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Capsicum and Eggplant Meeting

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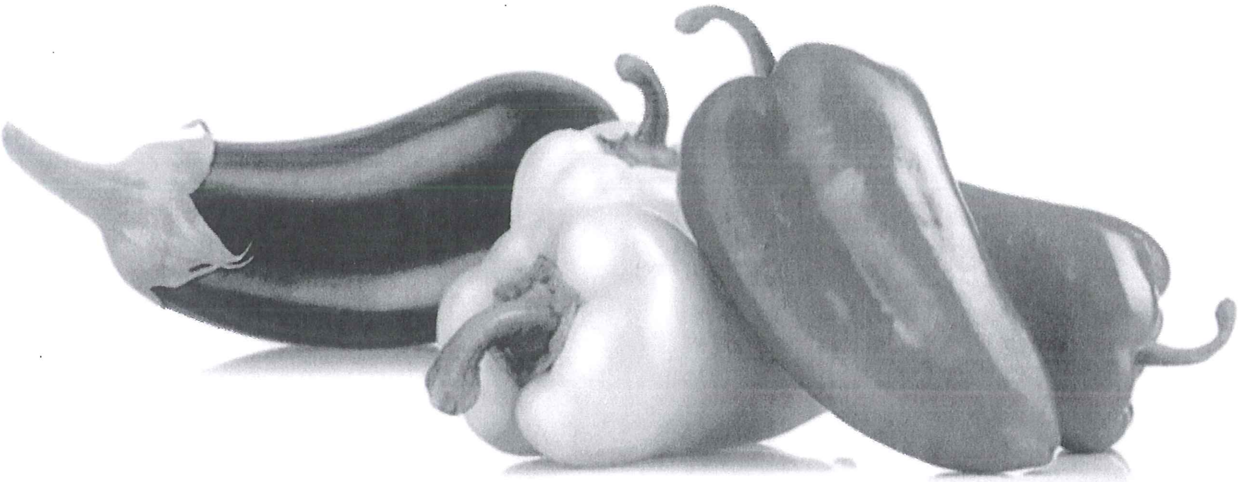
in memoriam
Dr. Alain Palloix



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Proceedings

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Screening for drought tolerance in eggplant relatives and interspecific hybrids

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Abstract

Eggplant (*Solanum melongena*) is related to a large number of wild species growing under drougth stress conditions. The latter are of potential interest for breeding programs aimed at increasing eggplant drought tolerance. In this work we evaluated accessions of cultivated *S. melongena*, the wild related species *S. anguivi*, *S. dasyphyllum*, *S. insanum*, and *S. linneanum* and the interspecific hybrids of *S. melongena* with *S. anguivi*, *S. dasyphyllum* and *S. insanum*. Young plantlets (at the stage of 3-4 leaves) were subjected to two treatments: control, in which plants were watered avoiding any drought stress and 50% reduction of irrigation compared to the control. Plant vegetative parameters as well as the photosynthetic rate were assessed. The wild species showed different responses to drought, with *S. anguivi* and *S. insanum* being the most tolerant. Some interspecific hybrids performed better than their parents showing hybrid vigor for tolerance to drought. These interspecific hybrids may be used directly as rootstocks or for backcross breeding programs aimed at improving *S. melongena* drought tolerance.

1. Introduction

Eggplant (*Solanum melongena* L.) is one of the most important vegetable crops worldwide. In 2015, the production of eggplant exhibited an increase reaching a production of 49 milion of tonnes [1]. Most of the production of eggplant takes place in tropical and subtropical areas, where climate change effects, including increased drought stress, have a significant impact. Although eggplant tolerates better drought condition than other crops, likely because of its leaf morphology, a good stomatal control and maintenance of photosyntesis under stress [2], drought is one of the abiotic stresses which may induce severe losses in production and affect the quality of the berries [3,4].

The cultivated eggplant is related to a large number of wild relatives, which grow in a wide range of environments, including desertic areas [5]. These wild materials are a potential source of tolerance to drought, since many of them can be hybridized with the cultivated *S. melongena* [6].

The objective of this work was to assess drought tolerance of several eggplant relatives and their interspecific hybrids in respect to eggplant, with the goal to identify germplams exploitable for eggplant breeding programs .

