Future Forage Systems Project

Poukawa Field Day Notes

Poukawa, 20th November 2012

Future Farming Systems - Background

This project aims to identify and test forage tools that dryland farmers could use to improve their performance (and reduce their risk) in what has become an increasingly variable climate. Farmers are bombarded with new forage solutions and it is increasingly hard to sort the "wheat from the chaff". For example in just one recent rural magazine (Country-Wide, January 2012) there were three articles suggesting remarkable production levels from new forages. An article (page 53) suggested that in winter, plantain could "grow at up to 80 kg DM/ha/day if it is not too cold". Yet another article (page 57) indicated that Persian clover could "grow at 50 kg DM/ha/day from March to August". Another article on creep grazing (page 63) suggested that "lambs still on their mothers were growing at nearly 400 g/d on lucerne". Compared to the published literature and commercial reality, these numbers seem extreme. Can they be replicated in our region, and, if they can, where is their place within a farming system? It is all very well to sow new forages, but they have to add value rather than create a problem at another time of the year or increase risk.

The East Coast Future Farming Systems Project provides the opportunity to road-test a range of forage technologies such as lucerne, plantain, annual clovers (as crops and on hill country) and more persistent dryland species mixes. Where possible, this will consist of on-farm demonstrations where new options are benchmarked against existing farm practice. Once we understand how these alternatives perform locally, we can look at integrating them into farming systems.

Lucerne (Kinburn)

Establishment

Paddocks (10 ha and 5 ha) were sprayed with glyphosate in early October 2011 and Aglime (6 Tonne/ha) and 300 kg/ha of lucerne mix (NPKS 0-19-51-46) were broadcast on 20th October prior to cultivation. Paddocks were conventionally cultivated and deep ripped. Lucerne (cv Kaituna) was sown at 13.35 kg/ha in two paddocks (10 ha and 5 ha) on 4th Nov 2011 using a Hatzenbichler 16 Broadcast Air Seeding drill fitted to a 'Cambridge' roller unit (6m wide). Two soil tests were undertaken in Jan and June 2012). Conditions were very dry after sowing and the area was irrigated. This led to a secondary strike and a significant weed problem - redroot, black nightshade, stinging nettle, fat hen, convolvulus, knotweed, barnyard grass and mallow. Weed control was made difficult by the different stages of lucerne growth and the area was eventually sprayed with Spinnaker – this had only a minor effect on the lucerne. Weeds were subsequently well controlled by grazing and then mowing off. In the 5 ha lucerne block, a problem with barnyard grass was controlled with Leopard.

Table 1. Soil test results

Date	pH	Olsen P	Potassium	Sulphate Sulphur	Organic Sulphur
Jan 2012	6.3	36	8	10	13
Jun 2012	6.5	33	5	12	5

Animal performance

Lucerne paddocks were rotationally grazed five times (average 33 days per rotation) between Jan and May. Average stocking rate was 25 lambs/ha and the average lamb growth rate was 178 g/d (Table 2). These low lamb growth rates may have been a result of very high water content (lambs may have been unable to eat enough). High protein levels may have impacted on growth rates.

In spring 2012, 502 lambs (average weight 32.1 kg) were rotationally grazed on lucerne at 33 lambs/ha for a 64 day trial grazing period and grew at 261 g/day. A group of 480 similar lambs were rotationally grazed at 15 lambs/ha on 32 ha of unimproved hill country and grew at 236 g/d. Because of the higher quality feed, lambs off lucerne also had a higher DO% (46.1% vs 45.1%). The combined effect of more lambs per ha, a higher lamb growth rate and a higher DO% meant that the lucerne resulted in an increase in lamb value of $1397/ha, considerably more than the $561/ha achieve under similar grazing management on resident pasture over the same time frame.

