Comunicata Scientiae
Horticultural Journal

ORIGINAL ARTICLE
published: 30 September 2025
https://doi.org/10.14295/CS.v16.4336

# Analysis of ´Coronel´ hybrid fertigated tomato growth and nutrient uptake rate

Leandro Hahn[1]*, Camila Moreira[2], Rafael Goulart Machado[3], Marlova Bernardi[4], Priscila Dal Bosco[2], Anderson Luiz Feltrim[1]

[1]Empresa de Pesquisa Agropecuária e Extensão Rural, Caçador-SC,Brasil
[2]Universidade Alto Vale do Rio do Peixe, Caçador-SC, Brasil
[3]Empresa de Pesquisa Agropecuária e Extensão Rural, Canoinhas-SC, Brasil
[4]Unidade Central de Educação Faem, Faculdade, Itapiranga-SC, Brasil
*Corresponding author, e-mail: leandrohahn@epagri.sc.gov.br

## Abstract

'Coronel' hybrid tomato is grown in approximately 80% of salad tomato crops in three Southern Brazil states. Shoot and fruit biomass, as well as nutrient uptake rate, are parameters adopted in decision-making processes focused on crop fertilization recommendations. The aim of the current study is to determine shoot and fruit dry mass, as well as nutrient accumulation in leaves, stems and fruits throughout the 'Coronel' hybrid tomato production cycle. The experiment was carried out in Typic Hapludox soil, in Caçador County-SC. It followed a randomized block design, with 4 replicates. Treatments comprised 10 different collection times (14, 28, 42, 56, 70, 84, 98, 112, 126 and 140 days after planting). Plant height, stem diameter, number of leaves, number and fresh mass of green and ripe fruits, were assessed at each sampling date. Total, commercial (extra AA and extra A) and non-commercial yield, as well as mean commercial fruit mass (extra AA and extra A), were assessed. Nutrient contents were determined in different plant organs. Fruit fresh mass reached 14.17 kg plant$^{-1}$, at 140 days after transplanting (DAT). If one takes into consideration the population of 11,111 plants ha$^{-1}$, it corresponds to production of 157.44 t ha$^{-1}$. K was the nutrient recording the highest accumulation rate in the shoot dry mass (480.2 kg ha$^{-1}$) at 140 DAT; it was followed by N (342.4 kg ha$^{-1}$), Ca (199.9 kg ha$^{-1}$), Mg (57.0 kg ha$^{-1}$) and P (43.6 kg ha$^{-1}$).

**Keywords:** macronutrient accumulation, micronutrient accumulation, plant nutrition, *Solanun lycopersicum L.*

## Introduction

Alto Vale do Rio do Peixe (Upper Peixe River Valley) region, in Midwestern Santa Catarina (SC) State, is one of the most important producing regions focused on tomato plants grown under field condition, during summer. Tomato production cost in this region, in the 2022-2023 crop season, was calculated close to R$ 200 mil ha$^{-1}$ or R$ 20 plant$^{-1}$ (Hortifruti Brasil, 2024). However, this crop requires the application of high fertilizer doses in order to develop, and it has significantly increased its cost in recent years.

The cost with fertilizers used in tomato crops corresponds to approximately 17.2% of the total cultivation cost (Hortifruti Brasil, 2024); mineral nutrition is the most important production factor after water availability. Thus, it is necessary improving scientific knowledge and finding technologies to enable the competitive production of such an important vegetable in SC. Fertigation is one of the most important techniques used by most tomato farmers in the aforementioned state. Nutrient dose applications must be based on the needs of new cultivars recommended for this region in order to guarantee the success of this technique. This factor helps avoiding nutrient waste - since excess of nutrients can lead to environmental contamination -, as well as increasing tomato yield and quality (Labate et al., 2018; Glanz-Idan & Wolf, 2020).

'Coronel' hybrid tomato shows indeterminate growth behavior of the salad type. Approximately 80% of salad tomato fields in all three Southern Brazil states were cultivated with this hybrid in the 2021-2022 crop season (Seminis, 2025, personal communication). This hybrid also represents important areas of cultivation in other regions of Brazil. Therefore, it is essential understanding the nutrient uptake curve or rate recorded for this variety, since information gathered during plant growth


Received: 16 February 2025
Accepted: 27 February 2025

comprise plants' nutritional requirements at different phenological stages and indicate the times when plants' mostly demand nutrient addition. However, it is important pointing out that the amount of nutrient uptake and proportionality are determined by some intrinsic plant features, as well as by external factors conditioning the uptake process, such as climatic conditions endured by plants throughout the cultivation cycle (Purquerio, 2016). Thus, it is necessary conducting scientific investigations to help better understanding the nutritional needs of, and fertilizer management indications for, this hybrid in Southern Brazil.

