Grower Summary

Developing Nutrient Management Recommendations for Selected Horticulture Crops.

HNS 200

Annual report 20

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Project leader:	Dr Jill England, RSK ADAS
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Key staff:	Dr Jill England, RSK ADAS David Talbot, RSK ADAS Ellie Georgiou, RSK ADAS Chloe Whiteside, RSK ADAS Elysia Bartel, RSK ADAS
Location of project:	ADAS Boxworth, Battlegate Rd, Boxworth, Cambs CB23 4NN
Industry Representative:	James Moffatt, James Coles & Sons Nurseries
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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.

Name: Dr Jill England

Position: Associate Director

Organisation: ADAS Horticulture

Signature ..... Date .....

Name: Chloe Whiteside

Position: Associate Director

Organisation: ADAS Horticulture

Signature ..... Date .....

Name: David Talbot

Position: Senior Horticulture Consultant

Organisation: ADAS Horticulture

Signature ..... Date .....

Report authorised by:

Name: Dr Barry Mulholland

Position: Director

Organisation: ADAS Horticulture

Signature ..... Date .....

GROWER SUMMARY

Headline

- Liquid feed applied weekly (0.5% and 1.0%) produced more marketable plants than higher dose rates for *Prunus lusitanica* 'Myrtifolia', *Spiraea arguta* and *Geranium* x *cantabrigiense* 'Westray'
- Liquid feed applied weekly (1.0%) was the most suitable feed for short term, vigorous crops such as *Tradescantia pallida* 'Purple Sabre'. Lower dose feeds can be used to restrict growth of this vigorous species.
- 'Feed to need' would be most useful on nurseries with a small range of plant species / cultivars in large batches.
- Regular EC and SPAD monitoring is useful for identifying excessive feed, particularly in shortening days and cooler temperatures, allowing growers to adjust feed rates.

Background

The majority of nursery stock growers currently use a base fertiliser with controlled release fertiliser (CRF), usually added by the growing media manufacturer to provide enough nutrition for the production phase. There is increased interest in using lower CRF rates and supplementing with liquid feed to provide enough nutrition during key growth phases, to avoid excess fertiliser at other times and to reduce the potential for nutrient loss in run-off water. The combination of CRF and liquid feed can provide growers with greater control but still meet plant nutrient requirements. Crop safety can be improved by using a lower CRF rate for autumn potting under glass and topping up with liquid feed in the spring as appropriate. Growers could benefit from the associated nutrient cost savings, but with more control over plant growth, there is an opportunity to optimise productivity and improve quality while reducing crop waste and minimising the potential for point source nutrient pollution from grower holdings.

Year 1 of this work programme focused on obtaining separate baseline data for CRF and liquid feed uptake in nursery stock liners for a range of nursery stock subjects. Year 2 trials were based on the data obtained in year 1 and combined lower CRF rates with a range of liquid feeding regimes to develop 'feed to need' strategies. Year 3 trials will be based on the outcomes of year 2 and will be designed to confirm the reproducibility of the results.

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 hardy nursery stock production under protection

This is the report for WP3.

Summary

Trials work took place at ADAS Boxworth from May – October 2020 using four hardy nursery stock species (**Table 1**). Plants were supplied as 9 cm liners (*Prunus* and *Spiraea*) or 5 cm plugs (*Tradescantia* and *Geranium*) and transplanted into 3 L pots on 18 May 2020 (week 20; *Prunus* and *Spiraea*) and 09 June 2020 (week 23; *Tradescantia* and *Geranium*). SinclairPro growing media (70% peat, 30% woodfibre) was used, with no base fertiliser. Osmocote Exact 12-14 month CRF was dibbled into each pot at a single dose rate (1.5 g/L) at the time of transplant. All plants were irrigated by hand for the duration of the trial.

Table 1. Hardy Nursery Stock species

Species	Vigour	Term
Prunus lusitanica 'Myrtifolia'	vigorous	long
Spiraea arguta	moderate	long
Geranium x cantabrigiense 'Westray'	moderate	short
Tradescantia pallida 'Purple Sabre'	vigorous	short

There were five liquid feed treatments (**Table 6**), including an untreated control, which were applied once per week from trial set-up, aside from T4 which was applied at every watering, and T5 which was applied according to weekly SPAD and EC measurements. For the *Geranium* and *Tradescantia* trial, T5 was split into two treatments 13 weeks after potting to create T6 (feed to need #2). T6 was created so that we could see what would happen to those plants that did not receive feed, then if they started to indicate signs of deficiency through the EC and SPAD readings, they could be fed later from that point in the trial.

Table 2. Liquid feed treatments used in the container trial, 2020

Treatment No.	Treatment
1	No liquid feed
2	Liquid feed applied once per week (0.5%)
3	Liquid feed applied once per week (1.0%)
4	Low dose liquid feed (0.5%) at each watering
5	Feed to need applied weekly (1.0%). Timing based on EC/SPAD monitoring
6	Feed to need applied weekly (1.0%) #2. From week 13 (after potting). *Geranium* and *Tradescantia* only.

