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Nitrogen doses and splitting in top dressing in the production and macronutrient content in fruits of zucchini

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Abstract

Nitrogen fertilization in cucurbits must be splitted, one part being supplied before planting and the rest applied in top dressing. However, there is a lack of research about this splitting throughout the cycle. The objective of this study was to evaluate the effect of nitrogen doses and splitting of this fertilization in top dressing on production and macronutrient content in fruits of zucchini. Two experiments were carried out, with thirteen treatments, in the factorial scheme 4x3+1, with four nitrogen doses in top dressing (62.5, 125.0, 187.5, 250.0 kg ha^{-1} of N), three splitting forms (1/6+1/3+1/2; 1/4+1/2+1/4; 1/3+1/3+1/3 of total dose in each application) and one treatment without fertilization in top dressing (control = dose zero), with four replicates. Experiment 1 and 2 were conducted in 2014 and 2015, respectively. Total and commercial fruit production (g), total and commercial fruit number per plant, length, diameter and average commercial fruit weight were evaluated. Only in experiment 2 the macronutrient content in the fruits were evaluated. In experiment 1, the 1/4+1/2+1/4 splitting provided greater number of total and commercial fruits per plant. In experiment 2, the increasing of the doses in the 1/6+1/3+1/2 and 1/3+1/3+1/3 splitting resulted in a linear increase in total and commercial fruit production. The decreasing order of macronutrient content in fruits was K>N>P>Ca>Mg>S.

Keywords: : *Cucurbita pepo*, fertilization, yield, nutrients

Introduction

Zucchini (*Cucurbita pepo L.*) is a species of the Cucurbitaceae family, originated in central Mexico. It is among the ten most cultivated vegetables in Brazil, and the fruits are important sources of minerals, mainly iron, calcium, magnesium and potassium, and vitamins, in particular β-carotene (pro-vitamin A), B, C and E (Cardoso & Souza Neto, 2016).

In order to obtain high yield it is indispensable to supply nutrients during all life cycle of the plant. For the cultivation of zucchini in the state of São Paulo, Brazil, 40 kg ha-1 of N, 200 to 400 kg ha-1 of P_2O_5 and 100 to 200 kg ha-1 of K_2O are recommended before planting. In top dressing, it is recommended 100 to 150 kg ha-1 of N and 60 to 120 kg ha-1 of K_2O. The top dressing fertilization should be divided into three applications, the first one at 15 to 20 days after germination and the others each 15 to 20 days (Trani & Raij, 1997).

Nitrogen is one of the nutrients most required by cucurbits (Araújo et al., 2015), but it is an element of high mobility in soil, easily lost by volatilization or leaching. The nitrogen losses are also intensified in sandy soils, due to the lack or absence of aggregator elements such as organic matter and clay (Colombari et al., 2018). In Cucurbitaceae, the increase of the dose of nitrogen, up to a certain limit, increases the leaf area of the plant; and therefore has an effect on the production of photoassimilates and, consequently, on fruit production, as related by Pôrto et al. (2014) in squash, Oliveira et al. (2008) in Cucumis anguria, Queiroga et al. (2007) in melon and Andrade Junior et al. (2006) in watermelon.

The insufficient supply of nitrogen decreases chlorophyll production, leading to foliar yellowing, consequently the photosynthetic process is affected, interfering with normal plant growth. However, excess nitrogen, in addition to increase production cost, causes

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excessive growth of leaves, and increasing in plant susceptibility to some pathogens and insects, and auto shading (Cecílio Filho et al., 2015).

Therefore, nitrogen should be available in the appropriate dose, taking into account several factors, such as the plant stage: in early stage the nutrient absorption is small, then a period of logarithmic accumulation follows and in a final period there is the stabilization phase (Faquin & Andrade, 2004). Therefore, there must be a synchronism between the dose applied and the need of the plant during its development (Colombari et al., 2018; Lanna et al., 2020; Tavares et al., 2021).

Thus, supply of nitrogen in top dressing through different forms of splitting can optimize the amount of this nutrient supplied as a result of the nutritional need of the crop at each stage of development. In the literature, the results of the most adequate nitrogen fertilization are divergent, depending on the species, with favorable results in carrot (Colombari et al., 2018). However, in common bean (Soratto et al., 2006) and arugula (Cecílio Filho et al., 2014), the authors did not observe a significant effect on the splitting in relation to production. In zucchini, Lanna et al. (2020) related the importance of splitting organic fertilization in top dressing to improve yield and Tavares et al. (2021) in the production of zucchini seeds.

