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Theme 2. Grassland production and utilization
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Management effect on rainfall use efficiency and growth rate of spineless cactus *cv.* Miúda in Northeast Brazil

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Introduction

Spineless cactus has a high rainfall use efficiency. Under water deficit, they open their stomata during the night to capture atmospheric carbon dioxide when the air temperature is lower and relative humidity higher (Taiz and Zeiger, 2009), losing less water to the atmosphere. The rainfall use efficiency (RUE) can be expressed as the amount of water used by the crop to produce dry matter (Han and Felker, 1997). The RUE showed by spineless cactus, a CAM plant, is three to five times greater than the one observed in C_3 and C_4 plants (Felker and Russel, 1988; Nobel, 1991). Therefore, spineless cacti (*Nopalea opuntia*) are important forage resource in northeast Brazil. Management practices, however, can affect the RUE and growth of spineless cactus, especially organic and mineral fertilization. Thus, the objective of this research was to evaluate the effect of organic and nitrogen fertilization and harvest frequency on rainfall use efficiency and growth rate of spineless cactus cv. Miúda (*Nopalea cochenillifera* Salm Dyck).

Materials and Methods

The experiment was carried out at the experimental research station of Pernambuco State Agricultural Institute (IPA), located in Caruaru, Agreste region of Pernambuco State. The site coordinates are 8°14' S and 35°55' W and altitude of 575 m above sea level. The rainfall during the experimental period was 946 mm and the soil of experimental station is classified as Regosol. Soil fertility results (0-20 cm layer) at the beginning of the trial are presented on Table 1. Treatments were a combination of organic fertilization (0, 10, 20, and 30 Mg of OM ha^{-1} $year^{-1}$, using cattle manure), levels of nitrogen fertilization (0, 120, 240 and 360 kg of N ha^{-1} $year^{-1}$, using urea) and harvest frequency (annual or biennial).

Table 1. Soil chemical characteristics at the experimental area before treatment application.

pH	mg dm^{-3}		$cmol_c$ dm^{-3}								g kg^{-1}	
	P^1		K	Na	Al	Ca	Mg	SB^2	CEC^3		V^4	$O.M.^5$
4.78	10.45		0.19	0.05	0.20	2.14	0.40	2.78	5.46		500.5	19.7

[1]Mehlich 1; [2]sum of bases; [3]cation exchange capacity; [4]base saturation; [5]soil organic matter.

The experimental design was randomized in blocks, arranged in a split-split-plot design with four replications per treatments. The main plot was the organic fertilization, the split-plot was the harvest frequency, and the split-split-plot the N fertilization. The cactus field was established in April and May of 2011. Plant spacing was 1.2 x 0.10 m, which is equivalent to a plant density of 83333 plants ha^{-1}. The organic fertilization was applied after the planting (June/2011) and after the annual harvest (July/2012). In the first year of growth, the nitrogen fertilization was applied in 05 June, and 19 July. In the second year of growth, the nitrogen fertilization was applied in 28 June and 23 July, and 19 August. Response variables evaluated included daily growth rate (kg of DM ha^{-1} day^{-1}) and rainfall use efficiency (RUE, kg of DM mm^{-1} of rainfall). Data were submitted to analysis of variance using the Proc Mixed procedure from SAS. LS Means were compared using the PDIFF procedure adjusted by Tukey used. When the effect of quantitative factors (organic and nitrogen fertilization) was significant ($p< 0.05$), polynomial orthogonal contrasts were used.

Results and Discussion

The rainfall use efficiency and cactus daily growth rate were not affected by harvest frequency or nitrogen fertilization. However, the daily growth rate increased linearly with increasing organic fertilization levels. The DGR varied between 16 kg of DM ha^{-1} day^{-1} in the absence of organic fertilization, and 58 kg of DM ha^{-1} day^{-1} with application of 30 Mg of OM ha^{-1} $year^{-1}$ (Figure 1).

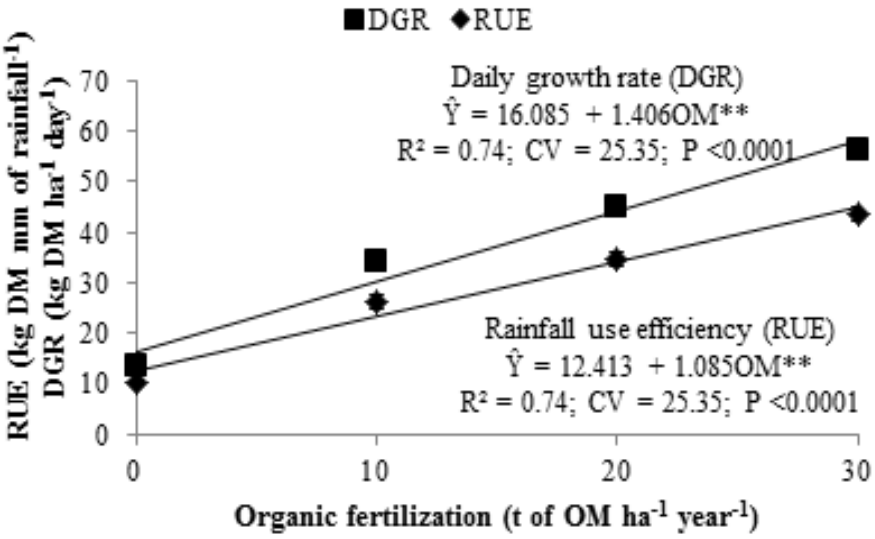

Fig. 1. Rainfall use efficiency (RUE) and daily growth rate (DGR) of spineless cactus cv. Miúda (Nopalea cochenillifera Salm Dyck), according to organic fertilization levels. Bars indicate standard error.

Rainfall use efficiency also increased linearly with increasing levels of organic fertilization, ranging from 12 kg of DM ha^{-1} mm^{-1} of rainfall in the absence of organic fertilization to 45 kg of DM ha^{-1} mm of $rainfall^{-1}$ (Figure 1). The amount of water required to produce 1 kg of DM were 975 and 230 kg for the treatments without organic fertilization and with 30 t of OM ha^{-1} $year^{-1}$, respectively. Water losses through evaporation, surface runoff, and deep drainage infiltration to deeper soil layers below the root system of the plant was not quantified, which might contribute to underestimate the results. Dubeux Jr. *et al*. (2006) evaluated *Opuntia ficus-indica (L.) Mill* and observed an average rainfall use efficiency of 18 kg of DM ha^{-1} mm^{-1} of rainfall and effects of N and P fertilization and plant density.

Conclusion

The daily growth rate and rainfall use efficiency increased linearly with the level of organic fertilization. Harvest frequency and nitrogen fertilization did not affect daily growth rate and rainfall use efficiency of spineless cactus cv. Miúda. (*Nopalea cochenillifera* Salm Dyck).

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