Northland Pastoral Extension:

Research Stocktake

NORTHLAND NATURALLY
FIRST REGION OF NEW ZEALAND

Sustainable Farming Fund

Fertilisers - Nitrogen

Contents

1.0 Pasture response to monthly applications of Nitrogen

Reference: M.B.O'Connor and G.L.B. Cumberland;
Dairy and General Conference 1973

Overview

On a dairy farm at Kaiwaka a paddock consisting of Kara silt loam was selected with one half receiving Nitrogen and the other half acting as the control. The trial was started in September 1970 and Nitrogen was applied every two months as sulphate of ammonia with a total annual application of Nitrogen of 420kgN per ha.

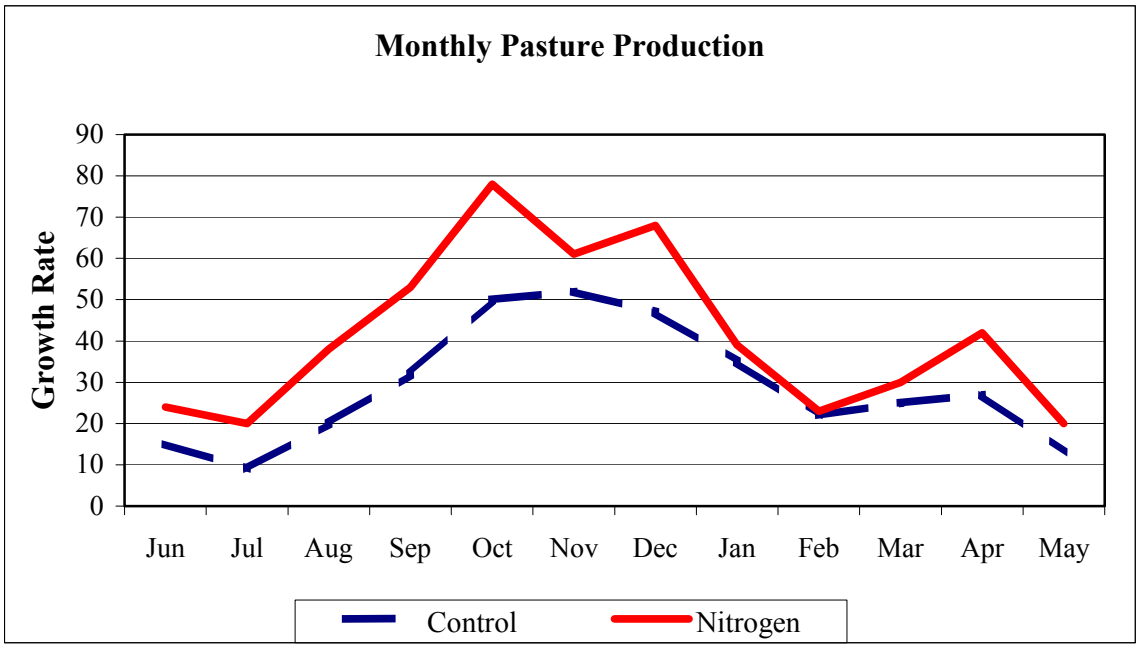
The paddock had received heavy applications of lime, potash and phosphate.

Milking cows with an overall stocking rate of 2.5 cows/ha grazed the paddock and while each half was grazed separately, both halves received the same grazing pattern. Randomly placed cages were mown every 3 weeks and the clover component of the sward was monitored with laboratory dissections of cut herbage. At each cut a sample of the herbage was analysed for its chemical composition.

The advantage to Nitrogen in year one was a 36% increased in pasture production, in year two 31% and in the final year a 40% response was obtained.

