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Production of italian zucchini in response to N and P fertilization

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ABSTRACT: The italian zucchini is a much-appreciated vegetable, besides being an economically viable alternative to the farmers. Nutrition with N and P is essential to produce vegetables, however, for the italian zucchini there are few scientific studies to guide fertilizing with these nutrients. The objective of this work was to evaluate the production of italian zucchini after N and P fertilization. The study was conducted in the agricultural area of the Irrigated Perimeter of Gorutuba, in the municipality of Nova Porteirinha-MG. A randomized block design with three replications was used. The treatments were arranged in a 5 × 4 factorial, using five doses of N (0, 50, 100, 150 and 200 kg ha^{-1}) and four doses of P (0, 50, 100 e 150 kg ha^{-1} of P_2O_5), in the form of urea and monoammonium phosphate, respectively. NF was increased with N and P doses, and the combination of 150 kg ha^{-1} of P_2O_5 with 100 kg ha^{-1} of N was responsible for the highest number of fruits, with 17.52 fruits per plot. The combination of 100 kg ha^{-1} of N and 150 kg ha^{-1} of P_2O_5 resulted in the maximum PROD, corresponding to 10,834.67 kg ha^{-1}. The elevation of P and N doses leads to an increase in the agronomic yield, without a marked change in the quality of the italian zucchini.

Key words: 'Caserta' zucchini; *Cucurbita pepo*; fertilization; productivity

Produção de abobrinha italiana em resposta a nutrição nitrogenada e fosfatada

RESUMO: A nutrição nitrogenada e fosfatada é primordial para a produção de olerícolas, no entanto, para a abobrinha italiana são escassos estudos científicos que norteiem a prática da adubação. O objetivo deste trabalho foi avaliar a produção da abobrinha italiana após a adução nitrogenada e fosfatada. O estudo foi conduzido em área agrícola do Perímetro Irrigado do Gorutuba, município de Nova Porteirinha-MG. Foi utilizado o delineamento experimental em blocos casualizados, com três repetições. Os tratamentos foram dispostos em esquema fatorial 5 × 4, sendo utilizadas cinco doses de nitrogênio (N) (0, 50, 100, 150 e 200 kg ha^{-1} de N) e quatro doses de fósforo (P) (0, 50, 100 e 150 kg ha^{-1} de P_2O_5), na forma de ureia e fosfato monoamônico, respectivamente. O NF foi incrementado com as doses de N e P, sendo a combinação de 150 kg ha^{-1} de P_2O_5 com 100 kg ha^{-1} de N responsável pelo maior número de frutos, com 17,52 frutos por parcela. A combinação de 100 kg ha^{-1} de N e 150 kg ha^{-1} de P_2O_5 resultou na máxima PROD, correspondendo a 10.834,67 kg ha^{-1}. A elevação das doses de fósforo e nitrogênio propicia aumento no rendimento agronômico, sem alterar de maneira acentuada a qualidade da abobrinha italiana.

Palavras-chave: abobrinha Caserta; *Cucurbita pepo*; adubação; produtividade

Introduction

The italian zucchini (*Cucurbita pepo* L.) is originated from México, and it stands out for being appreciated by a great part of the Brazilian population, showing a great potential for commercial cultivation (Filgueira, 2013; Resende, et al., 2013). The fruits have excellent nutritional quality, with high concentrations of Ca, P, Fe and fibers (Lúcio et al., 2008; Oliveira et al., 2013).

In 2018, 27.6 million t of italian zucchini were produced around the world, in an area of 2.04 million ha, and a productivity of approximately 13.53 t ha^{-1} (FAO, 2020). In Brazil, it is one of the vegetables with the highest economic value and increasing production, being the national productivity between 8 and 10 t ha^{-1} (Purquerio et al., 2019). The crop is mainly concentrated in the central and south regions of the country, and the state of São Paulo is one of the largest producers and consumers, although it is a vegetable that has been taking up space in other Brazilian regions, both in cultivation and consumption.

Its cultivation is carried out mainly by small producers, who are the main suppliers of the national market. Because it is a short-cycle crop, italian zucchini is a great opportunity for the smallholder to get short-term income. In less economically favored regions, its cultivation is a good income alternative for producers, since it is also an early crop, easy to handle and low production cost, and can be recommended for family farming (Souza et al., 2018).

Vegetables are highly demanding on soil fertility, requiring supplementation with mineral fertilization to reach high yields due to their rapid growth and high nutrient absorption. In modern agriculture, the search for maximum financial profitability is achieved through the use of productive varieties associated with the adequate nutritional and cultural management of vegetables.

