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Establishing diagnosis and recommendation integrated system (DRIS) for industrial use of tomato

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Abstract

This study aimed to establish DRIS norms for industry tomato plants cultivated in Goiânia city (Goiás State, Brazil). The soil was prepared by one plowing and one disk harrow leveling. Chemical analysis of nutrients were done the fourth leaf from the apex of the stems of plants. The diagnostic leaves were collected at 64 days after transplant. The levels of NH_4^+, $H_2PO_4^-$, K^+, Ca^{2+}, Mg^{2+}, SO_4^{2-}, $H_3BO_3^-$, Cu^{2+}, Fe^{2+}, Mn^{2+} and Zn^{2+} present in the leaves were evaluated in 25 genotypes of industrial tomato. Two levels of tomato yield were used for establishing a database with all binary relationships among all nutrients studied up to 48 t ha^{-1} of tomato fruits. The averages for each concentration of nutrient were calculated and they were used in each genotype. The nutrutional content of each nutrient and the nutrient balance index (IBN) of each production level were calculated. The industrial tomato genotypes differ in nutrient absorption efficiency. The deficiency order to high yield group plants (> 48 t ha^{-1}) was P > N > Mn > Ca > K > B > Zn > Cu > N > Mg > S The deficiency order to low yield group plants (< 48 t ha^{-1}) was S > Fe > Cu > Zn > K > N > P > Mn > Mg > Ca > B. The CVR 1 inbred lines, CVR 3, CVR 4, CVR 5, CVR 21 and CVR 22 are productive and efficient in the absorption of N, P and K.

Keywords: foliar diagnosis; industrial; nutrient; productivity; *Solanum lycopersicum* L.
Abbreviations: B _boron, Ca_calcium, Cu_copper, Fe_iron, K_potassium, Mg_magnesium, Mn_manganese, N_Nitrogen, P_ phosphorus, S_sufur and Zn _ zinc.

Introduction

The tomato is the second most produced vegetable crop in the world (Barankevicz et al., 2015). It is a culture of great nutritional and social importance mainly due to its source of natural antioxidant compounds (Ilahy et al., 2011) and the creation of jobs directly and indirectly responsible for the income of many families involved in production process (Alvarenga, 2013). Brazil ranks fourth in the world ranking of tomato production with a production of about 4.2 million tons per year. The average productivity of tomato in the country in 2015 was 63.75 t ha^{-1} (Agrianual, 2016). The economic importance of culture in light of high growth of population, climate and environmental change is necessary to study genotypes to identify features of interest to form hybrids that are able to adapt to climate and soil conditions of each region of Brazil.

The formation of tomato hybrids that add desirable characteristics to the producer, the processing industry and consumers as higher quality fruit, high yield, disease and pest resistance is possible by introducing new genes that condition such characteristics. For this, breeding is necessary to obtain new genotypes (Shah et al., 2015). Intrinsic factors of the plant as genetics, species, cultivar, efficiency of absorption of nutrients to pests and diseases, allelopathy, interaction with invasive plants and management directly influence the productivity of fruits and consequently on economic return of tomato production (Novais et al., 2007). Mineral nutrition is associated with factors such as adaptability of species to climate and soil conditions of the region and crop management practices (Fontes, 2014)

Information about nutrient absorption process of a species or cultivar plants provides subsidies for proper crop management, the peaks in demand by the plants and the relative proportion between the nutrients and dry matter accumulation. The periods of maximum absorption and the requirement of crops for nutrients cannot be inferred only by the full extraction, and it is necessary to study the nutrient uptake in function of plants cycle, to predict when and how much fertilizer should be applied (Duarte et al., 2003; Martinez et al., 2006). The use of leaf analysis as a diagnostic criterion is based on the premise that there is a relationship between the supply of nutrients and levels of the concentrations in relation to higher or lower yields. However, the nutritional assessment of the objective plant nutrients that are identified limits deficiency and toxicity, which limits the production of crops. For tissue analysis plants, normally visual inspection of the leaf or chemical analysis can be done by taking a single nutrient through the critical level method sufficiency range procedure or, alternatively, based on the ratio of nutrients made by the DRIS (Integrated Diagnosis and Recommendation) method (Orlando Filho and Zambello, 1983). The DRIS method evaluates the nutritional status of the plants considering the balance among nutrients, so that a nutritionally balanced culture can respond with high productivity, which does not happen in conditions of deficiency or nutritional imbalance (Sumner, 1999). The DRIS method can identify some cases where production is limited by nutritional imbalance, even when the content of any of nutrients is below its critical level (Baldock and Schulte, 1996).

