HNS 200 – Developing nutrient management guidance for HNS

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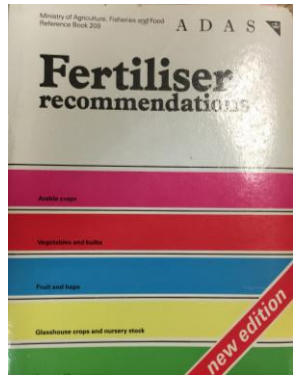
Introduction

To produce clear nutrient management guidance for HNS (**field** and container) crops to help growers to optimise nutrient management and minimise the environmental impact of their business activities

- Background to the nutrition of field-grown HNS
- Overview of field trials
- Trees
- Transplants
- Tree seedlings

Fertiliser recommendations

- Fertiliser Recommendations RB209 5th Edition (1988)



- Nutrient Management Guide (RB209)
  - Section 1: Principles of nutrient management

Consider *measuring* soil mineral nitrogen

- Target SMN measurements to fields where SMN is likely to be high or uncertain
  - Fields with a history of organic manures
  - Following high N residue crops
- Take samples as close to planting date as possible
- Do not sample within 2 months of manure or N fertiliser application
- Sample to 90 cm or rooting depth for shallow rooted crops
- Keep samples cool and send to the lab as soon as possible after sampling

Table 4.10 Soil nitrogen supply (SNS) Indices

SNS	SNS Index
Less than 60	0
61–80	1
81–100	2
101–120	3
121–160	4
161–240	5
More than 240	6

Fertiliser recommendations RB209

- P and K recommendations based on index system
  - Phosphorus – Olsen's P sodium bicarbonate extraction
  - Potassium and magnesium – ammonium nitrate extraction

Index	Phosphorus (P)	Potassium (K)	Magnesium (Mg)
	Olsen P (mg/L)	Ammonium nitrate extract (mg/L)	
0	0–9	0–60	0–25
1	10–15	61–120	26–50
2	16–25	121–180 (2-) 181–240 (2+)	51–100
3	26–45	241–400	101–175
4	46–70	401–600	176–250
5	71–100	601–900	251–350
6	101–140	901–1,500	351–600
7	141–200	1,501–2,400	601–1,000
8	201–280	2,401–3,600	1,001–1,500
9	Over 280	Over 3,600	Over 1,500

Phosphate and potassium

- Based on index system
  - P Index 2 for arable, grassland and fruit, and index 3 for vegetables
  - K Index 2 for arable, grassland and fruit, and index 2+ for vegetables
- Allow for P and K from organic materials
- Take soil samples for P, K, Mg and pH every 3-5 years
- Recommendation for field-grown HNS P index 2 and K index 2-

Nitrogen - assess soil nitrogen supply (SNS)

- Soil nitrogen that is available for crop uptake during the growing season
- It comprises: Soil Mineral Nitrogen (SMN) + N mineralisation
- The SNS will directly reduce the need for fertiliser N
- Factors that affect SNS:
  - Soil type
  - Previous cropping (residues)
  - Overwinter rainfall
  - Regular use of organic manures
  - Take account of previous crop performance (e.g. reduced yields due to drought)
- Assess SNS by:
  - Field assessment method (rainfall, soil type and past crop), or
  - Measurement method (sampling and analysis)

HNS 200 Literature review key findings

- Some nurseries carry out regular soil analysis to help determine rates of fertiliser to apply, whereas other nurseries do not currently carry out regular soil analysis and apply ‘standard’ rates of fertiliser each year, regardless of soil nutrient indices
- Due to the high value of field-grown HNS in relation to broad acre arable crops, the cost of fertiliser is relatively low compared to the value of the crop, which can result in excessive quantities being applied
- Laboratory analyses of samples (e.g. tissue) are destructive processes that can be costly and there can be a delay of up to a week between sample submission and reporting

HNS 200 Literature review - chlorophyll meters

- The atLEAF+ and Apogee MC-100 chlorophyll meter and Pro-check are considered the most useful of the equipment for use in a nursery setting to provide an immediate estimation of plant nitrogen status
- Results were site specific, so that it was not possible to compare readings between sites, and this equipment is most useful for readings taken over the course of a season to establish trends and identify reducing nitrogen status in crops
- Regular readings through the season using such methods of estimating plant nutrient status can be calibrated against a dose-response curve
- Identification of key high value crops or crops that are grown in large numbers to monitor through the season would be most useful when the data is collected and collated over multiple seasons and then used to inform decisions

