CONGRUITY BACKCROSSING: A METHOD TO REVERSE ISOLATION.

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Introduction
Hybridization between Phaseolus vulgaris (common bean) and P. acutifolius (tepary bean) is difficult because of reproductive barriers resulting from isolation and specialization (Pratt, 1983). Since tepary carries traits that would be worthwhile in common bean, many breeders have attempted this interspecific cross. The number of interspecific hybrids is usually rather small. Furthermore, the hybrids are mostly cripples, and have low fertility. Recurrent backcrossing has been used to introduce genes from one species to another, but this system results in loss of traits from the donor parent, and is inefficient in disrupting gene linkages (Wall, 1970; Haghighi and Ascher, 1988). Congruity backcrossing (CBC) involves recurrently crossing the hybrids with each parent in alternate generations, and results in a more congruous, less specialized, and fertile hybrid, without loss of traits of either of the original parents (Haghighi and Ascher, 1988; Urrea and Singh, 1995). Using Phaseolus sp. as a model, the objective of this study was to determine the extent to which CBC reverses incongruity. Such reversal would be measured by comparing direct crosses between the species with crosses involving CBC hybrids and accessions of the parental species not previously involved in the CBC pedigree.

Materials and Methods
A diverse array of P. vulgaris (16) and P. acutifolius (6) accessions, and CBC individuals (8) were used. CBC hybrids were crossed with accessions of either P. acutifolius or P. vulgaris, depending on which species would be next in continuing the CBC. Controls for crosses were reciprocal direct crosses between the selected P. vulgaris and P. acutifolius accessions (Diallel cross). Pollinations were made using Buishand's method (1956). To illustrate the differences between methods, data such as number of pollinations, embryos per pollination, percentage of crosses that set embryos, and seed set were taken. Validation of potential hybrids was done using 1-D SDS/PAGE protein electrophoresis.

Results and Discussion
Direct interspecific crosses having P. acutifolius as the female yielded a total of five embryos and nine mature seeds for a success rate of 0.99% and 1.65% of pollinations respectively. All mature seeds were produced by a single female, 89F 50-18. When P. vulgaris was used as female, 27.32% of the pollinations produced embryos. No mature seeds were produced. Haghighi and Ascher (1988) also reported the formation of mature seeds from crosses of tepary bean as female with common bean as male but none from the reciprocal. Considering P. acutifolius accessions as males. 89F 50-16 averaged 1.21 embryos per pollination and over 46% of the pollinations produced embryos, values that are roughly double those of the remaining tepary males. Accessions of P. vulgaris yielding
mature seeds as males were 'Cincuenteno', 'Cuarenteno', EAP 10-88, and DOR 482. Seven of the seeds resulting from direct interspecific crossing were planted. Four germinated but were crippled and died. Gel electrophoresis of cotyledonary protein suggested that these hybrids did not produce the main seed-storage protein, phaseolin.

Crosses having CBC individuals as the female yielded an average of 1.6 embryos/pod or 0.02 embryos per pollination, with a success rate of 1.53% of the pollinations. However, the greatest advantage of CBC hybrids appeared in the production of mature seeds, an average of 2.75 per pod, and in percentage of pollinations producing pods (5.51%) over pure accessions of *P. acutifolius* and *P. vulgaris*.

Using *P. acutifolius* accessions as males with CBC females, 89F 50-7 averaged 0.18 embryos per pollination and over 7% of the pollinations produced embryos. However, 89F 50-13 had the highest percentage of pollinations yielding seeds with 9.52%. Five accessions of *P. vulgaris* yielded mature seeds as males with CBC females at rates higher than 10% of the pollinations. They were 'Cuarenteno', DOR 475, RAB 205, 'Cincuenteno', and 'Desarrural'. The seeds resulting from the crosses involving CBC individuals were planted. All of them germinated and produced a normal plant.

References