Fertilization with P has contributed to the increase of flowering, fruiting, seed formation, and rooting of italian zucchini and pumpkin (Chaves, 2014; Araújo et al., 2015; Souza et al., 2018), while the balanced fertilization with N favors the vegetative formation and increases fruiting, quality of fruits, their size, shape, weight, coloration, besides avoiding some anomalies in muskmelon and zucchini plant development (Silva et al., 2011; Queiroga et al., 2007).

N and P fertilization has contributed to the increase of productivity of italian zucchini in some countries (Amin & Eissa, 2017; Rolbiecki et al., 2017; Pokluda, et al., 2018), however, with different doses of N and P_2O_5, possibly due to differences in the different cultivation conditions adopted by the authors, such as fertilizer sources, fertigation and evaluated cultivar, among other factors.

Studies related to the adoption of balanced doses of nutrients in italian zucchini, mainly N and P_2O_5, in Brazil are considered scarce, since almost all fertilization-related research is concentrated in obtaining an adequate N:K ratio (Mendoza Cortez, 2014; Silva et al., 2014). In this sense, the objective was to evaluate the production of italian zucchini cv. Caserta after N and P fertilization.

Materials and Methods

The study was conducted in the spring (September to November) in the agricultural area of the Irrigated Perimeter of Gorutuba, in the municipality of Nova Porteirinha, MG, Brazil, with coordinates 15º45’50’’S and 43º16’18’’W and altitude of 533 m. The soil in the cultivated area was classified as Red Yellow Latosol (Embrapa, 2006), and the typical climate of the region is Aw, according to Köpen’s climatic classification, tropical with dry winter.

In the initial phase of the study, soil samples were collected in the 0-20 cm depth layer, for chemical characterization, which showed these results: pH (water)=7,1; P (Mehlich-1)= 23.2 mg dm^{-3}; K (Mehlich-1)= 232 mg dm^{-3}; Na (Mehlich-1)= 0.2 mg dm^{-3}; Ca= 6.1 $cmol_c$ dm^{-3}; Mg= 1.1 $cmol_c$ dm^{-3}; Al (KCl)= 0.0 $cmol_c$ dm^{-3}; H+Al= 0.9 $cmol_c$ dm^{-3}; SB= 8.0 $cmol_c$ dm^{-3}; t= 8.0 $cmol_c$ dm^{-3} and base saturation (V%)= 90%.

The treatments were arrayed in a randomized-block experimental design, with three replications, in a 5 x 4 factorial, characterized by five N doses in top-dressing (0, 50, 100, 150 e 200 kg ha^{-1} of N) using urea as source, with 44% of N, and four doses of P (0, 50, 100 e 150 kg ha^{-1} de P_2O_5), applied at planting, using purified monoammonium P as source, with 60% of P_2O_5 and 11% of N.

Each plot was 10 m^2, with 2 m long and 4 m wide, consisting of five rows with 2 m in length, spaced 1 m between rows, and 0.5 m between plants within the row. The useful area of the plot was represented by the three central rows, with the end rows constituting the border. Sowing was done in a conventional system, with previous soil preparation, which consisted of one plowing and one harrowing. Correction of soil pH with liming was not necessary due to soil chemical characteristics. All plots received, at the time of sowing, 60 kg ha^{-1} of K_2O, 50 kg ha^{-1} of N and 15 t ha^{-1} of organic fertilizer, respectively, using as sources potassium chloride, urea and manure, respectively, according to recommendations (Ribeiro et al., 1999).

The study was carried out with the italian zucchini cultivar Caserta TS. On September 28, three seeds were sown on each hole; after thinning, one plant was left per hole, in order to obtain an average population of 20,000 plants per hectare. The experiment was conducted until November 15, when the final harvest occurred. The study was kept weed - free by hoeing, and other cultural treatments were performed according to the technical adjustment of the crop in the region. Irrigation was performed by microsprinkling and top-dressings were performed manually. There was an incidence of pests during the experimental period, with the main problem being the tobacco whitefly (*Bemisia tabaci* race B), which was controlled with the application of an insecticide based on thiametoxan, of the chemical group of neonicotinoids, in the dose of 600 g ha^{-1}, according to AGROFIT’s recommendation of agricultural pesticides recommendation software (Mapa, 2019). Fruit harvests started 38 days after planting, and were performed on alternate days. The fruits were harvested in the commercial standard with an average of 20 to 25 cm in length.

