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DISCLAIMER:

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

Headline

- A survey of 12 blackcurrant plantations in March 2010 showed that residual soil nitrogen levels were higher than in 2009 but still well below levels recorded in an earlier (1992) survey.

Background and expected deliverables

The current UK fertiliser recommendations for blackcurrants are largely based on the work of Bould and subsequently Bradfield (1969) at Long Ashton Research Station. Since that work was carried out cultivars and growing systems have changed. Whilst modern cultivars are high yielding, some can be excessively vigorous. There can be a conflict between achieving optimum growth, flower production, fruit set and quality with excessive growth causing problems with Botrytis.

In order to optimise applications of nitrogen, existing and potential soil nitrogen levels could be taken into account when making recommendations. Two methods of assessing soil nitrogen levels are available. Soil mineral nitrogen (SMN) is an estimate of the immediately available nitrogen in the soil profile. The anaerobic mineralisable nitrogen (AMN) (also referred to as potential mineralisable nitrogen) is a laboratory test that estimates the amount of nitrogen likely to become available to the crop during the season.

Earlier work by Marks (1995) showed that SMN levels could be quite high in UK blackcurrant plantations. More recently, New Zealand research (Craighead *et al* 2007) has shown that the use of soil anaerobic mineralisable nitrogen (AMN) tests gave a useful estimate of additional nitrogen likely to become available through mineralisation. The AMN level plus amount of fertiliser applied, gave the best correlation with yield when compared with other methods. The New Zealand researchers did not use SMN measurements in their study because previous experience there had shown nitrogen levels to be transient and the results somewhat variable (Craighead, pers. com.).

The main part of this study was a survey of soil N levels in a range of blackcurrant plantations and an assessment of the possible benefits in using soil mineral nitrogen (SMN) and/or anaerobic mineralisable nitrogen (AMN) tests to refine nitrogen recommendations for blackcurrants. All but two of the plantations were the same as those surveyed in a similar study in 2009.

A further study within this project assessed the value of using a controlled release nitrogen fertiliser compared with straight nitrogen formulations. Environmental considerations require growers to match more closely the nitrogen applications to crop requirements and avoid excessive nutrient leaching. The use of controlled release fertilisers offers the possibility of matching release more closely with demand thereby improving the efficacy of nitrogen use, but this has not been evaluated on blackcurrants.

Summary of the project and main conclusions

Soil samples were taken from 12 blackcurrant plantations in Kent, Norfolk and Herefordshire in early March 2010 prior to the application of fertilisers. The soil was tested for SMN in two profiles 0-30 cm and 30-60 cm, and the 0-30 sample was also tested for AMN. Sampling was repeated immediately after harvest in 5 plantations.

Soil nitrogen measurements in most of the plantations tested were moderately low, averaging 36.7 kg N/ha AMN and 39.7 kg N/ha SMN, but higher than in 2009 where the equivalent averages were 27 kg N/ha AMN and 20 kg N/ha SMN. AMN levels were on average about one half of those recorded in a survey of New Zealand plantations (Craighead *et al* 2007) where AMN is routinely used for assessing Nitrogen requirements. The higher levels of organic matter in New Zealand soils compared with UK probably accounts for this difference. Although increased compared with 2009, SMN levels were still much lower than in the 1992 survey of UK plantations by Marks (1995). Nitrogen applications by UK blackcurrant growers have been reduced over the last 15 years and this may have resulted in a reduction in the levels of SMN.

Unlike in 2009 there was no correlation between total N and yield in 2010. These results suggest that seasonal and climatic factors other than nitrogen nutrition (e.g. poor fruit set due to weather conditions) were largely influencing yield in 2010. In 2009 positive correlations between total N and yield were only found when low N utilization sites were excluded (i.e. sites with < 80 kg fruit per kg of total N). If the same criteria had been employed in 2010 all except two sites would have been excluded as soil N levels were higher but yields were generally lower.

Considering the relatively modest soil N levels in UK blackcurrant plantations and the strong seasonal factors that can limit yields it would appear that the routine annual testing of soil N is not really justified at this stage although ideally growers should be aware of typical levels in their plantations. To further refine the recommendations for UK blackcurrants it would be necessary to undertake replicated nitrogen response experiments on sites where SMN and AMN are monitored.