Results

	Monthly Pasture Growth Rates Kg/ha/day		Total Monthly Pasture Production		Response Rate KgPDM/kg N
	Control	Nitrogen	Control	Nitrogen	8
Jun	15	24	450	720	9
Jul	9	20	279	589	15
Aug	20	38	620	1116	18
Sep	32	53	990	1590	24
Oct	50	78	1550	2356	7
Nov	52	61	1590	1830	18
Dec	47	68	1457	2046	3
Jan	35	39	1085	1178	1
Feb	22	23	672	700	4
Mar	25	30	775	899	14
Apr	27	42	810	1260	6
May	13	20	403	589	11
Total	10680	14880	10681	14873	8



Summary

- In all three years there were marked responses to Nitrogen mid winter to early summer.
- Responses during December to February depended on rainfall and in one year there was a good response to Nitrogen in January after heavy December rainfall.
- When the trail was laid down the clover content of the swards was 20% white clover and in May 1973 the white clover was 30% in both the Nitrogen and control parts of the paddock.
- The mineral levels of the pasture were tested and no significant differences noted. In particular there was not any real increase in the Nitrogen levels in the Nitrogen treated samples.
- Some samples were tested for the minor elements of Mn, Zn, B, Cu and Mo and no differences were noted as a result of using Nitrogen fertilisers.

2.0 Economic Nitrogen responses on wet Northland soils

Reference: N I Rogers & H B Putt; New Zealand Grassland Association 1997

Overview

Three types of Nitrogen were applied to a Wharekohe silt loam and a marine clay soil to evaluate the most profitable Nitrogen produce for use on wet soils. The four treatments included ammonium sulphate nitrate (ASN), sulphate of ammonia (SOA), urea and a control.

Each site had three randomly allocated replicates and all treatments received one dressing of Nitrogen at 30kgN/ha in mid winter in 1996. The Wharekohe soil received the Nitrogen on 27 June and the marine clay on 19 July. The winter of 1996 was wetter and warmer than the 10-year average and on both sites the soils were at field capacity at the start of the trial.

Result - pasture production

	Total DM per ha as measured by a rising plate	
	Wharekohe- 60 days	Marine clay-38 days
Control	1230	1124
Urea	1720	1456
SOA	2318	1450
ASN	1925	1309
LSD 5%	315	265

Results - economics each product

Wharekohe	$/tonne	Rate applied Kg/ha	Extra DM per ha	Cents/kg DM
SOA	$320	142	1090	4.2
Urea	$480	65	490	6.3
ASN	$440	115	695	7.3

Marine clay	$/tonne	Rate applied Kg/ha	Extra DM Per ha	Cents/kg DM
SOA	$320	142	330	13.8
Urea	$480	65	325	9.6
ASN	$440	115	185	27.5

Summary

- On the Wharekohe silt loam a soil prone to leaching sulphur and Nitrogen the sulphate of ammonia gave the best growth response and at the most economical rate.

- On the marine clay, which is not, sulphur -limiting, sulphate of ammonia and urea gave a similar pasture growth response with the urea the more economical of the two.

- The ammonium sulphate nitrate gave a better response than urea on the Wharekohe soil but was not an economical product to use and was quite expensive on the Marine clay.

- The timing of sulphur applications on the mature gumland soils like the Wharekohe needs further research.

3.0 Pasture response to autumn applications of Nitrogen

Reference: Fertiliser Nitrogen use on Northland Pasture: pasture response in Autumn
Proceedings Agronomy Society of NZ 1983 13: 45-47

Author A.O.Taylor

Overview – Summary

Pasture growth responses to autumn applications of fertiliser N in Northland are highest around the natural peak of autumn growth in April. Responses are halved if Nitrogen applications are delayed until mid May. Average efficiency levels for Nitrogen use when applied at 50kg N/ha were 11.7kg DM/kgN applied in April, 8.1:1 for Mid May applications and 4.8:1 for Mid June applications.

Method - Trial 1979-1982

Urea was applied at 50kg N/ha in April, May and June to six sites throughout Northland as follows.

Kg of Pasture dry matter per Kg N applied, as measured by two pasture cuts over 10 weeks.

