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Selection of accessions based on the general and specific combining ability of a partial diallel of *Capsicum annuum* L

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ABSTRACT: ***Capsicum annuum*** **L. is recognized as the most globally traded peppers and bell peppers, standing out for its wide genetic variability and extensive range of varieties. Therefore, conducting studies on this crop becomes crucial in genetic improvement programs. The present work employed diallelic analysis to estimate general and specific combining ability in a partial diallel, using accessions of *C. annuum* L. The experiment was conducted in the greenhouse of the Department of Agronomy at the Federal University of Viçosa, following a completely randomized design with four replications. Nine genotypes of *C. annuum* L. and twenty hybrid combinations, originating from partial diallelic crosses based on six traits, were evaluated. Diallelic analysis was applied, and the general and specific combining ability parameters were estimated. The results indicate the existence of genetic variability in the components of the diallel for most traits, we also identified the most divergent accessions by estimating general and specific combining abilities. Thus, it can be concluded that the hybrids *Pimenta Vulcão* x *Pimentão Cascadura Ikeda*, *Pimenta Cayenne* x *Pimentão Cascadura Ikeda*, and *Pimenta Jamaica Yellow* x *Pimentão Cascadura Ikeda* stand out as options for the food market. The *Pimenta Picante para Vaso* x *Pimenta Doce Italiana* and *Pimenta Picante para Vaso* x *Pimentão Quadrado* hybrids show potential for the ornamental plant market. The hybrid *Pimenta Jamaica Yellow* x *Pimentão Quadrado* is not recommended for the F2 generation. The parent *Pimenta Picante para Vaso* offers the potential to reduce plant dimensions, height, and fruit width, making it valuable for the ornamental plant market. The parent *Pimenta Peter* stands out as a promising choice to meet the demand for nutritious and functional foods due to its high indicator of vitamin C content.**

Keywords: *pepper; diallelic analysis; genetic improvement; agrarian sciences; completely randomized design.*

INTRODUCTION

The fascinating universe of the Capsicum genus, which includes peppers and bell peppers (*Solanaceae* family), exhibits extraordinary diversity among its 38 cataloged species, with five emerging from human domestication. Notable among these are the species *C. annuum* L., *C. chinense* Jacq., *C. frutescens* L., *C. baccatum* L., and *C. pubescens* R. et P. Further details can be encountered in Cansian Júnior (2021), Moses et al. (2013), and OECD (2006).

An immersion into archaeological research in Central America, conducted by Ramjattan and Umaharam (2021), reveals that *Capsicum* is among the first genera of domesticated plants, with its cultivation roots dating back at least 7000 years. This historical connection leads us on a journey that explores the botanical diversity of this culture and cultural roots intertwined over millennia.

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As Rosa et al. (2023) highlighted, the *Solanaceae* family plays a significant role in the scenario of major vegetable crops in Brazil, constituting an extensive and promising productive sector essential for national agribusiness. Ferraz et al. (2016) emphasize the breadth of commercial utilization, including selling fresh or processed fruits, such as sauces, preserves, jellies, and paprikas. Additionally, the commercialization of ornamental plants and their use in the production of medicines and cosmetics is noteworthy. As highlighted by the EMBRAPA researcher Cláudia Ribeiro, in Vettore (2022), the *Capsicum* genus flourishes year-round in Brazil, leading to a high export rate. Given the significant importance of this genus, it is noteworthy that *C. annuum* is the most globally traded species, according to Rêgo and Rêgo (2016). Moreover, this species exhibits extensive genetic variability, as indicated by studies of Pessoa et al. (2017), and boasts many varieties, as pointed out by Hernández-Perez (2020).

