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INSTALLMENTS AND DOSES OF NITROGEN FERTIGATED INTO THE CORN CROP

PARCELAMENTOS E DOSES DE NITROGÊNIO FERTIRRIGADAS NACULTURA DO MILHO

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ABSTRACT: The aim of the study was to evaluate the impact of different forms of nitrogen installment and doses via fertigation on the corn crop in a semi-arid climate. The experiment was carried out in the field using the maize crop (Zea mays L.) hybrid AG 1051, with a randomized block design with four replications and treatments arranged in a factorial scheme (3x5), consisting of three forms of nitrogen dose installment (P1, P2 and P3) associated with five doses of nitrogen (D1 - control, D2 - 50, D3 - 100, D4 - 150 and D5 - 200% of the recommended dose, respectively 0, 85, 170, 255 and 340 kg ha-1). The irrigation system was localized drip irrigation with daily irrigations to replenish the ETc and the nitrogen source used was urea. Vegetative and production variables were assessed: Dry mass of the aerial part of the plant (MSPAP); Ear mass with straw (MESPCP); Ear mass without straw (MESPSP); 100-grain mass (M100G). The variables MSPAP, MESPCP and MESPSP were only influenced by the doses of N, while MP was not influenced and M100G showed a significant interaction between the treatments.

Keywords: *Zea mays L, plant nutrition, nitrogen fertilization.*

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RESUMO: O estudo teve por objetivo avaliar o impacto de diferentes formas de parcelamento e doses de nitrogênio via fertirrigação na cultura do milho em clima semiárido. O experimento foi realizado em campo utilizando a cultura do milho (Zea mays L.) híbrido AG 1051, com delineamento experimental de blocos ao acaso com quatro repetições e tratamentos arranjados em esquema fatorial (3x5), composto por três formas de parcelamento da dose de nitrogênio (P1, P2 e P3) associadas a cinco doses de nitrogênio (D1- testemunha, D2 - 50, D3 - 100, D4 – 150 e D5 - 200% da dose recomendada, respectivamente 0, 85, 170, 255 e 340 kg ha-1). O sistema de irrigação foi do tipo localizado por gotejamento com irrigações diárias visando repor a ETc e a fonte de nitrogênio utilizada ureia. Foram avaliadas as variáveis vegetativas e variáveis de produção: Massa seca da parte aérea planta (MSPAP); Massa da espiga com palha (MESPCP); Massa da espiga sem palha (MESPSP); Massa de 100 grãos (M100G). As variáveis MSPAP, MESPCP e MESPSP foram influenciadas somente pelas doses de N, enquanto a MP não foi influenciada e a M100G apresentou interação significativa entre os tratamentos.

Palavras-chave: *Zea mays L, nutrição de plantas, fertirrigação nitrogenada.*

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INTRODUCTION

Monitoringagroclimatic dynamics is crucial for Maize (Zea mays L.) is one of the main cereals produced in the world and the most widely grown in Brazil, in regions with high availability of water, nutrients and solar radiation, such as the tropics and subtropics, which favors high biomass production (DANTAS JUNIOR et al., 2016). In the Northeast, corn is widely grown by family farmers, mainly in areas smaller than 20 hectares. Its sale in the green stage is more profitable than that of dried grains, due to the high acceptance, prestige and added value of the product and its derivatives (VIEIRA et al., 2010).

Another highlight is the use of corn plants and the rest of the ears, which are not commercial, for animal feed, making it possible to make silage for feeding in times when there is a shortage of rain, which contributes to a higher return on capital per area planted (ALBUQUERQUE et al., 2008; SOUZA FILHO et al., 2016).

Given the importance of the crop, the search for methods to improve productivity is extremely important. According to Scudeler et al. (2011), nitrogen is the nutrient most required by corn and its absence is the main limiting factor in grain production. Research indicates positive effects of nitrogen application via irrigation water on corn crops. When analyzing the application of nitrogen by two different methods, Mesquita (2014) concluded that fertigation, compared to conventional fertilization, was more efficient in supplying nitrogen to the maize crop, with an optimum nitrogen dose of 123.2 kg ha-1.