HNS 200 Literature review - remaining legally compliant

- For field production there is a legal requirement for analysis of pH, P, K, Mg + and assessment of N every 3-5 years under the Farming Rules for Water

- High fertiliser rates may also contravene regulations such as the Nitrogen Vulnerable Zone regulations and contravene Catchment Sensitive Farming guidelines

HNS 200 Literature review - highlights knowledge gaps

- There are currently no standard fertiliser recommendations specifically for field-grown HNS species that are readily accessible to UK nurseries. Therefore, growers do not really know how much fertiliser to apply to their crops, which frequently results in high rates of fertiliser being applied, or low rates resulting in suppressed growth. Standard arable crop fertilisers can contain potassium chloride which can causes foliage scorch on chloride sensitive genera such as Rosaceae
- The potassium in muriate of potash (MOP) is fully available to plants. High rates of application should be avoided, particularly at crop establishment, as this can inhibit germination or damage the seedling. The chloride content can be a disadvantage in certain specialist horticultural crops.
- Although sulphate of potash (SOP) is generally regarded as a relatively high-cost source of potassium for application to soil in agriculture, it is a very important source of nutrient in horticulture, suitable in situations where both potassium and sulphur are required or where chloride is a concern. (The fertiliser directory materials guide)

Field-grown HNS trees

- Establish baseline information on nutrition for field-grown HNS trees
- Determine the impact of novel fertiliser application methods on plant nutrient status
- Evaluate crop nutrient assessment methods

Field-grown HNS trees

Species: *Betula utilis* var. *jacquemontii*

Aim: To determine if band application of fertiliser to crop rows was more effective than broadcast application

Treatments: Untreated / Broadcast / Band application

Fertiliser: 370 kg/ha (20-10-10)
(supplying 74kg/ha N, 37kg/ha P and K)

Analysis:

- Leaf tissue
- Soil nutrients / EC
- Leaf greenness (AtLeaf)

Field-grown HNS trees - soil analysis

Soil analysis was taken prior to fertiliser application

Soil pH	P Index	P mg/l available	K Index	K mg/l available	Mg Index	Mg mg/l available	Percentage organic matter
7.3	5	83.4	6	1247	5	282	6.7

Field-grown HNS trees

- No difference in growth (determined by girth measurements) occurred between *Betula utilis* var. *jacquemontii* trees in any of the treatments
- Nitrogen was the only likely limiting factor – no crop response
- When comparing tissue analysis results with published figures the data suggests that levels of N, P and K within plant tissue from all treatments were high, levels of sulphur were very similar to published figures in all treatments and levels of Mg, Ca, Fe, Cu, Zn, Mn and B were all on the low side within all treatments
- You do not need to maintain high P, K and Mg indices
- High phosphorus index can contribute to the pollution of water, particularly where soil erosion occurs
- Suggested target index of 2 for P, 2- for K
- There is potential for savings on fertiliser use and associated cost savings through regular soil analysis

Transplants

Species

- *Betula pendula* – high vigour
- *Crataegus monogyna* – medium vigour
- *Carpinus betula* – low vigour

Treatments

1. Untreated
2. Grower standard fertiliser
3. Straight N, K, Mg
4. Straights with slow-release N (Floranid N31)

Application method

- Broadcast

Assessments

- Leaf tissue, soil EC and chlorophyll: June, July, August and September
- Height, on 10 pre-determined plants / plot. Set up and end of growing season

Transplants - N application rate

Treatments

1. Untreated
2. 90kg/ha Origin 27% N which supplied two applications of 24.3 kg/ha N.
3. 186 kg/ha Origin 27% N x3 delivering split dose of three applications of 50.2 kg/ha N
4. First application 323 kg/ha Floranid N31 delivering 100.1 kg/ha N , Second application 162 kg/ha Floranid N31 delivering 50.2 kg/ha N

Application method (broadcast)

