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## The Degree of Extramedial Response to Hybridity in the Growth of the Mesocotyl and Coleoptile in a Series of Hybrids in Maize

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1. The degree of response in any one characteristic is usually higher during the most active period of growth than it is at maturity. That is, the hybrids grow at a more rapid rate and mature sooner than do their parents.

2. The hybrid which is poorest (has the lowest med. H.Q.) in any one respect also tends to be so in other respects. Also the hybrid which has the highest med. H.Q. in a given respect also tends to have the highest one in other respects. The remaining hybrids vary considerably among themselves, but occupy intermediate positions between the best and poorest hybrids.

3. When the absolute med. H.Q.'s of the various hybrids are compared it becomes evident that:

- a. The correlation in the degree of the extramedial response for different characteristics of the same hybrid is not very great.
- b. Therefore the degree of response in one character may not be used for prediction of the degree of response in another characteristic of the same hybrid.

4. These observations suggest that each characteristic of a hybrid is controlled by certain genes that do not affect the development of the various characters to the same degree and that those genes which control one character may be in a greater state of hybridity than those which control another.

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## THE DEGREE OF EXTRAMEDIAL RESPONSE TO HYBRIDITY IN THE GROWTH OF THE MESO- COTYL AND COLEOPTILE IN A SERIES OF HYBRIDS IN MAIZE

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If it were possible to predict the degree of extramedial response to hybridity as developed in commercially important characteristics of the mature plant from a study of the seedling characteristics of the same hybrid, the selection of crosses showing desirable characteristics would be greatly facilitated. With this in mind, a quantitative study of two seedling characters, mesocotyl length and coleoptile length, was made utilizing four inbreds and the six hybrids between them. These were the same strains as those reported on by Abbe and Wang<sup>1</sup>, but one generation later in origin. Extramedial hybrid-

<sup>1</sup> Abbe, E. C. and K.-W. Wang. The degree of extramedial response to hybridity in the growth rates of plant and ear in a series of hybrids in maize. Proc. Minnesota Acad. Sci., vol. 11, pp. 51-58.

EXTRAMEDIAL HYBRIDITY QUOTIENTS (MED. H.Q.)

	A96 x A116	A96 x A131	A96 x A163	A131 x A116	A116 x A163	A131 x A163
<i>Plant, dry weight</i>						
1. ....during growth .....	1.7	2.4	2.2	1.2	2.3	2.9
2. ....at maturity .....	1.3	1.5	1.6	1.2	1.6	1.7
<i>Ear, dry weight</i>						
3. ....during growth .....	3.0	3.9	3.7	2.1	2.8	4.8
4. ....at maturity .....	1.9	2.2	2.4	1.5	2.2	2.7
<i>Height of Plant</i>						
5. ....during growth .....	1.3 (2.2) <sup>3</sup>	1.4 (2.7)	1.4 (2.7)	1.1 (1.3)	1.4 (2.7)	1.5 (3.4)
6. ....at maturity .....	1.2 (1.7)	1.3 (2.2)	1.3 (2.2)	1.3 (2.2)	1.2 (1.7)	1.4 (2.7)
<i>Length of Mesocotyl</i>						
7. ....during growth .....	2.0 (8.0)	2.0 (8.0)	1.5 (3.4)	2.1 (9.3)	1.1 (1.3)	1.9 (6.9)
8. ....at maturity .....	1.5 (3.4)	1.6 (4.1)	1.4 (2.7)	1.8 (5.8)	1.4 (2.7)	1.4 (2.7)
<i>Length of Coleoptile</i>						
9. ....during growth .....	1.5 (3.4)	2.0 (8.0)	1.3 (2.2)	1.3 (2.2)	1.1 (1.3)	1.9 (6.9)
10. ....at maturity .....	1.5 (3.4)	1.6 (4.1)	1.0 (1.0)	1.6 (4.1)	1.3 (2.2)	2.5 (15.6)

<sup>3</sup> The figure in parenthesis is the cube of the number above it.

ity quotients were calculated following the procedure outlined by Abbe and Wang<sup>1</sup>. The results here reported may therefore be compared with the results already reported for the mature plants.