In localized irrigation, which restricts the root system to the zone wetted by the emitter, fertigation is essential to meet the constant demand for nutrients. It allows doses to be divided up according to the phenological stages of the crop and ensures better distribution of fertilizers in the area with the highest concentration of roots (MAROUELLI et al. 2011; COSTA et al., 2015).

In semi-arid regions, especially in places with sandy-textured soils with low water and nutrient retention capacity, it is recommended to fractionate the application of the nutrient in order to obtain the best crop yield (AZEVEDO et al., 2016).

The aim of this work is therefore to study the effects of different forms of fertilization and nitrogen doses applied by fertigation on the green maize crop in semi-arid climate conditions and to determine the best form of fertilization and nitrogen dose to be used on the maize crop, testing different forms of fertilization and nitrogen doses applied by fertigation and identifying the combination that provides the best growth and production of plant matter by the maize crop.

MATERIAL AND METHODS

The experiment was conducted at the Federal Institute of Education, Science and Technology of Ceará, Iguatu Campus, Iguatu, with 6° 21' 34" south latitude and 39° 17' 55" west longitude. The region's climate, according to the Koeppen classification, is of the Bsw'h' type - a hot, semi-arid steppe climate, with an average monthly temperature of over 18°C in the coldest month. Average annual rainfall is 859 mm, with 85% concentrated in the period from January to May (SANTOS et al., 2017).

The research was carried out with corn (Zea mays L.), double hybrid AG 1051, a material widely used in family farming, with the main purpose of use for the production of green corn and pamonha, which can also be used for silage, in addition to providing good results as grain corn (AGUIAR et al., 2008, SEMENTES AGROCERES, 2014). The experimental design was randomized blocks with four replications and treatments arranged in a factorial scheme (3x5), consisting of three ways of dividing up the nitrogen dose (P1 - dividing up the dose into weekly applications with different percentages according to the absorption rate adapted from Coelho et al, (2010), P2 - dose installment in weekly applications with equal percentages and P3 - installment in two applications at 7 and 28 days after sowing - DAS) associated with five nitrogen doses (D1 - control, D2 - 50, D3 - 100, D4 - 150 and D5 - 200% of the recommended dose, respectively 0, 85, 170, 255 and 340 kg ha-1). The individual plot area was 5 m2 (5 m x 1.0 m), containing 25 plants. The first two rows of plants and the last row of each block were used as a border.

The preparation of the area included deep plowing, two cross harrowings, cleaning and manual leveling to remove cultural remains and facilitate the installation of the irrigation system. Planting lines were then marked out at 1.0 m spacing, furrowing was carried out with the incorporation of the foundation fertilizer and the furrows were opened for sowing, with a spacing of 0.2 m between plants.

The nutrients applied were quantified according to the soil analysis of the experimental area and the recommendations proposed by Pereira Filho et al. (2003). Fertilization was carried out using 60 kg/ha of phosphorus pentoxide (P2O5) applied using simple superphosphate in a single application at the foundation. Potassium was applied in the form of potassium oxide (K2O) using white potassium chloride via fertigation in installments throughout the crop cycle in the amount of 40 kg/ha.

The irrigation system used was drip irrigation, with self-compensating drippers spaced 0.2 m apart, a flow rate of 1.6 L h-1 and a pressure of 100 kPa. The uniformity test, carried out using the Keller and Karmeli (1975) method, obtained a Christiansen uniformity coefficient (CUC) of 95%. Irrigation was managed via climate, based on crop evapotranspiration (ETc), calculated from reference evapotranspiration (ETo) using the Penman-Monteith method, FAO-56 (ALLEN et al., 1998), using data from an INMET automatic station near the experimental area.

Nitrogen fertilization was applied in the installments shown in Table 1.

Table 1. Percentage distribution of the nitrogen dose applied to the corn crop according to the proposed installments. Iguatu - CE. 2022.

