Frequency of 2n pollen in diploid hybrids between Solanum phureja Juz. & Buk. and Solanum chacoense Bitt.*

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Summary

Solanum phureja (PP) × Solanum chacoense (CC) hybrid families (PC) were evaluated for pollen fertility and frequency of 2n pollen in two seasons in Morocco. PP clones produced high frequencies of 2n pollen, whereas CC clones produced none. The percentage of plants with 2n pollen ranged from 2 to 63% among 20 PC families and was consistent in some PC families over two growing seasons, whereas others varied between fall and spring growing seasons. The expected ratio of 2n to non-2n pollen-producers within a PC family based on a single recessive gene model [i.e. 1:0 with CC homozygous dominant (PpPs) or 1:1 with CC heterozygous (PpPs)] was observed in only 5 of 20 progenies. Narrow sense heritability was 0.71, allowing gain from further selection. Only clones producing more than 10% 2n pollen exhibited more stable expressivity across seasons.

Introduction

The analytic breeding scheme is a proposed method to breed the tetraploid potato at the diploid level; it is based on the enhancement of divergent diploid species and their subsequent combination via 2n gametes into four-way hybrids in which maximum heterozygosity could be expressed by a high frequency of tetra-allelic loci (Chase, 1963; Mendiburu et al., 1974). Two basic requirements underlie these goals: (a) sufficient fertility for effective breeding at the diploid level, and (b) frequencies of 2n pollen or 2n eggs permitting sexual polyploidization.

Unreduced gametes are common in diploid potato species (Quinn et al., 1974; Mok et al., 1975, Den Nijs & Peloquin, 1977; Yerk & Peloquin, 1988). They are a major mechanism of gene flow within (Marks, 1966) and between species, even when they occur at low frequencies (Jacobsen, 1976; Jackson et al., 1978; Schroeder & Pelo-
Higher frequencies are generally required for breeding purposes. A low frequency of 2n pollen may result in insufficient seed set in 4x – 2x crosses (Jacobsen, 1976, 1980; Schroeder & Peloquin, 1983). Consequently, the expectations of analytic breeding schemes will not be readily attained unless high frequency of 2n pollen is genetically transmissible.

Although unreduced pollen in *Solanum* spp. has been associated with at least four types of cytological aberrations, for analytic breeding schemes, spindle co-orientation during the second meiotic division of microsporogenesis is of primary importance (Veilleux, 1985). This mechanism has genetic consequences similar to first division restitution (FDR) in which heterozygosity of the parent is largely preserved in the unreduced gamete except for changes resulting from genetic recombination. Among clones exhibiting this mechanism, Veilleux & Lauer (1981) distinguished between stable and unstable 2n pollen producers. The first category expressed relatively constant frequencies in different environments whereas the second fluctuated greatly even within locules of a single anther as well as among plants within a clone (Veilleux et al., 1982).

The frequency of 2n pollen within a clone has been reported to be sensitive to environmental and physiological influences. Although the effects of temperature and genotype and the interaction between them were significant on 2n pollen frequency, Veilleux & Lauer (1981) were unable to identify optimal conditions to induce 2n pollen. McHale (1983) found that mild field conditions with temperatures at about 20°C favoured 2n pollen frequency in some clones, although no trend could be discerned for others. Wagenvoort (1987) classified genotypes of *Solanum phureja* Juz. & Buk. (PP) as high, intermediate, or low 2n pollen producers. Cool temperatures (13 – 17°C) favoured 2n pollen frequencies in the high category, whereas high temperatures were unfavourable. The trend was reversed for intermediate and low categories. Owen et al. (1988) showed that maximum production of 2n pollen for a PP clone occurred when plants were grown under a constant 18 h rather than 10 h or 14 h daylength. For Veilleux & Lauer (1981) and for McHale (1983), the stage of plant development was not significant even though early flowers expressed higher frequencies of 2n pollen in both studies.

*Solanum chacoense* Bitt. represents a divergent gene pool with many desirable features that may contribute to an analytic breeding scheme (Bani-Aameur, 1989). However, its crossing barriers with dihaploid *S. tuberosum* (Grun & Aubertin, 1966; Matsubayashi, 1983) have limited its use in developing diploid hybrids. We have developed a *S. phureja* x *S. chacoense* hybrid population in an attempt to evaluate the yield-attributing traits of this plant material (Bani-Aameur, 1989). By substituting *S. phureja* for dihaploid *S. tuberosum* to access *S. chacoense*, we hope to preserve greater heterozygosity in the potentially tetra-allelic sexual polyploids.

This study is an examination of 2n pollen in this diploid PC hybrid population. We had two objectives: (1) to examine the inheritance of 2n pollen frequency in several crosses between PP clones with high 2n pollen frequencies and CC clones with no unreduced pollen, and (2) to examine the stability of 2n pollen expression in the same PP x CC (PC) hybrid clones in two environments.