Opinion

Sustainable pasture improvement in the south of Chile

Keywords: grass species, soil fertility, grazing, selectivity

Volume 6 Issue 6 - 2017

Paulina G Flores,[1,2] Ignacio F López,[2,3] Peter D Kemp,[3] José Dörner[4,5]
[1]Graduate School, Faculty of Agricultural Science, Universidad Austral de Chile
[2]Institute of Animal Production, Faculty of Agricultural Science, Universidad Austral de Chile
[3]Institute of Agriculture and Environment, Massey University, Palmerston North, New Zealand
[4]Institute of Soil Science, Faculty of Agricultural Science, Universidad Austral de Chile
[5]Research Center on Volcanic Soils, Universidad Austral de Chile

Correspondence: Paulina G Flores, Graduate School, Faculty of Agricultural Science, Universidad Austral de Chile, Casilla 567, Valdivia, Chile, Email paulina.flores@postgrado.uach.cl

Received: March 24, 2017 | **Published:** March 24, 2017

Opinion

Improving the pasture condition and productivity as a means for increasing animal production is the key factor for the grazing systems of the South of Chile. The climate of this region is temperature humid, with a period of pasture soil water restriction from November to March, associated with summer rainfall amount and frequency. Several limiting factors contribute to lower pasture growth and production, including soil nutrient deficiency related to volcanic ash soils (allophanic sols), such as soil acidity, high levels of soil aluminum saturation as well as high phosphorus fixation. Also there are problems associated with grazing management, often due to overgrazing, which encourage the development of slow growing species, classified as stress toleraters.[1] Degradation signs common to these pastures are low annual dry matter (DM) production, normally less than 5ton DM ha^{-1} $year^{-1}$.[2] There are about 1.3million ha^{-1} of pastures in the South of Chile,[3] 91% of these pastures are naturalized, with 48% of them not receiving any type of fertilizer to compensate soil nutrient deficiencies, and therefore showing signs of degradation.[3]

To alleviate the soil pasture growth constraints, farmers have being directing their attention to four areas of pasture improvement: soil fertility, grazing, plant species and broad leaf species control. The level of fertilizer input depends on the potential production of the soil at site level, soil nutrients that constraint plant growth thus requires to be increased and pasture attributes indicators of pasture condition, such as botanical composition, species density and pasture herbage mass and height. The application of nitrogen (N), phosphorus (P), potassium (K), lime and other micronutrients are based on soil laboratory testing results.[4]

Liming increases the availability of other essential nutrients in the soil in addition to calcium. For most naturalized pasture in the South of Chile, the soil fertility correction program begins with lime addition to increase soil pH and to diminish soil aluminum saturation, which often in these naturalized pastures is larger than 10%.[1,4] N, P, and K are beneficial for the long term species persistence and productivity. The most cost effective use of fertilizer is a late Summer application, after a rainfall, and repeat N in early Spring when temperature starts increasing and soil water availability does not restricts pasture growth. As grazing is the lowest cost method to nutrient removal and harvest, a well-balanced stocking rate-pasture ratio is required, along with grazing frequency and intensity. It is important to provide a resting period to allow the individual plants recover their reserves after defoliation and regrowth. A well-planned grazing management stimulates pasture growth.

Pastures species may respond differently to grazing. This is why it is important to understand their particular growth strategies and their relationship with environmental attributes. The pasture botanical composition and production are the result of the interaction between these variables. In the South of Chile pastures, grass species provide the majority of the herbage mass produced. The legumes fluctuate between 8-15% of the botanical composition. However, legumes are a keystone within a pastoral system, through N fixation and often offering a high nutritive value. Pasture improvement strategies have a positive effect on botanical composition; however the pasture persistency is close related to the improvement strategy applied. Establishing a new pasture through cultivation gives good results in terms of high herbage mass production in the short term. The widely utilized *Lolium perenne* L. combined with *Trifolium repens* L. It is typical that after three years the sown pasture has had significant changes in its botanical composition, production and quality. The establishment of a diverse pasture with species such as *L perenne*, *Bromus valdivianus* Phil, *Holcus lanatus* L, *Dactylis glomerata* L and *T repens* generates a more persistent and stable pasture, able to produce close to 14 t DM ha^{-1} $year^{-1}$.[3]

