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Cytogenetical studies on *Aerva javanica* (*Amaranthaceae*)

Abstract

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Aerva javanica (Burm. f.) Juss. ex Schult. (*Amaranthaceae*) is a perennial herb, found over a broad range of sandy sediments and different altitudes. Four samples of *A. javanica* were collected from different habitats and altitudes. Cytogenetical characters of *A. javanica* according to chromosomal numbers, SEM indumentum and seed coat sculpture characters were studied. Chromosomal numbers of *A. javanica* have been reported for the first time: $2n = 32$ and $2n = 34$ for specimens of low altitudes (0-600 m) and $2n = 64$ for specimens of high altitudes (1600-2200 m). In addition, SEM showed a wooly tomentose indumentum with multi-branched unicellular hairs and a granulated seed coat sculpture characterized by raised anticlinical cell boundaries and flat or slightly concave outer periclinal cell walls or by channelled anticlinal cell boundaries as well as the convex (domate) periclinal wall. The granulation of the seed coat sculpture is proportional to its ploidy level.

Introduction

Aerva javanica (Burm. f.) Juss. ex Schult. (*Amaranthaceae*) is a grey perennial tomentose-woolly shrub. It is native to the region from North Africa to South West Asia (Willis 1966; Gupta 1992). In Egypt, it grows in the Gebel Elba and surrounding mountainous region, Siwa, Farafra, Bahariya, Kharga, Dakhla, Kurkur, Uweinat, the Red Sea coastal strip and entire Sinai (Boulos 1995; Täckholm 1974; Muschler 1912). In Saudi Arabia, it is distributed in the Western and Southern parts (Migahid 1978; Chaudhary & Akram 1987; Mandaville 1990 and Al-Hzmi & Ghandour 1992).

Aerva javanica has erect pale stiff branching reaching a height of 1.6 m. The pale green 20-40 mm long leaves are alternate, lanceolate, oblong ovate or sub-orbicular, subsessile or shortly petiolate and have a covering of matted hairs, upper surface with a grayish appearance. a Inflorescence is usually a naked raceme of white woody, sessile dense pikes. Flowers are creamy-white and very small, the female larger than the males. Fruits immersed in silky white fleece, globular, single small black seeded. It flowers from January to May.

Aerva javanica was found suitable for the dune stabilization so, it was introduced in different areas to assist the revegetation of degraded range lands. The densely woolly parts of

the inflorescence were used by Bedouins in earlier times for stuffing saddle pads and cushons. Its roots and flowers are reported to possess medicinal properties against rheumatism and kidney troubles, and are known as a remedy for toothache (Mossa & al. 1987). The flowers are used for the treatment of wounds and to stop bleeding, and juice extracted from roots is used to treat eye diseases in Saudi Arabia (Abbas & al. 1992; Ghazanfar 1994).

SEM studies on seed coat patterns have demonstrated the existence of genetic diversity of various levels of taxonomic hierarchy (Linskens & al. 1977; Carolin 1980 and Rejdali 1990). A substantial amount of this variability is adaptive and of genetic origin (Newell & Hymowitz 1978; Rajendra & al. 1979; Gopinathan & Badu 1985).

Some ecological, phytochemical and pharmacological investigations have been reported on *Aerva* species. The present study covers some cytogenetical characters of *A. javanica* (Burm. f.) Juss. ex Schult.

Material and Methods

Sample collection: Different young mature leaves and inflorescences of *Aerva javanica* growing at low (0-600 m) and high altitudes (1200-2200 m) were collected from Egypt (St. Catherine, El-Soukhna and Aswan) and Saudi-Arabia (Western-Southern parts) (Fig. 1). The average weight of 50 mature seeds weight was determined for each sample.

