the tray rather than in the bed below. Our units have a temperature meter showing a constant reading of temperature which is also relayed back to the foreman's office. This enables the foreman to constantly review the propagation environment in all six different locations at one time.

Record keeping is an important aspect of our work as we frequently need to be good detectives in identifying a problem. Records are kept covering details of stock plant location, spraying operations prior to cuttings being taken, full daily weather records from our own weather station, details of personnel involved in the cutting production, and compost records of ingredients. All these aspects, as well as many others, help us in protecting the crops under propagation.

Water quality is a constant headache. Our water for propagation comes from a bore hole and is heavily laden with



minerals. Iron at 2.9 ppm and a total hardness of 390 ppm  $\text{CaCO}_3$  make up a water that naturally blocks nozzles and covers plants with a brown deposit in two weeks. To overcome this we have installed a three stage water treatment plant. The iron is first oxidised by a manganese dioxide filter, and the calcium and magnesium carbonates are removed in an exchange column water softener. Because the Ca and Mg are exchanged for sodium we have a reverse osmosis unit to remove the sodium. This leaves us with a water that is free from harmful minerals, has a neutral reaction, and is biologically pure. Checks on the rooting medium help us to be aware of water quality.

**One foot on the ground.** It is very easy for a large company to have its head in the clouds and forget that much of our life goes on 6 in. below the ground or pot surface, out of sight. We, therefore, have a firm commitment to foster the "growers" in the company. With departmentalisation and large scale task-oriented operations, it is easy to forget our responsibility to the crop, and the people who are "where the rubber meets the road".

The people in direct control of the crop are our most valuable asset, particularly when it comes to crop protection. In December we held a one-day seminar for all managers and foremen on modern crop protection systems and methods. We invited the best people in their field to come and speak to us. A Health and Safety divisional chief, ADAS Regional Ornamentals Adviser, National ADAS Weed Specialist, and Senior Technical Officer from ICI Midox. The seminar was held off the nursery in a local Country Club and everything was provided free to the delegates. This has helped the people who handle the plants to understand more about the way herbicides work, and has reduced the aura surrounding "nasty chemicals". The differences between residual, contact, systemic, and persistent modes of action were all explained. This made a significant contribution to our crop protection on the nursery.

We also encourage a group of people from different departments to look at any aspects of nursery efficiency. They are formed into what we call The Nursery Action Team. This, too, has helped in high-lighting where improvements in crop protection are needed.

Winning the assistance of our workforce is seen as a major asset of crop protection.

**The willing worker.** One of the means of being light on our toes is by the productive use of a computer. I stress the productive use because I am a firm believer in making the

computer do what you want — never the other way round. I have built up a series of programmes that will provide the truth at the speed of light and upon which we can make sound decisions. We have a large main-frame computer that handles all the important facilities of the company, but my faithful friend is a desk top micro. We have herbicide tolerance of over half of our plant genera with 8 different residual herbicides. By keying in the genera we can see instantly which herbicides are safe. We can then group our plants according to herbicides, a major efficiency factor in spraying. The production of spraying instruction sheets is by a computer and it works out the amount of water, chemical, the number of journeys, and the time it will take us. Planning a day's work can be a little more accurate. I haven't yet found a way of controlling the weather with it though!

Budgeting a year's crop production costs is also possible. By combining historical and projected data, a pattern of expenditure can be produced. This data is then used in part of the annual analysis of costs. By allocating costs to different crops and apportioning them together with labour, we can very quickly arrive at a price per square metre of a crop's protection costs.

**Prevention is better than cure.** It costs us 19 pence per square metre per year to carry out a full crop protection programme on a container bed. It is important that we get the best value for money from it. We are constantly looking at new ways of improving it and monitoring its performance. We have found that the best approach is to go for prevention rather than cure. To this end we have produced a programme that is routine and goes on whether the problem exists or not. We apply both a systemic and contact fungicide hoping to attack both those diseases which are subcutaneous and those caused by spores alighting on the leaf. Leaf spots, sooty moulds, and mildews are all targets for that system. We have been using MBC generators in general and carbendazim, in particular, for over 8 years now, and I am beginning to feel nervous about resistance. Therefore I am looking closely at prochloraz as the substitute. As well as the spray programmes, a compost incorporated fungistat is included to reduce the incidence of the water-borne phycomycetes like *Phytophthora* and *Pythium*. Chlorothalonil is also added to protect the newly-potted plant from *Rhizoctonia*. I am a strong believer in tank mixes and have added many products together in the past. The new legislation will no doubt make life more difficult for us in many ways, but we will strive to comply. When a specific disease occurs we will spray against that with a different product from the routine one.



