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Production of sweet potato branches in suspended pots depending on nitrogen fertilization

Produção de ramas de batata-doce em vasos suspensos em função de adubação nitrogenada

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Abstract

The use of branches from selected plants may favor the productivity of the sweet potato crop, which makes necessary high production of branches per unit of mother plant. Thus, this study aimed to evaluate the branches production of sweet potato plants grown in suspended pots containing substrate fertilized with different doses of nitrogen. For this study, the experiment was installed in randomized blocks with time split plot, with 10 repetitions. It was used a factorial 5 x 2, being five doses of N (0; 0.24; 0.48; 0.72 and 0.96 g per pot) and two the amount of plants per pot (one or two plants). The sweet potato seedlings were produced in trays and planted in pots. The fertilization of the substrate with urea occurred every 30 days. The branches of the plants were collected at 60, 105, 150 and 195 days after transplantation, keeping the potted plants with branches of 0.30 m. It were evaluated length and dry mass of the branches of sweet potato produced in pots. As a result, it was found that the use of nitrogen in doses of 0.72 and 0.96 g per pot and the cultivation of only one plant per pot favored greater growth of sweet potato plant branches. Therefore, the addition of nitrogen to the substrate where sweet potato plants are cultured is feasible to obtain greater amount of plant material in order to produce new plants.

Additional keywords: cutting; *Ipomoea batatas* (L.) Lam; mother plant; multiplication; substrate; vegetative propagation.

Resumo

A utilização de ramas provenientes de plantas selecionadas pode favorecer a produtividade da cultura da batata-doce, o que faz necessária elevada produção de ramas por unidade de planta-matriz. Assim, este trabalho teve por objetivo avaliar a produção de ramas de plantas de batata-doce cultivadas em vasos suspensos contendo substrato fertilizado com diferentes doses de nitrogênio. Para este estudo, foi instalado experimento em blocos casualizados, com parcelas subdivididas no tempo, com 10 repetições. Foi utilizado o esquema fatorial 5 x 2, sendo cinco doses de N (0; 0,24; 0,48; 0,72 e 0,96 g por vaso) e duas quantidades de plantas por vaso (uma ou duas plantas). As mudas de batata-doce foram produzidas em bandejas e foram plantadas em vasos. A fertilização do substrato com ureia ocorreu a cada 30 dias. As ramas das plantas foram coletadas aos 60; 105; 150 e 195 dias após o transplante, mantendo-se as plantas dos vasos com ramas de 0,30 m. Foram avaliados o comprimento e a massa seca das ramas de batata-doce produzidas em vaso. Como resultado, verificou-se que a utilização de nitrogênio nas doses de 0,72 e 0,96 g por vaso e o cultivo de apenas uma planta por vaso favoreceram maior crescimento de ramas de plantas de batata-doce. Logo, a adição de nitrogênio ao substrato onde são cultivadas plantas de batata-doce é viável para a obtenção de maior quantidade de material vegetativo com a finalidade de produção de novas plantas.

Palavras-chave adicionais: estaca; *Ipomoea batatas* (L.) Lam; multiplicação; planta matriz; propagação vegetativa; substrato.

Introduction

The culture of sweet potato has a high potential to produce tuberous roots, reaching an average of 30 t ha^{-1} (Silva et al., 2002). However, in 2012, the average productivity in Brazil was of 12.2 t ha^{-1} (IBGE, 2014). Several factors are responsible for the productivity below the culture potential, for example, low technological investment, use of varieties which are little suitable to the growing region and use of plant material from commercial crops with low sanitation and inadequate nutrition. Rós et al.

(2012) found that only by selecting propagation material with good sanitation and productivity one can increase crop yield by more than 50%.

Notwithstanding, when there are few healthy and productive mother plants for the supply of branches, the healthy material must be multiplied over and over again until obtaining a satisfactory amount of branches to implement the commercial planting. Thus, techniques that favor the obtaining of large numbers of seedlings from a few mother plants should be used so that one can have enough material for the implementation of the nursery area, which subsequently may provide planting material for the implementation of the commercial farming.

