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PRODUCTION PERFORMANCE OF BRS TUMUCUMAQUE COWPEA UNDER DIFFERENT PLANT DENSITIES AND WATER REGIMES[1]

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ABSTRACT - Cowpea is a legume of great socioeconomic importance for the North and Northeast regions of Brazil. However, studies to evaluate its production performance when cultivated under irrigated regime and under different plant densities are necessary. The objective of this work was to evaluate the effects of different water regimes and different plant densities on grain yield, production components and water use efficiency, and on the correlation between grain yield and production components of BRS Tumucumaque cowpea cultivar. The experiment was carried out at Embrapa Meio-Norte experimental area, in Teresina, Piauí State, Brazil, from June to September 2017, in an *Argissolo Vermelho-Amarelo eutrófico* (Ultisol). A randomized complete block design was used, in a split-plot scheme with four replicates, in which the water regimes occupied the plots (187.7; 233.5; 263.5 and 288.7 mm) and plant densities, the subplots (12; 16; 20 and 24 plants m^{-2}). The number of pods per plant, number of pods per square meter, pod length, dry grain yield and water use efficiency were evaluated. The maximum dry grain yield reached was 1,694.46 kg ha^{-1}, with application of 288.7 mm and density of 20.4 plants m^{-2}. The production component number of pods per square meter was the most correlated with dry grain yield.

Keywords: *Vigna unguiculata*. Irrigation depth. Water use efficiency.

DESEMPENHO PRODUTIVO DO FEIJÃO-CAUPI BRS TUMUCUMAQUE SOB DIFERENTES DENSIDADES DE PLANTAS E REGIMES HÍDRICOS

RESUMO - O feijão-caupi é uma leguminosa de grande importância socioeconômica para as regiões Norte e Nordeste do Brasil. Entretanto, ainda necessita de mais estudos que avaliem seu desempenho produtivo quando cultivado em regime irrigado e sob diferentes densidades de plantas. Objetivou-se, neste trabalho, avaliar os efeitos de diferentes regimes hídricos e densidades de plantas na produtividade de grãos, componentes de produção e eficiência do uso de água, bem como a correlação da produtividade de grãos com os componentes de produção da cultivar de feijão-caupi BRS Tumucumaque. O experimento foi conduzido na área experimental da Embrapa Meio-Norte, Teresina, Piauí, de junho a setembro de 2017, em um Argissolo Vermelho-Amarelo eutrófico. Utilizou-se o delineamento em blocos casualizados, sob esquema de parcelas subdivididas, com quatro repetições, em que os regimes hídricos ocuparam as parcelas (187,7; 233,5; 263,5 e 288,7 mm) e as densidades de plantas, as subparcelas (12; 16; 20 e 24 plantas m^{-2}). Foram avaliados o número de vagens por planta, o número de vagens por metro quadrado, o comprimento de vagens, a produtividade de grãos secos e a eficiência de uso da água. A máxima produtividade de grãos foi de 1.694,46 kg ha^{-1} com aplicação da lâmina de 288,7 mm e a densidade de 20,4 plantas m^{-2}. O componente de produção número de vagens por metro quadrado foi o que mais se correlacionou com a produtividade de grãos.

Palavras-chave: *Vigna unguiculata*. Lâminas de irrigação. Eficiência de uso da água.

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INTRODUCTION

Cowpea is a crop of great socioeconomic importance and is cultivated in large areas of the globe. In Brazil, it is cultivated mainly in the North and Northeast regions, the latter of which has a predominance of poor distribution of rains and low use of technologies, resulting in low grain yields.

In order to improve this scenario, new management practices that can improve the cowpea production system, increasing its yield and profitability, have been sought. Among the management practices, plant density stands out, a factor that directly influences morphophysiological characteristics and grain yield. Another important management practice is irrigation, which can minimize the risks due to water deficit.

In this context, some studies have been conducted to define the density and/or spacing of cowpea plants that promotes maximum grain yield in irrigated or rainfed production system (SOUZA et al., 2011; BEZERRA et al., 2012; SANTOS, 2013; BEZERRA et al., 2014; LOCATELLI et al., 2014; OLIVEIRA et al., 2015; COSTA JÚNIOR et al., 2017; MONTEIRO et al., 2017; CARDOSO, MELO and RIBEIRO, 2018). However, the optimal planting density is variable due to the conditions of soil, climate and plant growth habit. BRS Tumucumaque is a semi-erect cowpea cultivar and needs to be evaluated for the soil and climate conditions of the Teresina microregion. The number of plants per unit of area depends on the growth habit of the plant. Thus, upright or semi-erect cowpea cultivars withstand a higher plant density when compared to those of semi-prostrate growth habit.

In addition to growth habit, the adopted water regime influences the adequate number of plants per area. Oliveira et al. (2015), working with the cowpea cultivar BRS Itaim, of upright habit, found maximum grain yield of 1,668.86 kg ha^{-1} with the irrigation depth of 390.88 mm and plant density of 24.1 plants m^{-2}.

Monteiro et al. (2017), evaluating the effects of water regimes and plant densities on the production and yield components of the cowpea cultivar BRS Itaim in a conventional cultivation system, in the municipality of Teresina, PI, found the number of pods per square meter of 73.3, obtained with the combinations of irrigation depths and plant densities of 320 mm and 28 plants m^{-2}, respectively.

Obviously, the definition of the irrigation depth varies according to the soil and climate conditions of the region, as well as to the plant population adopted. Therefore, this study aimed to evaluate the effects of different water regimes and different plant densities on grain yield, production components and efficiency water use, as well as on the correlation of grain yield with the production components of the cowpea cultivar BRS Tumucumaque, under the edaphoclimatic conditions of Teresina, PI, Brazil.

MATERIAL AND METHODS

The experiment was conducted at the experimental field of Embrapa Meio-Norte, in Teresina, Piauí, Brazil (5°05' S, 42°29' W and 72 m), from June to September 2017. The climate of the municipality is C1sA'a', according to the climatic classification of Thornthwaite and Mather, characterized as dry sub-humid, megathermal, with moderate water surplus in the summer, with annual averages of temperature and rainfall of 28.1 °C and 1,342.4 mm (BASTOS; ANDRADE JÚNIOR, 2016). The soil of the area is classified as *Argissolo Vermelho Amarelo eutrófico* (Ultisol) (MELO; ANDRADE JÚNIOR; PESSOA, 2014).