Although nitrogen is an important nutrient for plants, information related to the dose and the appropriate time of fertilization should be considered, since they vary according to the species, cultivar, management techniques, source and conditions. In this context, the objective of this research was to evaluate the nitrogen fertilization doses and splitting in the production and macronutrient content in fruits of zucchini.

Material and Methods

Two experiments were carried out, one in 2014 (experiment 1) and another in 2015 (experiment 2), both in the São Manuel Experimental Farm, located in the municipality of São Manuel, Brazil, belonging to the School of Agriculture (FCA) of the São Paulo State University (UNESP). The geographical coordinates are: 22° 46' South latitude, 48° 34' West longitude and 740m altitude. The climate of the São Manuel region is Cfa, warm temperate (mesothermal) and humid (Cunha & Martins, 2009) and the soil is a Typical Red Dystrophic Latosol. It is a sandy soil (84% sand).

The results obtained in the soil chemical analysis were: Experiment 1 (2014): pH = 5.8; organic matter = 12 g dm^{-3}; H + Al = 15 $mmol_c$ dm^{-3}; P = 47 mg dm^{-3}; K = 0.9 $mmol_c$ dm^{-3}; Ca = 34 $mmol_c$ dm^{-3}; Mg = 10 $mmol_c$ dm^{-3}; basis sum = 45 $mmol_c$ dm^{-3}; CEC = 60 $mmol_c$ dm^{-3}; saturation basis (V) = 75%; Experiment 2 (2015): pH = 5.1; organic matter = 11 g dm^{-3}; H + Al = 29 $mmol_c$ dm^{-3}; P = 186 mg dm^{-3}; K = 1.9 $mmol_c$ dm^{-3}; Ca = 18 $mmol_c$ dm^{-3}; Mg = 3 $mmol_c$ dm^{-3}; basis sum = 23 $mmol_c$ dm^{-3}; CEC = 52 $mmol_c$ dm^{-3}; saturation basis (V) = 45%.

Based on the soil chemical analysis, liming was done on area of experiment 2 and fertilization before planting, in both experiments, was carried out according to the recommendation of Trani & Raij (1997): 40 kg ha^{-1} of N, 200 kg ha^{-1} of P_2O_5, 100 kg ha^{-1} of K_2O and 30 t ha^{-1} of organic compost (N = 0.6; P_2O_5 = 1.0; K_2O = 3.0; Ca = 2.3; Mg = 0.2; S = 0.3; U-65°C = 28; organic matter = 21,0; C = 12.0; all expressed as % of dry matter). After the incorporation of the fertilizers, the soil was prepared in beds, with a height of 0.20m and a width of 1.40m.

The experimental design was a randomized block design, with thirteen treatments, in the 4x3+1 factorial scheme, with four replications. The factors were four nitrogen doses in top dressing (62.5; 125.0; 187.5 and 250.0 kg ha^{-1}), three splitting (1/6+1/3+1/2; 1/4+1/2+1/4; 1/3+1/3+1/3 of total dose in each application), and a control (without nitrogen fertilization in top dressing).

The total doses were divided in three applications of 1/6, 1/3, 1/2; 1/4, 1/2, 1/4; and 1/3, 1/3 1/3 of the total dose of N, at 21 (vegetative development), 35 (flowering and beginning of harvest) and 49 (half of the harvest period) days after transplantation (DAT). Urea (45% N) was used as nitrogen source. For the definition of N doses, the mean dose (125 kg ha^{-1}) recommended by Trani & Raij (1997) for nitrogen fertilization in top dressing for zucchini was used as reference. It was applied 90 kg ha^{-1} of K_2O (potassium chloride: 60% of K_2O) in top dressing, in the proportion of 1/3+1/3+1/3, in all experimental plots, including control without N in top dressing, as recommended by these cited authors.

The hybrid Alicia (Sakata) was used. The sowing was carried out in polypropylene trays containing 162 cells containing commercial substrate on 08/18/2014 in experiment 1 and 07/29/2015 in experiment 2. In both experiments, transplantation was performed 14 days after sowing (DAS), with 0.7m between rows and 1.0m between plants, totaling 15 plants per plot (three lines of five plants), and the three central plants were considered for evaluations.

