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Foliar application of urea and bell pepper amino acids

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The Bell peppers is a tropical culture and it is in the 10 most consumed vegetables of the world. The mineral nutrition is essential to the productivity and better quality of the gather fruits. In bell pepper cultivation, high portions of nitrogen are essential to a good performance of fruits. The foliar fertilizing is a complement to the ground fertilizing. The amino acids are a good source of nitrogen, once these are quickly incorporated to the plants metabolism. Therefore, this work aimed to estimate the sources and portions of N to the foliar application in Bell pepper cultivar. The Randomized blocks design was utilized in a factorial scheme 2×4 , with four repetitions. The first factor corresponded in two sources of N: urea and amino acids. The second factor corresponded to the number of repetitions by foliar: 0, 1, 3, 5 and 7 applications during the culture cycle. The first foliar application occurred ten days after the transplant, and the subsequent in breaks of fifteen days after the first application. In the test there was not application. The baselines evaluated: Cross length of fruits, fruits diameters, number of total fruits and productivity in kg ha^{-1} . The results were submitted to variation and regression analysis. The application of amino acids by foliar in plants of Bell pepper, increased the diameter and the length of fruits. High sources of urea also provided morphological changes in fruits however lower amino acids utilization.

Key words: *Capsicum annuum* L., nitrogen fertilizing, fruit quality.

INTRODUCTION

The Bell pepper is from the family Solanaceae; it is a tropical culture. In an economic way, it is in the ten most important vegetables in the Brazilian market. It is a culture of fast return to investing, in a short period to the beginning of the production, which is why it is very explored by small and medium vegetables (Campos et al., 2008).

Into the factors of production of vegetables, the mineral nutrition is essential to raise the productivity and increase

the quality of picked products (Marcussi et al., 2004). In bell pepper harvest, to a high quality and high performance of fruits, it is essential to provide high portions of nitrogen (N). In literature, there are recommendations raging in 221 to 400 kg of N ha^{-1} , with parcel applications during the sowing and then in cover, to reduce the lost by leaching and increase the efficiency of fertilizing usage (Stagnari et al., 2007; Campos et al., 2008; Araújo et al., 2009).

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Table 1. Average standards referring to the height of plants, length of fruits, diameter of fruits, number of fruits and productivity in function of the treatments with urea and amino acids.

Treatments	Length of fruits (cm)	Diameter of fruits (cm)	Total of fruits (units ha ⁻¹)	Productivity of fruits
Amino acids	12.5	68.8 ^a	316.9 ^a	48.5 ^a
Urea	12.1 ^b	67.2 ^b	310.3 ^a	47.5 ^a
CV (%)	4.5	3.14	14.3	13.2

Means followed by the same letter in the column do not differ by Tukey test (P<0.05).

It is known that, in the field, the foliar fertilizing is a complement to the fertilizing done in the ground, related to the nitrogen provided to the cultures. This way, the incorporation of N by foliar fertilizing with amino acids can be an extra supply by ground in some growth stages. The usage of direct fertilizing in plants with free amino acids, decrease the chemistry transformation incorporated to the metabolism as it was synthesized by the plant adding to the process of growth and development (Lima et al., 2009; Gazola et al., 2014).

Besides that, there are other benefits of amino-acids application, quoted by Brandão (2007) and Kowalczyk and Zielony (2008). The better of photosynthesis, decreasing the phytotoxicity of some defensives, more tolerance to plagues and diseases, better absorbing and translocation of nutrients applied by foliar, making the root system more developed and with more strength, moderating the hormonal activities of the plants. Providing more tolerance to hydric and frost stress, more flowering of plants and increase the quality of picked products.

Although there are few works and researches published in Brazil about the effects of amino-acids pulverization on vegetables, this practice is too pervasive in horticultures, therefore, it is notorious the need in more information about the application of amino acids in agriculture, to obtain satisfactory improvement in the used culture. Therefore, the objective of this work is to evaluate the sources and portions of N to the foliar application in bell pepper culture (*Capsicum annuum* L.).

MATERIALS AND METHODS

The experiment was taken from August 2010 to April 2011, in the experimental area of Universidade Estadual de Goiás - UEG/UnU de Ipameri - GO (latitude 17° 43' 20" S and longitude 48° 09' 44" W) with a medium high level of 800 m. The weather of the region classified according to Koppen, is the Aw kind, with high temperatures, rain in the summer and dry winter.

The ground where the experiment was taken is the Latossolo Vermelho Amarelo Distrófico (Oxisol) (Embrapa, 2006). The chemistry analysis of the ground in layers from 0 to 0.2 m of depth. Showing the following characteristics: Organic Matter = 24 g dm⁻³; pH = 6.4; CTC = 52 mmol_c dm⁻³; basis saturation = 14%; H+Al = 44 mmol_c dm⁻³; P = 0.9 mg dm⁻³; K = 1.3 mmol_c dm⁻³; Ca = 50 mmol_c dm⁻³; Mg = 2 mmol_c dm⁻³.

