

# Future Forage Systems Project

## Plantain Hub Notes Update Te Mahanga, 1<sup>st</sup> October 2015

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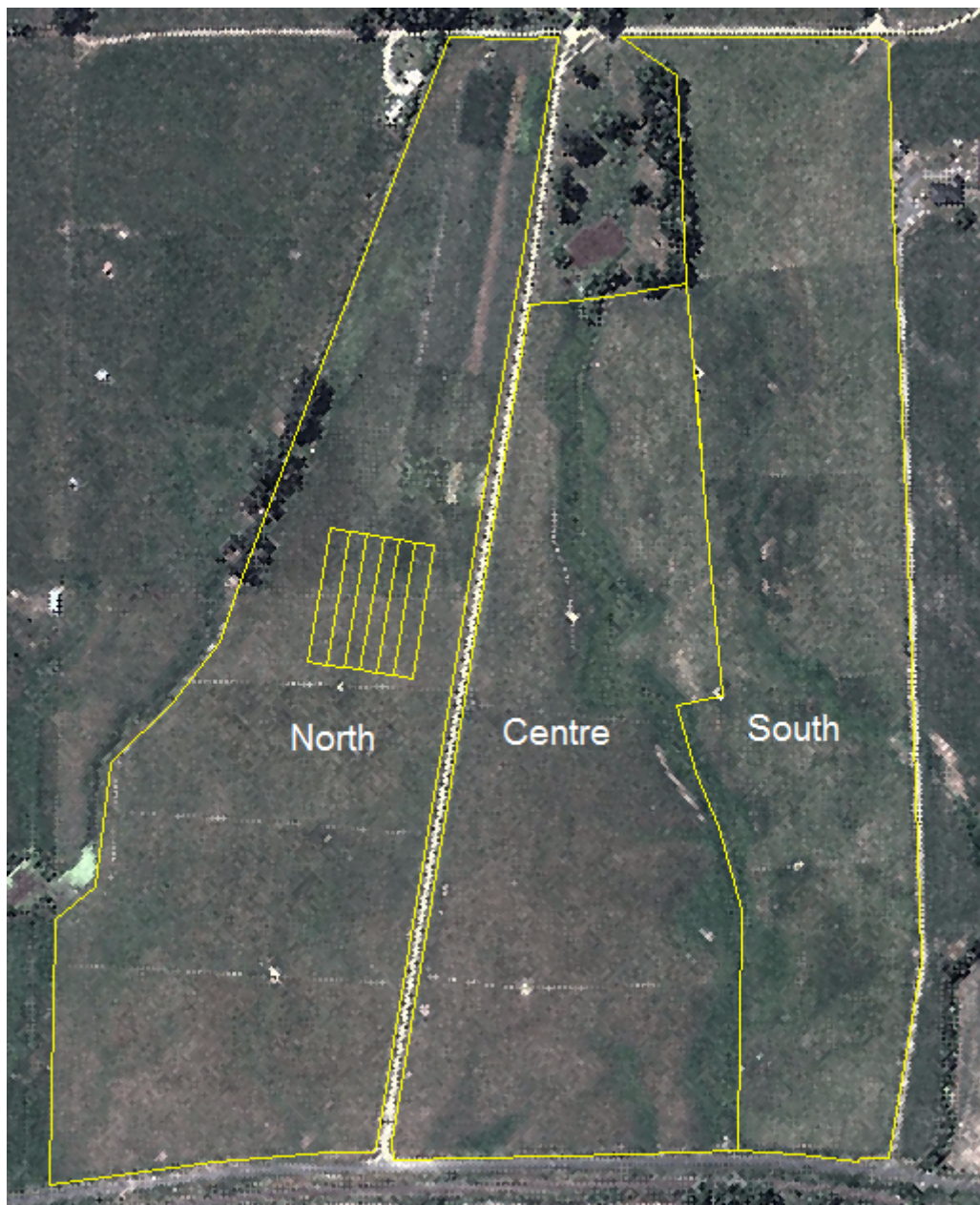
**Plantain and annual clovers with trade lambs in September at Te Mahanga**

### *Future Forage Systems - Background*

The East Coast Future Forage Systems Project provides the opportunity to road-test a range of forage technologies such as lucerne, plantain and annual clovers – both as crops and on hill country. 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.

The focus at Te Mahanga is to provide high quality feed for winter/spring lamb finishing

**Figure 1. Paddock layout and trial plot location**



### *Te Mahanga – 40.1 ha*

#### *Objectives:*

1. Evaluate production and animal performance (lamb growth) on plantain/clover
2. Evaluate role of annual clovers with plantain under grazing
3. Develop management systems for annual clover re-seeding

#### *Establishment*

The area was in annual ryegrass for the previous two years. On in early December 2013 cultivation commenced with spraying out of resident pasture (see timeline for full establishment details).

