Agronomic evaluation of chonto tomato (*Solanum lycopersicum* Mill.) lines of determinate growth

Evaluación agronómica de líneas de tomate chonto (*Solanum lycopersicum* Mill.) de crecimiento determinado

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ABSTRACT

The aim of this study was to evaluate the results of the agronomic performance of five chonto tomato lines of determinate growth in Valle del Cauca, Colombia, with plants of indeterminate growth Unapal Maravilla as control. In the field, a randomized complete block design was used for four evaluations, with four replicates and five plants as an experimental unit, respectively. The final plant height for all the lines, except Unapal Maravilla, was evaluated between 90 and 100 d with no statistical differences (P<0.05) between treatments. The lines of determinate growth expressed no differences (P<0.05) with Unapal Maravilla for the number of clusters per plant and the number of fruits per cluster. At the same time, they surpassed Unapal Maravilla in fruit weight at 117 g/fruit (lines JV9, JV7, and JV12), and final yield was greater than 4 kg/plant. The lines of determinate growth at physiological maturity were similar to Unapal Maravilla in the uniform final color of fruits (cherry red), fruit shape round in equatorial diameter and slightly elongated in polar diameter, and number of locules (bicavitary); they expressed inferiority for total fruit solids between 3.5 and 3.6° Brix vs. 4.32° Brix to the control (P<0.05). The final height for the lines of determinate growth ranged between 97.7 and 109.0 cm, respectively, while the Unapal Maravilla plants had more than 200 cm in height.

Key words: crop performance, fruit quality, genotype, plant breeding.

RESUMEN

El objetivo de este estudio fue evaluar el comportamiento agronómico de cinco líneas de tomate chonto de crecimiento determinado en el Valle del Cauca, Colombia. Se usaron cinco líneas de crecimiento determinado y un testigo de crecimiento indeterminado Unapal Maravilla. En campo, se usó un diseño de bloques completamente aleatorizados, con cuatro repeticiones y cinco plantas como unidad experimental respectivamente para las cuatro evaluaciones. La altura final de las plantas, para todas las líneas, excepto Unapal Maravilla, se evaluó entre 90 y 100 d sin diferencias estadísticas (P<0.05) entre tratamientos. Las líneas de crecimiento determinado no expresaron diferencias (P<0.05) con Unapal Maravilla para número de racimos por planta y número de frutos por racimo, mientras que el rendimiento fue superior a Unapal Maravilla en: peso del fruto, mayor a 117 g/fruto (líneas JV9, JV7 y JV12) y rendimiento final mayor a 4 kg/planta. Las líneas de crecimiento determinado en madurez fisiológica fueron similares a Unapal Maravilla en color final uniforme (rojo cereza), formato del fruto redondo en el diámetro ecuatorial y ligeramente elongado en el diámetro polar, y número de lóculos (bicavitarios); y expresaron inferioridad para sólidos totales en fruto entre 3.5 y 3.6 °Brix vs. 4.32 °Brix respecto al testigo (P<0.05). La altura final para las líneas de crecimiento determinado fluctuó entre 97.7 y 109.0 cm respectivamente, mientras que las plantas Unapal Maravilla tuvieron más de 200 cm de altura.

Palabras clave: desempeño de cultivo, calidad del fruto, genotipo, fitomejoramiento.

Introduction

The tomato (*Solanum lycopersicum* Mill.) is the most cultivated vegetable in the world, associated with the increasing demand for fresh and processed consumption (Maham *et al*., 2020; Rawat *et al*., 2020) as well as with its contribution to the socioeconomic welfare of horticulture and agribusiness worldwide (Tabe & Molua, 2017; Stilwell, 2020).

In Colombia, during 2020, 8,787 ha were cultivated and harvested, with 656,647 t ha^{-1} (FAOSTAT, 2020) produced in the departments of Cundinamarca, Norte de Santander, Valle del Cauca, Boyacá, Huila, Antioquia, Risaralda, and Caldas (Perilla *et al*., 2011).

However, in Colombia, the production of this vegetable is restrained by the limited release of new varieties with

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greater adaptability, causing significant pre-harvest losses due to pests and diseases (Burbano & Vallejo, 2017). Other problems are the high production costs attributed to the type of growth habit; in this case, those of indeterminate habit (most used by farmers) involve arduous pruning, trellising, and greater consumption of materials and inputs (Piotto & Perreira, 2012).

