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AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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GROWER SUMMARY

Headline

Using best practice growing methods is as important as the type of feed applied; monitoring growing media and water, as well as plant growth are vital in avoiding nutrient deficiency, toxicity, and unnecessary waste of feeds.

Application of liquid feed through overhead irrigation has the benefit of foliar uptake of nutrients but in periods of low water use, better results are achieved with a controlled release fertiliser (CRF).

Financial savings can be made using capillary matting as part of the irrigation system but monitor for unwanted salts.

Marginal leaf necrosis in primula has multiple causes, but calcium (Ca) nutrition can be improved by adapting the growing environment and application of foliar calcium nitrate ($Ca(NO_3)_2$).

Application of nitrogen (N) to field grown narcissus at leaf emergence has no benefit over later application.

Application of N at a rate of 80 kg/ha increases harvest bulb weight in field grown narcissus but does not increase incidence of basal rot (*Fusarium oxysporum* f.sp. *narcissi* (FON)). Application of N at rates of 50 kg/ha or lower have no impact on harvest bulb weight.

Background

The target of this project is to make nutritional recommendations for key crops in the protected ornamental, bulb and outdoor cut flower industry which could form part of the guidance available in RB209. When making nutritional recommendations it is important to understand the nutritional requirements of the plants and also how the different variables in the production system will alter the availability of different nutrients.

A key area of investigation was to see how peat-reduced growing media mixes containing different components interacted with liquid feed applied via different irrigation methods, and to different crops at different times of year. The aim was to provide best practice advice on the use of liquid feed in protected ornamental crops, and how to make changes in feed regimes in response to changes in growing media as peat is phased out of use.

Specific nutrient problems were identified in the project outline and in the scoping study; investigations were undertaken to improve primula nutrition for avoidance of leaf edge scorch and to tackle iron (Fe) deficiency in pH sensitive crops.

In a 3 year study on N nutrition in field-grown narcissus carried out at the trial sites in Cornwall and Lincolnshire, the aim was to review the current advice available in RB209 and to also look at the potential link between N application and incidence of basal rot.

Summary

Experimental investigations were carried out over a 4-year period, with trials undertaken at NIAB's Cambridge site for glasshouse work, and in Lincolnshire and Cornwall for the field-based narcissus trials. In Cambridge a bespoke set up of tabletop benches and irrigations systems were used to compare liquid feed application to bedding crops through different irrigation methods, a total of 5 trials were completed. The trial compared the results for plants grown in peat reduced growing medias, which were 70:30 peat perlite mix, 70:30 peat wood fibre mix, and 70:30 peat coir mix. A standard balanced feed was used, this was OMEX Adjust range, O-Mix 21-7-21 + 1.6 MgO + TE. In trials growing pansy in autumn/winter, the liquid feed was compared with a CRF with NPK ratio of 12-7-18 + TE, and a release time of 2 to 3 months (Osmocote Bloom), at a rate of 3 g per l.

Monitoring was carried out on growing media pH and electrical conductivity (EC) by saturated media extraction (SME), irrigation water and run off pH and EC, and nutrient content of growing media and leaf tissue by laboratory analysis.

The trial results showed that in spring/summer where water use was high, the 3 irrigation systems investigated (ebb and flow, overhead and drip irrigation with capillary matting) all produced a saleable crop. Plants grown under the ebb and flow irrigation system had the highest fresh weight, except where the growing media mix contained 30% wood fibre.