P, K and Mg were applied in line with RB209 5th edition recommendations

Transplants

Soil analysis results prior to fertiliser application; results tabulated below

Soil pH	P Index	P mg/l available	K Index	K mg/l available	Mg Index	Mg mg/l available	Percentage organic matter
6.7	3	42	2+	185	1	46	1.9

Transplants

Soil mineral nitrogen tested prior to fertiliser application; results tabulated below (Index 0)

Sampling depth	Nitrate-N kg/ha	Ammonium-N kg/ha	Soil mineral nitrogen kg/ha 30cm profile
0 – 30 cm	19	5.28	24
30 – 60 cm	10.52	5.16	16
60 – 90 cm	14.48	5.84	20
Total of all sample depths	44	16.3	60

Transplants

10 tagged plants per plot measured prior to fertiliser application and again at the end of the growing season. Figures below show actual growth in cm (end of season height – starting height)

Treatment	*Crataegus*	*Betula*	*Carpinus*
Untreated	9.4	32.9	17.9
Grower standard	9.9	30.5	17.3
Straights	9.5	34.1	18.1
Straights and Floranid N31	9.0	33.2	17.4

Transplants - findings

- No difference in growth (determined by height measurements) occurred within species in any of the treatments. This included the untreated plots that received no fertiliser
- This indicates that these species are either highly effective at taking N up or have a lower N requirement than is widely assumed
- The extreme heat at times during 2022 and periods of drought undoubtably limited growth in all treatments. Had the weather been less extreme greater differences may have been seen
- Although this trial has indicated that these species can perform well when some major nutrients are at low levels, regular (before planting or every three years) soil analysis to determine soil nutrient levels and tailoring fertiliser applications to crop need based on the soil analysis is still recommended

Field-grown HNS growers should aim to maintain soil at P Index 2, K at Index 2- which is consistent with target index values for arable and fruit crops published in RB209

Transplants - final year (2023)

Soil analysis results prior to fertiliser application; results tabulated below

Soil pH	P Index	P mg/l available	K Index	K mg/l available	Mg Index	Mg mg/l available	Percentage organic matter
7.2	4	53.2	3	251	2	60	1.9

Transplants - final year (2023)

Soil mineral nitrogen tested prior to fertiliser application; results tabulated below (Index 3)

Sampling depth	Nitrate-N kg/ha	Ammonium-N kg/ha	Soil mineral nitrogen kg/ha 30cm profile
0 – 30 cm	48.4	4.6	53
30 – 60 cm	30.9	3.3	34.2
60 – 90 cm	26.6	1.1	27.7
Total of all sample depths	105.9	9	114.9

Seedlings - final year (2023)

Soil analysis results prior to fertiliser application; results tabulated below

Soil pH	P Index	P mg/l available	K Index	K mg/l available	Mg Index	Mg mg/l available	Percentage organic matter
7.5	4	68.6	2+	225	2	67	1.8

Seedlings - final year (2023)

Soil mineral nitrogen tested prior to fertiliser application; results tabulated below (Index 1)

Sampling depth	Nitrate-N kg/ha	Ammonium-N kg/ha	Soil mineral nitrogen kg/ha 30cm profile
0 – 30 cm	42	2.1	44.1
30 – 60 cm	27.4	1.7	29.1
60 – 90 cm	26.6	1.1	27.7
Total of all sample depths	96	4.9	100.9

2023 Treatments (Transplants and seedlings)

Treatments

1. Untreated
2. 186 kg/ha Origin 27% N delivering 50.2kg/ha N
3. 186 kg/ha Origin 27% N x2 delivering split dose of two applications of 50.2kg/ha N
4. 162 kg/ha Floranid N31 delivering 50.2kg/ha N

Application method

Treatment 2 supplied one application of 50.2 kg/ha N

Treatment 3 supplied two applications of 50.2 kg/ha N

Treatment 4 supplied 50.2 kg/ha N

P, K and Mg were not applied as sufficient was available

2023 Indicative results

- No justification for higher rates of N than published in RB209 5th edition
- No response to N at SNS Index 0 site in year 2 but the crop was affected by drought
- Crops likely to be effective at taking up N

- Next steps:
- Process final years data
- Final report
- Recommendations for RB209

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