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Study of the Variability between Local Melon Cultivars in Tunisia
-Based on the Content of Mineral Elements in Leaves-

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Abstract: The levels of 3 mineral elements in leaves, sodium (Na+), potassium (K +) and phosphorus (P) were used to conduct a study of biodiversity between 24 local landraces and 3 reference varieties of melon in Tunisia.

The potassium mineral fraction is the most important since its content can reach 2% of dry weight of leaves while phosphorus is the minor fraction as does not exceed 0.313% of dry weight of leaves.

The analysis of variance allowed the mineral elements to be separated into two categories. The first category includes sodium and potassium and showed a significant difference between cultivars. The second category, which includes the phosphorus content does not show variability between cultivars and therefore is not an appropriate setting for the study of biodiversity.

The dendrogram obtained by combining the three factors gave three distinct groups; this classification reveals an affinity between some cultivars and commercial varieties on the content of mineral elements.

Keywords: Analysis of variance (ANOVA), Melon, Variability, Mineral elements in leaves (Na^+, K^+, P)

1. Introduction

Melon (*Cucumis melo* L 2n =2x =24) whose origin is thought to be Africa (Robinson and Decker-Walters, 1997) belongs to the cucurbitaceae (Kikbride, 1993). Melon is an important horticultural crop often cultivated in arid and semiarid regions of the world where salinity threatens to become, or already is, a problem (Navarro *et al*., 1999).

The level of salts in most irrigation waters is below the threshold for the more sensitive crops, salt accumulation in irrigated soils from both irrigation and groundwater sources can increase salinity to level which can reduce growth and yield of even the more tolerant crops. Overcoming salt stress is a main issue in these regions to ensure agricultural sustainability and continued food production (Heuer, 2003).

Sodium is the predominant soluble cation in many of the soils of arid and semi arid areas. However most plants, especially glycophytes, are very sensitive to high Na^+ concentrations. The ability of plant cells to maintain sodium concentrations low in the cystol is a vital process associated with the ability of the plant to grow under high salt regimes (Blunowold, 2000; Ashraf and Harris, 2004).

Potassium is a major plant macro-nutrient that plays important roles related to stomatal behavior, osmoregulation, enzyme activity, cell expansion, neutralization of nondiffusible negatively charged ions and membrane polarization (Maathuis and Sanders, 1996; Elumalai *et al*., 2002).

2. Materials and Methods

The seeds of twenty-four landraces of melon, collected from farmers in Tunisia (**Table 1**) and harvested in a field were used to provide the plant material for all studies. In addition to these local landraces of melon, we chose three commercial varieties that will serve as a reference. Data related to these cultivars are summarized in Table 1. The melon leaves are collected and dried in the oven for 48 hours at a temperature of 60 ˚C and then they are crushed (powdered). From each sample, 1 g in porcelain crucibles, were placed for 5 h in a muffle furnace set to a temperature of 550 ˚C. Once cooled, samples were exposed to 1 ml of hydrochloric acid and 4 ml of distilled water. Samples were then brought to boil after being placed on a hot plate and filtered twice in a flask.

Finally, the volume was brought to 100 ml and this solution served as the extract for the analysis of sodium, phosphorus and potassium. The concentration of potassium and sodium was determined using a

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Table 1. Code, date and locality of collection of cultivars.

Cultivar	Locality	Cultivar	Locality
M3	Lbness Elgataya kebili	M50	Eljazira, Souk lahad
M5	Isteftimi Kebili	M58	Gannouche, Gabes
M6	Hniche Douze	M61	Bir Amir, Tataouine
M9	Elrabta Kebili	M95	Ben Guerdane, Medenine
M15	Elrabta Kebili	M97	Oum Elsoumaa, Souk Lahad
M16	Elrabta Kebili	M116	Azmour, Dar Allouch, Nabeul
M17	Elrabta Kebili	M120	Kalaat Elandalouss, Bizerte
M18	Elmenchia, Souk Lahad	M122	Ghar El Melh, Bizerte
M19	Elmenchia, Souk Lahad	M125	Hammet Tozeur
M20	Rabta, Kebili	M131	Elrabta Kebili
M24	Dgache Tozeur	Yellow canari	JC
M26	Elmenchia Souk Lahad	Lobnani	LOB
M29	Rogba Tataouine	Maazoun	Maz
M31	Ferche Tataouine		

flame photometer while the phosphorus was determined using a spectrophotometer.

