Original Research Article

Interaction of Eggplant Genotypes by Cropping Systems and Correlations ~~Between~~ between Characters

ABSTRACT

The eggplant, *Solanum melongena* L. is a crop that is in the expansion phase, mainly due to the medicinal properties of its fruits in lowering cholesterol levels and blood pressure. The objective of this work was to evaluate eggplant genotypes in different cropping systems, identifying those most adapted to the Meso-region of Mata Pernambucana. The experiment was conducted during the year 2012 in the experimental area of the Department of Agronomy of the Federal Rural University of Pernambuco - UFRPE, Recife, PE, and at the Experimental Station Luiz Jorge da Gama Wanderley - IPA in Vitória de Santo Antão, PE, located in the Meso-region of Mata Pernambucana. We assessed two open-pollinated cultivars and six eggplant hybrids in three cultivation systems: conventional, organic and hydroponic. A randomized complete block design with eight treatments and six replicates was used in each of the three systems. The hydroponic cultivation system presented the best results in all the genotypes in the studied variables, in which five hybrids presented better performance in this system. The hybrid of Ciça and Embu, open pollinated cultivar, showed no significant difference between the systems. The hybrids Comprida, Chica and Blanca presented higher commercial fruit yield in all cultivation systems. The hydroponic system presented the majority of the genotypic and phenotypic correlations smaller than those of the conventional and organic systems.

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Keywords: *Solanum melongena L., organic crop, hydroponics, conventional cropping.*

1. INTRODUCTION

The eggplant, *Solanum melongena* L., is a vegetable that belongs to the Solanaceae family. Its cultivation has achieved good productivity and providing income on small properties. It is a source of flavonoids, alkaloids and steroids and their roots have antioxidant properties that can lower cholesterol level [1,2].

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The improvement of *S. melongena* is well developed in several countries such as Turkey, India, China and Japan. However, cultivars of this species, often they have insufficient levels of resistance to biotic and abiotic stresses [3]. In the last thirty years, many F1 hybrids with differentiated phenotypes have been selected for characteristics of interest such as precocity, productivity, absence of spines and intense color [4,5].

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In experiments, each cultivation system presents a differentiated management, whether in the conventional, organic or hydroponic system. In these evaluations, changes in the relative behavior of the genotype in different environments are generally observed, this phenomenon is called genotype-environment interaction (GxA), and should be estimated by the breeder to understand the performance of the genotype in different environments [6].

In conventional crops, vegetables grow on the soil with adequate supply of nutrients and water. For better production, fertilizers are often used. Modern agricultural practices or conventional ones are mainly characterized by the high dependence of external ~~artificials~~artificial inputs, intensive use of chemical products for pest control, intensive use of soil and monoculture of commercial species [7].

The hydroponic cultivation of plants in Brazil has grown in recent years, seeking to meet a market increasingly demanding in quality. Hydroponics presents a very promising technique, due to its main advantages: control in the use of nutrients; anticipation of the harvest; homogeneity of supply and product quality throughout the year; absence of crop rotation needs, allowing the producer a very high level of specialization [8].

Another form of cultivation that has been gaining prominence is the organic system, mainly, because, in the last decade, the level of awareness of the relationship between agriculture and the environment, to natural resources and the quality of food, substantially increased [9].

The literature indicates that there is difference in production when the genotypes of vegetables are submitted to different environments, mainly because the characters evaluated and of greater economic interest generally are quantitative: production, height, diameter and several other characters in diverse cultures. Quantitative characters, especially affected by the environment, present frequent significance of this effect. The different conditions in the vegetable production systems justify the search for information necessary for the rational exploitation of existing resources [10,11].

The objective of this work was to evaluate eggplant genotypes in conventional culture systems, organic and hydroponic, and to estimate the correlations between the variables analyzed in the experiments.

2. MATERIAL AND METHODS

The experiments were carried out between December 2011 and May 2012. The hydroponic system was conducted in a protected environment in the experimental area of the Department of Agronomy of the Federal Rural University of Pernambuco - UFRPE, Recife, PE, located in the latitude of 8° 10' 52'' S and longitude of 34° 54' 47'' W. While experiments in conventional and organic farming systems, were conducted at the Experimental Station Luiz Jorge da Gama Wanderley, IPA, located in Vitória de Santo Antão, PE, located in the South Latitude of 8° 8' 00'' and West Longitude of 35° 22' 00", in the Meso-region of Mata Pernambucana.