### *Fertiliser*

- **February 2013** - Lime application: Centre (pH 5.1) & South (pH 5.2) had agricultural lime 6 t/ha, North (pH 5.5) received 4 t/ha agricultural lime
- **Pre drilling April 2013** - Central & South 125kg/ha DAP, North Cropmaster 20 (N (19.3%), P (10%) & S (12.5%) at 125 kg/ha

### *Seed*

#### **Base mix**

- 6 kg/ha Tonic Plantain
  - 3 kg/ha "Tuscan" Red clover
  - 3 kg/ha 'Bolta' Balansa clover
  - 3 kg/ha "Lightning" Persian clover
  - 1.5 kg/ha 'Nomad' White clover
  - 1.5 kg/ha 'Tribute' White clover
- Total 18 kg/ha**

### *Timeline*

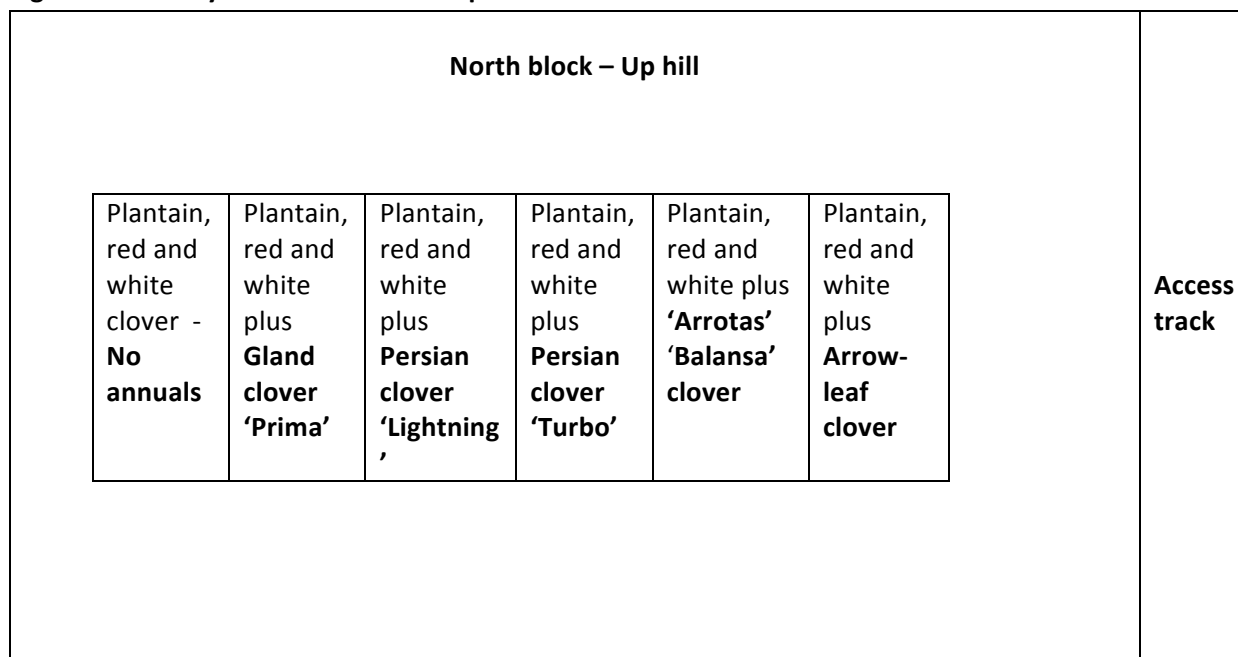
- **12 December 2012** – Glyphosate applied
- **13 January 2013** – Deep ripped twice, 2nd pass on angle
- **Early March 2013** – Discd and levelling bar before drilling
- **19 April 2013** – Centre sown with 6 metre air roller drill
- **25 April 2013** – North sown (including "Trial area")
- **26 April 2013** – South sown
- **5 June 2013** – Counts of established plantain and clover seedlings.
- **August 2013** – Rotational grazing of block commenced.
- **Autumn 2014** – seed collection

### *Experimental Area*

Whilst most of the area has been sown in the base mix a trial area of 0.4 ha was been sown in North with a range of annual clovers.

- A. 6kg/ha 'Bolta' Balansa clover (extensive root system) with plantain and white/red clover
- B. 6 kg/ha 'Lightning' Persian clover (tolerant of waterlogging) with plantain and white/red clover
- C. 6 kg/ha 'Turbo' Persian clover (tolerant of waterlogging) with plantain and white/red clover
- D. 6 kg/ha 'Arrotas' Arrowleaf clover (suited to summer dry) with plantain and white/red clover
- E. 6 kg/ha 'Prima' Gland clover (very early maturing) with plantain and white/red clover
- F. No annuals – Plantain and white/red clover only

**Figure 2 - Plot layout within northern paddock**



***Closing dates to enable re-seeding:***

- Early close – early October
- Mid close – early November
- Later close – early December
- No close

When seed heads are mature they were collected and seed extracted. Total seed production and hard seededness was measured.