The experimental design was randomized blocks in split-plot scheme, with four replicates, in which the water regimes [50%; 75%; 100% and 125% crop evapotranspiration – ETc), each corresponding to irrigation depths 1 (L1), 2 (L2), 3 (L3) and 4 (L4)], were arranged in the plots and plant densities (12; 16; 20 and 24 plants m^{-2}) in the subplots. Each subplot consisted of four planting rows with length of 4 m, spaced by 0.5 m, with a usable area of 4 m^2, formed by the two central rows.

Soil tillage consisted of one plowing and one harrowing. Basal fertilization was applied according to soil analysis (Table 1), and following the nutritional requirements of cowpea. In basal fertilization, 50 kg of P_2O_5 ha^{-1} and 40 kg of K_2O ha^{-1} were applied broadcast and, at 15 days after sowing (DAS), 20 kg of N ha^{-1} were applied, according to Melo and Cardoso (2017).

Table 1. Chemical analysis of the soil of the experimental area. Embrapa Meio-Norte. Teresina- PI, Brazil.

Depth (m)	OM g kg^{-1}	pH H_2O	P mg dm^{-3}	K^+	Na^+	Ca^{2+}	Mg^{2+} (mmol dm^{-3})	Al^{3+}	H^++Al^{3+}	CEC	V (%)
0.0 - 0.2	7.7	6.1	34.4	0.2	0.04	2.2	0.5	0.05	1.4	4.5	66.8
0.2 - 0.4	8.5	6	25.1	0.2	0.04	2.1	0.5	0.05	1.9	4.9	60.0

Source: Soil Laboratory of Embrapa Meio-Norte.

The cowpea cultivar BRS Tumucumaque was sown on June 12, 2017, using a tractor-mounted mechanical planter, regulated at the highest density among treatments (24 plants m^{-2}), with spacing of 0.5 m between rows and depth of 0.03 m. At 14 and 15 DAS, thinning was performed in order to standardize in the subplots the densities evaluated in the study.

Irrigations were carried out using a fixed conventional sprinkler system with sprinklers spaced by 12 x 12 m and 4.4 x 3.2 mm nozzles with flow rate of 1.59 m^3 h^{-1} at an operating pressure of 30 mwc. The water regimes were differentiated based on the crop coefficient (Kc) of cowpea recommended by Andrade Júnior, Rodrigues and Bastos (2000) and the reference evapotranspiration (ETo), estimated by the Penman-Monteith method, using data collected at the automatic agrometeorological station of the National Institute of Meteorology (INMET), located at Embrapa Meio-Norte, at a distance of 500 m from the experimental area. Until 18 DAS the irrigation depths were applied in equal quantities for all treatments, in order to ensure germination and uniform initial development of plants. From this period, water regimes were applied according to the variation of the pre-established ETc in the treatments.

Soil water content (% volume) was monitored through a Diviner 2000® capacitance probe from Sentek Pty Ltda, Australia. For this, 16 PVC access tubes were installed, 4 for each water regime. Relative frequency (RF) readings were taken daily from 22 DAS, beginning of the differentiation of the irrigation depths, until the end of the cycle.

Weeds were controlled by manual weeding, at 30 DAS. Phytosanitary pest control was performed with Thiamethoxam-based insecticide to prevent against aphid at the dose of 1 g L_{H2O}^{-1} and with Carbendazim-based fungicide at the dose of 1.5 mL L_{H2O}^{-1}.

Harvest was carried out manually on August 18, 2017, at 67 DAS. Pods were harvested in the two central rows of each subplot. The following production components were evaluated: number of pods per plant (NPP), which is equivalent to the total number of pods harvested in the usable area of the subplot divided by the number of plants in the same area; number of pods per m^2 (NPPM2), obtained by the relationship between the number of pods harvested in the usable area of the subplot and its area, in m^2; pod length (PODL), in cm, resulting from the average length of ten pods randomly chosen in the usable area of the subplot; and grain yield (GY), corrected to 13% moisture. Water use efficiency (WUE) was also evaluated, through the relationship between dry grain yields (kg ha^{-1}) and the irrigation depths applied (mm) in each treatment along the crop cycle.

Analysis of variance and regression were performed, according to the method proposed by Pimentel-Gomes (2009), using the statistical software SAS / STAT®, version 14.1. Pearson's correlation coefficients between the production components and grain yield were estimated using "R" environment, version 3.5.0.

RESULTS AND DISCUSSION

The percentages of variation in the pre-established irrigation depths were sufficient to promote a clear variation in soil moisture between treatments and enable significant differences between grain yields and production components. The variations in soil moisture under the different water regimes as a function of ETc, in the 0-20 cm and 20-40 cm layers, are presented in Figures 1 and 2, respectively.

Until 22 DAS, the values of soil moisture in the different irrigated strips were similar, because the irrigation depths had not been differentiated yet. At 56 DAS, there was an increase in the soil moisture of all irrigated strips, due to a 42.2 mm precipitation, which occurred on the night of the previous day. This fact did not interfere in the results of the study, because it occurred at the end of the reproductive stage of cowpea, marked by the senescence of plants (BASTOS et al., 2008) and, according to Bezerra et al. (2003), the most critical stage of the crop for water stress is grain filling.

The strip with irrigation depth 1 (50% ETc) kept soil moisture below the permanent wilting point (PWP) in the 0-20 cm layer (Figure 1), during most of the cycle. However, the plants of this treatment survived and produced even under these conditions, due to the higher moisture in the deeper layers of the soil (Figure 2), since the root system of cowpea reaches depths greater than 20 cm.

In the deeper soil layers (20 to 40 cm deep), the differences of moisture between treatments were smaller than those observed in the layers closest to the soil surface (0 to 20 cm deep). This occurred due to the lower water dynamics in the deeper layers of the soil, since there is less water extraction by cowpea roots in the 20-40 cm layer. In addition, at this depth, there is more clay than in the surface layer and, consequently, less movement and greater storage of water in the soil.

