THE PROFITABILITY OF NITROGEN FERTILISER APPLICATIONS ON SEASONAL SUPPLY DAIRY FARMS

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CHAPTER 1

PRESENT USE OF NITROGEN FERTILISER IN NEW ZEALAND AND OUTLINE OF THE STUDY

1.1 INTRODUCTION

Grassland farming in New Zealand is characterised by an almost complete reliance on pasture herbage as the diet for livestock throughout the year. Nitrogen (N) for grass growth is obtained from legumes, particularly white clover. The success of this grass-clover association can be largely attributed to the very high levels of N fixation possible under New Zealand climatic conditions 1/. The supply of available N in the system is not regular, however, and periods of temporary N deficiency occur annually in mixed pasture. Consequently, the question arises as to whether the productivity of the grass-clover pastures can be profitably raised by the use of fertiliser N.

1.2 SCOPE OF THE STUDY

If the use of fertiliser N is to be economic, it must either allow a new farming system to become feasible and profitable, or improve the profitability of an existing system. Advocates of increased N fertiliser use in New Zealand are not in agreement as to which alternative shows the greatest potential.

Mitchell (1969) anticipates a considerable decline in future fertiliser N costs and suggests that it could be used to substitute entirely for clover N. Animals are yarded throughout the year and are fed by high yielding summer and winter adapted crops, which are liberally dressed with fertiliser N, cut, and stored in silos 2/.

Such a system, it is argued, will deliver high quality feed at low unit cost to the animal. Full utilisation of the feed is ensured and supply can be easily adjusted to animal requirements. Time limitations, however, have forced the author to eliminate a consideration of this system from the study and consider only the application of N fertiliser to grazed ryegrass-clover swards. However, an economic comparison of these two basic systems must be undertaken in the future.

1/ Sears (1965) measured 600lbs of elemental N/acre fixed by white clover.

2/ The system of farming commonly referred to as 'zero' grazing.

The results of such an analysis will have a great influence on the future role of fertiliser N as an input in the New Zealand dairy industry.

The study is further restricted to a consideration of only seasonal supply dairy farming systems that may profitably use fertiliser N.

1.3 PRESENT FERTILISER N USAGE IN NEW ZEALAND

Considerable reductions in ammonia production costs have occurred in recent years throughout the world, as advances in mechanical equipment combined with changes in raw material supplies have allowed large scale plants based on oil or natural gas to replace smaller plants based on coke. High analysis fertilisers, (approximately 80% N content), can be produced by liquifying ammonia under pressure 1/ or dissolving ammonia in water 2/. However, these fertilisers are untried commercially in New Zealand. Ammonia is also used in the manufacture of low analysis N fertilisers, such as: urea, sulphate of ammonia (S/A) and compound fertilisers, such as Di-ammonium-phosphate (DAP), which are the major forms of N fertiliser used in New Zealand. Sales from the Hornby and Awatoto fertiliser works in North Canterbury and the East Coast of the North Island respectively, are presented in Table 1.1. The composition of total N fertiliser sales at Awatoto between 1964 and 1971 are also shown in Table 1.1.

TABLE 1.1 N FERTILISER SALES (,000 lbs N)

Fertiliser Works	Fertiliser	N content %	1964	1965	1966	1967	1968	1969	1970	1971
Awatoto *	S/A	21	294	299	224	195	179	356	125	188
	DAP ***	18	-	-	-	38	174	545	400	408
	Urea	48	2	8	-	-	21	571	1546	2178
	Total		296	307	224	233	374	1472	2071	2774
Hornby **	Total		325	-	-	430	1137	2667	3162	-

* Figures supplied by B.T. Robertson (pers. comm.).

** Figures supplied by D. Davies (pers. comm.).

*** DAP also contains 20% Phosphorus.

1/ Annhydrous Ammonia.

2/ Aqua Ammonia.

The main differences of practical interest between commonly used N fertilisers in New Zealand are in N content 1/, cost/unit N, efficiency as a source of N and effects on pasture production.

Because of the advent of cheaper ammonia production and despite rising shipping freight costs, there has been a general decline in the price of urea and S/A in New Zealand in recent years. However, prices increased during 1971 and early 1972, due mainly to the Japanese currency revaluation in 1971. Price trends between 1965 and 1972 are presented in Table 1.2. The prices of different forms of N fertiliser can vary widely between and within districts. Ball (1970) surveyed merchants in the Manawatu and received quotations for urea that ranged from $71 to $105/ton, (6.9 to 10.2c/lb N).

TABLE 1.2 N FERTILISER COSTS (c/lb N ex works)*

	1965	1966	1967	1968	1969	1970	1971	1972
S/A	11.4	12.1	11.5	10.0	10.6	11.1	11.1	12.0
Urea	9.2	9.4	9.6	8.2	8.5	7.3	7.3	8.0

* A purchase subsidy of $7.50/ton of fertiliser is available at present. The effect of this subsidy on N fertiliser prices is not included in the table.

Figures for 1965-1969 supplied by O. Griffin. (pers. comm.). Figures for 1970-72 are average yearly prices at Awatoto fertiliser works.

