Alternative forage crops for finishing lambs

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Executive Summary

Alternative forage crops offer a number of benefits for farmers including a cheap finishing system for lambs, benefits for soil condition, fertility building for rotations and providing a cover crop. Certain forages have also been demonstrated to have some anthelmintic benefits for lambs.

A demonstration study was undertaken to investigate the potential of six crops used in the horticulture industry (fertility building crops) as forage crops for weaned growing lambs. The crops include white mustard, Nemat (form of Rocket), Crimson Clover, Sweet Clover , Caliente 119 and Caliente 99 (*Cruciferae*). The grazing field was split into three blocks and two crops were sown in solid strips in each block. Each block also had grass headlands.

10 ewe lambs were randomly allocated (balanced for liveweight) to each block. Lambs were introduced to the blocks 1 week after crop emergence. Lambs were weighed fortnightly for 8 weeks. Mob faecal samples were also taken from each group on a fortnightly basis. Grazing behaviour assessments were also undertaken.

Lambs grazing the mustard treatment had the least liveweight gain of the three groups over the grazing period (average of 58g/day). Whereas lambs grazing the clover treatment had the greatest liveweight gain (average of 110g/day). Lambs grazing the Caliente treatment were intermediate (average of 92g/day). However, in the third grazing period lambs on the Caliente treatment had negative liveweight gains (-50 g/day).

Although activity varied throughout the day, on average 75% of lambs were grazing at any given time. For the Caliente treatment group on average at anytime 33% of lambs were grazing the Caliente 99 variety compared to 23% grazing the Caliente 119 variety. Only 16% of lambs were on average grazing the grass areas at any one time. In the clover treatment group 45% of lambs were to be found grazing the Crimson clover sward at any one time on average, 22% were grazing the Sweet clover sward and only 3% grazing the grass areas. For the mustard treatment 33% of lambs on average were grazing the Nemat sward at any time, with 22% grazing the white mustard sward and the grass areas.

This study suggests that fertility building crops such as Caliente, clover and mustard can be utilised as a grazed forage crops. However, it may be more appropriate to sow the crops as a mixed crop for grazing rather than as mono-culture. This would also increase any environmental benefits such as an increase in biodiversity.

Introduction

Alternative forage crops offer a number of benefits for farmers including a cheap finishing system for lambs, benefits for soil condition, fertility building for rotations and providing a cover crop. Certain forages have also been demonstrated to have some anthelmintic benefits for lambs.

Mustard belongs to the *Cruciferae* family which also contains the genus *Brassica*. Members of the *Brassica* family useful to sheep production include various types of turnips, rape, kale, tyfon and swedes. Varieties can be loosely categorised as forage, root or combination types. Generally forage varieties are used in late summer/early autumn with root varieties being used from autumn through winter. Although, there has been substantial research carried out into brassicas as fodder crops little work has been done with mustard.

Brassica crops provide a balanced source of carbohydrate, protein, fibre and minerals and are a very useful sheep feed. However, when fed exclusively, lambs seldom achieve growth rates which would be predicted on the basis of the feed analysis. This is because Brassica crops also contain secondary compounds which cause depressed appetite. The list of secondary plant compounds includes -

- nitrates
- photosensitive substances
- haemolytic anaemia factors
- oxalates
- glucosinolates (goitrogen precursors, which can induce iodine deficiency)

Brassicas can also be high in sulphur and molybdenum which can induce copper deficiency.

A number of plant secondary compounds have been shown to have some anthelmintic properties when included in animal diets. To date much of the research has focussed on condensed tannins. However, in the horticulture sector other secondary plant compounds have been shown to have nematicide properties.