The cultivation of bell pepper (*Capsicum annuum* L.), according to Duarte and Souza (2016), ranks among the top ten vegetable crops in terms of economic importance in the Brazilian market. Originating in Central and South America, as underscored by Deng et al. (2020), studies conducted by MacNeish (1964) and Pandey et al. (2012) indicate that this crop has a historical presence, being known since the beginning of civilization in the northern hemisphere and integrated into human diet since 7500 BC. This long historical trajectory of pepper in nutrition emphasizes its economic importance and ancestral enduring role in cuisine and daily life. Therefore, conducting studies on this specific crop becomes indispensable in breeding programs through hybridization. As accentuated by Veiga et al. (2000), in the context of plant species, a wide diversity of lineages and cultivars emerges, contributing to the formation of segregating populations. In line with the statements of Santos Pessoa et al. (2018), one of the most crucial elements in this breeding program paradigm is the careful selection of parents to undergo the crossing process.

Among the various available approaches, the diallel crossing technique stands out, allowing the use of various types of diallel, including balanced or complete, unbalanced, partial, circulating, and incomplete diallel, according to Veiga et al. (2000). This analysis, as indicated by Cruz et al. (2012), examines the genetic design, providing estimates of valuable parameters in the selection of parents for hybridization and understanding the genetic effects associated with trait determination.

It is important to note that, according to studies by Pimentel et al. (2013), the application of complete diallel is often limited when there is an interest in evaluating many parents. Furthermore, breeders only sometimes seek to evaluate all possible combinations but to identify populations originating from parents of different groups. In this sense, partial diallelic analysis emerges as a promising alternative to investigate the combinatorial capabilities of numerous parents.

Among the diallelic analysis methodologies employed, the proposal by Griffing (1956) stands out. According to Cruz et al. (2012), this method estimates the effects and sums of squares of the effects of general combining ability (GCA) and specific combining ability (SCA). Carvalho et al. (2014) emphasize that GCA methodology evaluates the lines with the best average performance within the tested parent set, while SCA evaluates the specific performance of hybrid combinations. Thus, as Rocha et al. (2014) pointed out, this analysis is essential for formulating effective strategies for improving promising varieties for *Capsicum* genetic improvement.

Given the importance this crop assumes, its investigation holds excellent relevance. Therefore, this work aimed to employ diallelic analysis to estimate general and specific combining ability in a partial diallel, including commercial genotypes of *C. annuum* L. and their hybrid combinations, through the evaluation of morphological and biochemical fruit traits to determine the most promising accessions resulting from the conducted experiment.

MATERIAL AND METHODS

The data for this study were obtained through an experiment conducted under a completely randomized design (CRD), with four replications, carried out in the greenhouse facilities of the Department of Agronomy at the Federal University of Viçosa (UFV), located in Viçosa, Minas Gerais, Brazil.

Twenty-nine accessions (varieties or lines) of *Capsicum annuum* L., consisting of nine genotypes distributed into two groups, were used as treatments. Group II consisted of four commercial genotypes of *C. annuum* L. without pungency, with flowers bearing receptive male organs responsible for pollen production. Group I, on the other hand, comprised five commercial genotypes of *C. annuum* L., notable for their pungency, involving flowers with female reproductive organs intended for pollen reception.

So, twenty hybrid combinations were generated using the methodology of partial diallel crosses (5×4), composing the F1 generation, i.e., the first generation of descendants after the initial crossing between parents from Group I and Group II. These combinations were duly recorded in the Vegetable Germplasm Bank (BGH/UFV), as shown in Table 1.

Table 1: Commercial genotypes of *Capsicum annuum* L. and hybrid combinations resulting from Partial Diallel Crosses (5×4) between Groups I and II, resulting in the F1 generation. The symbol (♀) indicates female and (♂) male flowers. The number between parentheses identified each accession.