Thus, there are several alternatives that can be used, preferably in an integrated manner, to the knowledge of the soil-plant system with sufficient nutrient levels for adoption of more efficient fertilization practices.

In this context, this study aimed to quantify the foliar nutrient content and the establishment of DRIS for twenty five genotypes of industrial tomato. It is hoped that this work identify the order of nutritional limitation and check the efficiency of nutrient absorption of the analyzed lines. These can be used to post for training commercial hybrids of certain tomatoes.

Results and Discussion

The absolute foliar standards for industry tomatoes genotypes which showed higher production (> 48 t ha^{-1}) and lower production (< 48 t ha^{-1}) (Table 1). The high and low production levels showed appropriate foliar nutrients: nitrogen (N), phosphorus (P), potassium (K), boron (B), iron (Fe), manganese (Mn) and zinc (Zn) with the standards established by Silva et al. (2012). As for the same authors the foliar standards nutrients, calcium(Ca), magnesium (Mg) and copper (Cu) were above and sulfur (S)was below the existing standards.

The lowest prodution group showed an excess in the micronutrients standards. The absolute contents of nutrients obtained were associated with peculiar variables of genotypes. The foliar standards proposed by Silva et al. (2012) were chosen in this study for industry tomatoes, which have higher nutritional requirement than tomatoes for fresh consumption. The Ca, Mg and Cu content levels in the soil were higher than appropriate as proposed by Alvarez et al. (1999). For the Ca and Mg levels,probably these nutrientes were available in soil before lime application (Table 2).The lime application was carried out to minimize the exchangeable acidity (H^+ + $Al^{+\ 3}$) and this increased the base saturation to 80%.

The S present content in the soil was 3.4 mg dm^{-3}, considered low (Table 2). Tomato leaves showed higher than appropriate foliar nutrient levels (Table 1). The use of formulated fertilizers (NPK) normally used by farmers has shown low S levels (Silva et al., 2012). A probable explanation is that the ammonium sulfate used in topdressing did not supply the demand of plants. In nine genotypes in yield above 48 t ha^{-1}, diagnosis through the DRIS index (Table 3) showed that approximately 66% of these genotypes had S deficiency and 31% had an excess of P and K. In the low productivity group consisting of 16 genotypes, 75% of those had K deficiency and 56% had an excess of S, showing that the genotypes differ in efficiency in the absorption of nutrients. Moreover, sulfur is an element of low mobility inside the plant.

The composition of fertilizers, in the last two decades, has changed to high-analysis and S-free products, crop production intensified, and SO_2 emissions decreased, S defiiency have become serious problem. Sulfur deficiency is often confused with other deficient element such as N. Adding S to the fertilization programs, regardless of S sources, increased tomato uptake of this nutrient (Santos et al., 2007).

Foliar macronutrient in groups of high and low productivity

Negative values in the DRIS index indicate nutrient deficiency, while positive values are related to excess nutrient. The closer the DRIS index is to zero the nutrient is in balance in the plant (Silva and Rodrigues, 2013). The larger the negative value the higher is the deficiency and the higher the positive value greater excess nutrient. There is variation between the positive and negative indices of macronutrients in tomato leaves genotypes. The Kátia tomato hybrid showed higher productivity in high production group (64.43 t ha^{-1}). This hybrid deficient was deficient for P, K, Ca; excess for N and better balanced for magnesium (0.5). The CRV22 genotype showed better balance for sulfur (-0.1) (Table 3).

In the high yield group it was found that potassium was in excess. The CRV3 had high potassium levels (21.0). Phosphorus was the macronutrient that was most limited in the high yield group. DRIS index for phosphorus (16.8) observed in CVR 3 in the high yield group productivity showed deficiency (Table 3).

The P content present in the soil before planting the tomato crop was considered very good (Tabela 2) (Alvarez et al., 1999). This nutrient is removed from the soil in lesser amounts when compared to the other nutrients. Its accumulation varies among other factors, with the plant developmental stage and the cultivate. The collection of leaves for leaf analysis was performed at the time of flowering. In the reproductive stage the nutrients N, P, K and Mg present intense translocation of the vegetative organs to reproductive (Bastos et al., 2013). This accounts for the lower amount of phosphorus observed in the leaves of the high yield group.