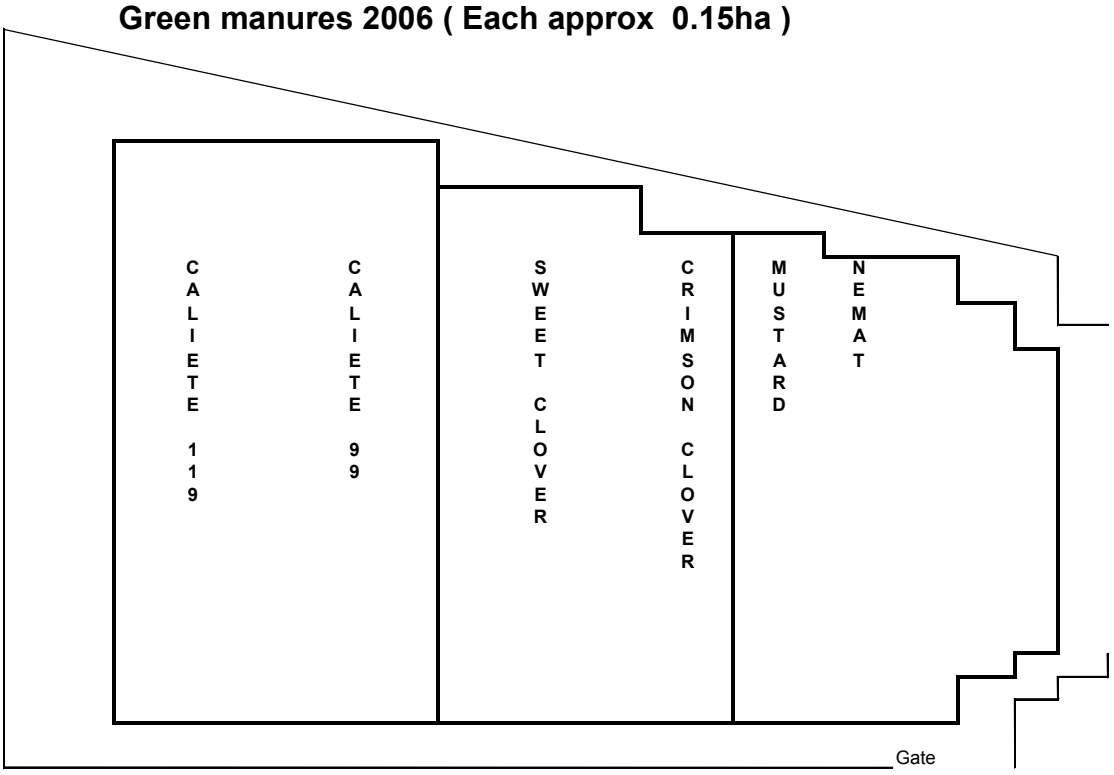
Current demonstration work being undertaken by CALU is investigating the potential of mustard crops in horticultural rotations. The same crops may have benefits for organic livestock systems as a standing forage crop as well as a fertility building crop. Mustard crops have traditionally been used in parts of the UK as sheep fodder crops.

The objective of this demonstration study was to investigate the same fertility building crops as forage crops for growing ewe lambs.

Demonstration study design

Six different forage crops were sown (three blocks of two crops) as part of a previous green manure study. Original plots were cut or flailed and incorporated in late July. In late August 2006, crops were re-sown and organic poultry manure applied (900kg/ha). The plot area was split into three blocks. Within each block two crops were sown as solid strips (see Figure 1 below for plot layout). Each block also had grass headlands.

Figure 1: Plot layout for Green manure study.



The sowing rates for each forage crop are given in Table 1. Each crop was sown at the recommended rate. Crops started to emerge within 3 or 4 days of sowing.

Table 1: Application rates for each forage crop

Treatment	Rate Kg/ha
Mustard	20
Caliente 119	15
Caliente 99	10
Sweet Clover	20
Crimson Clover	20
Nemat	8

10 ewe lambs were randomly allocated (balanced for liveweight) to each block. Lambs were introduced to the blocks 1 week after crop emergence. Lambs were weighed fortnightly for 8 weeks. Mob faecal samples were also taken from each group on a fortnightly basis.

In addition behavioural scans were undertaken covering a 12 hour period over a number of days. The behaviours being observed were grazing, laying down and standing. In addition which area was being used for the behaviour was noted. The behavioural data would indicate if one forage crop within a block was preferred.

Results

Crop establishment was uniform and quicker than the spring sowings. This was due to warmer soil conditions and sufficient soil moisture. Samples from each plot were analysed for nutritional value and this is given in Table 2 below.