Measurement of a limited number of sites post-harvest indicated that in all cases there was a good reserve of soil nitrogen available. It is therefore unlikely that any of these sites would have benefited from additional nitrogen applied post-harvest.

A small additional study assessed the effect of applying the nitrogen fertiliser in controlled release (CRF) form (Agroblen Base, Scotts Company) compared with straight fertiliser. The CRF treatment was compared with the farm standard programme using straights in an un-replicated observation applied to a mature plantation of Ben Hope at Gorgate Ltd, Gressenhall, Dereham, Norfolk (Table 1).

The row receiving the Agroblen Base CRF had noticeably yellower foliage but yielded 8.7 tonnes/ha – identical to the farm standard treatment applied to the rest of the field even though the latter received an additional 30 kg/ha N.

Soil conditions were dry after applying the fertilisers. At the end of May the crop was at 100% fruit set stage (growth stage I3) and with rapid growth the demand for nitrogen was likely to be relatively high. The nitrogen demand at this time appears to have been better met by a straight nitrogen fertiliser top dressing with immediate release than by the CRF although the apparent N deficiency was not reflected in reduced yields at this site.

Table 1. Treatments for controlled release fertiliser trial in blackcurrants

Treatment No.	Fertiliser	Product rate (kg/ha)	Nutrients applied (kg/ha)				Date applied
			N	**P_2O_5**	**K_2O**	**Mg**	
1	Agroblen (35:0:0)	171	60				1/4/10
	Potassium sulphate	240			120		21/5/10
	Magnesium sulphate	185				30	21/5/10
2	Compound (9.8:0:19.5:4.8)	612	60		120	30	1/4/10
	Ammonium nitrate		30				21/5/10

Financial benefits

The project has not shown a clear cost benefit in using routine soil N analysis. The combined AMN + SMN analysis cost is quite high at £48 per sample plus the cost of sampling (which requires a specialist auger). Therefore financial benefits would only be possible if there was a saving of 96 kg N per site sampled. As growers are generally applying nitrogen at rates on average of around 70 kg N/ha further saving are unlikely to be made.

There are however important environmental benefits in avoiding nitrogen applications in excess of the crops' requirements.

In the CRF study identical yields were achieved using 30 kg less nitrogen per ha giving a saving of £15 per ha assuming a cost of £0.50 per kg N as straights. However the cost of Agroblen Base N is £3.45 per kg N, so the additional cost of applying 60 kg N/ha by CRF compared with straight is £177 / ha. Therefore the study has not shown any financial benefit from the use of nitrogen in controlled release fertiliser form.

Action points for growers

- Annual testing for soil N is not recommended but growers could consider taking a limited number of soil samples for AMN and SMN analysis from representative fields on their farms to check general levels of soil N.

- If soil analysis is not carried out allowance could be made for around 40 kg N/ha to be available from soil reserves when estimating the crop requirements.

- There is no financial benefit from using CRF forms of nitrogen although a potential saving of 30 kg N/ha was demonstrated.

SCIENCE SECTION

Introduction

The current UK fertiliser recommendations for blackcurrants are largely based on the work of Bould and subsequently Bradfield (1969) at Long Ashton Research Station. Since that work was carried out cultivars and growing systems have changed. Whilst modern cultivars are high yielding, some can be excessively vigorous. There can be a conflict between achieving optimum growth, flower production, fruit set and quality.

In order to optimise applications of nitrogen, existing and potential soil nitrogen levels should be taken into account when making recommendations. Research in the early 1990s (Chambers *et al*., 1991) showed that soil mineral nitrogen (SMN) measurements in the spring could be used to estimate soil nitrogen supply and to reduce spring nitrogen applications for arable crops in high nitrogen residue situations. The technique is currently recommended in situations when high N residues are thought to occur (Anon, 2010).