In the low productivity group, it was found that the CVR9 showed higher and lower sulfur deficiency to CVR9 and CRV6 with index values (34.7) and (-50.5), respectively (Table 3). The CVR6 showed the low fruits yield 33,89 t ha^{-1}; Ca, Mg and S had deficiency levels and N, P and K were in excess in the leaves. In this group the nutrient balance showed greater potassium (0.5) and magnesium (-0.4) in CVR8 and calcium (-0.1) in CVR11 (Table 3).

Foliar micronutrient groups of high and low productivity

In the high yield group,the micronutrients index for boron was found (Table 4) to have a better balance boron value (-0.4) in the CVR1 line. Generally, the genotypes of low yield group observed were better in the boron and iron index (-0.1 and 0.4, respectively) in th CVR 16 line with an upper index (-0.3) and manganese index inCRV18 (Table 4).

The micronutrient excess in high yield genotypes group was manganese with DRIS index (16.70). The Katia hybrid showed deficiency of B and Fe. The most limiting micronutrient was iron (-18.20) to CRV21 line (Table 4). The genotypes that presented low productivity had the manganese micronutrient in excess whose higher DRIS index was (22.0) in CVR 9. The most limiting micronutrient was copper, with the DRIS index (-26.6) in CRV15. The lowest productivity was in CRV6 that showed deficiency in Mn and Zn, B, Cu, Fe in excess.

Table 1. Average values of nutrients in tomato leaves in samples yielding higher than 48 t ha^{-1} and less than 48 t ha^{-1}.

Yield	N	P	K	Ca	Mg	S	B	Cu	Fe	Mn	Zn
	g kg^{-1}						mg kg^{-1}				
					High of 48 t ha^{-1}						
54.58	30.83	2.88	30.47	41.01	10.32	0.79	31.40	42.61	572.58	109.86	39.77
					Less of 48 t ha^{-1}						
41.47	30.65	2.84	28.54	42.58	10.76	0.86	32.24	42.64	576.30	118.86	41.65

Table 2. Soil analysis of experimental área in depth 0-20cm.

pH $CaCl_2$	Ca	Mg	Al	P (Melich^{-1})	K	H+Al	T	V	m	MO
	-------cmol$_c$dm^{-3}------			-------mg dm^{-3}------		--cmol$_c$dm^{-3}---		-----%-----		g dm^{-3}
5.6	3.9	1.4	0.0	19.4	155	2.6	8.33	68.74	0.0	22.0

	Micronutrients					
S	Na	Zn	B	Cu	Fe	Mn
---------------------------------mg dm^{-3}----------------------------------						
3.4	6.0	8.7	0.23	4.1	41.7	25.1

P and K- Mehlich^{-1} (HCl 0,05 mol L^{-1}; + H_2SO_4) 0,025 mol L^{-1}); Ca, Mg e Al – KCl 1 mol L^{-1}; T-CTC potencial (pH 7,0); V- base saturation; MO - Organic matter).

Table 3. Application of DRIS in samples yielding higher than (> 48 t ha^{-1}) and yielding less (< 48 t ha^{-1}).