The data from all parameters were statistically analyzed by one way ANOVA, and means were separated by Duncan's Multiple Range Test using SPSS software. Finally, a dendrogram was obtained by cosine interval using the same software.

3. Results and Discussion

The analysis of variance showed that the mineral elements studied can be classified into two categories;

Minerals in the first category are sodium (Na^+) and potassium (K^+) showing significant difference ($p = 0.002$ and $0.031 < 0.05$ respectively), these factors are distinguishing parameters between the cultivars. The second category contains phosphorus where the average between cultivars do not show variability ($p=0.073 > 0.05$), so this parameter is not an appropriate setting for the study of polymorphism. For sodium (Na^+) and potassium (K^+), Duncan's test identified five groups while for phosphorus only three. Phosphorus represents the minor mineral fraction in leaves of melon as its maximum does not exceed 1.233% of dry weight for the cultivar M18 (**Fig. 1**). The cultivar with the minimum content is M24 (content equal to 0.138% of dry weight).

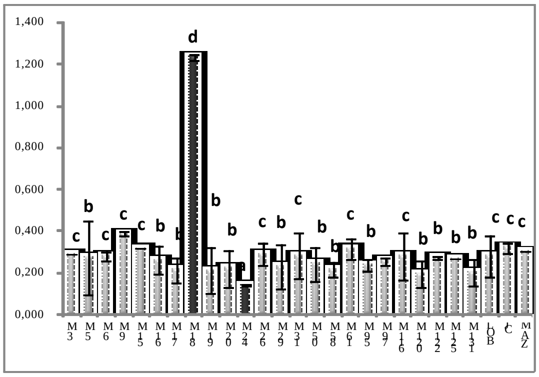

Fig. 1. Average of phosphorus content in leaves of different melon landraces.

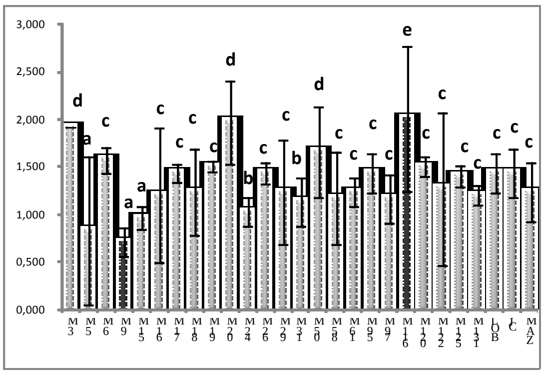

Fig. 2. Average of potassium content in leaves of different melon landraces.

The potassium mineral fraction is the most important and its share can reach up 2% of dry weight for the cultivar M116, its minimum is about 0.704% of dry weight in the variety M9 (**Fig. 2**).

The sodium content varies widely among different cultivars; it ranges from 0.174% of dry weight for the variety Maâzoun to 1.03% of dry weight for M6 (**Fig. 3**).

The differences between cultivars are not related to differences in the availability of mineral elements at ground level as the culture has been installed on the same plot.

When compared with those recorded by Sivritepe *et al.* (2005) on a control culture, the sodium content for different cultivars are considered high, this may be due to salinity in the irrigation water (2 g/l), or at ground level (2 dS/cm). The sodium content in leaves can learn about the plants more tolerant to salt stress since, according to Sebnem *et al.* (2007), the plants more tolerant to salt stress are those with low content of Na^+ in leaves in the same context Jones and Gorham (1989) reported that the plants more tolerant to stress are those with an important ratio of K^+/Na^+, all varieties have an important ratio of K^+/Na^+.

