

The role of lucerne and plantain on the East Coast of the North Island

Results of the Future Forage Systems Project (2011-2017)



Funded by Sustainable Farming Fund

Ministry for Primary Industries
Manatū Ahu Matua



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We also wish to pay a special tribute to Malcolm MacFarlane who passed away in April 2016 and who was instrumental in carrying out much of this work.



Background

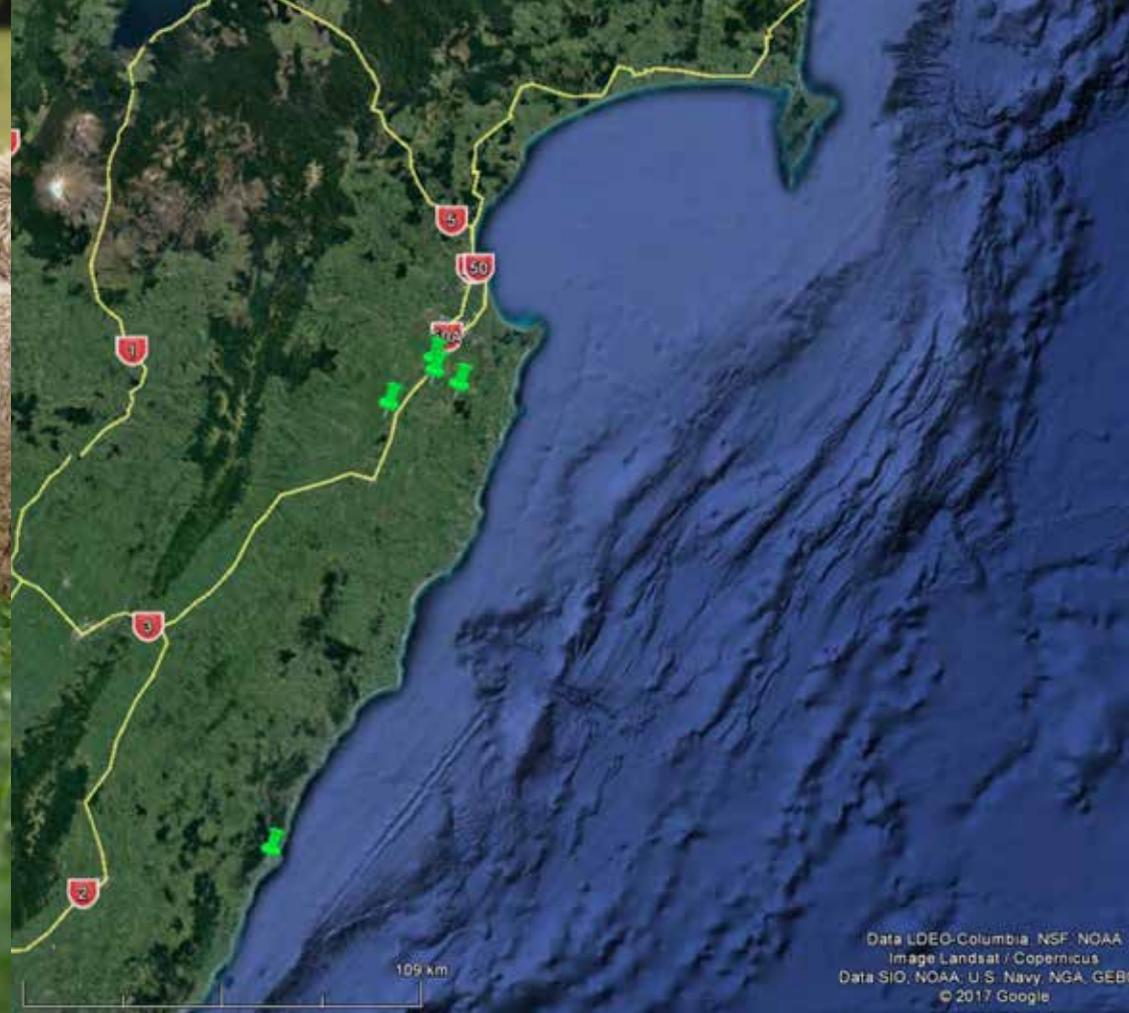
The future forage systems programme was set up to identify plants and management systems which could be game changers for East Coast dryland. Funded by MPI's Sustainable Farming Fund, B+LNZ and the Hawkes Bay Regional Council, data was collected on pasture yield, animal performance and management of lucerne and plantain across a range of environments on the East Coast. This comprehensive information was then used to model the effects of incorporating these species within a realistic East Coast farming system. There is a large amount of detailed information available on these crops and this booklet aims to provide a summary for farmers considering their pasture related options. More detailed information on establishment, management and weed control is available as fact sheets which can be downloaded from www.nzforagesystems.co.nz. More information on lucerne management is also available on the www.lincoln.ac.nz/dryland website.