Earlier work by Marks (1995) also showed that soil mineral nitrogen levels could be excessively high in UK blackcurrant plantations. More recently New Zealand research (Craighead *et al.,* 2007) has shown that the use of soil anaerobic mineralisable nitrogen (AMN) tests (Keeney & Bremner, 1966) can also give a good guide to the level of residual nitrogen in the soil and an estimate of the additional nitrogen likely to become available through mineralisation. The AMN level + applied fertiliser gave the best correlation with yield when compared with other methods. The New Zealand researchers did not use SMN measurements in their study because previous experience there had shown nitrogen levels to be transient and the results somewhat variable (Craighead, pers. com.). A five year HGCA project is also underway investigating the value of AMN measurements + SMN measurements in calculating the soil nitrogen supply (SNS) for arable crops (Kindred, 2008 and 2010).

In this project soil N levels were surveyed in a range of plantations as a preliminary investigation to see if there would be a value in using soil mineral nitrogen (SMN) and/or anaerobic mineralisable nitrogen (AMN) tests to refine nitrogen recommendations for blackcurrants.

A further study within this project investigated the value of using a controlled release nitrogen fertiliser compared with straight nitrogen formulations. Environmental considerations require growers to match more closely the nitrogen applications to crop requirements and avoid excessive nutrient leaching. The use of controlled release fertilisers offers the possibility of matching release more closely with demand, improving the efficacy of nitrogen use, but has not been evaluated on blackcurrants.

Soil nitrogen supply survey

Materials and methods

In early March 2010 soil samples were taken from 12 blackcurrant plantations. To achieve a geographical spread and a range of soil types, samples were taken from six farms, two from Kent, two from East Anglia and two from the West Midlands, sampling two plantations at each farm with either a soil type difference or a cultivar difference. Where possible the sites used in the 2009 survey were used again. This was not possible at one Hereford site, where the previously surveyed field had been grubbed, however a field with similar soil type and cultivar was used instead.

Samples were taken at each site taking at least 20 cores per field from within the herbicide strip of the crop row using a gouge core auger. Samples were taken at 0-30 cm and 30-60 cm depths. Samples were analysed for Soil Mineral Nitrogen (SMN), Anaerobic Mineralisable Nitrogen (AMN) and percentage organic matter at NRM Laboratories, Bracknell.

Plantation details, soil type, N fertiliser applications (pre-harvest), crop yield and growers' comments about plantation vigour were recorded for each site (Table 2).

Six sites (no 8 (two samples), 9, 10, 11 & 12) were re-sampled after harvest in August 2010.

In order to determine whether there were any significant relationships between yield and AMN, SMN, AMN + applied N, SMN + applied N or total N, the correlations were calculated and tested to see whether any were significant at P=0.05. Where the correlation indicated that there was a significant relationship the fitted line was calculated using regression analysis and the equation of the line and the R^2 value were determined.

Table 2. Details of blackcurrant plantations sampled in 2010

Site No.	Location	Cultivar	Planted	Soil Type	Nitrogen Application (kg/ha)	Timing
1	Kent	Ben Tirran	2004	CL	58	Early April
					33	Early June
2	Kent	Ben Gairn	1999	MSL	54	Early April
					39	Early June
3	Kent	B Lomond	1999	FSL	27	Mid April
4	Kent	Ben Hope	2001	FSL	15	Mid April
5	Norfolk	Ben Gairn	2000	MSL	50	End Mar
					60	Early May
6	Norfolk	Ben Hope	2002	SCL	50	End Mar
7	Norfolk	Ben Hope	1999	SCL	60	Early April
8	Norfolk	Ben Hope	1998	MSL	a) 60	Early April
					30	End May
					b) 60 crf*	Early April
9	Hereford	Ben Gairn	1997	ZCL	60	Early April
					35	Mid May
					03**	Apr-May
10	Hereford	Ben Hope	1997	ZCL	60	Mid April
					24	Mid May
11	Hereford	Ben Hope	2003	MSL	63	End Mar
12	Hereford	Ben Gairn	2000	MSL	50	End Mar
					50	Mid April

* One row of site 8 (b) received N as a controlled release fertiliser, this area was sampled separately post-harvest