Table 2: Nutritional value for each of the forage crops

	Caliente 119	Caliente 99	Sweet Clover	Crimson Clover	White Mustard	Nemat
Dry matter (%)	9.1	8.5	19.1	26.2	10.1	7.1
Total crude protein (%)	24.8	30.9	19.3	17.8	32.2	32.4
Metabolisable Energy (MJ/kg)	12.0	12.6	10.6	9.5	12.6	12.1
Digestible crude protein (g/kg)	187	242	138	124	254	256
D value	77	80	68	62	80	77

The metabolisable energy (ME) content of the Mustards and the Caliente forages was higher than that of the clover forages. The clover forages had higher dry matter content than the mustards or Caliente forages.

Lamb Performance

The lambs were put into the plots on 19th September. After two weeks there was insufficient forage available to continue grazing so all lambs were removed. The lambs then grazed a mix plot of grass, clover and white mustard for a further two weeks before returning to the original blocks for a further two weeks. An outline of the amended grazing regime is given in Table 3 below. Liveweights of lambs were recorded as they were removed from the grazing plots. Daily liveweight gains were calculated for each two week period. The results are given below in Table 4.

Table 3: Grazing Regime

Date	Period	Group 1	Group 2	Group 3
7 Sept. – 19 Sept.	P1	Caliente	Clover	Mustard
19 Sept. – 2 Oct.	P2	Grass Clover & Mustard Mix		
2 Oct. – 16 Oct.	P3	Caliente	Clover	Mustard

The lambs grazing the mustard plots very quickly consumed available forage. Had a longer period been allowed for crop establishment and growth it may have been possible to graze the mustard treatment for longer.

Table 4: Daily liveweight gain (g) of lambs grazing different forage crops

	Group 1	Group 2	Group 3	SED	Sig
Period 1	120^{ab}	140^{a}	13^{b}	56.8	*
Period 2	208	85	150	65.9	NS
Period 3	-50^{a}	104^{b}	21^{ab}	47.0	*

^{ab}Values on the same row not bearing common superscripts are significantly different ($P<0.05$)

Lambs grazing the mustard treatment (Group 3) had the least liveweight gain of the three groups over the three grazing periods. Lambs grazing the clover treatment had the greatest liveweight gain. During period 1 lambs grazing the mustard treatment had significantly reduced daily liveweight gain (DLG) compared to lambs grazing the clover treatment (13 vs 140 g respectively). However during period 3 lambs grazing the Caliente treatment had liveweight gains significantly lower than lambs on the clover treatment (-50 vs 104 g respectively).

Faecal samples were taken on Day 0 after allocation to treatment. The samples were pooled and sent to Innovis for worm egg counting. The results are given in Table 5.

Table 5: Faecal Egg Counts based on mob samples from lambs grazing different forage crops.

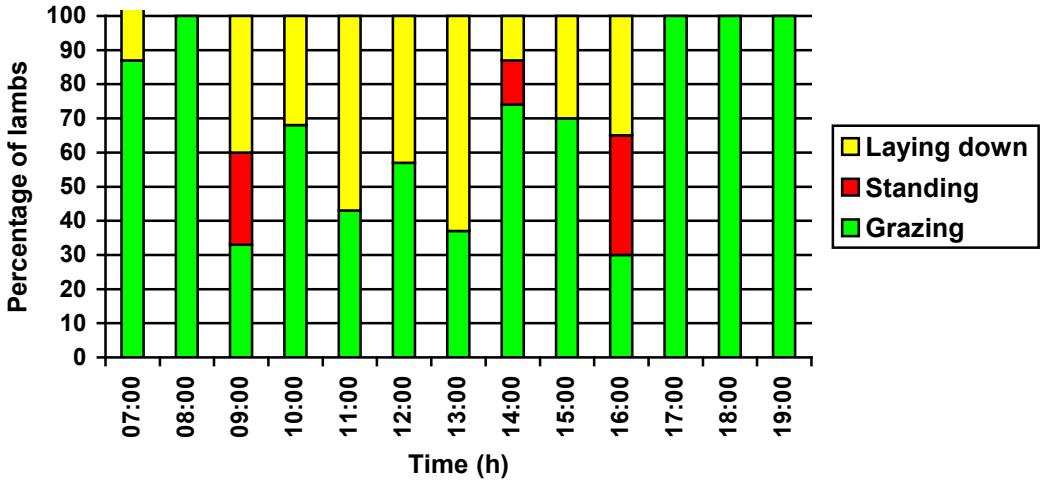
	Group 1	Group 2	Group 3
Day 0	510	540	450
End Period 1	840	540	660
End Period 2	240	90	30
End Period 3	120	570	240

Faecal egg counts were reduced for all groups after period 2 grazing a grass clover sward. As faecal egg counts were based on mob samples it is not possible to determine if there was an effect of forage type on parasite burdens.