Table 2. Lamb performance and returns on lucerne and unimproved pasture (22nd Aug to 25th Oct)

	Lucerne	Grass/clover
Stocking rate (lambs/ha)	33	15
Lamb LWG (g/d)	261	236
Total lamb LWG kg/ha)	551	226
DO%	46.1	45.1
Carcass weight/ha	254	102
Increase in lamb value/ha* ($)	1397	561

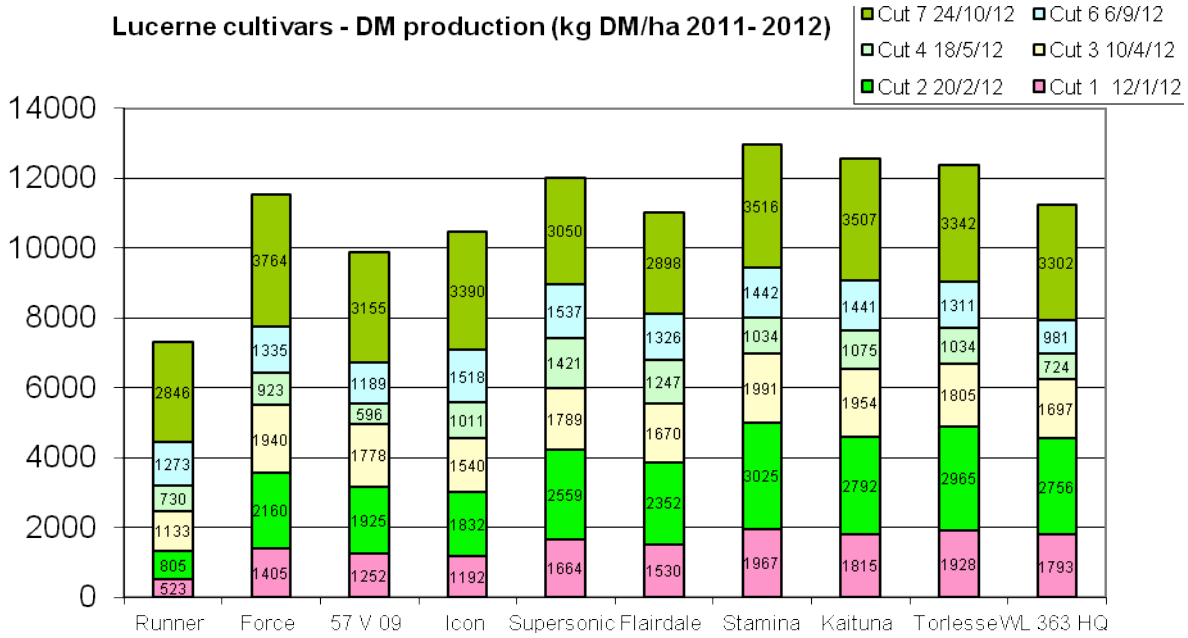
*Assuming a spring carcass value of $5.50/kg

Cultivar demonstration

Ten lucerne cultivars (Runner, Force, 57V09, Icon, Supersonic, Fairdale, Stamina, Kaituna, Torlesse and WL363HQ) were each sown in two drill widths leading to plots of 0.17 ha (278 m x 6 m). Seed rate was adjusted for seed weight and germination percentage with the intention of sowing all cultivars at a similar rate to Kaituna at 12 kg/ha. 'Nodulator' was added to all cultivars at 5 kg/ha. Actual sowing rate was calculated by weighing seed in and out of the drill between cultivars.

Plant populations*:* The life of a lucerne stand is dictated by the number of viable plants and plant numbers are at a maximum soon after sowing - thereafter the stand loses plants. Plant populations were assessed on 20 February 2012 and the plant population averaged 129 plants/m^2 (range 80-185 plants/m^2). Seed was sown at 500/m^2 so the 129 plants/ m^2 measured 3 months after sowing meant that only 26% of the seeds sown resulted in viable plants. This is typical with lucerne.

Production data: DM production was measured prior to each grazing by taking 4 quadrats per cultivar. Average production from sowing on 4th Nov to 24th Oct was 11008 kg DM/ha (Stamina). However, the relatively slow establishment phase will under-estimate the potential yield in Year 1. Highest growth rates were 78 kg DM/ha, achieved in Stamina in (Cut 2) and in Force (Cut 7). Highest winter growth rates (15 kg DM/ha/day) were achieved in Supersonic between mid-May and July.



