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Agronomic yield and quality of industrial tomatoes under NPK doses

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ABSTRACT: High doses of nitrogen, phosphorus and potassium in irrigated systems may lead to an increase in the productivity of industrial tomatoes, but may also alter the final quality of the fruits. The objective of this was to evaluate the agronomic yield and post-harvest quality of industrial tomatoes, under NPK doses for climatic conditions of Northern Minas Gerais state, Brazil. The study was conducted in the city of Jaíba, MG, Brazil, in randomized block design with four repetitions in a 3 x 3 factorial scheme, consisting of three doses of N (90, 135 and 180 kg ha⁻¹), of P (270, 405 and 540 kg ha⁻¹) and of K (225, 337 and 450 kg ha⁻¹), corresponding to 50, 75 and 100% of the fertilization recommendation; and three tomato hybrids: BRS Sena, Heinz 9553 and BHN 0574. The following variables were evaluated: number of bunches, number and weight of fruits, productivity and fertilizer efficiency index; besides the physico-chemical characteristics: firmness, soluble solids concentration, pH and pulp industrial yield. The hybrid Heinz 9553 showed higher weight, number of fruits, productivity and industrial yield at doses of 75 and 100% of NPK recommendation. The fertilizer doses did not interfere on the soluble solids, pH and fruit firmness of the three hybrids. The hybrid BRS Sena was not influenced by the increase of NPK and there was lower weight, number of fruits, productivity and fertilization efficiency. The hybrid BHN and Heinz hybrids can be indicated for cultivation at doses of 100 and 75% of NPK recommendation, because they promote higher agronomic yield and do not alter the post-harvest quality of the tomatoes.

Key words: *Solanum lycopersicum*, plant nutrition, low-growing tomato, pulp yield

Rendimento agrônômico e qualidade de tomates industriais sob doses de NPK

RESUMO: Doses elevadas de nitrogênio, fósforo e potássio em sistemas irrigados podem propiciar aumento na produtividade de tomate industrial, mas também podem alterar a qualidade final dos frutos. Objetivou-se avaliar o rendimento agrônômico e a qualidade pós-colheita de tomates industriais, sob doses de adubo NPK para condições climáticas do norte do Estado de Minas Gerais. O estudo foi conduzido no município de Jaíba, MG, em delineamento de blocos casualizados com quatro repetições e esquema fatorial 3 x 3, consistindo de três doses de N (90, 135 e 180 kg ha⁻¹), de P (270, 405 e 540 kg ha⁻¹) e de K (225, 337 e 450 kg ha⁻¹), correspondendo a 50, 75 e 100% da recomendação de adubação; e três híbridos de tomateiro: BRS Sena, Heinz 9553 e BHN 0574. Avaliaram-se número de cachos, número e peso de frutos, produtividade e índice de eficiência de adubação; além das características físico-químicas: firmeza, teor de sólidos solúveis, pH e rendimento industrial de polpa. O híbrido Heinz 9553 apresentou maior peso, número de frutos, produtividade e rendimento industrial, nas doses de 75 e 100% da recomendação de NPK. As doses do adubo não interferiram nos sólidos solúveis, pH e firmeza dos frutos dos três híbridos. O híbrido BRS Sena não foi influenciado pelo incremento de NPK e apresentou menor peso, número de frutos, produtividade e eficiência de adubação. Os híbridos BHN e Heinz podem ser indicados para o cultivo nas doses de 100 e 75% da recomendação de NPK, pois propiciam maior rendimento agrônômico e não alteram a qualidade pós-colheita dos tomates.

Palavras-chave: *Solanum lycopersicum*, nutrição de plantas, tomate rasteiro, rendimento de polpa



INTRODUCTION

Brazil is the eighth largest producer of tomato for industrialization in the world (WPTC, 2016), producing 1.2 million tons of tomato for industrial processing in 2016. The use of hybrids with higher productivity, phenotypic adaptability and resistance to diseases allowed greater profitability of this crop in the country (Peixoto et al., 2017).

The northern part of Minas Gerais state, Brazil, which is a semiarid region, has potential for the production of commercial plantations of irrigated industrial tomato, due to low air relative humidity and high insolation, which guarantee higher fruit quality. However, studies demonstrating the productive behavior of hybrid genotypes in the semiarid region of Minas Gerais state, Brazil, are necessary (Figueiredo et al., 2016).