After each harvest, the fruits of each plot were weighed and counted. At the end of the production cycle, the following characteristics were evaluated: plant height (ALT), number of fruits (NF), mean fruit weight (MFW), mean fruit diameter (MFD), productivity (PROD) and soluble solids (SS). Plant height was determined using a ruler, measuring from the lap of the plant to the insertion of the last fully open leaf. The average fruit weight was determined by dividing the total fruit weight of the plot by the total number of fruits. Productivity was estimated by the weight of fruits harvested in the area of the useful plot, converted to tones per hectare. The diameter measured in the median part of the fruit was determined using a caliper. The soluble solids concentration was determined in the laboratory, with the aid of refractometer, in which three drops of the fruit extract were allocated and the reading was then made, expressing the results in ºBrix.

The data were submitted to analysis of variance. Then, according to the significance of the interaction, the quantitative factors were analyzed with regression models chosen based on the significance of the regression coefficients and on the potential to explain the biological phenomenon in question. Statistical analysis was performed using the statistical analysis software SAEG 9.1 (Funarbe, 2007).

Results and Discussion

The rainfall and average maximum and minimum temperatures during the experiment were 2.48 mm, 33.27 and 20.25 ^{o}C

There was interaction between the doses of N and P ($p < 0.05$), for the characteristics related to the production components of italian zucchini cv. Caserta: plant height (ALT), number of fruits (NF), mean fruit weight (MFW), fruit diameter (FD), productivity (PROD) and soluble solids content (SS). The addition of 100 kg ha^{-1} of N associated with 150 kg ha^{-1} of P_2O_5 promoted the maximum height of 26.52 cm (Figure 1). The height of the zucchini plant is an important feature, since it is associated to the use and interception of light and helps in the definition of spacing between plants. Larger plants imply greater structural capacity for fruit production, contributing to the spatial distribution of these in the plant architecture. Adequate doses of P and N applied to the soil promote increases in energy production and in root and shoot growth (Epstein & Bloom, 2005).

The number of fruits per plot increased with the N and P doses, with the combination of 150 kg ha^{-1} of P_2O_5 with 100 kg ha^{-1} of N responsible for the highest number of fruits, with 17.52 fruits per plot (Figure 2). N fertilization higher than 100 kg ha^{-1} of N does not present technical viability for the crop, since fertilization increases from this point show a decrease in fruit production. The same was not observed for the doses of P, as the increasing doses of this nutrient linearly increased the production of fruits. The P, fifth most exported element by the italian zucchini, is very important in the fruiting of this crop, increasing fruit production when there are satisfactory quantities of this nutrient in the soil solution (Elfstrand & Lans, 2002; Rodas Gaitán et al., 2012). However, due to the great adsorption to the soil particles, especially in Latosols, fertilization with phosphorus becomes larger than that required by the crop (Brito Neto et al., 2018).

The increase in the number of fruits per plant is a characteristic desired by the producers, as it contributes to the increase of crop productivity. The adequate supply of P and N alter the source-drain relationship and, consequently, the distribution of assimilates between vegetative and reproductive organs (Araújo et al., 2015). A well-nourished plant, free of stress-causing factors, increases its flowering, fruiting and ensures greater numbers and weights of the fruits produced (Rouphael et al., 2015). In cucurbits, adequate doses of N increase the leaf area of the plant, increasing the production of photoassimilates and fruits (Queiroga et al., 2007). In the study conducted by Pôrto et al. (2014) with N fertilization in pumpkin plants, it provided a higher number of fruits per plant (11.94) after application of 322.5 kg ha^{-1} of N, a dose considered superior to the found in the present study.

The mean fruit weight was not influenced by the increase of the doses of P, and was increased linearly by the doses of N (Figure 3). The lack of effect of the doses of P on the average weight of the fruits was attributed to its specific functions in

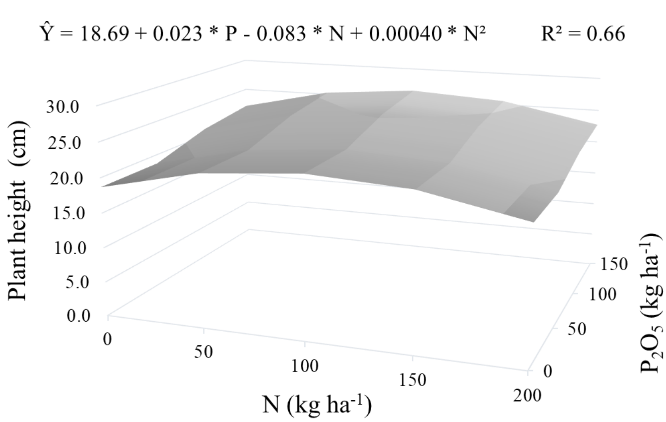

Figure 1. Plant height (ALT), of italian zucchini , cv. Caserta, as a function of N and P_2O_5 fertilization.

