CROSSABILITY OF 24-CHROMOSOME POTATO HYBRIDS WITH 48-CHROMOSOME CULTIVARS

R. E. HANNEMAN Jr. and S. J. PELOQUIN
Departments of Genetics and Horticulture, University of Wisconsin, Madison, Wisc., U.S.A.

SUMMARY

The crossability of 24-chromosome (2x) hybrids with 48-chromosome (4x) cultivars of the potato was examined through reciprocal matings utilizing one-hundred and seven 24-chromosome hybrids and twenty-one 48-chromosome cultivars. Approximately 14,000 pollinations were made which resulted in 6,863 seeds from 3,525 fruits of which 1,461 were seedless. The cultivars averaged 2.10 seeds/fruit and 0.55 seeds/pollination as males and 1.76 seeds/fruit and 0.45 seeds/pollination as females. Eleven of the 15 cultivars used reciprocally gave more seeds/fruit as females than as males. Based on data from reciprocal crosses, about 75% of the 24-chromosome clones averaged less than 2 seeds/fruit, and 95% averaged less than 10 seeds/fruit. One 24-chromosome clone averaged 56 seeds/fruit when used as a male. The seedling populations are vigorous and predominantly tetraploid. The simplicity and efficiency of this breeding technique warrants its use in germ plasm transfer from the diploid to the tetraploid level.

I. INTRODUCTION

Potato breeding is now proceeding along two lines of development as a result of the haploid approach. Some potato breeders direct their programs entirely at the tetraploid level, while others are now exploring the possibilities, suggested initially by HOUHAS and PELOQUIN (1958), of utilizing haploids in their breeding programs either for gene transfer to the tetraploid (4x) level or for breeding at the 24-chromosome (2x) level itself. The recognition of the relative ease of haploid extraction and the advantage of disomic over tetrasomic inheritance are probably the two major factors which have prompted the investigation of the use of haploids in breeding programs. With respect to gene transfer, it has been amply demonstrated that many species-haploid hybrids are extremely vigorous and fertile; hence, they are very easy to maintain and work with.

CHASE (1963) has proposed two alternative methods for the utilization of haploids in potato breeding. He has suggested in one scheme that breeding be conducted at the
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24-chromosome level until breeding stocks of the desired genetic combination are obtained. When this has been achieved, these stocks are to be doubled, and then intercrossed to obtain the desired tetraploid type. In the alternate scheme, he suggests that the desired 24-chromosome breeding stocks be intercrossed directly in an effort to take advantage of the functioning of gametes with the unreduced chromosome number ("unreduced" gametes) so as to obtain tetraploids directly. Such a program would save a step (one year) with respect to the former scheme involving colchicine doubling. The alternate scheme would be somewhat more difficult to carry out successfully than would the mating between 24-chromosome and 48-chromosome materials where "unreduced" gametes need only function from the 24-chromosome parent.

The use of 4x - 2x crosses to obtain tetraploid progeny has been successful in several genera. The most relevant example occurs in alfalfa. The progeny from crosses between *Medicago sativa* L. (2n = 32) and a meiotically normal "dihaploid" (2n = 16) were primarily tetraploid (2n = 32) (Clement and Lehman, 1962).

Swaminathan and Howard (1953) have indicated that "unreduced" gametes do function in 2x - 4x and 4x - 2x matings in the tuber-bearing Solanums, resulting in the formation of tetraploid progeny. They indicate that tetraploid progeny have been obtained from the crossing of *S. rybinii, S. phureja, S. chacoense, and S. catharhurum* with 48-chromosome *S. tuberosum*. A predominance of 4x progeny were obtained following the 4x - 2x matings employed in obtaining haploids (Pelouquin, unpublished). Based on cytological examination, von Wangenheim et al. (1960) reported that, following matings between the potato variety Merrimack (2n = 48) and a selected clone of Group Phureja (2n = 24), the majority of the developing seeds contained tetraploid embryos. An effective triploid screen was noted to exist in 2x - 4x matings (Von Wangenheim, 1962), which can explain in part why triploids are found with relatively low frequency in such crosses. The above results, a high frequency of tetraploids following 2x - 4x matings, indicate an exciting approach to gene transfer from diploids to tetraploids.

This report is concerned with the feasibility and efficiency of obtaining tetraploids by direct crossing between 24-chromosome hybrids and 48-chromosome cultivars.

2. MATERIALS AND METHODS

The materials used in this study were grown at two locations: the Experimental Farm at Hancock, Wisconsin and the University of Wisconsin Potato Research Farm at Rhinelander, Wisconsin. The Hancock plots provided a source of inflorescences from mid-June until mid-July, while the Rhinelander plots provided inflorescences from mid-July until late August. One-hundred and seven 24-chromosome hybrids and twenty-one 48-chromosome cultivars (Table 1 and 2) were utilized. Represented in the parentage of the 107 different 24-chromosome hybrids are selections from *Solanum tuberosum* Group Phureja, Group Stenotomum, Group Andigena and Group Tuberosum haploids, and *S. chacoense*. These selections include F1's (species-haploid hybrids,