***Measurements***

- Plant counts 4-6 weeks from emergence
- Seedlings at 9 weeks/plant numbers before first grazing
- Number of seed heads, seed set and percentage of hard seeds
- DM production cuts over 3 years and contribution of plantain, clovers and grass to production
- Animal performance over Year 1

***Results***

**Seedling establishment** – High numbers of plantain and clover seedlings were successfully established across the block and within the trial plots (Table 1). Sowing rates were not adjusted for differing seed weights or germination percentage of each clover. Differences in the percentage of viable or soft seed of each clover and seed size are most likely to have caused the variations seen in the numbers of seedlings establishing for each plot. Seedling numbers of 150 plants/m<sup>2</sup> are considered very good establishment rates for plantain.

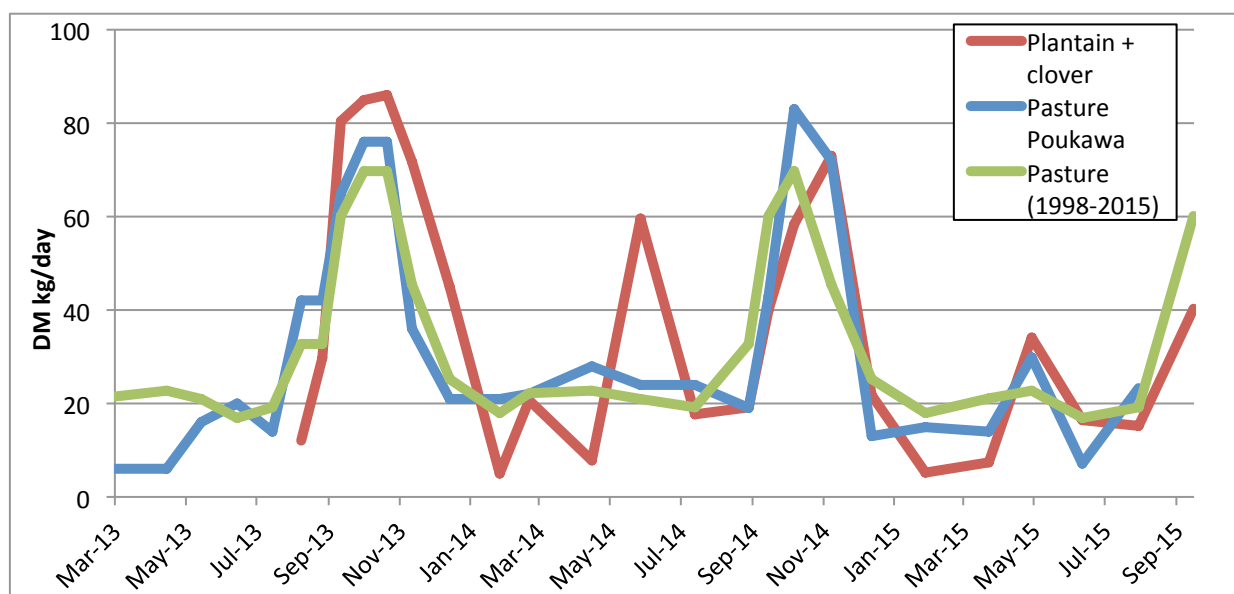
**Table 1. Seedling establishment 6 weeks after sowing**

Plot	Clover	Seedlings per m <sup>2</sup>	
		Plantain	Clover
A	No Annuals	151.6	400.4
B	Gland	149.3	395.6
C	Arrowleaf	172.4	381.8
D	Persian – Bolta	147.6	411.1
E	Persian – Lightning	184.4	344.0
F	Balansa	152.0	276.7
Paddock		174.7	489.3

**Lessons/observations to date:**

- Broadcasting clovers and plantain on to a prepared seedbed, followed by light tyre rolling was very effective in establishing both clovers and plantain.
- Competition from weeds and grasses was minor due to the well prepared seedbed.
- Some clover death has occurred in wetter areas.

