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Performance of Hybrids Between Local Varieties of Eggplant (*Solanum melongena*) and its Relation to the Mean of Parents and to Morphological and Genetic Distances among Parents

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Summary

Local varieties of eggplant (*Solanum melongena* L.) represent an elite germplasm for the development of hybrids specifically adapted to open field conditions. Fifteen local varieties obtained from a germplasm collection and selected so that they spanned a wide range of morphological and genetic distances, 10 experimental hybrids obtained using these materials as parents, and five commercial hybrids were evaluated in open field cultivation in Valencia, Spain. Traits studied were: yield, fruit weight, fruit flesh chroma, total phenolics (TP) and ascorbic acid concentration (AAC). We tested the suitability of the means of parents and morphological and genetic (AFLP-based) distances among parents for the prediction of hybrid performance and heterosis in these materials. Morphological distances were based on 35 traits and genetic distances on 65 polymorphic AFLP markers. As expected, local varieties had lower yields than commercial hybrids; however, some experimental hybrids presented yields similar to those of commercial hybrids. In general, experimental hybrids displayed heterosis for yield, with a mean value of 86.2 %. Variation existed among varieties for fruit weight, chroma, TP, and AAC, but mean values of heterosis for these fruit traits were not significant. Significant correlations were found between:
(i) the mean of parents and yield of their hybrids (r=0.799),
(ii) genetic distance between parents and yield of hybrids (r=0.691), and
(iii) genetic distance between parents and heterosis for yield (r=0.635).
No significant correlations were found between morphological distance and any of the traits studied. Results show that, in open field cultivation, eggplant hybrids obtained using germplasm accessions as parents could be competitive in yield with commercial hybrids and could contribute to increase the diversity of fruit types of current hybrid cultivars. The use of genetic distances could be of utility in selecting parents giving eggplant hybrids heterotic for yield.

Key words. ascorbic acid – germplasm – flesh colour – heterosis – molecular markers – total phenolics – yield

Introduction

Local varieties of eggplant (*Solanum melongena* L.) usually are highly homozygous and inbred due to the mostly autogamous reproduction of this crop (Kalloo 1993; Daunay et al. 1997). However, heterosis for yield traits in eggplant has been documented for a long time (Kakizaki 1931; Sambandam 1964) and yield improvements of up to 204 % above the means of parents have been recorded (Sidhu et al. 2004). In consequence, F_1 hybrids have been developed and are used in the commercial production, although the degree of utilization of hybrids varies greatly among growing systems. For example, the out of season cultivation under protected conditions in Mediterranean climate areas is mainly based on high yielding hybrid cultivars (Prohens et al. 2005a). These materials present specific adaptation to these conditions, like an improved ability to set fruits under suboptimal conditions for pollination (Marín 2004).

The use of hybrids in the open field cultivation, either for fresh market or for the food processing industry, has been less common, mainly because the seed of hybrids is more expensive than that of conventional cultivars and the price of the produce is lower than that for out-of-season cultivation. This picture is changing in the last years, and now there is an increase in the use of commercial hybrids under open field conditions, mainly because of the advantages represented by the high yield of these materials (Prohens et al. 2005a). Because up to now the utilization of hybrids in the open field has been marginal, the hybrid materials used for this type of cultivation often correspond to cultivars that were developed for greenhouse cultivation (Marín 2004). Because the growing and environmental conditions of greenhouse and open field cultivation are very different, the development of hybrids specifically adapted to open field conditions could lead to an optimal exploitation of genotype x environment interaction (Kang 1998).

Local varieties of eggplant have evolved and have been selected for cultivation in the open field. For each of the most important cultivar types, which are recognized by

the colour and shape of the fruit (DAUNAY et al. 1997; PROHENS et al. 2005b), many local varieties exist in European germplasm banks and breeders collections (DAUNAY et al. 2003). These materials represent an elite germplasm adapted to open field conditions and, therefore, could be used in the development of new hybrids that combine the specific adaptation to open field conditions of local varieties with the heterosis of hybrids.