**Foliar applied

Results & discussion

At the start of the season total SMN readings for the 12 sites surveyed ranged from 16.3 – 109.1 kg/ha, with the average being 39.7 kg/ha (Tables 3 and 5). This was double the figure for 2009, when the average was 20 kg/ha (Appendix 1, Table 10). The average was strongly influenced by three high readings; all the other nine results fell within the “low” category (0-40 kg/ha N) of the ADAS classification for arable crops (Chambers, 1992). These levels were considerably lower than the average of 165 kg/ha N reported by Marks (1995) from a survey of 10 blackcurrant plantations in late winter 1992. Marks suggested that these high readings were the result of routine nitrogen applications in excess of crop requirements The average application rate for N in the 1992 survey was equivalent to 155 kg/ha in the crop row. In most cases growers’ N applications were still within the published recommendations, leading Marks (1995) to suggest that the recommendations be reassessed. In practice the industry has reduced nitrogen application rates considerably since 1992. In the current survey the average N application rate was 73.4 kg/ha (Table 4) only 47% of the amount used in 1992.

Table 3. Soil nitrogen results for 12 blackcurrant sites, pre-season 2010

Site	% Org matter 0-30cm	AMN 0-30 cm	SMN 0-30 cm			SMN 30-60 cm			Total SMN Kg/ha	Total N kg/ha
		N kg/ha	NO_3-N mg/kg	NH_4-N mg/kg	N kg/ha	NO_3-N mg/kg	NH_4-N mg/kg	N kg/ha		
1	3.4	40	1.48	0.60	8.3	1.47	0.66	8.5	16.8	56.8
2	2.6	60	1.66	0.74	9.6	0.86	4.10	19.8	29.4	89.4
3	4.1	50	5.35	1.42	27.1	2.27	0.06	9.3	36.4	86.4
4	3.4	50	1.77	0.65	9.7	1.36	0.30	6.6	16.3	66.3
5	2.8	40	9.21	0.98	40.8	7.04	0.50	30.2	71.0	111.0
6	3.6	30	5.64	1.39	28.1	6.20	0.07	25.1	53.2	83.2
7	1.8	20	4.24	0.86	20.4	3.38	0.06	13.8	34.2	54.2
8	2.2	30	12.24	2.09	57.3	11.87	1.08	51.8	109.1	139.1
9	2.2	50	1.60	1.73	13.3	0.68	2.10	11.1	24.4	74.4
10	2.3	20	3.40	1.41	19.2	0.90	0.90	7.2	26.4	46.4
11	1.8	20	2.54	1.03	14.3	2.13	0.85	12.0	26.3	46.3
12	1.9	30	3.69	1.34	20.2	1.97	1.18	12.6	32.8	62.8

Pre-season AMN readings ranged from 20-60 kg/ha N, with an average of 36.7 kg/ha N (Table 3) this was higher than the average AMN recorded in 2009 (27 kg/ha). From field studies in 2005-6, Craighead *et al* (2007) showed that AMN levels in New Zealand blackcurrant plantations were relatively high. Results ranged from <50 to 200 kgN/ha with most 70-110 kgN/ha. By comparison the UK survey results are relatively low, although slightly higher than in 2009. Percentage organic matter levels ranged from 1.8 to 4.1 – also relatively low levels compared with New Zealand where the majority of sites sampled had over 4% and the highest was 8.5%. In New Zealand it is suggested that organic matter levels need to be over 4% to make a significant contribution to soil nitrogen supply. The UK sites with the higher levels of organic matter had higher levels of AMN but are still low relative to New Zealand.

Table 4. Soil nitrogen results post-harvest at 12 blackcurrant sites, 2010

Site	**AMN 0-30 cm**	**SMN 0-30 cm**			**SMN 30-60 cm**			**Total SMN kg/ha**	**Total N kg/ha**
	N kg/ha	NO_3-N mg/kg	NH_4-N mg/kg	N kg/ha	NO_3-N mg/kg	NH_4-N mg/kg	N kg/ha		
8a	20	3.17	0.84	16.1	7.16	0.56	30.9	47.0	67.0
8b*	50	8.47	0.63	36.4	2.6	0.54	12.6	49.0	99.0
9	40	7.86	1.11	35.9	1.83	0.41	9.0	44.9	84.9
10	30	4.72	0.99	22.9	0.91	0.05	3.9	26.8	56.8
11	40	12.5	2.29	59.2	3.99	1.2	20.8	80.0	120.0
12	30	31.13	4.56	142.8	12.25	0.90	52.6	195.4	225.4

* Site 8b received nitrogen as controlled release fertiliser.