Application	Season (DAP)	P1 (%Nitrogen)	P2 (%Nitrogen)	P3 (%Nitrogen)
1	7	5	11,11	50
2	14	5	11,11	
3	21	10	11,11	
4	28	20	11,11	50
5	35	20	11,11	
6	42	15	11,11	
7	49	10	11,11	
8	56	10	11,11	
9	63	5	11,11	
Total (%)		100	100	100

The crop treatments carried out were: thinning, weed, pest and disease control. Plants were collected for analysis 120 days after sowing (DAS). Three plants were removed from each row, along with their ears, and the following variables were determined: dry mass of the aerial part of the plant (MSPAP); mass of the ear with straw (MESPCP); mass of the ear without straw (MESPSP); mass of straw (MP) and mass of 100 grains (M100G).

RESULTS AND DISCUSSION

The summary of the analysis of variance for the variables analyzed is shown in Table 2. It can be seen that the variables MSPAP, MESPCP and MESPSP were only influenced by the doses of N, while MP was not influenced and M100G showed a significant interaction between the treatments.

Table 2 - Summary of the analysis of variance for MSPAP; MESPGCP; MESPSP; MP and M100G of the corn crop. Iguatu - CE, 2022.

FV	GL	Mean square				
		MSPAP	MESPCP	MESPSP	MP	M100G
Installments	2	98,37ns	265,90ns	156,29ns	20,00ns	8,34ns
Dose of N	4	270,76**	358,66*	324,67*	27,47ns	5,48ns
Install x Dose	8	89,21ns	183,00ns	190,35ns	28,75ns	10,44*
Blocks	3	54,82ns	120,51ns	96,29ns	6,72ns	2,03**
Residue	42	95,79	126,90	116,07	38,99	4,25
Total	59	-	-	-	-	-
CV (%)	-	14,56	7,81	8,52	33,13	8,40

**significant at 1% by the F test; *significant at 5% by the F test; (ns) not significant by the F test; GL - Degree of freedom.

The results obtained through the analysis of variance showed that there was no significant value for almost all the variables in the interaction between the plot and dose factors, where only the 100-grain mass (M100G) was significant according to the F test at the 0.05 probability level. Figure 1 shows that the response of plant dry mass to the doses of nitrogen applied was of the quadratic polynomial type with an R2 of 0.934, with the optimum dose of 181.5 kg ha-1 providing the best response for the variable of 73.16 g plant-1. The optimum dose for the variable in question is above that recommended for the crop, which is 170 kg ha-1.

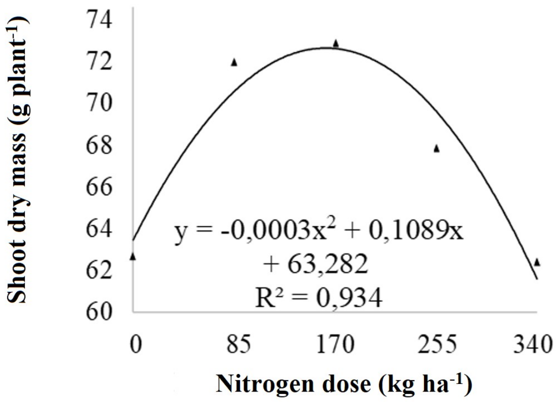

Figure 1. Dry mass of the aerial part of the plant.

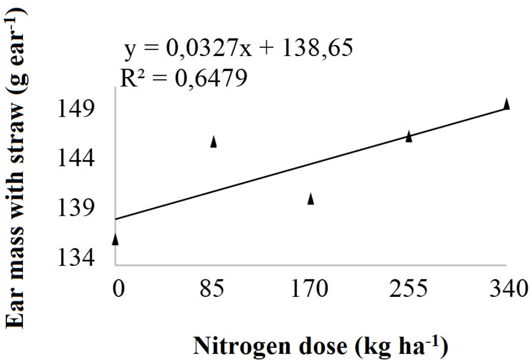

Figure 2. Ear mass with straw.

