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## Cytotaxonomic Notes on the *Dichanthium annulatum* Complex

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*Dichanthium annulatum* Stapf is a tropical and subtropical grass of the tribe *Andropogoneae*. This grass is widely distributed throughout the Old World and is generally regarded as an excellent fodder plant. A collection of 150 accessions of the *D. annulatum* complex has been maintained at the Oklahoma Agricultural Experiment Station since 1952 with the view of evaluating their use in the forage improvement program. The high quality, vigour and productivity of some accessions suggest their desirability as a source of genetic potential for the production of agronomic types suited to the Southern Great Plains.

In a preliminary survey of the morphological variation prevalent in this complex, Celarier and Harlan (1955) pointed out that, although clear lines of demarcation are rather difficult to draw, there appear to be three readily distinguishable types, i. e., Tropical, Mediterranean and South African. Further investigations revealed that, besides the bulk of the accessions that could be assigned to these categories, there were at least a few that could fit into these groups only with difficulty, while some others would not fit at all (Celarier, *et al.*, in press; Harlan, *et al.*, in press). Using the pictorialized diagram method of Anderson (1949) an attempt was made to understand the pattern of morphological variation present in this group and to collect evidence, if any, for introgression. The results of this study are presented here.

Five morphological characters: growth habit, length of the hairs at the nodes, the number of racemes, the thickness of the racemes, and the length of the hairs at the tips of the glumes, were studied in one hundred representative accessions. The pictorialized scatter diagrams were plotted by using the length of the primary floral axis and the length of the largest raceme as the ordinate and abscissa respectively (Figure 1).

It appears from the graph that the bulk of the accessions fall into three well-marked groups that are associated with polyploid levels. The first group consists of diploid accessions. This material is of the Tropical type, characterized by the presence of the prostrate, or sometimes decumbent forms, rooting at the nodes. The plants have fewer racemes of medium thickness, but are shorter in length than most tetraploid accessions of the Tropical type. The second, the tetraploid group, to which belongs the bulk of the accessions, occupies the central position in the graph. The morphological variation exhibits a suggestive pattern. On one side, adjacent to the diploids, are present typical Tropical tetraploids, which are prostrate or decumbent having medium size inflorescences with racemes of medium length and thickness; while on the other side are grouped a few distinct Mediterranean types, which are generally erect plants possessing somewhat longer and more lax inflorescences with longer and more slender racemes. Besides these there were recognized morphologically variant types, which would suggest the introgression in them of different combinations of these characters. Fairly prostrate or decumbent types were recognized among the Mediterranean types and also Tropical types were recovered possessing certain features of the Mediterranean types. This would suggest the presence of introgression in both directions. Somewhat central to, but at a little higher position on the graph, can be recognized a group of accessions composed of decumbent plants having longer hairs at the nodes and glumes, longer and more lax inflorescences, which were either median or slender in thickness. This suggests possible introgression with certain other species that we do not know at present. Two odd accessions, located higher on the graph (between 40 and 45), occupy an isolated position. The larger length of primary axis and the racemes of these plants suggest evidence of introgression presumably in the direction of the *Bothriochloa intermedia* complex. The third group comprises the erect-growing South African types, all hexaploids, which are characterized by their inflorescences having a much longer primary axis with longer but thicker racemes, the glumes of which possess longer hairs.

Celarier and Harlan (1955) reported the presence in the *D. annulatum* complex of an intraspecific polyploid series of diploid, tetraploid and hexaploid plants with somatic chromosome complements of 20, 40 and 60 respectively. A survey of the chromosome numbers (Celarier, *et al.*, in press) revealed, that out of fifty-eight accessions studied, four were diploids, seven were hexaploids, while the remaining forty seven were tetraploids. Details of meiotic behavior of these accessions have been discussed (Celarier, *et al.*, in press). Diploids showed regular meiotic behavior while the tetraploids and hexaploids possessed varying degrees of cytological irregularities. Typical Tropical and Mediterranean tetraploids were observed to be slightly irregular, while the intermediate types, with certain suggestions of introgression, were observed to be comparatively more irregular. It was interesting to observe that the two isolated entries which appeared to be diverging in the direction of *B. intermedia*, as well as the South African hexaploids were extremely irregular. This suggests that associated with morphological variation, there exists an irregular cytological behavior during meiosis, thus substantiating the hypothesis of introgression.