Preparation for L.M.: The study of chromosomal morphological characters was carried out on root tips of germinated seeds. These were pretreated in 0.05% colchicine for 4

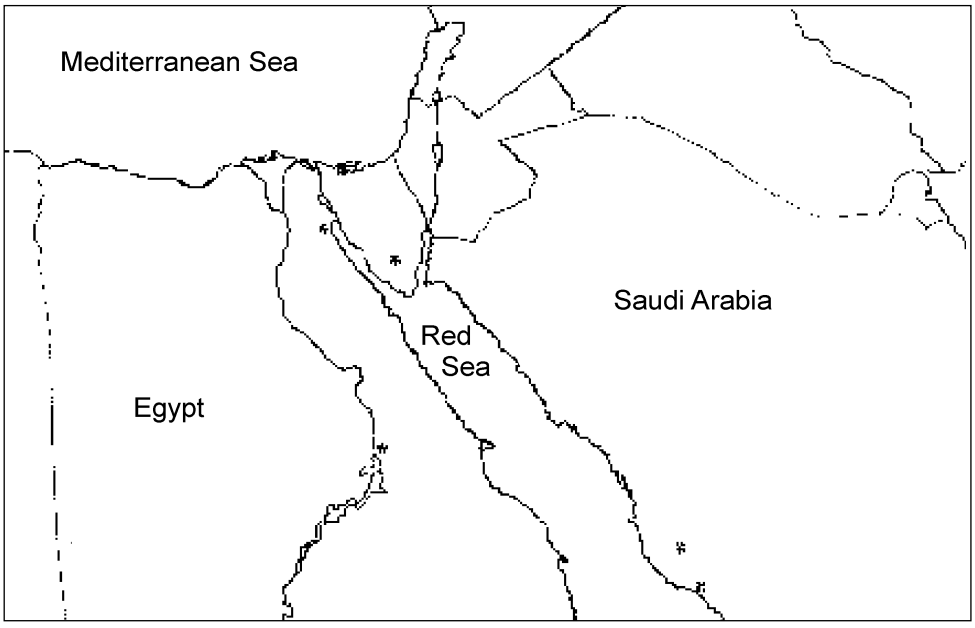

Fig. 1. Map showing different localities of sample collections "*" for *Aerva javanica* from Egypt and Saudi Arabia.

h at 5ºC, fixed overnight in 1:3 acetic-ethanol (v/v), squashed and stained in Feulgen stain following the procedure of Darlington and La-Cour (1976). Chromosomal measurements were carried out using a computer image analysis microscope.

Preparation for SEM: For epidermal indumentum, leaf samples were fixed in 2% glutaraldehyde, washed in 0.2 M sodium cacodylate buffer at pH 7.2, post-fixed in 1% osmium tetroxide in the same buffer and washed in the same buffer, dehydrated in a graded series of ethanol (25-100%), CO2, heating, gold coated and examined using a Zeiss SEM. For seed coat sculpture, dried seed samples were fixed to specimen stubs with an adhesive and placed on the revolving disc of Jeol Fine coat ion sputter (Jeol JFC-1100 E) where each seed was uniformly coated with a 30-50 mm thick gold layer. These specimen stubs were then fixed to the specimen holder of the scanning electron microscope (Jeol JSM 5300) and maintained at accelerating potential of 15 KV. Terminology by Berthott (1981) is adopted here to describe the seed coat patterns.

Results and discussion

Three different chromosome numbers have been found, 2*n*=32 and 2*n*=34 in plants growing at low altitudes (0 – 600 m) and 2*n*=64 in plants at higher altitude (1600-2200m), all collected from Saudi Arabia (Fig. 2). Gametic chromosome numbers have been report-