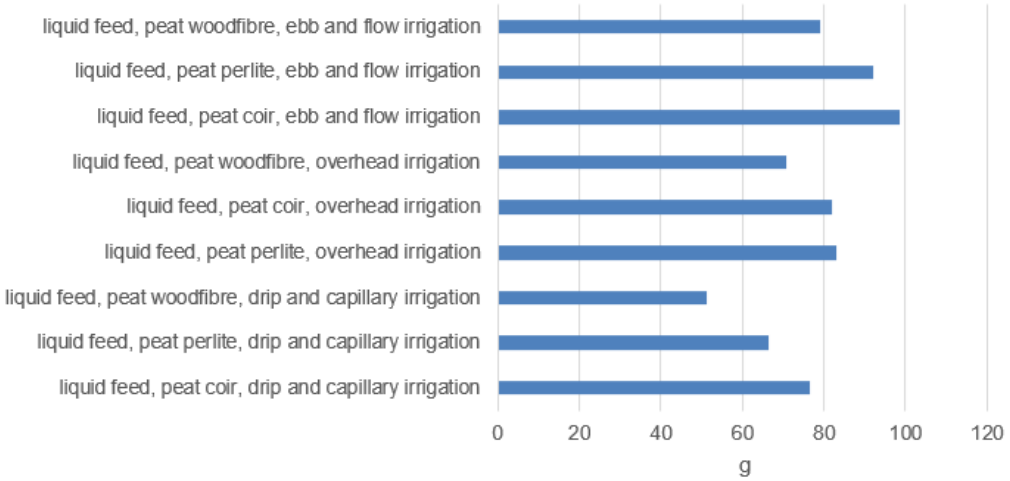

Figure 1. Results for spring/summer trial of petunia showing fresh weight (g) of above ground growth observations dated 07/08/2019.

Use of overhead irrigation proved very effective where water use was moderate to high, and in some trials this produced a fresh weight that was equal or higher than those grown with

ebb and flow irrigation. As the feed concentration is the same this is likely a result of the added action as a foliar feed. As overhead irrigation used less water in the trials than ebb and flow, this can be regarded as more efficient use of water and feed.

Use of overhead irrigation with hard water did result in the greatest increases in growing media pH over the duration of the trial, which is a concern for pH sensitive crops and resulted in bicarbonate induced chlorosis in petunia.

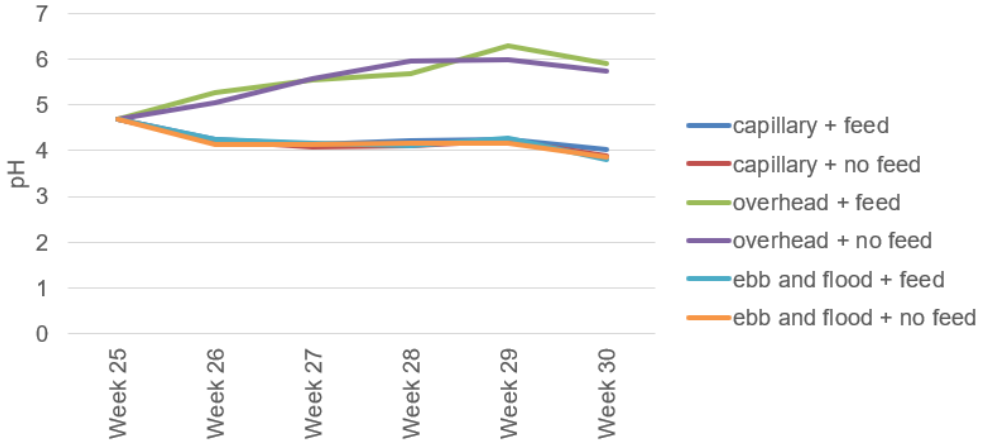

Figure 2. pH over duration of trial in peat and coir mix growing media treatments, from spring/summer trial of petunia 2019 trial.

In the winter where water use was very low, moving from liquid feed to a CRF produced the highest fresh weight. This was the case even when using an irrigation system with capillary matting with which liquid feed produced very low weight plants.