The *Prunus* and *Spiraea* were set-up first and therefore were grouped together as one trial. The *Geranium* and *Tradescantia* were grouped together as a second trial within the same polytunnel.

Weekly assessments began one week after potting and lasted for the duration of the trial. They were completed on the same day each week, prior to irrigation. Growing media electrical conductivity, EC (µS/cm), moisture content (%VMC), Leaf chlorophyll content (SPAD meter) were measured weekly.

In addition, there was a mid-season assessment in week 29 (20 July 2020; *Prunus* and *Spiraea*) and week 32 (13 August 2020; *Geranium* and *Tradescantia*), that assessed plant height, plant quality and root development. For final assessment in week 42 (20 October 2020; *Prunus* and *Spiraea*) and week 43 (27 October 2020; *Geranium* and *Tradescantia*) fresh and dry weights were also measured. Growing media and plant tissue samples were analysed (by Natural Resource Management, NRM) at the start of the trial, and then for each treatment and species at the final assessment. Tissue analysis results were compared with published standard figures (**Mills and Jones, 1996**).

***Prunus lusitanica* 'Myrtifolia' (Long term, vigorous crop)**

The most successful treatment in the *Prunus* trial was T4, in that plants were taller with higher root scores and a greater fresh weight, but they were less bushy compared with other treatments. However, the EC and SPAD measurements appeared to indicate that this treatment was too much and that there was excess feed. Plant quality was improved by treatments T3 and T5 compared with all other treatments, although the EC and SPAD

measurements for T3 were still generally on the high side. The growing media analyses indicated that there was available nitrate-Nitrogen (Nitrate-N, Phosphorus (P), Potassium (K) and Magnesium (Mg) in both ground and un-ground samples from T3 and T4. Plant tissue analysis was inconsistent in terms of standard figures, but N and Mg were within range for T1, T2, T3 and T5. The growing media analyses indicated there was available Nitrate-N, P, K and Mg in both ground and un-ground samples from T3 and T4, generally above the standard range, suggesting that liquid feed rates could be reduced towards the end of the season when monitoring indicates that plants require less nutrients.

***Spiraea arguta* (Long term, moderate vigour crop)**

In the *Spiraea* trial plant quality scores indicated that while there were differences between the plants produced in each treatment, all treatments except for the untreated control produced good quality although with some visible damage, indicating that additional liquid feed was beneficial. Treatment T4 produced the shortest plants but the roots filled the pot (100% rooting). T3 produced taller plants with greater fresh weight. Both T3 and T4 produced good quality plants, and it would be grower preference as to which of these treatments produced more marketable plants. A high EC from 18 weeks after potting suggests less feed was required as the season progressed, and temperature reduced. With the growing media analysis, generally all nutrients were less available than in the *Prunus* trial, which suggests that higher dose rates were more suitable for this species. Tissue analysis was inconsistent. N and Mg were generally high, and K was generally low compared with standard figures.

***Geranium x cantabrigiense* 'Westray' (Short term, moderate vigour crop)**

The *Geranium* trial showed that plants from T4 were taller and had a greater fresh weight. However, EC and SPAD measurements in this treatment were high, indicating excess feed, particularly as the season progressed. Plants in treatment T3 had a slightly higher plant quality score and appeared neater than those in T4; however, plants in T3 did have the lowest root score. Growing media analysis showed that generally there was plentiful nutrients remaining in all treatments apart from T1 and T6. Plant tissue analysis values were low in T1, T5 and T6. K was low in all treatments compared with the standard and Mg was high. This suggests that the although the *Geranium* have been termed 'moderately vigorous', they require less feed than the *Spiraea* (long term, moderate vigour) and feed rates could potentially be reduced for this crop group without a negative impact on plant quality.

***Tradescantia pallida* 'Purple Sabre' (Short term, vigorous crop)**

At the end of the trial period, there was very little difference between treatments for plant quality and growth. Plants grown in T4 were taller, with a higher fresh weight and improved plant quality. T3 produced marketable plants with less labour required to apply the feed.

SPAD measurements indicate high N, whilst EC was low in all treatments. Less feed was required as the season progressed. This is a vigorous plant species; potentially lower feed rates could be used to manage growth of this plant. Growing media analysis showed that N, P and K were low for most treatments by the end of the trial. Tissue analysis also showed that N, P and K were low in all treatments; Mg was high.

Summary

From a grower perspective, shorter but bushier plants with more breaks / side shoots are usually more marketable for this sector. *Prunus*, *Spirea* and *Geranium* plants produced under treatments T2 and T3 were considered more marketable. For the *Tradescantia*, plants produced under T3 required less labour to produce plants of similar quality; low feed regimes could be used to restrict growth of these vigorous plants.