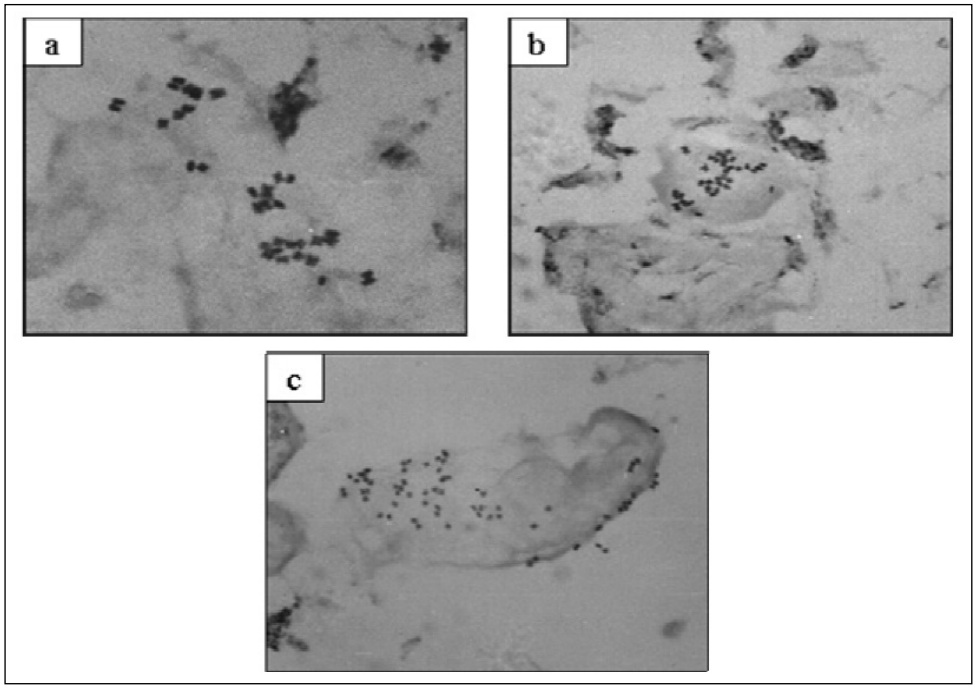

Fig. 2. The chromosomal counts for different samples of *Aerva javanica*: where 2*n* = 32 '0-600m', 34 and 64 '1600-2200' chromosomes (a, b and c respectively)..

