Effects of Environment on Selected Morphological Characters in the Dichanthium Annulatum Complex

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In order to compare the genotypic variation of a given taxon an experimental taxonomist will normally grow numerous collections of the taxon in the relatively uniform environment of an experimental garden. From this garden he frequently conducts detailed morphological studies. In such studies important material of a few collections are often received after a detailed study has already been completed for the bulk of the material. In such cases one is faced with the question of whether or not he should grow the entire collection again. Also living materials of certain morphological types and from certain areas are frequently inaccessible and in such cases one must depend entirely on information obtained from herbarium specimens.

Most workers appear to believe that all of this information may be pooled without serious difficulties. However, there are still a few who believe that plants grown in an experimental garden cannot be properly compared to field collections. Also some workers who study only, or predominantly, living cultured materials are doubtful of the reliability of studies made from herbarium specimens.

There is ample evidence (Clausen, Keck, and Hiesey, 1939, 1940, 1945, 1948; Turrill, 1936; Turesson, 1922, 1925 and others) to show that some species are less influenced by the environment than others, but most frequently it is individual characters that vary from species to species in their reaction to the environment. The same is generally true in regard to herbarium specimens and living material.

The present study deals with a comparison of the morphological variation recorded for seven accessions of the *Dichanthium annulatum* complex during three successive years, and also of measurements recorded from living material and from herbarium specimens in 1958 (Table 1). Six morphological characters were measured. From the previous study of this complex (Celarier and Harlan 1955; Mehra and Celarier, 1958) these characters were observed to be fairly reliable in distinguishing certain distinct morphological types. Of these characters only two were measured in an absolute scale while the rest were recorded in three classes.

Celarier et al., (1958) from a detailed cytogeographical study of this complex found diploids, tetraploids and hexaploids. The diploids were all of the morphological type designated tropical, the hexaploids all of the South African type, but the tetraploids were of two morphological types, tropical and mediterranean.

Materials and Methods

Seven accessions of the *Dichanthium annulatum* complex were grown (Celarier and Harlan, 1956) and studied separately in 1956, 1957 and 1958. The herbarium specimens prepared in 1958 were also studied. These seven accessions consisted of one diploid tropical type, one tetraploid tropical type, two tetraploids of the mediterranean type, and three hexaploids of the South African type. Morphological data were recorded from five plants of each accession. Each plant was represented by an inflorescence which was selected with the intention of obtaining a good repre-

[1] Posthumous, see In Memoriam.

sentation of the range of variation in the accession. The samples were, therefore, quite small and subjectively obtained. The average values for the morphological characters were compared for each accession between years and between living and herbarium specimens.

Experimental Results

(a) Length of the primary axis

This character was observed to be only slightly variable in all accessions between different years in the field and between field and herbarium specimens (Table 1). The average length of the primary axis in all accessions except A 4083 was observed to be higher for the living material grown in 1957 in comparison to the material grown in 1956 and 1958. The herbarium specimens in 1958 were slightly smaller than the field materials. This may not be due so much to an actual shrinkage of specimens, as to a tendency to select smaller specimens for pressing.

(b) Length of the longest raceme

The length of the longest raceme was observed to be only slightly variable between the different years in the field as well as between the field and the herbarium specimens (Table 1). Again, the pressed specimens were somewhat smaller than the field materials.

(c) Width of the racemes

This character was scored in three grades i.e. wide (+), medium (++) and thin (+++). This character was observed to be stable in different years in the field and in the herbarium specimens in all accessions.

(d) Number of racemes

This character was scored in three grades i.e. few (less than 7 racemes), medium (7 or 8 racemes) and many (more than 8 racemes) racemes. Although there was a slight difference in the total number of racemes per inflorescence, both in different years and in comparing field to herbarium material, nevertheless the grades remained the same (Table 1).

(e) Pubescence on the glume

The pubescence on the upper part of the glume was studied and scored in three grades i.e. scantly, medium and highly pubescent. This character remained stable in all accessions between different years (Table 1). In the herbarium specimens the hair seemed to have fallen off from many glumes in most accessions. However, the type of pubescence could be correctly determined in all cases after studying ten spikelets from different locations on the racemes.

(f) Pubescence on the nodes

Pubescence on the nodes of the stem was scored in three grades i.e. slight, medium and highly pubescent. This character was observed to be stable in the field between different years as well as between the living materials and the herbarium specimens.

Discussion and Conclusions

The purpose of this investigation was to find out if selected morphological characters remain stable in different years in the field and also if the data taken from herbarium specimens are similar to those from field material. The comparative morphological study revealed that four

TABLE 1

Morphological comparison between field and herbarium specimens in the *Dichanthium annulatum* complex.