T2 and T3, produced marketable plants with a bushier habit than other treatments, while T4 produced taller, less bushy plants and appeared to provide excess nutrients. However, it may be that the habit of the plants in T4 could be improved with lower dose rates.

T5 ‘feed to need’ could be useful on nurseries producing a small range of species arranged in large blocks, but HNS nurseries tend to have a wide range of species / cultivars; T3 is the more manageable treatment and produced good quality plants.

The combination of EC and SPAD measurements is useful to identify trends. In this trial it was helpful to compare several treatments for specific species. In a nursery setting, however, growers will need to compare data for the same plant or plant group over multiple seasons to be able to make comparisons and put the data into context, for example if sufficient feed was applied in a hot season, and if it should then be reduced in a cooler season to produce marketable plants. This will also help growers to identify and rectify any issues sooner.

High EC can be a cause for concern, particularly for sensitive plants, as it can result in root damage, and is usually addressed by irritating to flush the salts out of the growing media. In this trial, plants were watered by hand with a measured amount of water so that treatments were standardised. The build-up of growing media EC, which could be interpreted as excess nutrient supply (given a high dose rate), could result in N or P in the run-off water, forming a potential environmental risk. The highest risk liquid feed regime would be ‘little and often’, where feed is applied at every irrigation (T4 in this trial). This could be mitigated by applying a lower dose feed with care to limit run-off (or capture / recycle run-off water).

There is currently a lack of tissue analysis data for specific species / cultivars, particularly for the herbaceous species. Growers will need to supplement and realign published data with their own data for tissue analysis to be used to greatest effect.

Categorising plants into long/short term and vigour groups will prove useful and will help growers to extrapolate data to a wider range of species, noting that woody and herbaceous plants are not directly comparable in terms of vigour. Grouping plants according to vigour category will make it easier to manage plant feed regimes.

Financial Benefits

Routine monitoring will identify low nutrient levels and allow corrective action to be taken before deficiency symptoms appear. A nutrient management regime could include regular on-site monitoring of EC and perhaps leaf chlorophyll, with laboratory irrigation water, substrate and leaf tissue analysis as appropriate.

While there are costs associated with purchasing monitoring equipment and submitting samples for laboratory analysis, there are some lower cost options, and these costs can be offset through reduced crop losses due nutrition problems. Regular on-site substrate EC measurements in this trial were carried out using a Terros 12 sensor with a ProCheck hand held reader (**Table 3**). Leaf chlorophyll was measured using a SPAD, but the AtLEAF is a useful, less expensive alternative that was tested in AHDB project HNS 193.

Presented in **Table 4** is an example costing of a laboratory analysis monitoring regime for irrigation water, substrate and leaf tissue samples on a medium sized, single site HNS nursery, extracted from Bragg and Holmes (**2016**).

Improving nutrient management practices can reduce plant waste and could save 1% - 3% of the crop. While crop value will vary depending on the species and market, assuming a farm gate value of 80p per plant for 9 cm liners, and an estimated 750,000 plants per hectare, this equates to between £6,000 and £18,000 per hectare per annum. For 3 L pots assuming a farm gate value of £3.00 per plant, with an estimated 187,500 pots per hectare, this equates to £5,625 and £16,875 per hectare per annum.

*Table 3. Crop monitoring equipment example costs. The AtLeaf sensor was not used in this trial but is included as an example. *Costs derived from 2019 quotations*

Purpose	Device	Cost (+VAT)
Handheld reader for Terros 12 sensor	Decagon ProCheck *	£425
Substrate EC and moisture sensor	Terros 12*	£200
Chlorophyll sensor	Minolta SPAD 502 Plus	£2,680
	AtLEAF Standard version*	£268

	AtLEAF Standard version plus USB connection*	£339
	AtLEAF Standard version plus Bluetooth connection*	£372

Table 4. Analysis costs: growing media, water (including run-off), liquid feed and plant tissue, based on a medium sized, single site nursery. Extracted from Bragg and Holmes (2016)

Analysis	No of analyses	Cost	Comments
Water	4 analyses per year	£100 - £150	Includes irrigation and run-off water.
Growing media	18 analyses over 18 months	£360	Analysis of three substrate batches or crops; four samples per batch analysed per year.
Leaf tissue	12 analyses over 18 months	£360	Three indicator crops in three substrate mixes, four samples per crop over 18 months.
Total		£820 - £870	

Action Points

- Improve understanding of crop vigour and nutrient requirements through planned monitoring and recording of growing media EC and pH, run-off water and submission of samples for laboratory analysis.
- Build up an on-nursery database of tissue, growing media and irrigation water analyses over several seasons, including samples from plants with potential nutrient problems and healthy plants, determining critical thresholds where possible.
- Group plants according to vigour groups, matching nutrient application to vigour group needs.