For the sites where soil nitrogen was measured post-harvest, higher levels of SMN and AMN were generally recorded compared with pre-season measurements (Table 4). Similarly, higher levels of SMN were recorded by Marks (1995) in the autumn compared with the late winter. In the current survey post-harvest SMN results were more variable than pre-season, ranging from 26.8 to195.4 kgN/ha. It is difficult to explain the exceptionally high level at site 12, however the crop (Ben Gairn) may not have utilised all of the applied nitrogen. AMN levels were again slightly higher at most sites post-harvest compared with pre-season. In general it would appear that all of the sites were adequately supplied with available nitrogen and two out of five had high levels.

Average yields (Table 5) were lower in 2010 (9.3 t/ha) compared with 2009 (11.0 t/ha), probably as a result of cold weather during spring and early summer affecting fruit set on some sites. The average total N for 2010 was 149.8 kg/ha compared with 116 kg/ha in 2009. The higher total N level was almost entirely due to higher levels of soil N as the amount of N applied by growers was very similar to 2009.

Table 5. Nitrogen application, soil nitrogen pre-harvest and yield for 12 blackcurrant sites, 2010

Site	AMN	SMN	Applied N	Total N	Yield (t/ha)
1	40	16.8	91	147.8	10.0
2	60	29.4	93	182.4	8.0
3	50	36.4	27	113.4	9.9
4	50	16.3	15	81.3	4.9
5	40	71.0	110	221.0	*
6	30	53.2	50	133.2	*
7	20	34.2	60	114.2	*
8a	30	109.1	90	229.1	8.7
9	50	24.4	98	172.4	8.2
10	20	26.4	84	130.4	10.1
11	20	26.3	63	109.3	11.7
12	30	32.8	100	162.8	9.9
Average	**36.7**	**39.7**	**73.4**	**149.8**	**9.3**

* No yield because bushes were cut down for regeneration

The data set was tested for correlations between yield and AMN, SMN, AMN + applied N, SMN + applied N and AMN + SMN + applied N (Total N). Unlike 2009 there was no correlation between Total N and yield in 2010. The only correlation

was a marginally significant *negative* correlation ($p = 0.0402$) between AMN and yield. The correlation was is -0.6887. The equation of the fitted line was:
Yield =13.03 -0.0959AMN, r^2 value was 0.4003.

These results suggest that seasonal and climatic factors other than nitrogen nutrition (e.g. poor fruit set due to weather conditions) were largely influencing yield in 2010. In 2009 positive correlations between total N and yield were only found when low N utilization sites were excluded (i.e. sites with < 80 kg fruit per kg of total N). If the same criteria had been employed in 2010, all except sites 3 and 11 would have been excluded as soil N levels were higher but yields were generally lower.

Conclusions

Soil nitrogen measurements in most of the plantations tested in 2010 were relatively low for AMN and SMN although there were some exceptions. AMN levels were on average about a half of those recorded in a survey of New Zealand plantations (Craighead *et al*., 2007) where AMN is routinely used for assessing nitrogen requirements. SMN levels were also much lower than in the 1992 survey of UK plantations by Marks (1995). Nitrogen applications by UK blackcurrant growers have been reduced over the last 15 years and this may have resulted in a reduction in the levels of SMN.

The exact nitrogen requirement for blackcurrants is still subject to debate. The recommendations in the Defra Fertiliser Manual (formerly RB209) are still set at 160 kg/ha. However crops studies in New Zealand have indicated a normal requirement of 110 kg N / ha, with only the highest yielding crops requiring 150 kg N / ha. In the more recent work sponsored by GlaxoSmithKline Nutritional Healthcare (Horticulture Link project MRS/003/02) the authors claimed a yield response up to 152 kg N / ha (for cv Baldwin), however this result was not consistent between the two years of the field trials and there was also evidence to suggest that a lower (76 kg N / ha) rate of applied nitrogen was sufficient for cv Ben Lomond. No soil nitrogen measurements were made prior to treatment but it is likely that further N would have been available from soil reserves.

