CAN CHICORY BE USED TO REDUCE NUTRIENT LOADING ON THE EFFLUENT BLOCK?

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Abstract
Farmers can grow crops on farm dairy effluent blocks to reduce and redistribute the nutrients that have accumulated in the soil from effluent over time. Elevated soil potassium (K) status is common because farm dairy effluent (FDE) has high K concentration. High levels of soil K can result in metabolic health problems for cows (e.g. hypomagnesaemia). Chicory is a viable cropping option to consider for effluent blocks because it has greater potential to redistribute soil N and K than either maize or turnips. It also provides cheap feed right through the summer, at around 10 c/kg DM on effluent blocks (where no fertiliser is required). In addition, feed quality is high (12.5-13 MJME/kg DM), and the long tap root of chicory provides drought tolerance. Effluent can also continue to be applied once it is established.

Introduction
Increasing emphasis on resource use efficiency, together with increasing environmental awareness, has resulted in more dairy farmers using land-based application of FDE. However, application of FDE to pasture typically results in an accumulation of soil K. Common solutions for this problem include either increasing the size of the application area or growing crops like maize for silage on the effluent area. Maize is able to extract considerable amounts of soil K, due to its high yield potential. However, growing maize on the milking platform means less pasture area is available during summer, which effectively increases the stocking rate over the remaining farm area (Thomson et al., 1998).

Conversely, growing a summer forage crop, such as turnips or chicory, would provide feed when it is needed the most, whilst having a similar ability to reduce soil nutrient levels due to their deeper rooting properties. The cows grazing the crop then transfer the nutrients to other areas of the farm through excreta (Salazar et al., 2010).

An advantage of chicory is that it can be grown for minimal cost, at around 10 cents/kg DM on effluent blocks where no fertiliser is required. In addition, feed quality is high (12.5-13 MJ ME/kg DM), and chicory is able to remove excess nutrients from the soil due to its deep tap root (up to 1 m in length) which also provides drought tolerance. Effluent can also continue to be applied once it is established.

Methods and assumptions
Chicory feed analysis information was collated from Hill Laboratories (27 samples), GrazingInfo Limited, CropMark (samples taken from Morrinsville and Paterangi), NSW Agriculture, Reme Soils Goulburn and AgResearch New Zealand. Average pre-harvest crop yields were obtained and multiplied by average nutrient concentrations to estimate the soil nutrient uptake by the crop. The average utilisation of the forage crops (assumed to be 85%)

was included to estimate the amount of soil nutrient that would be removed from the paddock via excreta. Information on establishment costs and time out of pasture were also obtained.

Results

Costings

The average cost for chicory establishment and weed spraying was found to be typically in the range $1000-1500/ha. Based on a 6 month yield (as a summer crop only) of 13 t DM/ha, this equates to around 10 c/kg DM (A Henderson 2011, pers. comm., 8 Feb.)

Crop duration

Table 1: Time out of pasture for 3 common forage crops

	Chicory	**Maize**	**Summer Turnips**
Crop duration (days)	201	182	136
Time to first grazing of new pasture (days)	42	42	42

Chicory is out of pasture for longer than both maize and turnips (Table 1).

Crop yield and time out of pasture

Table 2. Annual paddock yield (t DM/ha) and days out of pasture for different cropping options

	Chicory	**Maize**	**Turnips**
Crop yield (t DM/ha)	13	22	10
Pasture yield (t DM/ha)*	7.5	7.5	9
Total annual yield (t DM/ha)	20.5	29.5	19
Days out of pasture	243	224	178

*Pasture yield from 1 June until sprayed out for sowing. For turnips it also includes pasture growth in May after crop

Days out of pasture = average crop duration + time to first grazing of new pasture

The annual paddock yields shown above (Table 2) are based on average crop yields and pasture growth rates. The yield for chicory is what can be expected from a year 1 crop over four grazings. The yield would be expected to be less in year 2 (around 12t DM/ha total annual yield).

Even though chicory is out of pasture for longer than maize and turnips, the estimated total annual yield for the paddock is similar, if not slightly better than for turnips, but less than maize (Table 2).

Nutrient uptake and removal by various crops

Table 3. Estimate of DM yield and soil potassium (K) and nitrogen (N) uptake and removal by chicory, maize, turnips and pasture silage from a FDE block

	Chicory	Maize	Turnips	Pasture silage
Yield (t DM/ha)	13	22	10	2
K conc. %	4.8	0.9	3.9	2.6
K uptake (kg/ha)	620	200	390	50
K removed (kg/ha)	530	200	330	50
N conc. %	3.3	1.1	2.1	3.5
N uptake (kg/ha)	430	242	210	70
N removed (kg/ha)	365	240	180	70

Average yields were multiplied by average nutrient concentrations to obtain uptake and an 85% utilisation rate were assumed for chicory and turnips

The estimated uptake and removal of soil potassium and nitrogen by chicory was higher than for maize, turnips and grass silage (Table 3). Note that the cows need to be moved off the chicory within 4 hours of grazing to ensure nutrient distribution to other areas of the farm occurs. This should not be an issue as it is standard farmer practice to graze cows for less than 4 hours on chicory.

Conclusions and recommendations

Chicory is a viable crop option for effluent blocks because it has greater potential to reduce and redistribute soil N and K than either maize or turnips, whilst providing feed to fill a feed deficit in summer. This is particularly important for non-irrigated, summer-dry farms. Additionally, feed quality is high (12.5-13 MJME/kg DM), and the long tap root of chicory provides drought tolerance. Effluent can also continue to be applied after it has been established, unlike most other crops. Chicory is a profitable crop option, as it can be grown cheaply, particularly on effluent blocks.

References

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Acknowledgements

This project was funded by New Zealand dairy farmers through DairyNZ. Thanks to Chris Glassey, Garry Waghorn and Duncan Smeaton (DairyNZ) for advice and direction; Bob Longhurst (AgResearch), Fiona Calvert (Hill Laboratories) and Aaron Henderson (CropMark) for nutrient analysis information; David Horne (Massey University), Mike Hedley (Massey University), Ian Williams (Pioneer) and Benjamin Trotter (Agricom) for crop yield data and soil nutrient transfer information.