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Lucerne

Lucerne is a perennial plant that stores its reserves in the crown and roots. These reserves are used for regrowth after each grazing and following winter dormancy. Managing these root reserves via rotational grazing is a key to stand longevity. Lucerne is expensive to establish but in the right location and under good management, stands can last more than 10 years. With a deep tap root, lucerne can extract water from a much greater depth than pasture and lucerne plants can also use the available water more efficiently than pastures. Lucerne needs to be rotationally grazed, with a rotation of around 6 weeks. It needs to be spelled through the winter when it is largely dormant. There is a period of rumen adjustment when animals are first introduced to lucerne.

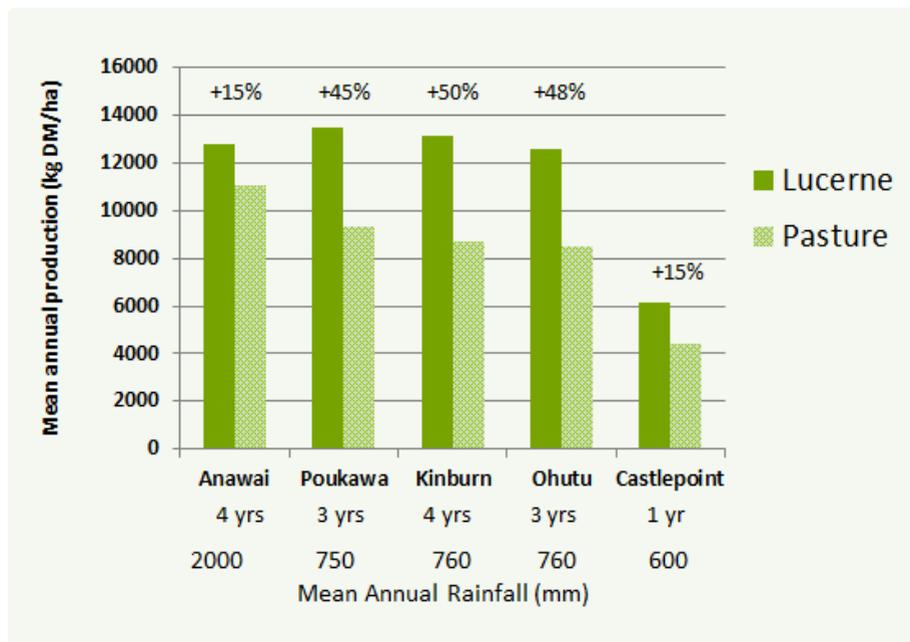


Lucerne - yields

Yield data was collected on established lucerne stands on five properties from Hawkes Bay to Wairarapa across a number of contrasting years (2010-2016). On each farm, dry matter production was also measured on a nearby paddock of resident pasture. Across four of the properties, the lucerne yields were remarkably similar - the biggest differences came in the yield of the resident pasture (Figure 1). For example, Anawai in the Maraetotara had a relatively high rainfall (2000 mm) but was still considered prone to periods of summer dry. Over four years, lucerne at Anawai produced a modest 15% more DM than resident pasture - the main reason being that, on average, a higher summer rainfall contributed to a relatively high pasture production. On the other hand, Poukawa, Kinburn and Ohutu are more typically "summer dry" with around 750 mm and on these properties lucerne generated an advantage over resident pasture of 40-50%. At Castlepoint, a low yielding lucerne stand was near the end of its life and the year in which measurements were made was extremely dry (~ 600 mm rainfall). Nevertheless, it still out-produced resident pasture by 40%.

