Produtividade da palma Miúda sob irrigação com diferentes níveis de água salina e doses de adubação orgânica no semiárido do Rio Grande do Norte

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Resumo: Avaliaram-se os efeitos de lâminas de água salina e doses de adubação orgânica com esterco bovino, sobre as características morfológicas da palma Miúda (*Nopalea cochenillifera* Salm Dick) em cultivo adensado. Realizou-se o experimento na EMPARN (5°31'21" Sul e 36°23'14" Oeste). O solo foi classificado como Cambissolo Háplico Carbonático Típico e a água de irrigação C4S1T3 (5,25 dS.m^{-1}). Plantio no espaçamento 2,0 x 0,25 m. Utilizou-se o delineamento inteiramente casualizado em parcelas subdivididas, com as lâminas de água salina (0; 7,5; 15 e 30 mm mês^{-1}) em intervalo de 10 dias, como as parcelas principais e adubação orgânica (0, 25 e 50 Mg ha^{-1} ano^{-1}), as subparcelas, com quatro repetições. Não houve influência da adubação orgânica com esterco bovino (P>0,05) sobre as variáveis estudadas. As lâminas de irrigação influenciaram significativamente (P<0,05) promovendo elevação nas produções de matéria verde e seca (13,55 Mg ha^{-1} ano^{-1}). A ausência da irrigação promoveu significativa expansão da praga da cochonilha de escama (*Diaspis echinocacti*) e quando irrigado com diferentes lâminas incrementou as perdas de estande, ocasionadas pela podridão mole (*Erwinia carotovora*), com mais intensidade na maior lâmina.

Palavras–chave: *Cactaceae*, forragem, irrigação, *Nopalea*, salinidade

Productivity of prickly pear cactus cv. *Miúda* irrigated with different levels of saline water and doses of organic fertilizer in Brazilian semiarid[1]

Abstract: This work evaluated the effects of different levels of saline water and doses of cow manure fertilization on the morphological characteristics and forage productivity of prickly-pear cactus cv. Miúda (*Nopalea cochenillifera* Salm Dick). The experiment was conducted at the (EMPARN, 5°31'2" South and 36°23'14" West). The soil was classified as Typical Cambisol Haplicum Carbonate and the water used in irrigation, was a C4S1T3 (5,25 dS.m^{-1}), with planting spacing of 2.0 x 0.25 m, standing a 20,000 plants ha^{-1}. A completely randomized design in a split plot was used, where water levels (0, 7.5, 15.0 and 30.0 mm month^{-1}) with 10 days intervals, were the main plots and organic fertilization (0 , 25 and 50 Mg ha^{-1} yr^{-1}) the subplots, with four replicates. There was no influence (P>0.05) of organic fertilization on most variables, particularly in relation to forage yield. The water levels had a significant influence (P<0.05), promoting increase on fresh and dry matter production (13.55 Mg DM ha^{-1} yr^{-1}). The absence of irrigation caused a significant expansion in cochineal pest (*Diaspis echinocacti*) while the soft rot (*Erwinia carotovora*) disease increased with irrigation.

Keywords: Cactaceae, forage, irrigation, Nopalea, salinity

Introduction

The cactus pear cultivated as forage crop has given support to the livestock feeding in semi-arid region of Brazil, due to its adaption to the soil and climate conditions of this region, being a MAC metabolism plant (crassulacean acid metabolism), with high water use efficiency, high energy value and good productivity in the semi-arid region of Rio Grande do Norte, of 30 Mg ha^{-1} year^{-1} (LIMA et al., 2014), when drip irrigated. However, at the backlands, the nights are hot and the humidity low, and these climatic conditions limit the full development of cactus pear, causing severe cladodes wilting even death of plants, when at the opening of the stomata at night, being the case in the *Seridó* and Central areas of RN. This picture has been reversed with irrigation, using minimal amounts of water, with a drip system, becoming an option for enabling technology for the pear cactus cultivation in these areas (LIMA et al., 2015). The objective of this work was to evaluate the effects of different levels of saline

water and doses of organic cow manure, on fresh and dry matter production of prickly pear cactus cv. *Miuda*, dense cultivated, in the central region of Rio Grande do Norte.

Material e Methods

The experiment was carried out at EMPARN Experimental Station (5° 21 ' 31 "South and 36° 23 ' 14" West), RN. The soil was classified as Typical Haplicum Carbonate Cambisol and the irrigation water as $C_4S_1T_3$ (5.25 dS m^{-1}). The planting was in August 2012, on the spacing of 2.0 x 0.25 m (20,000 plants ha^{-1}) in an area of 0.32 ha (74 m x 43 m). The treatments were initiated in November 2013 in a completely randomized design with subdivided plots, with four levels of saline water (0; 7.5; 15 and 30 mm $month^{-1}$) in intervals of 10 days, as the main plots and three doses of organic fertilizing with cow manure (0, 25 and 50 Mg ha^{-1} $year^{-1}$), as the subplots, with four replicates. Rainfall within the 12 months of the test period was 438.3 mm. The harvest was made in November 2014, preserving even the secondary order cladode and collecting samples of 1.0 kg per sub-plot for determining dry matter (SILVA & QUEIROZ, 2002), and subsequently calculation of dry matter (DMP) production.

