Salt tolerance in *Solanum kurzianum* and *S. tuberosum* cvs Alpha and Russet Burbank

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**Summary**

The cultivated potato *Solanum tuberosum* cvs Alpha and Russet Burbank and the wild species *S. kurzianum* were compared with respect to salt tolerance. Plants of the wild species were found to be more salt tolerant than those of the cultivated species since their growth was less impaired by the salinity, although they accumulated more sodium and less potassium ions in the shoot. Unlike the whole plant, callus derived from the wild plants was not more tolerant than that from the cultivated species. Differences in the responses to salinity between cultivated and wild plants, and between the whole plants and calli derived from them are discussed. Based on these differences and the similarity of the physiological responses to salt stress between *S. kurzianum* and the wild salt-tolerant relatives of tomato, the former is suggested as a potential source of genes for increasing the salt tolerance of potato.

**Introduction**

The feasibility of exploiting natural or induced genetic variation to develop plants better adapted to salt stress has been increasingly appreciated recently (Epstein & Norlyn, 1977; Shannon, 1985; Tal, 1985; Shannon, 1990). In some species this may be achieved by exploiting their intraspecific variation. Such a variation has been shown to exist in potato (Bernstein et al., 1951; Ahmad & Abdulla, 1979; Levy et al., 1988; Levy, 1992) which is considered as being moderately salt tolerant (Maas & Hoffman, 1977). However, since this variation is limited in potato, mutations existing or produced in tissue or cell culture may be used (Tal, 1994; 1995a). or genes may be transferred from closely related wild species that are adapted to high salinity (Tal, 1995b). Such wild species are known to exist in *Solanum*. Bilsky et al. (1988) compared survival and dry weight of tops of eleven accessions belonging to six wild species of *Solanum* grown under NaCl and Na2SO4 salinities and grouped them into four classes based on good or poor resistance to the salt solutions.

In the present study the genetic potential for salt tolerance was investigated in *Solanum kurzianum*, a wild relative of the cultivated potato, which occurs naturally in dry habitats at elevations of 1,400 to 2,500 m in Argentina (Hawkes, 1990). Growth and accumulation of sodium, chloride and potassium were compared in various
organs in plants of the cvs Alpha and Russet Burbank and the wild species, and in calli derived from the leaves of these plants when grown in control or saline media.

**Materials and methods**

**Plants and calli.** The species used in the present study included the cultivated potato *Solanum tuberosum* L., cvs Alpha (A) and Russet Burbank (RB), and the wild diploid (2n=24) species *S. kurzianum* Bitt. et Wittm. (Sk). Alpha, which is a popular cultivar in some countries, is considered to be relatively resistant to salt as well as diseases in the field (A. Nachmis, Gilat Experimental Station, ARO, Israel, personal communication). Russet Burbank is also an important cultivar and is considered to have moderate tolerance to saline soils similar to other cultivars currently used in North America (R.E. Thornton, Washington State University, Pullman, Washington, USA. personal communication). The wild species was selected on the basis of a preliminary study of the response to salinity of 14 wild species that evolved in dry habitats in South America (recommended by J.G. Hawkes, University of Birmingham, England, personal communication).

The plants were grown in a greenhouse with summer and winter day/night temperatures 30–20 °C and 20–10 °C, respectively. Young plantlets of both species were grown in vermiculite from which they were transferred to aerated Hoagland solution at 10 plants per container of 20 liter. Plants of A and RB were obtained from tuber buds and those of Sk from true seeds. Salt treatment of plants started at the stage of about four true leaves by increasing the NaCl concentration by 25 mol m$^{-3}$ per day. Final salt concentrations were 0, 25, 50, 75, 100, 125 and 150 mol m$^{-3}$ but only results from concentrations 0, 50, 100 and 150 mol m$^{-3}$ are represented here. Callus was prepared following the method of Sabbah & Tal (1990) and salt treatment started immediately.

For growth determination, whole plants, divided into shoots and roots, were dried at 70 °C for 72 h and weighed. Calli were removed after 35 days of growth, rinsed for five min. in cold 0.5 mol m$^{-3}$ CaSO$_4$, and the fresh and dry weight recorded. Plant parts were collected for ion analysis about two weeks after the last addition of salt. Detached shoot apices (2 cm length), the petiole (YLP) and lamina (YLL) of the youngest fully-developed leaves, the lamina of the oldest leaf (OLL) and the stem (2 cm length below the YLP) were oven dried. Roots were rinsed in CaSO$_4$ before drying. After weighing, the material was suspended in 4 ml distilled water and incubated at 70 °C for 1 h. Sodium and potassium were determined with a Corning EEL flame photometer and chloride with a Buchler-Cotlove chloridometer.

The data given here are for whole plants or calli from one summer experiment of four similar experiments performed during the summer and winter. Each genotype/treatment combination included at least five plants or calli.