SWEET CORN CROP UNDER DIFFERENT WATER REGIMES AND SOIL MANAGEMENT

Maria Albertina Monteiro dos Reis[1], Carlos Alessandro Chiodeloli[2], Alexsandro Oliveira da Silva[3]

ABSTRACT: Sweet corn production even though little explore create higher income that the grain corn production, this occurs to the bigger value of the commercialized product (ears), besides allow later plant exploitation for the animal alimentation or soil cover. The water is a limiting factor for the plant growth, principally in dry regions, being necessarily studies for the better use of water resources in these regions. The goal of this study is to evaluate the green corn yield in three tillage systems associated with five water depths. The evaluations were realized in the agricultural experimental area belonging to the Department of Agricultural Engineering of the University Federal of Ceará (UFC – Campus of Pici). The treatments were made by three tillage systems, P1 – conventional tillage (plough + harrow), P2 – chisel plow and P3 – no tillage and five depths of irrigation based on the crop evapotranspiration. The experimental design used was randomized blocks (DBC), in a 3x5 factorial arrangement in four replications, resulting in 60 treatments. The evaluated were the green corn yield components and water use efficiency. The data was submitted to an analysis of variance and when significant was submitted to a 5% of probability Tukey for qualitative variables and regression analysis for quantitative variables. The green corn yield is greater with higher evapotranspiration replacement, that is, higher irrigated volumes. The water use efficiency decreases with increasing water regime.

KEYWORDS: conventional, chisel plow, no tillage, evapotranspiration.

PRODUÇÃO DE MILHO VERDE EM DIFERENTE REGIMES HÍDRICOS E MANEJO DO SOLO

[1] Doutora em Agronomia, Profa. Dra. do curso de Agronomia, Universidade do Oeste Paulista, 19067-175, Presidente Prudente, SP, (85) 997892750, mariareis@unoeste.br
[2] Prof. Dr. curso de Agronomia, Universidade Federal do Triângulo Mineiro, Iturama, MG
[3] Prof. Dr. Departamento de Engenharia Agrícola, Universidade Federal do Ceará, Fortaleza, CE

RESUMO: A produção de milho verde apesar de pouco explorada gera maior renda que a produção de milho para grãos, isso se deve ao maior valor do produto comercializado (espiga), além de permitir o posterior aproveitamento da planta para alimentação animal ou cobertura do solo. A água é um fator limitante para o desenvolvimento das plantas, principalmente em regiões mais secas, sendo necessários estudos para o melhor aproveitamento dos recursos hídricos nessas regiões. Objetivou-se com o presente trabalho avaliar a produção de milho verde em três sistemas de preparo do solo associados à cinco regimes hídricos. As avaliações foram realizadas na área de experimentação agrícola pertencente ao Departamento de Engenharia Agrícola da Universidade Federal do Ceará (UFC – Campus do Pici) durante dois ciclos de produção. Os tratamentos foram constituídos por três sistemas de preparo do solo, P1 – preparo convencional (arado + grade), P2 – escarificador e P3 – semeadura direta e cinco regimes hídricos com base na evapotranspiração da cultura. O delineamento experimental utilizado foi em blocos ao acaso, em esquema fatorial (3x5), com quatro repetições totalizando 60 unidades experimentais. Foram avaliados os componentes de produção do milho verde e eficiência do uso da água. Os dados foram submetidos à análise de variância e quando significativos submetidos ao teste de Tukey a 5% de probabilidade para variáveis qualitativas e análise de regressão para variáveis quantitativas. A produção de milho verde é maior em maior reposição da evapotranspiração, ou seja, maiores volumes irrigados. A eficiência do uso da água reduz com o aumento do regime hídrico.

PALAVRAS-CHAVE: convencional, escarificador, semeadura direta, evapotranspiração.

INTRODUÇÃO

Corn (*Zea mays* L.) is usually consumed in natura for animal and human food, also presenting diversified industrial use. The sweet corn crop has increase potential worldwide due to profitability, since ears sold with lower maturity grains have a higher value when compared to corn in dry grains. In addition, this production absorbs family labor, especially at harvest time, which is carried out manually, thus contributing to job creation (CRUZ et al., 2006). In order to meet the growing demand for green corn consumption, the producer must seek to improve his production, providing products of high quality and quantity to supply the demanding markets. To achieve this goal, management techniques must be adopted that provide high yield, without losing the desired commercial characteristics (VIEIRA et al., 2010). To supply the population's need for food, it is necessary to increase yield per unit area. This yield