The aim of the current study was to determine shoot and fruit dry mass, as well as nutrient accumulation in 'Coronel' hybrid tomato leaves, stems and fruits throughout its production cycle.

**Materials and Methods**

Experiment was carried out in Caçador County, Santa Catarina State, Brazil. The soil at the experimental site was classified as Dystrophic Bruno Nitosol (Santos et al., 2018); it presented the following features in the 0-20 cm layer: 50% clay, 5.1 pH in water, 3.7% MO, 5.2 mg $dm^{-3}$ P Mehlich-1, 412 .0 mg $dm^{-3}$ K Mehlich-1, 5.8 $cmol_c$ Ca $dm^{-3}$, 2.1 $cmol_c$ Mg $dm^{-3}$, CEC pH 7.0 12.93 $cmol_c$ $dm^{-3}$.

The experiment has followed a randomized block design, with 4 replicates. Treatments comprised 10 different sampling dates (14, 28, 42, 56, 70, 84, 98, 112, 126 and 140 days after planting). Five plants were analyzed in the first three assessments, whereas three plants were analyzed in the other ones. Fertilization was carried out in compliance with Becker et al., (2016), based on using 550, 800 and 400 kg $ha^{-1}$ of N, $P_2O_5$ and $K_2O$, respectively. Half of P was applied to the total area and incorporated in the 20-cm soil layer before the black oat as previous crop; the other half of it was applied, in its triple superphosphate form, in the tomato-planting furrow. The N source was ammonium nitrate and K source was potassium chloride; they were both applied through drip irrigation system. Fertigation was carried out once a week and managed with the aid of tensiometers; the amount of water to be used was calculated based on crop's evapotranspiration.

Seedlings were transplanted into furrows in area managed through no-tillage system over black oat straw. Plants were conducted with the aid of two stems and vertically tutored with bamboo. Tomatoes were grown in double rows, at the following spacing: 1.0 m between rows, 0.6 m between plants and 2.0 m between double-rows; it totaled 11,111 plants $ha^{-1}$.

Plant height, stem diameter, number of leaves, number and fresh mass of green and ripe fruits were assessed at each sampling date. Total, commercial (extra AA and extra A) and non-commercial yields were assessed, as well as mean commercial fruit mass (extra AA and extra A). Extra AA fruits were the ones whose mass was higher than 150 g, whereas extra A fruits were the ones whose mass ranged from 100 g to 150 g. Fruits presenting physiological anomalies, phytopathological diseases, damage caused by insect pests and small fruits, i.e., those whose mass was lower than 100 g, were considered non-commercial. Harvests were carried out once or twice a week, depending on fruits' harvesting point. Harvested fruits' mass value was added to the fruit mass value recorded for plants assessed every 14 days, for extracted nutrients' calculation purposes.

Leaf, stem and fruit dry mass was assessed after drying in oven at 65°C. Nutrient contents in different plant organs were determined, based on Tedesco et al. (1995). Nutrient content results were multiplied by stem, leaf and fruit dry mass in order to find the amount of nutrients accumulated in different tomato plant parts, in each sampling date.

Data were subjected to ANOVA, based on interaction between 10 collection times and three plant parts. Non-linear regression models were tested (Gaussian, Sigmoidal, Logistics and Lorentzian) based on the application of Akaike Information Criteria (AIC); the most appropriate model was the one recording the lowest AIC value. Diagnostic analysis was performed to check likely trends or lack of fit by the adopted models. The R software, version 3.0.3 (R CORE TEAM, 2022), was used for statistical analyses, at 5% significance level.

**Results and Discussion**

Growth variables were recorded over 140 DAT (**Table 1**). The apical pruning of the two stems was carried out at 112 DAT, when they had already passed the limit of the driving system (wire). It was done to enable a large number of racimes, which reached 17, at most. Maximum height (2.36 m) and maximum number of leaves (55.67) were observed at 112 DAT; however, the number of leaves decreased from that day onwards due to the senescence of the first leaves. Stem diameter reached its maximum value (19.0 mm) at 126 DAT. Shoot fresh mass (leaves+steams) recorded its maximum value (approximately 3.0 kg $plant^{-1}$) at 98 DAT.