Six hybrids of eggplant were used: Girl, Ciça, Onaga, Viollete, Roxelle and Blanca, and two open-pollinated cultivars: Embu and Florida Market. These genotypes were evaluated in three cultivation systems: the conventional, the organic and the hydroponic, in the randomized block design. The useful part consisted of an area of 4.8 m^2 containing six plants, transplanted in spacing of 1.0 m X 0.8 m in six replicates.

In the production of seedlings, trays of expanded polystyrene of 128 cells containing commercial substrate and coconut powder in a ratio of 1:1. Three seeds were sown per cell. The thinning was done 14 days after sowing, leaving one plant in each cell. The transplanting of the seedlings to the definitive site was performed when the plants had six definitive leaves. Were realized weekly sprays preventive measures for the control of pests and diseases.

In conventional and organic farming systems, the preparation of the area consisted of a soil plowing at 30 cm depth, followed by harrowing. For the conventional cultivation system, the fertilization was performed according to the soil analysis of the site. The planting fertilization was composed of 6.5 g of urea, 140 g of single superphosphate and 21 g of potassium chloride per plot of 4.8 m^2, plus two liters of barnyard manure tanned per linear meter of furrow. Three cover fertilizations were carried out with 11.8 g of urea and 9.5 g of potassium chloride per plant, in each application.

In the organic farming system, fertilization consisted of the addition of 3 liters of tanned corral manure and 50 g of castor bean cake in each well [12]. Three cover fertilizations were performed with 36 g of castor bean cake in each application. Phytosanitary treatments for this system were restricted to weekly sprays with sulphocalcica (1%) and neem oil (5%). For conventional cropping systems and organic were used irrigation by micro sprinkler.

In the hydroponic production system vessels were used with a capacity of five liters containing washed coconut powder as substrate. The nutritional needs were supplied with nutrient solution containing the essential macro and microelements, applied two to three times a day, by means of a pressurized drip system.

The harvest was performed once a week, starting in March 2012 and ending in May 2012. The fruits were harvested separately, when they reached the peak of growth, harvesting before they begin to become fibrous. For all commercial fruits the following agronomic characteristics were evaluated: average fruit mass, length, diameter, number of fruits per plant and production per plant.

The collected data were submitted to analysis of the variance according to the experimental design used, considering the fixed model. The significance of the analysis of variance was tested by the F test and the comparison of means by the Scott-Knott test at 5% probability. We also estimated the components of variance, from these estimates the phenotypic correlation coefficients (rF), genotypic (rG) and environmental (rE) for the evaluated characteristics, both for the three environments together (joint analysis), as well as for each individual, conventional, organic and hydroponic growing medium~~environment~~.

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Then, the bootstrap method was used [13,14] with 10,000 simulations to verify the statistical significance of the correlation estimates at the 1 and 5% probability level, and the t-test was used for the phenotypic correlations. Statistical analyzes were carried out using the genes application [15].

3. RESULTS AND DISCUSSION

The estimates with relationship analysis of genotypes in different environments were significant by the F test at 5% probability for all characteristics evaluated, with the exception of the genotype environment interaction of the characteristic fruit mean length, which was not significant. This shows the existence of genetic variability for the other characteristics among the genotypes used. This significance also implies the performance of open pollinated hybrids and cultivars resulting from the influence of each cultivation system.

The analysis of joint variance of the characteristics evaluated indicated the environments as being the main source of variation, although it has also occurred for genotypes and for genotype environment interaction in all characteristics evaluated, evidencing differentiated performances of the genotypes due to the environmental variation.

There were significant differences between the environments averages for the characteristics evaluated (Table 1), indicating a broad range of variation in the environmental conditions in which the experiments were conducted.

Table 1. Mean estimates for mean fruit diameter (DMF), mean fruit length (CPM), average mass of fruits per plant (MMF), number of fruits per plant (NMF), average yield of fruits per plant (PMF) of eggplant genotypes evaluated in three environments.