Nitrogen is a constituent of molecules of amino acids, proteins, enzymes, nucleic acids and cytochromes, and also has important function as part of the chlorophyll molecule (Taiz & Zeiger, 2004). It is the nutrient responsible for vegetation, influencing the leaf area index and the production of vegetative buds (Malavolta, 2006). Hence, the addition of nitrogen in sweet potato mother plants may favor the production of plant material. According to Echer et al. (2009), nitrogen is the most absorbed nutrient, both by leaves and branches and by tuberous roots of sweet potato. Furthermore, this nutrient, in high quantity, favors the production of branches in detriment of the production of tuberous roots (Hartemink et al., 2000; Silva et al., 2002). In work of Oliveira et al. (2005), the productivity of sweet potato tuberous roots showed response according to quadratic model, with decreased productivity from 339 kg ha^{-1} urea, which, according to the authors, indicates that the nitrogen excess was detrimental to the formation of commercial roots in sweet potato, possibly due to high green mass production and formation of adventitious roots.

For the potato production is also necessary to have an adequate supply of nutrients, and nitrogen is one of the elements that can significantly increase the crop yield (Silva et al., 2009). And, as occurs in sweet potato, excessive amounts should be avoided because they may induce the plant to the production of excess leaves and increase the vegetative growth period, resulting in reduced tuber yield (Zvomuya et al., 2003).

Thus, this study aimed to evaluate the production of branches of sweet potato plants grown in hanging pots containing substrate fertilized with different levels of nitrogen, aiming to obtain plant material for production of new sweet potato plants.

Material and methods

The experiment was conducted from April to December 2013 in a fenced nursery in APTA (Agency of Agribusiness Technology in São Paulo) – Regional Pole of Alta Sorocabana, in Presidente Prudente-SP. For this study, the experimental design was a randomized block with time split plot, with 10 repetitions. It was used a factorial 5 x 2, being five doses of N (0; 0.24; 0.48; 0.72 and 0.96 g per pot) and two the amount of plants per pot (one or two plants). The samples were collected at 60, 105, 150 and 195 days after transplant.

To obtain the plants, it were used sweet potato branches segments with two nodes, obtained from plants of the variety Uruguaiana. The segments were removed from the apical portion of the branches (up to 0.6 m). The leaves were removed with pruning shears, taking care not to hurt the gems. Each segment was weighed, being selected those with similar masses. The segments were immersed in solution of 5 mL L^{-1} 50% carbendazin, for 10 minutes, to avoid fungal diseases.

The basal gem of the segments was inserted into substrate produced on the basis of vermiculite, plus pine bark (Bioplant®). It were used trays with 72 cells, with 11 cm in height and 5 cm in length.

At 30 days after planting, these segments were rooted and with leaves, and were planted in number of one or two plants in plastic pots suspended 1.4 m high and with a capacity of 4.2 L substrate. The spacing between the outer boundaries of a vessel and another was 0.25 m.

At 25 days after transplanting (DAT), the branches of the plants were cut, being kept 0.3 m branches in plants. The cut segments were not used in the evaluation. On that date was held the first fertilization with N. The N doses used were 0; 0.24; 0.48; 0.72 and 0.96 g per pot, which was equivalent to 0, 30, 60, 90 and 120 kg ha^{-1}. The fertilization was performed by use of urea. Soon after fertilization, the pots were irrigated. Nitrogen fertilization was performed every 30 days.

At that time, 25 DAP, it were also added 6 g of 13:6:16 slow-release fertilizer (Basacote®), with full release within three months. The fertilizer was lightly incorporated in the surface layer of the substrate. Its application took place every 60 days.

The sweet potato branches were harvested at 60, 105, 150 and 195 DAT, being maintained branch portions with 0.3 m in the plants. It were evaluated the length of the cut branches and the dry mass of sweet potato branches produced by vessel. From the second collection time, the values of length and dry mass of branches were added to the previous collections, in order to obtain the accumulated production in the period analyzed.

The data were submitted to variance analysis and, when necessary, the means were adjusted to polynomial regression equations. The criteria for choosing the model were the significance by F test, at 5% probability, and the higher values of the coefficient of determination (R^2).

Results and discussions

For the factor of length of branches, there was interaction between nitrogen dose and branches collection time; between the number of plants per pot and branches collection time; and between the number of plants per pot and nitrogen dose.

The length of branches presented increased linear response with the expansion of branches collection time for all doses used, which was expected, as the plants have not ceased their growth during the period of the experiment. The doses 0; 2.4 and 0.48 g pot^{-1} showed values which were close to each other, but lower than the values promoted by the doses 0.72 and 0.96 g pot^{-1} (Figure 1).