				Yield > 48 t ha^{-1}			
Genotypes	Yield	N	P	K	Ca	Mg	S
	t ha^{-1}			g kg^{-1}			
Kátia	64.43	5.5	-0.8	-1.6	-10.6	0.5	-3.6
CVR 3	58.18	16.0	5.5	21.0	-11.7	-1.0	-3.7
CVR 1	56.43	-2.1	4.7	1.1	1.5	1.5	2.6
CRV 22	55.39	-9.9	-16.8	-1.1	6.1	-3.0	-0.1
AP- 533	55.34	5.2	-6.2	-12.4	9.8	14.2	-9.2
SVR – 0453	52.02	-2.7	4.3	-8.4	11.8	-1.3	-2.3
CRV 21	51.04	3.9	-9.7	2.2	-0.1	4.4	14.0
CRV 4	49.62	-3.2	6.0	1.9	-4.1	-14.6	8.4
CVR 5	48.79	-5.8	7.9	4.5	-6.1	-3.1	-5.5
				Yield < 48 t ha^{-1}			
CRV 16	47.68	4.0	-2.1	-1.0	2.4	4.9	11.5
CRV 8	46.54	0.7	-3.2	0.5	-8.3	-0.4	-6.7
CRV 18	46.06	-4.0	-15.7	-16.2	6.8	-2.5	20.4
CRV 15	43.89	-4.5	-4.7	-15.2	13.7	21.7	15.5
CRV 11	42.93	-1.9	-5.2	-1.8	-0.1	-2.5	19.4
CRV 10	42.93	-1.5	-7.7	-12.3	8.9	8.5	26.0
CRV 14	42.52	-5.5	-11.7	-23.3	10.1	7.6	20.9
CRV 9	42.14	-14.0	2.0	-27.4	8.7	3.6	34.7
CRV 7	41.39	16.1	-2.5	10.7	-11.3	-11.8	-16.4
CRV 12	41.33	10.2	-8.6	-4.3	-0.8	12.5	-3.6
CRV 19	39.72	-21.3	0.8	-7.1	-8.4	-10.9	18.1
CVR 2	39.52	17.5	8.0	6.6	-3.7	-2.3	-15.0
CRV 17	38.72	-15.9	5.6	-16.2	1.8	-8.5	14.5
CRV 20	37.93	-16.2	-10.0	-7.7	-4.3	-2.8	-6.5
CRV 13	36.39	5.8	-6.5	-5.2	2.5	15.3	-1.9
CRV 6	33.89	6.5	20.5	15.8	-1.2	-3.3	-50.5

This difference in leaf nutrient content between genotypes of high productivity and low productivity corroborates the observations by Scucuglia and Creste (2014). These authors reported alternations in the amount of micronutrients, with sometimes valuse higher in the high yield group and sometimes in the low yield group.

In high yield group the micronutrients Cu, Fe, Mn and Zn showed a deficiency in 55% of the samples, but Cu, Fe, Mn and Zn were in excess in 44% of genotypes. The low yield group found Cu deficiency in 56% and excess Zn in approximately 68% of the genotypes. This demonstrates the importance of the planning of fertilization in the different nutritional requirement of the tomato genotypes. The tomato hybrid market is extremely dynamic because it must address the multiple demands of the productive chain to obtain plants with high industrial yield and capacity to become adapted at different climatic conditions. Annually several materials on the market are released with peculiar characteristics in relation to climatic conditions, management practices and nutritional demand. Because of this, it is necessary to develop information about these materials for possible adoption of the correct management and higher productive potential for these plants (Bhaduri and Pal, 2013). Silva and Maluf (2012) found differences about the phosphorus absorption efficiency of tomato genotypes in a protected enviromnent.

Index of nutritional balance and nutritional deficiency index

A low IBN value indicates there is a nutritional balance of plants. Nutritional balance is directly related to productivity (Queiroz et al., 2014), as well as in improving the defense capability of the plant against pests and diseases. Therefore, a

Table 4. Application of DRIS in samples yielding higher than (> 48 t ha^{-1}) and yielding less than (< 48 t ha^{-1}).