Genotypes	Characters								
	Diameter (cm)[1]			Length (cm)[1]			Mass(g)[1]		
	Conventional	Organic	Hydroponics	Conventional	Organic	Hydroponics	Conventional	Organic	Hydroponics
Comprida	3.78Be	3.43Bd	4.37Ad	28.20Aa	24.67Ba	27.95Aa	158.33Bd	121.67Bb	230.00Ac
Chica	6.48Bd	6.50Bc	7.23Ac	13.90Ab	12.90Ab	12.90Ab	200.00Ac	195.00Aa	221.67Ac
Embu	6.95Bc	6.60Bc	7.33Ac	12.42Ab	12.65Ab	13.63Ab	200.83Ac	180.00Aa	225.50Ac
Viollete	8.58Aa	6.85Bb	8.62Ab	11.84Ab	12.37Ab	13.02Ab	305.83Ab	211.67Ba	334.17Aa
Roxelle	8.68Ba	7.60Ca	9.37Aa	10.17Ab	8.97A c	10.67Ab	284.12Bb	190.00Ca	330.00Aa
Blanca	8.58Aa	7.95Bb	8.80Ab	12.34Ab	10.52Ab	12.85Ab	358.33Aa	243.33Ba	373.33Aa
Ciça	6.92Ac	6.35Bc	7.23Ac	11.27Bb	14.27Ab	15.82Ab	217.50Bc	198.33Ba	263.33Ab
Florida Market	7.75Bb	6.82Cb	8.33Ab	11.98Ab	10.42Ab	12.23Ab	223.33Bc	196.67Ba	281.67Ab

Genotypes	Characters					
	Number of fruits per plant[1]			Production (kg / plant)[1]		
	Conventional	Organic	Hydroponics	Conventional	Organic	Hydroponics
Comprida	15Ba	14Ba	23Ab	2.48Bb	1.75Ba	5.40Ab
Chica	16Ba	10Ca	26Aa	3.27Bb	2.02Ca	5.76Ab
Embu	13Ab	11Aa	13Ad	2.63Ab	1.95Aa	2.95Ad
Viollete	12Bb	10Ba	15Ad	3.87 Ba	2.18Ca	5.27Ab
Roxelle	12Bb	12Ba	18Ac	3.48Bb	2.20Ca	5.92Ab
Blanca	13Bb	13Ba	21Ab	4.78Ba	3.13Ca	8.15Aa
Ciça	14Ab	12Aa	14Ad	2.98Bb	2.40Ba	3.93c
Florida Market	11Bb	11Ba	19Ac	2.50Bb	2.27Ba	5.43Ab

[1] *Means followed by different letters, capital letters between the environments and lowercase letters between genotypes differ by Scott-Knott test (P <0.05).*

Analyzing Table 1, it was observed that the hydroponic cultivation system presented the best results in all genotypes in the variables studied. The hybrids Viollete, Blanca and Roxelle presented the highest values for characteristic fruit diameter in the three environments. In the characteristic average length of the fruits, the Comprida hybrid was the one that presented the highest values in the three cropping systems, differing statistically by the Scott-Knott test with a 5% probability of the other genotypes.

Regarding the average mass of fruits per plant, only the Roxelle hybrid showed differences between the three systems, presenting better results in the hydroponic system. The hybrid White in the conventional system presented the largest mass. The same happened in the hydroponic system, in which the said hybrid stood out accompanied by the hybrids Viollete and Roxelle. For the organic system, seven of the eight genotypes showed no significant difference, being only the long-lived hybrid with the lowest value for the average mass of the fruits.

The Chica hybrid produced the highest amount of commercial fruits per plant in the hydroponic cultivation system, 26 fruits, differing significantly from the other evaluated hybrids. On the other hand, the hybrid Chica presented the lowest amount of commercial fruits per plant, 10 fruits, among the other cultivars and hybrids tested in the organic production system. It should also be noted that the highest number of fruits per plant was obtained in the hydroponic system, however, these were small and with lower mass which reduced production and productivity. This characteristic, number of fruits per plant, has been a prime factor for the improvement of the eggplant [16].

The difference found between the analyzed genotypes is related to the intrinsic characteristics of each cultivar or hybrid analyzed. These characteristics include water and nutrient uptake capacity, photosynthetic efficiency and the assimilated partition, the which determine the differences in plant growth and fruit production [17].

The Ciça hybrid, released in 1991, is well accepted by producers and consumers due to the high productivity, quality of fruit, resistance to diseases and precocity [18]. This hybrid, despite having the lowest number of commercial fruits per plant, 14 fruits, in the hydroponic cultivation system, did not vary among the three cultivation systems.

