Benefits and uses of *Ceres Tonic* plantain (*Plantago lanceolata*) in sheep and beef systems

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Introduction

Narrow-leaved plantain *Plantago lanceolata* L. is a prostrate, perennial herb which occurs naturally in pastures, lawns and waste areas. Plantain has had a long history of use as a sown forage plant with records of use in pasture mixes in the UK and Europe dating back to the 1700s (Foster 1988). As a grazing herb, the species was first introduced into the Australasian seed industry via the AgResearch cultivar *Grasslands Lancelot* closely followed by the Agricom cultivar *Ceres Tonic* in the mid to late 1990s. Since this time it has become an important addition to pasture mixes, and more recently has been used as a monoculture but often accompanied with clover. The successful ecological adaptation to many environments throughout the world and its agronomic strengths combined with the palatability of plantain make this a valuable grazing species.

Although some agronomic characteristics are common for all plantain cultivars there are major differences in other aspects. This paper highlights the benefits of plantain but refers specifically to the benefits of Tonic plantain and explores five different ways this winter active and productive cultivar is being used commercially in sheep and beef systems in New Zealand.

Agronomic characteristics

Tonic is an upright, productive perennial-type herb capable of withstanding frequent defoliation. Tonic can be established by either cultivation and drilling, direct drilling or by broadcasting if sufficient gaps occur in the resident pasture (Glassey *et al*., 2012). Sown in either the autumn or spring Tonics' establishment speed is similar to that of a perennial ryegrass (Stewart 1996). Tonic should not be grazed before it develops six true leaves to minimise plant loss at first grazing (Powell *et al*. 2007). While plantain may be considered a low fertility plant because of its relative competitive advantage in low pH and phosphate environments, it also responds well to nitrogen and phosphate applications.

Tonic has a degree of drought and heat tolerance. It has a coarse fibrous root system with a short, narrow tap root which is shallower than other tap rooted plants like lucerne and chicory, for example. As a consequence, extended dry periods will reduce production dramatically as a strategy to survive. After a drought, its response to moisture is extremely rapid further enhanced by its strong cool season growth potential. There is a large difference between Tonic and other less winter active cultivars in this characteristic.

Tonic has excellent dry matter production with an annual total of 17-19tDM/ha/year recorded in Hamilton (Minnee *et al*. 2013) and 17tDM/ha/year at Palmerston North (Powell *et al*. 2007, Kemp 2012). Tonic is particularly active in the cooler months (Moorhead and Piggot 2009) providing benefits for grazing systems. In many environments Tonic plantain produces similar amounts of forage to perennial ryegrass over each season.

Not unlike traditional pasture species, increased pest populations pose a risk to Tonic plantain stands. Plantain is
susceptible to both grass grub and porina especially under high pest populations. Recently, plantain moth (*Epayaxa roseria*) has been identified as a problem in some areas. This species can reach devastating populations during periods of drought stress but are easily controlled by insecticides through January and February.

Although plantain is tolerant as a species of low fertility situations relative to perennial ryegrass for example, in a productive forage system, Tonic requires similar fertility to perennial ryegrass to be productive. Fertility programmes designed to encourage high clover content are desirable in mixed stands and additional nitrogen is an important factor for monocultures. In mixed pasture, plantain often becomes a minor species reaching only 20% of the sward after 2-3 years and fertility should be targeted to the other major species.

**Animal performance**

Early work (Fraser and Rowarth 1996, Robertson *et al*. 1995) suggested the performance of young weaned lambs grazing stemmy Lancelot plantain was poor. However, subsequent studies (Moorhead *et al*. 2002, Kemp 2012) showed with the more upright and leafy cultivar (Tonic) and the appropriate grazing management to reduce stem build up, young lambs grew very well.

Work with Tonic plantain as a feed during lactation showed increased liveweight gain of lambs and ewes compared with those on ryegrass (Judson *et al*. 2009, Hutton *et al*. 2011). Improved milk production by the ewe and increased forage intake by both ewe and lamb are likely mechanisms for this difference. Further, ewes grazing Tonic plantain had significantly lower faecal egg concentrations than their counterparts grazing ryegrass (Judson *et al*. 2009). Although the exact mechanism is unknown, an increase in metabolisable protein has been suggested.