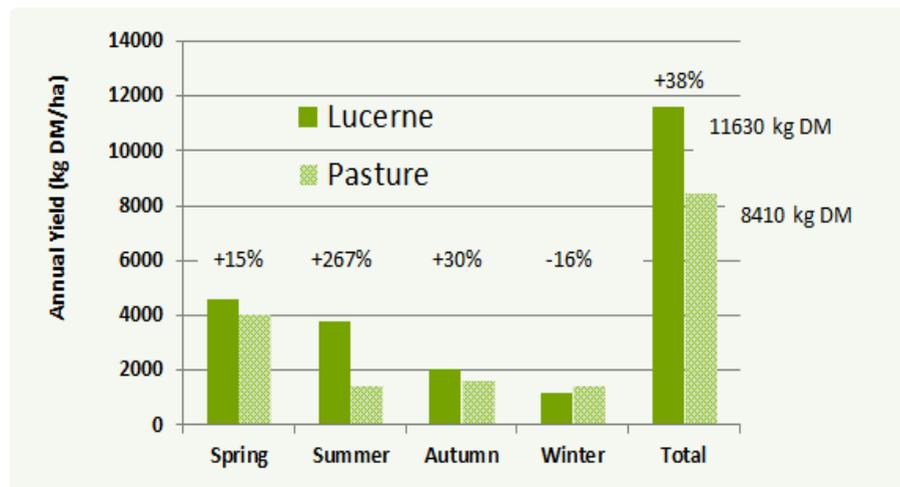


Figure 1. Lucerne and resident pasture yields across five East Coast properties.



Across all five properties and a total of 15 “measurement-years”, lucerne out-yielded resident pasture by 38% (11,600 kg DM/ha vs 8,400 kg DM/ha). Lucerne also out-yielded pasture in 3 of the 4 seasons - by 15% in spring, 167% in summer and 30% in autumn. Lucerne’s tap root and more efficient use of available water contributed to its significant advantage in summer. However, in winter, lucerne growth rates were 16% lower than pasture growth rates. It is worth noting that North Island East Coast properties are typically warm enough to deliver winter pasture growth rates of 10-20 kg DM/ha/day and this is a point of difference with lucerne growing areas which typically have low winter pasture growth rates. Whilst the increased summer yield can be beneficial in terms of finishing weaned lambs, the lower winter growth and the need to de-stock lucerne over winter and early spring can make managing early spring feed supply difficult. This is especially so for properties with early lambing ewes and targeting early season premiums.

Figure 2. Seasonal yields of lucerne and resident pastures across five East Coast properties



Lucerne - animal performance

Across five trials where lactating ewes were grazed on both lucerne and pasture, lambs grew 15% faster on lucerne (285 g/d) than on pasture (248 g/d). In general, lamb growth rates on lucerne do not appear to match the apparent quality of feed on offer. This is because rotational grazing needs to be employed to optimize lucerne production. When stock are put on a new lucerne break they are consuming a high energy ration - around 12 MJME/kg DM. However by the end of their break they are eating stalk (around 9 MJME/kg DM). So on average they are eating a diet of 10.5 MJME/kg DM which may not be all that different to ewes and lambs set stocked on spring pasture. We tested this by set stocking lambs for 9 weeks over summer on an old lucerne stand. These lambs were able to graze on newly growing shoots and grew at an average of 430 g/d. The optimum lucerne stand management in spring is probably to move ewes and lambs through to graze leaves and follow up with an appropriate class of cattle to graze the stalks. However, few farmers want to take on the extra complexity of management that is involved with this strategy.

On three trials where weaned lambs were grazed on lucerne, average liveweight gains were 178 g/d compared with 82 g/d on resident pasture. The lamb growth rates on summer lucerne were reasonably consistent but the performance on the summer pasture was highly variable due to variability in quality of summer pasture.