Alternatives to cultivation, as a pasture improvement method, are (i) direct drilling and (ii) the addition of fertilizer and lime with a controlled grazing.[5] Allophanic soils have shown to have a high physical resilience after compression.[6] Therefore, there are advantages to keep the physical structure of a prior pasture. Direct drilling ensures that the top soil is only disturbed in the sowing line; the rest of the soil maintains its physical attributes. Thus, mainly during the first year, the new pasture utilizes the soil pore continuity and functioning from what it was before sowing the new pasture. This is relevant for soil water retention and soil water flow in the soil profile, especially towards the first summer after establishing the pasture.[5]

The addition of fertilizer and lime with a controlled intensive grazing management constitutes another pasture improvement strategy. It is based on soil nutrient constraint alleviation for fast growing species. At the same time it encourages tillering from fast growing grasses, stolon bud growth in the case of *T. repens* or other stoloniferous legume species and favors light interception and

utilization by the pasture canopy resulting on increasing herbage mass production. Grazing management is based on targets looking at pasture herbage mass before and after grazing, as it was shown by INE[3] for dairy cows and by Flores[1] for sheep. The result from the interaction between soil nutrient constraint alleviation and grazing management is a succession of pasture species as part of the botanical composition, which increases fast growing species and the diminishes slow growing species. The changes may occur in the short to medium term, with the increase of the annual pasture production: first year from 4190kg DM ha^{-1} by the pasture that did not receive fertilizer (control) to 8415kg DM ha^{-1}, second year from 5854kg DM ha^{-1} given by the control to 8443kg DM ha^{-1}, and third year from 6188kg DM ha^{-1} by the control to 12800kg DM ha^{-1}.[1]

Intensive grazing by sheep increases the uniformity of the pasture after grazing, especially in diverse pastures, such as naturalized pasture. Grazing may also provide broad leaf species control, a more homogeneous distribution of urine and faeces, and also stimulate the mobilization of photosynthate reserves.[7,8] Sheep can be selective between species and parts of plants, increasing pasture quality.[9] The selective grazing generates a pasture structure, with areas intensively grazed and others less frequently grazed.[10,11] Selective grazing can highlight the succession of species in a pasture, stimulating the growth of some species more than others.[9,12] The grass species are selectively grazed on Spring time, which has a close relationship to a high crude protein content and tillering increase. However, sheep under available pasture restriction, for example during Summer when the growth rate of the fast growing grass species has diminished due to the soil water restriction,[13] the selection pressure is on broad leaf species because these species may have enough water soluble carbohydrate content to be palatable.[14] Several studies focused on sheep grazing behavior showed a pasture structure with a decreased broad leaf species while grasses and legumes species increased.[15–20]

Conclusion

In conclusion, the response to the increase in fast growing species and the pasture production are based on the fulfillment of the nutritive requirements of the species and the alleviation of soil constraints due to the addition of fertilizers, lime and the control of the grazing. The pasture improvement is a continuous process resulting from the close interaction between soil chemical and physical attributes and the pasture species. When the species were subjected to an intensive controlled sheep grazing then tillering of fast growing species was stimulated and the proportion of them in the pasture increased.

Acknowledgements

This work is a result of two research projects (Nº 1100957 and 1130795) sponsored by Fund for the Scientific and Technological Development (Fondecyt).

Conflict of interest

The author declares no conflict of interest.