In 2010 there were no positive correlations between any of the soil N measurements, applied N and yield, suggesting that in 2010 other factors such as weather conditions affecting fruit set were limiting yields and, with the possible exception of site 4 where very low applications of N were made and yields were the lowest, the range of N applications to cropping plantations were more than adequate for the fruit set.

Considering the relatively modest soil N levels in UK blackcurrant plantations and the strong seasonal factors that can limit yields it would appear that the routine annual testing of soil N is not really justified at this stage, although ideally growers should be aware of typical levels in their plantations.

To further refine the recommendations for UK blackcurrants it would be necessary to undertake replicated nitrogen response experiments on sites where SMN and AMN are monitored.

Controlled release fertiliser study

Materials and methods

A separate study was carried out to observe the effect of applying nitrogen in controlled release fertiliser (CRF) form. The product used was Agroblen Base (Scotts Co.), a proprietary sulphur coated urea. This is a nitrogen formulation that releases over 2-3 months according to moisture levels and is relatively cost effective.

Agroblen Base was compared with industry standard non-CRF nitrogen formulated fertilisers.

This study was an un-replicated observation with the treatments listed in Table 6.

Table 6. Treatments for controlled release fertiliser trial in blackcurrants

Treatment No.	Fertiliser	Product rate (kg/ha)	Nutrients applied (kg/ha)				Date applied
			N	P_2O_5	K_2O	Mg	
1	Agroblen (35:0:0)	171	60				1/4/10
	Potassium sulphate	240			120		21/5/10
	Magnesium sulphate	185				30	21/5/10
2	Compound (9.8:0:19.5:4.8)	612	60		120	30	1/4/10
	Ammonium nitrate		30				21/5/10

Crop and site details were as follows:

Location	Hall Fm, Gressenhall, Norfolk
Cultivar	Ben Hope
Planted	1998
Cut down (for rejuvenation)	Winter 2006/07
Row spacing	3.0 m x 0.3 m
Soil type	Medium sandy loam
Soil indices	P (4), K(2), Mg(2)
Soil N	AMN (30 kg/ha), SMN (109 kg/ha)
Irrigation	One 24mm application May
Plot size	One row per treatment (840 m^2)

Soil samples were taken in early March and again in mid August for laboratory analysis for SMN and AMN (NRM, Bracknell).

Yields were calculated from bin weights following machine harvesting of each of the trial rows early August 2010.

Extension growth was recorded on 18 August 2010 by measuring 20 shoots randomly selected along each row of the trial.

Results and discussion

The row receiving the Agroblen controlled release fertiliser had noticeably yellower foliage but yielded similarly to the farm standard treatment applied to the rest of the field (Table 7), even though the standard treatment had an additional 30 kg/ha N.

Soil conditions were dry after applying the fertilisers. At the end of May the crop was at 100% fruit set stage (growth stage I3) and with rapid growth the demand for nitrogen was likely to be relatively high. The nitrogen demand at this time appears to have been better met by a straight nitrogen fertiliser top dressing with immediate release than by a controlled release form for optimum leaf colour. However this apparent nitrogen deficiency does not appear to have affected yield in the same year at this site.

Table 7. Effect of fertiliser treatments on blackcurrant yields, Hall Fm. Gressenhall, 2010

Treatment No.	Fertiliser	N rate kg/ha	Timing	Yield (t/ha)
1	Agroblen (CRF)	60	1/4/10	8.7
2	Compound Ammonium nitrate	60 30	1/4/10 21/5/10	8.7

Both treatments sampled for soil N left substantial nitrogen residues available in the soil post harvest (Table 8).