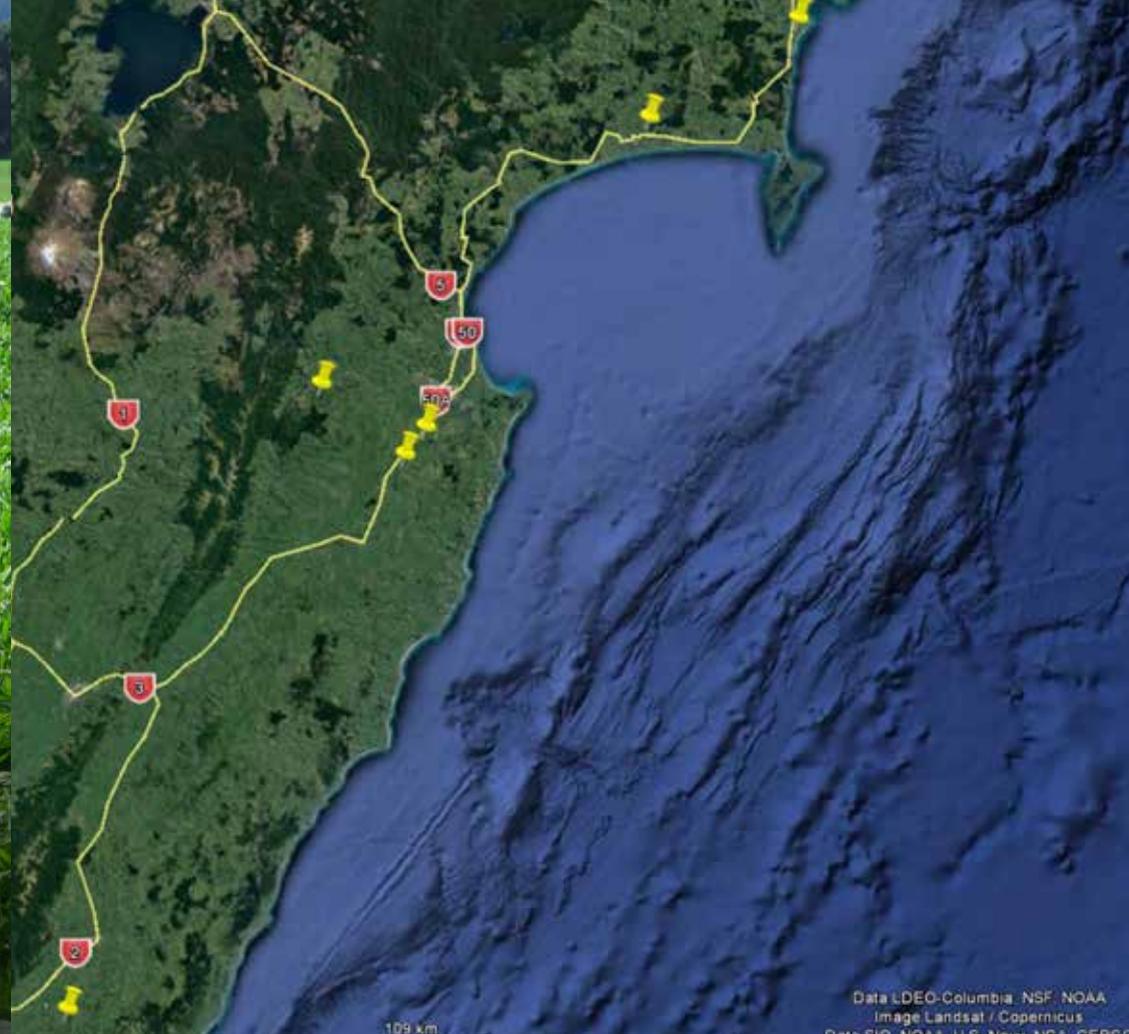
Pre-weaning lamb growth rates on pasture and lucerne	Pasture (g/d)	Lucerne (g/d)	Advantage to Lucerne
Lambs on ewes (5 trials)	248	285	+15%
Weaned lambs (3 trials)	82	178	+117%



Plantain

Plantain is not a replacement for ryegrass – rather it is a high performing short term crop which typically lasts 2-3 years. As with other crops, care is needed to get the best out of it. Plantain performs best when sown only with clover. It does not compete well with grasses and best practice is to spray out grasses and weeds post establishment. Although it has both tap and fibrous roots it is less tolerant of drought than chicory, red clover and lucerne. Managing grass invasion and pests (particularly plantain moth and slugs) is essential to maintaining a healthy plantain stand.

Grazing management is critical to maintain a healthy plantain based sward. Plants are first grazed when there are six fully developed leaves (20-30 cm). Grazing earlier reduces overall persistence as root reserves are insufficiently developed. Don't overgraze. Best practice is rotational grazing down to just 8 cm. Plant density is decreased by repeated hard grazing. A typical rotation is six paddocks of 2 ha each.



