PP 106 Short- and long-term effects of sowing rate on plant density of lucerne (*Medicago sativa* L.): a review of experiments.

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Efectos de la densidad de siembra de alfalfa sobre la densidad de plantas en el corto y largo plazo: revisión de experimentos.

Introduction

Sowing rate (SR) is a critical determinant of pasture establishment. Lucerne plants respond to low initial plant density by increasing the number of shoots per plant (Teixeira et al., 2007). This compensation mechanism determines relatively constant yields over a wide range of plant densities, but such plasticity has a limit. For instance, Teixeira et al. (2007) found that the productive potential of "Kaituna" lucerne declined below 43 plants m^{-2}. Berti et al (2018) indicated a higher threshold for lucerne crops in their establishment year (73 pl m^{-2}), while Romero et al. (1995) mentioned a threshold of 30 pl m^{-2} for Argentina.

Many experiments that evaluated the impacts of SR on yield and cover of lucerne pastures show that populations lower than 250 to 300 pl m^{-2} could expose the stand to weed encroaching and thus reduce lucerne cover and production (Huarte & Arnold, 2003).

The objective of this work was to analyse datasets from 23 experiments to assess the impact of SR on plant population of lucerne in both the seedling phase (*i.e.* first 90 days) and in the long term (*i.e.* up to 1800 days after sowing [DAS]).

Materials and methods

Data of SR (kg of bare seed ha^{-1}) and plant population (pl m-2) were retrieved from 23 papers. Thirteen of those papers also analysed the seedling phase. Papers covered a wide range of locations from the Northern and Southern Hemisphere and included experiments from Autumn, Spring and Summer sowings. Data in tables was extracted manually and in figures using Web Plot Digitizer (automeris.io/WebPlotDigitizer). Statistical analysis were carried out with JMP® (version 11, SAS Institute Inc., Cary, NC) and Sigmaplot ® (version 14, Systat Software, San Jose, CA).

Results and discussion

Figure 1 shows data gathered from all the experiments. Each symbol represents a range of SR (reported in the figure). Plant population declined exponentially in all SR [y=343.4e(-0.0015x); R^2=0.34, p<0.05]. The decline was slower (p<0.05) when SR was below 5 kg ha^{-1}, but the threshold number of plants (*i.e.* 40-50 pl m^{-2}) was reached ~400 days earlier (p<0.05) than the other treatments (1,000 vs 1,400 DAS).

There was a linear relationship (y=20x+41.5; R^2=0.79, p<0.05) between SR and the number of plants m^{-2} established 90 DAS (Figure 2). Increasing SR resulted in a higher number of plants established. Data from the experiments indicated that the probability (*i.e.* number of cases/total cases) of achieving the minimum recommended plant density at sowing (250 plants m^{-2}) increased as SR increased. It was 0%, 0%, 43.7% and 82.3% when SR was between <5 (n=107), 5-10 (n=166), 10-15 (n=155) and 15-20 (n=130) kg ha^{-1}; and was maximum (100% probability) when SR was above 20 (n=154) kg ha^{-1}.

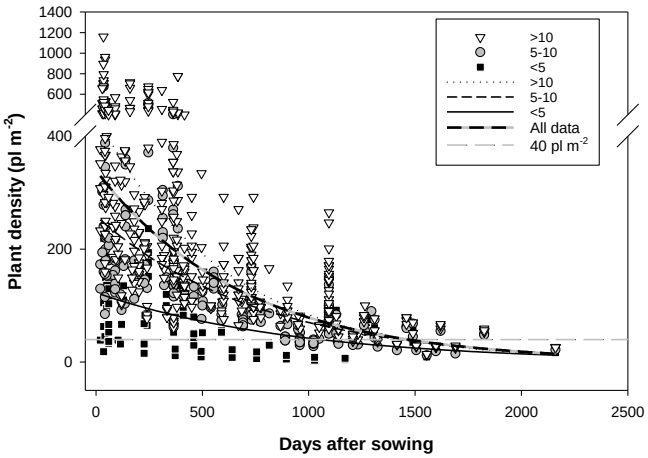

Figure 1. Evolution of lucerne plant density (plants m^{-2}). The grey and black line indicates the exponential decay of plant density for the whole dataset.

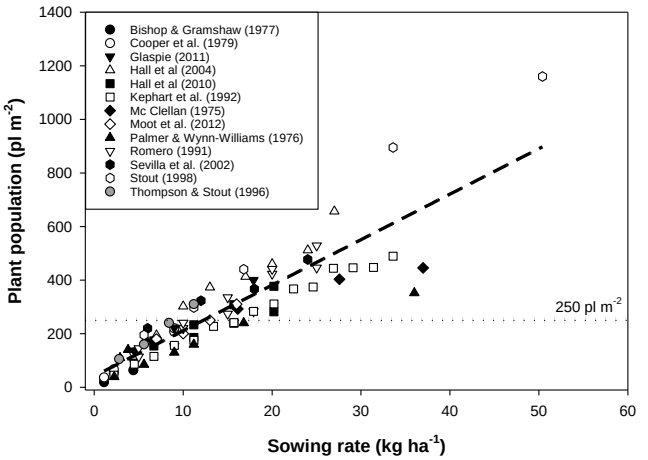

Figure 2. Lucerne plant density (plants m^{-2}) between 30 and 90 days after sowing in response to sowing density (kg of bare seed ha^{-1}). The dotted line indicates the minimum recommended plant density

Conclusions

During the seedling stage, more than 10 kg of bare seed ha^{-1} are required to reach the minimum recommended number of plants (250 pl m^{-2}). Even when data indicates that as little as 5 kg ha^{-1} of bare seed are enough to reduce the time it takes the stand to reach the threshold of minimal plant density by ~400 days, increasing sowing rate to >10 kg ha^{-1} appears to be necessary to reduce weed competition and the costs associated with herbicides.

References

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