

# Future Forage Systems Project

## Plantain – A brief literature review

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Narrow leaved plantain is an **upright** perennial herb which tolerates many pests and diseases. It has become increasingly popular as a specialist crop or sown in a pasture mix (typically sown at 2 kg/ha). Industry sources suggest that 5,000 ha of plantain was sown in 2011. Plantain is regarded as a “low fertility” plant and soil fertility determines the competitive ability of plantain when it is sown with other grasses. It establishes rapidly and grows on a wide range of soil types with varying soil acidity (pH 4.2–7.8) and fertility (Charlton and Stewart 1999). Its coarse root system consists of both a tap root and fibrous roots. The taproot grows to a shallower depth than other tap rooted plants and means that plantain is less tolerant of drought than chicory, red clover and lucerne, though the tap root does provide some degree of drought tolerance. Plantain requires careful management to obtain optimal animal production and persistence in the sward. Plant density will be decreased by repeated hard grazing or by pugging in winter. Whilst a number of claims have been made as to plantain's anthelmintic properties, trial results have shown mixed results.

### **Management.**

**Establishment.** Plantain should be sown in autumn once sufficient rainfall has occurred. Seed should be sown at a depth of 10 mm at 8-10 kg/ha when sown as a pure species, or 1-3 kg/ha when sown in a mixture (seed size is approx. 500,000/kg). Plantain can be fairly slow to establish and does not compete well with species with high seedling vigour. A well prepared, weed free seedbed is necessary. Pre-emergent weed control is important as plantain does not tolerate phenoxy-based herbicides (e.g. 2,4-D, MCPA) or diflufenican nor flumetsulam, so it can be difficult to control many competitive weed species. However, bentazone, paraquat/diquat and diuron may be used (Gawn *et al.*, 2012). When sown in a mix, plantain rarely exceeds 20% of the pasture.

**Grazing.** Initial grazing management is critical to maintain plant number 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 (30 cm with Tonic) plant losses are generally less than 10%. Grazing earlier than this increases plant losses and reduces overall pasture persistence as root reserves will not have built up to enable optimum post grazing regrowth. The shorter time to first grazing gives plantain an advantage over chicory as early spring forage. It is important to recognise that due to its high palatability, plantain will be normally be preferentially grazed in most 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 then left for about 2 – 6 weeks before re-grazing when regrowth should be about 15-- 25 cm high. This translates to on-offer herbage levels of 2000/3500kgDM/ha and residuals after grazing of 1000/2000kg. 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 as frequent (every 2 weeks) grazing down to 8 cm is recommended as providing the best compromise between optimum production/nutritive value and sward persistence.

**Persistence.** Few studies have reported contributions of plantain in mixed swards that are greater than 15%, 4-5 years after establishment. Plants are lost from the sward through competition from other species and by grazing and damage. Short grazing rotations and heavy grazing along with pugging in wet weather causes plant populations can be reduced. While plantain appears tolerant of hard grazing it must be allowed to recover to 6-7 leaves or 25-30 cm in height, which allows critical root reserves to be replenished.

**Yields.** There is limited data on plantain yields. Moorhead and Piggott (2009) compared the performance of old ryegrass pastures in Northland with new pastures sown with 2 kg plantain, 2 kg white clover, 3 kg red clover and 10 kg ryegrass. They found that “plantain based” pasture gave significant advantages over existing pastures. However, what was overlooked was that any new pasture is likely to provide a significant boost to DM production. This is supported by the fact that in the Moorhead and Piggott study, the advantage to plantain based pastures dropped from 6 T/ha to 1.2 T/ha by Year 3. In general, total yields of plantain have been similar to other pastures (Table 1).

There is limited data on the seasonal growth rate of plantain. Powell et al. (2007) reported growth rates of 30 kg/ha/day in pure species in the Manawatu between March and July, increasing to 76 kg DM/ha/day in spring/early summer and declining to 46 kg DM/ha/day as summer progresses (Fig 1). Moorhead and Piggott (2009) observed similar growth rates in plantain mixtures in Northland where plantain-based pasture dry matter production was not significantly different from the ryegrass-based pasture in winter, early spring and late spring. However in summer and autumn, plantain-based pasture significantly out yielded ryegrass-based pasture by 1.8 t DM/ha and 0.9 t DM/ha, respectively.