	Application date	
Temperate grasses and clover	9 April	17 May
Konoti clay (sheep pasture)	9.9	7.9
Waiotira clay (sheep pasture)	9.4	4.0
Basalt volcanic (dairy pasture)	21.1	22.6
Andesite semi-volcanic (sheep pasture)	1.5	6.0
Peaty sand (with pan) (sheep pasture)	11.1	3.5
Kikuyu pastures		
Sand (with no pan) (sheep pasture)	17.0	4.7

Summary

- Autumn Nitrogen responses vary in Northland as they do in other areas.
- The very low response on the andesite site was not expected but Rumball also recorded very small responses to a similar soil type to March and April applications at Kaikohe while there was very good responses on an adjacent podzol clay soil.
- It is possible that differences in microbial growth and decay between clay and volcanic soils in Northland could explain differences in responses to Autumn applications of N.
- The limited trial data to date suggests that autumn applications of Nitrogen will be maximised if the N is applied in April when soils have rewetted following the summer.
- Autumn applications of Nitrogen to volcanic soils cannot be recommended until the large variations measured to date are better understood.
- Swards dominated by kikuyu with show good response to Nitrogen applications in March and April.

4.0 Pasture and hogget response to spring applications of Nitrogen

Reference: Pasture and hogget response to urea in spring on a set stocked pasture in Northland. Proceedings Agronomy Society of NZ 1983 3: 53-54

Author P.J. Rumball

Overview – Summary

Nitrogen was applied to a short pasture on a northern podzol in late July and the response was measured under continuous grazing during the following 15 weeks. The objective was to assess the value of N fertilisers under conditions of high pasture utilisation in early spring under intensive grazing with sheep.

Method - Trial: July 1980

The trial area consisted of 6.5ha of Wharekohe silt loam with a pasture composition consisting mainly of perennial ryegrass and white clover producing 9-12 tonnes DM per year. The fertiliser input of 400kg/ha of 30% potassic super per year. For several years the stocking rate had been 20 breeding ewes per ha. The breeding ewes grazed the area up to 9 July then spelled until urea was applied on 23 July and the area stocked with hoggets at 22 per ha. The trial design was for six 1.2ha blocks with each block further subdivided into three 0.4ha plots each stocked with 9 hoggets. So there were six replications for each treatment. After 9 weeks the fences in each block were removed and the hoggets run as one mob. The hogget comparison therefore is from 23 July to 25 September but the pasture monitoring continued to 5 November, week 15.

Treatments and Results	Control	50kg N per ha	200kg N per ha
Pasture cover 23 July KgDM/ha	670	670	670
Pasture covers week 9	710	980	1140
Hogget LW gain per head gm/day	82	154	190
Hogget liveweight gain kg per ha	114	214	263
Herbage accumulation week 9	1141	2054	2594
Herbage accumulation week 15	2938	4173	6032
Kg pasture DM per kg N applied		24.7:1	10.5:1

Soil temperature	July	Aug	Sep	Oct
Soil Temp 10cm.	9.2	8.6	11.0	13.2

The soils were close to saturation in July and August, with periods of moisture deficit in October.

Summary

- Despite the high initial grazing pressure, pasture and hogget growth responded quickly to the Nitrogen.
- Annual poa gave the quickest and largest response, increasing its yield over the fist two cuts by 148% for 50kgN and 231% for 200kgN compared with increases of 66% and 76% for the ryegrass.
- The trial gives support for efficient sheep production response on dense, low growing pasture in early spring with up to 50kg N per ha.

5.0 Pasture response to spring applications of Nitrogen

Reference: Fertiliser Nitrogen use on Northland Pasture: Spring use on dairy farms.
Proceedings Agronomy Society of NZ 1983 13: 49-51

Author G J Piggot.

Overview – Summary

The use of N fertilisers by Northland Dairy farmers during the winter and spring is considered from four aspects; the regional use; the efficiency of DM production; the utilisation of N boosted grass; and the factors affecting farmer decision making in respect of N use.