Accession number	Location	Year	Length of the Primary axis (mm.) Range	Mean	Length of the longest raceme (mm.) Range	Mean	Width of the raceme	Number of racemes	Pubescence on glume	Pubescence at nodes
DIPLOIDS										
A-3242	India	1956 (F)[1]	9.0 - 11.0	10.2	35.0 - 41.0	38.2	+	+	+++	+++
		1957 (F)	9.0 - 14.0	11.4	38.0 - 42.0	39.6	+	+	+++	+++
		1958 (F)	9.0 - 12.0	10.2	35.0 - 40.0	36.8	+	+	+++	+++
		1958 (H)	9.0 - 12.0	10.0	34.0 - 39.0	35.5	+	+	+++	+++
TETRAPLOIDS										
(a) Mediterranean type										
A-3182	Isreal	1956 (F)	13.0 - 20.0	20.8	55.0 - 63.0	58.0	+++	++	+	+++
		1957 (F)	20.0 - 23.0	21.4	62.0 - 70.0	65.6	+++	++	+	+++
		1958 (F)	16.0 - 23.0	20.8	50.0 - 60.0	56.0	+++	++	+	+++
		1958 (H)	16.0 - 23.0	20.1	50.0 - 60.0	55.2	+++	++	+	+++
A-3789	Egypt	1956 (F)	14.0 - 22.0	17.6	54.0 - 68.0	61.0	+++	++	+	+++
		1957 (F)	13.0 - 25.0	20.4	55.0 - 66.0	60.2	+++	++	+	+++
		1958 (F)	17.0 - 19.0	18.0	56.0 - 68.0	62.8	+++	++	+	+++
		1958 (H)	14.0 - 20.0	16.0	55.0 - 68.0	62.6	+++	++	+	+++
(b) Tropical type										
A-3713	India	1956 (F)	12.0 - 18.0	15.6	47.0 - 59.0	52.4	+	+++	+++	+++
		1957 (F)	14.0 - 18.0	16.0	43.0 - 60.0	51.0	+	+++	+++	+++
		1958 (F)	13.0 - 18.0	15.6	52.0 - 56.0	54.4	+	+++	+++	+++
		1958 (H)	12.0 - 18.0	15.0	52.0 - 58.0	54.0	+	+++	+++	+++
HEXAPLOIDS										
A-3716	S. Africa	1956 (F)	19.0 - 30.0	25.2	73.0 - 85.0	79.4	+	+++	+++	+++
		1957 (F)	20.0 - 28.0	26.6	69.0 - 86.0	79.2	+	+++	+++	+++
		1958 (F)	23.0 - 30.0	26.2	75.0 - 80.0	76.0	+	+++	+++	+++
		1958 (H)	23.0 - 28.0	25.0	74.0 - 80.0	75.4	+	+++	+++	+++

[1] F indicates field measurements, H, measurements from specimens.

Morphological comparison between field and herbarium specimens in the *Dichanthium annulatum* complex.

Accession number	Location	Year	Length of the primary axis (mm.) Range	Mean	Length of the longest raceme (mm.) Range	Mean	Width of the raceme	Number of racemes	Pubescence on glume	Pubescence at nodes
A-4080	S. Africa	1956 (F)	23.0 - 30.0	25.8	71.0 - 76.0	73.2	+	+++	+++	+++
		1957 (F)	20.0 - 30.0	27.6	80.0 - 88.0	84.8	+	+++	+++	+++
		1958 (F)	21.0 - 25.0	23.4	80.0 - 90.0	84.0	+	+++	+++	+++
		1958 (H)	18.0 - 25.0	21.2	72.0 - 85.0	80.2	+	+++	+++	+++
A-4083	S. Africa	1956 (F)	25.0 - 34.0	29.0	61.0 - 79.0	70.6	+	++	+++	+++
		1957 (F)	24.0 - 30.0	27.6	70.0 - 82.0	76.4	+	++	+++	+++
		1958 (F)	25.0 - 31.0	27.4	70.0 - 80.0	76.8	+	++	+++	+++
		1958 (H)	22.0 - 29.0	24.0	70.0 - 80.0	75.0	+	++	+++	+++

out of the six morphological characters studied, showed consistent grades (same class interval) while the values for the remaining two characters were slightly variable in the field between different years as well as between the living material and herbarium specimens. The two characters showing differences were measured quantitatively. If they had been scored in three classes like the other four characters, they would have been just as stable.

The pressed specimens were somewhat smaller than the field material. How much of this was actually due to shrinkage and how much due to the selection of smaller inflorescences for pressing was not determined. The pressed material was taken later in the season when inflorescences tend to be smaller.

The data indicate that if one scored these six morphological characters in three class intervals. the data from different years and from herbarium specimens could be combined together with considerable confidence.

Also it is seen in Table 1 that those characters that have been used to separate ploidy levels (i.e. - lengths of primary axis and longest raceme) were consistently reliable during the three years and in both nursery and specimen measurements. The same is true for those characters (width of raceme, pubescence of first glume, and length of raceme) that are used to separate tropical from the Mediterranean type in the tetraploids.

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