To minimize the cost of production and environmental damage by excess use of pesticides and improve productivity, chonto tomato cultivars are needed for their specific growth habit (small and compact plant without a tutor system). This facilitates lower production costs (Sun *et al*., 2019; Casavian *et al*., 2021). This topic has been the subject of study of the Vegetable Breeding and Seed Production Program (PMGPSH, for its acronym in Spanish) at the Universidad Nacional de Colombia. This basic research has been conducted for more than six years, generating chonto tomato lines with a determinate growth habit from backcrossing between the Brazilian cultivar IPA 4 donor of the SP (*Self Pruning*) gene and the Colombian cultivar (recurrent progenitor) UNAPAL-Maravilla.

Research is needed to obtain new cultivars of determinate growth, with the objective of making better use of the natural resources used by farmers to achieve sustainability and profitability of crops.

Materials and methods

Plant material and location

Five lines of determinate growth chonto tomato (DGCT) (Fig. 1) generated by the Vegetable Program of theUniversidad Nacional de Colombia were used. As a control, indeterminate growth Chonto tomato cultivar Unapal Maravilla (IGCT) was used. Four field trials were conducted in the experiment, three of them at the experimental station Mario Gonzales Aranda (GMGA) farm in 2018 and 2019. This farm is located in Palmira, Valle del Cauca, Colombia, at an altitude of 998 m a.s.l. The mean temperature is 23°C, monthly rainfall is 60 mm, and average relative humidity is 80%. The experimental area's soil was classified as low organic matter, with a slightly acidic pH (5-6) and a low cation exchange capacity.

The fourth test was carried out in Candelaria, Valle del Cauca, Colombia, at the Experimental Station of the Universidad Nacional de Colombia, Palmira campus. It is located at an altitude of 980 m a.s.l., with a monthly rainfall of 26 mm, a mean temperature of 24°C, and a relative humidity of 76%. The experimental area's soil has low contents of organic matter (1.48 g 100 g^{-1}), a neutral pH of 6.8, and a high cation exchange capacity (27.1 cmol kg^{-1}).

Experimental conditions

All plants were transplanted 22 d after planting. Ten vigorous seedlings of each line were taken to the field. Unapal-Maravilla was used as a control in the experiment, and each genotype was placed in a furrow. The field layout was 1.50 and 0.50 m between rows and plants. Drip irrigation hoses were placed at a distance of 20 cm per dripper; individual tutors were used for each plant, and plastic thread was used to hold them. Fieldwork, such as fertilization and plant protection, was done based on the recommendation of the Vegetable Breeding Program of the Universidad Nacional de Colombia (Estrada *et al*., 2004).

Variables evaluated

The descriptors for tomato of the International Plant Genetic Resources Institute (IPGRI) (1996), now called Bioversity International, and the evaluation criteria suggested by Burbano and Vallejo (2017) were used. Phenology variables were: days to flowering initiation (DFI), days to harvest (DH), duration to harvest (HD), crop cycle (CC); yield component variables were: number of clusters per plant (NCPP), number of fruits per cluster (NFPC), number of fruits per plant (NFPP), fruit weight (FW) (g/fruit), yield per plant (YPP) (kg/plant); morphological variables were: final plant height (FPH) (cm), fruit color (FC), sphericity index (SI), polar fruit diameter (PD) (cm), equatorial fruit diameter (ED) (cm), number of locules per fruit (NL), pericarp thickness (PT), and contents of total soluble solids (TSS).

Statistical analysis

A randomized complete block design was used with four replicates, five DGCT lines in the test, and IGCT line as a control. One furrow per line was used, with ten plants per furrow and five central plants as experimental unit.

For the different variables, descriptive statistics, analysis of variance (ANOVA), and test of difference of means between lines (Tukey test at 5%) were performed using SAS v. 9.4 (Statistical Analysis System Institute, Cary, NC, USA).

FIGURE 1. Genotypes generated by the Vegetable Program of the Universidad Nacional de Colombia, Palmira (Colombia).

Results and discussion

The combined analysis of variance for the phenological variables (Tab. 1) showed highly significant differences (*P*<0.01) for the source of variation genotypes in the variables DFI, DH, CC, FPH, YPP, FW, NFPP, TSS, NL, PD, ED, and PT. These results indicated a heterogeneity between the genotypes for these characteristics, with differences in the values of the evaluated variables. No significant differences were found for NCPP, NFPC, and FC, suggesting that there are no genetic differences between the genotypes evaluated for these traits.