Group I= (♀) **Group II (♂)**	*Pimenta Doce Italiana* (06)	*Pimentão Quadrado* (07)	*Pimentão Cascadura Ikeda* (08)	*Pimentão Rubi Gigante* (09)
Pimenta Vulcão (01)	01 × 06 (10)	01 × 07 (11)	01 × 08 (12)	01 × 09 (13)
Pimenta Cayene (02)	02 × 06 (14)	02 × 07 (15)	02 × 08 (16)	02 × 09 (17)
Pimenta Peter (03)	03 × 06 (18)	03 × 07 (19)	03 × 08 (20)	03 × 09 (21)
Pimenta picante para Vaso (04)	04 × 06 (22)	04 × 07 (23)	04 × 08 (24)	04 × 09 (25)
Pimenta Jamaica Yellow (05)	05 × 06 (26)	05 × 07 (27)	05 × 08 (28)	05 × 09 (29)

The seeds were planted in Styrofoam trays with 200 cells filled with commercial substrate. Two seeds were placed per cell - individual compartment or alveolus in a seeding tray, allowing the seeds to develop separately before transplanting - and thinning was performed after germination. After reaching the stage of three pairs of definitive leaves, the plants were transplanted into individual five-liter (*l*) pots. All subsequent operations, such as cultural practices, were conducted according to specific recommendations for the crop, detailed in Selvakumar et al. (2022) and Padilha and Barbieri (2016).

The morphological characters chosen for analysis included mature fruit length (MFL), plant height (PH), fruit width (FW), and pericarp thickness (PT). For biochemical characteristics, the Vitamin C (VCC) and soluble solids (SSC) contents were considered.

These characters' measurements were conducted according to the following descriptions:

- MFL: Mature fruit length, expressed in millimeters (*mm*), was measured from the peduncle insertion to the fruit tip using digital calipers.
- PH: Plant height, expressed in centimeters (*cm*), was measured using a tape measure from the soil surface to the highest point of the plant.
- FW: Fruit width, expressed in millimeters (*mm*), was measured at the widest point of the cross-section using digital calipers.
- PT: Pericarp thickness measurement, expressed in millimeters (*mm*), was performed on the middle portion of the fruit cut transversely using digital caliper.
- VCC: The determination of vitamin C content, expressed in milligrams per hundred grams (*mg 100g-1*), was performed by the titrimetric method (a quantitative method used to determine the concentration of a solution.
- SSC: The soluble solids content, expressed in degrees Brix (°Brix), was determined by the fruit juice extraction. In this process, the refractometer was zeroed with distilled water, and one to two drops of juice were deposited on the prism of the device. Finally, °Brix was measured at 26 ºC (±2).

Diallelic analysis, based on the mean results of each replication, was conducted for each character using the method proposed by Griffing (1956), with adaptations by Geraldi and Miranda Filho (1988) for partial diallel. This technique evaluates p parents from one group (corresponding to Group I) and q from the other group (Group II), along with their $p \times q$ hybrid combinations. The following equation expresses the statistical model for partial diallel.

$$Y_{ij} = \mu + \frac{1}{2}(d_1 + d_2) + g_i + g'_j + s_{ij} + \underline{\varepsilon}_{ij}$$

Where,
Y_{ij} represents the mean of the cross involving the i-th parent from Group I and the j-th parent from Group II;
Y_{i0} is the mean of the i-th parent from Group I ($i = 0, 1, \ldots, p$).
Y_{0j} is the mean of the j-th parent from Group II ($j = 0, 1, \ldots, q$).
μ is the overall mean of the diallel.
d_1, d_2 are the respective contrasts involving means of Groups I and II and the overall mean.
g_i is the effect of the general combining ability of the i-th parent from Group I.
g'_j is the effect of the general combining ability of the j-th parent from Group II.
s_{ij} is the effect of the specific combining ability, i.e., the effect of the hybrid combination between the i-th parent from Group I and the j-th parent from Group II.
$\underline{\varepsilon}_{ij}$ is the average experimental error associated with observation Y_{ij}.

Estimates of GCA and SCA were analyzed to evaluate the relative performance of parents and their combinations, and the investigations were conducted using the computational software Genes, as per Cruz (2013), which provides a systematic and intuitive approach to evaluating diallelic analysis results.