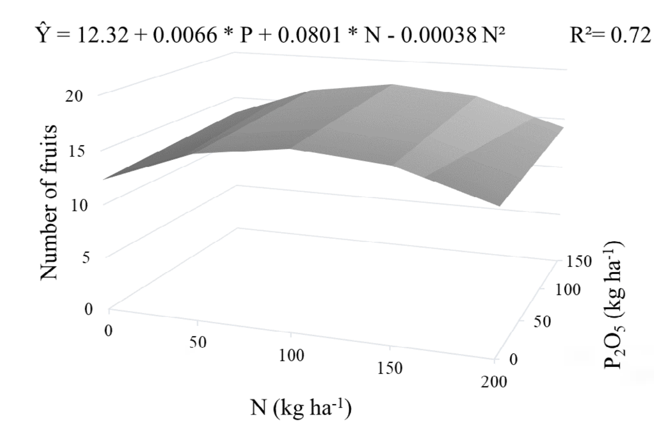

Figure 2. Number of fruits (NF), of italian zucchini , cv. Caserta, as a function of N and P_2O_5 fertilization.

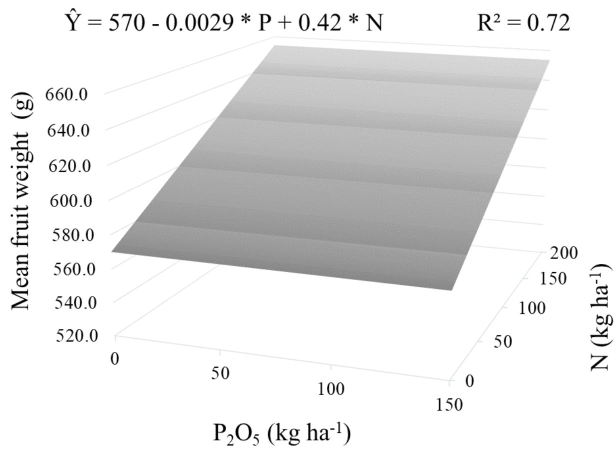

Figure 3. Mean fruit weight (MFW), of italian zucchini , cv. Caserta, as a function of N and P_2O_5 fertilization.

the plant, to which the formation of pollen grains and pumpkin fruits is linked, being less important in the accumulation of mass in the fruits (Lúcio et al., 2008; Chaves, 2014) In contrast, increasing doses of N in zucchini cultivars have led to a linear increase in fruit masses per plant (Silva et al., 2011). The provision of adequate doses of N favors vegetative growth, expands the photosynthetically active area and increases the crop's potential for production. In the fruit-vegetables, there is a direct and positive correlation between shoot weight and yield characteristics, such as number and weight of fruits (Filgueira, 2013).

The diameter of the fruits increased with the increase of the P and N doses, obtaining the maximum diameter of 6.09 cm after application of 150 kg ha^{-1} of P_2O_5 and 200 kg ha^{-1} of N (Figure 4).

The productive characteristics fruit diameter, weight and length are considered prime for commercialization, since the consumer market adopts standards ranging from 20 to 25 cm in length and 4 to 6 cm in diameter (Feijó et al., 2008). Fruits with greater diameters than these and lighter can be considered "hollow", with little pulp and not attractive to the consumer. Fruit yield increased with the application of N and P doses.

The combination of 100 kg ha^{-1} of N and 150 kg ha^{-1} of P resulted in maximum productivity, corresponding to 10,834.67 kg ha^{-1} (Figure 5). These doses of N and P provided an increase of 4,089 kg ha^{-1}, in comparison to the absence of fertilization. The increase of productivity with the increase of N and P fertilization was due to the higher availability of these nutrients in the soil and their absorption by the plants, allowing greater vegetative and root growth, especially of the secondary roots, important for the absorption of water and nutrients. In addition, the accumulation of P in the plant predisposes to the greater energetic capacity and structure of the vegetal tissues, and greater accumulation in the flowers and fruits, playing important role in pollination and fruiting (Taiz & Zeiger, 2013).

Doses of N higher than 100 kg ha^{-1} caused a decrease in productivity, possibly due to excessive N in the soil. The excess of N in the crop negatively affects its productivity by greatly increasing the vegetative mass of the plant, reducing the final quality of the fruits (Vidal et al., 2013).