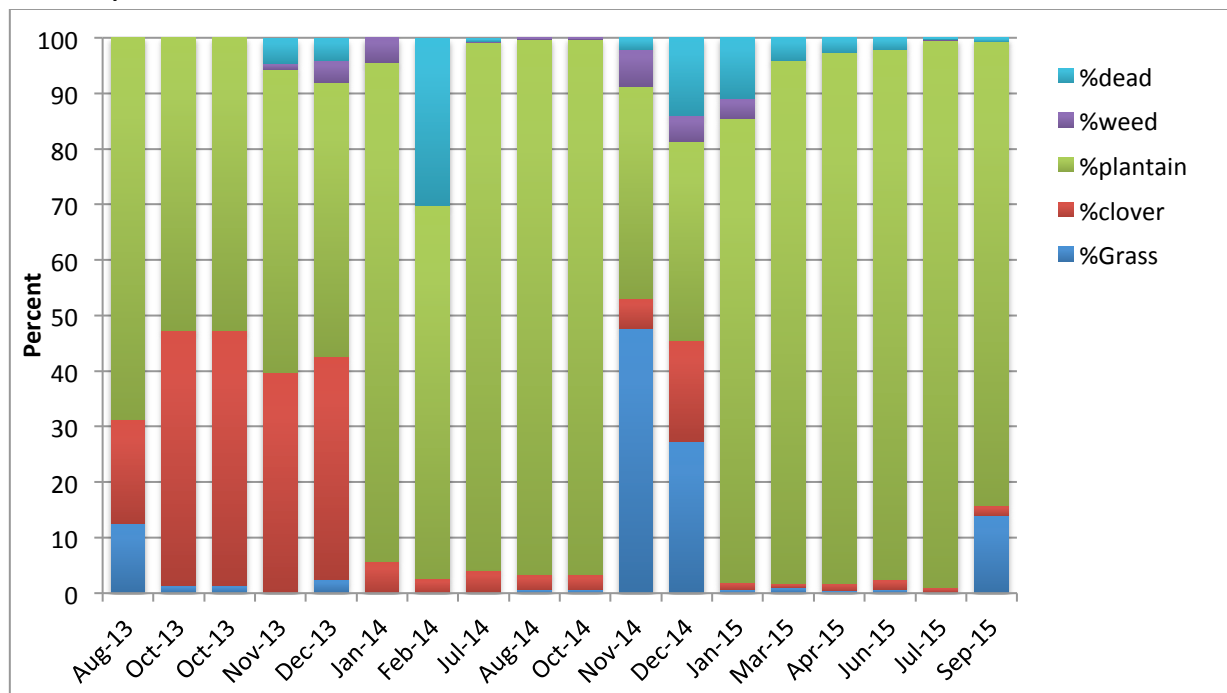
**Figure 1. Te Mahanga Dry Matter production (2012 –2015)**



In the first two years plantain/clover (April 2013 - April 2015) produced 25831 kg DM/ha while grass as Poukawa produced 22398 kg DM/ha over the same period. Growth rates were the highest in early September 2013. Following a dry winter and cold early spring the growth rate of plantain/clover in mid September 2015 was 40 kg DM/ha/day.

**Sward composition** - Clover content was 19% in August and 40-45% through into December 2013 (Figure 2). During the mid summer dry period growth almost stopped, however, little plant death was observed. Sward composition has changed with time. The annual clovers provided a large legume boost in the late winter, spring and early summer after sowing. Clover still contributed 6-18% of total DM in the second summer, for the rest of the year the percentage of clover was typically less than 5%.

**Figure 2. Sward composition (percentage of plantain, clovers, grass, weeds and dead material at each cut)**



**Reseeding** – Flowering and re-seeding of all clovers was affected by closing date (Figures 3 & 4). There was little flowering in Arrowleaf plots as most plants did not survive the wet winter conditions. Re-seeding was evident in both Persian and balansa clovers and plantain from November 2013 onwards. Following rain in autumn 2014 there was been a substantial germination of plantain seedlings with balansa clover plots and in the paddock areas where flowering occurred (Figure 4). Trial blocks maintained a good plantain density of 100 plants/m<sup>2</sup>.

Seed production was particularly high in both balansa and Persian clovers but arrowleaf set little seed because there were so few plants.