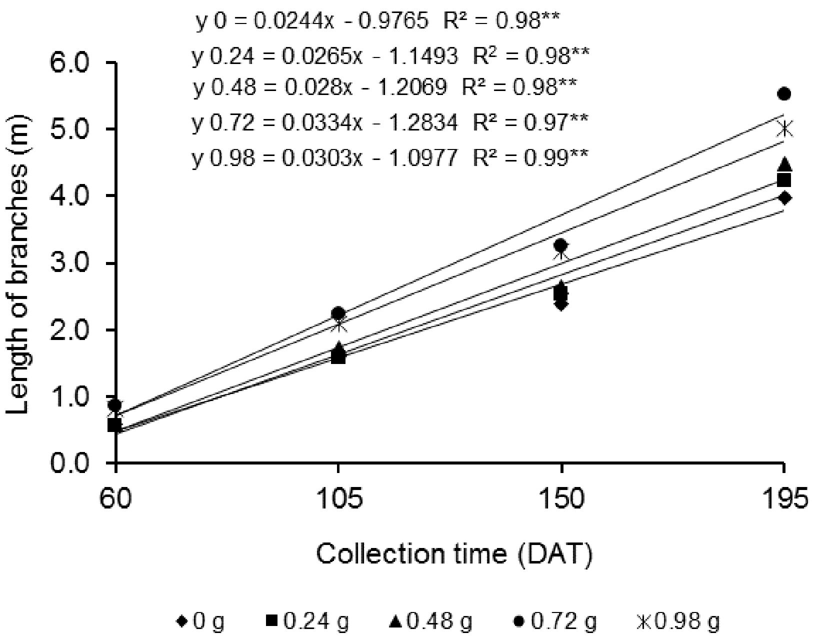

Figure 1 – Length of branches of sweet potato plants grown in pots with different nitrogen doses at different collection times.

At 195 DAT, the estimated amounts of branches produced in the doses 0; 0.72 and 0.96 g per pot were 3.78; 5.23 and 4.81 m, respectively. Thus, comparing the branches production, expressed in length, between the doses 0 and 0.72 g per pot, there was an increase in production of 38% when nitrogen was used. In work with nitrogen fertilization on cassava, Cardoso Junior et al. (2005) also found greater growth in the height of the shoots with the nitrogen addition to the dose of 400 kg ha^{-1}.

In work with jatropha plants, Albuquerque et al. (2009) also found a significant interaction between nitrogen doses and time, in which the increase of the nitrogen dose resulted in higher growth in plant height in all evaluation periods, and plant height also increased over time at a relatively constant rate.

In the interaction number of plants per pot and time of branches collection, the length of branches also presented positive linear response with the increase in length of stay of the plants in the pot (Figure 2).

It was found that, since the first collection, when there is maintenance of only one plant per pot, there is increased production of branches. This fact is due to the increased intraspecific competition for major environmental factors that promote growth, such as light and nutrients (Gava et al., 2001). At the last time of branches collection (195 DAT), the production of two plants per pot corresponded to 87.9% the production of one plant per pot.

The interaction between nitrogen rate and number of plants per pot demonstrates that there was an increase in the production of branches, with increasing doses used, both for one or two plants per pot. Nonetheless, there was greater growth, in all doses, when using only one plant per pot, fact related to the plant competition existing when they share the same recipient. The lengths of branches obtained, at a dosage of 0.96g per pot, with one and two plants per pot, were 3.15 m and 2.53, respectively, which corresponded to a difference of approximately 20% (Figure 3).

In work of Reguin et al. (2005), it was compared the growth in height of rocket plants cultivated with two and four plants per hill and it was verified that the greatest number of plants per hill promoted increased competition among plants, and resulted in lower individual growth, however, the fresh mass obtained by four plants was higher than that obtained by two plants.

In a study of nitrogen fertilization in melon with one or two plants per hill, Faria et al. (2000) found that the presence of two plants per hill resulted in damage to the crop yield, even with the application of higher doses of nitrogen.