It is observed that the soil moisture content in the 20-40 cm layer, under all water regimes, reached values close to or higher than the critical moisture (15%). Soil moisture in deeper layers stimulates the growth of roots to increase their capacity to absorb water. This probably justifies the survival and yield of plants subjected to the water regime of 50% ETc, whose soil moisture in the upper layers reached values below the permanent wilting point (9%).

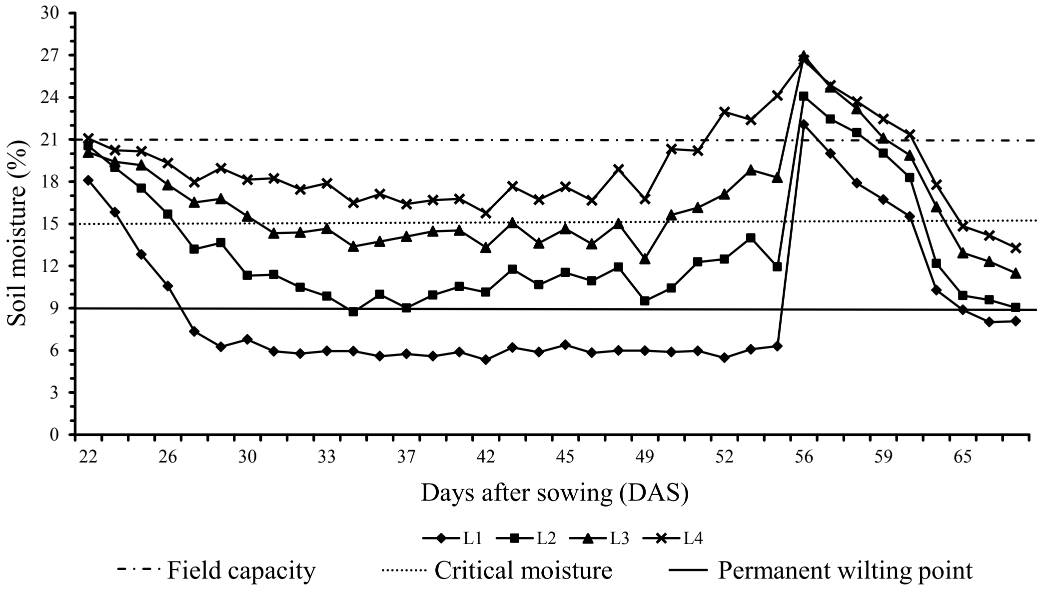

Figure 1. Variation of soil moisture in the 0-20 cm layer as a function of the irrigation depths applied (L1, L2, L3 and L4) based on different percentages of ETc (50%; 75%; 100% and 125%). Teresina, PI, Brazil.

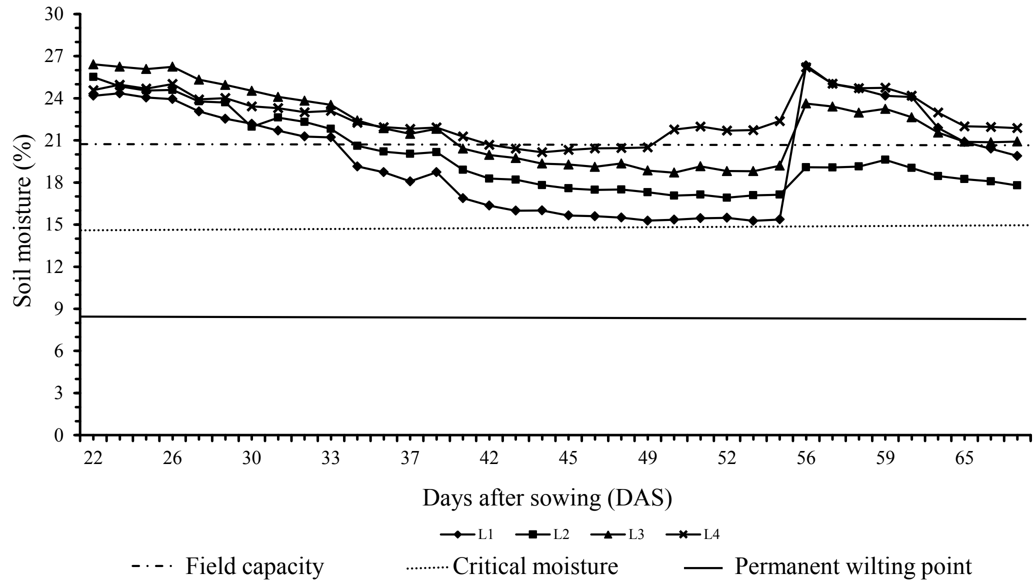

Figure 2. Variation of soil moisture in the 20-40 cm layer as a function of the irrigation depths applied (L1, L2, L3 and L4) based on different percentages of ETc (50%; 75%; 100% and 125%). Teresina, PI, Brazil.

There was significant interaction ($p \leq 0.05$) between the factors irrigation depth and plant density only for the production component NPPM2 and PODL (Table 2). All variables showed a significant response to the irrigation depth and to plant density, except for pod length, which was significantly affected only by irrigation depth. Gomes (2009) states that when at least one of the factors under study is composed of quantitative levels, response equations should be estimated for others. Thus, in this study, where the two factors evaluated are quantitative, the regression equations of the responses of the analyzed traits were estimated as a function of the irrigation depths and plant densities evaluated.

The component NPP showed maximum value of 2.5 (transformed value, corresponding to 6.4 pods plant^{-1}) with the combination of the irrigation depth of 288.7 mm and density of 12 plants m^{-2} (Figure 3). It is observed that this combination is the result of the highest water depth with the lowest population density under study.

Table 2. Summary of the analysis of variance for the number of pods per plant (NPP), number of pods per square meter (NPPM2), pod length (PODL), grain yield (GY) and water use efficiency (WUE) of the cowpea cultivar BRS Tumucumaque under conventional planting. Teresina, PI, Brazil.