Fruits were harvested three times a week, when they were about 17 centimeters in size. Harvests started at 35 and 36 DAT and were finalized at 60 and 59 DAT, in experiments 1 and 2, respectively. In both experiments, the following characteristics were evaluated: number of total fruits; number of commercial (without visual defects) fruits; total and commercial production (g) of fruits per plant; length, diameter and average weight of commercial fruit. Only in the experiment 2, the content (g kg^{-1} of dry weight (DW)) of macronutrients (N, P, K, Ca, Mg and S) were determined in fruits, according to the methodologies presented by Malavolta et al. (1997).

The data were submitted to analysis of variance and the regression analysis was performed to verify the effect of nitrogen doses, defining the best fit according to combination of significance and higher coefficient of determination, and Tukey test ($p > 0.05$) to compare the splitting. The data were processed by the Sisvar computer statistical analysis system (Ferreira, 2019).

Results and Discussion

Experiment 1 (2014)

There was no difference among the treatments for the average fruit weight (mean of 298 g) and diameter (mean of 5.2 cm). For fruit length, just the factor doses of N was significant, and it was observed a linear increase in fruit length, with estimated values ranging from 18.8 cm (control, dose 0) to 20,0 cm (250 kg ha^{-1} of N) (Figure 1). Probably fruits grow faster when they receive higher doses of nitrogen. Considering the average length, in all treatments the fruits were classified as "extra AA" (length between 17 and 22 cm) according to CEAGESP classification (HORTIESCOLHA-CEAGESP, 2014), that is, fruits with length most valued. As fruits of zucchini are harvested immature, the length, diameter and weight do not represent the potential of growth of them and each author chooses the moment of the harvest of each fruit. For example, Cavalcante et al. (2017) obtained the highest length of 16 cm at the dose of 150 kg of N ha^{-1}.

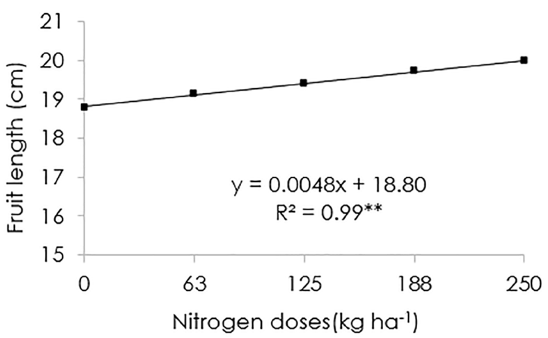

Figure 1. Length of zucchini fruits in function of nitrogen doses in top dressing. Experiment 1. 2014.

There was no difference among splittings for total fruit production (mean of 1.82 kg per plant) and commercial production (mean of 1.59 kg per plant). However, it was observed a higher number of total and commercial fruits per plant in the 1/4+1/2+1/4 split in comparison to the 1/6+1/3+1/2 (Table 1).

Table 1. Number of fruits, total (NFT) and commercial (NFC), production, total (PT) and commercial (PC), per plant of zucchini in function of splitting of nitrogen in top dressing. Experiment 1. 2014.

Splitting	NFT*	NFC*	PT	PC
	------Units $plant^{-1}$------		----------kg $plant^{-1}$----------	
1/6 + 1/3 + 1/2	5.4 b	4.8 b	1.67 a	1.47 a
1/4 + 1/2 + 1/4	6.5 a	5.9 a	1.95 a	1.72 a
1/3 + 1/3 + 1/3	5.7 ab	5.1 ab	1.83 a	1.59 a
CV (%)	21.5	23.2	23.7	24.9

* Means followed by same letter in columns do not differ each other by Tukey test (p<0,05).

The lowest number of total and commercial fruits obtained in the 1/6+1/3+1/2 splitting can be explained by the phenological stage of the plants in each application. The first cover fertilization was applied in the vegetative phase, the second in the beginning of the reproductive phase and the third in the middle of the reproductive phase. Therefore, in 1/6+1/3+1/2 splitting the supply of the highest proportion of N (1/2) was in the last application when the plants were in the middle of harvest period, about to start senescence. Thus, the time of greatest nitrogen need for both vegetative and reproductive growth was prior to this application. In the 1/4+1/2+1/4 split, half (1/2) of the nitrogen was applied at the beginning of the reproductive phase, that is, the phase of greatest need for this nutrient to fruit formation, a fact that may have promoted optimization of the fertilization and was reached the best production, when compared to the split in which most N (1/2) was applied after this stage.