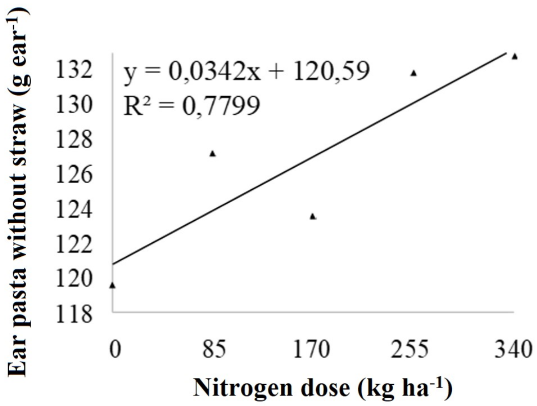

Figura 3. Ear pasta without straw.

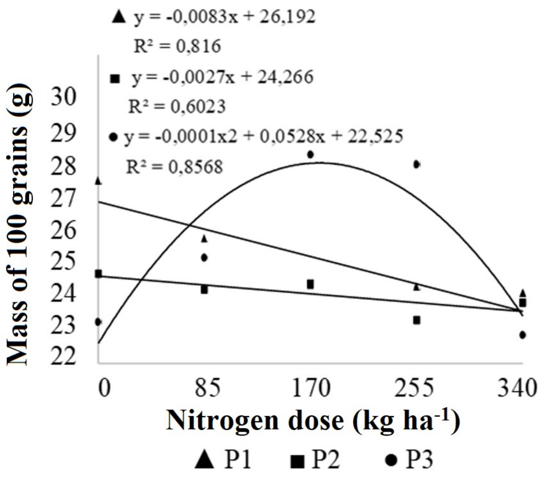

Figura 4. Mass of 100 grains for the 3 plants.

For the ear mass with and without straw variables, the best-fitting behavior was the increasing linear type with R2 values of 0.6479 and 0.7799, respectively (Figures 2 and 3). The highest estimated values for the variables were 149.77 and 132.22 g ear-1 with the highest applied dose of 340 kg ha-1. With regard to 100-grain mass, there was a different behavior depending on the dose of N for the different forms of parceling, with linear decreases for P1 and P2 and quadratic polynomials for P3. In P1 and P2, the highest values were 26.19 and 24.27 when no nitrogen was applied, while in P3 the maximum value for the variable, 27.49, was obtained with the optimum dose of 264 kg ha-1, which was more than 150% of the recommended dose for the crop (Figure 4).

The results show the benefits of nitrogen fertilization for the green maize crop. However, special attention should be paid to the way the nutrient is applied to the crop, since the greatest benefit was seen when the nutrient was applied in just two doses (P3), as was the case for the 100-grain mass variable.

CONCLUSIONS

Plotting methods only had an effect on the mass of 100 grains, while the doses of nitrogen affected the dry mass of the aerial part of the plant and the mass of the ear with and without straw.

The doses that provided the best responses to the variables are above those recommended in the literature for the crop, a fact that highlights the continued importance of studies that evaluate the crop's response to nitrogen fertilization in order to update the amounts of nutrient to be applied for greater efficiency in the production process.

REFERENCES

AGUIAR, R. A. DE; SILVEIRA3, P. M. DA; MOREIRA, J. A. A.; WANDER, A. E. Análise econômica de diferentes práticas culturais na cultura do milho (Zea mays L.). Pesquisa Agropecuária Tropical, v. 38, n. 4, p. 241-248, 2008.

ALBUQUERQUE, C. J. B.; VON PINHO, R. G.; SILVA, R. Produtividade de híbridos de milho verde experimentais e comerciais. Bioscience Journal, v. 24, n. 2, p. 69-76, 2008.

ALLEN, R.G.; PEREIRA, L.S.; PAES, D.; SMITH, M. Crop evapotranspiration: guidelines for computing crop water requirements. Roma: FAO, 1998. 328 p. (Irrigation and Drainage Paper, 56).