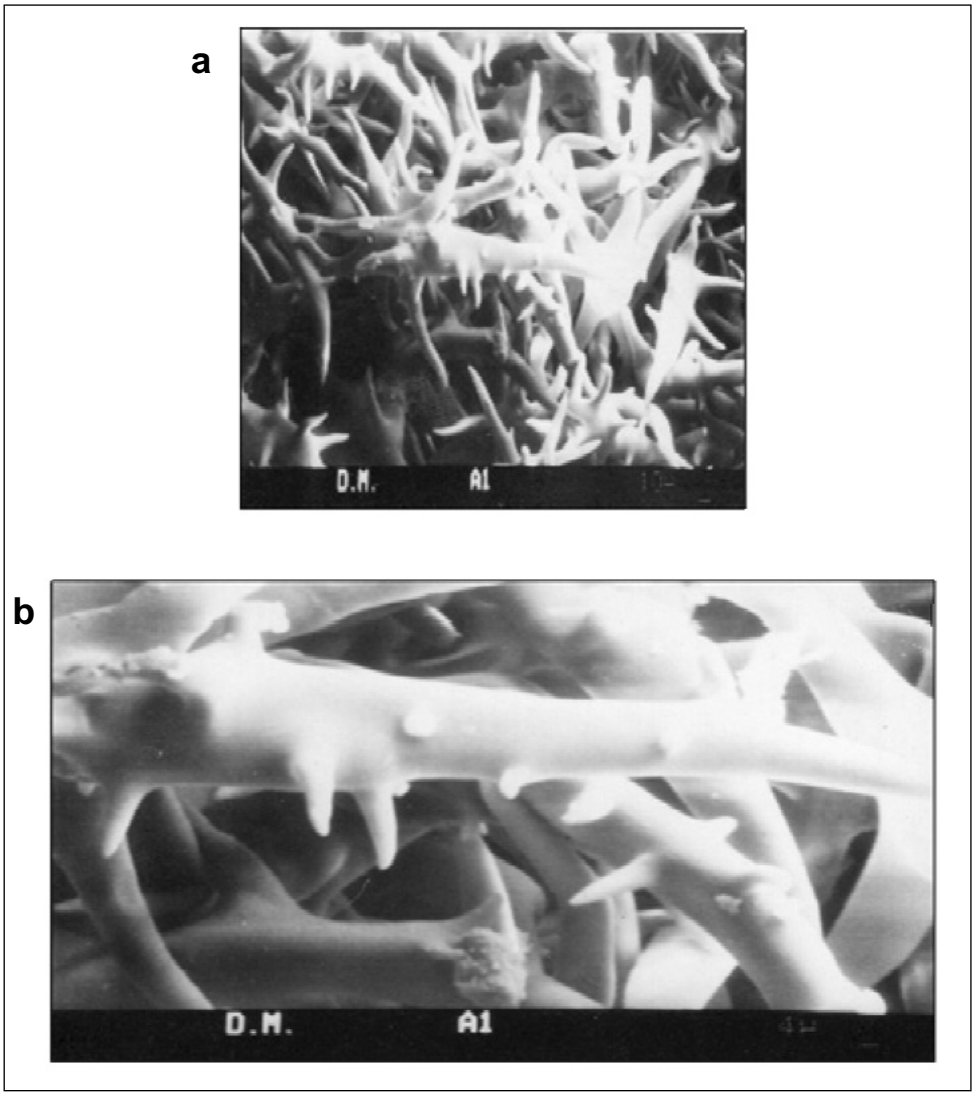

Fig. 3. SEM micrographs of indumentum for *Aerva javanica* sample (**a** & **b**) of 600-650m. bar = 10µ.

ed in genus *Amaranthus* (*n* = 16 & 17) and in some cases both numbers occur in the same species (Greizerstein & Poggio 1994; Greizerstein & al. 1997). *Amaranthus hypochondriacus* have been reported to have 2*n* = 32 (Pal & al. 1982) and 2*n* = 34 chromosomes (Tandom & Tawakley 1970; Palomino & Rubi 1991). *Amaranthus hybridus* 2*n* = 32 (Grant 1959; Queiros 1989) and 2*n* = 34 (Pal & Pandley 1989); *A. powellii* 2*n* = 32 (Hügin 1989) and 2*n* = 34 (Kiehn & al. 1991) cited from Greizerstein & al. (1997).

Pal & al. (1982) suggested that the gametic number *n* =17 originated from *n* = 16 through primary trisomy. Greizerstein & Poggio (1992), on the bases of the cytogenetic