Soratto et al. (2006) verified influence on the number of bean pods when the N was applied in top dressing but did not observe effect when the N was splitted in 1 or 2 times in the proportions 1-0; 2/3+1/3; 1/2+1/2; 1/3+2/3 and 0-1. Cardoso Neto et al. (2006) applied N in top dressing in 2, 3, 4 or 5 equal doses in the melon crop and did not find a significant difference in the number and weight of commercial fruits.

Probably, for each species, the effect of splitting should be influenced by the appropriate proportion of fertilizer at each stage, as well as climatic factors, soil type, irrigation, genetic and cultural characteristics, among others. For carrots, for example, the stage that has the most necessity in N is during the growth phase of the plant, and Colombari et al. (2018) obtained higher values for root weight, root diameter and yield in the 1/6+2/6+3/6 splitting in relation to the 1/3+1/3+1/3. But in zucchini the most important phase is in the beginning of flowering and harvest of fruits.

The total production (g plant^{-1}) in the 1/6+1/3+1/2 and 1/3+1/3+1/3 splits showed linear effect for N doses, with a 46% increase in production for the highest dose (250 kg ha^{-1}) in relation to the control (Figure 2). In the 1/4+1/2+1/4 split, the total production adjusted to the quadratic model, promoting a 66% increase in yield at the dose 144 kg ha^{-1} of N in relation to the control, which may have been favored by the larger amount of N provided at the beginning of the reproductive phase. Similar behavior was observed in the total number of fruits per plant for the 1/4+1/2+1/4 split, with quadratic adjustment, and a maximum number of fruits per plant was estimated at 150 kg ha^{-1} of N. However, in the 1/6+1/3+1/2 and 1/3+1/3+1/3 splits, there was no significant difference for the N doses, with averages of 5.3 and 5.5 fruits per plant, respectively.

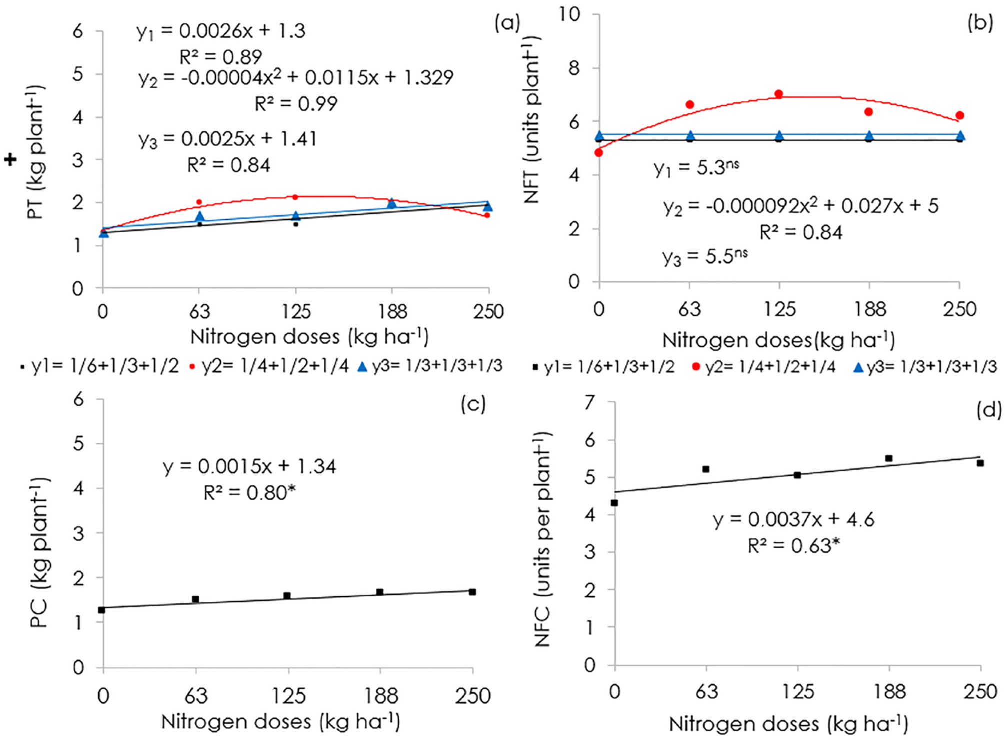

Figure 2 . Production of total fruits (PT) (a), number of total fruits (NFT) (b), production of commercial (PC) (a) and number of commercial fruits (NFC) (b) per plant in function of nitrogen doses in top dressing. Experiment1. 2014.