Method

Survey of N use and trends:
Six MAF advisors, a Dairy Board Consultant and a fertiliser company technical representative were surveyed re Nitrogen use on dairy farms in Northland.

N responses under mowing:
Data was summarised from 25 trials conducted between 1967 and 1976 where production cuts were taken 4-6 weeks after N application. In 12 of the 25 trials three or four subsequent cuts were taken. All the major dairy farmed soil types were represented within the 10 trial sites.

N responses under grazing:
Responses to N applied at 40-50kg N/ha to temperate-species-dominate paddocks in both July and August on a commercial dairy farm at Dargaville were monitored. Plastic sheets, 12 meters square, were placed to form six control plots in a single paddock receiving Nitrogen. The dry matter production from the “control plots” was paired with adjacent plots. Measurements were made before and after each subsequent grazing until the response disappeared.

Farmer decision making:
Pasture covers were assessed on ten Northland Dairy farms on a monthly basis during the winter and spring of 1982. Farm management discussions were held after each on-farm pasture cover assessment between the farm, his advisor and research personal re the use of Nitrogen.

Results

Survey of N use and trends:

- It was estimated that 60-70% of dairy farmers were using N in the spring on an occasional rather than annual basis.
- Less than 10% of Northland dairy farmers applied N to the whole farm at any one application.
- Most used Nitrogen to a small area of the farm up to 30% in any one application at rate of 20-30kgN/ha.
- Less than 10% of farmers used multiple applications.

N response under mowing	Month			
	Jun	Jul	Aug	Sep
Number of trials	4	8	9	4
Yield increase kg DM/ha				
N applied at 25kg/ha	250	270	430	370
N applied at 50kg/ha	400	440	660	560
Kg pasture dry matter/kg N				
25kgN/ha	10.1	10.8	17.2	14.9
50kgN/ha	8.0	8.9	13.2	11.1

Comments

Of the trials were cuts were continued, 10 out of the 12 trials responded significantly to N at the second cut, but in only one trial did the response persist to the third cut.

N responses under grazing:	Date of application			
	18 Jul 1980	4 Aug 1980	14 Jul 1981	25 Aug 1981
Period of response in days	70	110	100	60
Number of grazing	3	5	3	3
Pasture growth kgDM/ha/day	37	33	18	18
Kg pasture dry matter/kg N	18	58	28	7
Utilisation of response %	50%	40%	45%	26%

Comments

- Utilisation was calculated as a percentage of the available dry matter that was removed during grazing.
- Utilisation did not differ between the control and N treated plots.
- The pasture growth estimates were from the control plots.
- In 1981 the pasture growth rates in September were poor due to pugging damage at the first grazing in early September. For August and September total rainfall of 185mm was normal but rain occurred on 25 and 26 days of those respective months.

Farmer decision making

- The primary motivation for N use was to provide feed for milking cows in the early spring.
- All other options such as, grazing stock off the milking area, grazing on a long rotation, off-paddock wintering and the feeding of supplements were exhausted before Nitrogen was used.
- The use of Nitrogen was preferred over the purchase of supplements such as hay and silage.
- The use of meal was considered worthwhile to help get cows into calf.

Summary

- Northland dairy farmers consider Nitrogen as purchased feed to prevent under feeding of cows in early spring.

- Based on the pasture response to Nitrogen applied in August and September an increase in milking cow production up to 1.5kg milksolids per kg N applied can be achieved.

- The one trial at Dargaville suggests there maybe stronger carryover effects than those predicted from mowing trials.

6.0 Fate of a spring application of Nitrogen to two Northland soils

Reference: NZ Journal of Experimental Agriculture 1975 4: 415-421

Author K.W. Steele

Overview – Summary

The fate of Nitrogen applied to a gumland and volcanic soil was measured and over a 9 week period the Nitrogen recovers was 33-56% indicating considerable losses of Nitrogen from the soil.