Yield > 48 t ha^{-1}							
Materiais	Yield	B	Cu	Fe	Mn	Zn	IBN
	t ha^{-1}	mg Kg^{-1}					
Kátia	64.43	-10.3	5.5	-7.3	16.7	6.1	68.44
CRV 3	58.18	-7.1	1.3	-4.2	-12.7	-3.4	87.56
CRV 1	56.43	-0.4	-4.2	-6.6	-1.3	3.1	29.01
CRV 22	55.39	7.0	-9.2	14.4	3.7	8.9	80.27
AP – 533	55.34	-2.8	13.7	3.8	-11.5	-4.6	93.41
SVR – 0453	52.02	-3.9	-2.2	5.5	3.7	-4.7	50.80
CRV 21	51.04	3.5	-2.4	-18.2	-9.2	11.7	79.39
CRV 4	49.62	6.2	7.5	-2.1	-0.6	-5.4	59.77
CRV 5	48.79	7.8	-8.7	14.2	5.9	-11.1	80.61
						IBNm	69.92
Yield < 48 t ha^{-1}							
CRV 16	47.68	-0.1	-25.0	0.4	4.2	0.7	56.23
CRV 8	46.54	-12.0	-0.3	15.8	9.9	4.2	62.08
CRV 18	46.06	11.5	-7.7	4.4	0.3	2.5	92.16
CRV 15	43.89	2.2	-26.6	-13.2	2.0	9.2	128.52
CRV 11	42.93	6.6	14.6	-14.6	-2.6	-11.9	81.20
CRV 10	42.93	-5.2	10.9	-8.7	-9.4	-9.5	108.58
CRV 14	42.52	-5.3	8.3	-16.0	13.0	1.9	123.41
CRV 19	42.14	4.4	-21.0	-22.1	22.0	9.0	169.05
CRV 7	41.39	-5.8	17.9	9.3	10.4	-16.7	128.98
CRV 12	41.33	-2.2	-5.0	-6.5	-6.7	15.0	75.40
CRV 19	39.72	-5.5	-2.2	3.6	14.1	18.7	110.58
CRV 2	39.52	-0.8	3.5	3.7	-11.3	-6.1	78.44
CRV 17	38.72	7.4	-9.2	4.9	12.6	3.0	99.53
CRV 20	37.93	1.8	9.1	21.0	7.8	7.8	94.94
CRV 13	36.39	8.2	-16.3	-11.1	-3.4	12.6	88.83
CRV 6	33.89	4.0	11.7	12.7	-2.0	-14.1	142.43
						IBNm	102.52

Table 5. Deficiency index to high yield group (> 48 t ha^{-1}) and low yield group (< 48 t ha^{-1}) to industrial tomato plants.

Order	Defficiency index			
	> 48 t ha^{-1}		< 48 t ha^{-1}	
1º	P	-8.37	S	-16.76
2º	N	-7.61	Fe	-13.17
3º	Mn	-7.06	Cu	-12.58
4º	Ca	-6.52	Zn	-11.66
5º	K	-5.87	K	-11.44
6º	B	-5.86	N	-9.42
7º	Zn	-5.84	P	-6.38
8º	Cu	-5.34	Mn	-5.90
9º	N	-4.74	Mg	-5.00
10º	Mg	-4.60	Ca	-4.76
11º	S	-4.06	B	-4.61

nutritionally balanced plant is able to express much of its production potential. The lower IBN value founded was 29.01 at high yield group, CRV 1 (Table 4). The highest values for this character were observed in genotypes of low productivity. These differences come from the interaction between several factors such as the nutritional demand genotype, the relationship between nutrients, and their solution availability in soil for absorption by the plants.

The deficiency order to high yield group plants (> 48 t ha^{-1}) were values P > N > Mn > Ca > K > B > Zn > Cu > N > Mg > S (Table 5). There is evidence that the genotypes of high yield group demanded more macronutrients. Results were different in low yield group plants (<48 t ha^{-1}) that had deficient values S > Fe > Cu > Zn> K > N > P > Mn > Mg > Ca > B. Thus, were was a greater demand for micronutrients. The tomato genotypes for industrial processing differ in nutrient uptake efficiency. The high productivity group (> 48 t ha^{-1}) and produtivade low (< 48 t ha^{-1}) are different in nutrient deficiency order.

Materials and Methods

The study was carried out with industry tomatoes in Distrofic Ferralsols soils of medium texture, in the Goiânia city (Goiás-state), in 16º35’12”S, 49º21’14” W The average annual rainfall and altitude are 1487,2 mm and 730 m, respectively. The climate of the region is Humid Tropical by Köppen classification (Embrapa, 2013).

The industry tomato genotypes evaluated were: CVR 1, CVR 2, CVR 3, CVR 4, CVR 5, CVR 6, CVR 7, CVR 8, CVR 9, CVR 10, CVR 11, CVR 12, CVR 13, CVR 14, CVR 15, CVR 16, CVR 17, CVR 18, CVR 19, CVR 20, CVR 21 and CVR 22) and three commercial hybrids AP-533, SVR-0453 and Kátia. The genotypes belong to species *Solanum lycopersicum* L. The experiment was arranged in a randomized blocks design with 25 treatments (genotypes) and four replications totalling 100 plots. The experimental plots were composed of 6 lines with 6 plants 7.5 m apart with 3m in length, with a total area of 22.5 m^2 and 36 plants for plots. The drip irrigation system was used with the quantity of water supplied to variable plants according to evapotranspiration.