SV	DF	Mean squares				
		NPP¹	NPPM2¹	PODL	PROD	WUE
Blocks	3	0.0410^{ns}	0.7430^{ns}	0.3349^{ns}	45234.798^{ns}	0.6854^{ns}
Irrig. Depths (L)	3	1.6631**	29.1835**	2.2716*	1880428.98**	6.2348*
Error (a)	9	0.0301	0.5569	0.6888	62787.299	1.0091
Densities (D)	3	0.4527**	2.1818**	0.4531^{ns}	112983.435**	2.1132**
L x D	9	0.0249^{ns}	0.4081*	1.2164*	9142.253^{ns}	0.1729^{ns}
Error (b)	36	0.0152	0.1864	0.4585	11651.454	0.2122
CV (a)	-	8.9293	9.1454	4.2277	20.5905	20.3284
CV (b)	-	6.3423	5.2916	3.4495	8.8699	9.3212

[1]Data transformed to √x.
*, **Significant at 5% and 1% probability level, respectively, by F test; ^{ns}Not significant.

$$NPP = 5.60546 - 0.04095^{o}L + 0.04305^{ns}D + 0.00010294^{o}L^2 - 0.0121^{*}D^2 + 0.0000885^{*}LD^2 - 0.00000019^{*}L^2D^2$$

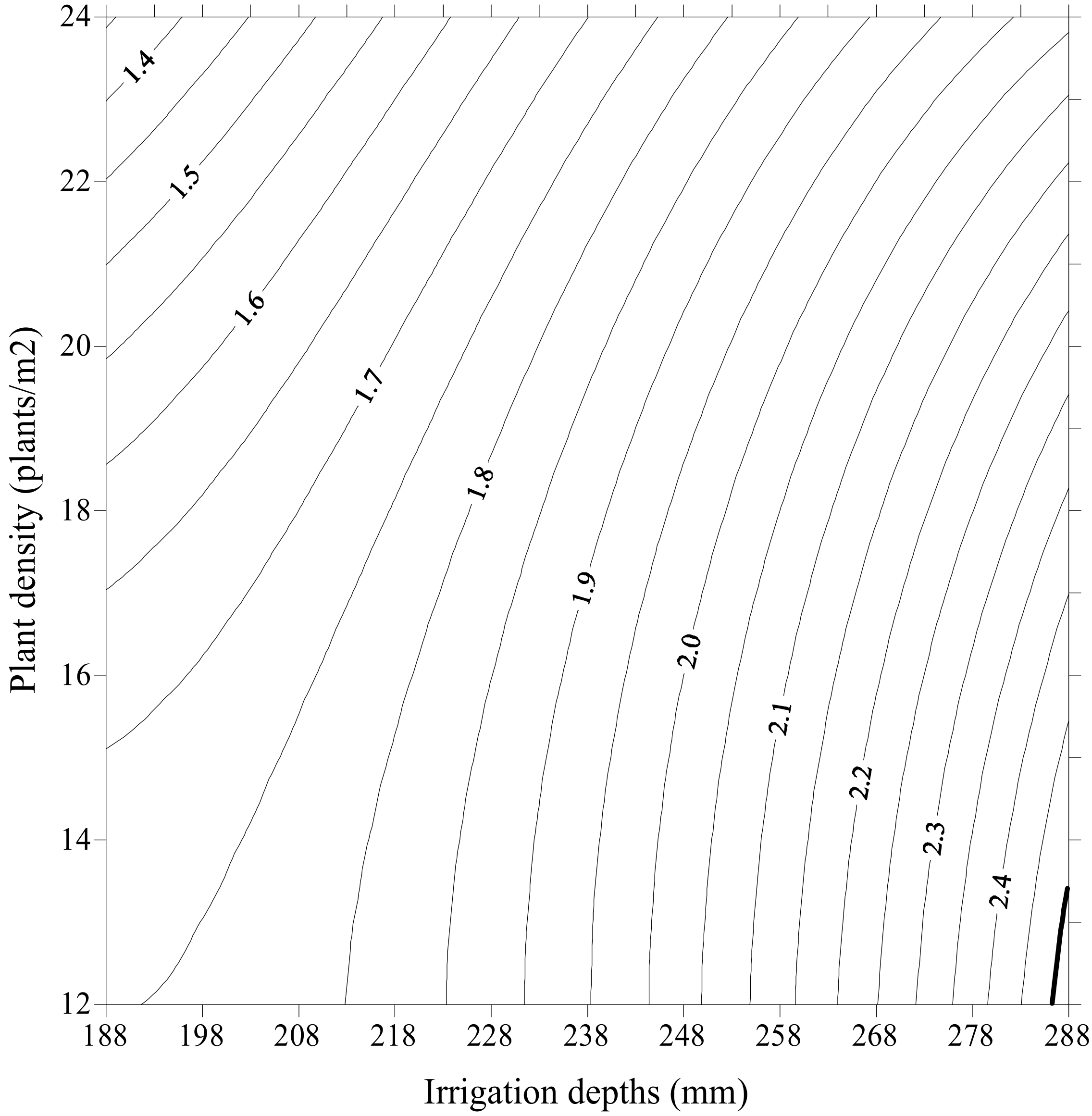

Figure 3. Response surface for the number of pods per plant (NPP) of the cowpea cultivar BRS Tumucumaque, as a function of irrigation depths (L) and plant density (D). Data transformed to √x. Teresina, PI, Brazil.

It is observed that the larger the plant population, the lower the production of pods per plant, a fact observed by several authors (BEZERRA et al., 2014; OLIVEIRA et al., 2015; MONTEIRO et al., 2017). This is justified by the high inter- and intra-plant competition at high population densities, a fact that is related to flower abortion and reduction in the number of lateral branches. According to Bezerra et al. (2009), the vast majority of cowpea pods are produced on the lateral branches. In addition, water deficit reduces leaf growth, negatively affecting the production of photoassimilates and, consequently, reducing the number of pods. According to Leite, Rodrigues and Virgens Filho (2000), this behavior can be explained as one of the mechanisms of drought tolerance used by the crop, in search of better conditions to overcome the lack of water, producing a lower quantity of pods.