The kernels of maize from which the seedlings were to be grown, were germinated and grown in a constant temperature (24° C.) and constant humidity (80%) dark room, using the procedure described by Hansen and Abbe<sup>2</sup>. Plants were collected at intervals throughout the development of the seedling, fixed in chrom-acetic-formalin, and stored in 70% ethyl alcohol. Measurements of coleoptile and mesocotyl were made under a binocular dissecting microscope for the earlier stages of development.

The Table below gives the med. H.Q. during growth and at maturity for length of mesocotyl and for length of coleoptile for each of the six hybrids studied. For the sake of comparison the corresponding data for the mature structures reported on by Abbe and Wang<sup>1</sup> are also included.

Length of mesocotyl during growth shows the greatest deviation from the mean between the parents in A131 x A116, having a med. H.Q. of 2.1, while the lowest med. H.Q. for this characteristic is possessed by A116 x A163. The first of these hybrids was poorest in the mature characters of dry weight of plant, dry weight of ear, and height of plant, and the second was intermediate. The hybrid which was uniformly highest for developmental characteristics of the older plant is intermediate in the response of its mesocotyl to the state of hybridity. The same general observations apply to the mesocotyl when it has reached maximum length, although the quantitative expression of the response differs from that during development. The hybrids which were best and poorest in characteristics developed after the seedling stage are represented by the graphs (Fig. 2), the length of the mesocotyl being plotted on the ordinate which is subdivided logarithmically, and age in hours being plotted on the abscissa; the same conventions are used as in the paper by Abbe

#### LEGEND

FIGURE 1. Curves illustrating the rate of increase in length of coleoptile in the two hybrids, A131 x A116 and A131 x A163, and of their respective parental inbreds.

The solid line in each case represents the arithmetic mean between the parents, and the broken line represents the mean med. H.Q.

FIGURE 2. Curves illustrating the rate of increase in the length of the mesocotyl.

FIGURE 3. Chart showing the degree of response to the state of hybridity achieved in dry weight of plant (columns 1 and 2), dry weight of ear (columns 3 and 4), height of plant (columns 5 and 6), length of mesocotyl (columns 7 and 8), and length of coleoptile (columns 9 and 10). The columns are numbered to correspond with the lines of the Table. The odd-numbered columns represent the med. H.Q. during growth, the even-numbered ones the med. H.Q. at maturity.

FIGURE 4. Chart showing the degree of med. H.Q. in per cent, the maximum med. H.Q. for each characteristic being reckoned as 100%.

<sup>2</sup> Hansen, A. and E. C. Abbe. Structure and growth of the mesocotyl in the mutant of maize, dwarf-1. Proc. Minnesota Acad. Sci., vol. 11, pp. 45-51.