The production of tomato seedlings was performed with polystyrene sowing trays with a capacity of 288 cells, each cell having a storage capacity 11 cm^3 of substrate. The substrate used was obtained by mixing peat and perlite in the ratio of (2.5: 1) and seeding at a depth of 8mm. The seedlings were transplanted 37 days after sowing.

The preparation of the soil of the field was carried out by plowing and then leveling by harrowing. According to data obtained from soil analysis (Table 2) 1.0 t ha^{-1} of dolomitic limestone were applied in the total area. Afterwards 1.0 t ha^{-1} of formulate fertilizer formulated 4-30-10 were applied. Subsequently, the installation of the irrigation system with drippers with flow capacity of 1 L h^{-1}was done. The spacing between plants used was 0.50m and 1.5 m between rows. For topdressing 80 kg ha^{-1} of ammonium sulfate was applied, split twice, the first at 29 days after transplanting (DAT) and the second at 55 DAT. The foliar application was carried out with 250 ml boron + calcium solution in proportion (Ca 8% - 112 g L^{-1} and B 2% - 28 g L^{-1}) in 100L.

Analyzed characters

One leaf per plant was collected; ten samples of leaves were collected per plot, without petiole, obtained in the fifth or sixth hand/lower, accordig to the center lines of the plots, discarding the sidelines and border lines at 64 days after transplant. After drying the plant material in plots with forced air ventilation, the chemical determination of macro and micronutrients was perfomed, according to the methodology described by Malavolta et al. (1997). The results were used to create a database for the productivity per plant in each plot.

In order to characterize the productivity eight fruits from two central lines were harvested. The calculations for the establishment of standards of DRIS were based on high productivity populations (or reference population) and low productivity. Treatments whose yields were higher than 48 t ha^{-1} were established as reference populations.

Statistical analysis

Productivity spreadsheets of the experiments, DRIS indices and Index of Nutritional Balance (IBN) were obtained using Excel software (Microsoft) and calculations using the original method proposed by Beaufils (1973) (Equations 1; 2; 3 and 4)

If: $Y/X_\alpha < Y/X_n$

Then: $\int(X/Y_n) = [1 - (Y/X_n/Y/X_\alpha] x (100 x K/CV)$ (1)

If: $Y/X_\alpha = Y/X_n$

Then: $\int(X/Y) = 0(zero)$ (2)

If: $Y/X_\alpha \geq Y/X_n$

Then: $\int(X/Y_n) = [(Y/X_\alpha/Y/Xn)] x (100 x K/CV)$ (3)

Where: $\int(Y/X)$ = calculated function of nutrients ratio Y and X; $\mathrm{Y/X}_\alpha$ = nutrients-to-sample ratio; $\mathrm{Y/X}n$ = nutrients-to-norm ratio; s= standard deviation ratio $\mathrm{Y/X}n$; CV= coefficient of variation (%) of the relation $\mathrm{Y/X}n$; k=constant of sensitivity.

$$I_y = \frac{\sum_{i=1} m\int (Y/X_i) - \sum_{j=1} m\int (X_i/Y)}{m+n} \qquad (4)$$

IBN = [índex A] + [índex B] + K + [índex N]

Where: I_y: DRIS index for the Y nutrient; Y: nutrient to calculate the index; X: other nutrient; *m*: number of functions whose nutrient Y is the denominator of the function; *n*: number of functions whose nutrient Y is in the numerator of the function.

Parameters related to nutrients are calculated using DRIS formula establishing which nutrients are negative, positive or zero. The negative and positive parameters indicate deficiency and excess, respectively; values near zero indicate adequate levels. Nutritional balance index (IBN) was established after the calculation of the index of each nutrient according to the original method proposed by Beaufils (1973).

$$\mathrm{IBN} = [\text{índex A}] + [\text{índex B}] + \mathrm{K} + [\text{índex N}]$$

Conclusion

The industrial tomato genotypes differ in nutrient absorption efficiency. The deficiency order in high yield group plants (> 48 t ha^{-1}) were values P > N > Mn > Ca > K > B > Zn > Cu > N > Mg > S. The deficiency order in low yield group plants (< 48 t ha^{-1})were values S > Fe > Cu > Zn > K > N > P > Mn > Mg > Ca > B. The use of DRIS method enables the adjustment of relationships between nutrients in the tomato crop, optimizing the management of fertilization.

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