### Spray programmes.

Pesticide Programme. (Routine treatments every 3-4 weeks)

Spray aphid control products . . . . .	H.C.H. Permethrin
Spray leaf spot fungicides (systemic & contact) . . . . .	carbendazim
. . . . .	dithane
Spray mildew control products (contact) . . . . .	bupirimate
Spray powdery mildew control products . . . . .	chlorothalonil
Specific Treatments:	
Heleborus leaf spot . . . . .	carbendazim + maneb
Glomerella on phormiums, heathers, etc. . . . .	carbendazim + maneb
Violet root rot on Kniphofia . . . . .	captan dust+Benlate
Iris borer . . . . .	Dursban on larvae
. . . . .	Rovral on wet rot
Rusts on geranium, Trollius, hollyhock . . . . .	bendonil
Nematodes on various (leaf tip & stem) . . . . .	Nemfos+Temik
Paeonia blight . . . . .	Benlate
Wilt diseases on asters . . . . .	carbendazim
Phytophthora cinnamomi . . . . .	Fosetyl aluminum
Rhizoctonia . . . . .	Rovral
Pestalotiopsis . . . . .	prochloraz
Root aphids . . . . .	Diazinon
Red spider mites . . . . .	Childion

### Herbicide programme.

Growing over 5,000 different plant cultivars on the nursery may be a sales asset, but from a crop protection point of view it is a nightmare. This nightmare is epitomized in the herbicide selection. We have started to group plants according to herbicide tolerance. This has the advantage of simplifying spraying by the large machinery we use. This works well in container areas but we have not yet extended it to the open field, particularly when planting is dictated by weather conditions or stock availability. Given time I believe we will have achieved the greater degree of coordination necessary by pre-planning the planting order.

**Never too old to learn.** We are constantly looking at new ways and new products in order to improve our crop protection. Research station results are very important to us, but we do not rely only on them. We also look at various other things that are of importance to us, not covered by the National

Institute and E.H.S. levels. We are currently interested in extended cold storage of plants and ways of improving winter hardiness by a closer control of nutrition. This is in addition to herbicide screening and other control products. The changes in funding of research in the future is something which will make us look closely at where we get the best value for money, in-house or at a national level. The expansion or contraction of these facilities is therefore under current review.

**A pencil in your hand, not a sprayer.** How long is a piece of string? I can't answer that question, but I do know where it starts. Crop protection starts by sitting down with a pencil, not a sprayer in your hand! As growers, we know what problems to expect and when they arrive, and are not pushed into crop protection. We strive to be one step ahead. Observation of the weather helps in identifying pending problems such as: aphids after 5-7 days of warm moist humid atmosphere; red spider mites after dry and warm weather for 2 weeks. The Mills and Beaumont period warnings are good reminders for fungal disorders like the mildews and some leaf spots. Wet autumns increase the likelihood of red core, and when controlled-release fertilizers respond to low temperatures like this year's, the addition of liquid feed is necessary to maintain conductivity levels.

We aim to protect the crop from a controlled position. It may seem non-productive to sit down in the winter and work out many of the aspects I've covered but we have learned that it pays off in the end. We have targets in our crop protection programme that we can aim at: labour profiles, chemical costs, and capital requirements. It is said that strategy does not win the immediate battle, but it wins the war. Spending time in planning our crop protection is proving to pay off on the bottom line.

## **PROGRESS WITH DISEASES AND DISEASE CONTROL**

JOHN EVANS<sup>1</sup>

*Agricultural Development and Advisory Service,  
Government Offices, Coley Park, Reading, RG1 6DT*

The temperatures and humidities maintained during propagation are favourable for the development of a wide range of pathogenic fungi. These can reduce very substantially the number of cuttings which produce vigorous, healthy root systems. This paper reviews the fungal diseases most important

---

<sup>1</sup> Regional Plant Pathologist