Plantain - yields

Plantain yields were measured across six East Coast North Island properties from Wairarapa to Gisborne. In each case, pasture growth rates were measured from resident pasture on neighbouring paddocks of similar contour. Yield data was collected from all 6 properties for Year 1 and 2 but data from Year 3 is currently only available from 2 properties. In the first two years after sowing, production was variable across the six sites but showed a clear advantage to plantain – around 29% more total DM. At Wairoa, a high fertility and high rainfall site produced 11 t/ha more in the plantain clover mixture over the two years than the resident pasture. The smallest gain was in Martinborough with just 3.1 t/ha advantage to plantain over two years. In very dry environments, plantain is only lasting two years but where summers are less harsh, plantain is lasting for three years or longer. The best approach appears to regard plantain as a two year crop in summer dry areas. Any more than that is a bonus.

Figure 3. Yields of plantain and resident pasture over three years.



Figure 4. Yields of plantain and resident pasture in two years after sowing on six East Coast properties.

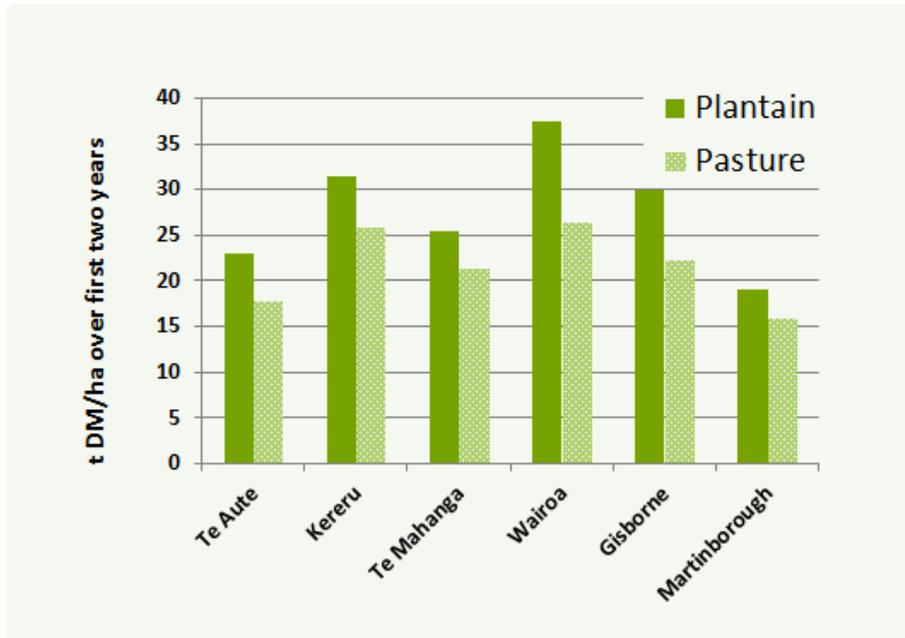
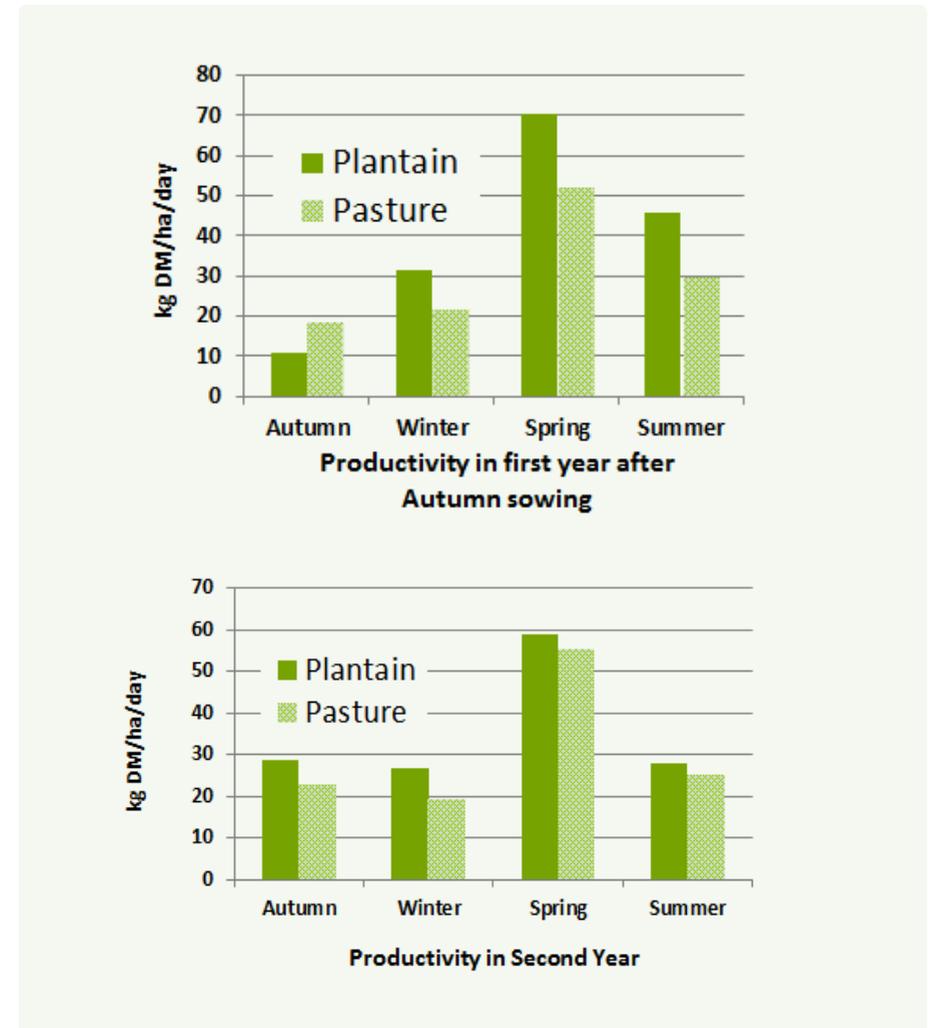