increase must be associated with the conscious use of natural resources, such as water and soil conservation, minimizing the environmental impact. Agriculture is responsible for consuming a large part of the available water, therefore, the proper management of this resource is essential, for this purpose, only the amount of water required by the crop must be provided, together with this the use of localized irrigation systems also decreases the waste of water. Thus, it becomes necessary to study the water use efficiency, in order to obtain higher yields that are economically viable. Allied to this, the indiscriminate use of mechanized operations has been causing soil degradation. The increase in mechanized agricultural operations causes more degradation in soil structure. Therefore, there is a need for conservationist soil management, reducing mechanized operations and utilizing the cover crop as a source of nutrients, as well as better soil structuring, allowing better water infiltration. Most of the soils in the Brazilian semi-arid region are shallow soils, often with good chemical characteristics and restricted physical characteristics. In this sense, it is important to evaluate the behavior of the most used soil management systems and the behavior of the corn crop in relation to different irrigation depths, thus providing more information for better water use and better forms of soil management to obtain high yield and natural resources conservation. The objective of the present work was to evaluate the green corn yield in three tillage systems associated with water regimes.

MATERIAL E METHODS

The experiment was conducted in the perios of August - November 2017 in the agricultural experimentation area of the Department of Agricultural Engineering of the Federal University of Ceará. The climate of the study region is defined as Aw' (KÖPPEN, 1923). The soil in the experimental area was classified as Red Yellow Argisol (EMBRAPA, 2013). The experimental design used was in randomized blocks, in a factorial scheme (3x5), with four replications, with three soil tillage systems (conventional tillage – 1 plowing + 1 harrowing, scarifier and no tillage) and five water regimes (25 %, 50%, 75%, 100%, 150% etc). Seeds of hybrid maize AG1051 were used. The number of rows per ear, number of grains per row, ear length, ear diameter in ten ears of each plot were evaluated. All ears of the useful area (5 m central of the central line) of each plot with straw were weighed. Water use efficiency was determined by the ratio between yield and the water volume consumed throughout the crop cycle. In the irrigation, the drip system was used. The irrigation time of the different applied depths was based on the crop evapotranspiration (ETc) for that, the evapotranspiration reference

(ETo), the crop coefficient (Kc) and the location coefficient were determined. The different crop coefficients adopted according to Doorenbos & Kassam (1994). The evapotranspiration reference was defined based on the Class A Tank evaporation, located at the meteorological station of the Federal University of Ceará, close to the experimental area. The data were submitted to the analysis of the asymmetry and kurtosis coefficient to verify the normality of the data. For variables with normal data distribution, analysis of variance (ANOVA) was performed and, when significant, the means were compared by Tuckey's test at 5% probability for qualitative variables and regression analysis for quantitative variables, using the program SISVAR statistics.

RESULTS AND DISCUSSION

The analysis of variance for the yield components and water use efficiency in the green corn crop are shown in Table 1.

Table 1. Analysis of variance of yield components and water use efficiency in the green corn crop.

Cause of variation		CP (cm)	DE (mm)	NF	NG	Yield (kg/ha)	WUE (kg/ha.mm)
ST	ST1	9,90	32,05	12,32	18,70	2844,16	12,53 a
	ST2	9,68	32,11	12,43	17,64	2648,12	9,01 b
	ST3	9,23	31,60	13,00	14,70	2060,27	8,59 b
WD	L1	9,61	29,44	11,00	9,70	1333,89	13,70
	L2	9,27	31,20	12,87	15,10	1905,76	10,63
	L3	9,99	32,68	12,96	18,04	2758,13	10,26
	L4	9,30	32,88	12,78	20,33	3076,83	9,09
	L5	9,84	33,40	13,30	21,88	3512,98	6,53
F Test	ST	0,70 ^{NS}	0,15 ^{NS}	1,58 ^{NS}	3,21 ^{NS}	2,92 ^{NS}	7,72*
	WD	0,35 ^{NS}	3,03*	5,79*	10,42*	8,25*	6,66*
	STxWD	0,54 ^{NS}	1,15 ^{NS}	2,99*	0,65 ^{NS}	1,25 ^{NS}	4,41*
	CV	19,25	10,02	10,33	30,41	42,43	34,71

* - significant at the 5% probability level ($p<0.05$); NS – not significant at the 5% probability level. ST1 - conventional tillage; ST2 - scarifier; ST3 – no tillage; L1 – 25%; L2 – 50%; L3 – 75%; L4 – 100%; L5 – 150%; CP – ear length; DE – ear diameter; NF – number of rows per ear; NG – number of grains per ear; WUE – water use efficiency; CV – coefficient of variation.