The management of nutrition in zucchini crops requires more studies related to the interaction between N and P, since almost all fertilization-related research is concentrated in obtaining an adequate relationship between N and K (Mendoza Cortez, 2014; Silva et al., 2014).

Good yields are expected when productivity reaches values of 10 to 20 t ha^{-1}, as observed in the present study. However, the productivity obtained in this study was lower than that obtained by Costa et al. (2015), when working with the italian zucchini cv. Novita Plus (*Cucurbita pepo* L.) in a protected environment with N fertilization, where they obtained productivity equivalent to 36 t ha^{-1} of fruits with the dose of 150 kg ha^{-1} of N. Possibly, this higher productivity was due to the different conditions of cultivation adopted by the authors, as protected environment, fertirrigation and studied cultivar. The total soluble solids content slightly decreased linearly with increasing P rates at all N doses (Figure 6). As P levels in the soil were very good, P fertilization favored the vegetative development of the plant preferentially, reducing transport from assimilated to fruits (Etienne et al., 2013; Delfim & Mauch, 2017).

Fertilization with N can also reduce sugars in the fruits, because the NH_4^+ in the plant does not promote the synthesis

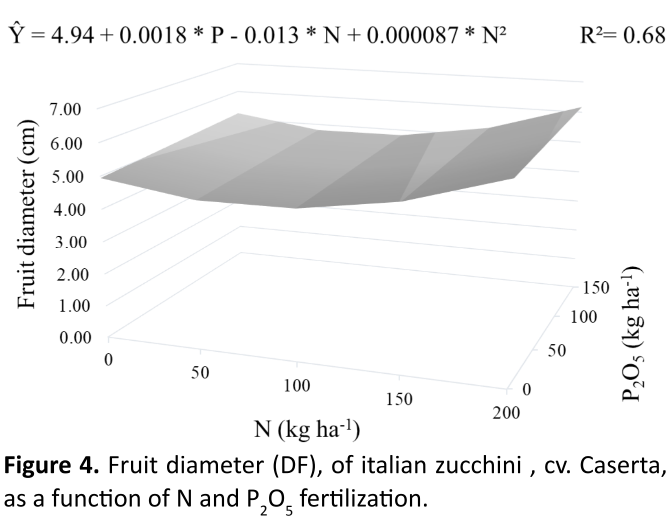

Figure 4. Fruit diameter (DF), of italian zucchini , cv. Caserta, as a function of N and P_2O_5 fertilization.

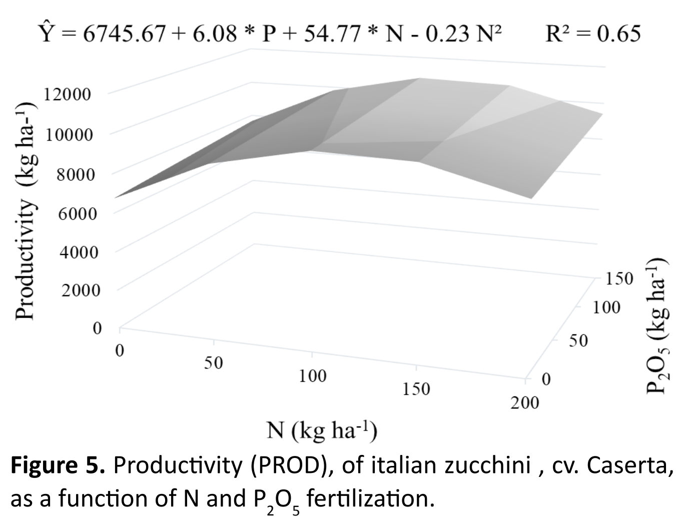

Figure 5. Productivity (PROD), of italian zucchini , cv. Caserta, as a function of N and P_2O_5 fertilization.

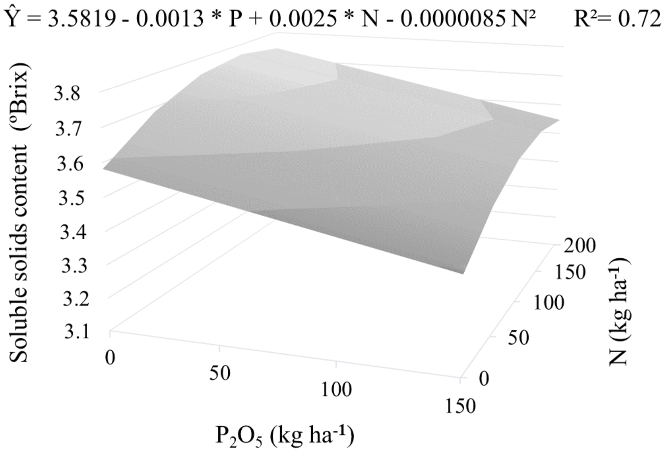

Figure 6. Soluble solids content (SS), of italian zucchini , cv. Caserta, as a function of N and P_2O_5 fertilization.

of organic anions, negatively affecting the absorption of K. As the N fertilizer adopted in this study produces NH_4^+ ions in soil transformation processes, over dosage adversely affected the production of organic compounds related to the accumulation of soluble solids in fruits (Oliveira et al., 2015).

