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STARTER NITROGEN AND PHOSPHORUS TO ESTABLISH CLOVER SWARDS

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In previously undeveloped areas with low levels of soil nitrogen (N), clovers may benefit from the use of starter N in addition to starter phosphorus (P) fertiliser in the period between drilling and the commencement of N fixation. To investigate the worthwhileness this practice, white and red clover was sown at two sites with medium total soil N levels (0.4 – 0.5%) in Central Canterbury and drilled with no fertiliser, N (urea), P (TSP) and N + P (DAP) to supply 27 kg N and 30 P/ha. At neither site did N affect early growth of the clover. One site with an adequate Olsen P of 19 µg/ml also showed no response in early clover growth to P. The other site with a low soil Olsen P of 10 µg/ml showed a large yield response to P at 3 months after sowing but this response was not present when the DM mass of the same ungrazed pasture was measured at 6 months. It can be concluded that for soils with a medium total N status, fertiliser N is not required to assist early clover growth. At a low soil Olsen P level, starter P is beneficial for early clover growth but this effect may only last until the roots can access sufficient soil P.

Background and rationale

Over the last decade, lucerne, white and red clover or a combination of both have been sown into cultivatable flat and rolling land in the South Island. The reason is twofold; to provide high quality feed to growing animals and to restore fixed N to the soil. On some infertile soils where pastures have been dominated by browntop, there is a lack of soil N to help establish the legumes before fixation is fully effective. In this situation fertiliser N has been applied at sowing to improve establishment and early growth. Where P is also applied from a fertiliser such as DAP down the drill, there can be further benefit from placing it closer to the expanding root system. The proposed project aims to quantify the potential legume yield response from using a starter N or P or N plus P when drilling into cultivated land into undeveloped land.

Methodology

Sites

The trials were sited on flat to sloping, cultivatable land at Willesden Farm near Kaituna in Central Canterbury and at Stockgrove near Amberley in North Canterbury. Both have average annual rainfall of around 1000 mm. The sites chosen were on land that had previously been undeveloped. The sites were cultivated in early spring 2021 and early autumn 2022 ready for white (5 kg/ha coated seed) and red clover (3 kg/ha) to be drilled in October 2021 and March 2022. Each site was soil tested for pH, P, S, K, Mg, Ca and total N before cultivation

Treatments

These were applied at sowing to 10 x 4 m drill strips and include control (no N and P applied),, the equivalent rate of N alone at 30 kg/ha (59 kg urea/ha, the equivalent rate of 30 kg P/ha alone (145 kg TSP/ha) and N at 30 kg/ha and N at 27 kg/ha (150 kg DAP/ha). There were eight replicates of each treatment in a randomised block design. All the fertiliser was applied down the drill in a separate box so it was placed adjacent to the seed.

Measurements

1. Pasture production was measured from each plot using a Pasture Plate Meter (10 recordings per plot) for the first two grazings and a universal calibration equation used to derive DM mass.
2. At one of these times, sown clover cover as a percentage was assessed for each plot.

Data management and analysis

Analysis of variance was undertaken for the DM production and clover cover results using the Jamovi statistical programme (The Jamovi Project 2022).

Results

Initial soil test results at Kaituna were pH 5.9, Olsen P 19 µg/ml, QTK 27, QTCa 12, QTMg 73 and total N 0.48 ppm and at Amberley pH 5.9, Olsen P 10 µg/ml, QTK 15, QTCa 5, QTMg 28 and total N 0.41 ppm. These levels were all adequate except for Olsen P at Amberley which was low and total N at both sites which were in the medium range.

Pasture DM mass at the Kaituna and Amberley sites are shown in Tables 1 and 2.

Table 1 Pasture DM mass (kg/ha)at Kaituna as measured on 25/1/22 and 11/4/22

Treatment	**Measurement date**	
	25/1/22	11/4/22
Control	3955	3095
N	4090	3110
P	4065	2790
N + P	4165	3110
P value	0.909	0.746

There was no significant difference in pasture DM mass between treatments at Kaituna at either measurement date.

Table 2 Pasture DM mass (kg/ha) at Amberley as measured on 10/7/22, 12/10/22 and 12/1/23

Treatment	**Measurement date**		
	10/7/22	12/10/22	12/1/23
Control	1255	6445	4620
N	1290	6660	4245
P	2050	6395	4720
N + P	2030	6440	4620
P value	<0.001	0.564	0.205

Although there was a highly significant response in pasture DM mass to P at the first measurement date, when the sward was allowed to further grow, no significant response was measured in October 2022 or January 2023. There was no significant effect of N on pasture DM mass at any of the measurement dates.

Sown clover cover was assessed at one date for each site as shown in Table 3.

Table 3 Sown clover cover (%) as assessed on 15/1/22 at Kaituna and 22/10/22 at Amberley

Treatment	Site	
	Kaituna	Amberley
Control	72	81
N	73	83
P	75	84
N + P	71	82
P value	0.653	0.779

There was no significant effect of N or P treatment on sown clover cover at either site.

Discussion

The lack of response in pasture DM production to N at these two sites with medium total soil N levels indicated that there was sufficient N mineralised from the soil to compensate for the lag period between plant emergence and when the clover plants were fixing sufficient N for their growth requirements. However less improved sites with lower soil total N levels may not be able to mineralise sufficient organic N to fill this gap in N supply.

The lack of a significant response in early clover growth at Kaituna to P placed near the seed where soil Olsen P levels were adequate suggested that the plant roots could access sufficient available soil P despite restricted root growth and the slow movement of P in the soil. At Amberley this may not have been the case initially because of the lower soil Olsen P levels but with time this deficiency seemed to be corrected as the roots grew to access more P.

Although there was no broadcast fertiliser treatments to compare the clover growth responses to N and P with, the results can be discussed in terms of the literature references with this comparison which mainly focussed on P. Houlbrooke (2007) in his review of the literature reported that an equal number of trials showed a growth response to banded P placed near the seed compared with broadcast P in relation to those where there was no significant differences in yield between the fertiliser placement methods. Because there were no negative effects of banding compared with broadcasting P fertiliser, Houlbrooke (2007) recommended the use of banding. It appeared that the growth response to the different fertiliser placement methods was affected by soil and crop type, soil moisture and fertility and direct drilling versus cultivation but it was difficult to discern a clear pattern from the trials conducted.

In theory, placing N fertiliser beneath the soil surface compared with broadcasting it on the surface should reduce the volatilisation of ammonia but there has been insufficient research carried out to verify this.

Conclusion and recommendations

Based on the results from these cultivated trials there is no requirement for starter N fertiliser placed near the clover seed on soils with moderate levels of total N.

On one site with an adequate Olsen P level, there was also no clover yield response to starter P which suggests there is less requirement for starter P where there is a sufficient supply of P from the soil.

At the other site with a low soil Olsen P level, there was a significant response to starter P in early clover growth but this advantage did not persist at the following measurements. This result suggests that there is a stronger requirement for starter P where the supply of soil P is limited initially after sowing.

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