For the commercial production of fruits (number and weight), the effect of factors N doses and splitting were significant, but the interaction was not. The application of nitrogen in top dressing promoted linear increase in production of commercial fruits per plant, with values of 1.7 kg and 5.5 fruits per plant for the highest dose (250 kg ha^{-1}) (Figure 2). This increase is explained by Queiroga et al. (2007) that reported that in Cucurbitaceae, as N doses increase, up to a certain limit, there is an effect on the production of photoassimilates and, consequently, fruit production. Similar results were obtained with other Cucurbits, such as watermelon (Andrade Junior et al., 2006), melon (Queiroga et al., 2007), maxixe (Oliveira et al., 2008) and seeds of zucchini (Tavares et al., 2021) with increase in fruit production the higher the N doses.

Experiment 2 (2015)

The factors doses of N and splitting were not significant, as well as the interaction between them, for average fruit weight (270 g) and diameter (4.8 cm) of the commercial fruits. For fruit length the factor N doses in top dressing was significant, and data fitted to the quadratic model, with maximum length estimated in 26.5cm for the dose 183.1 kg ha^{-1} of N, and a stabilization after this dose (Figure 3). Regardless of the treatment, the fruits were harvested with a standard size, ranging from 17 to 22 cm in length, but a significant increase in the values of length can be observed. This is explained by the fact that the fruits grow faster when they receive larger doses of N. In this case, the fruits were out of the classification standard by CEAGESP: maximum of 22 cm (HORTIESCOLHA-CEAGESP, 2014).

The average fruit length was 24.6cm, that means greater in relation to experiment 1 (2014) (Figure 1). The highest lengths obtained in the second experiment can be justified by the temperature during the harvest period. During the harvest of the fruits of experiment 1 (2014), the average temperature was 23°C with minimum of 14.4

and maximum of 27.3°C. However, in the same period, for experiment 2 (2015), the average temperature was 23.4°C with a minimum of 16.7°C and a maximum of 30.1°C, that is, with higher temperatures that accelerate the metabolism of the plant, favoring the faster growth of the fruits. Probably, the harvests should had been made daily to get only fruits with standard length in experiment 2.

There was interaction between the factors for all production characteristics (number and weight of fruits, total and commercial, per plant) (Figure 4). The increase of N doses promoted linear increase for all the characteristics of fruit production per plant in the 1/6+1/3+1/2 and 1/3+1/3+1/3 splits, and quadratic effect in the 1/4+1/2+1/4 split. For the 1/6+1/3+1/2 split, an increase of 1.0 fruit per plant (total and commercial) was observed for each 100 kg ha-1 of N.

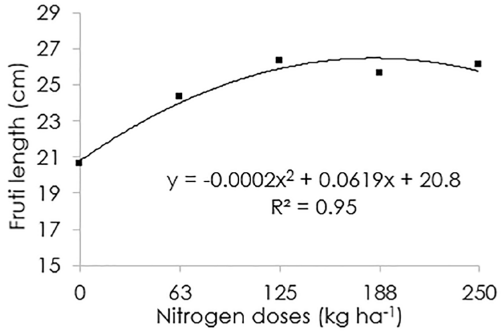

Figure 3. Length of zucchini fruits in function of nitrogen doses in top dressing. Experiment 2. 2015.

