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WHAT IS KNOWN ABOUT FORAGE HERBS AND THEIR POTENTIAL USE IN SOUTH AFRICA?

Cichorium intybus and *Plantago lanceolata*

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7 July 2016

Origin

Chicory (*Cichorium intybus* L.)

Asteraceae (daisy) family

- **origin in Europe, central and western Asia and North Africa** (Agfact 2000; Koch et al 1999)
- **Possibly also America** (Li and Kemp 2005)

Plantain or ribwort (*Plantago lanceolata*)

Plantaginaceae family

- **origin in Europe, central Asia** (FAO 2012)

Both species have long history of use: (Li and Kemp 2005, Stewart 1996)

- **Chicory as a vegetable and coffee substitute**
- **Plantain as a minor forage crop**

Morphology and Ecophysiology

Chicory (*Cichorium intybus* L.) (AgFact 2000, Lee et al. 2015, Li and Kemp 2005, Moloney and Milne 1993,

- **Temperate species**
- **Broad prostrate leaves in a single rosette in first year and multi-crowned rosette from second growing season**
- **Deep taproot up to 1.5m depending on soil properties**
- **Summer active growth (some winter growth – genotype dependent)**
- **Requires vernalization for flowering (min 3 weeks of 4°C)** (Demeulermester and de Proft 1999)
- **Tolerates soil acidity**
- **Drought tolerance – deep root and high photochemical efficiency (PS II)**
(Langworthy et al 2015)
- **Can resume production after periods of stress**
- **Excessive heat reduces root weight** (Mathieu et al, 2014)
- **Excessive heat increases total number of leaves but reduces size**
- **Excessive heat increases photosynthetic efficiency**
- **Excessive heat can induce flowering in some plants**



Morphology and Ecophysiology

Plantain (*Plantago lanceolata*) (Agricom, 2015, Stewart et al. 2014)

- Temperate species
- Narrow elongated leaves
- Taproot, deeper rooted than ryegrass but shallower than chicory
- Summer active growth (some winter active growth – genotype dependent)
- Flowering in plantain?
- Tolerates soil acidity
- Drought tolerance – under lenient grazing
- Compensatory growth after moisture stress



Advantages of chicory and plantain

Lee et al 2015a &b, Li and Kemp 2005, MacFarlane et al 2015, Pembleton 2015, Stewart et al 2014.

- **Spring, summer, early autumn growth**
- **Genotypes with good late autumn, winter and early spring growth**
- **Good forage quality – high ME and digestibility**
- **Deep root system**
 - Good in mixtures
 - Extracts water and nutrients from below grass root zone
- **Plantain contains secondary compounds which may benefit animal health**

Disadvantages chicory and plantain

Lee et al 2015a &b, Li and Kemp 2005, MacFarlane et al 2015, Pembleton 2015, Stewart et al 2014.

- **Chicory crowns can be damaged with**
 - low grazing residual
 - trampling
- **Grazing interval and NSC reserves important for regrowth (temporal effects)**
- **Flowering stems not very palatable**
- **Not all varieties have a high degree of uniformity**
- **Must differentiate between “vegetable” types and forage types**
- **Plantain often regarded as a weed and thus not always accepted**
- **Persistence 2 to 3 years but thus comparable to perennial ryegrass in sub-tropical environments**

Production potential and forage quality

Lee et al 2015a &b, Li and Kemp 2005, MacFarlane et al 2015, Pembleton 2015, Stewart et al 2014.

- **In NZ chicory yields $> 20 \text{ t DM ha}^{-1} \text{ an}^{-1}$ have been recorded under irrigation**
- **NZ: Chicory + plantain: 17 t DM ha^{-1} over 18 months**
- **Best dryland yields recorded $19 \text{ t DM ha}^{-1} \text{ an}^{-1}$**
- **Dryland plantain $14 \text{ to } 19 \text{ t DM ha}^{-1} \text{ an}^{-1}$**
- **Lower yields have also been recorded**
- **Likely that perennial ryegrass yields more per annum but chicory and plantain yield better in summer**
- **Will be important to determine yield potential in the climatic zone / environment it is used in.**

Utilization options

- **Spring planting preferred due to vernalization requirements for flowering**
- **Autumn planting also possible in mixtures but persistence could be affected**

- **Special purpose crop**
 - Chicory or plantain or chicory/clover mixture
 - Manage for optimal yield in summer

- **Chicory with grass/clover**
 - Soil temperature important $>12^{\circ}\text{C}$
 - Shallow sowing depth $<10\text{mm}$

- **Oversown into pasture**
 - In spring into an autumn established pasture

- **Effluent crop**
 - Can remove nitrogen and potassium
 - Recover nutrient beyond grass root zone

Agricom 2015

Need to determine best options for local grazing systems and climate

Do forage herbs have a role in South African pastures?

- **Currently perennial ryegrass is most relied on dairy pasture**

(Fulkerson and Donaghy 2001, Slack et al. 2000)

- Limitations are its lack of heat tolerance
- Photosynthesis reduces >28-29°C
- Night temperatures above 18°C – exponential carbohydrate losses with increased temperature
- At a day/night temperature regime of 24/19°C ryegrass yield was 44% lower than at 18/13°C.
- Slow growth in winter

- **Kikuyu has low forage quality in summer**

- Chicory would be a good alternative for summer production and improved forage quality
- Possibly oversown or as mixture rather than special purpose crop
- Plantain could improve winter production of pastures (specific varieties)
- Forage herbs have the potential to improve milk production

Do forage herbs have a role in South African pastures?

- **Environmental advantages** (Edwards et al. 2015, Minnee et al 2013, Totty et al. 2013, Woodward et al. 2013)
- **Reduced urinary N output**
 - Urine-N concentration 20% lower on diverse pastures containing forage herbs
 - Perennial ryegrass/white clover: 200g N/cow/day
 - Mixed sward with chicory and plantain: 100g N/cow/day
- **Improved water use efficiency**
 - Maintains yield better than other pastures during water deficit
 - Better WUE than perennial ryegrass
- **Deep rooted** (Cassida et al. 2013)
 - Extract nutrients that have moved below the grass root zone

What questions have to be answered?

- **Variety (genotype) information is very important for the success of these crops**
- **Yield, disease and pest tolerance**
- **Forage quality under South African growing conditions (shorter daylength than NZ)**
- **Flowering behaviour on variety level**
- **Persistence, what is a suitable re-establishment cycle?**
- **Use in mixtures – what are appropriate mixtures?**
- **Establishment methods including herbicide use**
- **Grazing management**

Conclusions

- **Pasture systems will have to change to adapt to climate change**
- **Will require more robust species and pasture systems**
- **Will need to reduce the environmental impact of pastures**
 - WUE
 - NUE
 - Greater production on the same or less area
 - Improved forage quality
 - Less excreted N from grazing animals
- Inclusion of forage herbs into pasture systems can contribute positively to production in a changing environment and add robustness to pasture systems

Thank you

Advantages of chicory and plantain