Fruit fresh mass reached 14.17 kg $plant^{-1}$ at 140 DAT. If one takes into consideration the population of 11,111 plants $ha^{-1}$, this value corresponds to commercial fruit yield of 157.44 t $ha^{-1}$, or to the equivalent of 644.1 boxes per thousand plants. Tomato yield observed in the

**Table 1.** Stem diameter, height, number of leaves and racimes, shoot (stems+leaves), fruit and total fresh and dry mass, in 'Coronel' hybrid tomatoes, based on days after transplanting (DAT).

| DAT | Stem diameter | Height | Number | | ----- Fresh mass ------ | | | ----- Dry mass ----- | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Leaves | Racemes | Shoot | Fruits | Total | Shoot | Fruits | Total |
| | mm | m | --- | --- | ------------------------- g.plant$^{-1}$ | | | ---------------------- | | |
| 14 | 6.20 | 0.13 | 6.19 | 5 | 43.9 | 0.0 | 43.9 | 5.6 | 0.0 | 5.6 |
| 28 | 9.32 | 0.50 | 16.45 | 10 | 223.7 | 0.0 | 223.7 | 21.1 | 0.0 | 21.1 |
| 42 | 11.63 | 1.03 | 27.67 | 12 | 948.3 | 357.5 | 1,305.8 | 106.3 | 22.5 | 128.8 |
| 56 | 16.17 | 1.62 | 37.58 | 14 | 2,137.5 | 1,372.5 | 3,510.0 | 219.6 | 59.0 | 278.7 |
| 70 | 15.17 | 1.83 | 43.25 | 16 | 2,179.2 | 3,063.3 | 5,242.5 | 281.7 | 159.6 | 441.3 |
| 84 | 16.33 | 2.09 | 49.83 | 16 | 2,518.3 | 6,132.9 | 8,651.2 | 283.5 | 297.9 | 581.4 |
| 98 | 17.88 | 2.22 | 54.42 | 17 | 2,917.5 | 9,152.5 | 12,070.0 | 353.0 | 447.6 | 800.6 |
| 112 | 18.54 | 2.36 | 55.67 | 17 | 2,910.8 | 13,654.2 | 16,565.0 | 340.0 | 645.9 | 985.9 |
| 126 | 19.00 | 2.34 | 46.67 | 17 | 2,725.0 | 13,358.4 | 16,083.4 | 355.6 | 713.1 | 1,068.7 |
| 140 | 16.79 | 2.36 | 43.50 | 17 | 2,571.7 | 14,169.1 | 16,740.8 | 340.3 | 707.4 | 1,047.7 |

present study can be considered excellent. It was far higher than Brazil's mean yield, which is approximately 72 t ha$^{-1}$, although Brazil accounts for the third largest tomato yield in world, it is right behind the United States and Spain - 98.04 t ha$^{-1}$ and 87.82 t ha$^{-1}$, respectively (FAO, 2019). Based on other studies focused on investigating nutrient uptake by tomato plants, cv. Santa Clara and EF-50 hybrid tomatoes grown in protected environment recorded lower yields - 88.6 t ha$^{-1}$ and 109.0 t ha$^{-1}$, respectively (Fayad et al., 2002). On the other hand, more recent studies recorded yields for 'Dominador' and 'Serato' hybrids that were much higher than, and close to, the one recorded in the current study - 131.9 t ha$^{-1}$ and 158.7 t ha$^{-1}$, respectively (Purquerio et al., 2016); other studies recorded 148.5 t ha$^{-1}$, for 'Gault' hybrids; and 122.6 t ha$^{-1}$, for 'Pomerano' (Moraes et al., 2018). The high performance observed in the present study has evidenced improved plant management and genetic evolution of hybrids currently available in the market.