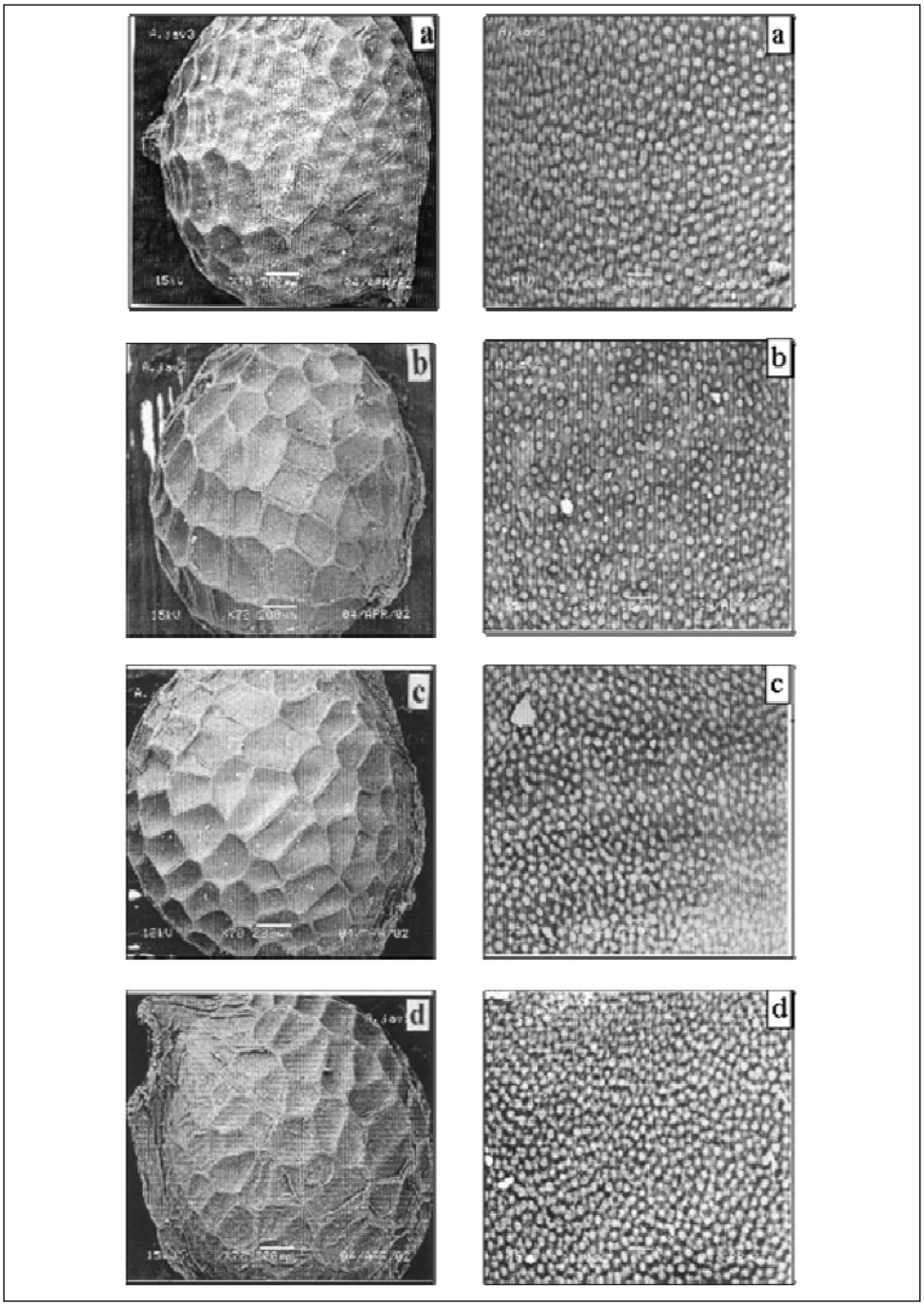

Fig. 4. SEM micrographs of seeds and seed coat sculpture for Aerva javanica samples of different altitudes; a, for 0.0-50.0m; b, for 600-650m; c, for 1350-1650m and d, for 2000-2300m sample.

analysis of interspecific hybrids support this hypothesis, and proposed that the species with $2n = 32$ are polyploids (base number $x = 8$) and that $x = 16$ is a derived base number. The base number x=17 would have appeared later by primary trisomy. The existence of accessions with $2n = 34$ and $2n = 32$ chromosomes for the same species points out that the knowledge of cytological features could predict crosses, Greizerstein & al. (1997).

The seeds appear nearly circular in shape, black in colour and their scanning areas range between 0.9 and 1.0 mm² (Fig. 4). The mean weight of 50 seeds varies between 0.08 (altitude 650 m) to 0.1mg (altitude 2300 m), which suggests a relationship between the chromosome number and its coresponding seed weight.

The woolly tomentose indumentum of different samples consist of multi-branched unicellular hairs (Fig. 3). The density of these hairs varies according to the location of each sample.

SEM for seed coat sculpture of *A. javanica* for the studied seed samples as shown in figure 4, and belong to two types. The first one is characterized by raised anticlinical cell boundaries and flat or slightly concave outer periclinal cell walls. This type distincts all diploid populations. The second one is characterized by channelled anticlinal cell boundaries as well as the convex (domate) periclinal wall and distinicts the polyploid specimens.

Aerva javanica periclinal cell wall sculpture is granulated, with granulae density varying according to the polyploidal level (Fig. 4).

In conclusion

Aerva javanica is characterized by somatic chromosomal numbers of $2n = 32$, $2n = 34$ and $2n = 64$; the average weight of 50 seeds range between 0.08 to 0.1gm; the wooly tomentose indumentum consist of multi-branched unicellular hairs; seed coat sculpture is characterized by raised anticlinical cell boundaries and flat or slightly concave outer periclinal cell walls or by channelled anticlinal cell boundaries as well as the (domate) periclinal wall and the cell wall sculpture is granulated with variabledensities according to the ploidy level.

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