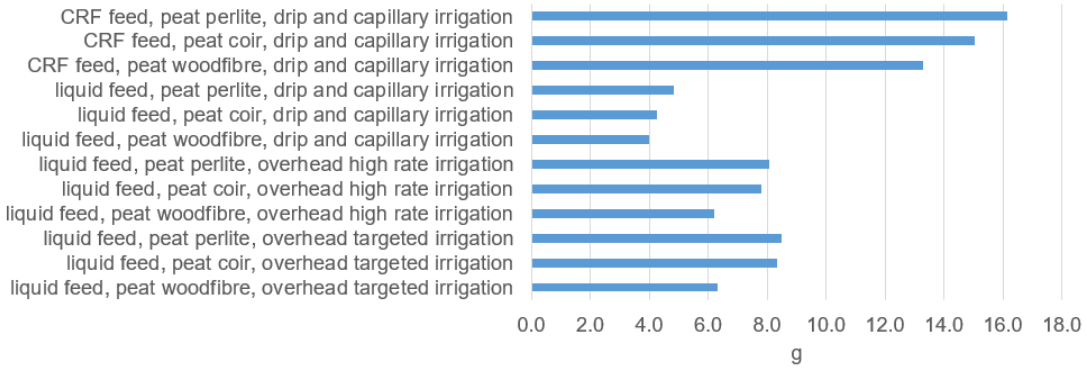

Figure 3. Results for winter trial of pansy showing fresh weight of above ground growth displayed according to irrigation method and ranked for weight (g), observations dated 06/01/2022.

The results in figure 3 also show that when watering was increased in the overhead irrigation (high rate vs targeted), there was no positive effect. Demonstrating that if plants do not require

additional water, they will not take up additional liquid feed. Increasing the feed:water ratio is a better option, which will help to avoid waterlogging and anaerobic growing media conditions.

Results showed that with 70% peat and 30% wood fibre growing media mix, plants had the lowest fresh weight in every combination of feed and irrigation, indicating that mixes high in this substrate would benefit from an increased concentration of feed. The growing media mixes containing 30% coir had consistently higher potassium (K) levels, due to properties of the substrate. Mixes high in coir should be checked for high levels of K and choose a feed which accounts for this to avoid inhibition of N and Ca uptake.

Investigations into leaf edge scorch in primula indicated that there are multiple causes of leaf necrotic tissue. Work over 4 trials at NIAB and a comparison with a commercial nursery indicate that causes can be diverse, as shown in figure 4.

Figure 4. Comparison of different possible causes of necrotic leaf margins, (from left to right) potential nutrient toxicity (possibly Na), thermal stress and potential nutrient deficiency (Ca).

Nutrition can be improved by altering environmental factors that affect movement of Ca in the plant, such as reducing humidity at crop leaf height, or avoiding water stress which also has the benefit of reducing the risk of thermal stress. Leaf necrosis in both cases is related to problems with lack of transpiration in the plant.

Ca nutrition was also seen to improve with foliar application of $Ca(NO_3)_2$, but not at rates lower than 1:250 of a compound containing 22.5% Ca, 15% N.

Primula is pH sensitive and prone to bicarbonate induced chlorosis due to Iron (Fe) deficiency, in trial conditions this was reversed by foliar applications of a 2% sequestered Fe product at 5 ml in 1 l water at weekly intervals for 4 weeks.

As growing media pH is a key factor in nutrient availability it was a reoccurring theme in the work. Changing the NH_4 (ammonium) to NO_3 (nitrate) ratio to influence pH is well documented in other studies, and where NH_4 is present as a greater part of the ratio in liquid feeds and base fertilisers it will have an acidifying effect. The opposite effect is seen when NO_3 is greater. For growers transitioning from peat-based growing media to peat-reduced and peat-

free mixes, the ability to influence pH using different forms of N could be of increasing relevance. Water retention in peat-reduced and peat-free mixes can be an issue, leading to more frequent or higher volume irrigation. If using water high in bicarbonate (HCO_3^-), the increase in pH seen over time could be greater than using a 100% peat media.

The N nutrition study in field grown narcissus showed that after 2 years of N application, there was an increase in harvested bulb weight with an increase in rate of N, but this was not reflected in stem length or the number of stems produced. The results suggest that the influence from the year (environment), has a greater effect for stem length than N application, and bulb age is a greater factor for number of flowers.

The weight of bulbs harvested at the end of the trial was higher with the application of N at a rate of 80 kg/ha from between 9% and 21% in the varieties tested, but not at lower rates.