According to Cruz et al. (2012), whether positive or negative, low GCA estimates indicate that the respective parent does not differ significantly from the overall mean of diallelic crosses. On the other hand, high and positive GCA estimates stand out as those contributing most to the increased expression of the trait. In contrast, high and negative values indicate a reduction in the manifestation of that trait.

Also, according to Cruz et al. (2012), low absolute values of SCA indicate that hybrid combinations exhibit the expected behavior considering the general combining ability of their parents. On the other hand, high absolute values suggest that the performance of a specific hybrid is relatively superior or inferior to expectations, considering the general combining ability of its parents. According to Cruz and Regazzi (1994), the best hybrid has the highest SCA estimate, and at least one parent has a high GCA estimate. In the development of this study, we evaluated the means of each accession within each evaluated characteristic to gain an intuitive understanding of the standout accessions. Subsequently, we conducted a variance analysis to assess significant differences between the studied accessions, considering each collected response variable. Afterward, we performed variance analysis for the partial diallel to check the significance of the GCA of each group and the SCA of the interaction between them. Finally, we obtained estimates of General Combining Ability (GCA) and Specific Combining Ability (SCA) to identify the best parents for combination and the best hybrids generated by the respective parents.

RESULTS

The estimates of the means of the studied accessions are detailed in Table 2, available at the link: [https://rpubs.com/JhenniferNascimento/table2] . Upon analysis, it was observed that parents 3, 4, and 7 exhibited the highest means and higher positive estimates of General Combining Ability (GCA) for traits VCC, SSC, and PT, respectively. In contrast, parent 4 showed lower means and estimates of GCA for traits MFL, PH, and FW.

In the context of progenies, hybrids 12 and 16 showed higher means and higher estimates of Specific Combining Ability (SCA) for traits PH and MFL, respectively. Conversely, hybrids 21 and 27 exhibited the lowest means and lowest estimates of SCA for traits PH and VCC. It should be noted that for traits SSC and FW, lower means' hybrids did not necessarily coincide with those showing the lowest estimates of SCA.

The analysis of variance performed to assess possible differences between accessions revealed statistical significance at the 1% and 5% levels, as indicated by the F-test. These differences were observed for all studied traits, as detailed in Table 3. The coefficient estimates of genetic variation, also presented in Table 3, ranged from 10% to 55%, with traits FW, PT, and MFL presenting the highest genetic variation among the studied accessions.

Table 3: This table presents the F-test of the analysis of variance of *Capsicum annuum* L. accessions for each evaluated trait, as well as the coefficient of genetic variation indicated by $CV_g(\%)$. The acronym MFL means the length of the mature fruit, PH means the plant height, FW means the width of the fruit, PT means the pulp thickness, VCC means the vitamin C content, and SSC means the soluble solids content.

SV	DF	MFL	PH	FW	PT	VCC	SSC	$F_{tab(1\%)}$	$F_{tab(5\%)}$
Accessions	28	89,46**	5,39**	104,61**	48,93**	7,99**	8,07**	2,03	1,65
Residuals	87	-	-	-	-	-		-	-
$CV_g(\%)$	-	40,87	17,05	54,16	44,45	17,46	10,06		

^{ls} means lack of significance, and ** means significant amounts of 1% and 5%, respectively.

In Table 4, we present the specific analysis of variance for the diallelic analysis of each studied trait, evaluating the significance of general combining ability (GCA) in groups I and II of parents and the interaction between them through specific combining ability (SCA). The F-test results indicated a lack of significance only for traits PH and SSC in the source of variation (SV) 'GCA Group II', and all analyses were statistically significant for the other traits.