Where to:

- **Cultivar performance:** The cultivar demonstration will continue to monitor disease susceptibility and plant persistence/production under grazing. High performing cultivars in Year 1 may not necessarily be the best performers in subsequent years.

- **Animal performance:** The relatively poor lamb growth rates on lucerne during the establishment phase generated considerable discussion around the merits of including other species into lucerne. This is being investigated by drilling plantain (4 kg/ha) and prairie grass (15 kg/ha) into a small area (0.2 ha) of the lucerne cultivar trial using a triple disc drill.

Summary

- Ten lucerne cultivars were sown to evaluate production and persistence under grazing. The best four cultivars produced in excess of 12 Tonne of high quality DM in a shortened 12 month period (i.e. includes establishment phase).

- Sowing rates of 12 kg/ha amount to 500 seeds/m2. However, this only translated to 130 plants/m2 – a 26% seed survival. This is typical in lucerne establishment.

- Lamb growth rates in the early stages of Year 1 were disappointing at 178 g/d. We suspect that this was the result of a low dry matter content and/or high protein content. However, in spring 2012, lamb growth rates had increased to 261 g/d. By comparison, lambs rotationally grazed on grass/clover grew at 236 g/d. Lucerne delivered not only better growth rates but the combination of higher carrying capacity and better DO% resulted in much greater returns per ha.

- With a return of $1397/ha over a 64 day spring grazing period, Rob is likely to achieve his goal of using lamb finishing on lucerne as a viable alternative to cash cropping

Annual clovers

Data from the East Coast of the South Island (CloverMax FITT Trial) suggests that Persian clover can produce 8 Tonneof dry matter by the end of August from a March sowing – i.e. an average pasture growth rate of 50 kg/ha/day through autumn and winter (albeit from a 90 kg sowing rate). Such a crop should then also fix around 200 kg N/ha –available for any subsequent grass/crop planting. Based on these figures it seemed sensible to evaluate the use of annual clovers as a crop. To do this we need to understand management and production and how they might fit within a farming system.

1. Te Mahanga - Demonstration site

Establishment: Six annual clovers (Table 1) were established in double drill rows (370 m long) in a 5 ha paddock on 28 March 2012. Soil test showed Olsen P levels of 40, Potassium of 7, Sulphate Sulphur of 17 and a pH of 5.7. Prior to cultivation, 150 kg DAP was applied. The area was initially disced and then sown with a 'one pass" rotary cultivator/air drill. Six annual clovers were established in double drill rows (370 metres long). Soil conditions at sowing were moderately wet, resulting in considerable compaction. Germination and initial establishment were generally very slow, with Persian and Balansa clovers having the best establishment. Seedlings appeared vulnerable to paradise ducks, slugs and clover root weevil and the trial was treated with chlorpyrifos (1.2 litres/ha) plus Mesurol on the 24th April.

Table 3. Establishment success (18 May) of annual clovers at Te Mahanga

Clover (species – cultivar)	Vigour score	Establishment success
Sub – Denmark (5 kg/ha)	3	2
Sub – Woogenellup (5 kg/ha)	4	2
Balansa – Bolta (5 kg/ha)	6	9
Arrowleaf – Arratas (5 kg/ha)	3	4
Arrowleaf – Cefalu (5 kg/ha)	5	3
Persian – Turbo (10 kg/ha)	7	10
Persian – Turbo (5 kg/ha)	8	9

Weed control: Volunteer brassica, perennial ryegrass, poa annua, and broadleaf weeds (principally speedwell and chickweed) all compromised establishment in the early stages. This was especially the case in the slower establishing Arrowleaf and Sub clover cultivars. Data from Australia showed that different annual clovers and cultivars were sensitive to different broad leaf weed herbicides and since no NZ data was available, we did our own trial work. This showed that Pulsar followed by Select were the best bets. However, cold weather limited the use of Pulsar at Te Mahanga so Select (3 litres in 200 litres H_20/ha) was applied on the 2nd June. This spraying set back the more actively growing Persian clover by two thirds. Bolta Balansa was slightly less affected than Persian, Cefalu least affected whilst Arrowleaf clover growth was dismal in both sprayed and unsprayed.

