# Getting plantain into your system

**New Zealand-bred plantain (*Plantago lanceolata* L.) cultivars are useful forages for dairy cows, not only for feed quality and good summer-dry forage production, but some are now recognised for their environmental benefits by reducing urinary nitrogen (N) concentration.**

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Here we will review the benefits and challenges around sucessful establishment and management of plantain in general, recognising that, as yet, there is limited published information on cultivar differences.

Plantain is an upright perennial dicotyledon herb with a coarse, fibrous root system. The species grows throughout New Zealand on a wide range of soils, including those of low to medium fertility and a wide pH range, but it is not suited to water-logged or saline soils[1].

Modern forage plantain can respond to good management by expressing a production potential similar to perennial ryegrass when newly established[2,3]. As plantain has a moderate to high tolerance of summer heat, in warmer and drier regions it can provide valuable forage and improve milk production during summer and autumn[4,5,6].

## Key findings

- Plantain can be established as a pure crop, in a herb-based mix or in a grass-based mix.
- Plantain establishes well in most regions and soils, and late spring sowing by direct drilling generally results in the best first-year yield.
- Frequent grazing and treading damage in winter will reduce plant density. Re-sowing after two to four years may be required to maintain a high proportion of plantain in the pasture.
- Two herbicides are now registered in New Zealand for use with plantain – Dynamo in mixed pastures and T-Max in forages without clover.

In the last five years, new impetus for plantain use has come from a number of studies that have consistently shown the cultivar Ceres Tonic to significantly reduce N concentrations in cattle urine[4,5]. This has important benefits for reducing nitrate leaching risk in dairy systems, where sufficient plantain is included in the animal diet.

The Forages for Reduced Nitrate Leaching (dairynz.co.nz/frnl) and Greener Pastures (http://nsentinel4.co.nz/collaboration/) research programmes are now determining the optimum dietary levels and how to achieve them in farm systems. Good establishment and management of forages containing plantain will be critical to getting the maximum benefit from plantain.

### Establishing plantain

Plantain can be sown in a variety of ways – as a pure sward, mixed with clovers and other herb species ('herb-based mix') or mixed with grass and clover ('grass-based mix'). The different forage types have their own advantages and disadvantages (Table 1).

Which type to use depends on the intended purpose of plantain on-farm. In all situations, plantain is best established by sowing at 10 mm depth, into a cultivated seedbed or direct drilling seed into herbicide-treated pasture, when the soil temperature is above 10°C. A range of establishment methods have been used in various field trials.

The only trial directly comparing methods showed that the more expensive direct drilling, compared with broadcasting seed, was more than compensated for by more dense plant populations, lower weed content and increased yield[7].

As with any forage species, sowing date will depend on the temperature and moisture conditions dictated by region and soil type. For plantain, there have not been any direct comparisons of sowing date, but both autumn and spring sowing has been successful in North and South Island regions, with summer sowing an option where irrigation is available.

For spring sowing, planting too early risks a late frost damaging young plants, while planting too late risks dry conditions reducing plant establishment and survival[9]. On winter-wet sites, a spring sowing after spraying with glyphosate, light cultivation and drilling is likely to be most successful[6,7].

For autumn sowing, planting too early risks poor germination in summer-dry conditions, while planting too late may not ensure sufficient leaf growth and root development before cooler winter temperatures arrive, and risks the first grazing being in wet and cold conditions[8].

### Plantain as a pure sward

The main advantage of a pure plantain sward is that it can be managed to meet the requirements of the plantain cultivar. Optimal sowing rates for pure swards are 7-10 kg/ha[11].

*Table 1: advantages and disadvantages of plantain forage options*

| Forage types | Advantages | Disadvantages |
|---|---|---|
| Pure plantain | • Dedicated grazing management (greater plantain production and persistence).<br>• Maximum benefit from plantain (e.g. minerals and reducing N leaching). | • Slow winter growth of some cultivars compared with ryegrass.<br>• Difficult to utilise well in wet winter conditions on heavy soils. |
| Plantain with clover and/or chicory ('herb-based mix') | • Dedicated grazing management (greater plantain production and persistence).<br>• High benefit from herbs (e.g. minerals and reducing N leaching).<br>• Clover provides nitrogen.<br>• Clover fills in gaps in sward rather than weeds. | • Slow winter growth of some cultivars compared with ryegrass.<br>• Difficult to utilise well in wet winter conditions on heavy soils.<br>• Potential bloat risk if swards become clover-dominant. |
| Plantain in diverse pasture mix ('grass-based mix') | • Better pasture production in summer/autumn.<br>• Higher nutritive value in summer/autumn.<br>• Longer growing season.<br>• Less N leaching if plantain present in sufficient proportion. | • Animals may selectively graze.<br>• Feeding value of herbs diluted.<br>• Plantain plants may not persist.<br>• Few herbicides available for control of broad-leaf weeds |

Plants should have a minimum of six fully developed leaves before they are ready for the first grazing, to ensure that plants have a well-developed root system[8].

Grazing management strategies designed to maximise quality and quantity of plantain crops aim to maximise leaf growth and minimise stem growth. Grazing at ~25 cm height down to a residual of ~8 cm is recommended, because as plantain leaves age they become more fibrous, less digestible and the quality declines regardless of stem content[9]. The main disadvantages of a pure plantain sward are poor winter growth compared with perennial ryegrass (although this varies with cultivar) and the relative sensitivity to pugging and winter damage due to the open crown growth of plantain.

