沙漠研究 **19**-1, 205- 208 (2009)
Journal of Arid Land Studies

"Desert Technology IX "
Refereed Paper

Characterization of Several Local Cultivars of Watermelon Collected from Arid Region in Tunisia

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Abstract: This study reports on the analysis of 8 local watermelon cultivars (*Citrullus lanatus* (Thumb)) collected in the South of Tunisia which were compared to two introduced watermelon cultivars widely-grown in this arid area. The analysis was based on the characterization of fruits. The Principal Component Analyze (PCA) showed that the three modern cultivars constitute a distingue group specified by their lower weight fruit and their relatively high fructose and glucose contents. However, it was found that the eight local cultivars was more variable and its belong to two diverse groups. This study clearly shows the need to safeguard and manage this precious local germplasm both *ex situ* and *in situ*, as this material may contain valuable genes for future breeding activities and also future cultivation practices.

Keywords: Arid lands, Biodiversity, Quality, Watermelon

1. Introduction

Watermelon (*Citrullus lanatus* (Thumb)) is originated in Africa and has a long history of cultivation in Africa and the Middle East. It has been an important vegetable in Egypt for at last 4000 years (Robinson and Deker-Walters, 1997). Watermelon is one of cultivated crops in the world. The production in 2007 exceeded 93 millions tons[A)].

In Tunisia, watermelon is largely consumed in summer as a fresh fruit. This cucurbit is cultivated in various areas in the country and occupies more than 16000 ha representing approximately 10% of the total cultivated area with vegetable crops (Boughalleb and ElMahjoub, 2006). Especially modern watermelon varieties are widely used which was replaced many autochthones cultivars more and more missed nowadays. According to Elgazzah and Chalbi (1995) and Elbekkay *et al*. (2008), local seeds of many crops like watermelon, melon and tomato are nowadays hard to find in Tunisia.

The objective of this study was to examine fruit characterization diversity of several local cultivars of watermelon collected from arid region in Tunisia.

2. Materials and Methods

Eight cultivars of watermelon (*Citrullus lanatus* (Thumb)) were collected from the south of Tunisia in 2005 and maintained in the genebank of the Institute of Arid Regions, Tunisia. These cultivars were compared with two modern cultivars (*cv* Sugar Baby and *cv* Giza) which are widely cultivated in south of Tunisia. Local cultivars are coded by the letter "P" and a number of the sample (e.g. P2).

The experiment was conducted under greenhouse, heated and irrigated by geothermal water, at the experimental station of the Institute of Arid Areas in Kebili in South Tunisia. The experiment was conducted from December 2007 to the end of May 2008. Nine plants from each cultivar were sown under the greenhouse on a gross sand soil. The seeds were sown with 1m × 0.5m between and within row distances. The fertigation solution was prepared by the use of commercial water-soluble fertiliser containing macro- and micro-nutrients (20-20-20 NPK) as noticed by Sivritepe *et al*. (2005).

The experimental layout of the experiment was a completely randomized block design with three blocks. Three plants per accession were randomized within each block.

The cultivars were categorized for 20 variables of fruit characteristics according to UPOV (International Union for the Protection of New Varieties of Plants) descriptors for watermelon (2004): time of maturity (P) (Number of days from sowing to first mature fruit for the nine plants), average fruit weight (W), fruit Shape (Shape), type of stripes (Tstripe), width of stripes (Wstripe), size of insertion of peduncle (Size_P), depression at base (Dep_base), fruit length (Fruit_L), fruit width (Fruit_W), thickness of pericarp (T_perica), main color of flesh (C_flesh), total soluble solids content in the juice (˚Brix), Acidity

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(determined by potentiometric titration with 0.1N NaOH to pH 8.1, using 50ml of juice and expressed as percentage citric acid in juice), pH of the juice, electric conductivity (EC) of the juice, fructose, glucose and vitamin C (vc) (mg/100g of flesh) contents (obtained using the chromatographic analysis using a KHAUER DEGASSER pumpK-501 HPLC (high performance liquid chromatography)), total phenol content (measured by spectrophotometer) and the dry mature ratio (dry_m) of the chair fruit.

These variables were observed at least on three fruits for each cultivars (**Table1**). The data were analyzed using SPSS version 11.5 for a Principal Component Analysis (PCA).

3. Results and Discussion

The quantitative trait values (means ± Standard Deviation) of the nine plants per accession of the 10 watermelon accessions are shown in Table 1.