Volunteer grass weeds also had to be controlled and we experimented with both Gallant Ultra (250 ml plus 1 litres Uptake/ha) and Arrow (750 ml plus 1 litre Uptake/ha) on the 20th July. Grass spraying (plus warmer weather) resulted in rapid growth of all the clovers. Ground conditions were extremely wet during July and August and the observation was that the poor drainage had compromised the Arrowleaf and Sub clovers. These clovers never actually got moving until ground conditions dried out well into September.

In mid-August, areas of the paddock were fenced off and the block was hard grazed with lambs. The Persian clover scored best in terms of grazing recovery.

Recovery of Persian clover after grazing (photo taken 5th September 2012).

Production*:* The growth of Persian and Balansa clovers was outstanding through August. On the 24th August, Persian and Balansa clovers were cut to assess dry matter production – these were the only clovers worth cutting at this time. Persian clover produced 1542 kg DM/ha (2817 kg DM/ha from a 10 kg/ha sowing) and Balansa clover produced 1561 kg DM/ha – almost all during August. By the 25th September, Balansa had produced 5014 kg DM/ha whereas the Persian clover had produced 3358 kg DM/ha. However, after the 25th September cut, Balansa failed to re-grow whereas Persian grew at 73 kg DM/ha for October and 40 kg DM/ha for November. In total, Persian produced 8381 kg DM/ha whereas Balansa produced 5014 kg DM/ha.

2. Poukawa – Demonstration site

A second demonstration site was set up at Poukawa as a small plot trial with exactly the same annual clovers as sown at Te Mahanga. The trial was established after full cultivation and small (10 x 2 metre) plots were established by hand sowing on the 28th April 2012. These clovers were left un-grazed and on the 9th October, half of each plot was cut to assess for DM production (table 4). Whilst Persian clover showed rapid re-growth after this late cut, other clovers failed to re-grow.

Small plot annual clover during and after cutting on the 9th October

Table 4. Establishment success and DM yield at Poukawa

Clover (species – cultivar)	Vigour scores 23rd September	DM Yield (Single cut 9th October)
Sub – Denmark (5 kg/ha)	3	2697
Sub – Woogenellup (5 kg/ha)	1	905
Balansa – Bolta (5 kg/ha)	10	6429
Arrowleaf – Arratas (5 kg/ha)	6	3547
Arrowleaf – Cefalu (5 kg/ha)	8	3482
Persian – Turbo (10 kg/ha)	7	2313
Persian – Turbo (5 kg/ha)	7.5	2727

3. Poukawa – Persian clover vs annual ryegrass (Moata)

This site was set up to compare animal performance on Persian clover and Annual (Moata) ryegrass. Since Persian clover seems capable of producing 8 Tonne DM/ha through winter and spring, it should also be fixing around 200 kg N/ha. This project also aims to look at the follow-on effects of fixed nitrogen on pasture production in subsequent years.

Establishment: The trial was established in six 1.5 ha paddocks on the 29 March 2012. The paddocks were previously in annual ryegrass and had been sprayed with Roundup. Soil test showed Olsen P levels of 31 and pH levels of 5.7. Prior to cultivation, 150 kg DAP was applied. The area was initially disced and then sown with a 'one pass' rotary cultivator/air drill. Three paddocks were sown in Persian clover @ 5kg/ha and 3 paddocks were sown in Moata @ 25 kg/ha.