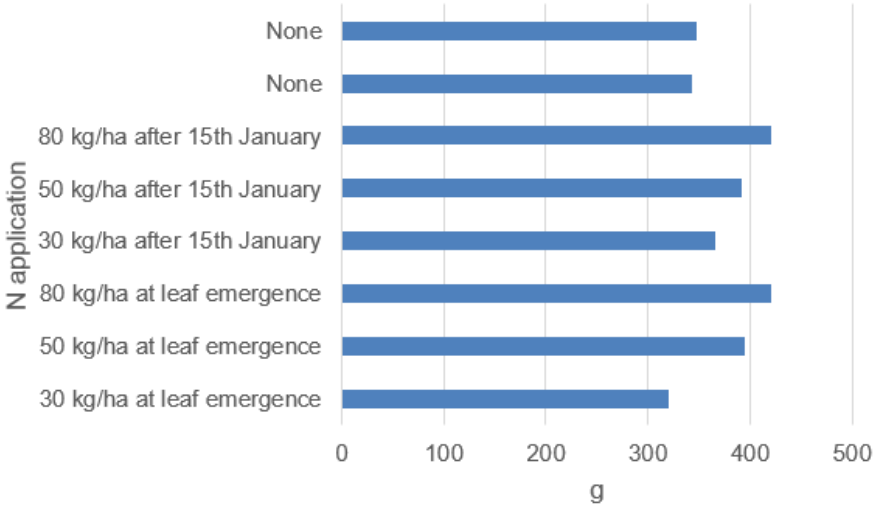

Figure 5. Treatment details and results for weight of harvest bulbs per m from Lincolnshire trial, observations dated 15/06/2022

The results do not support that it would be beneficial for application of N to take place at an earlier stage of the crop, i.e. at leaf emergence when that falls within the Nitrate Vulnerable Zone (NVZ) closed period. No improvement was seen over later application at the same site. This means that N applied during this period where NVZ restrictions do not apply, is likely to be less effective than if it is applied later in the growth stage of the plant.

The study has generated very little data in relation to a link between N fertility and basal rot. Currently there is no evidence to suggest application of N at rates of up to and including 80 kg/ha increased the rate of infection, but this may be a result of the trial design rather than there being no link.

Financial Benefits

By adapting irrigation methods to time of year, savings on fertiliser use can be made. Results indicate that during summer a reduction in fertiliser cost of 44% could be made using capillary matting.

The cost implication of changing from a liquid feed regime to CRF ranges from a 3 fold increase to potentially cost neutral. Cost saving is dependent on the efficiency of the watering system and therefore the amount of liquid feed wasted. Use of liquid feed maybe cheaper, however use of CRF has lower equipment cost and staff time input.

Symptoms of Fe deficiency in primula can be reversed by foliar application of liquid sequestered Fe at a cost of 30 pence* per 1000 plants, saving around 10% of the crop from any deficiency.

Routine Saturated Media Extraction (SME) testing can be completed at minimal cost*, initial outlay for EC/pH Meter – ExTech II - £150 and 2 x 500ml jugs - £10, plus price per test of 20 pence for distilled water and coffee filters.

Save fertiliser costs by avoiding early application of N (at leaf emergence) for field grown narcissus as it has no impact on stem length or flower number.

**Prices are correct as of submission date of report – December 2022.*

Action Points

- In periods of low transpiration be vigilant of overwatering and accumulation of salts (nutrients) in irrigations systems using capillary matting.
- Reduce humidity in the glasshouse to improve Ca content in plants, and avoid water stress (drought) to reduce the risk of scorch symptoms
- Electrical conductivity (EC) is only a method for measuring total ions. Undertake sampling and laboratory testing of irrigation water to get a clear understanding of the amount and type of nutrient ions that are present in the water supply. This can prevent unnecessary fertiliser use and avoid potential nutrient toxicity.
- Regularly monitor the growing media EC to identify both inadequate and excessive levels, particularly in low water use periods.
- Use controlled release fertilisers (CRF) or increase the feed/water ratio for winter crops where irrigation can be low in response to weather conditions.
- In spring and summer Primula crops, reduce humidity in the glasshouse to improve Ca content in plants. This should reduce scorch symptoms.
- Apply N as a top dressing to increase harvested bulb weight at rate of 80 kg/ha but avoid early application as it has no impact.