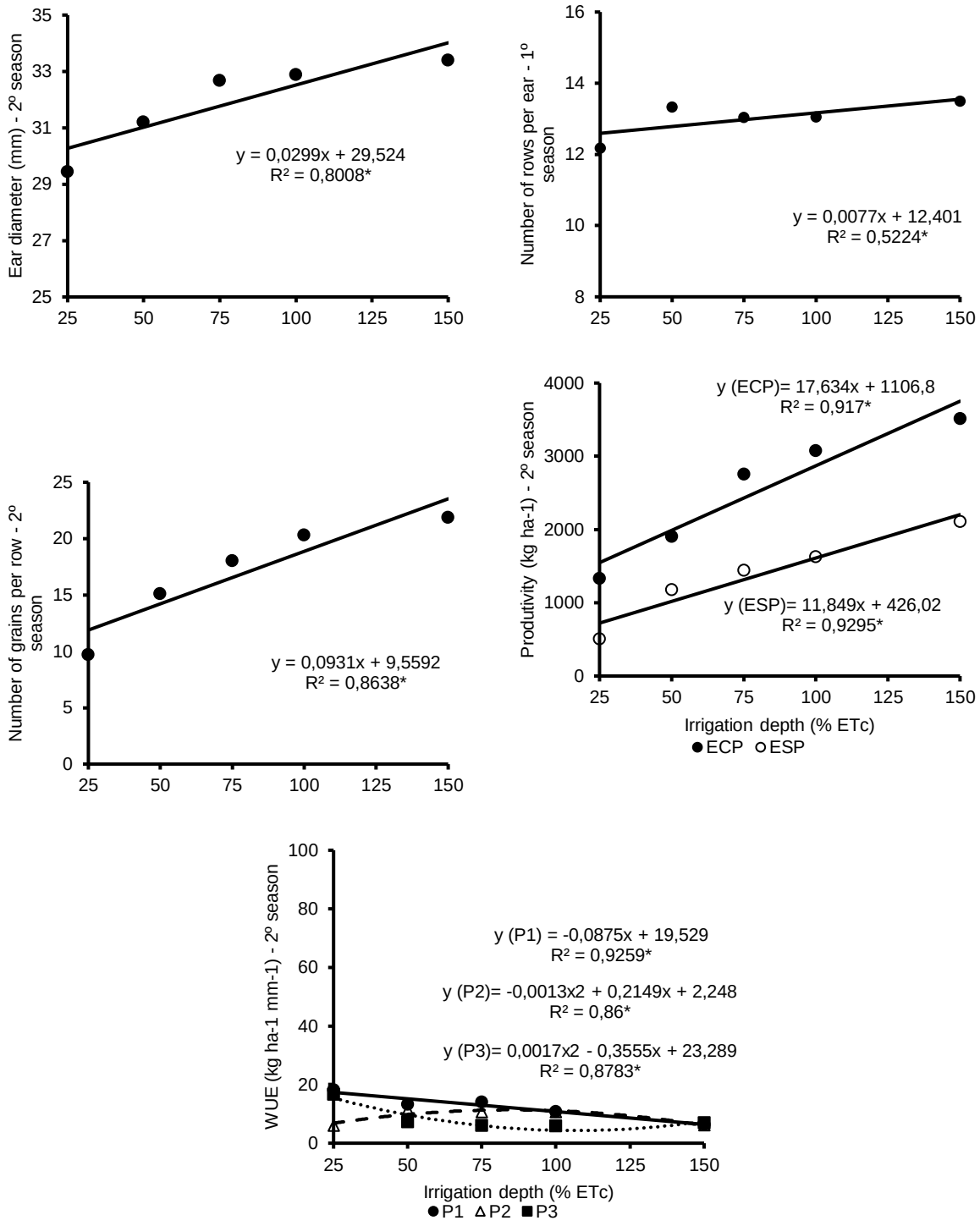

Figure 1. Regression analysis for yields components and water use efficiency in green corn crop in response to water regimes.

The ear diameter increased linearly with the irrigation depth, its highest value being 33.4 mm in the 150% ETc, representing an increase of 13.45% in relation to the 25% ETc. For Moraes (2009) and Santos et al. (2005), the ear diameter recommended for marketing green corn is at least 30 mm. Despite presenting a significant interaction between the parameters