A result similar to that of the present study was observed by Oliveira et al. (2015), who studied the interaction between water levels and plant density on the growth and grain yield of the cowpea cultivar BRS Itaim, in Teresina-PI, and observed maximum values of 5.01 pods per plant, obtained with an irrigation depth of 393.53 mm and density of approximately 110,000 plants ha^{-1}, obtained with the combination of the highest irrigation depth and lowest plant density.

Reduction of NPP with increased plant density was also observed by Cardoso, Melo and Ribeiro (2018), who evaluated the production performance of three cowpea cultivars with different types of growth habit as a function of population density, in the MATOPIBA region, and concluded that the number of pods per plant responded linearly to the increase in plant density, indicating that for the increase of one plant per square meter, there were reductions of 0.213, 0.166 and 0.378 pods per plant for cultivars with upright, semi-erect and semi-prostrate growth habits, respectively.

For NPPM2, the highest value of 10.07 pods m^{-2} (transformed value, corresponding to 101.4 pods m^{-2}) was obtained with the combination of the irrigation depth of 288.7 mm and the density of 19.4 plants m^{-2} (Figure 4). It can be noted that, within the studied interval, the higher the irrigation depth applied, the higher the NPPM2.

NPPM2 increases as plant density increases up to an optimal point, around 19 plants m^{-2}, and tends to decrease because, although higher plant density promotes reduction in the production of photoassimilates (intraspecific competition) and, consequently, in the number of pods per plant, in this case there is a balance due to the greater number of plants per unit of area. Therefore, although plants produce fewer pods, there are more plants per planted area.

Values similar to the one found in the present study were obtained by Monteiro et al. (2017), who found a maximum value of 105 pods m^{-2}, under no-tillage, with the association of 28 plants m^{-2} and irrigation depth of 256 mm. In this case, a similar value of NPPM2 was obtained with a higher plant density. This fact may be associated with the upright growth habit of the cowpea cultivar utilized by the authors (BRS Itaim), which enabled higher plant density.

The response surface for pod length is shown in Figure 5. It can be observed that the maximum value for this component was 20.5 cm, obtained with the combination between irrigation depth of 288.7 mm and density of 12 plants m^{-2}, agreeing with the characteristics of the cowpea cultivar BRS Tumucumaque (21 cm) presented by Cavalcante et al. (2014).

The lowest PODL value observed was 18.9 cm, obtained with irrigation depth of 188 mm and the same plant density that led to the maximum value (12 plants m^{-2}). Therefore, it can be noted that PODL was more influenced by irrigation depths than by plant densities, corroborating the results of Bezerra et al. (2014), who found that pod length was not significantly affected by plant densities for the cultivar BRS Novaera, also with semi-erect growth habit. This result can be explained by the fact that this component is more related to the genetic characteristics of the cultivar than to the factors associated with the environment.

Increasing values of PODL with increasing irrigation depth were also observed by Costa Junior et al. (2017) when studying the agronomic performance of the cowpea cultivar BRS Tumucumaque under different water regimes and spacings between plant rows.

The results found were similar to those reported by Tagliaferre et al. (2013) who observed pod length of 20.17 cm, on average, for the cowpea cultivar BRS Guariba, which has the same growth habit as the cultivar under study.

The maximum GY in this study was 1,694.5 kg ha^{-1}, obtained with the combination between irrigation depth of 288.7 mm and density of 20.4 plants m^{-2} (Figure 6). The highest grain yields were obtained with the highest irrigation depths. Grain yield results similar to those found here were obtained by Costa Junior et al. (201 7), who also evaluated the cowpea cultivar BRS Tumucumaque and obtained grain yield of 1,519.1 kg ha^{-1}, with the application of the treatment of highest irrigation depth (376.4 mm), and by Ferreira et al. (2010), who evaluated the cowpea cultivar BRS Guariba, whose maximum grain yield was 1,599.03 kg ha^{-1}, under an irrigation depth of 390.1 mm. These authors also worked with semi-erect cowpea cultivars.