It is now generally considered that plantain is a high quality pasture component capable of supporting high animal production particularly through late winter and spring.

The mechanism for improved animal performance is likely to include rapid rumen degradation rates leading to increased DM intake. Plantain leaf (25%/hr) has a much faster rumen clearance time than perennial ryegrass (11%/hr) (Burke *et al*. 2000). This is likely to be a function of the structure of plant cells and their rumen degradation characteristics. Plantain is known to contain significant concentrations of pectin, a structural but readily fermentable carbohydrate. Rapid rumen clearance rates are a logical explanation for increased DM intake (Judson *et al*. 2009).

More recent work illustrated that plantain can be more highly preferred than red and white clover in early spring (Cave *et al*. 2014). Issues of patchy grazing and poor utilisation can be associated with very mature crops (on long grazing rotations). Old plantain leaves do not perish quickly and the avoidance of “green” dead material by livestock is sometimes mistaken as a lack of palatability. Poor utilisation may also be an issue where nitrogen availability is low.

**Macro and trace element status**

Analysis of plant material reveals Tonic plantain is a good source of many macro and micro elements. A number of studies identify increased trace element status of particularly copper, and selenium (Moorhead *et al*. 2002) and cobalt (Hoskins *et al*. 2006). While the inclusion of plantain in pastures is a legitimate strategy for improving trace element supply to grazing livestock, particularly when these are applied in the fertiliser, it is not a stand-alone solution and should be used in conjunction with other supplementary options. However, with the development of plantain dominant feeding systems with stock spending extended period on these, the need for micro nutrient supplements is likely to be reduced.

**Animal health issues**

Animal health issues are relatively rare on plantain. However, bloat can be problematic during periods in spring, autumn and early winter in rapidly growing cattle. Nitrate poisoning is possible, but not common.

There is recent anecdotal evidence of cases of hypocalcaemia in commercial flocks when ewes come off plantain swards in late gestation or are cycled through a plantain paddock (which may only represent 48 hours grazing) as
part of a rotation. There appears to be no consequence for ewes remaining on plantain but a risk of hypocalcaemia if ewes are moved off the calcium-rich diet of Tonic plantain to a lower calcium diet like newly sown ryegrass in the weeks leading up to lambing. Work is underway to more fully understand these observations. However, as a hypothesis the calcium content of plantain (2.5-3% DM) is high relative to ryegrass (0.2-0.35% DM) especially in spring. It is possible that grazing plantain swards during gestation could delay the ewe from instigating the normal process of mobilising calcium from bones to meet the high calcium requirement of late gestation and lactation. Hypocalcaemia develops when they are moved off the plantain immediately prior to lambing.

**Uses of tonic plantain in sheep and beef systems**

**Tonic as an additional component of a perennial pasture**

Tonic plantain is a useful inclusion as a secondary species in general purpose pastures mixes. As a companion species, Tonic plantain improves summer forage quality through its ability to produce leaf throughout the seeding phase. At an immature stage (within two weeks of head emergence, seed head is palatable and highly preferred. During the seeding phase and under grazing the sward may still contain more than 70% leaf. This is likely to benefit lamb and beef finishing operations. In areas which dry out over the summer, autumn recovery and winter activity of Tonic is superior to that of perennial pastures and this may be particularly useful to autumn lamb trading systems. This may provide some benefits to sheep systems during the flushing phase prior to mating. There is some evidence that pastures containing plantain had lower faecal egg counts and that faecal dags were less of an issue compared with pastures without plantain (Turner 2002).

Although pastures may benefit from the inclusion of Tonic, the need to spray many perennial pastures for weeds, such as thistles, continues to limit the area of adoption because many of the herbicides used on ryegrass white clover pastures are equally effective on plantain. Controlling problems weeds and broadcasting plantain at a later date is one strategy for including plantain in perennial pastures.

