Inheritance of multiple aleurone layering

Aleurone tissue in corn and other cereals has been shown to be high in protein of excellent quality, and similar in nutrition to germ tissue. Any increase in the amount of aleurone tissue in feed grains should enhance their value as food for monogastric animals.

Prior to the results of M. J. Wolf et al. (Crop Sci. 12:440), no strains of corn had been reported with more than one layer of aleurone tissue. They reported the exotic strain Coroico had as many as six layers and the amount of aleurone tissue per kernel could be increased from 2 percent for single layered kernels to 4 percent for multiple layered kernels. In addition, the aleurone tissue from Coroico had a higher concentration of protein than tissue from single aleurone tissue. Lysine content of the two sources was essentially the same. From a limited number of observations they suggested the multiple aleurone character was controlled by a few partially dominant genes. O. E. Nelson and M. T. Chang (Crop Sci. 14:374, 1974), studying the inheritance of multiple aleurone layering, found considerable variation in the F_2 generation. Their results were not conclusive but neither refuted nor confirmed a single dominant gene hypothesis.

We conducted an inheritance study of the multiple aleurone character in two parts with the assumption that it was controlled by a large number of genes or a few genes plus modifiers. Under the second part we assumed the character was controlled by a few dominant genes.

The quantitive inheritance study consisted of the diallel analysis approach involving five multiple aleurone layered lines. The ratio of general combining ability to specific combining ability was 3.5. The relatively high sca value in relation to gca suggested that few genes with dominance control the multiple aleurone character.

The qualitative study involved two inbred line parents, one with multiple aleurone layering and the second with a single aleurone layer. The reciprocal F_1 crosses showed multiple aleurone layering to be dominant over single aleurone layering. The F_2 generation and two of the four backcrosses and reciprocals agreed with the two gene hypothesis (Table 1). We have no explanation why the one set of backcrosses did not conform to the two gene hypothesis.

Table 1. Chi-square test of the hypothesis that multiple aleurone layering is conditioned by two dominant genes with dosage effects that required at least one dominant gene at each locus.

Generation	Ratio tested	Chi-square value	Average number of aleurone layers	
			Obs.	Pred.
F_2				
(B57ma x B57) ⊗[a]	3:1	16.66**	1.59	1.56
(B57ma x B57) ⊗	9:7	3.18	1.59	1.56
Backcrosses				
(B57ma x B57) x B57	1:3	12.91**	1.24	1.25
(B57ma x B57) x B57ma	1:0	8.00**	1.82	2.00
Reciprocal backcross				
B57 x (B57/ma x B57)	1:3	1.31	1.11	1.15
B57ma x (B57ma x B57)	1:0	0.00	2.06	2.25

[a] 200 kernels observed in population.

** Significant at the 1% level.

The results from our study suggest that the multiple aleurone layering character is controlled by a few genes, possibly two with partial dominance where both dominant genes are necessary.

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Relation of hydroxamic acid concentration (DIMBOA) to resistance to the corn leaf aphid

In 1959, the cyclic hydroxamic acid 2,4-dihydroxy-7-methoxy-1,4-benzoxazin-3-one (DIMBOA) was first reported in maize and has since been directly implicated in resistance to several pathogens and insects. DIMBOA occurs naturally in the glucosidic form and is converted to the toxic aglucone through mycelial penetration or insect injury.

The objective of this study was to correlate DIMBOA concentration with resistance to the corn leaf aphid, Rhopalosiphum maidis (Fitch), through bioassay and field experiments. The bioassay experiment was performed to test toxic effects of DIMBOA on the corn leaf aphid. An artificial diet consisting mainly of a mixture of amino acids and vitamins was prepared for use in the bioassay. To the diet were added various amounts of DIMBOA (0.1, 0.25, and 0.5 mg/g diet) to give concentrations similar to those found in host plant tissue. Control diets contained no DIMBOA. Approximately 15 first instar apterous aphid nymphs were fed the diets through a Parafilm membrane. Mortality counts were recorded every 48 hours for 12 days.

In field trials twelve inbred lines of corn were evaluated for corn leaf aphid resistance under natural infestation. Aphid damage was evaluated at the mid-silking stage using a visual rating scale and an index system. Index values, indicating severity of aphid infestation, were compared to concentrations of DIMBOA found in each line using a colorimetric procedure based upon the reaction of DIMBOA with $FeCl_3$.

Results from the aphid bioassay demonstrated significant effects of DIMBOA on aphid mortality. DIMBOA concentrations of 0.1, 0.25, and 0.5 mg/g diet produced 5.1, 12.8, and 20.5 percent mortality, respectively, using Abbott's formula. Aphid index values from the field data ranged from 15.0 to 65.0, representing mild and severe damage, respectively. DIMBOA concentrations in plants at the fifth to sixth leaf stage ranged from 0.03 to 1.48 mg/g fresh weight. A significant correlation ($r = -0.72$, df. = 34) was obtained between these two traits, indicating that inbred lines containing a high concentration of DIMBOA generally have improved resistance to the corn leaf aphid.

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Localization of factors controlling the Texas type of cytoplasmic male sterility

The location of the factors responsible for the Texas type (cms-T) of cytoplasmic male sterility is unknown. Recent studies (e.g., Science 173:67, 1971; Phytopathology 63:1357, 1973) have shown differences in the response of mitochondria from maize with normal and "Texas" cytoplasms when challenged by toxins produced by race T of Helminthosporium maydis Nisikato and Miyake (southern corn leaf blight) and Phyllosticta maydis Arny and Nelson (yellow leaf blight). Since these studies suggest the involvement of mitochondria, mitochondrial DNA (mtDNA) must be considered as a possible site of factors responsible for traits associated with cms-T.