

THE PRODUCTION OF INTERSPECIFIC HYBRIDS USING
PHASEOLUS COCCINEUS L. AS SEED PARENT

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The difficulty of producing interspecific hybrids Ph. coccineus x Ph. vulgaris is notorious, particularly in view of the fact that the production of the reciprocal cross is so easy. Failure of the cross on Ph. coccineus can occur at almost any stage of embryonic development, with, for example, anomalous development of cotyledons without any trace of a main axis. Even when the embryo completes normal development the F₁ hybrid may show a dwarf necrotic syndrome or seedling lethality. However, once this final crossing barrier is surmounted, the fertility of the F₁ produced can be remarkably high. Pollen stainabilities in the range 70-80% are not uncommon in this hybrid; in contrast, pollen stainabilities in the reciprocal cross may only be one half or one quarter of this. The interesting consequence is that one can obtain near normal Mendelian type segregations in F₂ from this cross for both morphological and serological characters. (Smartt 1970, Smartt et al 1973).

The production of successful crosses using Ph. coccineus is highly unpredictable. Experience at Southampton suggests that both parental genotypes are important in determining the pattern of embryonic development and survival after germination. In the reciprocal cross, survival after germination may be determined in part by the pollen genotype, but rates of embryo abortion are not as a rule substantially different in hybrids from those of pure species embryos, regardless of genetic constitution. Initially an attempt was made to produce a Ph. coccineus genotype which might have broad range cross-compatibility with Ph. vulgaris as seed parent. Experience in attempting to produce such genotypes has led to the conclusion that what apparently happens is that certain genotypes 'nick' and produce viable seeds while others do not, and a broadly cross-compatible genotype of Ph. coccineus may not be easy to produce.

A good procedure is therefore to take a representative range of both species and cross all Ph. vulgaris cultivars on the range of Ph. coccineus seed parents. It is perhaps unlikely that viable, reasonably fertile hybrids will be produced at the first attempt. The combinations of parents which produce the most advanced embryos should be noted. The following alternative procedures can be employed:

1. The Ph. coccineus lines producing the most advanced embryos can be crossed with a wider range of Ph. vulgaris lines.
- or
2. The most successful lines of Ph. coccineus and Ph. vulgaris can be crossed inter-se and then F₁ hybrids crossed.

Both techniques have been used successfully to overcome genetic barriers to normal embryonic development and the post-germination barrier of complementary deleterious or lethal effects. The pattern of evolution of isolating mechanisms between the two species has followed a post-zygotic pattern in Ph. vulgaris in contrast to the predominantly pre-zygotic pattern in Ph. coccineus.

This is of course coupled with extra-chromosomal differentiation favouring embryo abortion in Ph. coccineus and reduced fertility in Ph. vulgaris. Hybrid breakdown apparently occurs in both crosses but is much more marked with crosses on Ph. vulgaris.

This pair of species is in a very interesting stage of evolutionary development with an almost completely evolved system of one-way cross-compatibility which has apparently evolved in a number of different ways by the assembly of different genetic components which can yet be circumvented because it has not apparently proceeded to fixation. The most promising lines to use in such studies are Mexican cultivars or older Western European materials. The more recently produced European cultivars have been selected in environments in which selection pressures for genetic isolation may be very high (since both species are often cultivated together) and as a result they are on the whole less useful.

References:

- Smartt, J. (1970) Interspecific hybridization between cultivated American species of the genus Phaseolus. Euphytica 19: 480-489.
- Smartt, J., Kloz, J. and Klozova, Eva (1973) Segregation of serological characters in the cross Phaseolus coccineus L. x Ph. vulgaris L. Biol. Plant. (Praha) 15: 369-373.

DOCUMENTATION OF USEFUL BEAN (PHASEOLUS VULGARIS) INTRODUCTIONS

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In support of the W-6 program (Plant Introductions) and to document the value of PI material in bean breeding programs, the following examples of useful bean (Phaseolus vulgaris) introductions was prepared for WRCC-10 and distributed to the Western Regional Directors.

Bacterial wilt disease - PI 165078 (Turkey) was found by Coyne and Schuster to have high tolerance to three strains of the bacterium Corynebacterium flaccumfaciens and was used as a source of resistance in the development of Great Northern "Emerson", a large-seeded