The lowest AIC value recorded for the sigmoidal model explains the shoot dry mass (**Figure 1**a) and macro (Figure 1b) and micronutrient (macro (Figure 1c) accumulation in "Coronel' tomato plants, as also reported by Carvalho et al. (2020). Fruits accounted for 67.5% of the

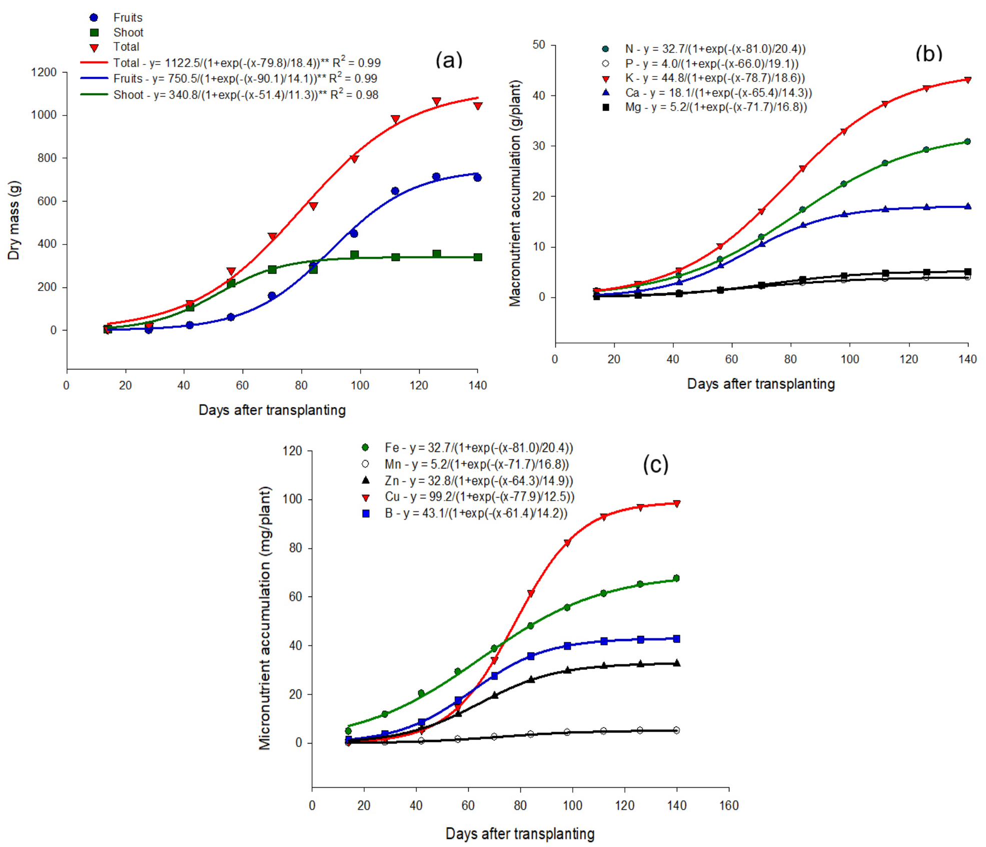


**Figure 1.** Fruit, shoot (leaves+rods) and total dry mass (a) and macronutrient (b) and micronutrient (c) accumulation in 'Coronel' hybrid tomato plants, based on days after transplanting.

total dry mass observed at the end of 'Coronel' growth cycle (Figure 1a). Similar values were recorded for 'Gault' and 'Pomerano' hybrids – 72% and 66%, respectively (Moraes et al., 2018). Dry mass distribution among plant organs plays important role in crop yield, since cultivation performance depends on harvesting organs' ability to accumulate biomass (Ronga et al., 2019). These findings also corroborate the great genetic capacity of current tomato hybrids to produce marketable fruits.

Plant shoot (leaves+stems) reached maximum dry mass at approximately 80 DAT; it remained stable until the end of the tomato assessment cycle (Figure 1a). Fruit and total dry mass, in their turn, have reached the peak at 140 DAT. Carbohydrates, as well as other organic and mineral compounds, were translocated from leaves to fruits, at the beginning of plants' reproduction process (Grangeiro & Cecílio Filho, 2005). Thus, fruits turned into the largest nutrient drain at 87 DAT, when fruit dry mass got higher than that of shoot.

Total macro- (**Figure 2**a) and micronutrient (Figure 2b) accumulation per plant was calculated by multiplying nutrient contents in tomato leaves (**Table 2**), steam (**Table 3**) and fruits (**Table 4**) by the available dry mass of these parts. Potassium (K) was the nutrient mostly accumulated (43.2 g plant$^{-1}$) at 140 DAT; it was followed by N (30.8 g plant$^{-1}$), Ca (18.0 g plant$^{-1}$), Mg (5.1 g plant$^{-1}$) and P (3.9 g plant$^{-1}$).

