

# Italian ryegrass establishment by self-seeding in integrated crop-livestock systems: effects of grazing management

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## Introduction

Recent reports have indicated that integrated crop-livestock systems (ICLS) can enhance sustained crop and livestock production by efficiently using agricultural system resources (Liu *et al.* 2012). In the subtropical South American regions, soybean (*Glycine max* L. Merrill) and maize (*Zea Mays* L.) crops are widely grown after Italian ryegrass (*Lolium multiflorum* Lam) pastures. In this system, the pasture may be established by self-seeding. Self-seedling reduces pasture production costs and extends the grazing period. The stoking method, and especially the grazing intensity, can greatly affect the quantity of seeds added to the soil by affecting the demography of the reproductive tillers. In subtropical areas where Italian ryegrass is used for winter pastures in ICLSs, the effects of crop rotation, stocking methods or grazing intensities on the subsequent ability of Italian ryegrass to self-seed are unknown.

The objectives of this study are to evaluate the effects of management practices (crop rotation, stocking method and herbage allowance) on the establishment of Italian ryegrass pastures by self-seedling in an ICLS.

## Methods

The study was conducted in Southern Brazil region (30°05'22"S, 51°39'08"W). The experiment was initiated in 2003 and covered a total area of 4.8 ha. The area is managed as an ICLS with Italian ryegrass pasture with sheep in the winter rotated with maize or soybean crops in the summer. The winter pasture establishes itself each year by self-seeding. The pasture has been managed with two stocking methods (continuous and rotational) managed with two herbage allowances (10 and 20 kg DM/100 kg LW). Details on the experiment can be found in Barth Neto *et al.* (2012). During the summer of 2011/2012 we sowed soybeans and maize, and the crops were harvested on 07 and 08/05/2012. The winter pasture was assessed during winter grazing in 2011 and pasture establishment in 2012. The winter pasture received one application of 75 kg/ha of nitrogen on 01/06/2012. We assessed the reproductive tiller density every two weeks during the winter grazing period of 2011. Sampling was conducted by collecting three sample replicates per

experimental unit. For each sample, we counted the number of reproductive tillers inside of a 10×10 cm metallic frame. We assessed the vegetative tiller density during pasture establishment in 2012 by following the same procedure. To determine the herbage mass, we cut all tillers inside of the metallic frame at ground level after they were counted and oven-dried these samples at 60°C. To account for potential spatial and temporal correlations in the data, we used mixed linear models for reproductive tiller density, vegetative tiller density and herbage mass accumulation in R 2.12.0 (R Development Core Team 2010).