TABLE 1. Combined analysis of variance with its mean squares and significance for the variables under study between determinate growth chonto tomato (DGCT) lines and the indeterminate growth chonto tomato (IGCT) cultivar Unapal-Maravilla.

Variables	Source of variation					CV (%)	Mean
	Genotype(G)	Environment(E)	Rep(E)	GXE	Error		
DF	5	3	11	15	55		
DFI	11.0**	52.9**	2.5**	2.6**	0.91	6.13	15
DH	128.3**	668.1**	10.4*	18.2**	5.16	3.37	67
HD	8.2ns	796.6**	15.2*	25.5**	7.2	10.69	25
CC	109.9**	1562.5**	7.9ns	27.3**	6.8	2.84	91
FPH	32240.6	1280.4	103.9	159.9	111.2	8.54	123.4
NCPP	0.35ns	139.97**	3.59ns	2.4ns	3.2	12.58	12.5
NFPC	0.06ns	0.21ns	0.2ns	0.15ns	0.12	9.41	3.6
NFPP	306.52**	1000.92ns	21.51ns	52.23ns	33.45	15.44	37.5
FW	157.72ns	829.75**	41.14ns	77.74*	41.83	5.64	114.66
YPP	6.65**	19.91**	0.3ns	0.48ns	0.39	15.56	4.03
TSS	0.69**	0.55**	0.02ns	0.03ns	0.06	6.63	3.69
NL	0.49**	0.08**	0.01ns	0.04**	0.01	4.8	2
PD	2.48**	1.96**	1.39ns	1.39ns	1.33	17.48	6.6
ED	0.1**	0.12**	0.03ns	0.03ns	0.02	2.58	5.62
PT	2.21**	3.02**	0.05ns	0.11ns	0.07	3.48	7.56
FC	0.07ns	0.04*	0.11**	0.03ns	0.03	2.1	6.8

Rep: replicate; DF: degrees of freedom; *significant (5% probability), **highly significant (1% probability), ns = not significant, DFI: days to flowering initiation; DH: days to harvest; HD: duration to harvest; CC: crop cycle; FPH: final plant height (cm); YPP: yield per plant (kg/plant); FW: fruit weight (g/fruit); NCPP: number of clusters per plant; NFPC: number of fruits per cluster; NFPP: number of fruits per plant; TSS: total soluble solids (°Brix); NL: locule number; PD: polar diameter (cm): ED: equatorial diameter (cm); PT: pericarp thickness (mm); FC: fruit color.

Days to flowering initiation (DFI)

All lines, except EB-L14, initiated flowering in a shorter time, between 14 and 15 d, with respect to the control. The JV6 line initiated flowering at 14 d, the earliest among the genotypes evaluated. These data coincide with the 16, 14, and 18 d in DGCT for days to flowering initiation in Kumar *et al*. (2016) and Burbano and Vallejo (2017) and contrasts with the 25 and 36 d for flowering initiation in DGCT in Sherpa *et al*. (2014) and the 44.4, and 34.7 reported by Raj *et al*. (2018) for DGCT. Genotypes that present a reduction in the DFI have less production time, a feature that is desirable in tomato breeding programs.

Days to harvest (DH)

For the variable "days to harvest", the lines DGCT were similar (P<0.05) with a period of approximately 65 d, earlier than the control, with a value of 73 d. This finding matches with Mahebub *et al*. (2021), who reported a DH of 67.7 d in determinate-growth tomato. However, Burbano and Vallejo (2017) working with the same DGCT lines of this study found DH greater than 70 d.

Duration to harvest (HD)

The average HD expressed no significant differences (P<0.05) between the lines and control, with an HD between 24 and 26 d. Some studies show that, in the case of indeterminate tomato, the HD corresponds to a period of 37 d, while for determinate tomato, it corresponds to 16 and 27 d (Moya *et al*., 2003).

Crop cycle (CC)

For IGCT, all activity was suspended just as the DGCT lines finished production and aged, which meant equal DH for the lines and DGCT (Tab. 2). This may seem incorrect, as IGCT remains in production for up to 150 d. The DGCT lines presented a lower productive cycle compared to the control, with a duration of 96 d; the EB-L14 line had the lowest cycle with a mean of 89.6 d, the other lines had a longer growth cycle, between 90.2 and 91.5 d (Tab. 2). Burbano and Vallejo (2017) report a much shorter productive cycle for determinate growth accessions with duration up to 87 to 88 d and for indeterminate type a period of 111 d.