**Table 1** Reported total yields of plantain

Site	Mean annual yield (t DM/ha)	Soil type	Irrigation	Fertiliser	Pasture yield (t DM/ha)
<b>Ceres Research Station<sup>1</sup>, Christchurch</b>					
- Lancelot (winter dormant)	7.6 (pure)	-	No	-	9.7 (grass)
- Tonic (winter active)	8.4 (pure)	-	No	-	9.7 (grass)
<b>Massey University, Palmerston North – Tonic<sup>2</sup></b>	17 (pure)	Manawatu silt loam	No	No	13.7 (chicory)
<b>Massey University, Palmerston North – Tonic<sup>3</sup></b>	17 (pure)	Manawatu silt loam	No	No	13.7 (chicory)
<b>Mangamuka, Northland – Tonic<sup>4</sup></b>	13 (mix with grass/clover)	-	-	-	17.6 (grass/clover)

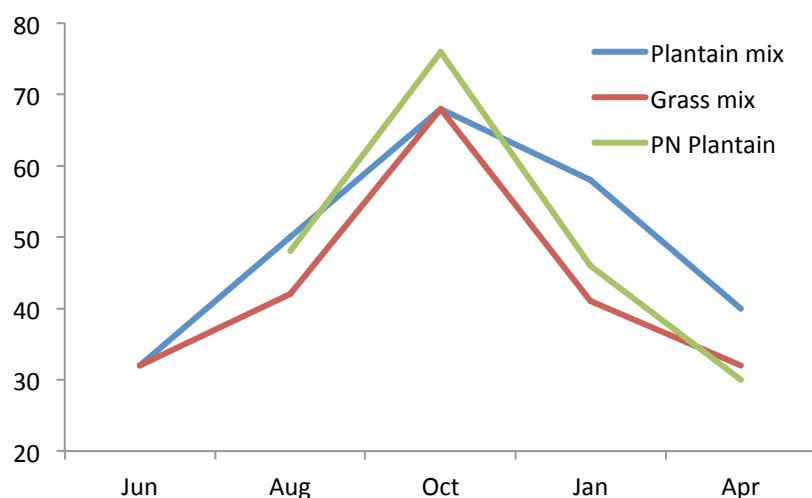
<sup>1</sup> Stewart (1996)

<sup>2</sup> Powell et al (2007)

<sup>3</sup> Kemp (2012)

<sup>4</sup> Moorhead and Piggott (2009)

**Figure 1.** Seasonal growth rates of plantain in the Manawatu and of plantain and grass mixtures in Northland (Powell et al., 2007; Moorhead and Piggott, 2009)



**Animal performance.** The feeding value of plantain is greater than ryegrass/white clover when plantain is fresh and soil moisture adequate. Feeding value is lower when plantain is moisture stressed and when the leaves are old. Liveweight gain trials using plantain have given variable results depending on whether pure swards or mixed plantain swards are used and how severe the summer dry conditions were. There are relatively few reports using plantain as a pure species. The Lincoln Trial (Table 2) was carried out in late summer/early autumn 3 years in a row and found that up to 60% of the plantain was low digestibility stem with low protein and poor palatability. Trials carried out in spring at Ceres Research Station (Canterbury) have shown higher ewe liveweights at weaning from rotationally grazing pure swards of plantain. Compared to grazing ryegrass; ewes gained 6.6 – 7.2 kg on plantain whereas ewe on ryegrass lost 2.3 – 7.5 kg. In one of these studies, the high ewe and lamb performance on plantain were probably associated with widely different pasture covers and quality at weaning (600 kg DM/ha on plantain versus 2100 kg DM/ha on pasture). In another study at Ceres Farm (Glenn Judson, unpublished) lactating hoggets showed much higher lamb liveweights gains on plantain (339 g/d) than on ryegrass (232 g/d). In that study, hogget liveweights were also heavier on plantain (61.2 kg) than on ryegrass (52.6 kg). However, these results came at the cost of a lower stocking rate on plantain (12.3 hoggets/ha) than on perennial ryegrass (18 hoggets/ha on). Trials at Massey University have shown high lamb liveweight gains from plantain in a moist summer grazed at 11 cm but not when grazed at 6 cm. Grazing at 11 cm gave poor utilisation, while at 6 cm animal intake was restricted. Most notable was that during a dry summer, liveweight gain was no greater on plantain than on ryegrass pasture. In a 2011 Massey trial, carcass weight per hectare was 306 kg for ryegrass white clover and 408 kg/ha for plantain based pasture, achieved with a 33% increase in stocking rate (Kemp 2012).