Balanced supply of fertilizers, in the correct quantity and time, is a primordial factor for maximum expression of the production potential of tomato hybrids. The nutrient supply can also influence the nutritional quality of the fruits as well as their yield, but these parameters do not increase at the same rate as the increment of nutrients (Marschner, 2012). According to Silva et al. (2012), fertilization with doses of 120 kg ha⁻¹ of nitrogen (N), 600 kg ha⁻¹ of phosphorus (P) and 250 kg ha⁻¹ of potassium (K) is indicated for the cultivation of tomato for processing in the Brazilian Cerrado region.

The nitrogen is cited as one of the main nutrients for tomato, because it constitutes organic compounds that are vital to plants and contributes to fruiting, productivity and economic profitability, but can decrease fruit firmness (Marschner, 2012). Despite being absorbed in smaller quantity and having lower concentrations in plant tissue, the phosphorus is extremely important in root formation and growth, besides increasing the commercial quality of the fruit (Mueller et al., 2013; Nowaki et al., 2017). The potassium is the most required nutrient by tomato (Prado et al., 2011) and contributes to the processes of photosynthesis, enzymatic activation and protein synthesis (Rebouças Neto et al., 2016). Balance between nutrient availability, fertilizer dose and application time should be recommended in order to reduce the risk of environmental contamination and increase the efficiency of fertilizer use by cultivated plants.

Thus, the adoption of balanced NPK doses, besides increasing productivity and soluble solids concentration, can increase pulp yield, fruit firmness of industrial tomatoes, among others. However, studies related to the adoption of balanced doses of nutrients in irrigated industrial tomato hybrids in the semiarid region are scarce. Therefore, the objective of this study was to evaluate the agronomic yield and postharvest quality of industrial tomato hybrids after fertilization with NPK doses.

MATERIAL AND METHODS

The study was conducted in 2015, in the Irrigation District of Jaíba (IDJ), municipality of Jaíba, MG, Brazil (15° 12' S, 44° 01' W and 456 m of altitude). The climate of the region is Aw, according to Köppen's climatic classification, tropical with dry winter and the soil of the experimental area was characterized as Inceptisol. Before the experiment began, the area was cultivated in rotation with maize for grain production and

plant residues were incorporated into the soil by conventional tillage, twice with a heavy harrow and once with a light harrow.

In the initial phase of the study, soil samples were collected (20 single samples to prepare one composite sample) in the 0-20 cm layer, for chemical characterization: organic matter: 3.4 dag kg⁻¹; pH (water): 6.5; P (Mehlich 1): 84.4 mg dm⁻³; K (Mehlich 1): 151 mg dm⁻³; Na (Mehlich 1): 0.1 mg dm⁻³; Ca: 10.1 cmol_c dm⁻³; Mg: 2.1 cmol_c dm⁻³; Al (KCl): 0 cmol_c dm⁻³; H+Al: 2 cmol_c dm⁻³; SB: 12.6 cmol_c dm⁻³; t: 12.6 cmol_c dm⁻³; base saturation (V%): 86%; B: 1.9 mg dm⁻³; Cu: 1.8 mg dm⁻³; Fe: 6.6 mg dm⁻³; Mn: 254 mg dm⁻³; Zn: 8.9 mg dm⁻³; Prem: 27 mg L⁻¹; EC: 0.3 dS m⁻¹; sand: 16 dag kg⁻¹; silt: 46 dag kg⁻¹ and clay: 38 dag kg⁻¹.

The experimental design consisted of randomized blocks, with four repetitions, in a 3 x 3 factorial scheme, corresponding to three tomato hybrids for industrial processing: BRS Sena (Embrapa Hortaliças), Heinz 9553 (Heinz Seeds) and BHN 0574 (Blueseed), and three doses of N: 90, 135 and 180 kg ha⁻¹, of P: 270, 405 and 540 kg ha⁻¹ and of K: 225, 337 and 450 kg ha⁻¹. These doses corresponded, respectively, to 50, 75 and 100% of the fertilizer recommendation for industrial tomato, as described by Filgueira et al. (1999) with adaptations in doses and managements for irrigated systems.

The treatments with NPK fertilizer in the tomato hybrids were managed as follows: at planting (basal fertilization) 20, 100 and 40% of nutrients N, P and K, respectively, were applied by means of the NPK 2-30-10 formulation; as topdressing, N and K were split into six times and applied by sprinkler fertigation at 18, 35, 40, 46, 51 and 59 days after transplanting (DAT). The following fertilizers were used as sources: ammonium sulfate, potassium nitrate and potassium chloride and superphosphate (simple).

