INTERSPECIFIC HYBRIDIZATION BETWEEN CULTIVATED AMERICAN SPECIES OF THE GENUS PHASEOLUS

J. SMARTT

Department of Botany, The University, Highfield, Southampton, England

Received 16 February 1970

SUMMARY

 Attempted interspecific hybridization between the species Phaseolus vulgaris, P. coccineus, P. acutifolius and P. lunatus has indicated that a close genetic relationship exists between P. vulgaris and P. coccineus. Viable hybrids of varying fertility can be made reciprocally between these species. Affinity is indicated with P. acutifolius by the formation of viable but sterile hybrids. Less affinity is apparent between these three species and P. lunatus with which they do not produce viable interspecific hybrids. Nevertheless morphological resemblances between the four species justify their retention within the same section of the genus.

Effects of cytoplasmic constitution on both fertility and viability were shown in the F2 and backcross progenies of P. vulgaris (♀) x P. coccineus (♂) hybrids and on viability in the P. vulgaris (♀) x P. acutifolius (♂) and reciprocal hybrids. In slightly fertile P. vulgaris (♀) x P. coccineus (♂) hybrids it was concluded that distorted F2 segregations were due to differential loss of P. coccineus genes in sporogenesis and embryogenesis occurring in a P. vulgaris plasmon.

INTRODUCTION

 Interspecific hybridization in the genus Phaseolus was first reported by MENDEL (1866). He described the hybrid Phaseolus vulgaris L. (♀) x P. coccineus (♂) L. and segregations in the F2 generation. The reciprocal hybrid was recorded by TSCHELMACKESEYSENNEGG (1942) who had also observed spontaneous hybrids P. vulgaris (♀) x P. coccineus (♂). The most detailed study of the cross P. vulgaris x P. coccineus was carried out by LAMPRECHT (1935; 1941; 1948a,b). He produced reciprocal hybrids P. vulgaris x P. coccineus and considered in detail later generation segregations, but gave little information on those of the F2. Segregants in later generations resembled the original seed parent, there was cytoplasmic control of genetic segregation in these hybrids. This finding has been supported by THOMAS (1964).

Lamprecht suggested that the two species P. vulgaris and P. coccineus differ principally in two "interspecific genes". These loci control the position of the cotyledons after germination and that of the stigma (i.e. whether it faces outward as in P. coccineus or inward as in P. vulgaris). He argued that these genes do not reproduce in an

1 Formerly at The School of Agriculture, University of Cambridge.
alien cytoplasm and as a result progeny (ca F₈) revert, with regard to these characters, to the state of pure species. Introggression for other characters ("intraspecific genes") which can recombine freely did occur.

Lorz (1952) produced an interspecific hybrid, P. lunatus L (♀) × P. polystachyus L (♂). The cytogenetic behaviour of parents, F₁ and later generations was studied by Dhaliwal et al. (1962) and Fozdar (1963). Some amphidiploid progeny were produced by the F₁. Segregation arising from allosyndetic pairing has been observed in progeny of these amphidiploids (Lorz pers. comm.).

Honma (1955, 1956) reported a hybrid P. vulgaris (♀) × P. acutifolius A. Gray (♂) obtained by embryo culture. This resembled P. vulgaris in both vegetative and floral characters. It was self-fertile and progeny segregated for halo blight resistance. Honma and Heeckt (1958) described a hybrid P. coccineus (♀) × P. lunatus (♂) which showed hypogeal germination. The vegetative morphology of the F₁ resembled P. coccineus. Segregation for germination habit was observed in F₁. Honma and Heeckt (1958) produced an interspecific hybrid between intervarietal hybrids of P. vulgaris (♀) and P. lunatus (♂). The majority of the progeny resembled P. vulgaris except for two sterile individuals. Segregations were observed in F₂ and later generations. Coyne (1964) obtained a hybrid P. acutifolius (♀) × P. coccineus (♂). Flower colour was red and cotyledons expanded just clear of the soil surface, as in P. vulgaris (♀) × P. coccineus (♂) (and reciprocal) and P. lunatus (♀) × P. polystachyus (♂). but unlike the reputed hybrid P. coccineus (♀) × P. lunatus (♂). Pollen production in Coyne's hybrid was reduced but some stainable pollen was found, the hybrid did not set any seed nor could any backcrosses be obtained. Coyne also produced an infertile complex hybrid. P. acutifolius (♀) × P. vulgaris × (F₁ P. vulgaris × P. coccineus) (♂).

Al-Yasiri and Coyne (1966) attempted hybridization among seven species of Phaseolus, four American species P. vulgaris, P. coccineus, P. acutifolius, P. lunatus and three Asiatic species, P. mungo L., P. angularis Wight and P. calcaratus Roxb. The only successful crosses were P. vulgaris × P. coccineus and its reciprocal. They concluded that cross-compatibility between two species varied according to the cultivars selected, explaining lack of success with the cross P. acutifolius (♀) × P. coccineus (♂) which Coyne (1964) had made previously. Al-Yasiri and Coyne (1966) attempted to relate pod formation and pod growth resulting from interspecific pollinations to genetic relationships.

In the literature some F₁ interspecific hybrids are noted as sterile or with reduced fertility, while others are fertile. There is little information on F₁ and F₂ behaviour in the reciprocal cross P. vulgaris × P. coccineus. Further information is needed and a re-examination of interspecific relationships between the four cultivated species P. vulgaris, P. coccineus, P. lunatus and P. acutifolius has therefore been attempted.

MATERIALS AND METHODS

A range of morphologically distinct types of each species was used from which cross-compatible genotypes were selected. A list of cultivars used is given in Table 1.

Emasculation and pollination techniques used were those of Buishand (1956). Flowers of P. vulgaris, P. lunatus and P. acutifolius were emasculated the day before

Euphytica 19 (1970) 481