Establishment was slow and weeds (speedwell, chickweed, stinging nettle and storksbill) were problematic. Grass weeds were prolific. Weed control solutions were sought from within NZ and Australia. However, advice re broadleaf weed control was not compelling or positive and we undertook our own testing. On the 8th May, four herbicides were used for broadleaf weed control in each paddock (Bladex, Jaguar, Select and Pulsar) along with a control strip of no herbicide). Pulsar caused only very minor damage to the Persian clover. Select was the next best option and Bladex and Jaguar are not an option. On the 2nd June, grass weeds were controlled with Arrow and Gallant. Once

again, a control strip was left in each paddock. Both were effective at removing grass weeds with minimal cover damage.

Table 5. Effect of herbicide on Persian clover at Poukawa

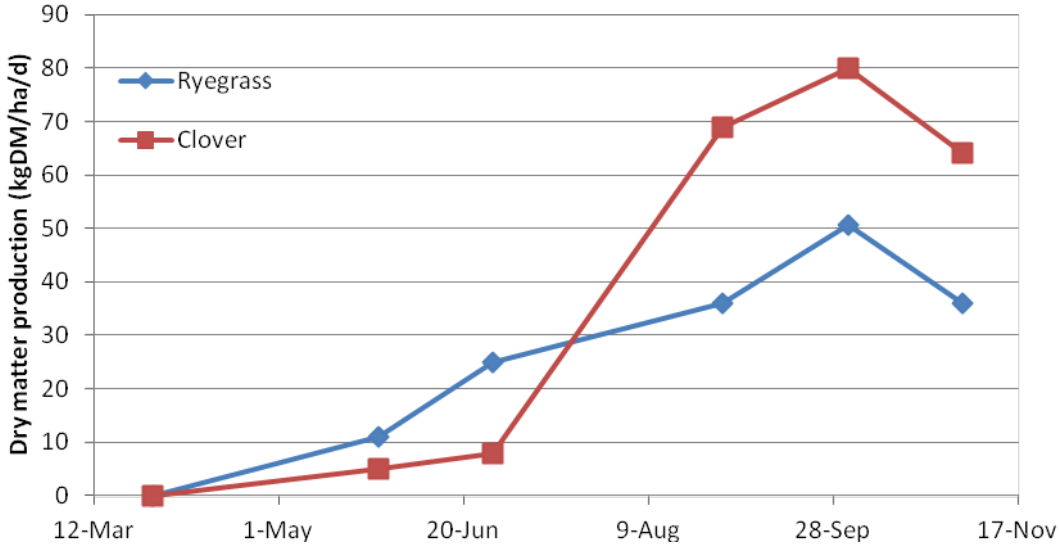
Herbicide	Damage score* (30th May)	Damage score* (18th July)	Clover height (18th July)
Control	0	0.0	160
Bladex	4	5.0	87
Jaguar	8	9.7	30
Pulsar	1	1.0	170
Select	3	2.3	140

*Score of 10 = most damage

Where we undertook no grass control, there was only 23% of the clover that was present within sprayed areas. Both Gallant and Arrow controlled grass weeds effectively and had no apparent impact on the Persian clover. Persian clover in an un-grazed state developed leaf rust (probably *Kabatiella caulivora*) but grazing markedly reduced this problem.

Yields: Annual ryegrass pastures were grazed as necessary and pasture growth rates measured using exclusion cages. By the end of August, annual ryegrasses had been grazed three times and had produced 3545 kg DM/ha while Persian clover which remained un-grazed had produced 3000 kg DM/ha. Persian clover grew at 70 kg DM/ha through August. 'Turbo' the Persian cultivar we used is not known as an early flowering variety so there may be benefits in choosing other varieties. Persian clover continued to grow strongly through spring, with growth rates of 65-80 kg DM/ha/day. On the other hand, Moata performed poorly through spring and only ever peaked at 50 kg DM/ha/day. Persian clover yields to 19th Nov were 8300 kg DM/ha (same as Te Mahanga). By comparison, Moata yields were 6500 kg DM/ha – well below our normal expectations. This may have been a function of a very wet late winter and/or a lack of nitrogen.