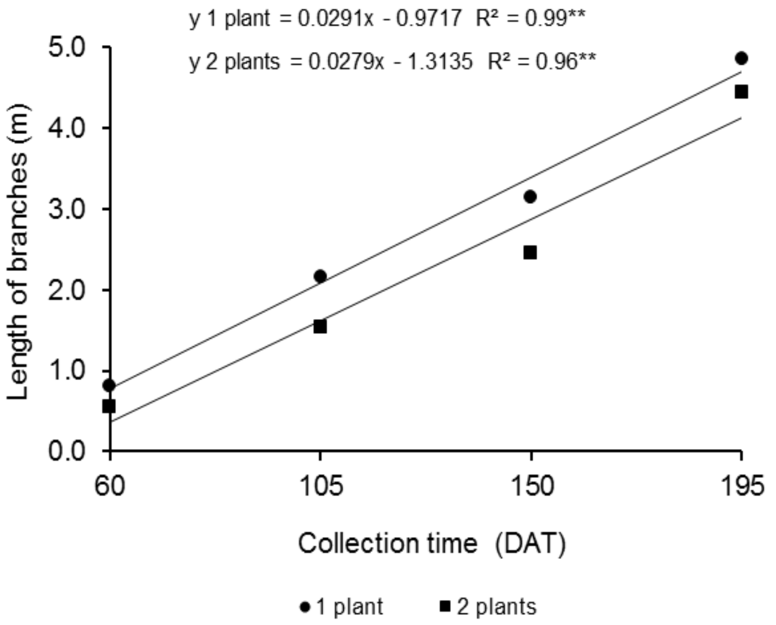

Figure 2 – Length of branches of sweet potato plants grown in pots with one or two plants at different collection times.

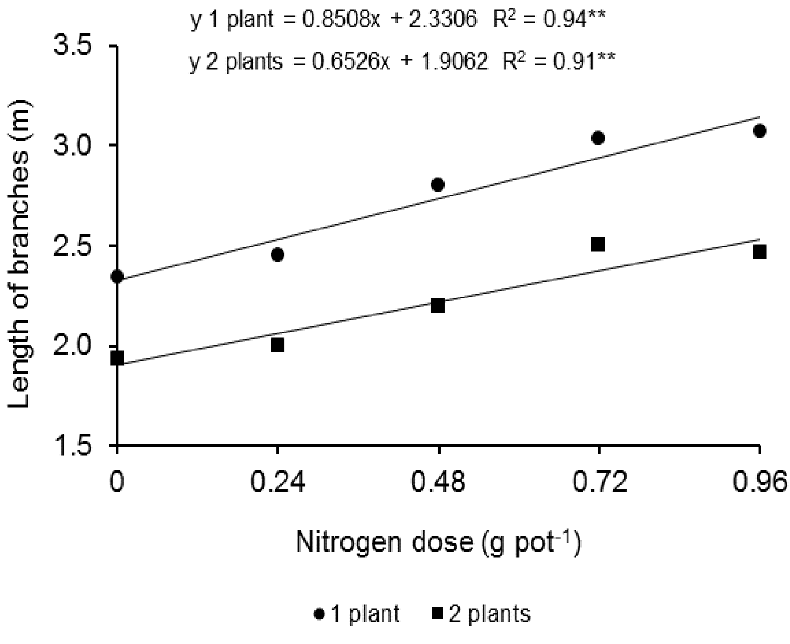

Figure 3 – Length of branches of sweet potato plants grown in pots with one or two plants with different nitrogen doses.

For the production of dry matter, there was interaction between nitrogen dose and time of branches collection; and between the number of plants per pot and time of branches collection.

The dry matter production presented positive linear response due to the increase of the collection time. And, in the same way as the characteristic length of branches, the two largest doses, 0.72 and 0.96 g pot^{-1}, promoted greater production of dry matter than the other (Figure 4). Similarly, in work of Diniz et al. (2011), wherein it was studied the use of liquid cattle manure with or without urea, it was verified higher number and dry matter of productive branches of sour passion fruit when there was the addition of urea, which was justified by the authors as stimulating function of nitrogen in the vegetative and productive plant growth.