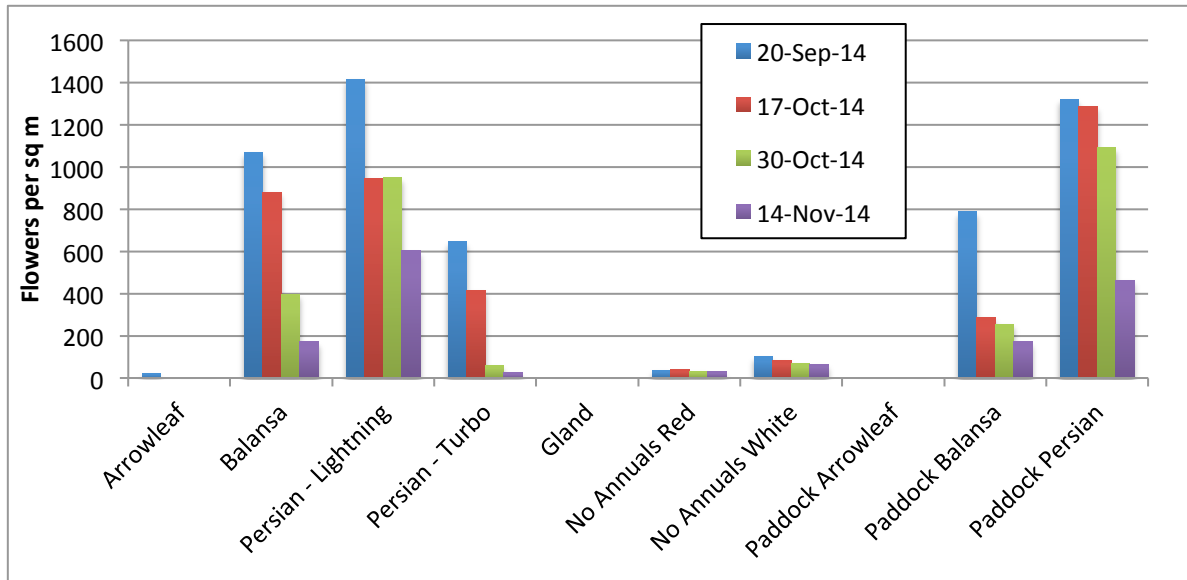
**Hardseededness** – Persian clover produced no hard seed. The soft seed germinated in the heads of plants after light rainfall events and meant the seed collected was mostly non-viable seed. Arrowleaf clover produced high level of hard seed (nearly 90%) while balansa had 55% hard seed. This data is very similar to that collected from other sites in the Hawke’s bay and the Wairarapa.

**Table 2. Average percentage of soft, hard and no viable seed collected from all closing dates**

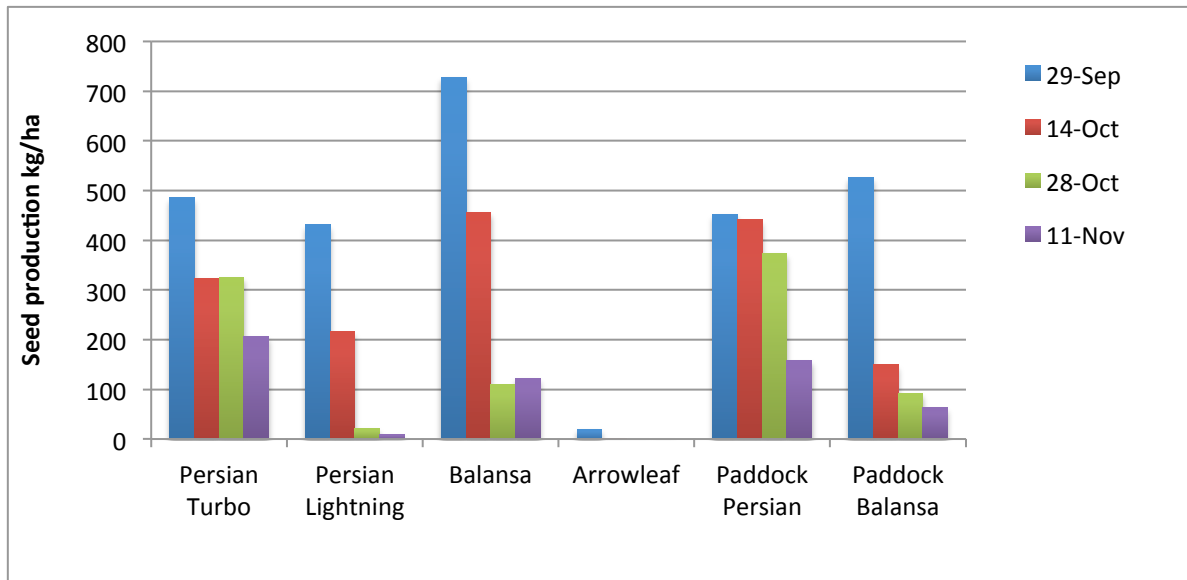
	% soft seed	% hardseed	% non viable seed
Arrowleaf	5.5	87.0	7.5
Persian	36.4	0.6	63.0
Balansa	27.6	54.3	18.1

**Re-establishment of clover plants** – Across the paddock there was a reasonable re-establishment of clover seedlings in April 2014 (Figure 5) but the plant numbers were still lower than the seedling number at establishment in 2013 (Table 1). However by May 2015 the density of plantain plants in the paddock area was 241 plants per m<sup>2</sup>, indicating that there has been an increase in plants establishment from seed since sowing.

