Information Sheet 01/02

Protected Ornamentals

Horticultural Development Council

Bradbourne House
East Malling
Kent ME19 6DZ
T: 01732 848383
F: 01732 848498
E: hdc@hdc.org.uk

Growth regulation of ornamental plants by reduced phosphorus 'P' availability

By Conny Wang Hansen, Danish Institute of Agricultural Sciences, Aarslev, Denmark

This information sheet reports on studies conducted at the Danish Institute of Agricultural Sciences in Aarslev where a novel buffering material has been developed that allows for the growth regulation of protected ornamentals by reduced phosphorus 'P' nutrition.

Ornamental plants are often chemically growth regulated in order to reach the desired size and shape for a saleable product. The intensive use of chemical growth retardants in horticulture, and the restrictions introduced in recent years on the use of chemical growth regulation, reflects a need for developing new methods for efficient growth control. Experiments with genetically and ecologically widely differing plant species have shown that reducing phosphorus 'P' availability by 10 to 20 fold from current levels of inclusion in substrates, through the development of a P buffer technique, is a new and promising method for non-chemical growth regulation of ornamental plants. The results reported in this information sheet are from experiments conducted at the Danish Institute of Agricultural Sciences in Aarslev, Denmark.

Figure 1 Growing Pansy with low P throughout production resulted in a too strong growth regulation (left). In the dynamic P treatment (middle) the same low P buffer as in the 'low P' treatment was used. However, the addition of three times higher P with the irrigation water in the propagation phase (middle) resulted in sufficient growth regulation and high quality plants. Control plants (right) needed growth regulation.

Growth retarding effects of low phosphorus nutrition

One of the characteristics of plants grown at low P availability is that root growth gains at the expense of shoot growth resulting in a high root to shoot ratio. Shoot growth is therefore restrained and root growth enhanced as shown in Figures 1 and 2 with Pansy. Similar responses were seen in more than 10 different plant species. The growth retardant effect was mainly seen as reduced plant height whereas the number of nodes and therefore the branching ability was unaffected when a mild P stress was employed. In some species the reduced P method seems to be so effective for growth regulation that chemical growth regulation can be significantly reduced or even avoided (Figure 3 for Aster).

The number of flowers and flower buds may be reduced in some species when grown with reduced P. However, this can be avoided for most species by adding additional P with the irrigation water for a short period, in particular during the first 2 to 3 weeks after propagation (see Figure 1; dynamic P treatment).

Effects of low phosphorus nutrition on root growth

Maintaining a high root activity in the production and post-production phase of ornamentals may be considered as a method to improve plant quality in the supply chain and during shelf-life. In particular it is believed that a higher root activity reduces sensitivity to stress in shelf-life, with improved water and nutrient uptake under these less favourable growth conditions. A well developed and strong root system is particularly important when using robots for handling of plug raised plantlets and to ensure a fast adaptation to new growth conditions after transplanting into 'packs', large pots or in the garden.

Optimising low phosphorus nutrition by the development of a novel buffering material

In order to achieve effective growth regulation by reduced P, the available concentration must be very low, so low in fact that it is difficult to maintain the desired P concentration using traditional fertigation techniques with nutrients supplied through the irrigation water, and with the risk of plant P deficiency. To overcome these problems, a novel buffering material, Compalox®–P buffer, has been developed in association with Martinswerk GmbH, a commercial company in Germany. Compalox® is an activated aluminum oxide that has a very high affinity for P adsorption and desorption. The Compalox®–P buffer can simply be added to the growing substrate, thereby supplying a predetermined P concentration. With this technique it is possible to produce plants showing a mild and a desired P-stress (reduced plant height and enhanced root growth) and to avoid P deficiency problems.

The Compalox®–P buffer can be mixed into a wide range of growth substrates. The only change to normal fertiliser additions is that the source of P is replaced by the Compalox®–P buffer; this being the only source of P fertiliser in the growth substrate. If the production time for the crop is relatively short (approximately 3 months) it may be sufficient to mix only 1% (v/v) or less of the Compalox®–P buffer into the growth substrate, whereas 2% (v/v) is recommended for species with a longer production time.

Figure 2 Root growth was stimulated by mixing Compalox®–P buffer into the peat-based growth substrate (left and middle) compared to plants grown without the buffer (right).

Figure 3 Reduced P availability as a method to growth regulate *Aster novi-belgii* (left). Plants grown with high P and without growth regulation (middle) needed growth regulation. Right, chemically growth regulated plants. Plants growth regulated with reduced P had a shorter production time than chemically growth regulated plants.