The choice of the best parental matings is crucial for the development of superior hybrids and, because combinations of hybrids grow exponentially with the potential number of parents to be used, this is one of the most expensive and time-consuming steps in hybrid development programmes (AGRAWAL 1998). A parameter extensively used for the prediction of hybrid performance is the mean of parents. However, this requires an evaluation of the parents for each of the traits of interest (yield, quality or both) before obtaining and evaluating the hybrids. Also, morphological and molecular-based genetic distances among parents have been shown to be associated with hybrid performance, heterosis, or both, for yield traits in several crops (BERNARDO 1992; RIDAY et al. 2003; RODRÍGUEZ-BURRUEZO et al. 2003; YU et al. 2005; TEKLEWOLD and BECKER 2006). Morphological characterizations are often available from germplasm banks (DAUNAY et al. 2003; PROHENS et al. 2003; http://www.ecpgr.cgiar.org) and this allows obtaining an estimate of distances among accessions that could be used as potential parents. The availability of molecular characterizations from germplasm banks is less common; however, the utilization of high throughput molecular markers for obtaining genetic distances among parents is becoming more frequent (HAUSSMANN et al. 2004), even in small plant breeding laboratories, and it does not need the cultivation of adult plants.

Here we study the performance for yield and several external and internal quality traits representative of different breeding objectives in the genetic improvement of eggplant (DAUNAY 2007) in traditional local materials obtained from a germplasm collection and experimental hybrids obtained between them, and we compare them to commercial hybrids. We also study the potential use of the mean of parents and the morphological and genetic distances among parents for predicting the performance of eggplant hybrids. The objective is obtaining information of relevance for eggplant breeding.

Materials and Methods

Plant material and growing conditions

Fifteen local varieties of eggplant from different origins and belonging to different cultivar groups (Table 1) were used as parents for the development of experimental hybrids. The selection of the experimental hybrids to be used was performed taking into account:

(i) the availability of seeds,

(ii) that each parent participated in just one or two hybrids in order to avoid potential bias in the results due to overrepresentation of some of the parents,

Table 1. Origin and cultivar group of the parents and commercial hybrids used.

Accession	Locality/Seed company[a]	Province	Region/COUNTRY	Cultivar group
Local varieties				
P 1	Castro del Río	Córdoba	Andalusia/SPAIN	Semi-long
P 2	Uguíjar	Granada	Andalusia/SPAIN	Round
P 3	Carena	Jaén	Andalusia/SPAIN	Semi-long
P 5	Beijing	Beijing	Beijing/CHINA	Round
P 6	Vilafranca Penedés	Barcelona	Catalonia/SPAIN	Long
P 7	n. a.	Valencia	Valencia/SPAIN	Semi-long
P 8	n. a.	Valencia	Valencia/SPAIN	Semi-long
P 9	n. a.	Valencia	Valencia/SPAIN	Semi-long
P10	n. a.	Valencia	Valencia/SPAIN	Semi-long
P11	Monteagudo	Murcia	Murcia/SPAIN	Semi-long
P12	Media Legua	Murcia	Murcia/SPAIN	Round
P13	La Habana	La Habana	La Habana/CUBA	Semi-long
P14	La Aparecida	Alicante	Valencia/SPAIN	Round
P15	La Aparecida	Alicante	Valencia/SPAIN	Semi-long
P16	Gandía	Valencia	Valencia/SPAIN	Long
Commercial hybrids				
'10-201' F_1	Rijk Zwaan			Semi-long
'10-501' F_1	Rijk Zwaan			Semi-long
'Calanda' F_1	Ramiro Arnedo SA			Semi-long
'Mulata' F_1	Ramiro Arnedo SA			Semi-long
'Petra' F_1	Semillas Fitó SA			Semi-long

n. a.: not announced

[a]Locality of origin for the parents, or seed company for the commercial hybrids

(iii) that hybrids spanned a wide and continuous range for the morphological and genetic distances among parents,
(iv) that the experimental hybrids tested included crossings between different groups of cultivars as well as crossings within cultivar groups, and
(v) that the correlation between morphological and genetic distances among parents in the materials studied was non-significant.