To the elevation of basis evaluation of the ground to 80%, was applied 4600 kg ha⁻¹ of limestone, parceled in two applications, on 80 and 60 days before the sowing, and a limestone with a portion of

810 kg ha⁻¹. The ground was prepared right after, with one plow and two light harrows.

The basis fertilizing was the same to all treatments, in furrow 15 days before the seedling transplantation, with 10.000 kg ha⁻¹ of chicken manure; 340 kg ha⁻¹ of P₂O₅; 45 kg ha⁻¹ of N in 70% in basis and 30% in cover; and 95 kg ha⁻¹ of K₂O in 70% in basis and 30% in cover. The fertilizing of cover was parcel in five applications in breaks of 15 days.

The experimental design was the randomized blocks design, in a factorial scheme 2 × 5, with four replications. The first factor corresponded to two sources of N: urea and amino acids. The second factor corresponded to the number of foliar applications: 0, 1, 3, 5 and 7 applications during the culture cycle, doses of a commercial product were use with concentration of 1% of N and 8% of an amino-acid complex. Each replication had dimensions of 3.60 × 2.00 m (7.20 m²), where the seedling of the bell pepper hybrid Magali R in a tray, were transplanted in 30 days after the emergence in parallel lines, making the total of 20 plants per parcel, distant 0.40 m, and the space between the lines of 0.80 m. In which were consider useful to the plants of the centerlines, in six plants.

The first foliar application occurred ten days after the transplant, and the subsequent in breaks of fifteen days after the first application. In the test, there was not N application by foliar. To the foliar applications it was used a pressuring pulverization of CO₂ with pressure of two kgf and flow of 200 L ha⁻¹. The solutions to the foliar application were prepared with concentrations of N 2% in both treatments, mixture volume equivalent to 200 L ha⁻¹, corresponding to 0.5, 1.5, 2.5 and 3.5 g ha⁻¹ of N. In the treatments with amino acids, a commercial product was use with concentration of 1% of N and 8% of an amino-acid complex.

The control of plagues and diseases was prophylactive and when showed incidence, to the control were utilized products based on thiophanate methyl 70%, mancozeb 80%, oxichloride of copper 84%, hydroxide of copper 54%, imidacloprid 70%, deltametrina 2%, metomil 21.5%, abamectina 1.8%. The control of weeds was manual. The irrigation was realized according to the need or in each three days, with a splitter of 8 mm.

The parameters evaluated were crossed length of fruits, diameter of fruits, total number of fruits and total productivity of fruits in kg ha⁻¹, being, and all the information collected, in plants of usage area of the parcel. The results were subordinated to a variance analysis, with medium comparison according to the Tukey (P<0.05) test and of regression, utilizing the software SISVAR.

RESULTS AND DISCUSSION

The treatments were different in the portions average, only for length and diameter of fruit, in the others the answers were not different (Table 1). In the treatments with amino acids, to each gram of N applicate, occurred an increase of 0.31 cm on the length of fruits, in the

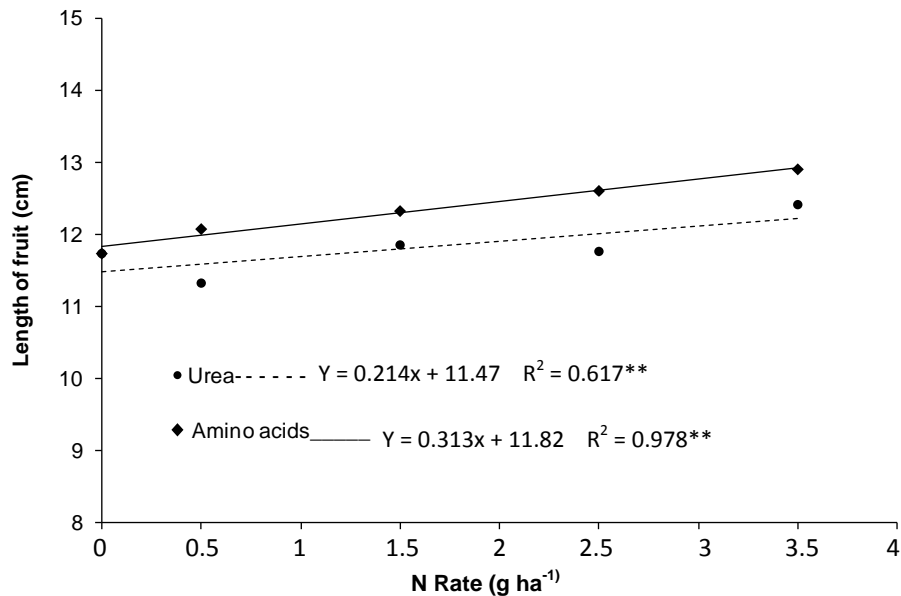


Figure 1. Length of fruits of bell pepper in function of the N portions, utilizing sources of urea and amino acids.

