Pak. J. Bot., 11 (2). 167-172, 1979.

STUDIES ON LIBYAN GRASSES. V. POPULATION VARIABILITY AND DISTRIBUTION OF *SCHISMUS ARABICUS* AND *S. BARBATUS* IN LIBYA

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Abstract

Populations of *Schismus arabicus* and *S. barbatus* from different locations of Libya were collected and their morphology, cytology and reproductive behaviour were studied. The two species show a distinct morphological break between allopatric populations. Under sympatric conditions only *S. barbatus* and the tentative hybrids occur. This indicates that although *S. arabicus* did occur in this area in the past, now because of hybridization it has either disappeared or it has become very rare. Although both the species are self-breeders, but there must be frequent breakdown in autogamy. Chromosomal pairing and fertility of the tentative natural hybrids was normal.

Introduction

The genus *Schismus* P. Beauv. includes about five species of cool desert annuals distributed in Southern Europe, Africa, Middle East Asia and probably naturalized in the U.S.A. In Libya this genus is represented by two species, i.e. *S. arabicus* Nees and *S. barbatus* (L.) Thell. These two species are reported to be distributed both in Cyrenaica and Tripolitania (Scholz, 1974). As a consequence of a very fast rate of seed germination (Love, 1972), these species provide some of the earliest winter pastures for cattle and sheep in Libya.

Bor (1968) has differentiated the two species from each other on the basis that in *S. arabicus* the glumes are over 5 mm long, the lower most lemma is acuminate and the lemma fissure is one third to one half as long as lemma. Moreover, there is usually a short awn present in the fissure. Conversely in *S. barbatus* the glumes are less than 5 mm long, while the lobes of the lower most lemma are either obtuse or acute and the lemma fissure is just a notch and the small awn is absent. Bor (1968) has pointed out some overlap of characters and he has suggested some possibilities of hybridization between the two taxa. Maire (1955) and Tackholm (1974) do not regard these as two distinct species and thus treat them as one. Bor (1968), however, has maintained these as two species because according to him, Haines (in Agnew, Bull. Coll. Sci. Baghdad 6 (Suppl.): 87. 1962) regarded it so and Haines had seen these plants in nature. Gould (1968) and Scholz (1974) also regard these as two species.

In order to check the extent and the basis of variation, populations were sampled

from their distribution range in Libya. The present paper reports the morphology, cytology, reproductive behaviour and distribution of these plants.

Material and Methods

Plants were sampled where several of them were growing together. All of these plants were collected under the same number and if buds were available, these were fixed in 3:1 (alcohol: acetic acid) for meiotic study. All the buds of one population were pooled together and these were given the same number as those for herbarium specimens.

In morphological study lemma characters were studied from the lower most floret. For meiosis PMC squash were prepared using propiono-carmine. Chromosomes were counted in anaphase I and chromosomal pairing was studied in diakinesis or metaphase I or both. The breeding behaviour was investigated from the plants raised in the nursery. Unopened florets were studied for anthesis and embryo formation. For the study of embryo development, fresh ovary was placed on a slide and its lower end was punctured by a dissecting needle. A drop of aceto-orcein was placed on the ovary and the slide was heated several times. After 2-3 minutes a cover glass was placed on the slide and under a binocular the cover glass was pressed gently by a dissecting needle till the ovule came out. Repeating the process again the ovule was ruptured to see if the embryo was formed.

Results

Morphology: The study of individual morphological characters in the Libyan material of *Schismus arabicus* and *S. barbatus* shows that glume and lemma characters are highly variable. Awn is either present or it is absent in the local population of *S. barbatus,* and it is absent in *S. arabicus.* The two species, however, are separated from each other on the basis of the depth of lemma notch which is deeper in *S. arabicus* as compared to the other species. Moreover palea is not visible through the notch in *S. arabicus* and it is either clearly visible or somewhat visible in one floret and not visible in the other floret of the same plant of *S. barbatus.*

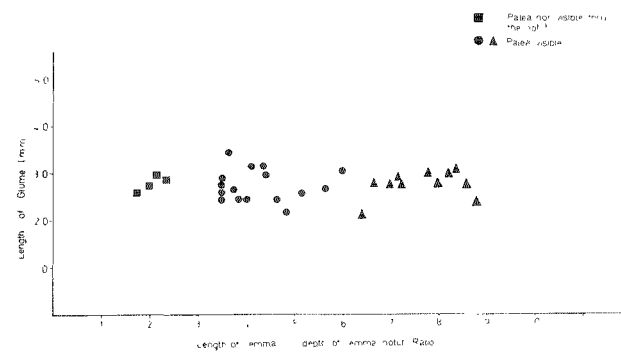

Fig. 1. Scatter diagram showing the variation pattern is *S. barbatus* (▲▲) *S. arabicus* (■■) and intermediate populations (●●) showing the evidence of gene exchange between the two species.