This last requirement allows the independent study of the relationship between morphological distances of parents and hybrid performance or heterosis on one hand and the relationship between genetic distances of parents and hybrid performance or heterosis on the other. If we had chosen parents in which the morphological and genetic distances were correlated then we would have had that the estimations of the correlations between morphological or genetic distances and performance or heterosis of hybrids would be related and, in consequence, it would have been difficult to discern which of the two estimates (morphological or genetic distances) is better in the selection of hybrids. This resulted in the selection of 10 experimental hybrids for the experiment (Table 2). In addition, five F_1 commercial hybrids commonly used in Spain, both in greenhouse and in open field cultivation, were used as controls (Table 1).

Seeds of the local varieties, experimental hybrids and control hybrids were germinated on moistened filter paper in Petri dishes. Germinated seeds were transferred to seedling trays and, in July 2004, were transplanted to an experimental field in Valencia, Spain. Plants were spaced 1 m between rows and 0.4 m apart in the row and were drip irrigated. The standard horticultural practices for eggplant production in the area of Valencia were followed (Baixauli 2001). Fertilization was applied with the drip irrigation system and phytosanitary treatments were performed when necessary.

A completely randomised design, with five replications, and one plant per replication was used. The number of plants per variety tested (five) and the experimental design used was based on previous experiences by our group (e.g. Prohens et al. 2005b), which show that the experimental field and cultivation conditions used allow obtaining reliable estimates of the means and detection of significant differences among the materials tested. Special care was taken to improve the precision of the experiment (Little and Hills 1978) in order to reduce the experimental error associated to differences in the developmental stage of plantlets used for the transplant and in the management of the crop (e.g. drip irrigation with pressure compensating emitters to ensure the same amount of water and fertilizer per plant, pruning of the stem base off-shots to obtain a homogeneous intra-plant development, etc.). Experiments performed during several years by our group within the framework of the Eggplant Genetic Resources Network (EGGNET) in the same field plot used for this experiment have shown that under our conditions there is a high degree of dynamic stability (Dabholkar 1992) in the yield performance of eggplant (unpublished data), which indicates that data from a single year are meaningful for our purposes.

Traits studied

Total yield, fruit weight and the chroma, total phenolics (TP) and ascorbic acid concentration (AAC) of the fruit flesh, were obtained for individual plants. Plants were harvested (fruits at commercial stage, which was evaluated by the colour and glossiness of the fruit skin) once a week during the period August–October, and the total yield was obtained as the accumulated yield at the end of the growing period. Depending on the fruit size of each accession, between two and seven fruits per plant were used in the evaluation of fruit flesh quality traits. The chroma of the flesh of the fruit was calculated from the a* and b* CIELAB 1976 colour coordinates values obtained after measuring the flesh colour with a Minolta CR-300 chroma-meter (Minolta Co. Ltd., Osaka, Japan) fitted with a 8 mm diameter aperture using the formula chroma=$(a^{*2}+b^{*2})^{0.5}$. TP was determined in diluted juice according to the Folin-Ciocalteu procedure and expressed as μmol kg^{-1} of chlorogenic acid, as this is the most abundant phenolic compound (>75 % of TP) in eggplant (Whitaker and Stommel 2003; Luthria and Mukhopadhyay 2006). AAC (μmol kg^{-1}) was also determined in diluted juice by dichlorophenolindolephenol dye titration. Data were subjected to factorial analyses of variance (ANOVA) using a fixed effects model for the effect of variety. The average (pooled) standard error for each trait was obtained from the corresponding ANOVA. Heterosis for the traits measured was estimated using the formula H = 100 x ((F1−MP)/MP), where H= heterosis, F1= mean

Table 2. Parental cultivar groups and estimates of morphological (Euclidean) and genetic (Dice) distances between parents of the experimental hybrids tested.