Figure 2. DM production of Persian clover and Moata at Poukawa



Animal production: A mixture of late lambing ewes and hoggets were allocated to Persian and Moata blocks and rotationally grazed from early September. Lambs were mostly multiples, with ewes on annual ryegrass rearing 165% lambs and ewes on Persian clover rearing 168% lambs. The intention was that ewes and lambs would not be limited for feed so we could determine the potential growth rates. More ewes and lambs were added to the Persian clover mob and stocking rate averaged 11 ewes/ha (Table 6). On the other hand, stocking rate on the Moata averaged 7.5 ewes/ha. Over a 54 day period grazing period, lambs on Persian clover grew at 349 g/d (lambs on ewes 380 g/d and lambs on hoggets 294 g/d) whereas lambs on annual ryegrass grew at 276 g/d (lambs on ewes 290 g/d and lambs on hoggets 246 g/d). Ewes on the Persian clover put on weight and were 5 kg heavier than their counterpart on the Moata. Ewes and lambs had to be removed from the Moata on the 16th Nov because of poor feed quality.

Table 6. Preliminary lamb grazing results (5th Sep – 9th Nov)

	Moata	Persian
SR - ewes and hoggets/ha	7.5	11.0
LWG of lambs on ewes (g/d)	276	380
LWG of lambs on hoggets (g/d)	246	294
Ewe LWG (kg)	+0.9	+5.9
Lamb LWG (kg/ha)	191	342

Summary

- Each clover crop needs to be chosen to suit site and drainage. All annual clovers like warm dry sites but Persian (and possibly Balansa) seem to be more tolerant than the others. Arrowleaf, in particular, does not like it wet.

- Seedbed preparation is critical and seed should be sown shallow or broadcast followed by a light chain harrow. With a good seedbed, 5 kg/ha seems an adequate sowing rate for Persian clover (Seed cost is $11-$12/kg).

- Young clover crops are sensitive to weeds – particularly to grass weeds which will eventually suppress the crop. Control volunteer grasses first when clover is at the 3-5 leaf stage. Then tackle broadleaf weeds. Early spraying will enable Pulsar to be used whilst it is still warm. Persian and Balansa are more vigorous and may well out-compete broadleaf weeds. The most cost effective herbicide for broadleaf weed control in Persian clover is Pulsar ($62/ha) followed by Select ($46/ha). Select was reasonably kind on Arrowleaf, Balansa and Sub clover. Gallant Ultra ($86/ha) or Arrow ($77/ha) were equally effective in controlling grass weeds.

- Persian clover produced in excess of 8000 kg DM/ha at both Te Mahanga and Poukawa. At Poukawa, Persian out-performed what was by normal standards, a poor Moata crop – this might reflect the very wet late winter and/or lack of nitrogen applied to the Moata (other than DAP at sowing).

- Persian clover responded well to rotational grazing and provided a bulk of high quality feed in early spring. The quality of the feed was evidenced by exceptionally high lamb growth rates (380 g/d in lambs on ewes and 294 g/d in lambs on hoggets).

- Persian clover needs grazing to stimulate growth and reduce the incidence of rust. Work from the Victorian DPI suggests that grazing can occur in autumn and early spring with a rotation length of 30-40 days and a grazing residual of 4-5 cm. In winter rotation length should be 50-60 days with a residual grazing height of 2-3 cm. Fast rotational grazing (3 days on one area) should be practised once clover gets to be 10-15 cm in height.

- Although we have less of an understanding of grazing management of Balansa and Arrowleaf clovers, there may be opportunities to combine a mix of clovers – Persian for early growth and Balansa for mid spring and Arrowleaf for late spring.

- We need to consider the opportunities for combining annual clovers (particularly Persian) with plantain to provide a bulk of high quality feed in late winter and spring.

Plantain at Te Aute

Establishment

Three paddocks (19 ha in total – pH 5.9, Olsen P 30) were sown with different pasture mixes on 24th March, 2012 (Table 6). In each case, the sowing rate of the clover components (white clover, red clover, sub clover) remained the same. Because of the higher ryegrass sowing rate, the amount of seed sown in the ryegrass based pastures was greater (31-33 kg/ha) and more expensive ($300/ha) than the plantain/clover mix (17 kg/ha and $180/ha). Prior to establishment, pastures had been planted in a summer brassica crop (Hunter) and then fully cultivated and sown with a Great Plains disc drill along with 125kg/ha DAP. Fertiliser was applied aerially on the 18/6/2012 (90 kg/ha Urea) and on the 12/8/2012 (200 kg/ha DAP 13S).

