SOME OBSERVATIONS ON THE ORIGIN AND EVOLUTION OF THE WINGED BEAN
(PSOPHOCARPUS TETRAGONOLOBUS)

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SUMMARY

On the basis of phytogeographic evidence it is suggested that Psophocarpus tetragonolobus has an African ancestry, a possible parallel with the origin of guar (Cyamopsis tetragonoloba) is suggested. The most probable ancestral species is Ps. grandiflorus native to East Africa from Ethiopia to Zaire. This hypothesis could be tested by experimental hybridization between the cultigen and its closest wild relative Ps. grandiflorus.

INTRODUCTION

The winged bean has recently acquired notoriety as a potentially valuable plant-protein producer in the humid tropics where the soyabean cannot be grown satisfactorily. The origin and evolution of this crop has acquired considerable topical interest since a great deal of effort is now being expended on germplasm collection and evaluation (KHAN, 1973, 1975, 1976). Fortunately a comprehensive and probably definitive monograph of the genus Psophocarpus has been produced recently by Verdcourt & Halliday (1978). This is of considerable interest to all interested in breeding and improvement of the winged bean since it establishes nomenclature within the genus on a sound footing in addition to suggesting phylogenetic relationships. The genus contains nine species, eight of which are wild and one, the winged bean itself, is found in cultivation. While the wild species have been collected only in Africa, Madagascar and the Mascarene islands, the winged bean has a largely Asiatic distribution ranging from Mauritius to New Guinea (BURKILL, 1906). The apparent absence of any truly wild form of Psophocarpus from Asia is a perplexing feature.

PHYTOGEOGRAPHIC EVIDENCE

The importance of phytogeographic evidence in determining probable centres of origin for crop plants can scarcely be underestimated. It has for example been decisive in establishing the New World origin of maize and groundnuts. In the case of groundnuts it has also enabled archaeological evidence to be interpreted correctly. The most ancient archaeological material of groundnuts has been found in Peru, but the weight
of botanical evidence is against a Peruvian origin of the groundnut but strongly suggestive of an origin in the eastern foothills of the Andes. The trans-Andean migration has undoubtedly been effected by man (GREGORY et al., 1978). A more extreme situation has been investigated by Hymowitz (1972) in guar (Cyamopsis tetragonoloba). This he regards as a crop developed in Asia from original seed stock of African origin, that is to say guar is a transdomesticate.

The situation in the winged bean strongly resembles that in guar. The question arises could this crop have arisen in a similar way? The somewhat limited evidence suggests that it could. Of the wild species that VERDCOURT & HALLIDAY (1978) describe, that with the closest general resemblance to the winged bean is Ps. grandiflorus. Interestingly enough this is found in Eastern Africa from Ethiopia through Uganda to Zaire in upland areas at ± 1750 m above sea level. This area is sufficiently close to the trade routes from East Africa to Asia for this suggested movement to be a distinct possibility. It is also of some interest to note that the winged bean itself flourishes best in montane areas for example in Papua-New Guinea. VERDCOURT & HALLIDAY (1978) do point out that palynologically Ps. grandiflorus and Ps. tetragonolobus are distinguishable. A more critical test might well be of the ability of the two forms to cross and produce viable, fertile hybrids, certainly no successful hybridization has been reported between Ps. tetragonolobus and Ps. scandens.

In view of the weight of phytogeographic evidence it is surprising that there are so few advocates of an African origin for the winged bean. BURKILL (1906) strongly favoured this hypothesis, most recent authors with the exception of ZEVEN & ZHKHOVSKY (1975) incline towards an Asiatic origin. It is arguable that Asia has on the whole been collected botanically more thoroughly and systematically over a longer period than Africa and if wild Psophocarpus species were still extant it would be reasonable to expect them to have been collected. It is possible that an Asiatic ancestral species might have become extinct, but there is no evidence at present that wild Psophocarpus occurred in Asia in comparatively recent times. In view of the parallels with crops such as the cowpea (STEELE, 1976), guar (HYMOWITZ, 1972) and sorghum (DOGGETT, 1976) which have been moved by man from Africa to Asia, it is not unreasonable to suggest that the winged bean might be included in this group. Certainly little or no hard evidence has been advanced by VERDCOURT & HALLIDAY (1978), WESTPHAL (1974) or HYMOWITZ & BOYD (1977) to identify with any degree of conviction a specific centre of origin outside Africa.

CYTOLOGY AND INTERSPECIFIC HYBRIDIZATION

It can be expected that studies of experimental interspecific hybridization could be informative and that cytogenetic studies would also be instructive. The present cytological position is confused but some clarification is emerging. FRAHM-LELIVELD (1960) reported a chromosome complement 2n = 20 for Ps. palustris (? Ps. scandens), on the other hand MIÈGE (1960) found 2n = 22. These counts are noted by CAVE (1961, 1964) and WESTPHAL (1974). RAMIREZ (1960) found 2n = 26 in meiotic material of Ps. tetragonolobus. However TIXIER (1965) observed 2n = 18 in Ps. tetragonolobus, a count which has been confirmed by KHAN (1976) and HAQ & SMARTT (1977) who also found 2n = 18 in Ps. scandens (Ps. palustris). The latter authors also found some material of