The results of PCA conducted with 20 characters for watermelon accessions were presented in **Figure 1**. The first three PCs (Principal Components) explained 74.74% of the variation. The first principal component, which explains 37.26% of the variability, is determined by precocity (-0,53), weight fruit (-0,9), shape (+0,828), depression at base (+0,747), size of insertion of peduncle (+0,904), fruit length (+0,91), fruit weight (+0,745), acidity (-0,801), fructose content (-0,673), EC (+0,677) and VC (+0,516). The second PC explains 22,05% of the variability and is determined by pH (-0,81), Dry mature (+0,864), phenol content (+0,748), glucose (+0,556), thickness of pericarp (+0,662), type of stripes (-0,669). Wide of stripe (-0,752), color of chair (+0,661) and Brix (+0,689) were relatively more important than other variables in constructing PC3 which explains 15,4% of the variability.

On the basis of the PCA, three groups can be distinguished: the modern cultivar present a distinct group (G1), the second group (G2) is consists of five local cultivars (P27, P28, P31, P33 and P35) and the third group (G3) is consists of three local cultivars (P2, P15 and P21) (Fig. 1). The local cultivars (G2 and G3) are earlier than the two modern cultivars (G1) considered in this study. This is especially true for P15 with more than 15 days of precocity. Furthermore, the local cultivars showed significantly higher

Table 1. Mean values of the various watermelon quantitative traits examined.

Cultivars	Repetition	P2	P15	P21	P27	P28	P31	P33	P35	SB	GIZA
Precocity (days)	9 plants	138,5 ±3,9	121,43 ±6,5	122,86 ±0,38	143,5 ±4,8	131,5 ±2,12	131,5 ±2,12	127,75 ±4,57	144,5 ±6,26	136 ±5,46	147,5 ±2,02
Weight (g/fruit)	9 fruits	4050 ±91,92	3587,4 ±188	2714,4 ±934	1688,9 ±724,1	1322,3 ±138,8	1864,8 ±616,1	1413,7 ±548,3	1766,4 ±219,1	912,6 ±448,1	881,3 ±514,7
Size of insertion of peduncle (mm)	9 fruits	10 ±1,41	10,1 ±1,95	8,3 ±1,8	9,5 ±3,5	5 ±1,2	3,5 ±0,7	8 ±1,4	5 ±1,6	5 ±0,9	4 ±1,3
Width of stripes	9 fruits	11,5 ±0,71	14,86 ±2,05	9,29 ±1,11	22,5 ±3,36	13,5 ±0,71	6 ±0, 4	9,25 ±2,50	9 ±0,71	4,5 ±0,54	11,5 ±2,83
Thickness of pericarp (mm)	9 fruits	10 ±0,73	11,5 ±2,64	9 ±1,91	10,5 ±1,95	7 ±0,32	6 ±0,51	9,25 ±2,63	9 ±0,82	4,5 ±0,64	11,5 ±0,71
Fruit length (mm)	9 fruits	355 ±1,71	325,7 ±4,79	270 ±4,16	194 ±6,22	152 ±1,13	1625 ±2,47	220 ±5,83	190 ±2,83	190 ±1,41	132 ±3,96
Fruit width (mm)	9 fruits	235 ±2,12	245,7 ±2,23	244,3 ±3,91	128 ±1,13	121 ±0,28	157,5 ±0,35	178,8 ±5,11	160 ±2,83	180 ±2,83	117,5 ±3,75
°Brix (%)	9 fruits	8 ±0,71	8,77 ±0,78	7,14 ±1,49	5,75 ±0,35	6,75 ±0,35	7 ±0,32	8,35 ±0,72	9 ±0,41	7,25 ±0,35	6,5 ±0,69
pH	9 fruits	5,82 ±0,06	5,81 ±0,12	5,63 ±0,19	5,73 ±0,08	6 ±0,30	6,22 ±0,27	6,03 ±0,02	5,77 ±0,02	5,71 ±0,08	5,8 ±0,01
EC (mS/cm)	9 fruits	3,57 ±0,81	3,51 ±0,40	3 ±0,26	3,74 ±0,27	2,79 ±0,28	3,87 ±0,06	3,6 ±0,23	2,73 ±0,02	2,54 ±0,29	2,43 ±0,16
Vitamin C	3 fruits	4,76 ±0,12	4,59 ±0,33	4,65 ±0,76	3,35 ±0,17	1,48 ±0,21	2,31 ±0,09	4,41 ±0,15	4,26 ±0,47	1,76 ±0,62	4,13 ±0,89
Fructose	3 fruits	3,65 ±0,78	0,45 ±0,11	3,42 ±0,41	2,99 ±0,97	4,13 ±0,63	3,29 ±0,58	3,24 ±0,22	3,51 ±0,48	4,36 ±0,72	4,27 ±0,31
Glucose	3 fruits	0	0	0	2,16 ±0,11	0	0	2,01 ±0,43	2,82 ±0,14	0	3,52 ±0,27
Phenol	3 fruits	0,69 ±0,19	0,92 ±0,22	1,1 ±0,17	1,05 ±0,11	0,87 ±0,16	0,83 ±0,12	0,81 ±0,09	1,05 ±0,13	0,9 ±0,1	1,07 ±0,21
Acidity (%)	3 fruits	0,06 ±0,01	0,09 ±0,02	0,12 ±0,04	0,08 ±0,02	0,08 ±0,01	0,16 ±0,03	0,09 ±0,02	0,19 ±0,06	0,16 ±0,03	0,19 ±0,05
Dry Mature (%)	9 fruits	8,45 ±1,12	9,42 ±2, 32	11,15 ±1,24	8,41 ±0,92	5,2 ±0,56	6,04 ±1,02	7,17 ±0,82	9,43 ±1,42	8,71 ±1,06	9,42 ±1,75