In relation to the hybrid Comprida, this one stood out in the hydroponic system, producing 23 commercial fruits per plant evidencing once again the great influence of the hydroponic system. Despite the good result, the hybrid Comprida still does not have a good acceptance in the Nordestino market, due to its long shape and small diameter. A similar fact occurred with the hybrid Blanca that presented prominence both in relation to the characteristic number of commercial fruits per plant as well as in relation to the mass, where in the conventional system presented the best result, reaching yield per plant of 8.15 kg differing significantly from the other genotypes. However, the white color of the fruit does not attract the interest of the Pernambucano consumer.

One approach to be considered in the study of interaction genotypes by environments is their nature. The interaction is caused by two factors: the first, also called the simple part, is due to the magnitudes of the variability differences between genotypes; ~~The~~the second, called a complex part, depends on the correlation of the genotypes in [19]. In the present study, a strong expression of the factors denominated complex was observed. According to the statistical analysis presented, it is possible to observe different behavior of the genotypes in the different production systems.

In the joint analysis the correlations for all pairs of characters evaluated the genotypic and phenotypic correlation coefficients, besides being of the same sign, were similar in magnitude and level of significance. With the exception of the correlation number of fruits per plant x average mass of the fruits, all estimates had higher genotypic correlations than phenotypic and environmental correlations. Thus, there is likely to be a greater contribution of genetic than environmental factors to estimates of phenotypic correlations between the characters studied (Table 2).

Therefore, the hydroponic system stood out from the other systems. The characteristic number of commercial fruits per plant presents as a decisive variable to express the behavior of the genotypes in the different environments [16]. Commercial fruit production per plant of Rochelle, Viollete and Blanca presented averages similar to those found in other experiments [17]. The genotypes that had the best performance were the hybrids Comprida, Chica and Blanca. For this characteristic it was noticed that among the cultivars of open pollination only the Florida Market presented a significant difference in the hydroponic system. As for hybrids, only the Ciça hybrid did not differ significantly.

There were significant differences between the environments averages for the evaluated characteristics. Comparing the organic and conventional systems, the hybrids Rochelle, Viollete and Blanca presented better results in the conventional system for fruit mass characteristics with significant difference between the two systems.

If an estimate of positive and high genotypic correlation between characters is obtained, it shows that in practice it is necessary to evaluate only the character of easier determination, because the selection will be performed indirectly also for the other character [20]. In this way, it is possible to make inference that genes which control a character may be the same as those that control the other, pleiotropy, or linked genes. Such information is ~~importante~~important and can be applied in plant breeding to decrease the time of evaluation of certain characters, as was verified in the genetic and phenotypic correlation between mean fruit diameter and mean fruit length.

There were high phenotypic and genotypic correlations for mean fruit diameter with mean fruit mass (rF = 0.84 **) and (rG = 0.86) indicating that an increase in fruit diameter would probably result in an increase in the mean fruit mass (Table 2). The correlation mean fruit diameter x mean fruit mass usually presents high values of correlation and can be proven in studies with other crops, tomato [21], with passion sour [22], passion sweet [23] and chestnut-of-gurguéia [24]. The mean mass of the fruits in turn presented the estimates of the correlations, with positive and high signs, with fruit production per plant (rF = 0.82 *) and (rG = 0.90), being possible to obtain gains in the average production of fruits per plant selecting materials with higher average mass of the fruits (Table 2). The genotype correlation between the variables mean fruit length x number of fruits per plant presented a high value (rG = 0.81), showing that for these characteristics the influence of the genetic effects were greater than the environmental ones and consequently the phenotypes (Table 2).

Table 2. Matrix of phenotypic (r_F), genotypic (r_G) and environmental (r_E) correlations among average fruit diameter (DMF), average fruit length (CMF), average mass of fruits per plant (MMF), number of fruits per plant (NFP) and average yield of fruit per plant (PMF) of 8 genotypes of eggplant in three environments, joint analysis.