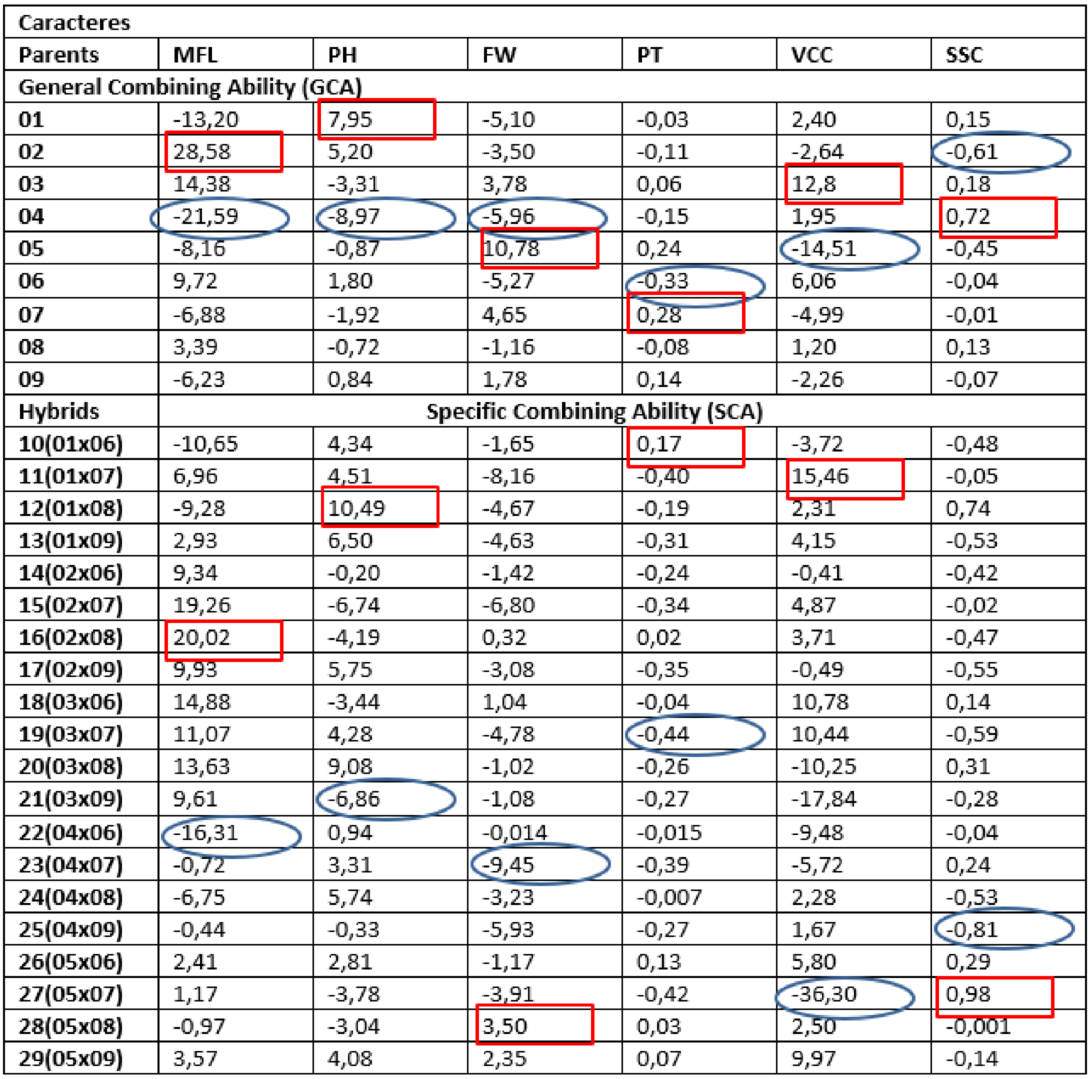
Table 4: F-test of the analysis of variance of a partial diallel associated with the effects of combinatorial capacity for the six traits related to the twenty-nine accessions of *Capsicum annuum* L., covering parents and their hybrid combinations. The acronym MFL means the length of the mature fruit, PH means the plant height, FW means the width of the fruit, PT means the pulp thickness, VCC means the vitamin C content, and SSC means the soluble solids content.