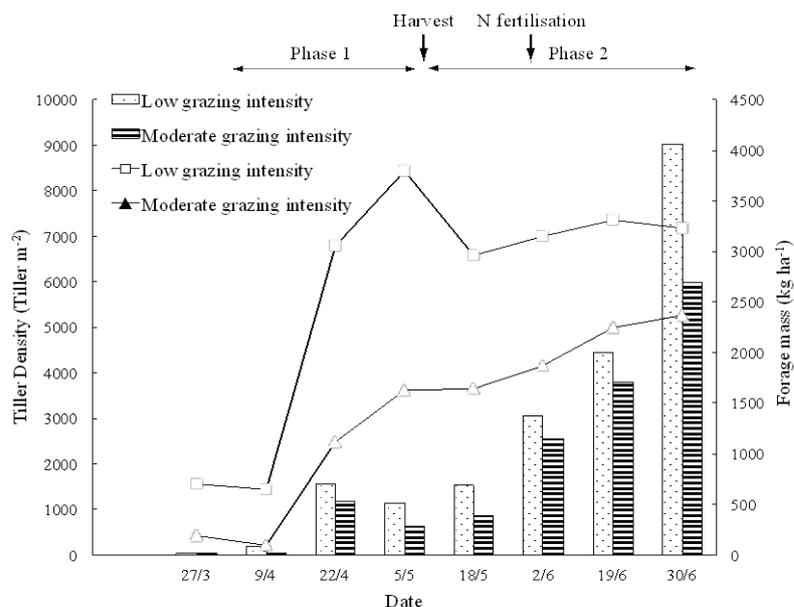
## Results

The establishment of Italian ryegrass showed two distinct phases regarding the dynamics of vegetative tiller density and herbage mass in 2012 (Fig. 1). Between March 27<sup>th</sup> and May 5<sup>th</sup>, the vegetative tiller density increased rapidly to a maximum value. During that first phase, the herbage mass remained low. However, during the second phase (after May 5<sup>th</sup>), the vegetative tiller density in the treatment with low grazing tended to stabilise while with moderate grazing it continued to increase. In contrast, the herbage mass regularly increased, with rates varying with treatments. At the end of the first ryegrass establishment phase (May 5<sup>th</sup>, 2012), we observed a statistic significant quadratic relationship ( $P=0.029$ ) between reproductive tiller density in 2011 and vegetative tiller density in 2012 (Fig. 2). Grazing intensity had a significant negative effect on the intercept of this relationship. Low grazing intensity had a significant positive effect on vegetative tiller density, which reflected the higher vegetative tiller density that was reached during the first establishment phase in the low grazing treatments (Fig. 1).

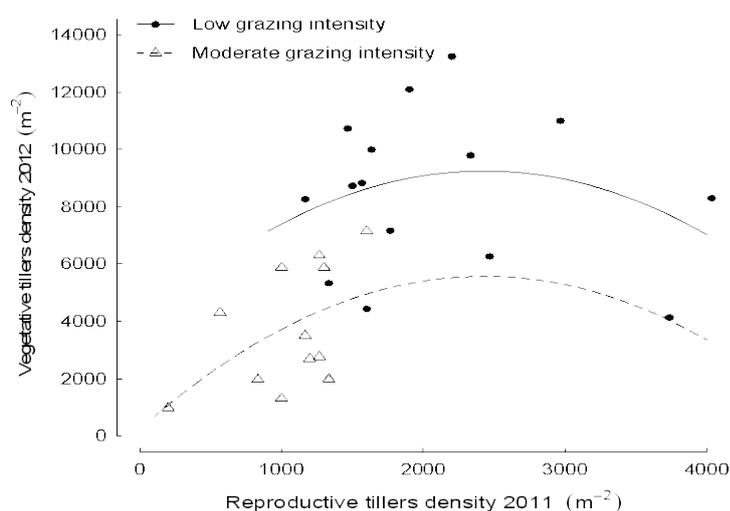
## Discussion

This two phase dynamic process corresponded to tiller population establishment, and the development and growth of the established tillers. When a very high tiller density was reached in the first phase, the tiller population decreased during the second phase, probably because of competition between tillers according to the size/density compensation theory (Sackville *et al.* 1995).

Grazing management, and particularly grazing



**Figure 1.** Evolutions of Italian ryegrass vegetative tiller density and herbage mass during pasture establishment in 2012. Treatments included prior grazing intensity (low or moderate).



**Figure 2.** Relationship between the reproductive tiller density on the last sampling date of the grazing phase in 2011 and the vegetative tiller density on 05/05/2012. The plotted lines represent the predicted quadratic regression, determined by minimising the deviation of the fitted values.

intensity in one year, was the most important factor that affected the success of pasture establishment in the following year. Tiller density increased more quickly during the first phase and reached greater values when the pasture suffered lower grazing intensities in the previous year (Fig. 1). This advantage, observed at the beginning of the establishment, predicted the success of pasture establishment regarding both tiller density and herbage mass. However, low grazing intensities lead to more mature pastures with greater photosynthetic capacities. As a result, these pastures may produce more seeds per reproductive tiller and with higher germination rates (Fig. 2).

## Conclusion

To ensure pasture re-establishment, it is important to manage grazing and, particularly, herbage allowance to allow for sufficient reproductive tiller production (*i.e.*,

$\geq 1300$  tillers/m<sup>2</sup>). Pasture establishment was faster in the ICLSs that were managed with low grazing intensity, thus allowing grazing herbivores to enter the system earlier, which increases the grazing period.

## References

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