The most accumulated micronutrients (Figure 2b) were Cu (98.5 mg plant$^{-1}$), Mn (91.7 mg plant$^{-1}$), Fe (67.5 mg plant$^{-1}$), B (42.9 mg plant$^{-1}$) and Zn (32.6 mg plant$^{-1}$). The multiplication of the number of plants per hectare (11,111 plants) by the number of total nutrients accumulated per plant resulted in total nutrient accumulation per hectare. Nutrient amounts are herein presented in descending order, as follows: macronutrients - K (480.2 kg ha$^{-1}$), N (342.4 kg ha$^{-1}$), Ca (199.9 kg ha$^{-1}$), Mg (57.0 kg ha$^{-1}$) and P (43.6 kg ha$^{-1}$); micronutrients - Cu (1,094.1 g ha$^{-1}$), Mn (1,018.7 g ha$^{-1}$), Fe (750.2 g ha$^{-1}$), B (476, 6 g ha$^{-1}$) and Zn (362.5 g ha$^{-1}$). Moraes et al. (2018) recorded similar results, in decreasing order, for nutrient accumulation in tomato shoot: K, N, Ca, S, Mg, P, Mn, Fe, Cu, Zn and B reached maximum values of 402.3 kg ha$^{-1}$, 215.3 kg ha$^{-1}$,135.9 kg ha$^{-1}$, 41.8 kg ha$^{-1}$, 40.0 kg ha$^{-1}$, 27 kg ha$^{-1}$; 971.6 g ha$^{-1}$, 824.4 g ha$^{-1}$, 612.4 g ha$^{-1}$ and 301.3 g ha$^{-1}$ for cultivar 'Gault', respectively; as well as 397.8 kg ha$^{-1}$, 208.5 kg ha$^{-1}$, 115.0 kg ha$^{-1}$, 41.8 kg ha$^{-1}$, 42.8 kg ha$^{-1}$, 29.7 kg ha$^{-1}$,1,182.8 g ha$^{-1}$; 1,055.1 g ha$^{-1}$; 534.6 g ha$^{-1}$ and 278.0 g ha$^{-1}$ for cultivar 'Pomerano', respectively.

Measuring macro- (Figure 2a) and micronutrient (Figure 2b) accumulation rate at 14-day intervals

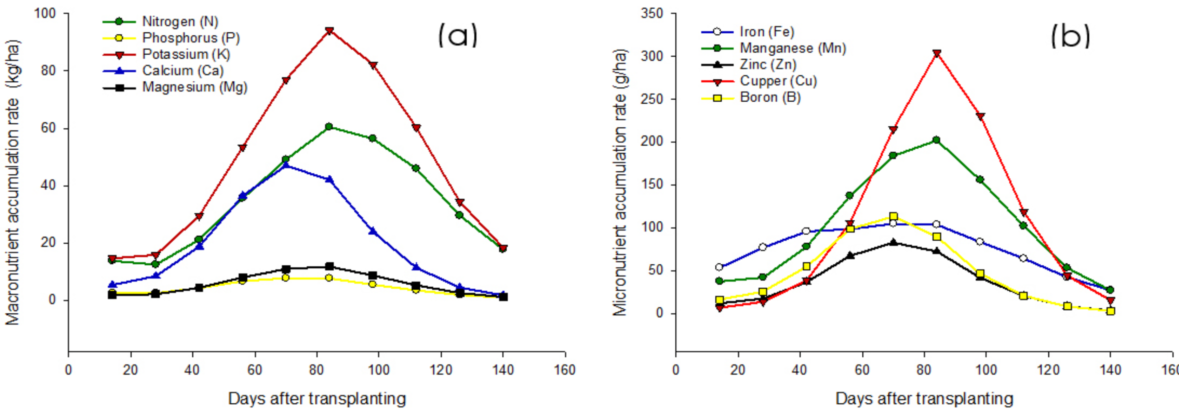


**Figure 2.** Macronutrient (a) and micronutrient (b) accumulation rate, every 14 days, in 'Coronel' hybrid tomato plants, based on days after transplanting.