Behavioural assessments

Behavioural scans were carried out once an hour every hour over a 12 hour period during period 3. At each scan lambs were recorded as either, grazing, standing or laying down. In addition it was noted which plot within each block the lambs were carrying out each activity. Figure 2 below indicates the percentage of lambs carrying out each activity over the 12 hour period.

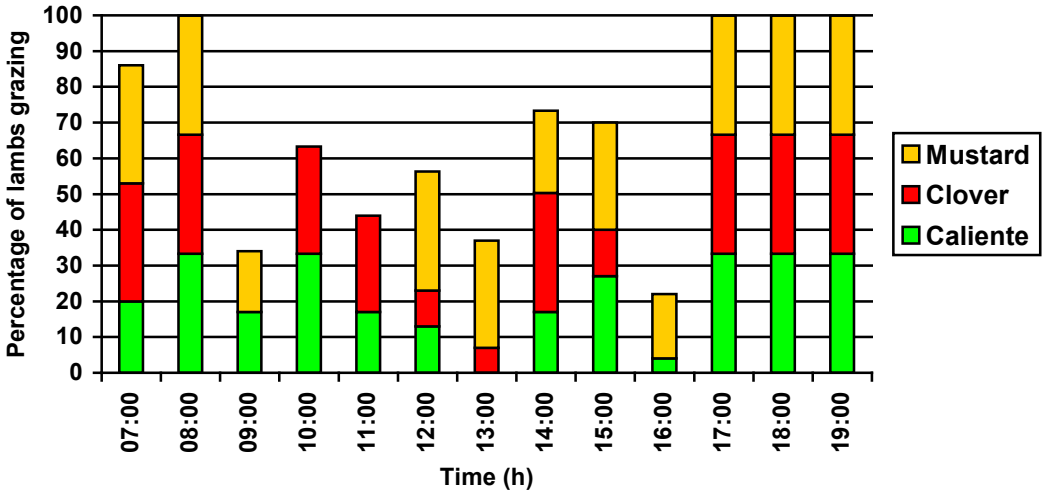
Figure 2: Percentage of lambs carrying out a specific behaviour at each time point over a 12 hour period.



Although there is variation in activity throughout the day the majority of the day was spent grazing by lambs. During the early morning period (7:00 – 8:00 h) the majority of lambs were grazing. Between 17:00 – 19:00 h all

lambs were grazing. On average 75% of lambs were grazing at any time during the day. The percentage of lambs grazing at each time point on each treatment is depicted in Figure 3 below. On average 27% of lambs were grazing the mustard treatments at anytime and 24% of lambs grazing the Caliente and clover treatments.

Figure 3: Percentage of lambs grazing each of the treatment areas at each time point over a 12 hour period.



Within each of the treatment plots, records were made of where each lamb was carrying out specific behaviours. The results are depicted in Figures 4a-c below.

Figure 4a: Percentage of lambs grazing different plots within the Caliente treatment block

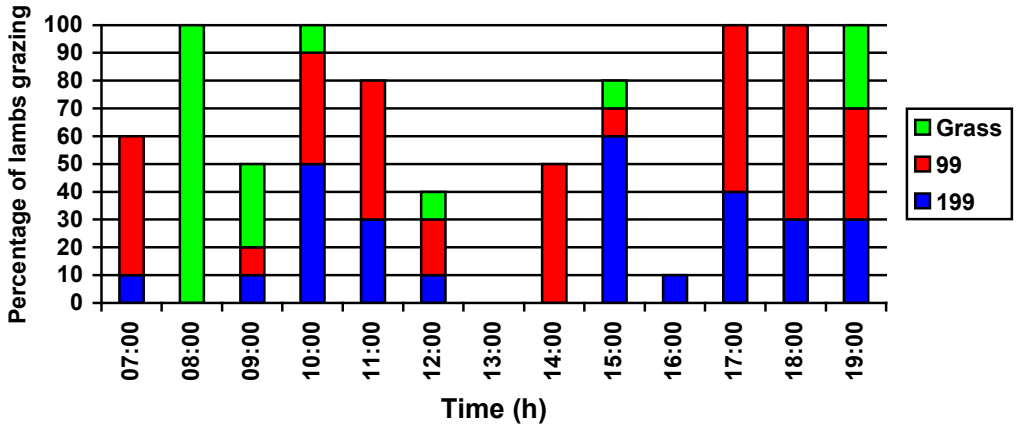


Figure 4b: Percentage of lambs grazing different plots within the Clover treatment block

