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Non-chemical growth regulation of ornamental plants

Most potted plants produced today need chemical growth regulation, but the restrictions introduced in recent years on the use of chemical growth retardants will probably continue. The intensive use of chemical growth retardants in nurseries and within agriculture reflects a need for efficient growth regulation methods without the use of chemicals. Experiments at the Department of Ornamentals at Aarslev in Denmark have shown that growth regulation by reducing phosphorus availability is a new and very promising method. The above photograph shows Pentas lanceolata ‚Apollo' grown at four phosphorus levels.

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Ministry of Food, Agriculture and Fisheries

Danish Institute of Agricultural Sciences

One of the characteristics of plants grown at low phosphorus availability is that root growth gains at the expense of shoot growth. Shoot growth is therefore restrained and root activity strengthened. In previous experiments with Chrysanthemum and potted miniature roses (see photograph 1) low phosphorus availability has proved to have a strong growth-retarding effect. Plant height is reduced, with little or no influence on flowering, and there is no impairment of plant quality. In an ongoing project, a series of genetically and ecologically widely differing plant species is being tested to investigate whether growing at low phosphorus availibility is an effective method for regulating growth without the use of chemicals. In addition, the hypothesis that the stress tolerance of plants grown at low phosphorus availability is improved is tested.

Foto 1. Rosa-hybrid 'Bianca Parade®'

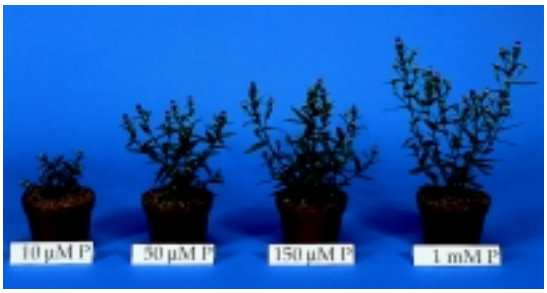

Photo 2. Aster novi-belgii 'Purple Viking'

Answers are sought to the following questions:

- How is plant growth affected at low phosphorus availability?
- How is the stress tolerance of plants affected at low phosphorus availability?
- Is it possible to use reduced phosphorus availability as an alternative to chemical growth regulation?

Plant species

The plant species selected for the experiments all have a considerable need for growth regulation and are produced to a great extent in Denmark:

- Argyranthemum frutescens (Marguerite)
- Aster novi-belgii
- Pentas lanceolata
- Euphorbia pulcherrima (poinsettia)

Phosphorus treatments

- 10 µM (100 x reduced compared to standard)
- 50 µM (20 x reduced compared to standard)
- 150 µM (6-7 x reduced compared to standard)
- 1 mM (standard)

Results

The preliminary results indicate a growth-retarding effect in all the tested plant species when the phosphorus level is at least 20 times reduced compared to a traditionally high phosphorus level (see photographs 2-4). In Pentas and Aster grown at 50 µM phosphorus, growth regulation is so effective that it might be possible at this level to replace chemical growth regulation in these plant species completely (see photographs 2 and 3, and the front page).

Even though the growth-regulating effect in Argyranthemum at low phosphorus availability was strong in the vegetative growth phase, the phosphorus availability did not seem to affect the length of the flower stalk (see photograph 4). This suggests that growing Argyranthemum at low phosphorus availability may significantly reduce the use of chemical growth retardants but not completely until breeding of species with shorter flower stalks is successful.

Reducing the phosphorus concentration of the growth medium 6-7 times compared to standard

Photo 3. Pentas lanceolata 'Apollo'

Photo 4. Argyranthemum frutescens 'Dana'

showed no essential growth reduction, which indicates that the plants were over-fertilized when grown at the traditionally high phosphorus level. Argyranthemum grown at a standard high phosphorus concentration had greatly reduced root growth compared to plants grown at reduced phosphorus availability (see photograph 5). This means that there is a smaller root system to provide a larger top with water and nutrient and perhaps this has a negative effect on the postharvest stress tolerance of the plants.

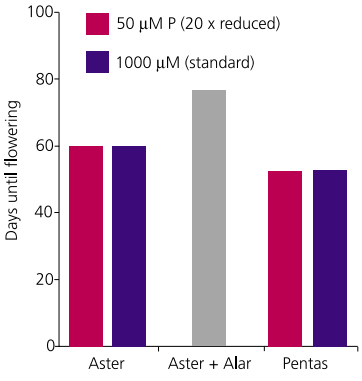

Figure 1. Production time when the plants were grown with low phosphorus availability or treated with chemical growth retardants, respectively.

Production time

Growing at low phosphorus availability did not affect the production time of the plant species tested (see Fig. 1). For Aster, however, the production time was extended by 17 days when growth was regulated by Alar, a commonly used chemical growth retardant for Aster.

Low and stable phosphorus availability

In order to achieve effective growth regulation by low phosphorus, the concentrations must be very low, so low in fact that it is difficult to maintain plant stability using the traditional fertigation techniques with nutrients supplied through the irrigation water. However, by adding a phosphorus buffer to the growth medium, which supplies a predetermined phosphorus concentration, it is possible to maintain a constantly low and stable phosphorus concentration in the growth medium. Research on developing nutrient buffers is being carried out at the Department of Ornamentals at Aarslev.

Stress tolerance

Even though potted plants produced in Denmark generally have good keeping quality, it is important constantly to continue to develop production methods towards improving keeping quality, otherwise Danish growers will not be able to maintain their share of the European market. In a previous experiment on pot ro-

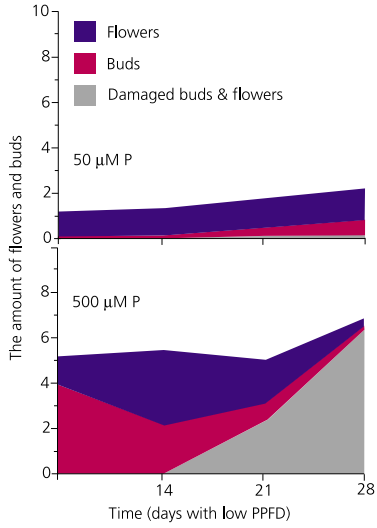

Figure 2. Keeping quality of pot roses grown at low (50 µM) and high (500 µM) phosphorus availability.

grøn viden

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ses it was shown that plants grown at a low phosphorus level had an essentially better keeping quality than plants grown at a traditionally high phosphorus level (see Fig. 2). Plants grown at high phosphorus availability formed more flowers and buds, but they wilted significantly more quickly than plants grown at reduced phosphorus availability. Whether the improved keeping quality in low-phosphorus plants can be explained by (1) a lower number of flowers and buds and therefore a lower assimilate demand, (2) increased root activity leading to good and continuous water and nutrient uptake, and/or (3) increased storage of starch and carbohydrate in the different organ categories in the plant are some of the questions which have to be answered in future experiments investigating the influence of phosphorus availability on keeping quality in a series of plant species.

Photo 5. Argyranthemum frutescens ‚Dana' at (from the left) 10, 50, 150 and 1000 µM phosphorus, respectively.