2. Material and methods

Accessions of *S. melongena* (Mel) as well as of the wild species *S. anguivi* (Ang), *S. dasyphyllum* (Das), *S. insanum* (Ins), *S. linneanum* (Lin) and their interspecific hybrids with *S. melongena* (Mel x Ang, Mel x Das, Mel x Ins) were used.

Seeds were germinated in Petri dishes and then transplanted to 0.5 L pots filled with peat. When the plantlets were grown at the stage of three-to-four leaves, two alternative treatments were applied: i) control irrigation (usually was performed around 100 ml in each watering, which depending on the needs of the plant) and ii) 50% reduction of irrigation. Plants were grown in a climatic chamber with 16 h light / 8 h darkness photoperiod with a temperature of 25 °C. After 8 weeks of treatment, all plants were measured with an Infrared Gas Analyzer (Li-Cor 6400, Nebraska, USA) for photosynthetic rate (A), transpiration rate (E), stomatal conductance to H_2O (g_s) and intercellular CO_2 concentration (Ci). All measurements were performed in the morning. Intrinsic Water-used efficiency (intrinsic WUE) was calculated from ratio between photosynthetic rate (A) and stomatal conductance (g).

Foliar length and width (from three leaves) were measured with a ruler to estimate Leaf Area as the length per width divided by 2. Also the plant height, aerial and root parts fresh and dry weights were measured. Water use efficiency (regarding biomass) was measured as the ratio of dry weight and total amount of water used to irrigate the plants.

3. Results and discussion

The results of multifactorial ANOVA analysis showed significant effects of the two irrigation treatment on the vegetative parameters (leaf area, plant height, aereal part dry weight and root dry weight), except than for the root dry weight (Table 1). The drought treatment induced an average reduction of 17% in leaf area, 30% in plant height, and 35% in aerial dry weight. These results confirm what previuosly reported in literature [7]. The not significant reduction in the root dry weight is presumably due to a progressive plant adaptation to drought or the maintenance of the water absorptive area [8]. Although ANOVA did not highlighted any significant interaction between genotypes and irrigation treatments (Table 1), the comparison of individual accessions or hybrids revealed that some genotypes (i.e.*Solanum melongena, S. dasyphylum* and *S. Linneanum*) were less tolerant to drought (Fig 1). Interestingly, the hybrid Mel x Das performed better that both its parents. *Solanum anguivi, S. insanum* and their hybrids with *S. melongena* were not very affected by drought.

		Mean squares			
	df[1]	Leaf Area (cm^2)	Plant height (cm)	Aerial part dry weight (g)	Root dry weight (g)
Main effects					
Accession (A)	7	3695^{***}	34.1^{***}	1.11^{**}	0.37^{ns}
Treatment (T)	1	4733^{**}	43.2^{***}	2.43^{**}	0.11^{ns}
Interactions					
TxA	7	355^{ns}	1.31^{ns}	0.15^{ns}	0.04^{ns}
Error	51	470	3.9	0.31	0.09

Table 1:
Multifactorial ANOVA analyzing biometric values [1] Degrees of freedom; ^{ns}, *, **, ***, mean non-significant, P-value < 0.05, 0.01, and 0.001 respectively

The multifactorial ANOVA over the WUE and instrinsic WUE (A/g_s) also showed significant differences among accessions and treatments (Table 2). An increase of WUE was detected following the water stress treatment. This indicates, as in many other plants, that eggplants tend to adjust their development depending on the availability of water and are more efficient under stress.

	df[1]	Mean squares	
		WUE (g ml H_2O^{-1})	Intrinsic WUE (µmol CO_2 mol^{-1} H_2O)
Main effects			
Accession (A)	7	1.98^{*}	6763^{***}
Treatment (T)	1	6.62^{**}	2264^{*}
Interactions			
TxA	7	0.44^{ns}	904^{ns}
Error	51	0.84	466

Table 2
Multifactorial ANOVA analyzing WUE measures. [1] Degrees of freedom; ^{ns}, *, **, ***, mean non-significant, P-value < 0.05, 0.01, and 0.001 respectively

The only genotypes which significantly increased their WUE under water stress were *S. insanum* and its hybrid with *S. melongena* (Fig 2), indicating that these genotypes are the most tolerant to drought Intrinsic WUE was significantly higher under drought for Mel x Ang, *S. insanum* and *S. linneanum* (Fig. 2). This parameter was significantly lower under water stress for Das. In leaves , intrinsic WUE indicates the ratio of the instantaneous rates of CO_2 assimilation and stomatal transpiration. Differences between genotypes in A/gs have been reported to have a genetic basis and breeding for high WUE has become a main goal in other crops [9].