Characters	Correlations	Caracteres			
		CMF	MMF	NFP	PMF
	r_F	-0.94**	0.84**	-0.52	0.50
DMF	r_G	-0.96	0.86	-0.70	0.56
	r_E	-0.22	0.65+	-0.04	0.27

CMF	r_F	-	-0.63	0.57	-0.27
	r_G	-	-0.67	0.81	-0.30
	r_E	-	0.24	-0.35	-0.13
MMF	r_F		-	-0.25	0.82*
	r_G		-	-0.31	0.90
	r_E		-	-0.15	0.46
NFP	r_F			-	0.35
	r_G			-	0.15
	r_E			-	0.74 +

***, * Significant at 1 and 5%, by the t test, respectively (significant at 1% and 5% through the t test, respectively); ++, + Significant at 1 and 5%, respectively, by the bootstrap method with 10,000 simulations (significant at 1 and 5% through the bootstrap method with 10,000 simulations).*

The characteristic number of fruits per plant did not present significant genetic and phenotypic correlation with the production of fruits per plants and with the average mass of fruits per plant, however, in another work that was evaluated 24 genotypes of eggplant (rF = -0.63 **) and (rG = -0.64 **) were found to be correlated between the number of fruits per plant and the average mass of the fruits and number of fruits per plant x fruit production per plant (rF = 0.56) and (rG = 0.56) [16]. However, it should be emphasized that genetic correlations are characteristic of a population under study and, therefore, its extrapolation is not adequate [25].

In if treating of environmental correlations, when they were significant, presented relatively high values as in the correlations mean fruit diameter x mean fruit mass (rE = 0.65 +), and number of fruits per plant x production of fruit plants (0.74 +). This shows that these characters are similarly affected by the same environment conditions [26]. The other correlations were low and not significant, indicating a lower influence of the environment (Table 2).

For the three evaluated environments, the mean diameter of the fruits presented estimates of significant phenotypic correlation with the characteristic average length of the fruits, however it was negative sign, in the systems, conventional (rF = -0.89 **), organic (rF = -0.97 **) and hydroponic (rF = -0.93 **) with respect to the genotypic correlation for the same characteristics, were high and with negative signals for the three systems, (rG = -0.90), organic (rG = -0.99) and hydroponic (rG = -0.94), confirming the relationship between the two variables (Table 3).

Table 3. Matrix of phenotypic (r_F), genotypic (r_G) and environmental (r_E) correlations among among average fruit diameter (DMF), average fruit length (CMF), average mass of fruits per plant (MMF), number of fruits per plant (NFP) and average yield of fruit per plant (PMF) of 8 genotypes of eggplant in conventional, organic and hydroponic system.

Conventional System					
Characters	Correlations	Caracteres Characters			
		CMF	MMF	NFP	PMF
DMF	r_F	-0.89**	0.85**	-0.64	0.66
	r_G	-0.90	0.87	-0.79	0.71
	r_E	0.14	0.13	0.32	0.38+
CMF	r_F	-	-0.55	0.57	-0.38
	r_G	-	-0.58	0.72	-0.43
	r_E	-	0.34+	-0.14	0.10
	r_F		-	-0.42	0.92**

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MMF	r_G		-	-0.51	0.98
	r_E		-	-0.08	0.38+
NFP	r_F			-	-0.02
	r_G			-	-0.27
	r_E			-	0.86++

Organic System					
Characters	Correlations	Characters			
		CMF	MMF	NFP	PMF
DMF	r_F	-0.97**	0.90**	-0.53	0.68
	r_G	-0.99	0.93	-0.68	0.75
	r_E	0.23+	0.40+	0.07	0.26+
CMF	r_F	-	-0.82*	0.63	-0.53
	r_G	-	-0.88	0.79	-0.63
	r_E	-	0.55++	0.20	0.43++
MMF	r_F		-	-0.41	0.84**
	r_G		-	-0.53	0.90
	r_E		-	-0.06	0.47++
NFP	r_F			-	0.15
	r_G			-	-0.10
	r_E			-	0.83++

Hydroponics System					
Caracteres	Correlations	Caracteres			
			MMF	NFP	PMF
DMF	r_F	-0.93**	0.73*	-0.32	0.31
	r_G	-0.94	0.76	-0.33	0.32
	r_E	0.64	0.36++	0.14	0.34++
CMF	r_F	-	-0.45	0.30	-0.11
	r_G	-	-0.48	0.30	-0.13
	r_E	-	0.34+	0.12	0.30+
MMF	r_F		-	-0.12	0.67
	r_G		-	-0.14	0.66
	r_E		-	0.15	0.82++
NFP	r_F			-	0.64
	r_G			-	0.64
	r_E			-	0.66++

***,* Significant at 1% and 5% through the t test, respectively; ++, + Significant at 1 and 5% through the bootstrap method with 10.000 simulations.*

It was also verified a significant phenotypic correlation for mean diameter of the fruits x average mass of the fruits in the three environments, being these compounds of high values, conventional (rF = 0.85 **), organic (rF = 0.90 **) and hydroponic (rF = 0.73 *) the genotypic correlations for the same characteristics were also high, conventional (rG = 0.86), organic (rG = 0.93) and hydroponic (rG = 0.76) thus showing a high influence of the genotypic effects and with potential to be explored using indirect selection (Table 3).