According to Chitarra & Chitarra (2005), the accumulated sugars are the main chemical substances of the fruits, and when the SS is low, fruits of worse flavor are reported. Several studies carried out with italian zucchini show heterogeneity in the content of soluble solids, from 2.0 to 4.94 °Brix (Botrel et al., 2007; Araújo et al., 2013; Bianchini, 2013; Delfim & Mauch, 2017) evidencing the possibility that several factors influence the soluble solids content of zucchini fruits, such as cultivation sites (edaphoclimatic factors), fertilization and crop treatments.

Conclusion

The increase of P and N doses increases height (26.52 cm) and production of italian zucchini, with the highest number of fruits (17.52) and productivity (10.83 t ha^{-1}) obtained with the combination of 100 kg ha^{-1} of N and 150 kg ha^{-1} of P_2O_5.

The increasing N and P doses did not significantly alter the quality of the italian zucchini, with a slight reduction in the soluble solids contents, within the normal culture standard.

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Literature Cited

Amin, A.E.A.Z; Eissa, M. A. Biochar effects on nitrogen and phosphorus use efficiencies of zucchini plants grown in a calcareous sandy soil. Journal of Soil Science and Plant Nutrition, v. 17, n. 4, p. 912-921, 2017. https://doi.org/10.4067/S0718-95162017000400006.

Araújo, H.S.; Cardoso, I.A.I.; Oliveira Júnior, M.X.; Magro, F.O. Macronutrients content and extraction in zucchini plants in function of potassium top dressing levels. Revista Brasileira de Ciências Agrárias, v.10, n.3, p.389-395, 2015. https://doi.org/10.5039/agraria.v10i3a4937.

Araújo, H.S.; Oliveira Júnior, M.X.; Magro, F.O.; Cardoso, A.I.I. Potassium top dressing levels on fruit yield of summer squash. Revista de Ciência Agrárias, v.36, n.3, p.303-309, 2013. http://www.scielo.mec.pt/pdf/rca/v36n3/v36n3a04.pdf. 17 Feb. 2019.

Bianchini, C. Sistemas de manejo do solo para a produção de abobrinha de tronco (*Curcubita pepo*). Pato Branco: Universidade Tecnológica Federal do Paraná, 2013. 80p. MSc. Thesis. http://repositorio.utfpr.edu.br/jspui/handle/1/624. 02 Feb. 2019.

Botrel, N.F.; Resende, M.O.; Guimarães, R.F.A. Qualidade pós-colheita de abobrinha italiana, produzida em sistema orgânico com composto de farelos, tipo Bokashi®. Revista Brasileira de Agroecologia, v.2, n.2, p.16-18, 2007. http://revistas.aba-agroecologia.org.br/index.php/rbagroecologia/article/view/6712/4996. 10 Feb. 2019.

Brito Neto, J.E.F.E.; Bull, L.T.; Silva, A.E.L.P.; Soares, C.S.; Lima Junior, J.A. Phosphorus adsorption and its relationship to the physical and chemical characteristics with different soil classes. African Journal of Agricultural Research, v.13, n.9, p.419-424, 2018. https://doi.org/10.5897/AJAR2018.12996.

Chaves, A.P. Efeito residual da adubação fosfatada sobre a produção e acúmulo de nutrientes de abóbora. Mossoró: Universidade Federal Rural do Semiárido, 2014. 51p. MSc. Thesis. https://ppgfito.ufersa.edu.br/wp-content/uploads/sites/45/2015/02/Disserta%C3%A7%C3%A3o-2014-ARID%C3%8ANIA-PEIXOTO-CHAVES.pdf. 17 Feb. 2019.

Chitarra, M.I.; Chitarra, A.B. Pós-colheita de frutos e hortaliças: fisiologia e manuseio. Lavras: Universidade Federal de Lavras, 2005. 783p.