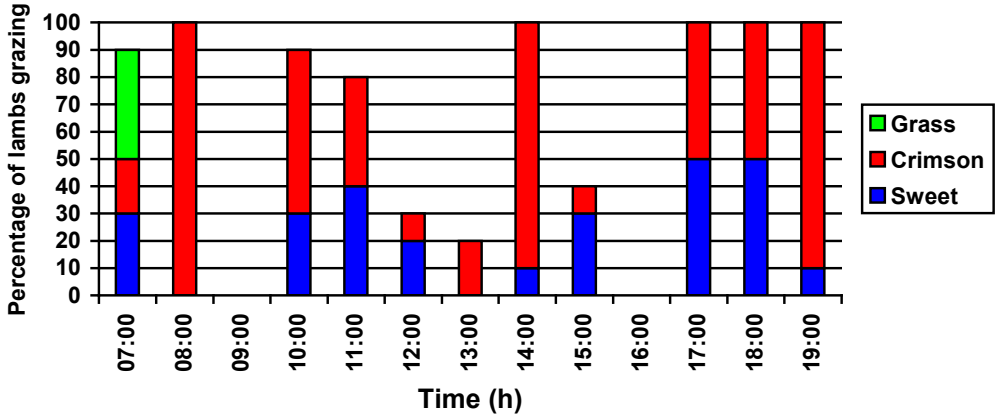
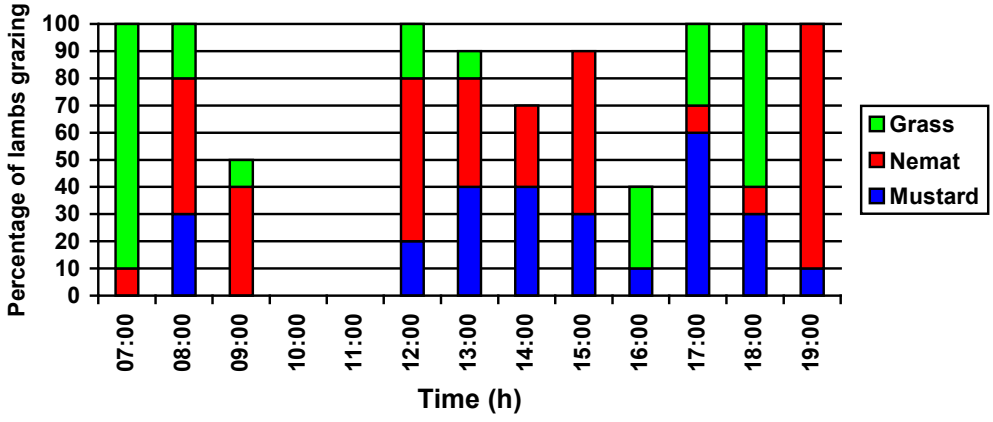


Figure 4c: Percentage of lambs grazing different plots within the Mustard treatment block



For the Caliente treatment group on average at anytime 33% of lambs were grazing the Caliente 99 variety compared to 23% grazing the Caliente 119 variety. Only 16% of lambs were on average grazing the grass areas at any one time. In the clover treatment group 45% of lambs were to be found grazing the Crimson clover sward at any one time on average, 22% were grazing the Sweet clover sward and only 3% grazing the grass areas. For the mustard treatment 33% of lambs on average were grazing the Nemat sward at any time, with 22% grazing the white mustard sward and the grass areas.

Although only a demonstration study the behavioural scans suggest that within the clover treatment both clover varieties were grazed in preference to grass. This was also the case for the Caliente treatments although not as marked as for the clover treatment. In the mustard treatment plots the percentage of lambs grazing was similar although a larger proportion grazed the Nemat sward compared to the White mustard sward or the grass areas.