Hybrid	Parental cultivar groups	Morphological distance	Genetic distance ($x10^{-2}$)
P 2 x P 5	Round x Round	63870	3.817
P 3 x P 8	Semi-long x Semi-long	89417	2.326
P 6 x P 5	Long x Round	89285	3.797
P 7 x P 3	Semi-long x Semi-long	79784	2.062
P 8 x P 7	Semi-long x Semi-long	48231	0.775
P10 x P16	Semi-long x Long	85562	2.813
P11 x P 1	Semi-long x Semi-long	67811	3.553
P12 x P 9	Round x Semi-long	84355	5.556
P12 x P15	Round x Semi-long	71336	4.040
P14 x P13	Semi-long x Round	81143	5.789

of the F_1 hybrid, and MP = mean of parents, and tested for significance using a t-test.

Morphological and genetic distances

Morphological and molecular characterization data of the local varieties were available from the germplasm bank of the Instituto de Conservación y Mejora de la Agrodiversidad Valenciana (COMAV, Spain). The morphological characterization data consisted of seven vegetative traits and 28 inflorescence and fruit traits corresponding to primary characterization descriptors developed by the European Eggplant Genetic Resources Network (EGGNET) and had been obtained from plants characterized in the open air. Molecular characterization was made with amplified fragment length polymorphisms (AFLPs) using four combinations of primers for the selective amplification. This resulted in 65 polymorphic AFLP markers among the materials studied. Full details of the morphological and molecular characterization can be consulted elsewhere (Prohens et al. 2005b). For the morphological traits, data were standardized and analysed using the Phyltools software (Buntjer 2001) in order to calculate the pair wise Euclidean distances among the parents, while for the AFLP data, genetic similarities were estimated with the Dice (1945) similarity coefficient and used to calculate the genetic distances. Pearson and Spearman correlation tests between the mean of parents, morphological and genetic distances on one side, and hybrid means and heterosis on the other, were calculated.

Results

Morphological and genetic distances

The parents of the experimental hybrids displayed considerable differences in the morphological and genetic distances among them (Table 2), although the relative differences among genetic distances were greater than among the morphological distances. At this respect, the ratio between the highest and lowest values for the morphological distances was 1.85, while for the genetic distances was 7.47. The coefficient of correlation between morphological and genetic distances in the hybrids studied is non-significant (r=0.406; P=0.245) and in consequence, the coefficient of determination (r^2) between both distances is low (r^2=0.164), indicating that in the materials studied only a small part of the morphological variation is explained by the molecular variation. This allows us the independent comparison of the utility of both distances (morphological and genetic) in the prediction of the performance and heterosis of hybrids.

Performance of parents, experimental and control hybrids

Important differences for yield were found among the local varieties (0.69 and 4.09 kg m^{-2}) or experimental hybrids (1.57 to 7.05 kg m^{-2}), but not among commercial control hybrids (4.46 and 5.81 kg m^{-2}) (Table 3). Local varieties had lower mean values (2.23 kg m^{-2}) than experimental (4.33 kg m^{-2}) or commercial hybrids (5.16 kg m^{-2}). Some experimental hybrids had yields which did not differ significantly from those of the control commercial hybrids, and even one of them (P2xP5) had a yield greater than 7 kg m^{-2}, while commercial hybrids did not reach 6 kg m^{-2} (Table 3). All experimental hybrids, except one (P8xP7), had a yield higher than that of the mean of parents. At this respect, the mean value of heterosis for yield was of 86.2 % (Table 4), although in some cases the experimental hybrids presented values of heterosis above 100 % (P2xP5, P11xP1 and P12xP9).

The differences among local varieties for fruit weight (172–463 g) were greater than among experimental or commercial control hybrids (308–491 and 271–377 g, respectively) (Table 3). This is because two of the hybrids (P7xP3 and P11xP1) gave fruits considerably greater than their parents (Table 3). Nonetheless, mean differences among the parents and their hybrids (as well as with the commercial hybrids) were not important and accordingly, and contrarily to what occurred for yield, the mean heterosis value was not significant (Table 4).