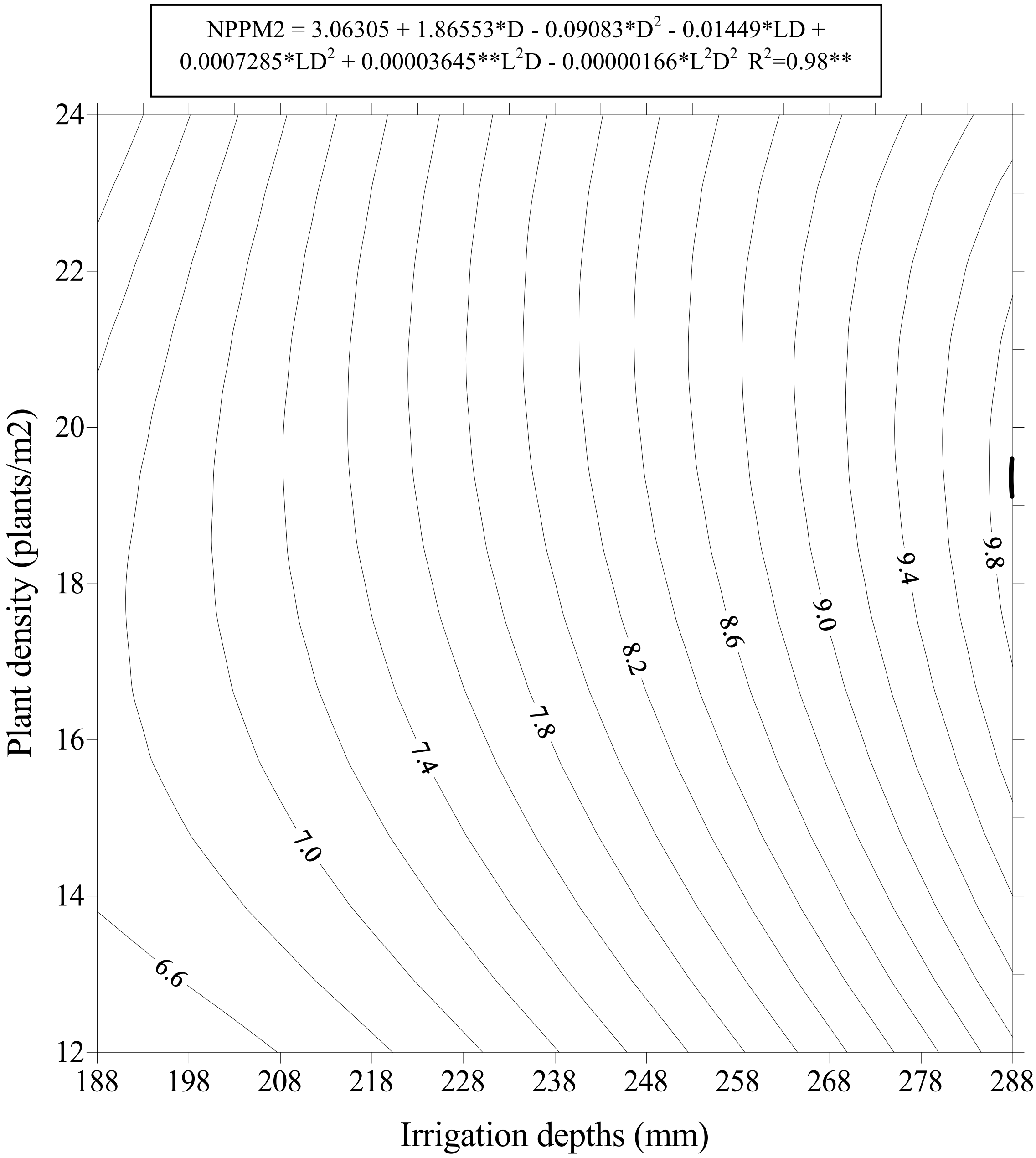

Figure 4. Response surface for the number of pods per square meter (NPPM2) of the cowpea cultivar BRS Tumucumaque, as a function of irrigation depths (L) and plant density (D). Data transformed to √x. Teresina, PI, Brazil.

It is observed that the lower the irrigation depth, the lower the grain yield (Figure 6). This fact can be explained by the deleterious effect of water deficit, which reduces the water potential of plants, decreasing stomatal conductance and leaf transpiration. This causes increase in leaf temperature and reduction in the production of photoassimilates, causing reduction in crop yield (TAIZ; ZEIGER, 2013).

Nascimento et al. (2011), when evaluating the effect of water deficit on the physiological and production characteristics of cowpea to select drought-tolerant genotypes in two experiments (one with water deficit and the other without) under soil and climate conditions of Teresina, PI, found a 60% reduction in the average grain yield comparing genotypes under full irrigation to those of the experiment under water deficit.

The maximum value of WUE reached was 5.8 kg ha^{-1} mm^{-1}, obtained with irrigation depth of 288.7 mm and density of 19.5 plants m^{-2} (Figure 7).

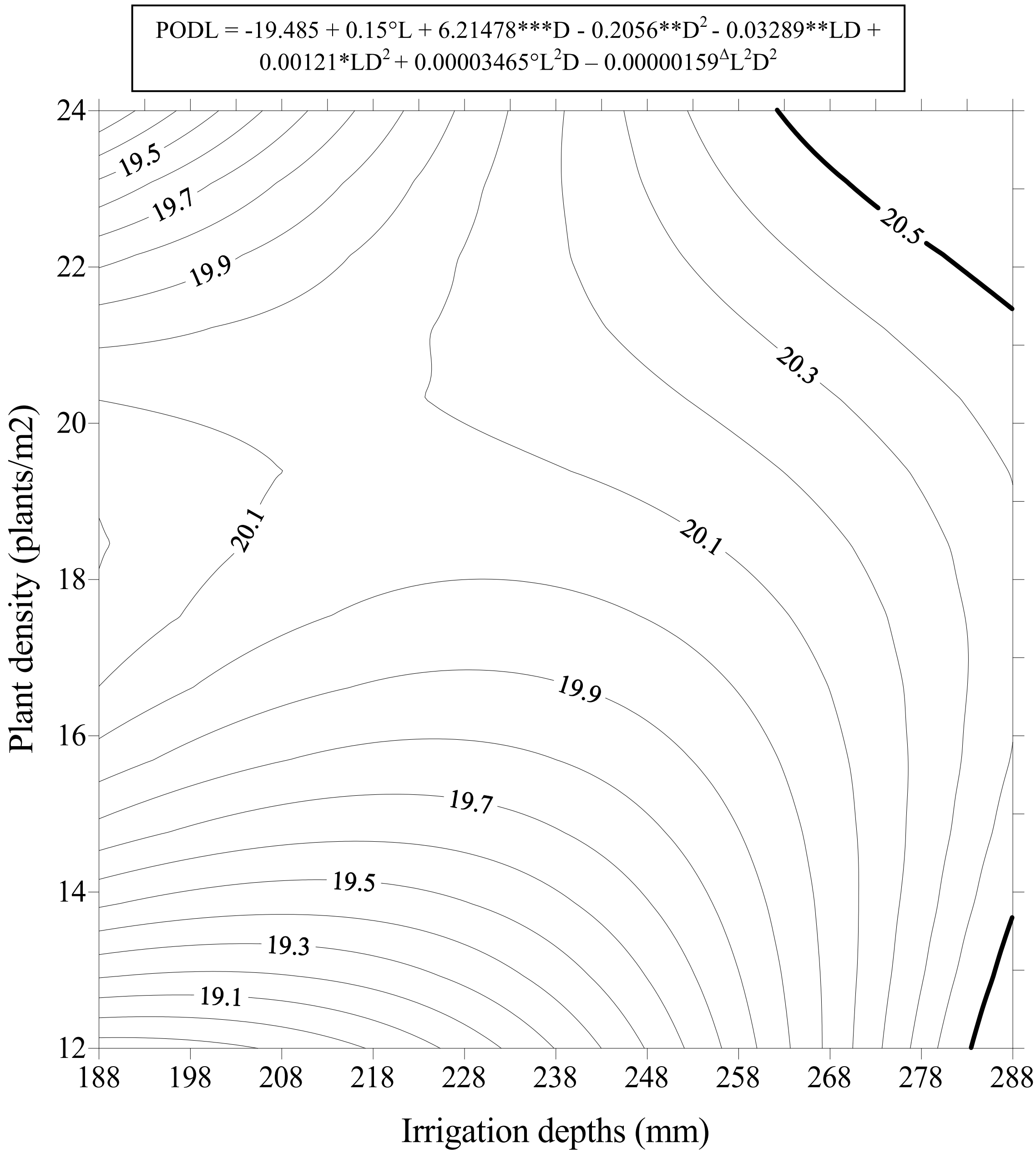

Figure 5. Response surface for pod length (PODL) of the cowpea cultivar BRS Tumucumaque, as a function of irrigation depths (L) and plant density (D). Teresina, PI, Brazil.