Discussion

The purpose of this demonstration study was to investigate if fertility building crops commonly used within organic horticultural rotations could also offer benefits to the organic livestock farmer as a grazed forage crop.

For the type of lambs used in this study, liveweight gains of at least 100 g/day would be achievable from grass swards. The clover treatment (which included both sweet and crimson) resulted in the highest daily liveweight gains (mean gain of 110 g/day) compared to the Caliente or mustard treatment. During the initial grazing period daily liveweight gains on the Caliente treatment were 120 g/day however during the third grazing period lambs lost weight at an average of 50 g/day. Liveweight gains for lambs on the mustard treatment were low for both the first and third grazing period (13 and 21 g/day respectively). When lambs were switched to a grass, clover, mustard mixed sward for a two week period the liveweight gains of lambs from the Caliente and mustard treatments increased substantially (208 and 150 g/day respectively). The results suggest that the intakes of mustard alone were sufficient for animals at maintenance bit not sufficient for growth whereas initially the nutritive value of the Caliente was sufficient for growth but this was not maintained over a period. The improvement in daily liveweight gain when moved on to a mixed sward suggests that this would be a more beneficial rotation for livestock farmers.

The behavioural observations suggest that the more novel forage crops of Caliente and mustard were palatable to the lambs with a greater proportion of lambs grazing the treatment plots compared to the grass areas at any point in time. Lambs grazing the clover plots also demonstrated a preference for the treatment plots over the grass areas, particularly the Crimson clover treatment plot.

Conclusions

This study suggests that fertility building crops such as Caliente, clover and mustard can be utilised as a grazed forage crops. However, it may be more appropriate to sow the crops as a mixed crop for grazing rather than as mono-culture. This would also increase any environmental benefits such as an increase in biodiversity.

Demonstration event and technology transfer

A open day demonstrating the grazing study was held on 20th September in conjunction with an CALU open day demonstrating potato trial work. For the open day a factsheet was produced with the results from the first grazing period. In addition a poster has been produced outlining the trial work and this was displayed at an ADAS/HCC sheep breeding seminar, OCW Organic Producers Conference, Welsh Winter Fair (ADAS Stand) & ADAS/OCW Organic Health Workshop.

Acknowledgements

We would like to acknowledge Farming Connect for supporting this work.

APPENDIX 1: DEMONSTRATION POSTER

Alternative forage grazing Crops
ADAS Pwllpeiran

Alternative forage crops offer a number of benefits to farming systems including:

- environmental benefits for wildlife,
- low-cost finishing system for lambs
- benefits for soil condition
- fertility building for rotations
- providing a cover crop.

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Mustard crop in flower

Establishment of forage grazing crops

Mustard may have benefits for organic livestock systems as a standing forage crop for finishing lambs.

There is current interest in mustard as a cover and fertility building crop in the horticulture sector because of their ability to reduce soil pests.

Demonstration work being undertaken by ADAS on behalf of CALU is investigating the potential of new varieties of Caliente mustard crops in horticultural rotations.

In a new project, organic weaned lambs will graze stands of mustard (White & Caliente), Nemat (Wild Rocket) and Clover (Crimson & White).

Crop availability and lamb performance will be monitored through until finishing

This project is funded by Farming Connect through Organic Centre Wales

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APPENDIX 2: OPEN DAY HANDOUT