Method

The trials were carried out on a Wharekohe silt loam a podsol soil and on Kiripaka silt loam a stony brown loam soil. The soil properties were as follows:

	pH	K	Turog P	N%	Organic C%
Wharekohe	5.1	4	6	0.31	7.2
Kiripaka	5.9	11	10	0.48	8.6

There were two trials one started 5 August, the other 9 September 1974, and each consisted of a control and 100kg N applied per ha as urea. There were four replications and a basal application of 50kg P/ha as superphosphate and 60kgK/ha as potassium chloride.

Pasture yield was measured by cutting plots to 5cm every 3 weeks for 9 weeks. Ten soil samples were collected from each plot to determine the fate of the Nitrogen.

Results: August trial

	Wharekohe site		Kiripaka site	
	Control	Nitrogen	Control	Nitrogen
5 Aug to 26 Aug Cut 1	13.6	26.3	22.1	34.8
26 Aug to 16 Sep Cut 2	8.1	23.8	29.0	46.4
16 Sep to 7 Oct Cut 3	28.7	43.3	46.7	57.0
Total DM grown	1058	1960	2053	2903
Increase %		85%		41%
Response KgDM/Kg N		9:1		8.5:1

Results: September trial

	Wharekohe site		Kiripaka site	
	Control	Nitrogen	Control	Nitrogen
9 Sep to 30 Sep Cut 1	18.7	54.4	40.4	71.0
30 Sep to 21 Oct Cut 2	27.2	52.7	60.2	69.0
21 Oct to 17 Nov Cut 3	26.2	25.5	40.1	38.0
Total DM grown	1517	2785	2956	3739
Increase %		84%		26%
Response KgDM/Kg N		12.7:1		7.8:1

Comments

- The largest increase in pasture growth for the August trials occurred at the second cut on the 16 September.
- The largest increase in pasture growth for the September trail occurred at the first cut on the 30 September.
- The proportion of clover in the herbage was 18% on the Kiripaka site and 8% on the Wharekohe site and was not affected by the application of Nitrogen in any of the trials.

Nitrogen Recovery

Soil samples were collected from the trial plots before and 24 hours after the urea was applied with more samples collected at 7, 14, 21, and 28 days after application. The sampling dept was limited to 0-15cm on the Wharekohe site due to the presence of a pan. On the Kiripaka site the sampling depth was 0-15cm, 15-30cm, and 30-45cm. The soil samples were tested for ammonium Nitrogen and for nitrate Nitrogen.

Results: Recovery of inorganic Nitrogen in kgN per ha

	Nitrogen recovered 21 days after application			N recovered in the plant 63 days after application
	Soil	Plant	Total	
Wharekohe Aug.	2.5%	28.5%	31.0%	55%
Wharekohe Sep	1.8%	41.2%	43.0%	57%
Kiripaka Aug	0.7%	24.6%	25.3%	48%
Kiripaka Sep	3.0%	33.9%	36.9%	34%

Comments

- In the control plots on both soil types the nitrate Nitrogen was low at all sampling times.
- The ammonium Nitrogen in the control plots was moderately high in August, lower in September, and then fell to low levels.
- When Nitrogen was applied the ammonium Nitrogen levels were very high the day after application for both trials, then fell abruptly between days 1 and 2, and showed small changes up to day 28. The nitrate Nitrogen levels were low initially and remained at this level.
- The recovery of Nitrogen at 34 to 57% is consistent with other trial work elsewhere in New Zealand.
- There was no accumulation of N below 15cm on the Kiripaka site so leaching losses are very low or non-existent.

Summary

- The large increases in dry matter production in August and September to Nitrogen applications indicate that available Nitrogen reserves in the soil are low.
- The low recovery of applied Nitrogen indicate that large losses do occur but not from leaching.
- The lateral movement of soil moisture in both soil types suggests Nitrogen loss from lateral movement of water in theses soils is possible.
- At both sites the soil moisture levels were at field capacity and surface runoff of applied Nitrogen is possible as well and needs further study.

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Part of the SFF: Northland Pastoral Extension Project and coordinated by the Northland Pastoral Farming Development Group