It can be noted that the maximum values of WUE and GY were obtained with the application of the same irrigation depth and with similar densities, 19.5 and 20.4 plants ha^{-1}, respectively. However, it must be pointed out that the treatments promoting the highest grain yields are the same ones that enable the highest values of water use efficiency. When the maximum WUE value is obtained with an irrigation depth lower than that which promotes highest grain yield, the application of irrigation depths aiming at highest grain yield should only be economically recommended if water is not a limiting factor for agricultural production or has low cost (ANDRADE JÚNIOR et al., 2002).

A similar result was observed by Costa Junior et al. (2017), who evaluated the agronomic performance of the cowpea cultivar BRS Tumucumaque and found a maximum WUE value of 5.4 kg ha^{-1} mm^{-1}, with the application of the irrigation depth of 305.4 mm. Similarly, Andrade Júnior et al. (2002) observed maximum WUE of 6.6 kg ha^{-1} mm^{-1}, with application of irrigation depth of 306.3 mm, considering the average of two cultivars (BR 17 - Gurguéia and BR 14 - Mulato).

The correlation coefficients between the production components and grain yield and their respective significance levels are presented in Table 3.

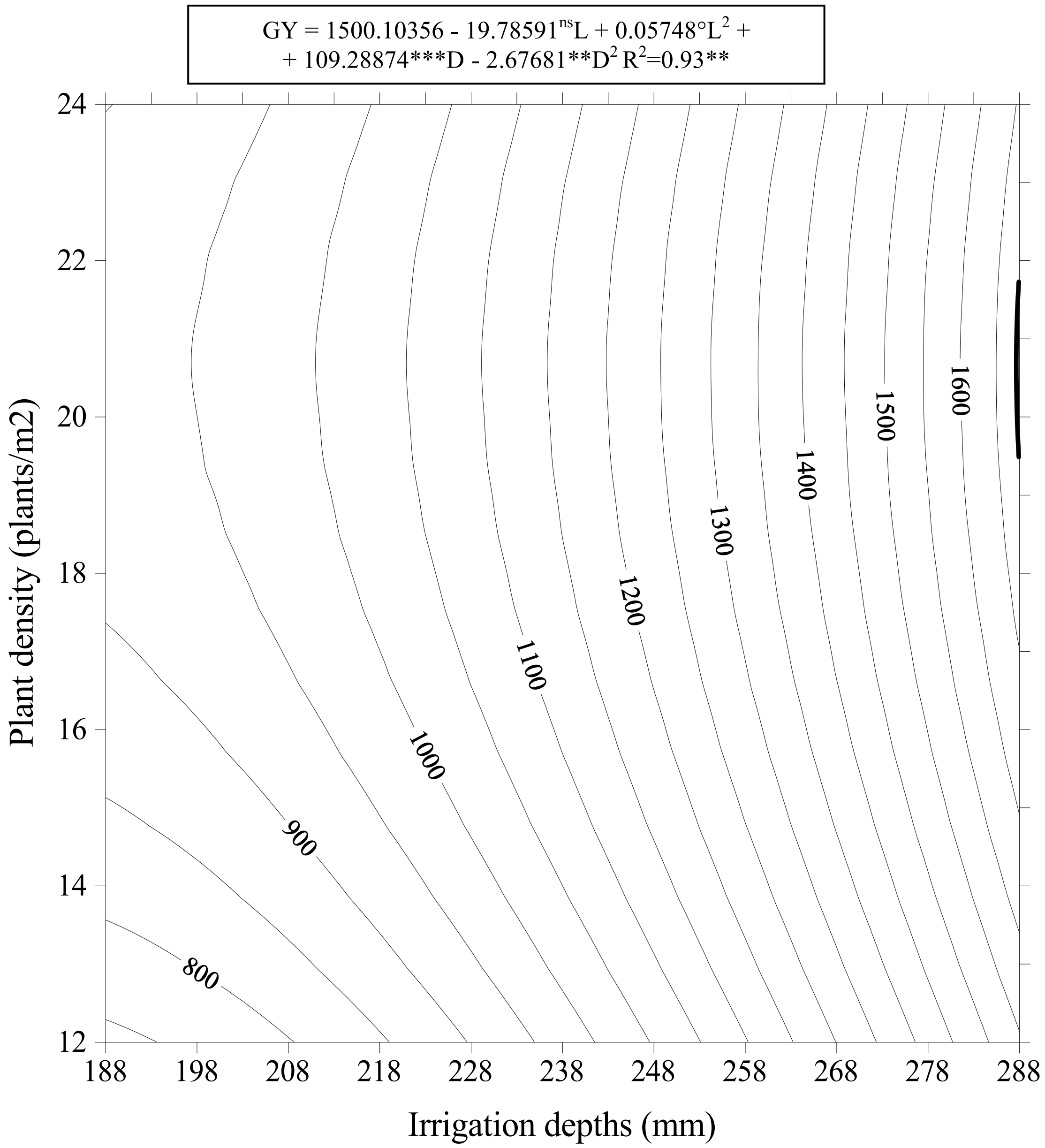

Figure 6. Response surface for grain yield (GY) of the cowpea cultivar BRS Tumucumaque, as a function of irrigation depths (L) and plant density (D). Teresina, PI, Brazil.