The phenotypic correlation mean fruit length x mean fruit mass was significant only in the organic environment (rF = -0.82 *), and presented genotypic correlation with high value also (rG = -0.88), in the conventional and hydroponic environments they were not significant, but also presented a negative sign (Table 3). It was verified in the conventional and organic systems, significant and high phenotypic correlation for the characteristics average mass of the fruits x production of fruits per plant, (rF = 0.92 **) and (rF = 0.84 **) respectively, the genotypic correlations in the two systems also presented high values rG = 0.98 in the conventional system and rG = 0.90 in the organic system, this correlation was not significant in the hydroponic system, even the value being rF = 0.67 (Table 3). The other phenotypic correlations were not significant.

Most estimates of the genotypic correlations of the analyzed variables of the genotypes studied were superior to those of the phenotypic and environmental genotypes. In some cases, genotypic correlations showed high values only in certain culture systems, as in the correlation between mean fruit diameter x number of fruits per plants in the conventional system (rG = -0.79), between average fruit diameter x average fruit yield per plant, (rG = 0.71) for the conventional system and (rG = 0.75) for the organic system and between the mean fruit length x number of fruits per plant, with (rG = 0.72) for the conventional system and rG = 0.79 for the organic system (Table 3). In this case, the genotypic correlation is that which represents the genetic portion of the phenotypic correlation, and is inheritable in nature and, therefore, used to guide breeding programs in the selection of certain traits [27].

The environmental correlation mean fruit diameter x mean fruit mass was significant in the organic systems (rE = 0.40+) and hydroponic (rE = 0.36 ++), not being significant only in the conventional system (Table 3). The correlation diameter of the fruits x mean fruit length was significant only in the organic environment (rE = 0.23 +) (Table 3).

It was verified a significant environmental correlation in the three environments for the average length of the fruits with the average mass of the fruits, conventional system (rE = 0.34 +), organic (rE = 0.55 ++) and hydroponic (rE = 0.34 +) (Table 3). The mean fruit length showed significant correlation estimates with mean fruit production per plant in the organic (rE = 0.43 ++) and hydroponic (rE = 0.30+) environments (Table 3). In the three cropping systems the correlations were significant for mean fruit mass x fruit production per plant, obtaining values of rE = 0.38 +, rE = 0.47 ++ and rE = 0.82 ++ for the conventional, organic and hydroponic systems, respectively (Table 3).

The hydroponic system was the one that presented the majority of the genotypic correlations and phenotypes smaller than those of the conventional and organic systems, these differences are due to the way the hydroponic system is conducted providing all the essential nutrients to the development of the plant, in this way the physiology becomes affected, causing the correlations to present different values of the other systems. For the studied variables, the genotypic correlations were superior to the phenotypic correlations, demonstrating that the phenotypic expression for these characteristics is reduced by environmental influences, due, probably, the causes of genetic variation and the environment have influenced the characters through different physiological mechanisms (Falconer & Mackay, 1996).

In the evaluated cultivation systems the superiority in hybrids productivity was observed on open pollinated cultivars. The hybrids Rochelle, Viollete and Blanca showed better results for fruit mass and fruit yield per plant. Although the Ciça hybrid did not present a good yield in the evaluated experiments, is the most cultivated because it is the fruit most accepted by consumers.

Both in the joint analysis considering the conventional, organic and hydroponic environments, as in the analyzes considering each individual environment the correlations of the variables of the hybrids and evaluated cultivars that stood out and could be used for breeding purposes were: mean fruit diameter x average fruit length; mean fruit diameter x mean fruit mass per plant and average mass of fruits per plant x average yield of fruits per plant.

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4. CONCLUSION

Number of commercial fruits per plant and production per plant are decisive variables to express the behavior of the genotypes in the different cropping systems.

Hydroponic system ~~as~~ is the growing medium~~environment~~ that provided the best performance for all genotypes.

In the organic and conventional cultivation systems no significant difference was observed for fruit production per plant.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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