The hybrids used in the study have the following characteristics: BRS Sena was developed by EMBRAPA, has great performance in mechanical harvesting, cycle of 110 days, soluble solids concentrations varying from 5.8 to 6.7 °Brix; the hybrid Heinz 9553 has a cycle of 110 to 120 days and soluble solids concentration of 4.9 to 5.1 °Brix; and the hybrid BHN 0574, developed by the company Blueseed, has concentrated maturity and high soluble solids concentration.

Each experimental plot consisted of four planting rows and the two central rows were considered for the observations, with 30 m in length and 5.2 m in width, in a total area of 5,616 m², totaling 240 plants per plot. The seedlings were produced on polypropylene trays of 400 cells, with the commercial substrate Carolina Soli and grown in greenhouse. Transplanting was performed on May 20, 2015, when the seedlings had three to four true leaves. Planting in the experimental area was carried out mechanically, in a single-row system, with spacing of 1.3 m between rows and 0.25 m between plants.

Phytosanitary treatments were performed with the application of herbicides (glyphosate, metribuzin), systemic insecticides (Actara) and contact insecticides (pyrethroid), applied preventively, and fungicides (chlorothalonil, copper hydroxide, famoxadone and mancozeb) applied according to the schedule of the farm. Irrigation was carried out according to the water need of the crop, using the center-pivot sprinkler irrigation system. The total water depth applied during the crop cycle was 414 mm.

At the end of the crop cycle (September 5, 2015), the four central plants were evaluated for the agronomic characteristics: number of bunches (NB), number of fruits per plant (NF), fruit weight per plant (kg) (FW), productivity (PRODUCT) estimated in t ha⁻¹, and fertilization efficiency index (FEI), obtained by dividing the productivity (kg ha⁻¹) by the dose of each nutrient used.

In addition, 3 kg of fruits with uniform maturation from the four central plants were separated and sent to the Postharvest Laboratory to determine the physico-chemical characteristics: firmness – FIRM, expressed in Newtons (N), determined using a hand-held penetrometer, with a thin tip (8 mm), in the median region of the fruit; soluble solids concentration - °Brix, by refractometry, using a digital refractometer (Atago), with values expressed in °Brix; pH, determined directly in the processed juice of the fruits, using a pH meter; and industrial pulp yield, using the formula: Yield – PY (t ha⁻¹ of pulp) = [(Productivity (t ha⁻¹) x °Brix of the Juice]/28 (Clemente & Boiteux, 2012).

The obtained data were subjected to normality (Shapiro-Wilk) and homogeneity tests and then analysis of variance was performed. When significant, the data were subjected to Tukey's means comparison test at p < 0.05. Statistical analysis was carried out using the statistical software R.

RESULTS AND DISCUSSION

There was interaction between the doses of NPK fertilizer and the hybrids for the characteristics fruit weight per plant (FW), number of fruits per plant (NF) and productivity (PRODUCT). For the number of bunches (NB), difference was only caused by the hybrids (Table 1).

For NB, the hybrid Heinz 9553 was superior, with 23 bunches per plant, followed by the BRS Sena (19 bunches) and BHN 0574 (17 bunches). On the contrary, the NPK doses did not influence the NB (Table 1), indicating that this is a genetic trait not influenced by fertilization. This same aspect

was reported by Blanco & Folegatti (2008), who attributed the lack of difference to genetic characteristics of the genotypes.

The doses of 100 and 75% of NPK recommendation promoted increase of FW in the hybrids BHN 0574 and Heinz 9553, with weights of 4.93 and 5.18 kg per plant, respectively (Table 1). These results suggest that higher doses of NPK favor the growth and formation of tomato fruits, especially for the hybrids BHN 0574 and Heinz 9553. The increase in fruit weight can be explained by the increase in photoassimilates transported in the plant from source organs to sink organs (Singh et al., 2010). For the industry, it is desirable to produce larger fruits in size and weight, because this usually leads to greater pulp production (Silva et al., 2012). For the hybrid BRS Sena, there was no difference in FW with the NPK doses (Table 1), probably due to the high natural fertility of the soil used in this experiment.