**Table 2.** Lamb liveweight gains on ryegrass and plantain

Site		Growth rate		Kg/ha	
		Stocking Rate	Plantain g/lamb/day		Ryegrass g/lamb/day
Lincoln <sup>a</sup>	Post-weaning		84 – 141	98 – 136	Not available
Canterbury <sup>b</sup>	Pre-weaning	Diff	376	296	Low sign
Canterbury <sup>c</sup>	Pre-weaning	Same	346	309	High sign
Canterbury <sup>d</sup>	Post-weaning	Diff	222	135	Non sign
Canterbury <sup>e</sup>	Pre-weaning	Same	370	270	Not available
Massey <sup>f</sup>	Post weaning	Diff	214	154	Not available
Massey <sup>f</sup>	Post weaning	Diff	231	188	High sign
Bennydale <sup>g</sup>	Post weaning		260		

<sup>a</sup> Legumes, herbs or grass for lamb performance - only higher on plantain in Year 1 (Fraser and Rowarth 1996)

<sup>b</sup> Ewes at different stocking rates 15.1 ryegrass and 10.4 plantain. Weaning weight 785 kg/ha on ryegrass vs 618 kg/ha on plantain (Judson et al 2009)

<sup>c</sup> Twin-bearing ewes at similar same stocking rates 9.5 ryegrass and 10.4 plantain (Judson et al 2009)

<sup>d</sup> Different stocking rates with 8 week old lambs - 27.2 lambs/ha on plantain and 37.3 lambs/ha on ryegrass. No significant difference in weight gain per hectare from Dec - Mar although growth rates much higher on plantain. Ryegrass was high endophyte which may have contributed to lower liveweight gains (Moorhead et al 2002)

<sup>e</sup> Judson (2008)

<sup>f</sup> Kemp (2012)

<sup>g</sup> Lambs over 96 day period and 0.9 kg carcass weight heavier than grass fed (Anon, 2011)

In the Lincoln trial, ewes grazing plantain produced faecal egg counts through lactation which were one third to one quarter of those grazing ryegrass. The mechanism for this effect with plantain is not clear. In a Farmer Initiated Technology & Transfer project in Southland where there was no difference in growth rates for ewes and lambs grazing plantain enhanced pasture. Faecal egg counts showed a tendency, after a lengthy period of exposure, to be lower where plantain was a part of the diet. Dagginess levels were also generally less in lambs grazing plantain (Turner, 2002)

### **Cultivars (Note - Breeders descriptions):**

**Boston:** - Boston is a New Zealand plantain that is a rapid establishing, deep rooted, drought, heat and cold tolerant, mineral rich, tender leafy green perennial pasture herb. It is 28 days later flowering than Tonic. Boston is small seeded compared to most other cultivars and sowing rates can be reduced.

**Endurance:** - Endurance is a broad leaf organic plantain that is BioGro certified and also available as conventional seed. The large tap root enables this plant to be very persistent in droughts and helps it to perform well in all ranges of fertility. Endurance has a quick response to water and has good stock performance. It flowers 25 days later than Tonic.

**Hercules:** - Hercules is a bi-annual Plantain. It is 28 days later flowering than Tonic with a higher dry matter production. It is European sourced. It has good all year round growth with strong summer and autumn growth suitable to all types of soil conditions.

**Tonic:** - Erect growing, with good cool season growth, with larger leaves than Lancelot.

**Lancelot:** - Selected from local ecotypes in the North Island of NZ for its erect, bushy growth habit and ability to tiller strongly under close grazing. Cultivar of plantain with cool season growth.

**Ceres Tonic:** - Selected in New Zealand from plants originating in northern Portugal for erect growth habit. When compared with Lancelot it has larger leaves, flowers six days earlier (under NZ conditions) and has better autumn-winter production. It requires rotational grazing.

**Endurance:** - Mid season flowering, winter active and will tolerate frosts.

**Summary.** Plantain is not as drought tolerant as chicory or red clover. Plantain like lucerne requires careful management. Plantain seems to have a clear advantage as a high performance spring feed for lactating ewes and their lambs. However, the higher intakes on plantain often result in lower pasture covers at weaning and in all likelihood mean a much lower carrying capacity. This needs to be understood and caution is needed on how it fits within a farm system. The opportunity for plantain may lie in specialised systems – for example a once-bred ewe policy where ewes and lambs are sold at weaning for a premium. Plantain may also be useful for hogget lambing where it is critical to get good lamb liveweight gains over lactation and superior weight gains in their hogget/two tooth mothers. .

There is limited data on the performance and management of plantain, particularly in a North Island East Coast context. Better data is needed on monthly growth rates of pure plantain and plantain based pastures in comparison with ryegrass pastures of a similar age and management and how plantain might fit within different farming systems.

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