The results showed that there is a wide diversity among wild species in the response to drought. Some interspecific hybrids performed better than their parents displaying hybrid vigor for tolerance to drought. These interspecific hybrids may be used directly as rootstocks or to start a backcross breeding program for improving the tolerance to drought of *S. melongena*.

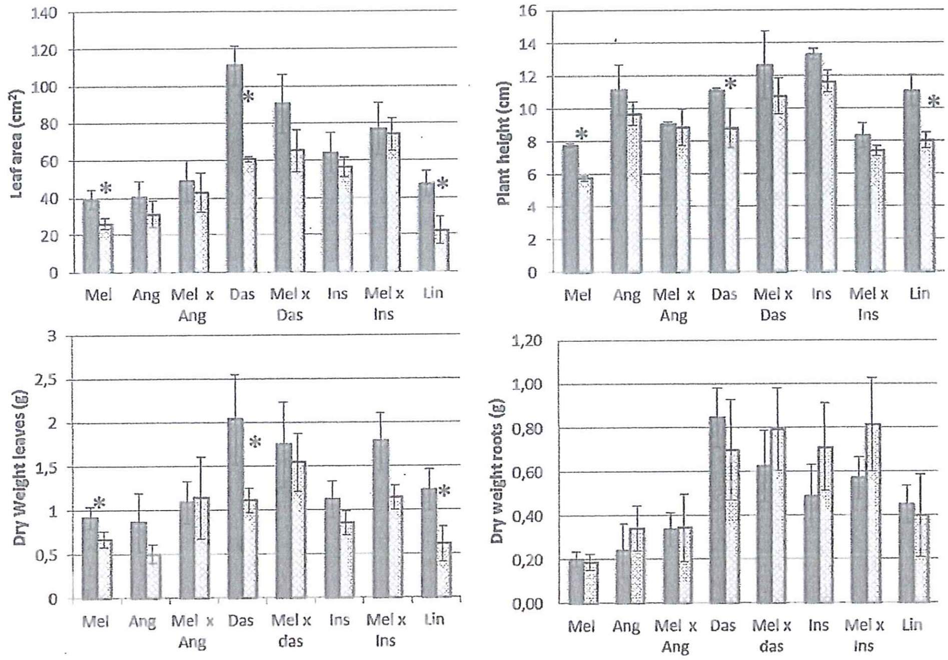

Figure 1

*Average values ± SE per accession and treatment of the vegetatvie parameters evaluated. Each bar is the average of at least 4 plants. * indicates significant differences among avegares of control and drought treatments.*

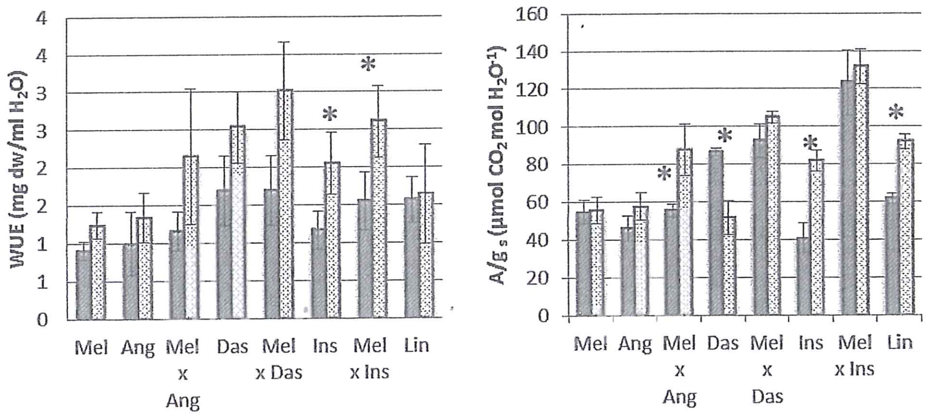

Figure 2

*Average values ± SE per accession and treatment of the WUE, WUE intrinsic (A/g_S) and WUE instantaneous evaluated (A/E).Each bar is the average of at least 4 plants. * indicates significant differences among avegares of control and drought treatments.*

4. Acknowledgements

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