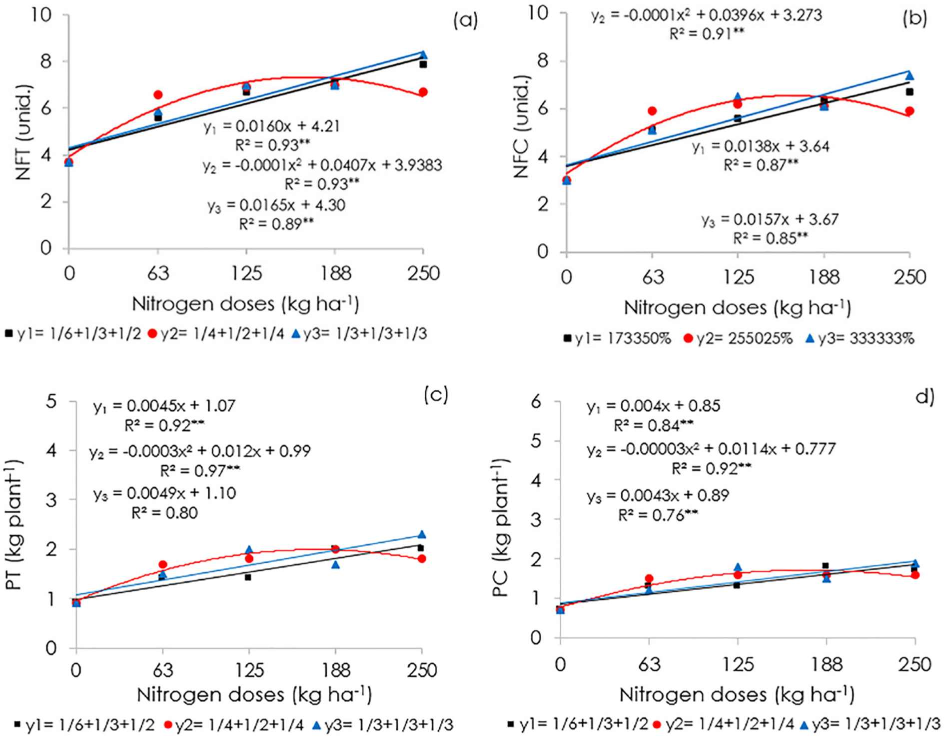

Figure 4. Number of total (NFT) (a), commercial (NFC) (b), production total (PT) (c) and commercial (PC) (d) fruits in zucchini plants in function of nitrogen doses in top dressing for each splitting. Experiment 2. 2015.

Comparing the control (dose 0) with the highest dose (250 kg ha^{-1} of N), increases were 114% and 94% in total and commercial fruit numbers, respectively. In the 1/3+1/3+1/3 split, the results were similar, however, with a 124% increase in the number of total fruits and 108% in the number of commercial fruits (Figure 4). Similar behavior was found by Silva et al. (2011), who obtained linear increase in number and fruit yield when they tested N doses (0 to 90 kg ha^{-1}) in top dressing in squash cv. Menina Brasileira and Piramoita with equal (1/2+1/2) splitting performed at 45 and 55 DAT.

The need for larger doses of nitrogen required in present research in relation to that recommended for zucchini in the state of São Paulo by Trani & Raij (1997), which is 150 kg ha^{-1}, can be explained by the fact that this recommendation is old, at a time when hybrids were almost not used, which, in most cases, are more nutrient-demanding materials to express their maximum production potential. Also Lanna et al. (2020) obtained the maximum fruit and seed yield in zucchini with higher doses of organic fertilizer compared to recommendation of these authors.

In the 1/4+1/2+1/4 split, maximum values estimated in 8.1 total fruits, 7.2 commercial fruits, 2.1 kg plant-1 in total production and 1.9 kg plant-1 in commercial production (Figure 4) were obtained for doses 203, 198, 182 and 190 kg ha-1, respectively. Pedrosa et al. (2012) reported an increase in the number of commercial fruits in pumpkin with the increase of nitrogen fertilization up to the dose of 219 kg ha-1. According to Queiroga et al. (2007), the increase in N dose, to a certain extent, promotes an increase in the leaf area of the plant, altering source-drain relations, photoassimilates production, fruit fixation and, consequently, productivity increase. Therefore, for the 1/4+1/2+1/4 split, excess nitrogen may have occurred at the highest doses, thus reducing the production. On the other hand, with this split, the maximum production was obtained with a lower dose than the other two splitting.