Costa, A.R.; Rezende, R.; De 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. https://doi.org/10.15809/irriga.2015v20n1p105

Delfim, T.F.; Mauch, C.R. Fenologia, qualidade e produtividade de frutos de genótipos de abobrinha cultivados em ambiente protegido. Tecnologia & Ciência Agropecuária, v.11, n.3, p.49-55, 2017. http://revistatca.pb.gov.br/edicoes/volume-11-2017/copy_of_v-11-n-1-marco-2017/9-fenologia-qualidade-e-rendimento-de-frutos.pdf. 10 Feb. 2019.

Elfstrand, S.; Lans, H. Yield responses to different plant nutrition management for buttercup squash, *Cucurbita maxima*. Swedish Journal of Agricultural Sciences, v.26, n.1, p.29-31, 2002.

Empresa Brasileira de Pesquisa Agropecuária - Embrapa. Sistema brasileiro de classificação de solos. 2.ed. Rio de Janeiro: Embrapa Solos. 2006. 306p.

Epstein, E.; Bloom, A.J. Mineral plant nutrition of plants: principles and perspectives. 2.ed. Sunderland: Sinauer Associates, 2005. 400p.

Etienne, A.; Génard, M.; Lobit, P.; Mbeguié-A-Mbéguié, D.; Bugaud, C. What controls fleshy fruit acidity? A review of malate and citrate accumulation in fruit cells. Journal of Experimental Botany, v.64, n.6, p.1451–1469, 2013. https://doi.org/10.1093/jxb/ert035.

Feijó, S.; Lúcio, A.D.; Storck, L.; Lopes, S.J.; Carpes, R.H. Heterogeneity index of zucchini yield on a protected environment and experimental planning. Horticultura Brasileira, v.26, n.1, p.35-39, 2008. https://doi.org/10.1590/S0102-05362008000100007.

Filgueira, F.A.R. Novo manual de olericultura: agrotecnologia moderna na produção e comercialização de hortaliças. 3.ed. Vicosa: UFV, 2013. 421p.

Food and Agriculture Organization of the United Nations - FAO. FAOSTAT. http://www.fao.org/faostat/en/?#compare - Compare data. Groups production. Crops. World total. Area harvested. Production quantity. Yield. Pumpkins, squash and gourds. 13 Apr. 2020.

Fundação Arthur Bernardes – Funarbe. System for Statistical Analysis – SAEG. version 9.1. Viçosa: Fundação Arthur Bernardes; UFV, 2007.

Lúcio, A.D.; Carpes, R.H.; Storck, L.; Lopes, S.J.; Paludo, A.L. Variância e média da massa de frutos de abobrinha-italiana em múltiplas colheitas. Horticultura Brasileira, v.26, n.3, p.335-341, 2008. https://doi.org/10.1590/S0102-05362008000300009.

Mendoza Cortez, J.W.; Cecílio Filho, A.B.; Grangeiro, L.C.; Oliveira, F.H.T. Influence of phosphorus fertilizer on melon (*Cucumis melo* L.) production. Australian Journal of Crop Science, v.8, n.5, p.799-805, 2014. http://www.cropj.com/cortez_8_5_2014_799_805.pdf. 20 Jan. 2019.

Ministério da Agricultura, Pecuária e Abastecimento – Mapa. AGROFIT. Sistema de Agrotóxicos Fitossanitários. http://agrofit.agricultura.gov.br/agrofit_cons/principal_agrofit_cons. 03 Mar. 2019.

Oliveira, A.M.G.; Pereira, M.E.C.; Natale, W.; Nunes, W.S.; Ledo, C.A.D.S. Qualidade do abacaxizeiro 'BRS Imperial' em função de doses de N-K. Revista Brasileira de Fruticultura, v.37, n.2, p.497-506, 2015. http://dx.doi.org/10.1590/0100-2945-056/14.

Oliveira, N.L.C.; Puiatti, M.; Bhering, A.S.; Cecon, P.R.; Santos, R.H.S.; Silva, G.C.C. Crescimento e produção da abobrinha em função de concentração e via de aplicação da urina de vaca. Revista Brasileira de Agropecuária Sustentável, v.3, n.2, p.129-136, 2013. https://periodicos.ufv.br/rbas/article/view/2818/1301. 10 Jan. 2019.

Pokluda, R.; Shehata, S.M.; Kopta, T. Vegetative, Chemical status and productivity of zucchini squash (*Cucurbita pepo* L.) plants in responses to foliar application of pentakeep and strigolactones under NPK rates. Gesunde Pflanzen, v.70, p.21-29, 2018. https://doi.org/10.1007/s10343-017-0409-5.