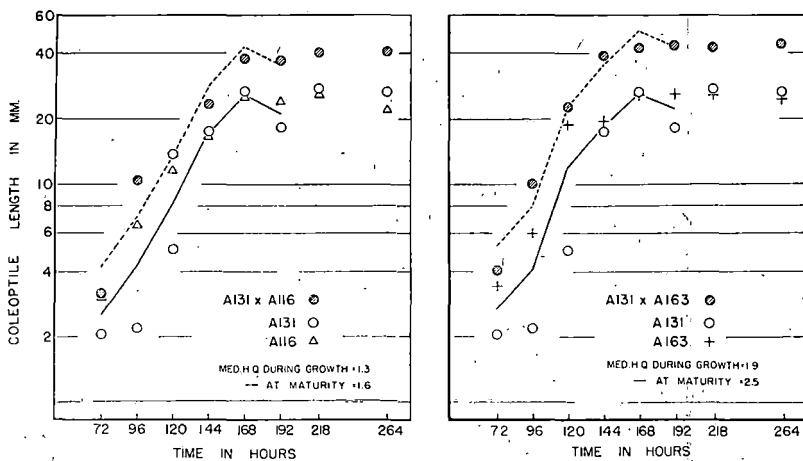


FIGURE 1

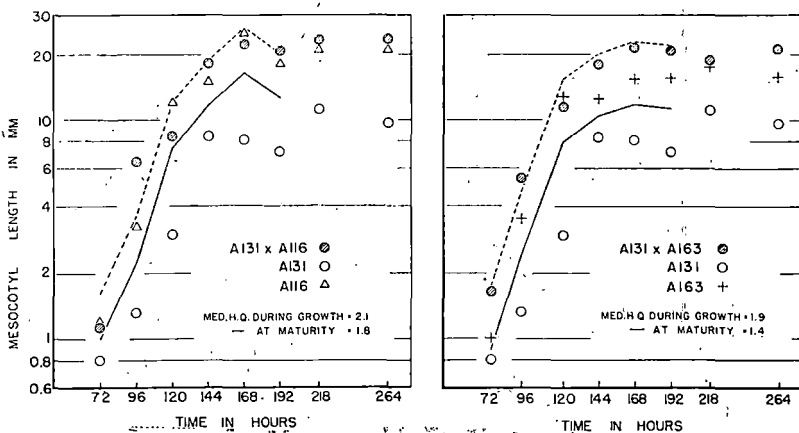


FIGURE 2

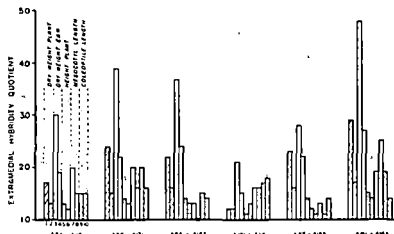


FIG 3

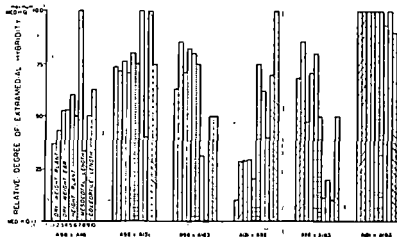


FIG 4

and Wang<sup>1</sup>. It will be noted that the tendency for the hybrid to possess a higher growth rate than the parents is not uniformly present here. This is reflected by the med. H.Q. sometimes being slightly higher at maturity than during growth.

Length of coleoptile provides information of the same general tenor as length of mesocotyl. There is no correspondence between the highest med. H.Q. for length of mesocotyl during growth and the highest med. H.Q. for older plant characteristics.

Figures 3 and 4 provide a basis for comparison of the results obtained in this study with the results obtained from mature plants and it is clear that there is great discrepancy between seedling characters and mature characters. There is neither quantitative correlation in *absolute* degree of extramedial response to the state of hybridity (Fig. 3) nor is there a correlation in the *relative* degree of response (Fig. 4).

On the basis of these observations we would conclude that for the hybrids under consideration the seedling characters of mesocotyl length and coleoptile length are not correlated with mature plant characters in the degree of response to the state of hybridity and that therefore they may not be used to predict the degree of response to be expected in mature plant characteristics.

#### SUMMARY

Six maize hybrids and their respective parents are used to study the degree of extramedial response to hybridity developed for two seedling characters, mesocotyl length and coleoptile length. Developmental and mature med. H.Q.'s for these characteristics are compared among themselves, and with the developmental and mature med. H.Q.'s of mature plant characteristics. The following conclusions are reached:—

1. The med. H.Q.'s of the seedling characteristics are correlated neither qualitatively nor quantitatively with the med. H.Q.'s for the characteristics of older plants. It follows that in this material it would be impossible to predict the med. H.Q.'s of the characteristics of older plants from the med. H.Q.'s of seedling characteristics.

2. There is neither a qualitative nor a quantitative correlation between the med. H.Q.'s for mesocotyl length and coleoptile length within the same hybrid.

3. The above conclusions support the idea that the expression of the interaction of the genes in a hybrid depends on the character studied and the time in ontogeny when it develops.