Grower Summary

Developing Nutrient Management Recommendations for Selected Horticulture Crops.

HNS 200

Annual report 2020

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The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.

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

Headlines

- Under high soil P, K and Mg indices, growth was not affected by additional fertiliser.
- Crop nutrient offtake (nutrients removed by plants when the crop is lifted) is relatively low in *Betula utilis* var*. jacquemontii*

Background

Field HNS growers typically use single nutrients known as straights (e.g. ammonium nitrate) or compound fertilisers (containing mixes of nitrogen (N), phosphorus (P) and potassium (K) fertilisers), with limited use of slow / controlled release fertilisers in some crops. Some nurseries carry out regular soil analysis to find out what levels of P, K and magnesium (Mg) are present in soil to help determine rates of fertiliser to apply. Soil sampling for residual N is less common than sampling for P, K & Mg. Other nurseries do not currently carry out regular soil analysis; some of those that do carry out soil analysis sometimes struggle to interpret the results and simply apply the same rates of fertiliser every year, regardless of soil nutrient indices / crop need. The situation is complicated by the fact that there are no readily accessible standard fertiliser recommendations for field, soil-grown HNS species for UK growers. The most recent recommendations were published in 1988.

Because of the high value of field grown HNS in relation to the price of fertiliser, the cost of application is not always considered. Many growers use historic application rates of fertiliser rather than analysis-based application rates, which can result in excessive use of nutrients. However there is the potential for savings to be made which can contribute to improved profitability (refer to financial benefits).

Growers must also comply with legislation such as limits on the amount of N (a total N limit of 250 kg/ha) that can be applied in Nitrate Vulnerable Zones (NVZs) to prevent the pollution of water. Fertiliser production and usage directly contributes to greenhouse gas emissions and hence climate change so efficient use of N fertilisers is vitally important. High levels of P should be avoided (above Index 3) as surface run off (particularly where soil erosion is a problem) can transport phosphates into water courses.

Maintaining an unnecessarily high P index is considered bad practice as it increases the risk of pollution and further legislation such as the implementation of phosphate vulnerable zones. There are not currently any phosphate vulnerable zones in the UK but in Northern Ireland phosphate regulations are now part of their nutrient action programme – since

January 2020, there are restrictions on the maximum phosphate fertiliser applications allowed in certain situations.

A better understanding of the nutritional needs of field grown HNS species, and the optimum type of fertiliser for HNS could help to optimise crop nutrition. For example, fertilisers containing muriate of potash (potassium chloride) can scorch the foliage and result in slow establishment of some ornamental chloride-sensitive genera; potassium sulphate is a more suitable K source for ornamental crops. Urea-based N fertilisers are generally cheaper than ammonium nitrate however ornamental species do not all respond as well to urea.

Aim of the trial: To establish baseline information on nutrition for field-grown HNS trees, determine the impact of novel fertiliser application methods on plant nutrient status, and evaluate crop nutrient assessment methods (soil electrical conductivity (EC), tissue analysis or leaf chlorophyll measurement) to provide data that correlate most closely to crop nutritional needs.

Year 1

Objective 1: To take soil and tissue analyses from one species with existing data for comparable nutrient levels (samples taken up to 4 times per growing season), measure soil EC and use chlorophyll meters to determine crop nutrient status.

Objective 2: To determine which method provides the most robust data on the test crop nutritional status, correlates most closely with crop nutritional needs and is easy to interpret.

Objective 3: To compare crop nutrient status due to novel targeted fertiliser application methods (broadcast vs band application).

This project is comprised of three work packages:

WP1. HNS (field and container) Literature review

WP2. Field tree production. To establish baseline information on nutrition for field-grown HNS trees by categorising the main plant families into vigour groups (e.g. Low; low – medium; medium - high), explore novel methods for applying fertilisers and determine the most suitable analyses (soil EC, tissue and/or leaf chlorophyll) to assess crop nutrient status (submitted as a separate report)

WP3. Container production. Optimisation of combined controlled release fertiliser (CRF) and liquid feed regimes for nursery stock liner production under protection

This is the report for WP2. **The reports for WP1 and WP3 are submitted separately.**

Summary

During 2019 a field tree nutrition trial was carried out on field grown *Betula utilis* var. *jacquemontii* using the host nursery's standard rate of fertiliser.

Table 1. 2019 Field tree trial year one treatments.

Treatment number	Application method	Product (name)	Nutrient content	Rate (L/ha or kg/ha)
1.	-	-	-	Untreated
2.	Broadcast (nursery standard treatment)	Glasson Fertilisers 20 -10 - 10	Ammonical nitrogen (Ammonia) 11.1% Nitric nitrogen 8.1% Phosphorus pentoxide (P205) Potassium oxide (K20) as muriate of Potash	370
3.	Band application to crop rows	Glasson Fertilisers 20 -10 - 10	Ammonical nitrogen (ammonia) 11.1% Nitric nitrogen 8.1% Phosphorus pentoxide (P205) Potassium Oxide (K20) as muriate of Potash	370

2019 Field Tree Trial

This field tree nutrition trial was set up in 2019 at James Coles & Sons (Nurseries) Ltd, Gaddesby, Leicestershire on field grown *Betula utilis* var. *jacquemontii.* Trees were planted in the field as 5 L container grown trees in late winter / early spring of 2019 to be grown on in field production as trees in medium loam soil. The aim of the work carried out was to determine if band applications of fertiliser to crop rows were more effective than traditional broadcast applications.