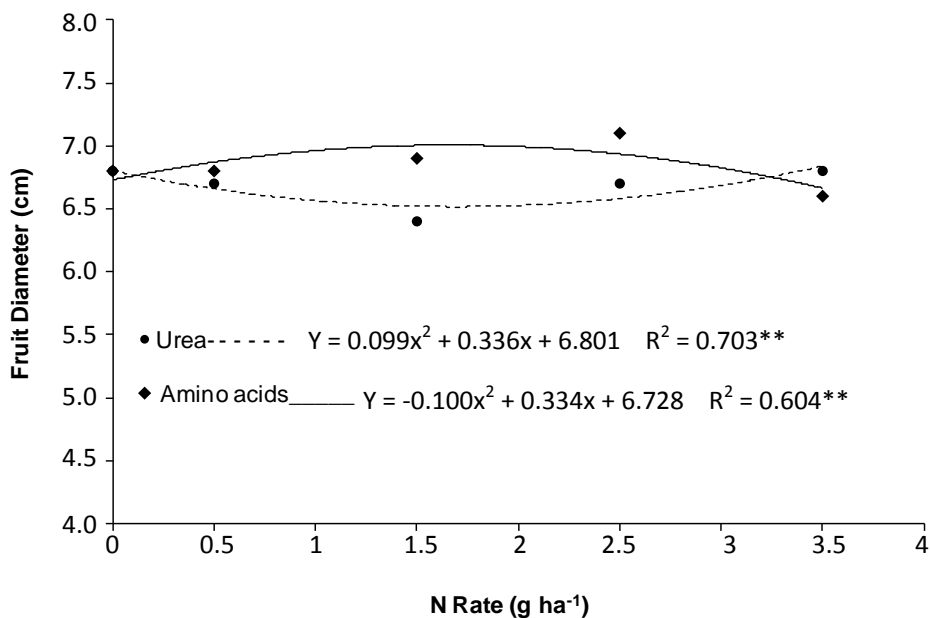


Figure 2. Diameter of bell pepper fruits in function of N, utilizing sources of urea and amino acids.

portion of 3.5 g ha⁻¹ of N, providing an average of fruits with 12.91 cm, 8.4% superior when compared with the test without foliar N application (Figure 1). To the tests with urea, to each gram of N applied, there was an increase in 0.28 cm in the length of fruits, making possible the portion of 3.5 g ha⁻¹ of N in an average of fruits with 12.41 cm, 7.8% when compared to the test

without foliar N application (Figure 1).

Related to the diameter of fruits, in the treatments with amino acids, the maximum diameter of 7.6 cm was possible with 1.7 g ha⁻¹ of N. In this portion, there was a shorter fruit of 6.6 cm, but, increasing the portion, the diameter increased, reaching 6.8 cm with 3.5 g ha⁻¹ of N (Figure 2). However, the maximum diameter reached with

1.72 g of N ha⁻¹ of amino-acids source was superior to 2.8% of the diameter reached with the source of 3.5 g ha⁻¹ of N of urea source.

The amino acids as a source of N contributed to a better plant absorbing, which reflected in the difference of length and fruit diameter related to the urea as a source of N. Commercial amino acids as a source of N, proved more absorbing of vine leaves, where the plants showed air system growth and right N concentration (Albuquerque et al. (2008). According to Abd El-Aal et al. (2010), the basics components of live cells are the protein, and the main source of protein in vegetables tissues is the nitrogen or amino acids.

Several researches showed that amino acids could influence the physiologic activities during the plants growth, increasing the productivity. The foliar application of amino acids provided more growth and better quality of fruits in plants of potatoes, chili pepper, cucumber, garlic and pigeon pea (Kamar and Omar, 1987; Karuppaiah et al., 2000; El-Shabasi et al., 2005; Awad and Shall, 2007; El-Zohiri and Asfour, 2009; Moraditochae et al., 2012). Others studies also showed that the foliar pulverization with urea during the phase of growing in many vegetables influence the better quality of fruits of cucumber, okra and pea (Xu-Fuli et al., 2004; Elizabeth et al., 2006; Shaheen et al., 2006, 2008).

In this work, the application of the treatments prorogued differences only to the length and diameter of fruits, not changing the number of fruits and the total productivity. Therefore the foliar applications of amino acids in bell pepper plants do not influence in quantity variations if plants but in quality variations of fruits, increasing the process of synthesis and translocation of sugars and empower the accumulation of the organ of supply, as the fruit.

Noticing the importance of biometrics variations to the benefice, and commercialization of vegetables deal in large warehouse of supply of agricultural products; the fruits produced in this study are classified as medium fruits - fruits of 12 to 15 cm of length and more than 6 cm of diameter, according to CEAGESP (2004). The size and shape are important, because the variation between the units of a product can affect the choice of the consumer.

In the same meaning, the results obtained by Luz et al. (2010), with applications of the foliar fertilizing Aminoagro Fruto® in plants of tomatoes, the treatments provided more productivity, and increased the production of better classified fruits in superior bunches, where, according to Fontes and Silva (2005), normally the production is shorter in the inferior bunches.

Conclusions

1. The foliar application of amino acids in plants of bell pepper increases the diameter and length of fruits.

2. High portions of urea also provide morphologic changes in fruits, however it is lower using amino acids.

Conflict of Interests

The authors have not declared any conflict of interests.

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