Obtaining short cycle genotypes is of great interest in breeding programs, since it allows a reduction of the plant exposure in the field and adverse environmental situations such as drought stress and diseases (Nascimento *et al*., 2020). In addition, the amount of chemical fertilizer applications is reduced, which is beneficial in ecological and economic terms, since fewer inputs are required (Burbano & Vallejo, 2017).

Final plant height (FPH)

Overall, the DGCT lines expressed the expected height, with a 50% difference from IGCT (*P*<0.05), ranging between 97.7 and 109.0 cm for JV6 and EB-L14, respectively (Tab. 2). These results agree with Muhammad *et al.* (2019) who report DGCT accessions of no more than 1 m until reaching height and initiating senescence. In the same sense and in contrast to the present study data, Kumar *et al.* (2016) evaluated 40 DGCT genotypes and reported a final plant height ranging between 52.1 and 184.5 cm.

According to the above data, determinate growth lines of tomato presented the desired height, which implies a reduction in production costs from less labor, less use of materials and inputs, and less pruning (Piotto & Peres, 2012). In addition, determinate-growth tomatoes are ideal in the open field because sympodial shoots quickly differentiate into flowers that result in rapid and uniform fruit maturity (Jiang *et al.*, 2013). This rapid and uniform maturity of the fruits allows for the mechanized harvest in tomatoes in open field, ideal for the industry (Silva *et al.*, 2017). Therefore, a new alternative is available that could be adopted by Colombian farmers in the Cauca Valley region in the future.

TABLE 2. Comparison of means for phenological variables and final plant height of determinate growth chonto tomato (DGCT) lines and the indeterminate growth chonto tomato (IGCT) cultivar Unapal-Maravilla.

Genotypes	DFI	DH	HD	CC	FPH
JV6	15.0c	66.2b	24.7a	90.7b	97.7b
JV9	14.7c	65.8b	24.98a	90.2b	102.9b
JV7	15.2bc	67.0b	24.0a	91.8b	108.6b
EB-L14	16.1ab	66.3b	25.7a	89.6b	109.0b
JV12	15.1bc	65.8b	258a	90.8b	102.8b
UNAPAL-Maravilla	16.9a	73.0a	26.0a	96.5a	219.4a
Mean	15.5	67.4	25.1	91.5	123.4
LSD	1.0	2.4	2.9	2.80	11.3

In the column, values with the same letter are equal (*P*<0.05) LSD = least significant differences. DFI = days to flowering initiation (d); DH = days to harvest (d); HD = duration to harvest (d); CC = crop cycle (d); FPH = final plant height (cm).

Number of clusters per plant (NCPP) and number of fruits per cluster (NFPC)

The NCPP and NFPC variables were not significantly different (*P*<0.05) between the lines and the control (Tab. 3). The NCPP presented a mean of 14.2 in the plants. The NFPC values were above 3.5; these results are similar to those reported by Kumar *et al.* (2016), who evaluated 40 genotypes of determinate and semi-determinate habit and found a mean of 3.8 NFPC for determinate and semi-determinate genotypes. This coincides with the data reported by Sinha *et al.* (2020) in 14 genotypes of indeterminate growth tomato where NFPC was between 3.6 and 3.8.

Number of fruits per plant (NFPP)

No statistical differences (*P*<0.05) were observed among the lines for the variable of number of fruits per plant NFPP. The determinate growth lines presented a mean surpassing the commercial control. Line JV6 produced the highest number of fruits per plant with 49.4; for the other lines, the NFPP was similar, between 37.7 and 39.0 fruits per plant. The control produced 29.6 fruits per plant, being the genotype with the lowest number of fruits. Elsadek *et al.* (2022) reported values of 36.5 fruits per plant in tomato with indeterminate habit; other studies conducted by Martínez-Solís *et al.* (2005) in indeterminate tomato ball type obtained values ranging from 17.7 to 29.3. These results are similar to those found in Unapal Maravilla for this study.

On the other hand, Kouam *et al.* (2018) evaluated two hybrids of determinate growth (Roma Savana and Roma Rossol), obtaining values of 22 to 24 fruits per plant, respectively. These results were lower than those observed in this study.