The hybrid Heinz 9553 under 75% NPK dose obtained higher FW compared to the other tomato genotypes studied (Table 1). It is known that this hybrid is widely used in Brazilian production and experimental fields, mainly due to its characteristics of production and adaptability (Figueiredo et al., 2016; Luz et al., 2016). Carvalho et al. (2003), evaluating tomato hybrids under three doses of NPK fertilizer, reported higher weight in the fruit of the Heinz 9553, which indicates higher genetic potential of production. The lower FW obtained in BRS Sena for the doses of 100 and 75% NPK was attributed to its production characteristic, because it has lower average weights (70 g) compared to the hybrids Heinz 9553 (80 g) and BHN 0574 (95 g) (Quezado-Duval et al., 2014).

The highest NPK dose (100%) increased NF only for the hybrid Heinz, compared to the 50% NPK dose (Table 1). On the other hand, Singh et al. (2010), working with NPK doses in tomato, found higher number of fruits (37) under the dose of NPK (120:60:60 kg ha⁻¹). However, for the hybrid BRS Sena, the highest NF was obtained with the dose of 50% NPK, and there was no effect of fertilization on the hybrid BHN 0574 (Table 1).

Table 1. Number of bunches per plant (NB), fruit weight (FW), number of fruits (NF), productivity (PRODUCT) and fertilization efficiency index (FEI) of industrial tomato hybrids under NPK fertilizer doses

	Hybrids	Fertilizer doses			Mean
		50%	75%	100%	
NB (per plant)	BRS Sena	17.50	21.37	19.62	19.50 ab
	Heinz 9553	21.00	26.82	22.66	23.50 a
	BHN 0574	18.75	13.82	18.50	17.02 b
Means		19.08 A	20.67 A	20.26 A	
FW (kg per plant)	BRS Sena	3.15 aA	2.94 bA	3.06 bA	3.05
	Heinz 9553	3.77 aB	5.18 aA	4.20 abAB	4.38
	BHN 0574	3.35 aB	3.07 bB	4.93 aA	3.78
Means		3.43	3.73	4.07	
NF (fruits per plant)	BRS Sena	113.18 aA	75.41 aB	99.56 aAB	87.05
	Heinz 9553	87.83 aB	105.33 aAB	129.56 aA	107.57
	BHN 0574	86.50 aA	76.62 aA	62.75 bA	75.29
Means		79.00	85.78	97.29	
PRODUCT (t ha ⁻¹)	BRS Sena	116.62 aA	104.93 bA	113.23 bA	111.59
	Heinz 9553	139.39 aB	191.39 aB	155.38 abAB	162.05
	BHN 0574	124.00 aB	113.54 bB	182.15 aA	139.90
Means		126.67	136.62	150.26	
FEI*	BRS Sena	1.29;0.43;0.51	0.77;0.26;0.31	0.63;0.21;0.25	-
	Heinz 9553	1.55;0.52;0.62	1.42;0.47;0.57	1.01;0.33;0.40	-
	BHN 0574	1.38;0.46;0.55	0.84;0.28;0.34	1.01;0.34;0.40	-

Means followed by the same lowercase letter in the column and uppercase letter in the row do not differ by Tukey test (p ≤ 0.05). *Refers to the fertilization efficiency of the nutrients nitrogen, phosphorus and potassium (FEI = PRODUCT/Dose of the nutrient), respectively

The classification of tomato genotypes destined for processing considers as the best the ones which have lower fruit weight and higher number of fruits per plant (Carvalho et al., 2003; Silva et al., 2012). Santos et al. (2001) working with three doses of NPK in tomato hybrids, observed that the highest number of fruits was obtained at the highest NPK doses, 3.5 and 5 t ha⁻¹. Salam et al. (2010) also found that, at the highest dose of NPK (2.2:1.8:1), there was higher number of tomato fruits. Higher nutrient availability for tomato plants prolongs the vegetative stage, increasing the production of inflorescences and, consequently, the number of fruits (Santos et al., 2001; Marschner, 2012).

At the dose of 50% NPK, there was a similar productivity among the hybrids, corresponding to 126.67 t ha⁻¹ (Table 1). However, the productivity obtained is within the production pattern of commercial plantations of tomato for processing, demonstrating the high production capacity of these hybrids for the northern region of Minas Gerais, Brazil. At the dose of 75% NPK, the hybrid Heinz 9553 was superior (191.39 t ha⁻¹), differing from the other hybrids. At the highest fertilizer dose (100%), there was average productivity of 150.26 t ha⁻¹ and the hybrids BHN (182.15 kg ha⁻¹) and Heinz (155.38 t ha⁻¹) outperformed BRS Sena (113.23 t ha⁻¹) (Table 1). These productivities were considered higher than those obtained by Carvalho et al. (2003), which corresponded to 124 t ha⁻¹ for the hybrid Heinz under drip irrigation system.

