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White clover seed production response to irrigation

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Introduction

White clover is more sensitive to soil water restriction compared to other perennial legumes, due to its shallow root system and poor stomatal control. Its undetermined growth is influenced by soil water content and seed production is reduced when vegetative growth is not restricted through irrigation management. Restricting the amount of soil available water during the bloom stage reduced plant vegetative growth and increases seed production (Clifford, 1986). In Uruguay, there is not a defined rainy season, and annual average ranges between 1100 and 1300mm. However, due to higher water demand during late spring and summer, a water deficit period is usually registered between November and February, during white clover reproductive stage. The objective of our research was to determine white clover seed production response to different levels of irrigation in Uruguay.

Methods

The experiment was conducted in 2012 growing season at INIA Treinta y Tres (Uruguay), "Estación Experimental del Este" research station, on a second year white clover (*Trifolium repens L.*, Ladino-type cv Zapican) stand. The soil at the site is an Oxiaquic Argiudoll, with a water holding capacity of 75mm in the first 60 cm depth.

The crop was re fertilized with 200 kg of phosphate rock in the fall. Before staring the irrigation treatments, the field was grazed with steers to consume the forage produced, and the remaining forage was mowed to 10 cm height.

The treatments consisted in a factorial of two re-growth periods, called "early" or "late" field closing (September 15 or October 15), and four levels of irrigation: 0 mm (control), 15 mm, 30 mm, and 45 mm. The experimental design was a split-plot with three replications. The size of the plots receiving the 8 treatments was 10 x 15m.

The irrigation method was conventional spray using with linear pivot. After the field was stopped grazing and mowed ("closing time"), irrigation was applied each time plant available water was depleted by 45 mm. Therefore, plots receiving 45mm of irrigation always reached field capacity, while treatments receiving 30 and 15 mm always showing some water deficit. The soil water balance was calculated on a daily basis to determine irrigation needs, using the crop evaportanspiration (Penman-Monteith), registered precipitation at the experimental site, and the soil water holding capacity. Precipitation during October, November and December, was 142, 31 and 215 mm, respectively. According to the water balance calculated, three irrigation events were needed in November.

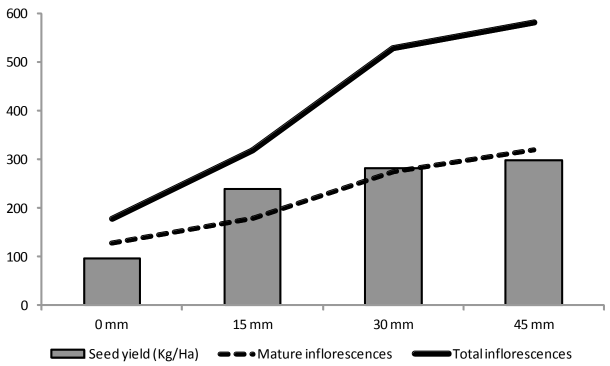

Figure 1. Seeds production (kg/ha), number of mature and number of total inflorescences of White Clover cv Zapican for four treatments of irrigation: 0 mm (control), 15 mm, 30 mm and 45 mm.

Seed yield and biomass production was evaluated harvesting 2m^2 in each plot with a gas-powered mower. The mowed plant material was gathered by hand, put in burlap bags, and dried at 40 ºC for 2days. Above-ground phytomass was weighed and the seeds threshed, cleaned, and weighed. Moreover, the total number of inflorescences was counted, as well as the number of mature inflorescences for 3 samples of 0.5 x 0.2m on each plot. The number of flowers were counted on 10 clipped mature inflorescences per sample. Three flowers of each of these inflorescences were separated and the number of seeds counted. Harvesting was defined when 60% of the inflorescences reached maturity. A seed sample of each treatment was weight and counted, and the weight expressed as 1000 seed weight. All variables were tested by analysis of variance.

Results

The field closing date did not affect seed production. Irrigated treatments had higher seed production respect to the non-irrigated treatments (Fig. 1). The greatest seed production (299 kg/ha) was registered on the highest irrigation treatment (45mm), while the control treatment had three times less yield. There was no yield differences between treatments that received irrigation, however, treatments with higher irrigation volume tended to have greater yields. The total number of inflorescences was the most variable of the yield components, ranging from 178 inflorescences/m^2 for the control treatment to 582 inflorescences/m^2 on the 45 mm treatment. Irrigation of 30 and 45mm had similar total numbers of inflorescences, while 15 and 30 mm treatments presented lower values. The number of flowers per inflorescence was lower for the control respect to the irrigated treatments. However, the number of seeds per flower and seed weight were similar for all treatments. The accumulated biomass showed the similar results as seed production. The irrigated treatments presented similar production (3056 kg/ha at 45 mm), while the non-irrigated treatment produced less biomass (771 kg/ha).

Conclusions

White clover showed a high response to irrigation in terms of biomass and seed production. On summer with total precipitation above average values, the scarce precipitation registered in November (31 mm) determined big differences between irrigated and non-irrigated treatments. No statistical differences were found between different irrigation levels, however, treatments with higher amount of water added tended to show higher responses levels.

References

Clifford PTP (1986). Effect of closing date and irrigation on seed yield (and some yield components) of 'Grasslands Kopu' white clover. *New Zealand Journal of Experimental Agriculture* **14**, 271-277.