Fruit weight (FW)

For the FW variable, no statistical differences (*P*<0.05) were found between the lines and the control, where lines JV9, JV7, and JV12 obtained the heaviest fruits with values greater than 117 g/fruit while lines EB-L14 and JV6 presented the lowest weight fruits with values of 112.05 and 113.04 g/fruit, respectively. When comparing the lines with the control, all plants were superior, with fruits with weights of 110 g/fruit. However, these results were superior to those reported by Burbano and Vallejo (2017), where the determinate growth lines failed to overcome the control Unapal Maravilla with a weight of 104.5 g/fruit. The values found in the lines are similar to those observed by Shamil *et al.* (2017), who reported weight of 118.33 g/ fruit in determinate growth varieties. The data found for the Unapal-Maravilla control were similar to those reported by Malia *et al.* (2015) on indeterminate grown tomatoes (Santa Clara) with a FW of 110.2 g/fruit.

Yield per plant (YPP)

The determinate growth lines presented a superior performance to the Unapal Maravilla control with yields between 4.1 and 4.3 kg/plant, while the control produced a yield of 3.35 kg/plant. In addition, among the lines, the yield was statistically similar. These results are not similar to those reported by Burbano and Vallejo (2017) who found a yield of 4.6 kg/plant in the variety Unapal Maravilla, which was superior to the determinate growth line. These results agree with Maciel *et al.* (2016), who reported a yield of 3.83 kg/plant in tomato hybrids of indeterminate growth. These results show that there are promising tomato lines for the yield characteristic which is of great importance for breeding programs. These lines could be registered as a new variety or provide farmers with basic seed for them to carry out their own breeding program.

TABLE 3. Comparison of means for yield components between determinate growth chonto tomato (DGCT) lines and the indeterminate growth chonto tomato (IGCT) cultivar Unapal-Maravilla.

Genotypes	NCPP	NFPC	NFPP	FW	YPP
JV6	14.1a	3.5a	41. 4a	112.05ab	4.65a
JV9	14.5a	3.6a	39.0a	117.45a	4.58a
JV7	14.2a	3.58a	39.7a	117.51a	4.67a
EB-L14	13.9a	3.72a	38.7a	113.04ab	4.38a
JV12	14.2a	3.6a	37.7a	117.59a	4.44a
UNAPAL-Maravilla	14.2a	3.5a	29.6b	110.34b	3,29b
Mean	14.2	3.6	37.7	114.76	4.33
LSD	1.93	0.36	6.24	6.97	0.67

In the column, values with the same letter are equal ($P<0.05$), LSD = least significant differences. NCPP = number of clusters per plant; NFPC = number of fruits per cluster; NFPP = number of fruits per plant; FW = fruit weight (g/fruit⁻); YPP = yield per plant (kg/plant).

Number of locules per fruit (NL)

In general, the DGCT lines expressed a manifest bilocular behavior, with no differences among them ($P<0.05$). At the same time, the IGCT control showed a decided tendency towards a trilocular fruit structure (Tab. 4). These results are in agreement with Eklund *et al.* (2005), who found an NL with a mean of 2.5 and 2.2 in DGCT type Santa Cruz and Santa Clara, respectively. Bilocular fruits are desired at the market since they are more stable for postharvest handling. In any case, the DGCT control showed similar results in full agreement with Sherpa *et al.* (2014), who evaluated 18 DGCT genotypes and found NL between 3.1 and 4.3. This agrees with what was expressed in this study by the Unapal Maravilla cultivar.

Sphericity index (SI)

All of the DGCT lines expressed an SI between 1.16 and 1.28 (slightly elongated), without statistical differences among them ($P<0.05$). In contrast, the Unapal Maravilla cultivar (IGCT) expressed an SI=1.06 (Tab. 4). Vasiform or fleshy berry shaped fruits, such as fresh Chonto tomatoes, probably, have a higher acceptance if they have an appearance close to sphericity. This depends on the non-percentage ratio between the polar diameter (PD) and the equatorial diameter (ED) of the fruits; this ratio generates an index of sphericity (SI) such that, if SI ≥ 1, then the fruit is elongated; if SI = 0, the fruit is spherical and, finally if SI ≤1, the fruit is a flat (Niño *et al.,* 2019). In general, SI has a direct impact on consumer preference (Niño *et al.*, 2019; Waiba *et al.*, 2021); the commercial Unapal Maravilla cultivar and the lines of determinate growth could be considered as desirable genotypes because they present a format according to the demands of the Colombian market, which prefers fruits with a Chonto type format, either rounded or elongated rounded.

The JV7 line had the highest PD with a mean of 7.26 cm and an SI of 1.28, while the other lines presented statistically similar means with values between 6.59 and 6.64 cm. In addition, all the lines surpassed the Unapal Maravilla control for this variable, which obtained a mean of 5.91. The JV6 line and the control were the genotypes with the lowest ED, with values of 5.50 cm and 5.54 cm, respectively; the other genotypes had a mean between 5.59 cm and 5.71 cm.