Regarding fruit flesh quality traits, values of chroma ranged between 10.56 and 22.15, those of TP between 939 and 2160 μmol kg^{-1}, and those of AAC between 88.0 and 123.4 μmol kg^{-1}. These results show that in relative terms, chroma and TP show greater variation than AAC, and the concentrations of TP are, in absolute terms, much greater than those of AAC, the other antioxidant studied. Also, it is of interest to notice that in all cases, the range of variation among genotypes was wider in the local varieties and experimental hybrids than in the control hybrids (Table 3). In all cases the values of the commercial hybrids are within the range of those found for the parents and experimental hybrids (Table 3). Mean heterosis value for these three fruit flesh quality traits was non-significant as well (Table 4).

Relationship of hybrids performance to the mean of parents and to morphological and genetic distances among parents

Pearson and Spearman correlation values were very similar and highly correlated (r=0.93; P<0.001), and in consequence we just present the results of one of them (Pearson correlations). A significant correlation was found between the mean of parents and the mean of the experimental hybrids tested for yield, but not for fruit weight, chroma, TP or AAC (Table 5). No significant correlation was detected between the means for any of the traits and morphological distances. However, there was a significant correlation of yield with genetic distance among parents (Table 5).

Regarding the correlations between the mean of parents, parental morphological or genetic distances and the heterosis of the hybrids (Table 5) for the traits studied, only the negative correlation between the mean of parents and heterosis for fruit weight (Pearson correlation coefficient r=0.861**), as well as the positive correlation between genetic distance and heterosis for yield (0.635*) were found to be significant (Table 5). No significant correlations were detected between morphological distances of the parents and hybrid heterosis for any of the traits.

Discussion

The results obtained suggest that eggplant hybrids obtained by crossing accessions from germplasm banks represent an opportunity for developing new materials for

Table 3. Mean values and average standard error (SE; obtained from the ANOVA analyses) for five quantitative yield and fruit quality traits for the parents, commercial hybrids and experimental hybrids tested.

Accession	Yield (kg m^{-2})	Fruit weight (g)	Chroma	TP (μmol kg^{-1})	AAC (μmol kg^{-1})
Local varieties					
P 1	0.69	172	21.96	2160	123.4
P 2	2.32	330	16.50	1156	100.9
P 3	1.32	203	19.25	2123	108.3
P 5	4.09	463	18.60	1197	112.5
P 6	2.17	194	22.15	939	106.6
P 7	2.41	368	14.98	1204	109.2
P 8	1.83	446	13.42	1568	92.1
P 9	2.12	454	12.14	1238	88.1
P10	1.26	431	13.98	1437	96.0
P11	2.81	226	13.73	885	99.4
P12	2.86	373	17.07	972	114.5
P13	1.02	233	17.91	972	113.9
P14	3.59	394	17.89	1471	120.4
P15	3.19	420	17.59	1141	105.6
P16	1.74	421	14.53	1132	88.0
Mean	**2.23**	**342**	**16.78**	**1306**	**105.3**
Commercial hybrids					
'10-201'	4.46	271	20.05	1006	93.2
'10-501'	5.81	377	18.18	1430	100.0
'Calanda'	5.07	353	18.01	1185	98.9
'Mulata'	4.88	274	19.83	1178	106.1
'Petra'	5.56	324	18.59	1104	98.6
Mean	**5.16**	**320**	**18.93**	**1181**	**99.4**
Experimental hybrids					
P 2 x P 5	7.05	460	19.73	1297	88.2
P 3 x P 8	2.94	381	12.42	1133	75.1
P 6 x P 5	6.09	392	19.97	1053	99.1
P 7 x P 3	3.20	426	14.58	1479	97.0
P 8 x P 7	1.57	308	18.57	1473	113.3
P10 x P16	2.05	358	13.30	1145	94.4
P11 x P 1	4.82	346	15.87	2093	98.6
P12 x P 9	5.89	491	16.57	950	101.3
P12 x P15	5.38	447	17.04	1099	104.5
P14 x P13	4.34	364	10.56	957	106.6
Mean	**4.33**	**397**	**15.86**	**1268**	**97.8**
SE	**0.67**	**35**	**0.57**	**92**	**3.3**