Table 8. Effect of fertiliser treatments on soil N measurements post blackcurrant harvest, Hall Fm. Gressenhall, 2010

Treatment No.	Fertiliser	Soil N measurements post-harvest (kgN/ha)		
		AMN	SMN	Total N
1	Agroblen (CRF)	50	49.0	99.0
2	Compound Ammonium nitrate	20	47.0	67.0

There were some differences in extension growth between the treatment rows (Table 9). The standard treatment had the most extension growth compared with the CRF Agroblen Base. However differences were small and should be treated with caution because it was not possible to statistically analyse the results.

Table 9. Effect of fertiliser treatments on blackcurrant extension growth, Hall Fm. Gressenhall, 18 August 2010

Treatment No.	Fertiliser	Extension growth (cm)
1	Agroblen (CRF)	22.6
2	Compound Ammonium nitrate	26.1

Conclusions

Although from leaf colour It appeared that the nitrogen supply in May was limiting in the CRF plots there was no reduction in yield and the total amount of nitrogen applied was 30 kg/ha less than in the standard treatment. It is possible that yields in the CRF plots might be reduced in 2011 compared with the standard as extension growth was slightly reduced.

Technology transfer

No technology transfer activities took place during this project.

References

Anon.(2010). Fertiliser recommendations for agricultural and horticultural crops (RB209): Eighth edition (2010). Defra, London. (http://www.defra.gov.uk/farm/environment/land-manage/nutrient/fert/rb209/index.htm)

Bradfield, E. (1969). The effect of intensity of nutrient supply on growth, yield and leaf composition of black currant grown in sand culture. *Journal of Horticultural Science* 44:211–218.

Chambers, B.J. (1992). Soil nitrogen supply (SNS) in arable cropping. ADAS Eastern Region Soil Science Newsletter SS/92/5. ADAS, Cambridge, UK.

Craighead, M.D., Langford, G. and Braithwaite B.E. (2007). Tools to aid with the Nitrogen nutrition of Blackcurrants and Boysenberries. MAF, New Zealand.

Keeney, D.R. (1966). Comparison and evaluation of laboratory methods of obtaining an index of soil nitrogen availabilit *Agronomy Journal* 58:494-503.

Kindred, D. (2008). Establishing Best Practice for Estimating Soil Nitrogen Supply (SNS). Annual report for HGCA project RD-2007-3425

Kindred, D. (2010). Establishing Best Practice for Estimating Soil Nitrogen Supply (SNS). Project update for HGCA project RD-2007-3425

Marks, M.J. (1995). A survey of the amount of soil mineral nitrogen in UK fruit plantations. *Acta Horticulturae* 383:97–104.

Appendix 1 – Soil N measurements from 2009

Table 10. Soil nitrogen results for 12 blackcurrant sites, pre-season 2009

Site	**AMN 0-30 cm**	**SMN 0-30 cm**			**SMN 30-60 cm**			**Total SMN Kg/ha**	**Total N kg/ha**
	N kg/ha	NO_3-N mg/kg	NH_4-N mg/kg	N kg/ha	NO_3-N mg/kg	NH_4-N mg/kg	N kg/ha		
1	20	1.02	0.96	7.9	0.85	0.73	6.3	14.2	34.2
2	20	2.41	1.14	14.2	1.72	0.69	9.6	23.8	43.8
3	20	1.3	1.4	12.1	0.86	0.92	7.1	19.2	39.2
4	50	0.89	0.76	6.6	0.49	0.64	4.5	11.1	61.1
5	40	2.13	0.94	12.5	1.47	0.37	9.4	21.9	61.9
6	20	2.69	1.06	15.1	1.34	0.56	7.6	22.7	42.7
7	30	3.53	1.84	21.5	1.41	0.81	8.9	30.4	60.4
8	30	5.11	1.19	25.2	3.26	1.54	19.2	44.4	74.4
9	20	0.61	0.76	5.5	0.05	0.53	2.3	7.8	27.8
10	20	0.97	0.60	6.3	0.05	0.51	2.3	8.6	28.6
11	30	1.23	0.93	8.6	0.57	1.01	6.3	14.9	44.9
12	20	1.45	1.55	12.0	1.28	0.72	8.0	20.0	40.0