Table 6. Sowing rates

	Black Tank	North hill	Duck pond
Treatment	Ryegrass/clover	Ryegrass/plantain/clover	Plantain/clover
Area	7.8	5.8	5.4
Sowing rates (kg/ha)			
Ryegrass – 'Extreme AR37'	20	20	
White Clover – 'Nomad'	2	2	2
White Clover – 'Tribute'	1	1	1
Red Clover – 'Tuscan'	2	2	2
Sub Clover – 'Denmark'	6	6	6
Plantain – 'Tonic		2	6
Weight seed/ha	31	33	17
Cost seed/ha	287	309	181

Pasture growth rates

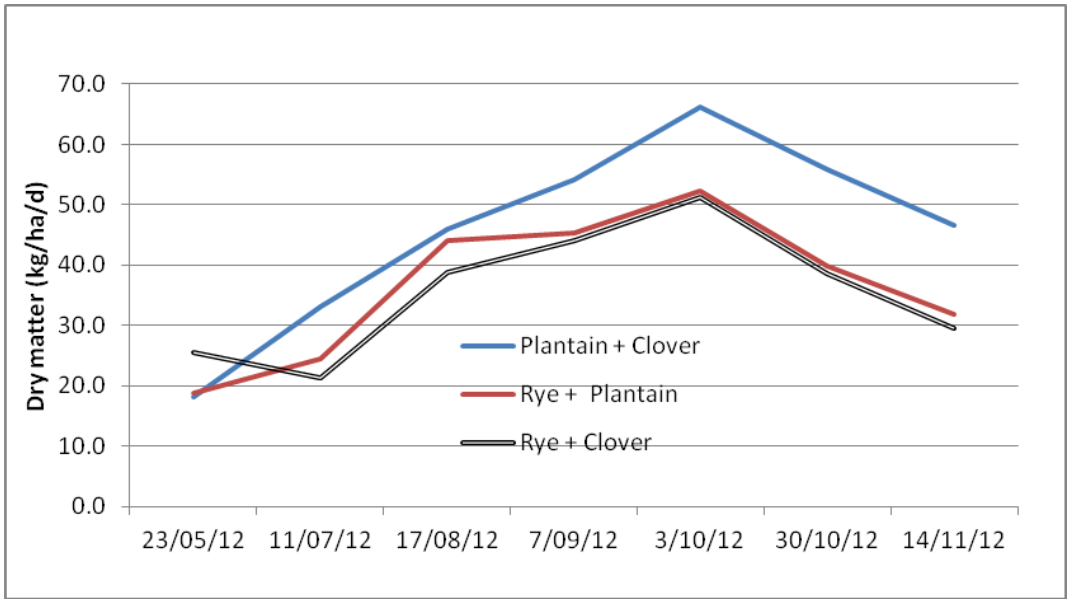
With the exception of the early establishment period, plantain based pastures have out-yielded the ryegrass based pastures. From 24th March (sowing) to the 1st October, plantain/clover pastures produced 22% more DM than the ryegrass based pastures (9477 vs 7787 kg DM/ha). The plantain/clover pasture consistently had a lower dry matter percentage (~14%) than the ryegrass based pastures (~20%), making visual estimates of pasture dry matter more difficult.

Despite being sown with the same amount of clover, the plantain/clover pasture had more clover through spring (32% on a DM basis) whereas the ryegrass/clover pastures had 20.6% clover and the ryegrass/plantain/clover had 6.5% clover. Plantain comprised 65% of the sward in the plantain/clover pasture, but it only made up 10% of the ryegrass/plantain/clover sward. This suggests the 20 kg ryegrass sowing rate has negatively impacted on both the clover and plantain.