open field cultivation superior to the local landraces and with a yield comparable to that of the commercial F_1 hybrids. Commercial hybrids of eggplant usually have been developed for cultivation under greenhouse (Marín 2004) and, although these materials have either a high fertility or are parthenocarpic and give a good fruit set and yield under the suboptimal conditions of out of season cultivation under greenhouse (Abak and Guler 1994), their performance in the open air conditions is not superior to that of the best experimental hybrids. This indicates that, as proposed in other *Solanum* vegetable crops (Rodríguez-Burruezo et al. 2002), there are ample opportunities for exploiting the genotype x environment interaction in breeding for yield in eggplant.

On average, eggplant displays heterosis for yield, but not for the external (fruit weight and colour) and internal (total phenolics and ascorbic acid content) quality traits studied. However, for each trait important differences exist among hybrids for the individual values of heterosis. These results are similar to that obtained in

Table 4. Heterosis calculated on the basis of the parental means for five quantitative yield and fruit quality traits in the experimental hybrids tested.

Accession	Yield	Fruit weight	Chroma	TP	AAC
P 2 x P 5	120.0**	16.0^{ns}	–2.9^{ns}	10.3^{ns}	–17.3**
P 3 x P 8	86.7*	17.4^{ns}	–35.4***	–38.6**	–25.1**
P 6 x P 5	94.6*	19.3^{ns}	–8.9*	–1.4^{ns}	–9.5*
P 7 x P 3	71.6^{ns}	49.2*	15.3**	–11.1^{ns}	–10.9*
P 8 x P 7	–25.9^{ns}	–24.3*	–6.3^{ns}	6.3^{ns}	12.6*
P10 x P16	36.7^{ns}	–16.0^{ns}	–12.9*	–10.8^{ns}	2.6^{ns}
P11 x P 1	175.4*	73.9*	11.9*	37.5**	–11.5*
P12 x P 9	136.5**	18.7^{ns}	–0.2^{ns}	–14.0^{ns}	0.0^{ns}
P12 x P15	77.9*	12.7^{ns}	–8.4^{ns}	4.0^{ns}	–5.1^{ns}
P14 x P13	88.3*	16.1^{ns}	–7.4^{ns}	–21.7*	–9.0*
Mean	**86.2****	**18.3**^{ns}	**–5.5**^{ns}	**–4.0**^{ns}	**–7.3**^{ns}

^{ns}, *, **, *** indicate non-significant, or significant at P=0.05, 0.01 and 0.001, respectively.

Table 5. Pearson correlation coefficients between the mean of parents, morphological and genetic distances between parents, and: (a) the mean value (above), and (b) the heterosis calculated on the basis of the parental means (below), in the 10 experimental hybrids tested for the five traits studied.

	Mean of parents	Morphological distance	Genetic distance
Mean value in the 10 experimental hybrids			
Yield	0.799**	0.122^{ns}	0.691*
Fruit weight	0.289^{ns}	0.289^{ns}	0.513^{ns}
Chroma	0.208^{ns}	–0.455^{ns}	0.168^{ns}
Phenolics	0.455^{ns}	–0.520^{ns}	–0.437^{ns}
AAC	0.299^{ns}	–0.481^{ns}	0.112^{ns}
Heterosis in the 10 experimental hybrids			
Yield	0.181^{ns}	0.313^{ns}	0.635*
Fruit weight	–0.861**	0.170^{ns}	0.236^{ns}
Chroma	0.139^{ns}	–0.328^{ns}	0.094^{ns}
Phenolics	–0.246^{ns}	–0.628^{ns}	–0.077^{ns}
AAC	–0.340^{ns}	–0.431^{ns}	–0.182^{ns}

^{ns}, *, ** indicate non significant, or significant at P=0.05 and 0.01, respectively

other Solanaceous crops (Georgiev 1991; Rodríguez-Burruezo et al. 2003; Geleta and Labuschagne 2004) and suggest that the use of traditional varieties in the development of hybrids can contribute to increase yield without a negative effect on the external and internal quality traits studied. Furthermore, given that there is considerable variation among experimental hybrids for the quality traits studied, selection for these quality traits could be made, so that new varieties more adapted to the demands of the consumers can be developed. At this respect, there is an increasing demand for vegetables having a higher content in antioxidants (Schröder 2003). Given its high content in phenolics (Stommel and Whitaker 2003), eggplant is one of the vegetables with a greatest antioxidant activity (Cao et al. 1996; Bor et al. 2006), and selection for a higher concentration of these compounds could be of interest in developing new hybrids with improved nutritional quality.