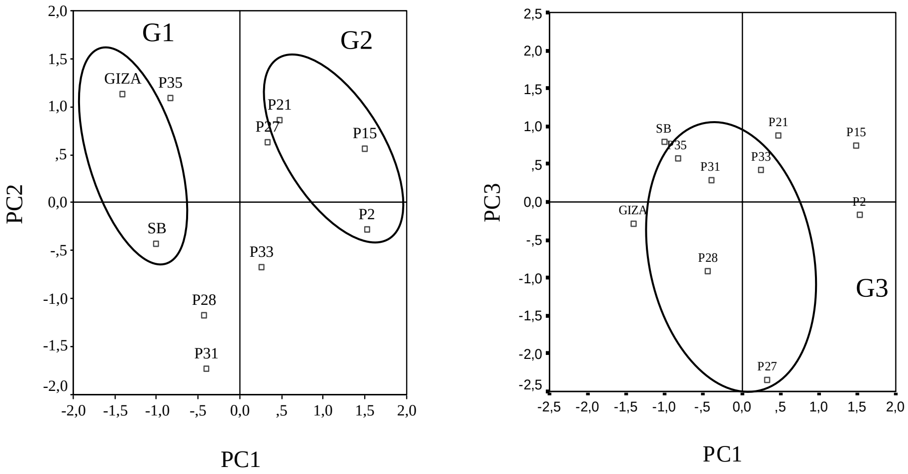

Fig. 1. The results of PCA for Tunisian arid region watermelon accessions.

weight of fruit compared to Giza and Sugar Baby (SB) cultivars. However the modern cultivars have significantly higher fructose and glucose content than the local ones.

This study shown that the local germplasm harbours an important variation in agronomically traits. According to Elbekkay *et al*. (2008), the local germplasm can be seen as a rich source of variation, although they are less adapted to the market. Therefore modern watermelon cultivars have a high appeal by local farmers (Navikof, 1951; Loumerem *et al*., 2004). As in many arid land, also in Tunisian arid region, the process of replacement by modern cultivars goes (luckily) slowly and consequently there will be a period that both modern and local cultivars are cultivated adjacent to each other which gives a chance to collect and preserve the local material (Louette, 2000; Maredia *et al*., 2000; Bardsley and Thomas, 2006).

In subsequent studies we will focus on the further collection and evaluation of this local Tunisian watermelon material including physiological and molecular studies.

4. Conclusions

Since thousands of years, farmers are relying on their own harvests to select seeds for the following season. Nowadays, however, many farmers have become dependent on seeds supplied by seed companies and this can eventually lead to a loss of local crop diversity. The present research focussed on the evaluation of diversity in watermelon in the arid region of Tunisia by comparing traditional local varieties and two modern widely grown cultivars. Even though Tunisia is not the centers of origin for watermelon our study showed that high diversity exists for traits in germplasm collected. Selection and evaluation of germplasm among these collections have priority for future breeding programs.

Annotation

A) FAO (2008): FAOSTAT. The FAO statistical database on-line. (http://faostat.fao.org/DesktopDefault.aspx?PageID=567&lang=fr)

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