SV	DF	MFL	PH	FW	PT	VCC	SSC	$F_{tab(1\%)}$	$F_{tab(5\%)}$
Group	1	600,39**	8,78**	1375,29**	1006,36**	74,84**	53,30**	7,08	4,00
GCA Group I	4	329,94**	21,77**	209,91**	11,89**	17,77**	24,14**	3,65	2,53
GCA Group II	3	54,98**	$1{,}46^{ns}$	83,17**	37,26**	4,65**	$0{,}76^{ns}$	4,13	2,76
SCA IxII	20	20,98**	2,53**	23,23**	10,22**	3,19**	3,69**	2,20	1,75
Residuals	87	-	-	-	-	-	-	-	-

^{ls} means lack of significance, and ** means significant amounts of 1% and 5%, respectively.

Finally, Table 5 presents the general combining ability (GCA) estimates for each parent and specific combining ability (SCA) for each hybrid, covering all studied traits. We highlight the highest estimates with red rectangles and the lowest with blue circles for each parameter inside each character evaluated.

Table 5: Estimates of general combining ability (GCA) for each parent and estimates of specific combining ability (SCA) for each hybrid for traits mature fruit's length (MFL), plant height (PH), fruit width (FW), pulp thickness (PT), vitamin C content (VCC), and soluble solids content (SSC).



Caracteres						
Parents	**MFL**	**PH**	**FW**	**PT**	**VCC**	**SSC**
General Combining Ability (GCA)						
01	-13,20	7,95	-5,10	-0,03	2,40	0,15
02	28,58	5,20	-3,50	-0,11	-2,64	-0,61
03	14,38	-3,31	3,78	0,06	12,8	0,18
04	-21,59	-8,97	-5,96	-0,15	1,95	0,72
05	-8,16	-0,87	10,78	0,24	-14,51	-0,45
06	9,72	1,80	-5,27	-0,33	6,06	-0,04
07	-6,88	-1,92	4,65	0,28	-4,99	-0,01
08	3,39	-0,72	-1,16	-0,08	1,20	0,13
09	-6,23	0,84	1,78	0,14	-2,26	-0,07
Hybrids	**Specific Combining Ability (SCA)**					
10(01x06)	-10,65	4,34	-1,65	0,17	-3,72	-0,48
11(01x07)	6,96	4,51	-8,16	-0,40	15,46	-0,05
12(01x08)	-9,28	10,49	-4,67	-0,19	2,31	0,74
13(01x09)	2,93	6,50	-4,63	-0,31	4,15	-0,53
14(02x06)	9,34	-0,20	-1,42	-0,24	-0,41	-0,42
15(02x07)	19,26	-6,74	-6,80	-0,34	4,87	-0,02
16(02x08)	20,02	-4,19	0,32	0,02	3,71	-0,47
17(02x09)	9,93	5,75	-3,08	-0,35	-0,49	-0,55
18(03x06)	14,88	-3,44	1,04	-0,04	10,78	0,14
19(03x07)	11,07	4,28	-4,78	-0,44	10,44	-0,59
20(03x08)	13,63	9,08	-1,02	-0,26	-10,25	0,31
21(03x09)	9,61	-6,86	-1,08	-0,27	-17,84	-0,28
22(04x06)	-16,31	0,94	-0,014	-0,015	-9,48	-0,04
23(04x07)	-0,72	3,31	-9,45	-0,39	-5,72	0,24
24(04x08)	-6,75	5,74	-3,23	-0,007	2,28	-0,53
25(04x09)	-0,44	-0,33	-5,93	-0,27	1,67	-0,81
26(05x06)	2,41	2,81	-1,17	0,13	5,80	0,29
27(05x07)	1,17	-3,78	-3,91	-0,42	-36,30	0,98
28(05x08)	-0,97	-3,04	3,50	0,03	2,50	-0,001
29(05x09)	3,57	4,08	2,35	0,07	9,97	-0,14

Based on the GCA estimates, it is relevant to note that each trait had a distinct parent with higher estimates. However, for the lower estimates, parent 4 was the only one with lower values in more than one trait (MFL, PH, and FW). Standout parents are explicitly detailed in Table 5.