The ratio of lemma length/depth of lemma notch when plotted against glume length gave the separation of 4 populations of *S. arabicus* from the remaining 27 populations. The latter could again be separated into two groups of 11 and 16 populations. The group of 11 populations represents *S. barbatus* while that of 16 represents as intermediate population or tentative hybrids of *S. arabicus* and *S. barbatus* (Fig. 1).

Distribution: In Libya *S. barbatus* has a much wider distribution than *S. arabicus* (Fig. 2). The former covers most of the coastal plains west of Benghazi and extends into the hilly areas of Jabal Nafusa (i.e. Nalut – Garyan – Tarhuna), while the latter is confined to Jabal Akhder area (i.e. Ras el Helal – Baida) and its nearby plains upto Benina near Benghazi. The tentative hybrids have more or less the same distribution pattern as *S. barbatus,* but these are more frequent in the Jabal Nafusa area than any where else.

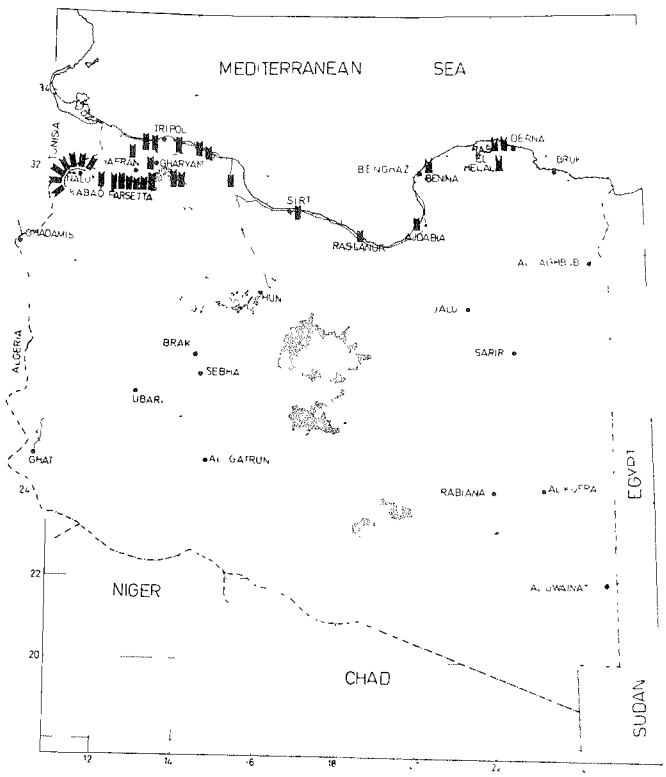

Fig. 2. Distribution of *S. barbatus, S. arabicus* and their tentative natural hybrids in Libya. Each symbol represents relative lemma length and depth of the lemma notch.

Cytology: Out of six populations of *Schismus* which were studied cytologically, each showed n=6 chromosomes (Table 1). The chromosomal pairing in diakinesis and metaphase I was regular with 6 bivalents in each of the populations (Figs. 3-8). These included *S. arabicus, S. barbatus* and the tentative natural hybrids. Anaphase I was also regular with perfect separation of six chromosomes at each pole (Fig. 9). Pollen fertility in all the plant population studied was more or less 100 percent.

Table 1 Chromosome number and meiotic behaviour of *Schismus barbatus*, *S. arabicus* and their tentative natural hybrids.

Accession number	Locality	Name of species	n number	Metaphase I	Anaphase I
1076	Nalut	*S. barbatus*	6	6 II	normal
1343	Tawargha	*S. barbatus*	6	6 II	normal
1075	Nalut	*S. barbatus* X *S. arabicus*	6	6 II	normal
1400	Ajdabia	*S. barbatus* X *S. arabicus*	6	6 II	normal
1354	Benina	*S. arabicus*	6	6 II	normal
1355	Benina	*S. arabicus*	6	6 II	normal

Breeding behaviour: The study of unopened florets in *S. barbatus* showed that anthesis takes place several days before the opening of the florets. The stigma branches then have all its branches at right angles, and the filaments look highly tangled up with the stigmatic hairs. Consequently self pollination takes place quite effectively. The more or less empty anthers do emerge out of the florets finally, but by this time the embryos are already in their later stages of development. In *S. arabicus* this study was made from the preserved material. In this species also self fertilization is the normal way of reproduction.