In general, the productions and productivities obtained in this study were considered superior to those described in the literature (Silva et al., 2012). The expected productivity for the Brazilian Cerrado region is approximately 100 t ha⁻¹ in plantations with high technological dose, because the use of highly productive genetic materials associated with the application of modern technologies results in high productivity (Peixoto et al., 2017).

For the hybrid BRS Sena, the NPK doses did not influence productivity (111.59 t ha⁻¹) (Table 1). This result is of great importance, since 50% of the recommended dose (90 kg ha⁻¹ of N, 270 kg ha⁻¹ of P and 225 kg ha⁻¹ of K) statistically led to the same gain in productivity as the doses of 75 and 100% NPK. The productivity obtained by this hybrid was considered higher than the average of 87.6 t ha⁻¹ obtained for the Jaíba region, MG, Brazil (Quezado-Duval et al., 2014). Fratoni et al. (2016) also observed no difference in the productivity of fertigated Italian tomatoes with the increase of K doses.

For the hybrid Heinz 9553, the addition of 75% NPK led to a productivity of 191.39 t ha⁻¹ (Table 1), not differing from the dose of 100% NPK. These results indicate that the application of 75% of NPK (N: 135 kg ha⁻¹, P: 405 kg ha⁻¹ and K: 337 kg ha⁻¹) promotes adequate productivity for the hybrid Heinz, cultivated under irrigated system in the northern region of Minas Gerais, Brazil.

The lowest productivity was observed in the hybrid BRS Sena, compared to the others (Table 1), indicating its lower adaptation to the climatic conditions of the semiarid region. Quezado-Duval et al. (2014) reported that there is a reduction in the productivity of BRS Sena when it is cultivated in the hottest periods of the Cerrado in Goiás, Brazil. In turn, the hybrid BHN 0574 obtained higher productivity at the 100%

NPK dose (Table 1), corresponding to 182.15 t ha⁻¹, expressing its maximum genetic potential under this condition of fertilization.

The hybrid Heinz 9553 obtained higher fertilization efficiency index (FEI) at all NPK doses (Table 1), whereas the opposite was observed for BRS Sena. Higher indices suggest that there is efficiency in the amount of tomato produced per unit of nutrient applied. BRS Sena had higher FEI at the dose of 50% NPK, for the nutrients nitrogen, phosphorus and potassium (Table 1), confirming that this hybrid has greater efficiency in the use of NPK fertilizers at the lowest fertilization dose, which was also verified for the hybrid BHN 0574. Badr et al. (2016) found that the lowest dose of N (120 kg ha⁻¹) led to higher efficiency in the use of the fertilizer and, on the other hand, at the highest dose of N (300 kg ha⁻¹), there was lower agronomic efficiency in low-growing tomato. For Heinz 9553, there was higher FEI at the doses of 50 and 75% NPK, corroborating its maximum productivity, which was obtained at the dose of 75% NPK.

In the evaluation of fruit postharvest characteristics, it was observed that firmness and pulp industrial yield were influenced by the interaction between doses of NPK fertilizer and the hybrids studied (Table 2). However, the soluble solids concentration was not influenced by the studied factors, with an average of 5.65 °Brix (Table 2), a value considered higher than that recommended in the industry of tomato products, of 5 °Brix (Clemente & Boiteux, 2012). The soluble solids concentration is directly linked to pulp yield; for every increase of one °Brix, there is a 20% increment in the industrial yield of tomato, leading to lower energy expenditure to obtain the pulp (Rocco & Morobito, 2016).

The characteristic pulp pH was influenced only by the cultivated hybrids (Table 2). The BRS Sena showed higher pulp pH than the others (4.71), while the hybrids Heinz 9553 (4.53) and BHN 0574 (4.49) did not differ from each other (Table 2). For the industry of tomato products, the desirable pH is less than 4.5, because high pH promotes greater proliferation of microorganisms in the final product, besides increasing the heating time in the process of obtaining the pulp. On the

Table 2. Soluble solids concentration (°Brix), hydrogen potential (pH), fruit firmness (FIRM) and pulp yield (PY) of industrial tomato hybrids under doses of NPK fertilizer