**Tonic as a companion with a summer brassica**

Tonic can be used as spring-sown component of a brassica crop. Jacobs *et al.* 2006 reported that plantain (along with chicory) sown in Australia with summer forage brassica crops in the spring can increase forage production in the following autumn, and reduce weed ingress into newly sown pastures in their first year. The presence of plantain in a brassica crop can also mitigate, to some degree, animal health issues which can arise on brassica monocultures from time to time such as photosensitivity.

**Tonic as a mono-culture**

Much of the recent research work has evaluated Tonic plantain as a monoculture. Initially, this work has focussed on summer liveweight gain of weaned lambs. In these studies Tonic plantain supported greater liveweight gain and a higher stocking rate than those grazing perennial ryegrass and also elevated liver copper and selenium concentrations (Moorhead *et al.* 2002). Although the liveweight gain potential of Tonic in summer is greater than ryegrass, it is generally less that of summer legumes, summer brassica and chicory.

More recently Judson *et al.* 2009 evaluated Tonic plantain as lactation feed for twin-bearing ewes lambing in August. The winter and early spring activity of Tonic provided sufficient feed to support twin-bearing lactating ewes in early spring. The ability to consume more plantain, probably as a result of its fast rumen degradation rates, improved the weaning weight of the lambs by between 10 and 34% over the four years of studies. Ewes were also heavier at weaning by up to 14kg. In a farm system where the sale of cull ewes or last-lambing ewes is a valuable income stream, using targeted lactation forage that puts weight on the ewe by weaning is a real asset. Further, the use of Tonic in hogget lambing systems to grow out the hogget is also valuable.

Monocultures are used commercially where the weed burden is perceived to be too great or where plantain is being used as a break crop to clean up problem broadleaf and grass weeds. From a systems viewpoint monocultures are useful for lactation feed, as general forage and in dryland situations where clovers fail to perform as a consequence of the environment.
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Tonic and clover

Tonic is increasingly being used in place of ryegrass in stands where high legume content is desirable. These stands are particularly useful in summer and autumn finishing systems and are becoming the most popular way Tonic plantain is being used on farm. These swards are high quality and grow significant amounts of dry matter. The high legume content provides the nitrogen required to grow large volumes of Tonic and supports high animal performance and high stocking rates.

Tonic as a companion with lucerne

Lucerne systems are characterised by excellent summer growth particularly in hotter, drier environments. Where lucerne is used in sheep systems in drier environments, winter-active species need to be included in the farming system to fill feed gaps left by inactive lucerne in winter and early spring. Such species have included cereals and short rotation ryegrass. More recently, adding Tonic plantain to lucerne stands has provided valuable feed in early spring and late autumn, which complements the summer production of lucerne. Broadcasting Tonic into lucerne stands which are running out is a successful way of extending the life of the lucerne by 2-3 years.

Summary

Tonic Plantain has a number of characteristics which make it a valuable pasture component for intensive and semi-intensive agriculture. High annual dry matter production, winter activity and animal health and performance all contribute to the overall effectiveness of this pasture species and consequently Tonic has found a number of roles in a range of sheep and beef systems throughout New Zealand.

References


Cave LM, Kenyon PR, Morris ST, Lopez-Villalobos N, Kemp PD. Ewe lamb diet selection on plantain (Plantago lanceolata) and on a herb and legume mix, including plantain, chicory (Cichorium intybus), red clover (Trifolium pretense) and white clover (Trifolium repens) Animal Production Science, 2014


Glassey CB, Clark CEF, Roach CG, Lee JM. Herbicide application and direct drilling improves establishment and yield of chicory and plantain Grass and Forage Science 68(1), 178-185, 2012


Hutton PG, Kenyon PR, Bedi MK, Kemp PD, Stafford KJ, West DM, Morris ST. A herb and legume mix increased ewe milk production and ewe and lamb liveweight gain to weaning compared to a ryegrass dominant sward. Animal Feed Science and Technology 164, 1-7, 2011


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Minnee EMK, Clark CEF, Clark DA. Herbage production from five grazable forages *Proceedings of the New Zealand Grasslands Association* 75, 245-250, 2013


Powell AM, Kemp PD, Jaya ID, Osborne MA. Establishment, growth and development of plantain and chicory under grazing. *Proceedings of the New Zealand Grassland Association* 69, 41-45, 2007


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