Temperate Grassland: Grass/Legume Swards

French: Pâturages à base de tréfle; Spanish: Pastoreos a base de trébol y hierba; Italian: Pratos mistos a trifoglio; German: Kleegras

Crop data

Temperate grass/legume associations for grazing and conservation are based on white clover (Trifolium repens) and perennial grasses; those for conservation are based on lucerne or alfalfa (Medicago sativa) and red clover (Trifolium pratense), most commonly in pure stands but sometimes with grass. In New Zealand, Maku lotus (Lotus uliginosus cv. Maku), which has been selected as a replacement for white clover on hill land, tolerates wet and acid soils and has a lower P requirement than white clover; this species is showing considerable promise in subtropical highland areas where temperate pasture species are grown.

The legume component of grass/legume swards provides the N source for the sward through the fixation of atmospheric N by Rhizobium bacteria in the root nodules. Where suitable Rhizobia are not present in the soil, legume seed must be treated with a specific inoculant to ensure effective nodulation. The legume component is independent of soil N; once the sward is established, the grass component obtains N from the legume through available N in the soil derived from the decay of legume root nodules and that recycled in urine from grazing livestock. Productivity depends on a substantial (i.e. 50 % legume at peak growth in mid-season) and vigorous legume component. Fertilizer practice and management are aimed at maintaining its vigour.

Application of fertilizer N reduces N fixation by the legume and increases the competitiveness of the grass, thus causing a reduction in the legume contribution. Single applications may, however be made in some circumstances to promote early growth or for a conservation crop.

A vigorous grass/white clover sward produces some 70-80 % of the yield of a pure grass sward receiving the optimum rate of fertilizer N but, because of the higher nutritive quality, animal output is about 90 % of that from a pure grass sward.

Soil pH should be maintained at >6.0 by regular liming.

Nutrient demand/uptake/removal

Nutrient uptake/removal (approximate) - Macronutrients Grass/white clover sward yielding 8 000 kg/ha DM					
kg/ha					
N	P2O5	K2O	MgO	CaO	S
320	69	240	33	189	25

Nutrient uptake/removal (approximate) - Micronutrients Grass/white clover sward yielding 8 000 kg/ha DM				
g/ha				
Fe	Mn	Zn	Cu	Mo
1 500	880	260	80	5

Uptake by grass/red clover or lucerne associations is of a similar order of magnitude but with a higher uptake of K2O (ca. 300 kg/ha K2O).

Plant analysis data

Ranges of analytical data and, in brackets, critical values for white clover (when grown in association with grass) are indicated below:

Plant analysis data - Macronutrients				
% of dry matter				
P	**K**	**Mg**	**Ca**	**S**
0.19-0.47	1.54-3.80	0.15-0.29	1.6-2.3	0.25-0.30
(0.30)	(2.00)	(0.15)	(1.0)	(0.25)

Plant analysis data - Micronutrients					
ppm dry matter					
Fe	**Mn**	**Zn**	**Cu**	**B**	**Mo**
102-448	40-63	22-31	5.4-9.7	25-35	0.05-0.64
(50)	(30)	(15)	(6.0)	(30)	(0.15)

Red clover and lucerne are of similar composition to white clover. The N content of legumes is high (2.4-4.5 %) and depends on the stage of growth.

Fertilizer recommendations

Nutrient demand is a function of the rate of growth. The grass and legume components compete actively for all nutrients, particularly K, and it is essential to maintain an adequate supply in the soil for both. This applies especially to P and K. Fertilizer recommendations are based on the maintenance of an adequate availability in the soil and the replacement of any nutrients removed. Under grazing, the removal is minimal but maintenance applications of fertilizer are necessary and should be based on regular soil analyses. When the sward is cut for conservation, considerable quantities of nutrients are removed and it is essential that P and K, and other nutrients as necessary, are replaced.

Legume growth and N fixation are influenced to a greater extent than grass growth by nutrient deficiency. Adequate Mo is essential for effective N fixation; where Mo deficiency is recognized locally (often in acid soils), then Mo must be applied, most conveniently in the form of molybdenized superphosphate. Other nutrients, such as S, Mg, Zn and B, should be applied where deficiencies are recognized.

Fertilizer requirements are the same whether the sward is permanent or temporary (sown as a ley):

P and K recommendations:

For grazed grass/legume swards		
¦Soil nutrient status	**kg/ha**	
	P2O5	**K2O**
Deficient	80	120
Low	60	80
Moderate	40	60
Adequate	20	0
High	0	0

For establishment	
Soil nutrient status	**kg/ha**

	P2O5	K2O
Deficient	80	120
Low	60	80
Moderate	40	60
Adequate	20	0
High	0	0

For silage and hay			
Soil nutrient status	kg/ha		
	First cut		Later cuts
	P2O5	K2O	K2O
Deficient	100	100	80
Low	80	80	60
Moderate	60	60	40
Adequate	30	40	0
High	0	0	0

N recommendations:

Grass/legume swards in general require no fertilizer N; any fertilizer N reduces the legume contribution and continued use reduces the legume component to an ineffective proportion. There are, however, three situations where fertilizer N might be applied:

- for establishment: 25-50 kg/ha N applied to the seedbed to encourage the growth of legume seedlings before the nodule system is fully established, and of the companion grass seedlings; this is only necessary on soils with a low N status;

- for early grazing: grass/white clover swards have a lower early production than grass swards receiving fertilizer N, but a spring application of 50 kg/ha N can improve early production;

- for the first cut for silage: grass/white clover swards have a more uniform seasonal pattern of production (when cut for conservation they yield 3-4 t DM/ha at the first cut followed by 2-3 t DM/ha at the second cut, compared with grass swards receiving intensive fertilizer N which give 5-7 t DM/ha at the first cut followed by 1-2 t DM/ha at the second cut), but a spring application of up to 100 kg/ha N will increase the first cut to about 5 t/ha DM, mainly grass, although there will be some reduction of the clover contribution and yield in mid-season.

Animal manures and slurry

Grass/legume swards respond well to stable manure or slurry which are useful sources of K and P and can replace some of the mineral fertilizer which would otherwise be required. Spring or early summer application to swards to be cut for conservation is the most effective method of use.

Preferred nutrient forms

P: - Usually applied as single or triple superphosphate, either straight or in compounds. Single superphosphate, which contains an appreciable amount of S, as well as Ca, is a useful fertilizer for S-deficient soil. On acid soils with a high Al content, on which some of the P applied in soluble forms becomes unavailable through fixation, part of the P requirement should be given in the form of ground rock phosphate. Basic slag, a by-product of the iron and steel industry, is a traditional source of P for grassland on acid soils but, with changes in the steelmaking process, it is no longer widely available.

K: - As chloride (muriate) or sulphate in straight or compound form.

Further reading

See chapter : Temperate grassland: Permanent grass and sown grass or leys

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