DAP is a compound fertiliser consisting of 18%N and 20%P and is manufactured by reacting Phosphoric acid with ammonia. At present prices, it is slightly more expensive than a mixture of the equivalent amount of S/A and superphosphate. A further disadvantage is that DAP contains only 3% sulphur. However, with the price of phosphoric acid also falling overseas 2/, this fertiliser may become competitive with present N fertilisers in the future if pasture responses are satisfactory. The effect of DAP on pasture productivity could not be assessed in the present study because most experimentation has been conducted with urea or S/A.

1/ See Table 1.1

2/ Roberts (1967).

Neither urea or S/A are leached rapidly from the soil. Losses of ammonia to the atmosphere can occur, however, when urea is applied to the surface of the soil, although these losses are unlikely to be of practical importance unless high rates of urea are applied. Losses with urea can be reduced to a minimum if it is washed into the soil immediately after application by rain or irrigation water 1/.

S/A has an acidifying effect on soils and During (1967), on the basis of Department of Agriculture trials, suggests that approximately 130 lbs of lime are required to counteract the soil acidity caused by 100 lbs of S/A. Its fine particle nature may also cause it to lodge on herbage, particularly clover and flat weeds, causing 'scorching' at heavy rates of application 2/.

However, Ball (unpub.), found no difference in efficiency, or effect on pasture composition between urea or S/A, so it would appear on economic grounds that urea is the more favourable form of N to use. This may explain why urea sales have represented an increasing proportion of total N fertiliser sales in recent years, (Table 1.1).

Australia, despite an upsurge in consumption of ammonia fertilisers, now faces an over-production problem, and it has been suggested that, if imported in large quantities, further reductions in N fertiliser costs in New Zealand may occur 3/. As the use of higher analysis N fertilisers involves the application of a concentrated liquid at or below the soil surface, a considerable initial investment in high pressure tanks, sophisticated metering devices and injection devices, would be required. There is also the annual cost involved in servicing and maintaining the plant and added precautions required for application such as the need for protective clothing. It is unlikely that demand for such an imput will occur until it can be demonstrated that the regular application of N to large areas of the farm is economically justified.

Although the decline in N fertiliser costs has been accompanied by a general increase in demand as shown in Table 1.1, information is not available to partition this demand between the different farming

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1/ During (1967).

2/ Ball (pers. comm.).

3/ Walton (1971).

industries. Consequently, the amount of N used on seasonal supply dairy farms at present is unknown. However, McKenzie (1970) surveyed commercial firms in Taranaki and found that the percentage of dairy farmers using fertiliser N had risen from 12.1% in 1966/67 to 25.2% in 1968/69. These figures indicate tht farmers are in the process of exploring and evolving systems of production using N fertiliser. However, as yet there is little research information available on how N fertiliser could be most profitably incorporated into dairy farm management systems.

1.4 OBJECTIVES OF THE STUDY

The objectives of the study are to examine in detail both technical and economic factors associated with fertiliser N use in seasonal supply dairy farming. The conditions under which fertiliser N, at present prices, is likely to be profitable are to be defined and pasture management adjustments that should follow N application to ensure that the pasture response is fully utilised are to be established. Adjustments to N use that should accompany any further reductions in N cost or changes in butterfat price will also be examined.

1.5 THE APPROACH ADOPTED

The possibility of assessing the economics of N fertiliser use by surveying farmers known to have used this input was considered [1/], and approximately twenty farms in the Levin/Otaki area were visited. While valuable information was gathered on the technical aspects of N fertiliser use, information on economic factors proved disappointing.

Many farmers were still in the process of testing N to see if they could obtain a reliable pasture response on their farms and had not taken steps to ensure that any increased growth was efficiently utilised. Consequently, any response that has been obtained was not reflected in farm output.

Of those farmers who had incorporated N permanently into the farm plan, their use of it was largely confined to hay and silage paddocks or to small grazing areas for newly calved cows in early spring. While enthusiastic about the responses obtained at this particular time of the year, most had not yet tested applications at other times of the year, although many expressed interest in doing so in the future.

1/ Graham (1963) had conducted a survey in Taranaki to investigate the profitability of high rates of fertiliser application.

In the author's opinion, the limited use of N, both in amount applied and time of application provided insufficient information to conduct a full economic evaluation of the potential for N use. Consequently, it was decided to construct a mathematical model of a grazing system for this purpose, rather than persist with the farm survey in other dairying areas.

The objectives of the study were extended to include a consideration of major problems to overcome in developing a realistic grazing model. It was expected that limitations would be imposed because of insufficient experimental data. The construction of a model, however, does allow a 'stocktaking' of available information to be made so that areas where further research is required can be indicated.

1.6 ORGANISATION OF THE STUDY

In Chapter Two the grazing complex is discussed and in Chapters Three and Four the grazing model is developed. Chapters Six, Seven, and Eight outline the experimental work conducted on the model and the results obtained. In Chapter Nine, limitations of the study are discussed and Chapter Ten presents a summary of results and conclusions.