**Figure 3. Flowers produced from each closing date**

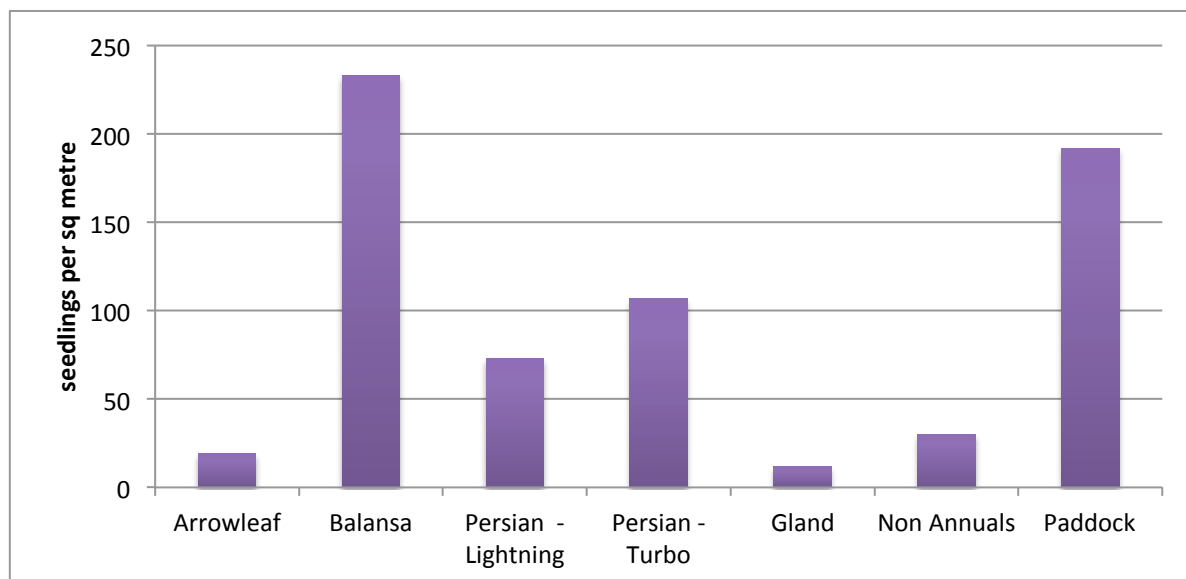


**Figure 4. Total seed production kg/ha from each species from each closing date**



**Grazing Management for Persistence.** Grazing management is critical to maintain plant numbers and timing and severity of first grazing will affect both plantain survival and persistence. When plants are grazed after they have six fully developed leaves (30 cm with Tonic) plant losses are generally less than 10%. Grazing earlier than this increases plant losses and reduces pasture persistence as root reserves can be insufficient to support post-grazing regrowth. As with lucerne, plantain should be rotationally grazed to prevent damage to the crown and to maintain feed quality. Grazing frequency is a compromise between maximising animal production and allowing plants to recover from grazing.

**Figure 5. Plantain plants and newly established seedlings/m<sup>2</sup> with 1 or more true leaves in April 2014**



**Pest Management** - During March 2014 high slug numbers were observed and leaves were beginning to show damage (large holes in the leaves). Slugbait was distributed at recommended rates and was very effective in reducing slugs to acceptable levels.

**Animal Performance** - At Te Mahanga, grazing commenced on 8 August, 2013. Two mobs of lambs were moved quickly through the blocks until early December, 2013. Some paddocks were skipped when conditions were wet underfoot. As the feed on offer increased during spring, additional lambs were added to the mobs. Up until 11 November, 4716 lambs (79,880 lamb grazing days) had been finished on this 38.2 block. Lamb growth rates on the plantain/clover have ranged between 243 and 310 g/day (Table 3). Dressing-out percentages have consistently been 1-2% higher than lambs grazed on grass (Moata).

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 dressing out percentage meant a \$290/ha advantage over new ryegrass pastures over a 75 day spring grazing period at Te Aute in a similar trial. At Te Mahanga, output per ha was even higher, probably due being more productive flat land and the use annual clovers in the mix.

**Table 3. Te Mahanga - Animal performance and dressing out percentages**

	plantain/clover
Grazing days/ha	2056
Lamb growth rate g/day	298
Total lamb LWG kg/ha	613
Dressing out %	48.4
Carcass value/ha (@\$6.00/kg)	\$1,780



During the summer of 2013-14, the block was grazed by 600 hoggets (December to March) with an average liveweight gain of 150 g/day and 78 mixed sex weaner calves (December to April) with an average live weight gain of 640 g/day (December to February).