However other studies suggest that generally the most salt tolerant plants accumulate Na^+ in their shoots whereas sensitive plants don't. In the first type, called "Includers", salt was trapped and accumulated in the aerial organs cells, mainly in its vacuoles (Levigneron *et al.*, 1995; Yeo and Flowers, 1986).

In the second type, referred to as “excluder” the salt conveyed to the shoots, fault to be trapped, was re-exported towards the roots by the phloemic tissue (Fortmeir and Schubert, 1995; Lessani and Marschnner, 1978; Slama, 1982; Wieneke and Laüchli, 1980).

This accumulation was associated with a water content stability. Such a mechanism reflects probably an inclusive behavior of the plants and a good aptitude to use the dominant ions (Na^+) for the osmotic adjustment. Consequently, plants have been probably adapted to the osmotic stress by either closing their stomata or increasing the osmotic pressure of the leaf cells

Recently, Sebnem *et al.* (2007) reports that the accumulation rate of Na^+ in tolerant varieties is high and found no significant difference between tolerant and sensitive plants to this level and concluded that the ratios K/Na and Ca/Na are not useful parameters for determining the level of tolerance to salt stress in melon.

The study of genetic variability among landraces of melon on the basis of the mineral analysis has revealed variability between cultivars and provided for discrimination among them into three groups (**Fig. 4**).

The first group formed by cultivars M16, M97, M31, M131, M6, M24 and M5 characterized by a high Na^+ containing, relatively low average concentrations of potassium and phosphorus; The second group includes the cultivars M3, M95, M50, M20, M26, M125, M29, M122, JC, MAZ, that are characterized by a low content in sodium, variable potassium level, and a low phosphorus level; The third group includes two cultivars: M15 and M61 that are characterized by moderate sodium and potassium content and high phosphorus level.

The fourth group contains M17, M16, M19, M58, LOB, M120; They have mineral leaves concentrations that are very similar to those of the commercial variety LOB. They are characterized by moderate sodium content while potassium and phosphorus are variable.

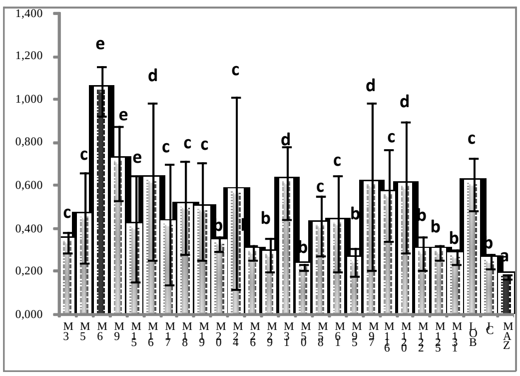

Fig. 3. Average content of Na^+ in leaves of different melon landraces.

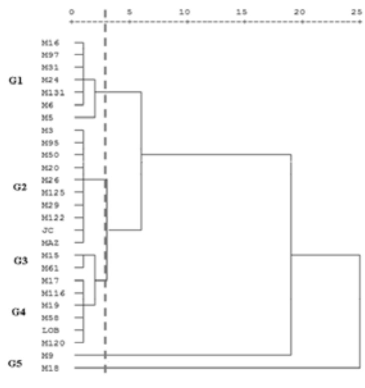

Fig. 4. Dendrogram of different landraces of melon as classified on the bases of three mineral elements.

The last one regrouped M9 and M8 and is characterized by moderate content in sodium and potassium and an important phosphorus level.

From this analysis, it appears that cultivars of the same groups are not primarily collected in one place. This proves that the origin of diversity is not geographic. Some cultivars showed a similarity to the reference varieties at stake but the mineral study alone is not enough to draw complete similarities given this must be proven to genetic scale.

4. Recommendations

If the landraces studied showed a tolerance, it is due to them being indigenous and therefore adapted to the environmental constraints.

This study was performed to establish a hierarchical classification of studied landraces; stress tolerance must be proved by a study with greater salt concentrations.

Variability should be studied at the genetic level because the accumulation of minerals in leaves is a result of genotype × environment interaction.

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