AZEVEDO, B. M. de; FERNANDES, C. N. V.; NASCIMENTO NETO, J. R. do; VIANA, T. V. De A.; VASCONCELOS, D. V.; FERNANDES, C. N. D. Frequência da fertirrigação fosfatada na produtividade da cultura da melancia. Irriga, v. 21, n. 2, p. 257-268, 2016.

COELHO, A. M.; FRANÇA, G. E. de; PITTA, G. V. E.; ALVES, V. M. C.; HERNANI, L. C. Cultivo do Milho: Fertilidade de solos: Nutrição e adubação do milho. Embrapa Milho e Sorgo, 2010. 6 ed., 11 p. (Sistema de Produção, 1).

COSTA, A. R.; REZENDE, R.; FREITAS, P. S. L.; GONÇALVES, A. C. A.; FRIZZONE, J. A. A cultura da abobrinha italiana (Cucurbita pepo L.) em ambiente protegido utilizando fertirrigação nitrogenada e potássica. Irriga, v. 20, n. 1, p. 105-127, 2015.

DANTAS JUNIOR, E. E; CHAVES, L. G.; FERNANDES, J. D. Lâminas de irrigação localizada e adubação potássica na produção de milho verde, em condições semiáridas. Revista espacios, n. 27, v. 37, 2016.

KELLER, J.; KARMELI D. Trickle irrigation design. Glendora: Rain Bird Sprinkler Manufacturing, 1975. 133p

MAROUELLI, W. A; SOUSA, V. F. de; Irrigação e fertirrigação. In: SOUSA, V. F. DE; MAROUELLI, W. A.; COELHO, E. F.; PINTO, J. M.; COELHO FILHO, M. A. (Ed.). Irrigação e fertirrigação em fruteiras e hortaliças. 1. ed. Brasília, DF: Embrapa, 2011. p. 771.

MESQUITA, J. B. R. DE. Influência de lâminas de irrigação, doses de nitrogênio e de potássio aplicadas pelo método convencional e por fertirrigação na cultura do milho. 2014. 88 f. (Doutorado em Engenharia Agrícola – Irrigação e drenagem) - Universidade Federal do Ceará, Fortaleza, 2014.

PEREIRA FILHO, I. A.; VASCONCELOS, C. A; CRUZ, J. C. Adubação para o Cultivo do Milho Verde. In: PEREIRA FILHO, I. A. (Ed.). O Cultivo do milho-verde. Brasília, DF: Embrapa Informações Tecnológicas, 2003. p. 68-79.

SANTOS, J. C. N.; ANDRADE, E.M.; MEDEIROS, P. H. A.; GUERREIRO, M. J. S.; PALÁCIO, H. A. Q. Land use impact on soil erosion at different scales in the Brazilian semi-arid. Revista Ciência Agronômica, v. 48, p. 251-260, 2017.

SEMENTES AGROCERES. Guia de híbridos. 2014. Disponível em: <http://www.sementesagroceres.com.br/pages/ManuaisTecnicos.aspx>. Acesso em: 10 de agosto de 2024.

SCUDELER, F.; VENEGAS, F.; CORDEIRO, R. N. Avaliação técnica e econômica de fontes de nitrogênio em plantio e cobertura na cultura do milho (Zea mays L.). Ensaios e Ciências: Ciências Biológicas, Agrárias e da Saúde, v. 15, n. 2, p. 67-75, 2011.

SOUZA FILHO, A. L.; OLIVEIRA, F. H. T.; PRESTON, W.; SILVA, G. F.; CARVALHO, S. L. Nitrogen and phosphate fertilizer on green corn grown in succession to the melon crop. Horticultura brasileira, v. 34, n. 3, jul.-set. 2016.

VIEIRA, M. DE A.; CAMARGO, M. K.; DAROS, E.; ZAGONEL, J.; KOEHLER, H. S. Cultivares de milho e população de plantas que afetam a produtividade de espigas verdes. Acta Scientiarum. Agronomy. v. 32, n. 1, p. 81-86, 2010.