Pôrto, M.L.A.; Puiatti, M.; Fontes, P.C.R.; Cecon, P.R.; Alves, J.C. Produtividade e acúmulo de nitrato nos frutos da abóbora "Tetsukabuto" em função da adubação nitrogenada. Horticultura Brasileira, v.32, n.3, p.280-285, 2014. https://doi.org/10.1590/S0102-05362014000300007.

Purquerio, L. F. V.; Mattar, G. S.; Duart, A. M.; Moraes, C. C.; Araújo, H. S.; Santos, F. F. Growth, yield, nutrient accumulation and export and thermal sum of Italian zucchini. Horticultura Brasileira, v.37, n.2, p.221-227, 2019. https://doi.org/10.1590/s0102-053620190214.

Queiroga, R.C.F.; Puiatti, M.; Fontes, P.C.R.; Cecon, P.R.; Finger, F.L. Influência de doses de nitrogênio na produtividade e qualidade do melão *Cantalupensis* sob ambiente protegido. Horticultura Brasileira, v.25, n.4, p.550-556, 2007. https://doi.org/10.1590/S0102-05362007000400011.

Resende, G.M.; Borges, R.M.E.; Gonçalves, N.P.S. Produtividade da cultura da abóbora em diferentes densidades de plantio no Vale do São Francisco. Horticultura Brasileira, v.31, n.3, p.504-508, 2013. https://doi.org/10.1590/S0102-05362013000300027.

Ribeiro, A.C.; Guimarães, P.T.G.; Alvarez, V.H. (Eds.). Recomendações para o uso de corretivos e fertilizantes em Minas Gerais: 5ª aproximação. 1. ed. Viçosa: Comissão de Fertilidade do Solo do Estado de Minas Gerais; SBCS, 1999. 359p.

Rodas Gaitán, H.A.; Rodríguez Fuentes, H.; Ojeda Zacarias, M.C.; Vidales Contreras, J.A.; Luna Maldonado, A.L. Curvas de absorción de macronutrientes en calabacita italiana (*Cucurbita pepo* L.). Fitotecnia Mexicana, v.35, n. especial 5, p.57-60, 2012. https://www.revistafitotecniamexicana.org/documentos/35-3_Especial_5/10a.pdf. 31 Jan. 2019.

Rolbiecki, R.; Rolbiecki, S.; Figas, A.; Wichrowska, D.; Jagosz, B.; Ptach, W. The efficiency of drip fertigation in cultivation of winter squash „Gomez" on the very light soil. Infrastruktura i Ekologia Terenów Wiejskich, v.3, n.2, p.1201-1211, 2017. https://doi.org/10.14597/infraeco.2017.3.2.092.

Rouphael, Y.; Cardarelli, M.; Colla, G. Role of arbuscular mycorrhizal fungi in alleviating the adverse effects of acidity and aluminium toxicity in zucchini squash. Scientia Horticulturae, v.188, p.97-105, 2015. https://doi.org/10.1016/j.scienta.2015.03.031

Silva, L.V.; Oliveira, G.Q.; Silva, M.G.; Nagel, P.L.; Machado, M.M.V. Doses de nitrogênio em cobertura em duas cultivares de abobrinha no município de Aquidauana-MS. Revista Brasileira de Ciências Agrárias, v.6, n.3, p.447-451, 2011. https://doi.org/10.5039/agraria.v6i3a1127.

Silva, M.V.T.; Santos, A.P.F.; Oliveira, F.L.; Souza, S.S.; Medeiros, J.F. Eficiência agronômica e fisiológica na melancia fertirrigada com diferentes doses de nitrogênio e fósforo. Revista Verde, v.9, n.2, p.264-269, 2014. https://www.gvaa.com.br/revista/index.php/RVADS/article/view/2796/2307. 17 Feb. 2019.

Souza, F.I.; Grangeiro, L.C.; Souza, V.F.L.; Gonçalvez, F.C.; Oliveira, F.H.T.; Jesus, P. M.M. Agronomic performance of Italian zucchini as a function of phosphate fertilization. Revista Brasileira de Engenharia Agrícola e Ambiental, v.22, n.3, p.206-211, 2018. https://doi.org/10.1590/1807-1929/agriambi.v22n3p206-211

Taiz, L.; Zeiger, E. Fisiologia vegetal. 5.ed. Porto Alegre: Artmed, 2013. 954p.

Vidal, V.M.; Pires, W.M.; Pina Filho, O.C.; Schwerz, T.; Teixeira, M.B.; Soares, F.A.L. Doses de nitrogênio na produção de frutos de abóbora menina brasileira irrigada. Global Science and Technology, v.6, n.2, p.48-54, 2013. https://doi.org/10.14688/1984-3801.v06n02a06.