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WIDE CROSSES IN SOYBEANS: PROSPECTS AND LIMITATIONS

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SUMMARY

It was attempted, though in vain, to cross soybean with *Glycine* species of the subgenus *Glycine*.

Utilization of wild species for improving their cultivated counterparts is steadily increasing in various crops (HARLAN, 1976). Exploitation of the wild progenitors is the most reasonable approach since a cultigen and its wild progenitor are genetically members of the same species and gene transfer between them is a relatively simple task. Exploitation of other wild species, such as those which belong to the secondary or tertiary gene pools of the cultigen (HARLAN & DE WET, 1971) is much more difficult since various types of isolating mechanisms that prevent gene flow between different biological units must be overcome. On the other hand, because of genetic remoteness of these wild species from the cultigen there is a good possibility that they possess variation in characteristics of economic value which is missing in the cultivated germplasm, e.g., pest and disease resistance.

The genus *Glycine* WILLD. is currently divided into two subgenera, *Glycine* and *Soja* (MOENCH) F. J. HERM. The subgenus *Soja* includes the cultivated soybean, *Glycine max* (L.) MERRILL and its wild progenitor *G. soja* SIEB. and ZUCC. The subgenus *Glycine* contains six parennial wild species: *Glycine canescens* F. J. HERM., *G. Clandestina* WENDL., *G. falcata* BENTH., *G. latrobeana* (MEISSM.) BENTH., *G. tabacina* (LABILL.) BENTH. and *G. tomentella* HAYATA (HYMOWITZ & NEWELL, 1979). In the past few years a sizeable collection of species belonging to the subgenus *Glycine* has been assembled at the Department of Agronomy, University of Illinois, Urbana, and a study aiming at assessing intra and interspecific variation was initiated (NEWELL & HYMOWITZ, 1978). However, from a plant breeding point of view it is important to have concrete information not only regarding the ranges of variation but also the possible exploitation of these species for improving the cultivated soybean. In other words, it is crucial to determine the rate of crossability between the cultigen and these wild species, the behavior of F_1 hybrids and their progeny.

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In winter 1978, we initiated a crossing program in the greenhouse between soybean cv. Amsoy, a genetic male sterile line, and five species of the subgenus *Glycine*. As a result of these crosses pod initiation was observed when the cultivated species served either as male or female parent. Pod sizes did not exceed 10 mm and they dried out about 20 days after pollination when the soybean served as the famele parent, and after 10–12 days when the wild species served as the female parent.

In autumn 1978 interspecific crosses again were made in the greenhouse. This time only the genetic male sterile soybean line was employed as the female parent and the five wild species as pollen donors. Germination of the pollen grains of the alien species on the stigma of the cultivated soybean was proven by the fluorescence technique of CHOU & HARBERD (1970). The pollen grains germinated easily and 48 hours after pollination they were found abundantly around the ovules. Many pod initiations were observed about a week later. Three hundred and seventy-two interspecific crosses were made yielding forty intiations of pod development (Table 1). The largest number of pods was developed following pollinations with *Glycine tomentella* pollen. In that

Table 1. Interspecific crosses between the soybean and five species of the subgenus *Glycine*.

Species	Number of accessions	Number of crosses	Number of pods	Pod size (mm)
G. canescens	1	42	2	5–8
G. clandestina	1	38	0	–
G. falcata	1	27	0	–
G. tabacina	2	19	1	4
G. tomentella	11	245	37	4–32

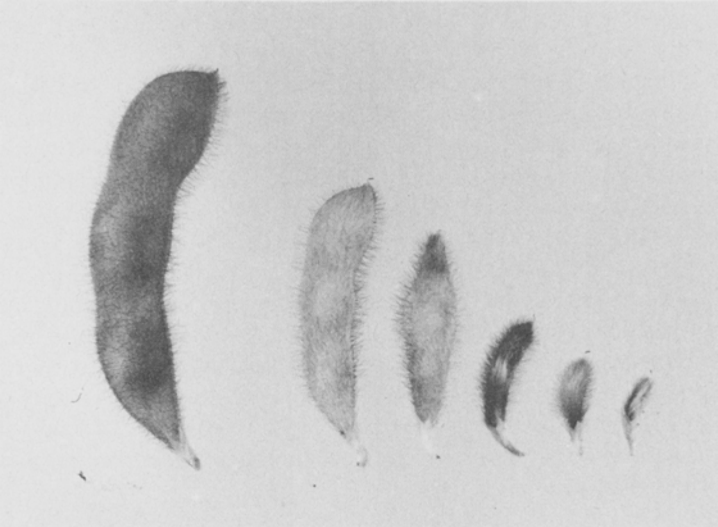

Fig. 1. Pods produced from interspecific crosses between the soybeans and species of the subgenus *Glycine* (right) and a soybean pod of comparable age (extreme left).

combination they also reached the largest size before they turned yellow and dropped. Pod size varied from 4 to 32 mm in the various cross combinations (Fig. 1). Some of the pods dried out after 10 days, others after about three weeks. The largest pod reached about 2/3 of a normal soybean pod of comparable age. However, there was no association in the hybrid pods between pod size and embryo development. Even in the largest pods the embryo remained very small and only slightly larger than the ovules.

Initiation of pod development following interspecific crosses in soybean indicates that pollen tubes of most subgenus *Glycine* species are capable of fertilizing the soybean ovules. Pod initiation was also observed following crosses with *Glycine falcata* made in the winter. The hybrid zygotes apparently started to develop, triggering pod formation, but shortly thereafter embryo development apparently was arrested either because of disharmony between the two genomes or due to malfunctioning of the endosperm. In many interspecific crosses this latter barrier has been overcome by transforming the young hybrid embryo to culture medium, allowing immediate development from immature embryo to plant. Our attempts to develop such a culture medium for soybeans, thus far, have been unsuccessful. If such a medium could be developed it would enable testing the nature of the pod abortion in the interspecific crosses between the soybean and members of the subgenus *Glycine*. If the hybrid embryos continue to grow on a culture medium which is suitable for soybeans it would indicate that the endosperm of the hybrid embryos is not functioning and there would be a possibility of obtaining hybrid plants by that method. However, if the hybrid embryos failed to grow on such a medium it could be interpreted as a serious disharmony between the genomes of soybean and the wild species of the subgenus *Glycine*. Hence, there would be little chance that these wild species could be exploited for breeding purposes.

ACKNOWLEDGMENT

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