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**Integration of herb pastures into farming systems in New Zealand**

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**Abstract**

The perennial herb pasture species chicory (*Cichorium intybus*) and plantain (*Plantago lanceolata*) are now widely in temperate pasture regions around the world. When combined with pasture legumes red clover (*Trifolium pratense*) and white clover (*T. repens*) both herb species enable livestock growth rates of sheep and bulls from late spring to autumn that are superior to those for livestock on perennial ryegrass (*Lolium perenne*) and white clover pasture. This paper provides data for a variety of livestock systems based on herb pastures plus some examples of how farmers are using these pastures.

**Key words:** perennial pasture; *Cichorium intybus*; *Plantago lanceolata*; production systems

**Resumen**

Las especies de plantas herbáceas perennes, la achicoria (*Cichorium intybus*) y el plátano (*Plantago lanceolata*) se encuentran actualmente en regiones de pastos templados de todo el mundo. Cuando se combinan con leguminosas de pasto, Trébol rojo (*Trifolium pratense*) y Trébol blanco (*T. repens*), ambas especies de hierbas permiten el crecimiento del ganado ovino y toro desde finales de primavera a otoño que son superiores a los del ganado en ryegrass perenne (*Lolium perenne*) y Pasto de trébol blanco. Este documento proporciona datos para una variedad de sistemas de ganado basados en pastos de hierbas, además de algunos ejemplos de cómo los agricultores están utilizando estos pastos.

**Palabras clave:** pasto perenne; *Cichorium intybus*; *Plantago lanceolata*; sistemas de producción

**Introduction**

The perennial herb pasture species chicory (*Cichorium intybus*) and plantain (*Plantago lanceolata*) are now widely used in pastures in New Zealand and other temperate pasture regions around the world. Both chicory and plantain produce more herbage over summer and autumn than perennial ryegrass. They are, however, both dormant to semi-dormant in the winter months. These different, but complementary growth patterns of chicory and plantain, compared with perennial ryegrass (*Lolium perenne*), have led to the incorporation of herb based pastures into the full range of pastoral livestock systems. This paper provides production data for a variety of livestock systems using herb pastures plus some examples of how farmers are using these pastures. Chicory and plantain can be used as single species forage crops or in combination with a variety of legume and grass pasture species. Legume species combined with herb species provide biological nitrogen fixation and when combined with plantain increased nutritive value (Table 1). The nutritive value of plantain cv Tonic is typically the same as perennial ryegrass in early spring and slightly higher or similar to ryegrass in summer and autumn. One factor that affects the nutritive value of plantain is water stress in summer, which

results in decreased crude protein (CP) concentration (Kemp *et al.*, 2014). Comparison of lamb growth rates on pure plantain and on plantain and red clover (*Trifolium pratense*) and white clover (*T. repens*) mixes has demonstrated it is essential to combine plantain with pasture legumes to obtain daily weight gains superior to those on perennial ryegrass and white clover pasture (Kemp *et al.*, 2014).

The nutritive value of chicory is superior to that of plantain. Typically nutritive value and feeding value of chicory is similar to red clover and lucerne (Kemp *et al.*, 2010). However, the shorter growing season of chicory compared with plantain is a disadvantage for farmers requiring herbage production early in spring or in late autumn and early winter (Powell *et al.*, 2007). The growing season of chicory can therefore be extended by combining with plantain and the addition of red clover and white clover provides increased nutritive value and N fixation (Cranston *et al.*, 2015).

Both chicory and plantain are sometimes combined with grass species (Totty *et al.*, 2013) as well as legumes. The lifespan of chicory is less when combined with grass due to its relatively greater sensitivity to treading damage in winter

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than grass and the typically more frequent grazing required for grass compared with the 3 to 5 weeks required for chicory persistence (Li and Kemp, 2005). Plantain is tolerant of the grazing frequency and intensity used on ryegrass and similar temperate grass species but it is not as tolerant of treading damage in winter, especially on poorly drained soils, as grass species (Stewart, 1996).