The prediction of hybrid performance for traits of interest is a main goal for breeders trying to develop new hybrids, as this helps choosing the best parental combinations and reduces the need of costly and time-consuming trials (Agrawal 1998). The use of parameters based on the mean of parents, and on the distances between parents obtained from morphological or molecular characterization data has been extensively used for predicting the performance of hybrids in field crops, although the results have not been fully consistent (Brandle and McVetty 1989; Bernardo 1992; Betran et al. 2003; Riday et al. 2003; Yu et al. 2005; Teklewold and Becker 2006). Few reports exist for the use of these parameters in vegetable crops and, similarly to what occurs in field crops, the results are different depending on the crop. For exam-

ple, if we consider crops included in the same family than eggplant (*Solanaceae*), Rodríguez-Burruezo et al. (2003) found that genetic distance was useful for predicting the yield of hybrids in pepino (*Solanum muricatum* L.), while Geleta et al. (2004) did not find a correlation between morphological or genetic distance with yield of hybrids in pepper (*Capsicum annuum* L.). Here, we show that the use of the mean of parents is useful for predicting the yield of eggplant hybrids, but not for predicting its heterosis (Table 5). Prohens et al. (2005b) found, in a collection of eggplants from a germplasm bank, that morphological and genetic distances show a moderate positive correlation. However, here we have selected deliberately parents for which morphological and genetic distances are not correlated and this has allowed us the independent study of the utility of these parameters in predicting performance and heterosis of hybrids. Using this approach we have found that morphological distances between parents were not correlated neither with the means nor with heterosis of the hybrids (Table 5). However, and for yield only, the use of AFLP-based genetic distances, apart from being useful for predicting the means of hybrids is also correlated with heterosis for yield (Table 5). In this way, the screening by means of molecular markers of germplasm collections could allow the selection of combinations of parents potentially useful for the development of hybrids, and even for the detection of heterotic groups (Beattie et al. 2003; Rodríguez-Burruezo et al. 2003; Warburton et al. 2005). In any case, further works with a greater number of hybrids and parents would be needed to test the validity of these results for other eggplant materials such as Asian materials.

Regarding fruit quality traits, the literature shows that, for vegetable crops, in general, there is no correlation among morphological or genetic distance parameters and external or internal fruit quality traits (Rodríguez-Burruezo et al. 2003; Geleta et al. 2004; Sureja et al. 2006). Here, we have found similar results, so that neither morphological nor genetic distances have been useful to predict the mean or the heterosis of hybrids for the four quality traits we have studied. The fact that, despite the increment in yield in the experimental hybrids, compared to their parents, the fruit weight generally does not increase (Table 3), indicates that in these materials heterosis is caused by an improved fruit set.

In conclusion, here we show that eggplant hybrids heterotic for yield and that may be competitive with commercial cultivars in the open air conditions can be obtained by using local materials as parents. The use of molecular markers may be of great utility for the selection of genetically distant parents that will give hybrids with high yield. At this respect, local varieties could be used for broadening the genetic base of commercial hybrids for open field cultivation and for increasing the diversity of fruit types of commercial hybrid cultivars (as long as they fit the market requirements), either by using them for crossing with the breeding lines already obtained by breeding companies, or even for developing new commercial hybrids resulting from the cross of two local varieties. Nonetheless, for the development of a successful commercial variety, apart from a high yield, acceptable fruit size and colour, and high levels of nutritional compounds, other traits important in the marketing of eggplant, like the fruit shape, calyx colour or firmness, have to be taken into account in breeding programmes.

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