Testing growth control of plants with the novel Compalox®–P buffer

We have seen a growth retardant effect of reduced P availability in chrysanthemum, marguerite daisies, pansy, miniature roses, Campanula, Aster, Poinsettia, Pentas, Schlumbergera, Exacum, Azalea, Stephanotis, *Pinus pinea* and Kalanchoë. Species like Osteospermum and Pelargonium which are genetically adapted to low P soils did not show any growth response to the mild P-stress employed by the Compalox®–P buffer technique in our tests. In species like Aster and Campanula we have seen an additive growth retardant response by combining reduced P availability with drought stress.

Effects of low phosphorus nutrition on shelf-life of pot plants

Experiments with marguerite daisies, miniature roses, Pentas and Aster have shown that plants grown at low P level had a better keeping quality than plants grown at a traditionally high P level. Reduced P availability improved plant tolerance to post-production stress by delaying floral senescence (Figure 4) and reducing root dieback. Figure 4 also shows that chemically growth regulated marguerite daisies grown at high P availability (commercial standard) formed more flowers and buds, but they wilted significantly more quickly than plants grown at reduced P availability.

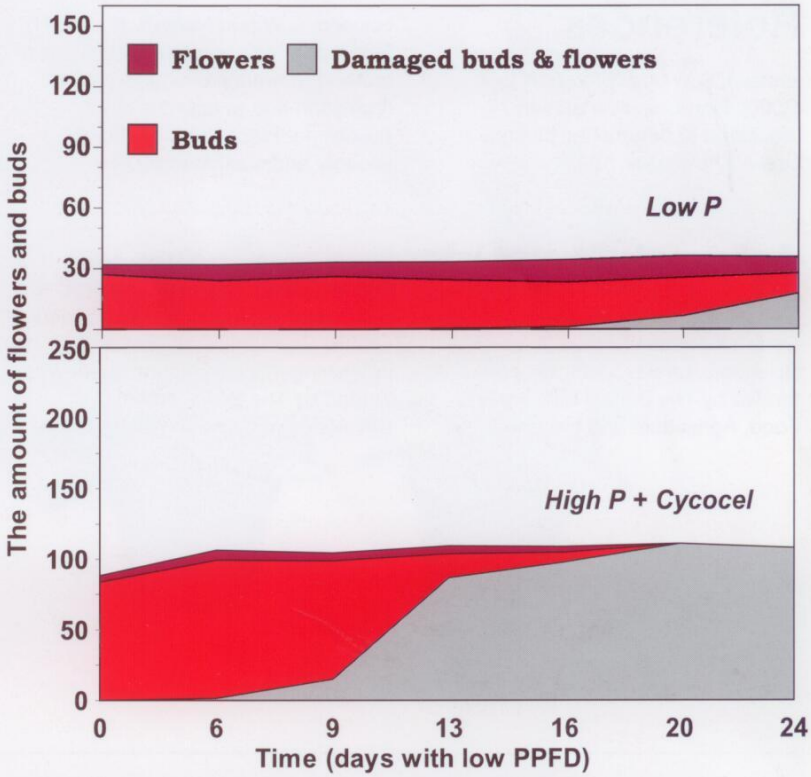

Figure 4 Floral senescence was delayed in marguerite daisies (*Argyranthemum frutescence*) when grown at reduced P availability compared with conventionally produced plants. (PPFD = photosynthetic photon flux density = measurement of light intensity as μmol/m²/s).

In *Pentas lanceolata*, 94% of the flowers in high P produced plants were damaged after 28 days under low light levels. The number of damaged flowers was significantly less when grown with low P availability (Figure 5). These findings have considerable importance for the horticultural industry and for the consumer, and offer the possibility of reduced fertiliser use, reduced use of chemical growth regulators while improving the keeping quality of ornamental plants.

Figure 5 After 28 days in an interior room with low light intensity, plants grown at reduced P availability (left) had significantly less damaged buds and flowers than conventionally produced plants of *Pentas lanceolata*.

Conclusions

Incorporation of Compalox®–P buffer into the growth substrate can be used as a technique to maintain predetermined and stable P concentrations in the growth substrate. This is of interest for different purposes, for example:

- Plant growth regulation using reduced P availability as an alternative method to chemical growth regulation.
- Enhance root growth since reduced P availability increases the root to shoot ratio.
- Improving the shelf-life of plants by reduced P availability.
- Faster adaptation to new growing conditions after transplanting.

For more information about Compalox®–P buffer, please see http://www.martinswerk.de

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Acknowledgements

This research was conducted at The Danish Institute of Agricultural Sciences, Aarslev, Denmark and funded by The Danish Ministry of Food, Agriculture and Fisheries, Danish Growers and Martinswerk GmbH, Germany. The Compalox®–P buffer was produced by Martinswerk GmbH, Germany. The cost of publishing this information sheet was funded by The Horticultural Development Council (HDC), UK.

Neil Bragg, Bulrush Horticulture Ltd., UK, and Dr Annette Carey, HDC, UK are gratefully acknowledged as technical editors of this publication.

January 2002