**Table 2.** Nutrient contents in 'Coronel' tomato leaves, based on days after transplanting – DAT.

| DAT | N | P | K | Ca | Mg | Fe | Mn | Zn | Cu | B |
|---|---|---|---|---|---|---|---|---|---|---|
| | g kg$^{-1}$ | | | | | mg kg$^{-1}$ | | | | |
| 14 | 40.7 | 7.8 | 35.8 | 28.1 | 7.9 | 197.4 | 134.7 | 32.7 | 154.4 | 272.4 |
| 28 | 51.7 | 9.3 | 38.8 | 37.2 | 9.1 | 597.7 | 66.9 | 33.9 | 67.6 | 124.5 |
| 42 | 41.0 | 6.4 | 34.5 | 36.5 | 8.3 | 343.3 | 71.9 | 26.8 | 52.1 | 108.1 |
| 56 | 36.4 | 4.6 | 39.4 | 36.2 | 7.4 | 570.2 | 173.0 | 63.0 | 89.0 | 81.5 |
| 70 | 31.0 | 4.5 | 36.1 | 44.9 | 8.2 | 121.4 | 197.5 | 55.6 | 172.2 | 90.5 |
| 84 | 31.9 | 3.5 | 34.0 | 44.0 | 9.4 | 171.7 | 250.8 | 59.9 | 274.2 | 130.7 |
| 98 | 29.9 | 4.0 | 34.6 | 53.9 | 9.0 | 181.8 | 227.2 | 52.9 | 338.0 | 118.8 |
| 112 | 29.0 | 3.8 | 34.6 | 52.1 | 8.7 | 167.0 | 239.3 | 60.5 | 347.8 | 113.0 |
| 126 | 29.4 | 4.0 | 31.2 | 51.9 | 9.0 | 200.8 | 291.3 | 52.5 | 407.3 | 123.3 |
| 140 | 29.9 | 3.5 | 32.0 | 51.6 | 8.9 | 174.8 | 303.0 | 47.3 | 389.0 | 96.3 |

**Table 3.** Mean nutrient content in 'Coronel' tomato stems, based on days after transplanting (DAT).

| DAT | N | P | K | Ca | Mg | Fe | Mn | Zn | Cu | B |
|---|---|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ | | | | | mg $kg^{-1}$ | | | | |
| 14 | 29.8 | 7.9 | 73.2 | 15.8 | 8.1 | 273.8 | 50.3 | 53.5 | 67.3 | 120.9 |
| 28 | 32.5 | 9.3 | 63.8 | 11.5 | 5.5 | 528.8 | 26.5 | 47.6 | 20.5 | 79.3 |
| 42 | 25.9 | 7.8 | 52.4 | 11.4 | 4.9 | 128.8 | 40.7 | 50.4 | 15.2 | 36.4 |
| 56 | 20.4 | 6.5 | 48.2 | 9.8 | 4.3 | 48.7 | 74.5 | 55.2 | 15.6 | 32.4 |
| 70 | 16.6 | 4.9 | 43.5 | 15.4 | 4.8 | 30.6 | 63.5 | 45.7 | 23.8 | 31.4 |
| 84 | 15.5 | 3.2 | 40.2 | 16.5 | 5.1 | 50.9 | 63.5 | 52.3 | 29.2 | 32.3 |
| 98 | 14.7 | 3.5 | 41.1 | 18.0 | 6.0 | 46.2 | 89.0 | 55.8 | 29.9 | 29.4 |
| 112 | 14.4 | 3.0 | 40.0 | 22.5 | 6.2 | 48.9 | 83.3 | 50.6 | 20.6 | 27.6 |
| 126 | 13.3 | 3.1 | 38.8 | 25.8 | 5.2 | 42.9 | 76.0 | 58.6 | 21.5 | 22.1 |
| 140 | 12.2 | 3.0 | 39.9 | 29.3 | 5.0 | 37.0 | 77.5 | 56.2 | 22.9 | 19.2 |