### Plantain in a herb-based mix

The main advantage of herb-based mixes is the high forage quality from combining plantain with chicory and/or clovers[3]. Optimal sowing rates are 6-8 kg/ha for the plantain component, with the other species making up an additional 10-12 kg/ha (e.g. chicory and clover).

The guideline of first grazing at the six-leaf stage also applies to herb mixes[8] and, subsequently, it is recommended that swards be grazed to ~8 cm residual heights with four-week intervals[3]. For dairy cows, the main disadvantage of this forage type is the risk of bloat, which has been anecdotally reported.

### Plantain in a grass-based mix

Plantain improves the summer quality and autumn recovery of perennial ryegrass pastures, especially in summer-dry environments[6]. Optimal sowing rates are 2-4 kg/ha, any lower has a minimal benefit for herbage production[10]. Plantain in a ryegrass pasture mix is necessarily managed as with a ryegrass-white clover pasture (grazing to residuals of 1500-1600 kg DM/ha), which is within the tolerance of plantain[9,10].

Plantain can be drilled or broadcast into already established pasture, although establishment is slower and plant populations may not reach the density required to affect urinary nitrogen concentration. The recommendation to graze at six developed leaves does not apply, as this will be too long a rotation for the grass and will shade out the plantain seedlings. A normal ryegrass rotation will allow the plantain to emerge within the established pasture.

*Figure 1: one-year-old perennial ryegrass/plantain/clover mix near Dannevirke. The pasture was sprayed, drilled and rolled in March 2017. The seed sown comprised 22 kg perennial ryegrass + 3 kg plantain + 2 kg sub clover + 2 kg white clover.*

### Challenges for management

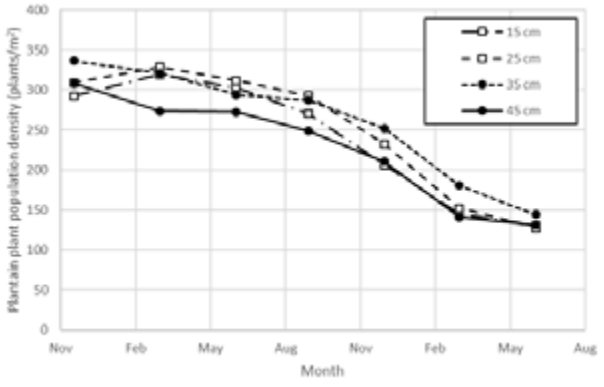
The main challenges for managing plantain are maintaining plant population density, control of broad leaf weeds and sporadic palatability issues.

A substantial reduction in plant numbers can occur after 2-4 years and thus plantain is often regarded as a short-lived perennial[11]. Only one study (in Northland) has reported contributions of plantain in mixed swards greater than 15 percent of total forage dry matter after four years[6].

When plant populations have been measured, the decline has often occurred in the second summer-autumn[7,9] (e.g. Figure 2) and is often associated with insect pests. Severe outbreaks of plantain moth infestation can occur in pure plantain swards, which can be controlled with the registered insecticides Exirel or Minecto Star. In herb mixes and grass mixes, the moth damage is generally not substantial enough to warrant action.

Instead, plants appear to be mainly lost through competition from other species, by short grazing rotations and from treading damage on wet soils. While plantain appears tolerant of low grazing residuals, it must be allowed to recover to six leaves (or approximately 25 cm in height) for critical root reserves to be replenished[9].

*Figure 2: typical loss of plantain populations during a Waikato study of pure plantain swards harvested at four pre-graze heights: 15, 25, 35 and 45 cm[9].*



Plantain is a prolific seeding plant and new plants can establish from natural reseeding under rotational grazing with dairy cows[1]. A detailed Manawatu study showed new plants making up 14% of growing shoots from natural establishment over winter and spring[12].

Stock will avoid eating seed heads and germination occurs quickly with sufficient moisture and warmth, though seedling survival is best where there is bare ground and competition is limited[1,12]. However, to maintain plant populations at a level sufficient to ensure plantain is a high proportion of the cow's diet, under-sowing by drilling or broadcasting plantain seed in spring may be necessary.

It is wise to eliminate weeds as thoroughly as possible before sowing plantain, as there are few post-establishment herbicides available that do not harm plantain[13]. Only two products are currently registered, Dynamo (a.i. bentazone) can be used in grass-based mixtures and T-Max (a.i. aminopyralid) can be used in pure plantain crops or mixtures without clover.

### Plantain cultivars

Several plantain cultivars are now available for dairy farmers. They largely differ in their flowering dates and seasonal growth rates (with implications for seasonal growth habit and palatability) but there is currently no published information on their relative efficacy in reducing urinary nitrogen concentration.

There is little evidence that establishment requirements differ substantially between cultivars, although late autumn sowing of winter-dormant cultivars should be avoided.

## *Resources*

- DairyNZ Farm Fact Plantain Establishment 1-78a

  DairyNZ Farm Fact Plantain Management 1-78b

  dairynz.co.nz/farmfacts (>farm management >forages)
- The proceedings of the New Zealand Grassland Association has over 40 papers covering various aspects of plantain forage management, of which 15 relate to dairy systems. https://www.grassland.org.nz/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