The fertiliser used was the nursery's standard 20-10-10 product supplied by Glasson Fertilisers Ltd. It was applied at a rate of 370 Kg/ha, as a single application in spring, as routinely used by the nursery; the K source was muriate of potash. Leaf tissue analysis,

measurements of the chlorophyll content of leaves (using an atLEAF hand-held device), soil EC, water content and temperature were carried out throughout the growing season. The girth of selected young trees was also measured through the growing season to determine differences in growth between treatments.

Soil analysis was taken prior to fertiliser application (see **Table 3, Science section)** and at the end of the growing season (see **Table 9, Science section).**

There were no differences in mean girth measurements between treatments (including the untreated controls) when measured in weeks 26, 34 and 43.

There were no differences in mean chlorophyll content measured by the atLEAF until week 30, when chlorophyll content within broadcast plots was higher than in untreated plots. This trend continued when the final assessment was carried out in week 34.

Although tissue analysis showed some significant differences between means on the assessment dates, none of these significant differences persisted through the season. Tissue analysis, compared with published figures, indicated that levels of micronutrients were low in all treatments throughout the growing season.

Discussion

None of the treatments resulted in any difference in the growth (determined by girth measurements) of *Betula* within this trial during the 2019 growing season.

Levels of P, K and Mg were found to be high before fertiliser was applied. The fact that plants performed equally well where fertiliser (regardless of application method) and no fertiliser was applied, highlights the importance of regular soil analysis (before planting or every three years), to check soil nutrient levels to determine which nutrients are required. Growers should also note that excessive amounts of most nutrients can create nutrient incompatibility, where an excess of one nutrient inhibits the uptake of another, potentially creating unnecessary deficiency symptoms and associated reductions in growth. P, K and Mg soil indices decline slowly hence soil analysis is typically only required every three years. Soil pH was 7.3, and lime only needs to be applied to maintain a soil pH between 6 – 6.5, so there was no lime requirement either. Levels of micronutrients were found to be low when compared to published figures; low levels of micronutrients may be limiting potential crop growth.

There was no correlation between chlorophyll content and growth in *Betula utilis* var. *jacquemontii* (a crop with available tissue analysis data) at high soil P, K and Mg indices.

Conclusions

- No difference in growth (determined by girth measurements) occurred between *Betula utilis* var*. jacquemontii* trees in plots where no fertiliser was applied, where fertiliser was broadcast or applied as a band treatment.
- P can contribute to the pollution of water, particularly where soil erosion occurs; phosphates can enter water courses bound to soil particles lost through soil erosion.
- P index should not be maintained above Index 2-3.
- K index should not be maintained above Index 3.
- Mg index should not be maintained above Index 2.
- Unnecessary applications of nutrients are potentially environmentally damaging whilst also increasing production costs.
- There is potential for savings on fertiliser use and associated costs through the use of regular soil analysis.
- Tissue analysis can be used to check micro nutrient levels within crops to determine when micronutrients should be applied.
- More work is required to determine if chlorophyll meters can be used to determine crop nutrient status of *Betula utilis* var*. jacquemontii.*

Financial Benefits

The host nursery single application of 370 kg/ha 20–10-10, (19.2% N), P, K fertiliser cost £188.70/ha. Soil analysis showed that P and K Index was high, therefore it was not necessary to apply any more P or K to this crop as both were at a high index (above Index 3). Applying P and K where the soil is already at a high index is potentially environmentally damaging, can be detrimental to optimum crop growth due to nutrient incompatibility, and also results in unnecessary expenditure on fertilisers. This resulted in 71.04 kg/ha of N being applied to the crop in a single application; applying this much N in one go carries a high risk of N leaching before it is taken up by the crop, especially on light textured soils.

In growing seasons where this occurs, it is likely that the crop would be short of N during at least part of the growing season which may result in sub-optimal growth.

If ammonium nitrate (34.5% N) was applied as the sole fertiliser (as P and K were not needed) applying 206 kg/ha of product would supply a similar amount of N (71.07 kg/ha) as the nursery standard treatment, which would cost £54.18, resulting in a saving of £134.52/ha. Given that N readily leaches it is standard practice to apply all forms of N that are readily

available (such as ammonium nitrate) splitting the dose between three applications during the growing season to enable crops to best use the N supplied, whilst optimising crop growth.

There was no difference in growth within any of the treatments / application methods including the untreated plots that received no fertiliser (where N was the only likely limiting factor). Therefore *Betula* may not have a high N requirement for growth as it readily naturally colonises heathland and other habitats that are naturally low in N. There may be potential to further reduce N applications to this species whilst maintaining crop growth.

Annual *Betula* offtakes of P, K and Mg are relatively low (see **Table 10, Science section**) so fertiliser savings can be achieved over a number of years where high indices occur as it typically takes a number of years for the soil Index to decline to levels where P, K and Mg fertiliser applications are required.

Action Points

- Always carry out soil analysis to base fertiliser application decisions on.
- Where P and K Index is above Index 3 there is no need to apply either of these nutrients.
- Only apply Mg where the soil Index is below 3.