**Table 4.** Mean nutrient content in 'Coronel' tomato fruits, based on days after transplanting (DAT).

| DAT | N | P | K | Ca | Mg | Fe | Mn | Zn | Cu | B |
|---|---|---|---|---|---|---|---|---|---|---|
| | g $kg^{-1}$ | | | | | mg $kg^{-1}$ | | | | |
| 14 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 28 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 42 | 34.5 | 8.5 | 39.4 | 3.6 | 2.6 | 75.1 | 55.0 | 33.3 | 15.2 | 45.9 |
| 56 | 34.9 | 9.3 | 41.5 | 3.3 | 2.9 | 55.4 | 30.6 | 35.7 | 13.6 | 48.9 |
| 70 | 28.3 | 6.5 | 48.1 | 3.5 | 3.2 | 16.7 | 26.1 | 26.7 | 11.0 | 39.8 |
| 84 | 29.7 | 4.9 | 43.8 | 4.0 | 3.4 | 19.1 | 21.2 | 24.9 | 10.3 | 24.7 |
| 98 | 29.5 | 4.4 | 42.3 | 4.1 | 3.5 | 25.3 | 21.9 | 24.3 | 10.6 | 23.8 |
| 112 | 30.4 | 4.0 | 43.3 | 4.2 | 3.3 | 25.2 | 23.5 | 20.4 | 10.8 | 22.5 |
| 126 | 28.3 | 3.8 | 42.4 | 4.1 | 3.4 | 28.8 | 22.5 | 19.6 | 9.5 | 21.6 |
| 140 | 32.3 | 3.7 | 42.5 | 4.1 | 3.4 | 30.1 | 27.4 | 20.6 | 10.5 | 20.1 |

enabled identifying the crop growth periods demanding the highest nutrient amounts. The period recording the highest accumulation rate changed depending on the assessed nutrient. High demand for K and N in the mid-third of 'Coronel' growth cycle stood out for its uptake peak at 84 DAT, which matched the period of maximum fruit filling. This period recording the highest nutrient uptake rate comprised similar number of days to that observed by Silva (2017), according to whom, N, P, K, Ca, Mg and S in 'Minotauro' cultivar have reached peak nutrient uptake at 89, 92, 93, 77, 73 and 77 DAT, respectively. Nutrients such as Ca, P, Fe, Zn and B have reached the highest accumulation rate earlier, at 70 DAT.

The main reason for determining tomato hybrid's nutrient uptake rate is to guide technicians and producers on fertilization recommendations. Thus, the current study provided important information about 'Coronel' hybrid tomatoes' nutrient uptake rate, which can be widely applied by technicians and producers in Southern Brazil, since this cultivar accounts for 80% of the area planted with salad tomatoes in this region. Based on results recorded for dry mass and nutrient accumulation rates in the present research, it is possible recommending fertilizer applications, based on the need of 'Coronel' plants, in order to reach high yield of high-quality fruits, as well as to provide greater profitability for tomato growers. In order to do so, it is necessary taking into consideration efficiency indices recorded for nutrients applied via

**Table 5.** N, $P_2O_5$, $K_2O$, Ca and Mg amounts to be provided to 'Coronel' hybrid tomato plants, every 14 days after transplanting (DAT), in a population of 11.111 plants $ha^{-1}$.

| DAT | N | $P_2O_5$ | $K_2O$ | Ca | Mg |
|---|---|---|---|---|---|
| | kg $ha^{-1}$ | | | | |
| 1 (14) | 17.3 | 17.1 | 22.0 | 10.8 | 3.6 |
| 2 (28) | 15.6 | 16.7 | 23.8 | 17.1 | 4.5 |
| 3 (42) | 26.5 | 28.0 | 44.2 | 37.6 | 8.7 |
| 4 (56) | 44.5 | 43.6 | 80.2 | 73.0 | 16.0 |
| 5 (70) | 61.3 | 51.2 | 115.4 | 94.1 | 22.0 |
| 6 (84) | 75.6 | 50.1 | 141.3 | 84.2 | 23.7 |
| 7 (98) | 70.4 | 36.1 | 123.5 | 47.8 | 17.3 |
| 8 (112) | 57.4 | 23.1 | 90.5 | 22.9 | 10.6 |
| 9 (126) | 37.0 | 12.3 | 51.6 | 9.0 | 5.2 |
| 10 (140) | 22.3 | 6.4 | 27.7 | 3.6 | 2.4 |
| **Total** | 427.8 | 284.6 | 720.3 | 400.0 | 114.0 |

fertilizers. The present study adopted the following indices: 80% for N, 80% for K, 35% for P, and 50% for Ca and Mg. Furthermore, P should to be converted into $P_2O_5$ by multiplying P by 2.29, whereas K should be converted into $K_2O$ by multiplying K by 1.2. **Table 5** presents the N, P, K, Ca and Mg amounts to be supplied to 'Coronel' hybrid tomatoes, every 14 days.