Comparing the highest total production (2.2 kg plant-1) and commercial (1.9 kg plant-1) obtained in this work with other researches, these were superior to those reported by Ramos et al. (2013), with 1.3 and 1.1 kg plant-1 in total and commercial fruit production, respectively, using the Caserta cultivar. Pôrto et al. (2014), with the same cultivar, obtained total production of 1.79 kg plant-1 in the dose 331 kg ha-1 of N, dose higher than those studied in this study. On the other hand, the values were lower than those obtained by Araújo et al. (2013), which using the recommended fertilization and the Aline hybrid, obtained a total yield of 3.6 kg plant-1. It can be observed that in the researches where hybrids were used, the production was higher. According to Cardoso & Souza Neto (2016), the use of adapted hybrids results in greater yield potential, precocity, greater uniformity, better standardization and fruit quality, and stability of behavior under different environmental conditions. In addition to the genetic material, other factors that may influence the production of zucchini fruits are the growing season (Araújo et al., 2013), soil type, phytosanitary management and environmental conditions.

For all macronutrient content in the fruits, there was no interaction between the N doses and the splitting factors. For the nitrogen content, both the splitting (Table 2) and the N doses (Figure 5) were significant.

Table 2. Nitrogen content in zucchini fruits in function of splitting of nitrogen in top dressing. Experiment 2. 2015.

Splitting	Nitrogen content (g kg^{-1} of DM)*
1/6 + 1/3 + 1/2	29.2 b
1/4 + 1/2 + 1/4	31.6 ab
1/3 + 1/3 + 1/3	32.7 a
CV (%)	10.3

* Means followed by same letter do not differ each other by Tukey test (p<0,05).. DM = dry matter.

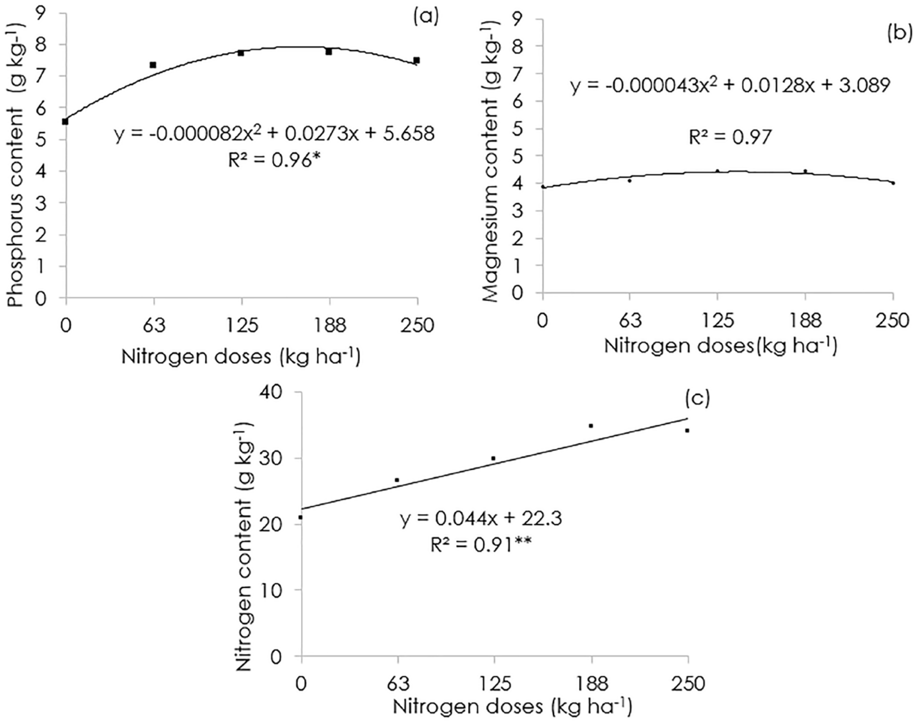

Figure 5. Phosphorus (a), magnesium (b) and nitrogen (c) content in zucchini fruits in function of nitrogen doses in top dressing. Experiment 2. 2015.

Higher nitrogen content was obtained in the 1/3+1/3+1/3 splitting in relation to the 1/6+1/3+1/2 split (Table 2). The low N content obtained in the 1/6+1/3+1/2 split may be due to the fact that the greatest amount of nitrogen was applied in the 3rd application, very close to the end of the harvests. As the analysis of the nitrogen content was made by a composite sample of fruits of all the harvests, as recommended by Araújo et al. (2015), most fruits were sampled when little proportion of N had been applied in this treatment. According to Araújo et al. (2015), the N content in the fruits of zucchini are higher in the first harvests, reducing with the advancement of the cycle. Thus, with a lower proportion of N in this 1/6+1/3+1/2 split the fruits of most crops may have received less N than in the other splitting resulting in a lower average N content.