number of rows and irrigation depths, tillage with a scarifier and no-tillage did not show significant regression models. In conventional soil tillage, it was observed that the 75% ETc provided 14 rows per ear, which was the highest among the evaluated depths. The number of grains per row grew linearly with the irrigation depths, showing values of 10 and 22 at 25% and 150% ETc, respectively. According to Nascimento et al. (2017) this variation is due to the water deficit, causing a reduction in leaf area and photosynthesis, that is, it is a variable that is directly linked to the plant metabolism. According to Bergamaschi et al. (2004) in conditions of water deficit, the male inflorescence will delay the stigmas emission, causing a break in the synchronism of the stigmas emission and the pollen release, which will result in a germination failure. The highest yield was 3,512.98 kg ha^{-1} in the 150% ETc (537.81 mm). Thus, an increase of 163% in yield can be verified compared to the regime with less water replacement. Water restriction leads to a lower rate of the stomatal opening so that there are less gas exchanges and maintenance of the water level of the plant, therefore there will be less production of photoassimilates. According to Oliveira et al. (2017) higher water regimes lead to greater soil water storage, which will reduce stress during the formation and development of ears, therefore, there will be an increase in crop yield. Nascimento et al. (2017) mention that the higher soil water content provides greater leaf development, with greater production of photoassimilates, therefore, greater ears production. Conventional tillage showed the highest water use efficiency, reaching a value of 18.28 kg ha^{-1} mm^{-1} at the lowest irrigation depth applied (25% ETc). In no-tillage, the WUE obtained was 16.73 kg ha^{-1} mm^{-1}, also in the lower irrigation depth (48.45 mm). In the soil tillage carried out with a scarifier, the highest WUE was 11.46 kg ha^{-1} mm^{-1}, occurred in the depth of 50% ETc (96.90 mm). According to Phene (1989), deficit irrigation aims to maximize the production per unit of water volume water, that is, to increase the water efficiency and save water, a fact observed in the present work, in which the lowest water depth applied got the biggest WUE.

CONCLUSIONS

The green corn yield is greater with higher evapotranspiration replacement, that is, higher irrigated volumes. The water use efficiency decreases with the increasing water regime.

BIBLIOGRAPHIC REFERENCES

BERGAMASCHI, H.; DALMAGO, G. A.; BERGOCI, J. I.; BIACHI, C. A. M.; MÜLLER, A. G.; COMIRAN, F.; HELCKLER, B. M. Distribuição hídrica no período crítico do milho e produção de grãos. **Pesquisa Agropecuária Brasileira**, Brasília, v. 39, n. 9, p. 831-839, 2004.

CRUZ, J. C.; KONZEN, E. A.; FILHO, I. A. P.; MARRIEL, I. E.; CRUZ, E.; DUARTE, J. O.; OLIVEIRA, M. F.; ALVARENGA, R. C. **Produção de milho orgânico na agricultura Familiar**. Comunicado Técnico 81 – EMBRAPA, Sete Lagoas: Embrapa-CNPMS, 17p. 2006.

DOORENBOS, J.; KASSAM A. H. **Efeito da água no rendimento das culturas**. Campina Grande: Universidade Federal da Paraíba, 1994. 306 p.

EMBRAPA. **Sistema Brasileiro de Classificação de Solos**. 3 ed. Brasília: Empresa Brasileira de pesquisa Agropecuária, 2013. 353 p.

KÖPPEN, W. **Die klimate der Erde**. Berlin: Guyter, 1923, 369 p.

MORAES, A. R. A. de. **A cultura do milho verde**. 2009. Disponível em: <http://www.infobibos.com/Artigos/2009_2/MilhoVerde/index.htm>. Acesso em: 10 nov. 2017.

NASCIMENTO, F. N.; BASTOS, E. A.; CARDOSO, M. J.; ANDRADE JÚNIOR, A. S.; RAMOS, H. M. Desempenho da produtividade de espigas de milho verde sob diferentes regimes hídricos. **Revista Brasileira de Milho e Sorgo**, v. 16, n. 1, p. 94-108, 2017.

OLIVEIRA, F. C. C.; PEDROTTI, A.; FELIX, A. G. S.; SOUZA, J. L. S.; HOLANDA, F. S. R.; JUNIOR, A. V. M. Caracteristicas químicas de um argissolo e a produção de milho verde nos tabuleiros costeiros sergipanos. **Revista Brasileira de Ciências Agrárias**, v. 12, n. 3, p. 354-360, 2017.

PHENE, C. J. Techniques for computerized irrigation management. **Computer and Eletronics in Agriculture**, New York, v.3, n.3, p.189-208, 1989.

SANTOS, I. C.; MIRANDA, G. V.; MELO, A. V.; MATTOS, R. N.; OLIVEIRA, L. R.; LIMA, J. S.; GALVÃO, J. C. Comportamento de cultivares de milho produzidos organicamente e correlações entre características das espigas colhidas no estádio verde. **Revista Brasileira de Milho e Sorgo**, v. 4, n. 1, p. 45-53, 2005.

VIEIRA, M. 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**, Maringá, v. 32, n. 1, p. 81-86, 2010.