Figure 5. Seasonal yields of plantain and resident on six East Coast properties in the two years after establishment.



Across the six farms monitored, average production was lower for plantain than pasture in the first autumn because on two farms, late autumn rains meant slow growth of establishing plantain. Otherwise seasonal yields indicate that plantain produces more dry matter than resident pastures in each season of the first two years. Tonic plantain was the cultivar used in all the farms in this study.



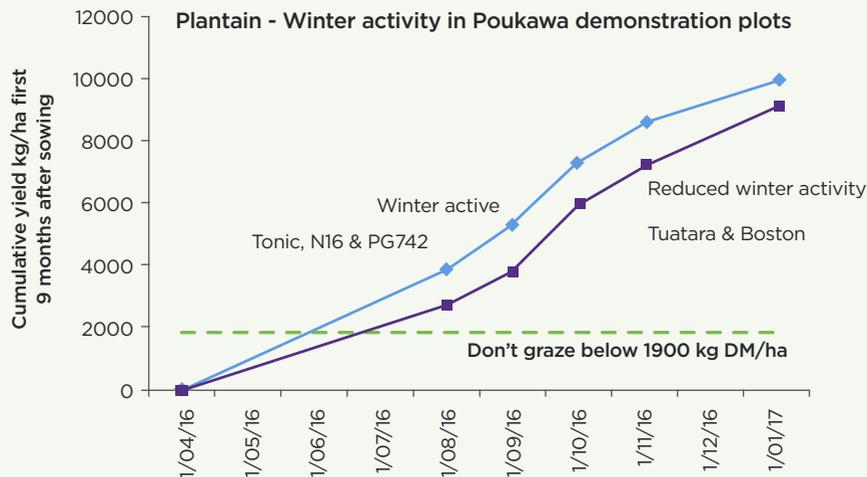
Plantain can produce good winter growth rates, with average growth rates of 30 kg DM/ha/day through the first winter. By comparison resident pasture averaged 20 kg DM/ha/day. These good winter growth rates are dependent on using a winter active cultivar - note that there are several cultivars on the market which are effectively winter-dormant. The photos above were taken in mid-August after autumn sowing and show cultivar differences. These winter dormant cultivars produce less winter feed - around 2 t DM/ha less from sowing to by mid-August. Whilst these cultivars are also later flowering but in summer dry conditions this has not translated into better or extended spring/summer growth.

Plantain is a very good companion crop for clover. In newly sown ryegrass/white clover pastures, clover content in spring only makes up around 5% of total DM during spring because ryegrass competes for the available water, nutrients and light. When the same clover rates are sown with plantain, spring clover content is typically 25% of DM. Plantain is less competitive and the architecture of the plantain plant allows clover to express itself. We recommend sowing annual clovers (Persian clover and balansa clover at 3 kg/ha each) along with white and red clover as this lifts spring legume content to around 45% of total DM in the first spring. Both these erect annual clovers grow vigorously under the North Island East Coast spring conditions.