In relation to the N doses, the nitrogen content was adjusted to the linear model (Figure 5), with an estimated increase of 32.9% in the highest dose (250.0 kg ha^{-1}) compared to the control (dose 0). The increase in N content may be a sign of luxury absorption, that is, the increase in N content in fruits may be due to the greater nutrient availability in the soil. The luxury uptake has already been reported for potassium in zucchini (Araújo et al., 2015) and pumpkin (Araújo et al., 2012). Lanna et al. (2020) also related linear increase in N content in ripe fruits of zucchini the higher the castor bean cake dose, organic fertilizer that was used as N source.

The nitrogen content of the fruits was between 25.1 and 37.1 g kg^{-1} of dry matter (DM), values close to those reported by Araújo et al. (2015) which obtained approximately 30 g kg^{-1} of N. Corrêa et al. (2014) also reported increasing values (between 15.1 and 25.9 g kg^{-1} of DM) for the N content in the pumpkin fruits of hybrid Miriam (*C. moschata*) by testing the same range of N doses in top dressing (0 to 250 kg ha^{-1}). These authors state that due to the easy translocation of nitrogen from the leaves to the fruits, and the fertilization with increasing doses of N, it is expected that the nutrient content in the fruit increases.

For the phosphorus and magnesium content only the nitrogen dose factor was significant (Figure 5) and data were adjusted to the quadratic model, reaching higher contents at the doses of 166 kg ha^{-1} and 140 kg ha^{-1} of N, respectively. The P content ranged from 5.6 to 7.9 g kg^{-1} DM, values a little superior than the related by Araújo et al. (2015) that obtained 5.4 to 5.9 g kg^{-1} DM. For Mg content the values ranged from 3.1 to 4.0 g kg^{-1} DM, similar to that related by these authors.

There is synergism between magnesium and phosphorus, since magnesium tends to interrelate with nitrogenous bases and phosphoryl groups, being fundamental in the transport of phosphorus in the biochemical processes in the plant and as part of the chlorophyll molecule (Taiz & Zeiger, 2017). These interactions may justify the similar behavior between the values of the content of these macronutrients in the fruit. The reduction in P and Mg contents at the highest doses may have been due to the dilution effect, since there was a linear increase in fruit production for most treatments, with no increase in the doses of these macronutrients.

The potassium, calcium and sulfur contents were not influenced by the treatments. For K the mean content (51.2 g kg^{-1} DM) is much higher than that related by Araújo et al. (2015) that obtained 5.4 to 5.9 g kg^{-1} DM, while for Ca content (mean of 3.83 g kg^{-1} DM) was similar and for S content (mean of 1.57 g kg^{-1} DM) was lesser than the observed by these authors, that related means of 3.8 and 2.3 g kg^{-1} DM for Ca and S, respectively.

The decreasing order of macronutrient content in the immature fruit was K>N>P>Ca>Mg>S. The same order was obtained by Araújo et al. (2015) in hybrid Aline. In zucchini, nutritional requirements usually follow the order K>N>P>Mg>Ca>S (Faquin & Andrade, 2004). Possible differences in the order of macronutrient content may occur according to genetic material, cultural treatments and edaphoclimatic conditions.

Potassium was highlighted as the nutrient with the highest content and nitrogen the second one, which was also reported in fruits of other cucurbitaceae: Vidigal et al. (2007) with 'Tetsukabuto' pumpkin, Araújo et al. (2012) with pumpkin 'Miriam' and Lanna et al. (2020) in ripe fruits of zucchini cv. Caserta.

Conclusions

In experiment 1 (2014), the 1/4+1/2+1/4 split showed linear increase in the number of fruits, total and commercial per plant, with N doses in top dressing, and was superior to 1/6+1/3+1/2 split for number of fruits per plant.

In Experiment 2 (2015), the 1/6+1/3+1/2 and 1/3+1/3+1/3 splits provided linear increase in the production of zucchini fruits the higher the N doses.

The decreasing order of macronutrient contents in the immature fruit was K>N>P>Ca>Mg>S.

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