Cytological studies (Celarier, *et al.*, in press) have shown a well marked correlation between intraspecific polyploidy and geographical distribution of the complex. Cytoecological studies might throw light on the proper choice of materials to be utilized in an improvement program aimed at developing strains best suited for specific agroclimatic conditions.

The possible origin and evolution of the complex have been discussed

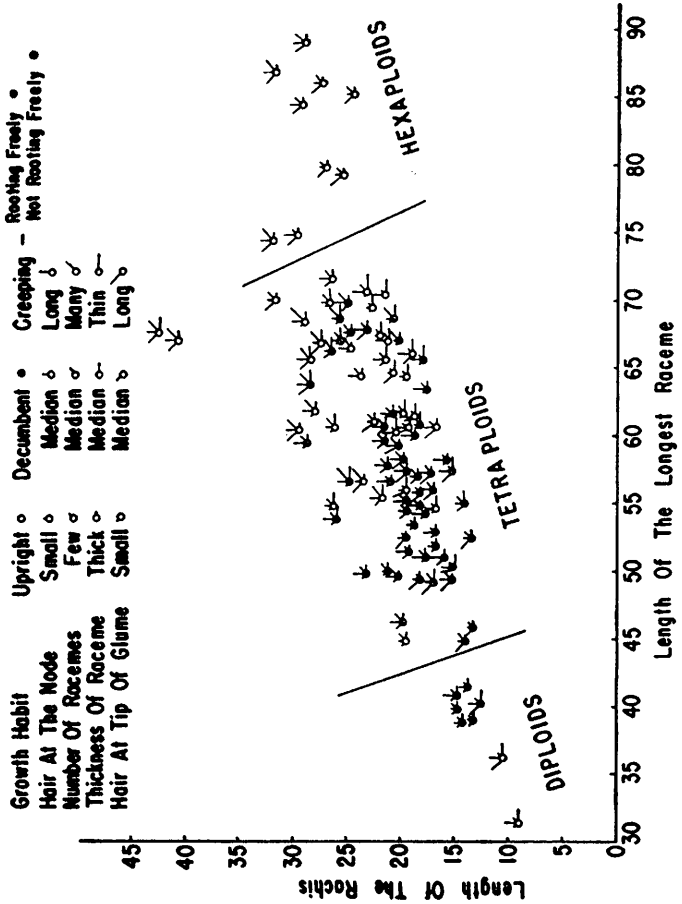


Figure 1. Pictorialized scatter diagram showing the morphological variation in the *Dichanthium annulatum* complex. Note the distinctness of the ploidy levels. (drawing made by Jack I. Fryrear of the Agric. Engr. Dept.).

by Celarier *et al.*, (in press). It was postulated that the tetraploid Tropical types may have originated by natural doubling of hybrids between two closely related diploid *Dichanthium annulatum* types. Once produced, such tetraploid types underwent an active cytogenetic differentiation and evolution. The validity of the above hypothesis can be tested by artificially doubling the chromosomes of inter-racial diploid hybrids, followed by crossing such tetraploids with naturally occurring tetraploids. A comparison of the cytological behavior of the artificial and the natural Tropical tetraploid, as well as the hybrid between them, would throw light on the validity of this hypothesis. Artificial inter-racial diploid hybrids have been produced, which shall be doubled in due course.

Introgression of certain characters of an unknown species into the Tropical tetraploids has been proposed (Celarier, *et al.*, in press) to account for the origin of Mediterranean types. The validity of such a proposal could be tested by comparing the morphological characters and meiotic behavior of hybrids produced between the typical Tropical and the Mediterranean type.

The origin of the hexaploid types has been postulated (Celarier, *et al.*, in press) as having been due to hybridization between tetraploid *D. annulatum* and *D. aristatum* Hubb. in which an unreduced gamete of one species was fertilized by the reduced gamete of the other. The correctness of this view could be tested by a direct cross of the species involved. The cytological behavior of such an artificial hexaploid would be compared with the naturally occurring hexaploid.

Several studies are now in progress at this station to test these theories.

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