Plantain is a high value crop and it deserves the highest returning sheep enterprise - this could be lambing hoggets where the better feeding on plantain will enable earlier weaning and heavier two tooth ewes at mating. Another option is to graze one year ewes, particularly those with multiple lambs. At weaning, plantain fed ewes can be drafted early and for a premium at good carcass weights. Furthermore a higher percentage of lambs can be drafted for slaughter when compared with standard grass based systems. Across 11 trials with lambs reared on both ewes and hoggets, lamb growth rates on plantain have been consistently higher (324 g/d), than in lambs reared on pasture (272 g/d).

Post-weaning, lambs can be put back on plantain with no check in growth rate. Lambs off plantain have a consistently higher dressing out percentage (DO%) off plantain (around 2.3% higher). This is because plantain is a high quality feed with a faster rate of passage so rumen contents are reduced when compared with pasture fed animals. This means that a liveweight of 36 kg, lambs off pasture will have a carcass weight of 16.4 kg whereas at the same liveweight, those off plantain will have a carcass weight of 17.2 kg. Better growth rates and DO% enable either lighter drafting weights or heavier lamb carcass weights. The end result is significantly more lamb carcass weight drafted at weaning.

Ewes also perform extremely well when fed on plantain pastures. In seven trials, ewes and hoggets on plantain were an average of 7.2 kg heavier at weaning than those grazed on pasture. This extra liveweight at weaning has a significant impact on subsequent mating performance the following year. Ewes have an even higher DO% - a gain of 3.4%. This is a compelling reason for grazing one year ewes with twins on plantain and then killing the ewes and most of the lambs in November, when premiums are available and well before the main lamb kill pressure gets underway at processing plants.



Ewe weight gains during lactation on pasture and plantain	Pasture (kg)	Plantain (kg)	Advantage to Plantain
Ewes (4 trials)	67.6	76.0	+8.4
Hoggets (3 trials)	57.1	61.8	+4.7
Overall	64.5	71.7	+7.2 kg

Lamb growth rates on pasture and plantain	Pasture (g/d)	Plantain (g/d)	Advantage to Plantain
Lambs on ewes (8 trials)	289	341	+18%
Lambs on hoggets (3 trials)	229	280	+22%
Overall	272	324	+19% (+52 g/d)

Developing the model

A Farmax model was developed by AgFirst Hastings using data provided by the B+LNZ Economic Service for a typical summer dry hill block. The data is collected from 18 farms and represent 975 Class 4 farms on the East Coast of the North Island. The hypothetical farm is 495 ha, 50 ha of which is flat and used for silage and/or winter crop. Average DM produced from the flats is 9,372 kg DM/ha. The farm carries 2,800 breeding ewes and 860 hoggets. No hoggets are mated. Only 8% of lambs are drafted at weaning and the remaining lambs are finished through summer at average carcass weights of 16.1 kg. Cattle make up 40% of the stock units with 90 breeding cows and steers finished at 2.5 - 3 years. 108 weaner bulls are purchased in summer and autumn and sold at 2.5 years. Using average beef and lamb prices for 2016, the base model shows a gross margin of \$360,266 or \$728/ha.

Incorporating lucerne into the base model

For this exercise the 50 ha flat block was assigned to lucerne within the base model. The lucerne was assumed to have a 7 year life span. Lucerne stands were followed by annual ryegrass in autumn followed by spring sown lucerne. Thus, the farm has 6.25 ha in new lucerne, 37.5 ha in established lucerne and 6.25 ha which has come out of lucerne and is in annual ryegrass. Data on yield and animal performance was as measured across a number of East Coast properties. Lucerne was only grazed by sheep and had no impact on cattle policy or returns.

- Lucerne is spring sown and produces 9.8 t DM/ha in the establishment year and 12.9 t DM/ha in subsequent years with a drop-off to 10.3 t DM/ha in Year 7.
- 610 one year ewes and their lambs are rotationally grazed on lucerne between docking and weaning.
- Compared to the pasture in the base model, lambs grow 15% faster on lucerne during lactation and 117% faster over the summer.
- The model assumes a ewe death rate of 6%, increasing to 6.5% in the lucerne model. Lamb death rate of 2% increases to 4% when grazing lucerne.