References

1. Flores PG, López IF, Kemp PD, et al. Prediction by decision tree modelling of the relative magnitude of functional group abundance in a pasture ecosystem in the south of Chile. *Agriculture Ecosystems and Environment*. 2017;239:38–50.
2. Balocchi OA, López IF. Herbage production, nutritive value and grazing preference of diploid and tetraploid perennial ryegrass cultivars (*Lolium perenne* L). *Chilean Journal of Agricultural Research*. 2009;69(3):331–339.
3. INE. Instituto Nacional de Estadística VII Censo Nacional Agropecuario. Santiago Chile; 2007.
4. Keim JP, López IF, Balocchi OA. Sward herbage accumulation and nutritive value as affected by pasture renovation trategy. *Grass and Forage Science*. 2015;70(2):283–295.
5. Zúñiga F, Ivelic–Sáez J, López I, et al. Temporal dynamics of the physical quality of an Andisol under a grazing system subjected to different pasture improvement strategies. *Soil and Tillage Research*. 2015;145:233–241.
6. Dec D, Dörner J, Balocchi O, et al. Temporal dynamics of hydraulic and mechanical properties of an Andosol under grazing. *Soil and Tillage Research*. 2012;125:44–51.
7. Liu J, Wang L, Wang D, et al. Plants can benefit from Herbivory: Stimulatory effects of sheep saliva on growth of Leymus chinensis. *PloS ONE*. 2012;7(1):e29259.
8. Soder KJ, Rook AJ, Sanderson MA, et al. Interaction of plant species diversity on grazing behavior and performance of livestock grazing temperate region pastures. *Crop Science*. 2007;47(1):416–425.
9. López IF, Hodgson J, Hedderley DI, et al. Selective defoliation by sheep according to slope and plant species in the hill country of New Zealand. *Grass and Forage Science*. 2003;58(4):339–349.
10. Chapman DF, Parsons AJ, Cosgrove GP, et al. Impacts of spatial patterns in pasture on animal grazing behavior, intake, and performance. *Crop Science*. 2007;47(1):399–415.
11. Rossignol N, Chadoeuf J, Carrere P, et al. A hierarchical model for analysing the stability of vegetation patterns created by grazing in temperate pastures. *Applied Vegetation Science*. 2011;14(2):189–199.
12. Zaller JG. Sheep grazing vs. cutting:regeneration and soil nutrient exploitation of the grassland weed *Rumex obtusifolius*. *BioControl*. 2006;51(6):837–850.
13. Ordoñez I, López I, Kemp P, et al. *Effect of pasture improvement managements on physical properties and water content dynamics of a volcanic ash soil in southern Chil*e. In preparation; 2017.
14. Flores P. *Interacciones ecosistémicas y cambios en las relaciones pratenses al mejorar praderas naturalizadas degradadas con pastoreo ovino intensive [Ecosystem interactions and changes in pratenses relations by improving naturalized degraded pasture with sheep grazing intensive]*. Thesis Doctor in Agricultural Sciences Universidad Austral de Chile; 2015. 224 p.
15. Black JL, Kenney PA. Factors affecting diet selection by sheep. 2. Height and density of pasture. *Crop and Pasture Science*. 1984;35(4):565–578.
16. Evju M, Mysterud A, Austrheim G, et al. Selecting herb species and traits as indicators of sheep grazing pressure in a Norwegian alpine habitat. *Ecoscience*. 2006;13(4):459–468.
17. Grime JP, Hodgson JG, Hunt R. Comparative plant ecology: a functional approach to common british species, first ed. Unwin Hyman London; 1989.
18. Hamilton BA, Hutchinson KJ, Annis PC, et al. Relationships between the diet selected by grazing sheep and the herbage on offer. *Crop and Pasture Science*. 1973;24(2):271–277.

19. Newman JA, Parsons AJ, Harvey A. Not all sheep prefer clover:diet selection revisited. *The Journal of Agricultural Sciene*. 1992;119(2):275–283.

20. Villalba JJ, Provenza FD, Hall JO, et al. Selection of tannins by sheep in response to gastrointestinal nematode infection. *Journal of Animal Science*. 2010;88(6):2189–2198.

Citation: Flores PG, López IF, Kemp PD, et al. Sustainable pasture improvement in the south of Chile. *Adv Plants Agric Res.* 2017;6(6):171–173.
DOI: 10.15406/apar.2017.06.00232