Table 7. Pasture growth data (sowing to 14th Nov)

	Ryegrass/clover	Ryegrass/clover/plantain	Plantain/clover
DM%	20.2	19.5	13.9
DM (kg/ha)	7749.0	7826.0	9477.0
Growth (kg DM/d)	36.3	36.7	45.7

Figure 3. Te Aute DM production (23/5 – 14/11)



Lamb performance

A lamb grazing trial was started on the 18th July and finished on the 1st October. Each paddock was fenced into a grazing rotation with three wire electric fences. Lambs with an average LW of 33.4 kg were drenched and tagged. Additional lambs were added on the 10th August and again on the 5th September to control pasture growth. For this reason, yearling bulls were added to each farmlet on the 14th Sept (Table 8).

Lambs over 48 kg were drafted for slaughter on the 5th Sept and 1st Oct and all lambs were scored for dags. The criteria used was "would they have to be dagged if they were being sent for slaughter". There was evidence that lambs grazing plantain/clover appeared to have fewer dags, with an average of 22% classed as dirty compared to 32% of lambs grazing the ryegrass based blocks. In general, lambs grew faster (321 vs 240 g/d) over the first grazing period (18/7 – 5/9) than over the second grazing period (5/9 – 1/10). However, lambs on plantain grew consistently faster and over the 73 day trial period grew at 273 g/d compared to 220 g/d for the ryegrass based blocks. As a result, more lambs were drafted for slaughter off the plantain/clover block at both the first and second kills.

There were also significant differences at slaughter, with lambs off plantain having a higher dressing out percentage (47.3%) versus 45.5% for lambs off ryegrass based pastures. This happens on highly digestible feeds with a faster rate of passage resulting in reduced rumen contents. The end result was that lambs on plantain had significantly heavier carcass weights.

Over the 75 day trial period (18/7 – 1/10), the combination of higher liveweight gains and higher dressing out percentage meant that lambs on plantain/clover produced 222 kg of carcass weight/ha compared to 181 kg for lambs on ryegrass/clover and 156 kg/ha for lambs on ryegrass/plantain/clover. At $5.50 per kg carcass, this meant an advantage of $291/ha for plantain/clover pastures over the ryegrass based farmlets.

Table 8. Lamb performance

		Ryegrass/clover	Ryegrass/plantain/clover	Plantain/clover
18/7/12	Start at start	93	67	63
10/8/12	Lambs added	81	62	57
5/9/12	Lambs added	109	89	88
14/9/12	Bulls added	10	6	10
For a 75 day grazing period from 18/7 and 1/10				
Grazing days (number/ha)		1734	1741	1722
Stocking rate (lambs/ha/day)		23.1	23.2	23.0
Lamb growth rate (g/d)		233	205	273
Total lamb LWG/ha (kg)		403	357	471
Average dressing out %		45.0	43.9	47.2
Average carcass weight (kg)		22.3	21.8	23.5
Increase in carcass value/ha ($)		$997	$862	$1223

Summary

- Plantain pastures were established at a lower seed cost ($100/ha cheaper)
- High sowing rates of ryegrass appeared to suppress plantain and clover growth.
- If a mixed pasture is desired, the challenge will be to establish the optimum mix of grass and plantain so that plantain and clover are not suppressed.
- Apart from a short period during the establishment phase, plantain based pastures produced more DM at each cut. From sowing to 14th Nov, plantain based pastures produced an additional 1670 kg DM/ha.
- The growth habit of plantain appears to encourage clover growth
- In spite of more DM and higher clover contents, stocking rates were similar. It appears the higher production and quality of plantain/clover simply enabled higher feed intakes and better liveweight gains.
- As well as having higher liveweight gains, lambs on plantain dominant pastures had a higher dressing out percentage, resulting in extra carcass weight per ha. This double whammy of better liveweight gain and a better DO% meant a $290/ha advantage over a 75 day grazing period.
- With plantain, the big unknown will be on-going productivity and persistence and a change in thinking around weed control.