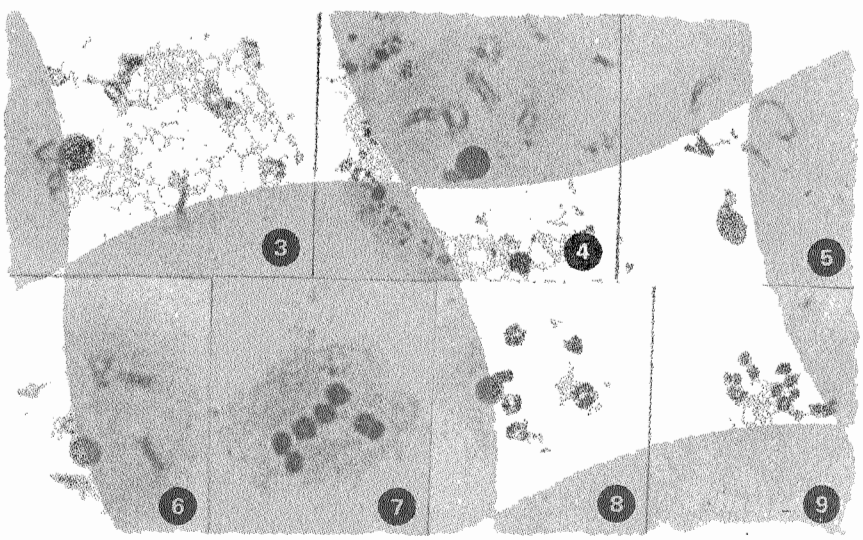

Fig. 3 Late diplotene in *Schismus barbatus* (1075) showing 6 bivalents.
Fig. 4 Diakinesis in *S. barbatus* X *S. arabicus* showing 6 bivalents.
Fig. 5 Diakinesis in *S. barbatus* (1076) showing 6 bivalents.
Fig. 6 Metaphase I in *S. barbatus* X *S. arabicus* showing 6 bivalents.
Fig. 7 Diakinesis in *S. arabicus* (1355) showing 6 bivalents.
Fig. 8 Metaphase I in *S. arabicus* (1355) showing 6 bivalents.
Fig. 9 Anaphase I in *S. arabicus* (1355) showing regular distribution of chromosomes.

Discussion

Morphological analysis of 31 populations of *Schismus arabicus* and *S. barbatus* showed that these two species could be separated from each other on the basis of the ratio of lemma length/depth of lemma notch of the lower most lemma and whether palea is visible or not visible through the notch. On the other hand the character of awn is highly unreliable in separating the two species. In the literature awn on lemma is present in *S. arabicus* and absent in *S. barbatus* (Bor, 1968). In the Libyan material, however, awn is absent in *S. arabicus* whereas in *S. barbatus* it is either present or absent. Similarly these two species in Libya cannot be differentiated on the basis of glumes which seem to be important in these species ocurring elsewhere (Bor, 1968). The plants which are intermediate in the scatter diagram (Fig. 1) are similar to *S. barbatus* in the characteristics of awn and palea.

In Libya the two species are reported to be distributed both in Tripolitania and Cyrenaica (Scholz, 1974). The present study, however, shows the presence of *S. arabicus* in Cyrenaica only. Presence of natural hybrids in the cooler areas of Tripolitania is indicative of the past distribution of *S. arabicus* which now became either very rare or extinct because of hybridization with *S. barbatus.*

Morphological analysis of populations indicates (Fig. 1) that gene exchange between the two taxa is quite frequent and the natural hybrids are fully fertile and cytologically their chromosomes pair regularly (Fig. 3-9; Table 1). Thus a genetic barrier between them is completely lacking. Still, populations whether parental or intermediate are able to show some stability because of self reproducing mechanism. But it seems that these populations also undergo frequent periodic breakdown in autogamy (Harlan, 1945; Stebbins, 1957; Grant, 1958) which keeps the species in an active state of evolution. If *S. arabicus* and *S. barbatus* were confined to Libya, the only logical conclusion would be to merge them together, but this could be done because both the species have a wide range of distribution and that they might also be sympatric in certain areas. For example both the species are reported from the U.S.A., where *S. arabicus* grows in Arizona, Nevada and Southern California, while *S. barbatus* extends from Western Texas to Southern California (Gould, 1968). Thus, there are possibilities that the two species are sympatric in Southern California. Examples are known when such sympatric taxa in one locality act as one species and in the other locality as two good sympatric species (Beeks, 1962; Grant, 1971; Quraish & Faruqi, 1969). A possibility, therefore exists that the two species elsewhere might behave differently. Moreover, in a recent taxonomic revision of the genus *Schismus* (Conert & Turpe, 1974) have maintatined the two as distinct although they have demonstrated variation of overlapping nature between the two species. Under these conditions a taxonomic decision should wait until intensive population studies from their entire range of distribution is made available.

Acknowledgements

The authors are highly indebted to the Arab Development Institute for financing

this project. Thanks are extended also to our Lab. Technician Mr. Mohammad Ahmad who prepared the morphological slides and took the measrements.

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