### **Plantain what we don't know**

- With plantain, the big unknown is on-going productivity and persistence.
- Plantain decline is observed in most swards and to what extent the losses are due to grazing damage, pests and diseases is not known.
- How to encourage new seedlings to fill empty spaces within the paddock. When should management change to encourage replacement seedling vs managing for existing plants.
- Recommendations for on-going weed and pest control

### ***Annual clovers - Notes on species and cultivars***

A number of erect annual clovers are now being used on the East Coast. These are arrowleaf, balansa, Persian and gland clovers. These are all erect clovers which flower at the top of the stem. This means they get grazed by stock so setting seed is very difficult and they are generally used as one-off crops.

**These clovers are not at all like sub clovers.** We are finding that both Persian and balansa clovers give a one-off boost of legumes when sown with plantain. The erect growth habit of plantain suits these clovers. **These clovers do not work well when sown with grass as the grass is too competitive.**

**Arrowleaf clover (*Trifolium vesiculosum*)** Originally from the Mediterranean, Arrowleaf clover is an annual legume which provides valuable high quality feed over late spring/summer. It is relatively new to New Zealand and has been used successfully in Hawke's Bay for lamb fattening and as a late season hay crop. As a single species during November and December it grew at 153kg DM/ha/day in a Lincoln University experiment. 'Arrotas' produced 9,800 kg DM/ha compared with 3,370 kg DM/ha from subterranean and 1,790 kg DM/ha from white clover. Widely used in temperate Australia and USA where annual rainfall is below 500 mm. Very good growth rates of ewes at lambs under rotational grazing in Hawkes Bay. Does not tolerate cold conditions or wet feet.

#### ***Balansa clover (*Trifolium michelianum*)***

Balansa clover is a self-regenerating annual clover, with most growth occurring over spring in cold climates but winter growth can be quite impressive in warmer parts of the North Island. . It has been used as an alternative to subterranean clover where soils are wet in winter. As it seeds above ground, plants need to be spelled or lightly stocked in the first spring to allow enough seed to be set for future regeneration. The seed shed by plants can require more than one year to germinate, so plants are not always present in the second winter after planting. Requires careful management to ensure re-establishment from seed.

#### ***Persian clover (*Trifolium resupinatum* L. var. *majus* Boiss. (ssp. *majus*)***

Persian clover is native to wider Persia (Turkey, Afghanistan, Iraq, Iran) and Greece and performs well in temperate dryland pastures of southern Australia. Persian clover is very tolerant of waterlogged soils during winter and has some tolerance to saline conditions. Very soft seeded and prone to false strikes. In a recent trial in Marlborough Persian clover produced the most amount of dry matter of 8 clovers trialled. Very good lamb and ewe growth rates have been reported from Hawkes Bay. When grown as a pure stand phytotoxicity has occasionally been reported in ewes in New Zealand.

### **Gland clover (*Trifolium glanduliferum*)**

Little work has been done with Gland clover in New Zealand. Gland clover can be used as a component of long- term pastures or in the pasture phase of cropping rotations to provide high quality fodder for livestock. Very winter active and extremely early flowering. Poor performer in most trials. Not recommended except in special situations.

### **Subterranean clover (*Trifolium subterraneum* L.)**

Very different to the above clovers. Named for its ability to bury its seed, its seed heads bend and are pushed into the soil surface after flowering, so the plant survives the summer as a seed. As an annual, the plant disappears from pastures during summer. The seeds germinate when rainfall resumes, but some can fail during subsequent dry spells ("false strike"). Different cultivars have different amounts of hardseed. Sub clover is useful in dry east coast regions, particularly in situations too dry for white clover, where it can contribute up to 20% of the herbage during the cool season. However, it is important to minimise grazing during flowering to allow maximum seed set and to use cultivars with an appropriate flowering time to ensure it sets seed before the dry summer. Late-flowering cultivars are best suited to NZ.

## ***Plantain notes***

### **Establishment and weed control**

Plantain should be sown in autumn once sufficient rainfall has occurred. Seed should be sown at a depth of 10 mm at rates of 6-8 kg/ha when sown alone, or 1-3 kg/ha when sown in a mixture (seed size is approx. 500,000/kg). Plantain will also establish when broadcast (followed by rolling) onto a well prepared seedbed. With careful preparation plantain has been successfully oversown into uncultivable hill country, however it is essential that good seed-soil contact occurs and that the existing sward is well controlled or suppressed.

Annual clovers (arrowleaf, balansa and Persian) have been shown to be very compatible with plantain. Larger leaved white clovers should also be considered as they will withstand rotational grazing.

Plantain can be fairly slow to establish and does not compete well with other species with high seedling vigour. A well prepared, weed free seedbed is necessary as post emergence weed control can be difficult. Pre-emergent weed control is important as plantain does not tolerate phenoxy-based herbicides (e.g. 2, 4-D, MCPA, MCPB), diflufenican or flumetsulam, so it can be difficult to control many weed species that may begin to compete with it. Currently there are no labelled recommendations for controlling grasses or weeds in plantain. Good results have been achieved using a mix of Haloxypop-P and Bentazone together with a suitable wetting agent.