By subplot, based on the DMP and the amount of available water (precipitation plus irrigation level) the water use efficiency (WUE) in kg DM per mm of $water^{-1}$ was calculated. After harvesting, the experimental plants, the damage over plants caused by cochineal scale (*Diaspis echinocacti*) and by rot disease (*Erwinia carotovora*) were scale measured. Both injuries were scaled with notes in a range from zero to four, being, 0 for absent, 1 for light, 2 for moderate, 3 to high and 4 for very high. The data were subjected to analysis of variance and regression, the 5% level of significance (SISVAR, 1996) and average comparisons of treatments by Tukey test ($P < 0.05$).

Results and Discussion

There was no interaction ($P > 0.05$) among the factors studied, saline water levels and doses of organic fertilizer with cow manure for the variables studied. And also, no significant response of organic fertilizer was obtained for the variables studied. There were isolated effects of levels of saline water ($P < 0.05$) to fresh matter production (FMP), DMP, cochineal and rot disease damage but not for WUE.

Increasing linear effect ($P < 0.05$) of the FMP for levels was observed, obtaining higher production (191.25 Mg ha^{-1} $year^{-1}$) in 30 mm blade $month^{-1}$, intermediate in 15 mm blade (114.42) and smallest with 7.5 mm (97.88) and in the absence of irrigation (58.83), which were not different among themselves. There was a quadratic effect ($P < 0.05$) of saline water levels for the concentration of DM, being higher when in the absence of irrigation (13.11%) and lower, when on 30 mm level (7.14%). There was a positive linear effect of water levels ($P < 0.05$) on DMP of prickly pear cactus cv. *Miúda* at 12 months of regrowth with different levels of saline water applied and no effect on WUE and values are presented in Table 1.

Table 1. Dry matter production (DMP) and water use efficiency (WUE) of prickly pear cactus cv. *Miúda* at 12 months regrowth under saline water levels of irrigation

Levels of water (mm $month^{-1}$)	DMP (Mg ha^{-1} $year^{-1}$)	WUE (kg DM mm $water^{-1}$)
0	7,63 b	17,42 a
7,5	9,11 ab	17,24 a
15	9,66 ab	15,62 a
30	13,55 a	16,98 a
CV (%)	19,34	18,51
Equation	Y = 7,45 + 0,194x (P<0,05)	---
r^2	0,97	---

Means followed by same letter in column are not different by Tukey test (P>0,05)
r^2 – coefficient of determination

The treatment with 30 mm level of water $month^{-1}$ had an increment of 77.59% in the production of DM than treatment without irrigation. However, it is worth mentioning that the differences among the treatments were lower when compared to the production of FM, due to the large differences in concentration of DM among the treatments within levels, since DMP is calculated by multiplying the FMP by concentration of DM. In the treatments without irrigation and those receiving 7.5 mm $month^{-1}$ the plants had high transpiration rate and severe wilting. In general, DM yielding obtained may be considered significant, as mention by Dubeux Jr. & Santos (2005), to whom cactus pear yields in the northeastern semi-arid region in the order of 10 to 20 Mg ha^{-1} $year^{-1}$, is difficult to be obtained with other forage crop, mainly with equal quality.

The absence of response to different water levels for the variable WUE can be explained by the smaller difference in DMP among treatments, associated with different amounts of water available by the sum of precipitation plus water applied through irrigation.

A descending linear effect was observed ($P < 0.05$) for water levels on the presence and the damage caused by cochineal on the prickly pear cactus cv. *Miúda* at 12 months of regrowth. On the other hand, there has been increasing linear effect ($P < 0.05$) for the occurrence of the soft rot due to irrigation applied. In table 2, are the averages of the scale of notes applied (0 to 4) depending on the level of stand damage.

Table 2. Damage caused by cochineal pest and rot disease on prickly pear cactus cv. *Miúda* at 12 months of regrowth under saline water irrigation

Levels of water (mm month^{-1})	Cochineal damage	Soft rot disease damage
0	3,08 a	0,33 c
7,5	2,75 ab	1,67 b
15	1,83 bc	1,67 b
30	1,33 c	3,0 a
CV (%)	13,81	35,77
Equation	Y = 3,05 – 0,061x (P<0,05)	Y = 0,60 + 0,081x (P<0,05)
r^2	0,93	0,91

Means followed by same letter in column did not differ by Tukey test (P>0,05)
r^2 – coefficient of determination

As for the cochineal presence on plants the incidence was increased in the dry season, with 100% of non-irrigated plots heavily affected, showing 42% with very high damage and 25% with high damage (Grade 4 and 3, respectively), reaching almost 70% of the experiment. For bacterial infection, the 30 mm blade had severe damage and loss of stand by soft rot disease, observing that 100% of the parcels of this treatment were infected, and 50% with very high incidence (Grade 4).

Conclusions

There was no influence of organic fertilization with cow manure on the variables studied, particularly in relation to the production of FM and DM. The levels of irrigation with saline water had significant influence on the variables and promoted increase in the productions of FM and DM, especially on 30 mm month^{-1} level. The absence of irrigation promoted significant expansion of the cochineal pest and irrigation with different levels of water increased the damages and losses caused by the soft rot disease, intensified in the largest blade. The continuity of research will evaluate the evolutions of responses to organic fertilizing, the saline water and the intensity of damage promoted by insect and bacteria.

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