## Conclusions

Shoot and fruit dry mass have reached maximum accumulation value at 80 and 140 DAT, respectively. Potassium (K) was the most accumulated macronutrient (480.2 kg $ha^{-1}$) in the tomato population of 11,111 plants $ha^{-1}$; it was followed by N (342.4 kg $ha^{-1}$), Ca (199.9 kg $ha^{-1}$), Mg (57.0 kg $ha^{-1}$) and P (43.6 kg $ha^{-1}$). On the other hand, Cu (1094.1 g $ha^{-1}$) was the most accumulated micronutrient; it was followed by Mn (1,094.1 g $ha^{-1}$), Fe (1,094.1 g $ha^{-1}$), B (476.6 g $ha^{-1}$) and Zn (362.5 g $ha^{-1}$).

**References**

Becker, W.F., Wamser, A.F., Feltrim, A.L., Suzuki, A., Santos, J.P., Valmorbida, J., Hahn, L., Marcuzzo, L.L., Mueller, S. et al. 2016. *Sistema de Produção Integrada para o tomate tutorado em Santa Catarina*. Epagri, Florianópolis, SC. 149p.

Carvalho, D.B.M., Souza, A.V., Domingues Neto, F.J., Iglesias, L., Nogueira, B.B., Zanetti, W.A., Gabriel Filho, L.R.A., Putti, F.F. 2020. Growth models and nutrient uptake curve of tomato BRS 1509 subjected to irrigation pulses. *Journal of Plant Nutrition* 43: 1999-2012.

FAO. FOOD AND AGRICULTURE ORGANIZATION. 2019. http://www.fao.org/faostat/en/#data/QC/visualize / <Access on 18 Jun. 2021>

Fayad, J.A., Fontes, P.C.R., Cardoso, A.A., Finger, F.L., Ferreira, F.A. 2002. Absorção de nutrientes pelo tomateiro cultivado sob condições de campo e de ambiente protegido. *Horticultura Brasileira* 20: 90-94.

Glanz-Idan, N., Wolf, S. 2020. Upregulation of photosynthesis in mineral nutrition-deficient tomato plants by reduced source-to-sink ratio. *Plant Signaling & Behavior* 15: 1-4.

Grangeiro, L.C., Cecílio Filho, A.B. 2005. Acúmulo e exportação de macronutrientes em melancia sem sementes. *Horticultura Brasileira* 23: 763-767.

HORTIFRUTI BRASIL. 2024. Custo de produção de tomate em Caçador - SC, pequena e larga escala. *Cepea-Esalq/USP-SP* 245, 38p.

Labate, J.A., Breksa, A.P., Robertson, L., King, B.A. 2018. Genetic differences in macro-element mineral concentrations among 52 historically important tomato varieties. *Plant Genetic Resources* 16: 343–351.

Moraes, C.C., Factor, T.L., Araújo, H.S., Purquerio, L.F.V. 2018. Plant growth and nutrient accumulation in two tomato hybrids under tropical conditions. *Australian Journal of Crop Science* 12: 1419-1425.

Purquerio, L.F.V. 2016. *Absorção de nutrientes pelo híbrido de tomate Arendell*. Campinas: IAC.

R CORE TEAM. R: A language and environment for statistical computing. R Foundation for Statistical Computing. 2022. https://www.R-project.org/ / <Access on 23 Nov. 2022>

Ronga, D., Parisi, M., Pentangelo, A., Mori, M., Di Mola, I. 2019. Effects of Nitrogen Management on Biomass Production and Dry Matter Distribution of Processing Tomato Cropped in Southern Italy. *Agronomy* 9: 855.

Santos, H.G., Jacomine, P.K.T., Anjos, L.H.C., Oliveira, V.A., Oliveira, J.B., Coelho, M.R., Lumbreras, J.F., Cunha, T.J.F. 2018. *Sistema brasileiro de classificação de solos*. Embrapa Solos, Rio de Janeiro, Brasil. 356p.

Silva, B.F.I. 2017. *Acúmulo de nutrientes ao longo do ciclo por tomateiros do grupo salada*. 66 p. Dissertação (Mestrado em Agricultura Tropical e Subtropical), Curso de Pós-Graduação em Agricultura Tropical e Subtropical, Instituto Agronômico de Campinas, Campinas, Brazil.

Tedesco, M.J., Gianello, C., Bissani, C.A., Bohnen, H., Volkweiss, S.J. 1995. *Analysis of soil, plants and other materials*. UFRGS/Departamento de Solos, Porto Alegre, RS. 147 p.

**Conflict of Interest Statement:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.