Springtails can be a problem as seedlings establish. Careful monitoring (every three days) should be undertaken.

### **Grazing management**

Initial grazing management is critical to maintain plant numbers as the timing and severity of the first grazing after sowing will affect plantain survival and persistence. If plants are only grazed after they have six fully developed leaves (typically 25-30 cm high with 'Tonic') plant losses are generally less

than 10%. Grazing earlier than this increases plant losses and reduces pasture persistence as root reserves will not have built up to support post-grazing regrowth.

Because of its high palatability, plantain will normally be preferentially grazed in mixed pastures. As with lucerne, plantain should be rotationally grazed to prevent damage to the crown and growing points, and to maintain feed quality. Plants should only be grazed down to 8 cm and left for 2 – 4 weeks before re-grazing when regrowth should be about 20 - 30 cm high. This translates to pre-grazing herbage levels of 2500/3500 kg DM/ha and post-grazing residuals of 1500/2000 kg DM/ha.

Feed quality and palatability decline with flowering as the proportion of stalk increases. Frequent grazing will minimise the production of seed heads. Animals typically graze the younger, more palatable leaves first. Grazing frequency is a compromise between maximising animal production and allowing plants time to recover from grazing. Frequent grazing (every 2 weeks) down to 8 cm is recommended as a compromise between best production and nutritive value

#### **Key Points:**

- Graze when plantain has 6 or 7 true leaves. True leaves must be fully or very near full expansion. The first grazing should remove no more than 2/3 of the existing herbage. Leave 8 cm behind.
- Grazing should be done to minimise pugging as plantain crowns are very susceptible to damage when ground is wet.
- **Do not set stock plantain**, this will deplete plant reserves and will thin the sward rapidly
- **Learn to graze for optimum residuals**
  - **Annual clovers (first year).** When annual clovers have been sown, frequent grazing (every 2 weeks) from 20-30 cm down to 12 cm is recommended.
  - **No annual clovers.** When only white and red clovers have been sown with plantain, it is possible to graze lower for best production and nutritive value. Frequent grazing (every 2 weeks) from 20-30 cm down to 7-8 cm is recommended.

#### **Persistence:**

Few studies have reported contributions of plantain in mixed swards at greater than 15%, 4-5 years after establishment. Plants are lost from the sward through competition from other species and by grazing and damage. If pugging occurs during wet weather, plant populations can be severely reduced. While plantain appears tolerant of hard grazing it must be allowed to recover to 5-7 leaves or 25-30 cm in height, which allows critical root reserves to be replenished. Plantain is very free seeding and, if allowed, seed set over summer can exceed 400 kg/ha. It has been advocated that allowing older, thinner plantain pastures can be rejuvenated by letting them set seed. Bare ground is a requirement for successful reestablishment from seed.

Repeated over grazing and grass invasion are the most common reasons for stand decline. Spraying to remove grasses is generally very successful.

Plantain moth has been a problem in some instances from the second year onwards in the late summer and autumn. There are no formal recommendations as to when to spray. If many of the newest leaves are being attacked spraying should be considered.

### Plantain/grass comparisons

There have been a small number of trials that have compared animal performance on both grass/clover and plantain/clover, these have been summarised below. All have shown an advantage to plantain/clover. Because plantain is of high quality, rumen transit time is short and animals have less rumen contents. This means they have higher dressing out percentages – i.e. better carcass weights at a given liveweight. We have also corrected growth rates for this in the tables below.

#### Summary of lamb growth on plantain and pasture

	Growth rate on grass (g/d)	Growth rate on plantain (g/d)	Growth rate (g/d) advantage to plantain	Growth rate on plantain corrected for DO% advantage of 2% (g/d)	Growth rate advantage after DO% correction (g/d)	No. farms
Lambs on hoggets	229	280	+51 (+22%)	302	+73 (+32%)	3
Lambs on ewes	297	342	+45 (+15%)	364	+67 (+22%)	5
Lambs post weaning	190	230	+40 (+21%)	252	+62 (+33%)	3

#### Summary of ewe and hogget performance on plantain and pasture at weaning

	Weaning weight off grass (kg)	Weaning weight off plantain (kg)	Weight advantage to plantain (kg)	Weaning weight corrected for DO% advantage of 2% (kg)	Weight advantage to plantain after correction (kg)	No. farms
Hogget at weaning	57.1	61.8	+4.7 (8.2%)	64.5	+7.4 (+13%)	3
Ewe at weaning	66.4	75.3	+8.9 (+13%)	78.6	+12.2 (+18%)	4