Regarding the estimates of SCA, it is interesting to note that both hybrids with lower estimates and those with higher estimates were distinct for each trait, reinforcing the diversity in genetic interactions.

DISCUSSION

In the preliminary analysis of the mean estimates of the studied accessions, available in Table 2, it was possible to anticipate the trends of the GCA estimates. The correspondence between higher means and higher GCA estimates, as well as lower means and lower GCA estimates, aligns with the observations of Kurek et al. (2001), indicating that the early assessment of original means facilitates the identification of the best parents in the diallel analysis. When examining the progeny means, we again observe a correspondence between higher means and higher estimates of SCA and lower means and lower estimates of SCA. However, it is crucial to note that there were cases where this correspondence was not evident, highlighting the complexity of heritable traits. Thus, the preliminary analysis of means raises an optimistic perspective regarding the potential for superior performance, even before conducting the diallel analysis.

The identification of significant differences between accessions for all studied traits, highlighted by the F-test in Table 3, emphasizes the presence of genetic variability among at least two of the investigated accessions for each evaluated trait. Identifying such differences is vital, as emphasized by Ferrão et al. (2011); the detection of genetic gains is essential in directing future plant breeding endeavors.

Considering the estimates of the genetic coefficient of variation, a parameter that provides insights into the magnitude of this variability (Ferrão et al., 2008), the estimated values, ranging from 10% to 55%, indicate that higher estimates are associated with a higher probability of selecting accessions with desirable agronomic characteristics (Leite et al., 2015). In this context, the traits FW, PT, and MFL emerge as key characteristics that contribute significantly to selecting promising genotypes.

As we delve into the analysis of variances in the diallel analysis, as presented in Table 4, the observation of statistically significant differences for all traits in the 'Groups' source of variation highlights the contrast between Groups I and II of parents, indicating the need for further investigation of crosses between them. The detection of significant differences in the source of variation 'GCA Group I' indicates that at least one parent in this group differs from the others regarding the frequency of favorable alleles in all studied traits. On the other hand, the non-significance of the F-test for PH and SSC traits in the source of variation 'GCA Group II' indicates that the overall combining ability of parents in this group does not differ statistically. Therefore, the GCA effects for these traits are null, suggesting a lower probability of inheritance of these traits by the progeny.

The finding of significant differences in all studied traits in the 'SCA I x II' source of variation (related to the interaction between Groups I and II) suggests the existence of at least one hybrid combination with divergent parents. In other words, at least one hybrid exhibits high variability and a high frequency of favorable alleles. These findings are consistent with the evaluations of GCA and SCA estimates, as presented in Table 5.

In evaluating hybrids, we consider good those with higher estimates of Specific Combining Ability (SCA) and at least one parent with the highest General Combining Ability (GCA) for the same trait. Thus, the hybrids *Pimenta Vulcão* x *Pimentão Cascadura Ikeda* (12), *Pimenta Cayenne* x *Pimentão Cascadura Ikeda* (16), and *Pimenta Jamaica Yellow* x *Pimentão Cascadura Ikeda* (28) stood out as promising for the PH, MFL, and FW traits, respectively. These hybrids had the respective parents *Pimenta Vulcão* (1), *Pimenta Cayenne* (2), and *Pimenta Jamaica Yellow* (5) with the highest GCA estimates, indicating a potential gain in improving these traits in their progeny. These findings are particularly relevant for genetic improvement, as these traits are valued in the food market and can be considered promising candidates for future crosses.