Given the similarity in nutritive value and grazing tolerance of plantain and grasses they are

compatible when combined in a pasture. The disadvantages of combining plantain and grasses are the decreased expression of summer herbage production from the plantain and the likelihood of a lower legume percentage than when the competition from grass is not present. For the above reasons the emphasis in this review is on herb and legume pasture mixes that do not include grass.

**Nutritive value**

Table 1 shows the nutritive value of chicory, plantain, herb and legume mix and perennial ryegrass and white clover in summer. The pastures were irrigated. Even under irrigation the ME of chicory was superior and the ME of both the plantain and the herb and legume mix were

greater than that of ryegrass and clover. In drier summers the ME of ryegrass and white clover pasture is typically lower than that of herb pastures or herb and legume mixes (Somasiri et al., 2015).

**Table 1. Nutritive value (crude protein (CP, g/kg DM), neutral detergent fibre (NDF, g/kg DM) and metabolisable energy content (ME, MJ/kg DM) of chicory, plantain and a mix of chicory, plantain, red clover and white clover (CPRW) compared with perennial ryegrass and white clover (RW) pasture in summer (S.Navarrete, unpublished PhD, 2015).**

Pasture	CP	NDF	ME
Chicory	262	159	12.4
Plantain	242	224	11.8
CPRW	262	224	11.8
RW	260	371	11.1

The NDF's of chicory, plantain and the herb and legume mix are lower than that of grass based pastures which usually result in livestock intakes being greater (Table 1; Hodgson, 1990). The CP of plantain was lower in summer even when

irrigated (Table 1) than for the other species supporting the case for the addition of legumes. Kemp *et al.* (2014) and Pain *et al.*, (2014) have shown that plantain is prone to low CP in dry summers.

**Livestock systems**

The superior nutritive value of the herb and legume mix relative to perennial ryegrass and white clover pasture in summer and autumn contributes to the superior feeding value of the herb and legume mix (Kemp *et al.*, 2014) for weaned lambs and rising one year old bulls. In spring the herb and legume mix has been shown to produce superior daily weight gains of lambs and their mother including for twin and triplet bearing mature age ewes, and for mated hogget's bearing a single lamb (Hutton *et al.*, 2011). The capability of the herb and legume mix to support weight gains in the ewe while it is feeding its pre-weaning lambs has a two-fold effect on the

productivity of a sheep system. First, there is the short term advantage of greater lamb weight gains due to higher milk production by the ewe (Hutton *et al.*, 2011). Second, the recovery in bodyweight and condition of the ewe ensures future lambing percentage is high. The weight gain of weaned lambs is greater on herb and legume mixes than perennial ryegrass and white clover pasture from late spring to early autumn. For example, the daily live weight gain of Romney lambs averaged over two summers was 145, 229 and 217 g/day for perennial ryegrass and white clover, plantain mix (plantain, red clover, white clover) and chicory mix (chicory, plantain, red clover, white clover),

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respectively (Somasiri *et al.*, 2015). The lambs on the herb and legumes mixes also had a dressing out percentage that was 3 – 4 % greater than for lambs on perennial ryegrass with the overall effect of the herb and legume mixes being they produced lambs with carcass weights that were 2 – 3 kg heavier (Somasiri *et al.*, 2015).

Young bulls achieve their target live weight of 300 kg earlier when grazed on herb and legume mix pasture than on ryegrass and white clover pasture (S.T. Morris, pers. comm.). Bull calves weighting 116 kg were grazed on either herb and legume mix or ryegrass and white clover pasture from November onwards except for 6 weeks from late March due to drought. During the drought all bulls were grazed together on whatever pasture was available but no weight gain occurred. The bulls returned to the treatment pasture in early

May. By 3rd June the live weight of the bulls on the herb and legume mix was 310 kg and on the ryegrass and white clover it as 249 kg.

The performance of livestock on chicory, plantain, and herb and legume combinations has led to widespread adoption of these pastures by New Zealand farmers. As a consequence farmers have used these species in a variety of innovative ways. Examples, include chicory used as a summer forage crop for one or two years, plantain combined with red clover and white clover used for finishing lambs and bulls, plantain broadcast on hillsides to finish lambs and maintain ewe condition, and a herb and legume mix (chicory, plantain, red clover, white clover) used for lambing through to weaning and then used for finishing lambs and bulls in summer.

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