Results with lucerne in the model

The higher DM production and better animal performance combined to increase gross margins by \$144/ha across the whole farm by having a well-managed lucerne block on the better country. This added \$71,400 to the bottom line for this type of farm.

- The extra feed available from the lucerne block means that it acts as a force multiplier across the rest of the farm. With more feed available to other ewes on the farm their liveweights increase from 60 kg to 68 kg over time. This results in lambing percentage increasing from 123% in the base model to 135% in the plantain model.
- Lambs are heavier at weaning and more lambs are drafted FOM (from 8% in base model to 14% in the farm with lucerne). Overall lamb carcass weights increased from 16.1 kg in the base model to 17.9 kg in the status quo lucerne model.
- The heavier lamb weaning weights enabled 440 hoggets to be mated (60% weaning). The combination of heavier ewes, a higher lambing % and hogget mating meant 335 more lambs for sale.
- Spring sown lucerne gives the best establishment but there is a risk of failure with spring sown lucerne in an early and extended summer dry.
- Lucerne is expensive to establish and maintain so needs to be grazed with the highest returning class of stock - ewes with twins or hoggets rearing lambs.
- Lucerne requires a change in thinking and specialised management around establishment, weed and pest control and stock management.



Results with plantain in the model

The higher DM production, better animal performance and better DO% combined to increase gross margins across the whole farm by \$200/ha for both 2 and 3 year old plantain. This added \$100,000 to the bottom line when plantain was incorporated into this type of farm

- Plantain decreased on-farm risk with more stock drafted before summer, with 37% of lambs FOM.
- Cull ewes are slaughtered off plantain in November at heavier carcass weights and a higher price (+\$36/head).
- The extra feed available from plantain meant the 50 ha cultivatable block became a force multiplier for the rest of the farm. More feed was available to other ewes on the farm and their liveweights increased from 60 kg to 68 kg over time. The increased liveweights mean that lambing percentage increased from 123% in the base model to 135% in the plantain model.
- Ewe lambs were heavier at weaning and this allowed some hogget mating to occur. The combination of heavier ewes, a higher lambing % and hogget mating meant around 500 more lambs were available for sale.
- Plantain crops are expensive to establish and maintain so they need to be grazed with the highest returning class of stock – e.g. ewes with twins or hoggets rearing lambs. One year ewes rearing multiples are a particularly good fit with plantain – ewes can be slaughtered at weaning at heavy weights and premium prices. A significant number of lambs can be slaughtered off the plantain and the remainder can be put back on plantain and finished without a weaning check.
- Plantain is not a substitute for ryegrass and needs to be viewed as a 2 or possibly 3 year crop. Successful plantain management requires a change in thinking and specialised management around establishment, weed and pest control and stock management.
- Plantain is suited to summer dry areas with winter growth potential but choose winter active cultivars.

Assumptions	Base model	3 yr plantain	2 yr plantain	Lucerne
Ewe liveweight (kg)	60	68	68	68
Ewes mated	2800	2600	2600	2600
Hoggets mated	0	440	440	440
Lambing %	123%	135%	135%	135%
Lambs drafted FOM at weaning	8%	37%	37%	14%
Number of lambs sold	2,585	3,076	3,017	2,919
Average lamb carcass weight (kg)	16.1	18.6	19.0	17.9

Financial results (status quo)	Base model (\$)	3 yr plantain (\$)	2 yr plantain (\$)	Lucerne (\$)
Sheep (Sales - purchasers)	232,347	345,004	352,682	302,420
Wool	70,285	66,519	64,434	69,451
Beef (Sales - purchases)	212,860	212,860	212,860	212,875
Total revenue	515,492	624,383	629,977	590,746
Conservation	6,000	0	0	4,500
Forage crops	9,619	12,406	16,515	5,625
Establishment/spray etc	0	19,195	22,249	11,250
Extra fertiliser	0	1,167	1,040	1,567
Re-grassing	4,800	0	0	0
Nitrogen	12,281	14,381	13,634	9,946
Total crop, feed, N & extra fertiliser	32,700	47,149	53,438	32,888
Stock costs - animal health	24,419	23,031	22,925	23,164
- shearing	33,043	28,656	27,941	30,799
Interest on capital (livestock & feed)	77,414	77,723	77,539	78,594
Total variable expenses	167,576	176,559	181,843	166,425
Gross margin	347,916	447,824	448,134	419,320
Gross margin per ha	703	905	905	847



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