The correlation coefficients obtained have minimum and maximum values of 0.57 and 0.96 for the components PODL and NPPM2, respectively.

The low correlation between PODL and GY occurred because the results of the former are more associated with the genetic characteristics of the cultivar than with the application of treatments. Therefore, it does not respond in correlation with grain yield when subjected to the treatments with variation in irrigation depth and plant density.

The high correlation of NPPM2 occurs because grain yield is directly associated with the increase in the number of pods per area, that is, the more pods per unit of area, the higher the grain yield.

It can be noted that the same does not occur with NPP, because a high NPP does not necessarily mean high yield, considering that a plant may have several pods but, simultaneously, there may be few plants per unit of area. In addition, there may be a high number of small pods, with fewer grains per pod, due to the intraspecific competition between plants.

A similar result was observed by Cardoso, Melo and Ribeiro (2018), who evaluated the production performance of three cowpea cultivars of different types of growth habit, as a function of population density, in the MATOPIBA region, and observed that the production component most correlated with grain yield was the number of pods per area.

Water use efficiency also showed a high correlation with grain yield, since WUE, mathematically, increases with the increase in GY.

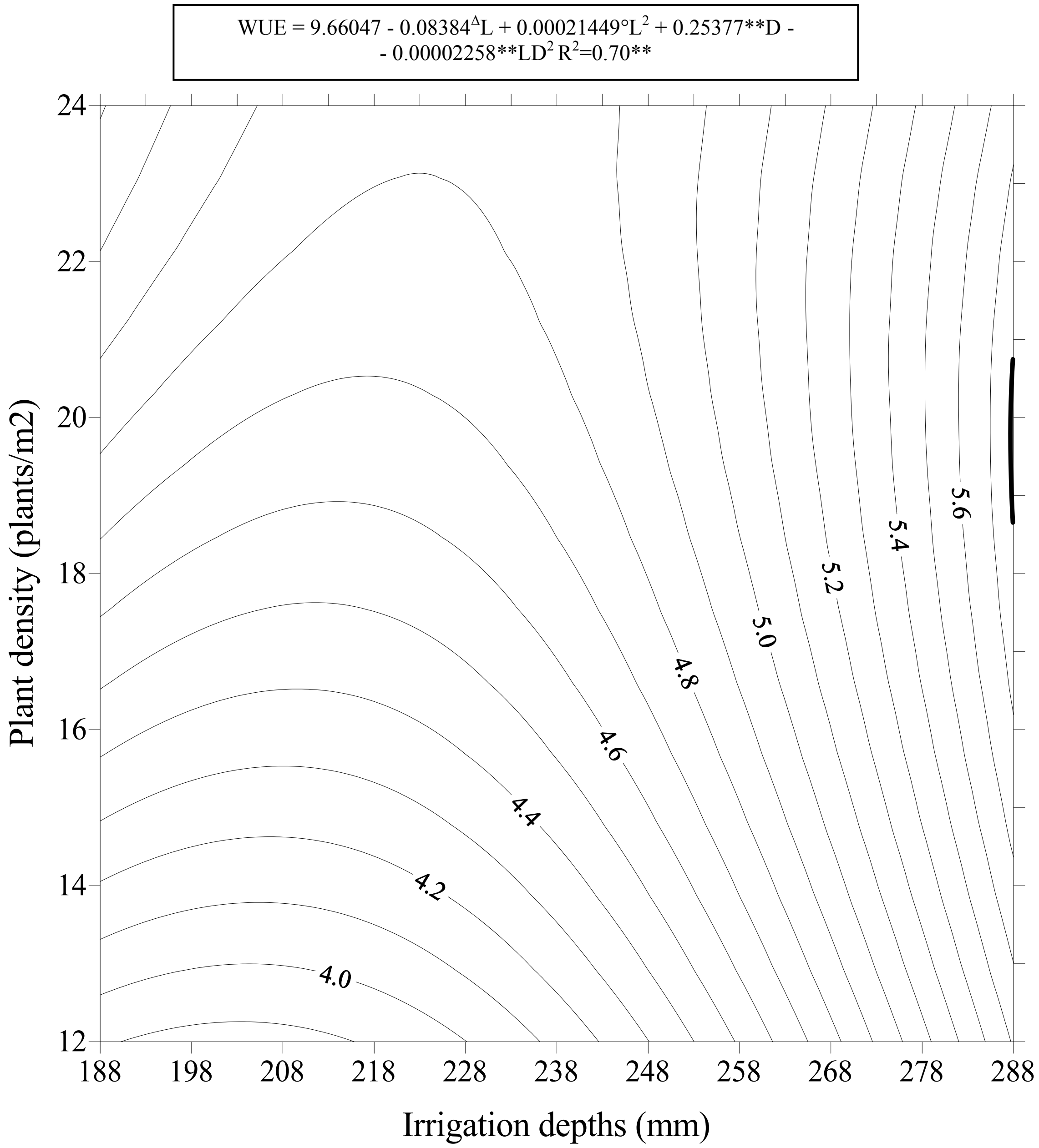

Figure 7. Response surface for water use efficiency (WUE) of the cowpea cultivar BRS Tumucumaque, as a function of irrigation depths (L) and plant density (D). Teresina, PI, Brazil.

Table 3. Estimation of Pearson's coefficients of correlation between grain yield (GY) and number of pods per plant (NPP), number of pods per m^2 (NPPM2), pod length (PODL) and water use efficiency (WUE) of the cowpea cultivar BRS Tumucumaque. Teresina, PI, Brazil.

Production component	Coefficient of correlation with GY
NPP	0.77**
NPPM2	0.96**
PODL	0.57*
WUE	0.87**

*, **Significant at 5% and 1% probability levels, respectively, by t-test.

CONCLUSIONS

The cowpea cultivar BRS Tumucumaque shows different production behavior according to the water regimes and plant densities.

Irrigation depth of 288.7 mm associated with density of 20.4 plants m^{-2} promotes maximum grain yield and water use efficiency in the cowpea cultivar BRS Tumucumaque.

Number of pods per square meter is the

production component most correlated with the grain yield of the cowpea cultivar BRS Tumucumaque.

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