These results coincide with those reported by Santos *et al.* (2011), who reported values of 6.0 to 7.25 cm for fruit PD and 5.57 cm for fruit ED in IGCT. Other studies (Srivastav *et al.*, 2022) reported values in DGCT below 5.2 and 4.0 cm for PD and ED, respectively.

Pericarp thickness (PT)

The lines under study were superior to the control in pericarp thickness (PT) and statistically equal to each other ($P<0.05$), with values between 7.66 and 7.80 mm. The results obtained were lower than those found by Trento *et al.* (2021), who worked with five tomato cultivars of determinate growth and obtained pericarp thickness averages between 7.2 mm and 10.4 mm. However, there is no pattern as Sherpa *et al.* (2014) found PD for DGCT between 4.13 to 6.89 mm, lower than those reported in this study. In any case, Chonto tomato fruits with a greater pericarp thickness are desirable because they provide a longer shelf life and better withstand transport; in addition, they contribute more weight to the yield and influence fruit size, an important consideration for both fresh and industrial tomato consumption (Waiba *et al.*, 2021).

Fruit color (FC)

All genotypes presented a mean above 6.7, corresponding to the Chonto red color from stages 5 and 6. In this sense, tomatoes in the categories above are considered desirable organoleptic quality by the consumer, who appreciates the color of the fruits and the significant contribution of lycopene, vitamin C, and carotenoids (Siueia Júnior *et al.*, 2020).

Total soluble solids content (TSS)

For all DGCT lines in the trial, TSS values were significantly equal (P<0.05) with values between 3.54 and 3.62 °Brix; with evident superiority of the IGCT cultivar Unapal Marvilla, with 4.32 °Brix (Tab. 4). TSS content is one of the most important characteristics in the processing industry (Salim *et al*., 2020); quality is associated with soluble sugars (flavor and sweetness), which is correlated with the degree of maturity and vitamin C (Huang & Chen, 2018; Siueia *et al*., 2020). Total soluble solids are affected by the type of growth habit, where tomatoes with determinate growth tend to have a lower amount of soluble solids in the fruits compared to those with indeterminate growth, as shown in the data found in this research, because the latter have a greater number of leaves in relation to the number of fruits, which generates a greater capacity of the fruits to extract photoassimilates (Vicente *et al*., 2015), 4.3 and 5.5 for IGCT.

TABLE 4. Comparison of means for morphological variables and soluble solids of determinate growth chonto tomato (DGCT) lines and the indeterminate growth chonto tomato (IGCT) cultivar Unapal-Maravilla.

Genotypes	NL	PD	ED	SI	PT	FC	TSS
JV6	2.2b	6.40ab	5.5c	1.21a	7.80a	6.7a	3.62b
JV9	2.2b	6.61ab	5.7a	1.16ab	7.56a	6.8a	3.63b
JV7	2.3b	7.26a	5.7b	1.28a	7.82a	6.8a	3.48b
EB-L14	2.2b	6.59ab	5.6b	1.18a	7.76a	6.8a	3.54b
JV12	2.3b	6.63ab	5.6b	1.18a	7.66a	6.8a	3.56b
UNAPAL-M	2.7a	5.91b	5.5c	1.06b	6.78b	6.9a	4.32a
Mean	2.3	6.6	5.6	1.7	7.56	6.8	3.69
LSD	0.12	1.24	0.15	0.10	0.28	0.19	0.4

Values in the column with the same literal are equal (P<0.05), LSD = least significant differences. NL: locule number; PD: polar diameter (cm); ED: equatorial diameter (cm); SI: Sphericity index; PT: pericarp thickness (mm); FC: fruit color; TSS: total soluble solids (°Brix).

Conclusions

The Chonto tomato lines of determinate growth showed a statistically similar agronomic performance among the lines, which would allow the producers to receive basic seed of all the lines. Growers can be part of the continuation of the breeding process, which can be participative or a pool of the five lines of determinate growth habit, to obtain a new cultivar for the Colombian farmers.

Conflict of interest statement

The authors declare that there is no conflict of interests regarding the publication of this article.

Author's contributions

AJVG, FAVC, SOG, and MCSV designed the experiments, AJVG, MCSV, and DGGG carried out the field and laboratory experiments, FASV and DGGG contributed to the data analysis, AJVG, FAVC, and SOG wrote the article. All authors reviewed the final version of the manuscript.

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