For those interested in reducing the expression of fruit length and width traits (MFL and FW), the *Pimenta Picante para Vaso* x *Pimenta Doce Italiana* (22) and *Pimenta Picante para Vaso* x *Pimentão Quadrado* (23) hybrids are highlighted for their lower SCA estimates for these traits, in addition to having the parent *Pimenta Picante para Vaso* (04), which has the lowest GCA estimate for these traits. These hybrids may be attractive for the ornamental plant market, and the parent *Pimenta Picante para Vaso* (04) proves promising to be employed in the F2 generation.

However, the hybrid *Pimenta Jamaica Yellow* x *Pimentão Quadrado* (27), which has a lower SCA estimate for vitamin C content (VCC), and the parent *Pimenta Jamaica Yellow* (05), with the lowest GCA estimate for VCC, is not recommended for the F2 generation, as it suggests a reduction in the expression of this trait. Considering that high levels of vitamin C are desirable to positively influence the fruit's aroma, taste, and coloration, as Pinto et al. (2013) mentioned, this observation has high relevance.
Regarding fruit thickness (PT), a contrasting dynamic was observed, where the parent *Pimenta Doce Italiana* (06) exhibited lower GCA, and the descendant 10 [*Pimenta Vulcão* (01) x *Pimenta Doce Italiana* (06)], with higher SCA, suggest an increase in the expression of this trait when a reduction was expected. Furthermore, the parent *Pimentão Quadrado* (07), possessing the highest positive GCA, produces the progeny 19 [*Pimenta Peter* (03) x *Pimentão Quadrado* (07)] with lower negative SCA, suggesting a reduction in the expression of this trait when an increase was expected. These two cases emphasize the intrinsic complexity of these genetic interactions.

Finally, hybrids had no significant distinction regarding the characteristic of soluble solids content (SSC). This characteristic is directly linked to the sugar content in the fruit, with high levels of soluble solids desirable to ensure fruit quality (Moreno-Reséndez et al., 2016) and to impart greater pungency in peppers that exhibit this trait (Marouelli and Silva., 2008). Therefore, no hybrid demonstrated notable performance in higher soluble solids content.

CONCLUSIONS

Our research revealed significant variability among the studied accessions, providing a foundation for the selection of lines for future breeding programs. These programs aim to enhance essential agronomic characteristics of *Capsicum annuum* L. to meet specific market demands. In this context, the hybrids *Pimenta Vulcão* x *Pimentão Cascadura Ikeda* (12), *Pimenta Cayenne* x *Pimentão Cascadura Ikeda* (16), and *Pimenta Jamaica Yellow* x *Pimentão Cascadura Ikeda* (28) outstood as options for the food market, especially in the production of pepper-based sauces. The *Pimenta Picante para Vaso* x *Pimenta Doce Italiana* (22) and *Pimenta Picante para Vaso* x *Pimentão Quadrado* (23) hybrids showed potential for the ornamental plant market. Due to the reduced vitamin C content, the hybrid *Pimenta Jamaica Yellow* x *Pimentão Quadrado* (27) is not recommended for the F2 generation. On the other hand, the parent *Pimenta Picante para Vaso* (4) proved strategic, offering the potential to reduce plant dimensions, height, and fruit width, making it valuable for the ornamental plant market. Lastly, the parent *Pimenta Peter* (3) stood out as a promising choice to meet the growing demand for nutritious and functional foods, thanks to its high indicator of vitamin C content.

Conflict Of Interest

The authors declare no conflict of interest.

Competing Interests

There are no competing interests.

Ethics Committee

None.

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Authorship Contributions

The authors of this publication contributed to the following capacities:
Thaynara Aparecida de Souza Neto: Conceptualized the study, contributed to data analysis and interpretation, and wrote the manuscript.
Jhennifer dos Santos Nascimento: Conducted the critical content review, wrote the manuscript and translated the manuscript.
Beatriz Barbosa Lopes: Reviewed the theoretical framework.
Paulo Roberto Cecon: Contributed to the study's conceptualization, conducted critical content review, and provided final manuscript approval.
Paulo César Emiliano: Contributed to the critical content review and provided final manuscript approval.

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