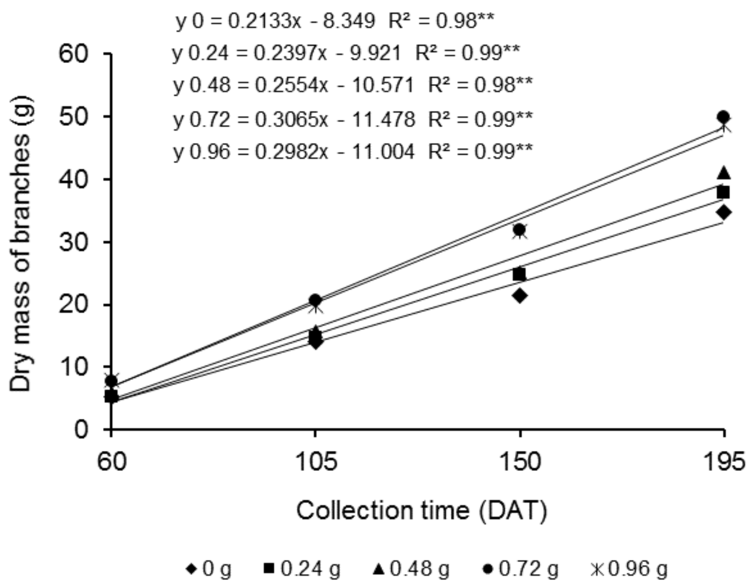

Figure 4 – Dry mass of branches of sweet potato grown in pots with different nitrogen doses at different collection times.

The higher dry matter production with the application of nitrogen in coverage demonstrates that the isolated application of the slow-release fertilizer, at the dose used, was not sufficient to meet the nitrogen needs of plants. Unlikely, in soil with high fertility, Palácio et al. (2007) found no difference in the dry matter production in carqueja when performed periodic collections of shoots of plants grown in soil fertilized with different doses of nitrogen.

The highest dry matter yield was obtained with the cultivation of only one plant per pot unit, indicating that there was competition since the first collection. However, the difference in percentage of the dry matter production per pot was decreasing over time. At 60 DAT, the dry matter yield in the pot with two plants was only 33.7% compared to the production with one plant. In the last date of collection, 195 DAT, the production obtained in pots with two plants reached 80.8% of the production of plants grown alone (Figure 5).

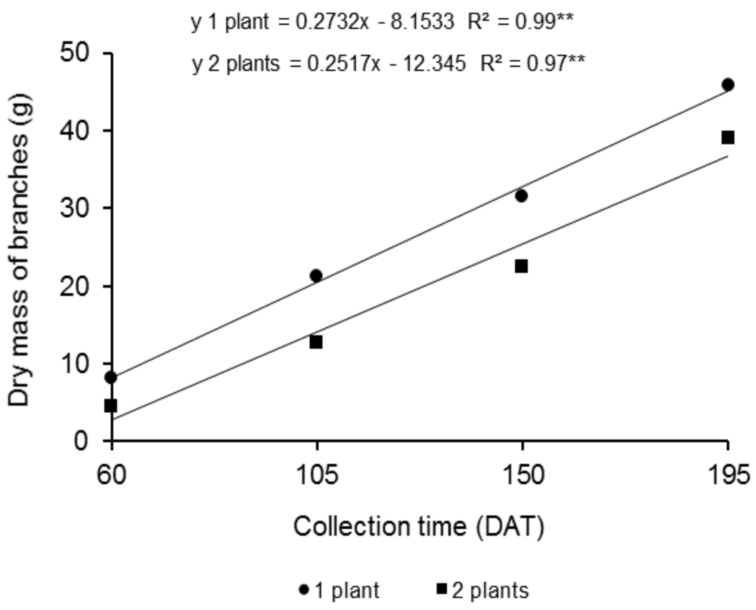

Figure 5 – Dry mass of branches of sweet potato plants grown in pots with one or two plants at different collection times.

The similar behavior between length and dry mass of branches was expected, since increasing the production of branches, expressed in length, with increasing N rate, there would likely be increased dry matter production. It is found that the sweet potato plant showed high sensitivity to increased density, for when a plant, analyzed individually, divided the vessel with another, it produced only 40% of the dry mass of a single plant in the pot. In work of Reguin et al. (2005), it was found that fresh and dry masses of rocket plants grown in number from two to four plants per hill resulted in higher individual values in lower density, however, unlike the present study, the dry matter produced per hill unit was greater when four plants were used.

Lastly, analyzing the production of branches, by means of length and dry mass, it was found that, as the yield obtained was similar between 0.72 and 0.96 g pot^{-1}, one can choose to use the dose of 0.72 g pot^{-1}. Notwithstanding, as even at the dose of 0.96 g pot^{-1} added every 30 days there was no negative effect to plants, studies with larger doses are needed, as these can promote branches productivity higher than in the present work.

Conclusions

The addition of nitrogen to the substrate where sweet potato plants are cultured is feasible to obtain greater amount of plant material in order to produce new plants, and this cultivation must be of one plant per pot unit.

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