	Hybrids	Fertilizer doses			Mean
		50%	75%	100%	
°Brix	BRS Sena	5.62	5.70	5.87	5.73 a
	Heinz 9553	6.07	5.42	5.70	5.73 a
	BHN 0574	5.75	5.37	5.35	5.48 a
	Means	5.80 A	5.64 A	5.50 A	
pH	BRS Sena	4.67	4.79	4.70	4.71 a
	Heinz 9553	4.58	4.56	4.45	4.53 b
	BHN 0574	4.53	4.46	4.46	4.49 b
	Means	4.59 A	4.58 A	4.54 A	
FIRM (N)	BRS Sena	25.88 abA	21.81 aA	23.44 aA	24.32
	Heinz 9553	21.37bA	22.89 aA	25.50 aA	23.92
	BHN 0574	28.34aA	23.53 aA	25.20 aA	25.69
	Means	25.20	23.92	25.20	
PY (t ha ⁻¹)	BRS Sena	17.58 bA	16.76 bA	18.39 bA	17.58
	Heinz 9553	23.92 aA	29.11aA	28.81 aA	27.28
	BHN 0574	20.83 abB	17.35 bB	27.41 aA	21.86
	Means	20.77	21.08	24.87	

Means followed by the same lowercase letter in the column and uppercase letter in the row do not differ by Tukey test at $p \leq 0.05$

other hand, pH less than 4 results in excessively acidic product (Clemente & Boiteux, 2012). Thus, the pH was within the range desired by the industry (4.49) only for the hybrid BHN 0574.

The NPK doses did not influence fruit firmness in the evaluated hybrids (Table 2), with mean values varying from 24.32 to 25.69 N, which are considered adequate for the resistance to transport (Clemente & Boiteux, 2012). However, among the hybrids studied, at the lowest dose of NPK (50%), BHN 0574 obtained higher fruit firmness (28.34 N), differing from Heinz 9553 (21.37 N), which in turn had firmness similar to that of BRS Sena (25.88 N). Luz et al. (2016), evaluating 53 genotypes of industrial tomato in the field, reinforce that this is one of the main characteristic to select hybrids with resistance to transport. Among the 53, 13 genotypes were selected as firm and concentrated maturity, including the hybrid Heinz 9553, which was used as a comparative among the genotypes.

The pulp yield of the fruits was influenced by the NPK doses only in the BHN 0574. The dose of 100% NPK resulted in a yield of 27.41 t ha⁻¹, higher than those obtained at doses of 75% (17.35 t ha⁻¹) and 50% (20.83 t ha⁻¹) of NPK, which did not differ from each other (Table 2). The greater availability of N, P and K in the treatment with 100% of the fertilization possibly contributed to the higher plant growth, favoring the production and accumulation of photoassimilates and productivity (Santos et al., 2001; Badr et al., 2010; Singh et al., 2010), and these factors contribute to the highest pulp industrial yield.

Among the hybrids evaluated, higher pulp yield (29.11 t ha⁻¹) was obtained in the Heinz 9553, at the dose of 75% NPK compared to the others (Table 2). This hybrid also had the highest pulp yields at the doses of 100 and 50% NPK, but at the dose of 100% NPK, the pulp yield between the hybrids Heinz 9553 and BHN 0574 did not differ and were superior to the results obtained with the BRS Sena. The higher pulp yield of Heinz 9553 was attributed to its higher productivity, since the soluble solids concentration did not vary between the studied hybrids. Rocco & Morabito (2016) report that the amount of pulp after processing is the combined result of productivity and soluble solids concentration. This result suggests that the hybrid Heinz has greater efficiency in the use of NPK fertilizers. However, Nowaki et al. (2017) found no difference between the yields of tomato plants working with P in areas of high and low fertility in São Paulo state, Brazil, and these authors point out the need for balanced management of nutrients during tomato cultivation.

CONCLUSIONS

1. The hybrid Heinz 9553 has higher fruit weight, number of fruits, productivity and pulp industrial yield at the dose of 75% of the NPK recommendation.

2. The dose of 100% of the NPK recommendation promotes greater fruit weight, number of fruits, productivity, and pulp industrial yield for the hybrid BHN 0574.

3. The fertilizer doses did not interfere with the fruit weight, number of fruits, productivity and pulp industrial yield of the hybrid BRS Sena.

4. Highest fertilization efficiency index was obtained at the 50% of the NPK recommended dose for all hybrids. The Heinz 9553 obtained higher fertilization efficiency index.

5. Soluble solids concentration, pH and firmness are not altered by NPK doses. The pulp industrial yield is higher at the 75% of the NPK recommendation dose for the hybrid Heinz 9553 and, at the 100% NPK dose, there was higher pulp yield for the hybrid BHN 0574.

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