ALTERNATIVE FORAGES FOR FINISHING LAMBS

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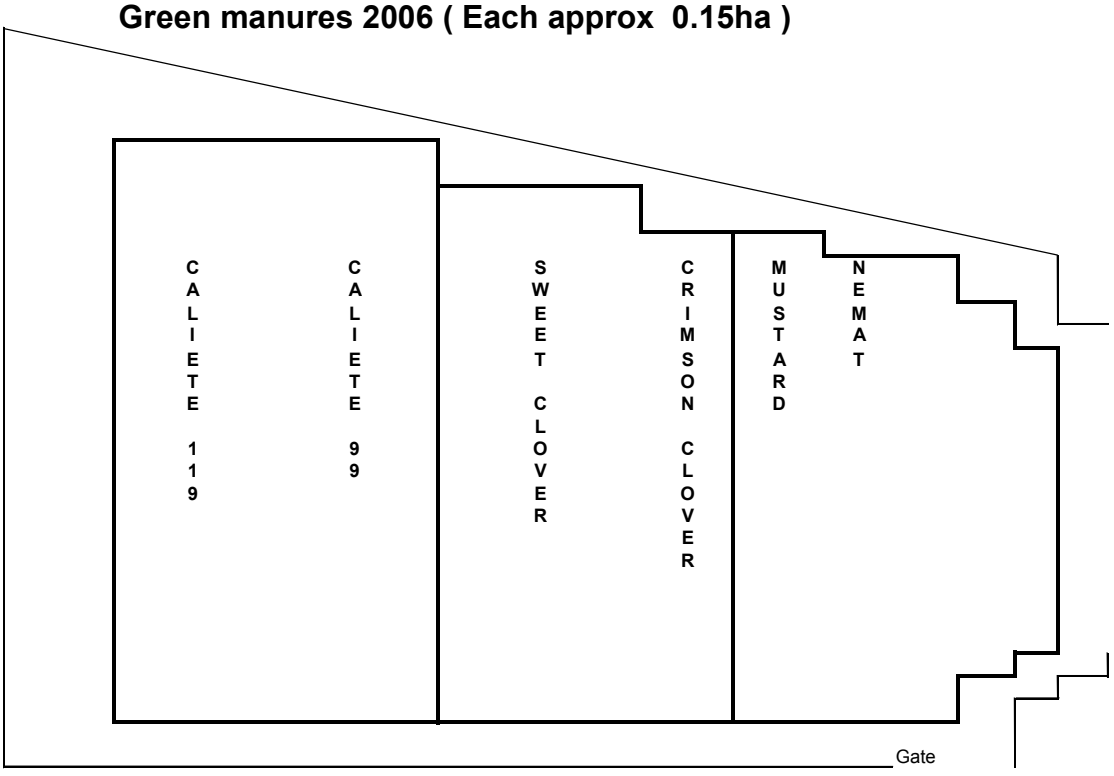
Six different forage crops were sown (three blocks of two crops) as part of a previous green manure study. After harvesting in August 2006, crops were re-sown or topped and organic poultry manure applied (900kg/ha).

Green manures 2006 (Each approx 0.15ha)

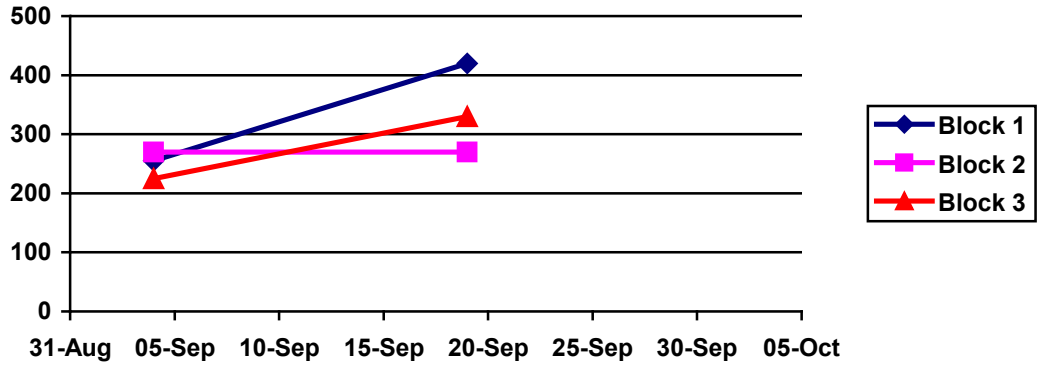


Treatment	Rate Kg/ha
Mustard	20
Caliente 119	15
Caliente 99	10
Sweet Clover	20
Crimson Clover	20
Nemat	8

RESULTS TO DATE

TREATMENT	CROP	Daily Liveweight Gain
BLOCK 1	Caliente119/Caliente 99	0.12 kg
BLOCK 2	Sweet clover/Crimson Clover	0.18 kg
BLOCK 3	Mustard/Neemat	0.01 kg

Faecal Egg Counts to date



All forage crops appear to be highly palatable to the lambs. However, the initial liveweight gains for lambs on the mustard/neemat mix are very low. Weight gains for lambs on the other treatments are acceptable.

Further information will be available at the Welsh Winter Fair

Demonstration work is being funded by Farming Connect through Organic Centre Wales