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## MODIFIED OPAQUE MAIZE FOR POSSIBIE APPLIED USE

ABSTRACT

The opaque-2 ($o_2$) gene has been incorporated by backcross method into eleven Indian inbreds with a view to develop a composite and hybrid varieties of high protein quality. The opaque-2 composite developed after two backcrosses and, subsequent selfing, showed variegation for normal sectors. The sectored types were classified into five distinct types ($S_2$–$S_6$). The lysine content of most, of the sectored types was the same as in opaque-2 control, suggesting that the presence of normal (translucent) tissue may not alter the quality of protein. The two types of sectors $S_5$ ($\frac{1}{2}$ opaque : $\frac{1}{2}$ normal) and $S_6$, similar in phenotype but with an 'opaque spot' on the top of the kernal, may be useful in breeding high protein quality maize with higher grain weight, better yield and normal texture.

THE opaque-2 gene in recessive condition boosts up the production of lysine by about 69–100% and tryptophane by about 66% over the normal maize. Feeding trials conducted with this maize on rats showed a weight gain of 3·6 times in 28 days over the control[1]. The six leading Indian hybrids were surveyed for some essential amino-acids and protein content[2]. It was found that although these hybrids are a little superior to some tested American varieties, the protein quality is still poor compared to opaque-2. A backcross breeding programme was undertaken in 1966 with eleven inbreds : CM 104, CM 105, CM 109, CM 110, CM 111, CM 201, CM 202, Eto-182, Eto-25 AF, Eto-297, and PTR-605 obtained from Maize Research Station, Amberpet, Hyderabad, to improve the protein quality of Indian maize. After two backcrosses with subsequent selfing, an yellow opaque-2 synthetic was developed from the opaque seed of the eleven inbred lines,

Though the yield of the synthetic was significantly higher than that of white opaque-2. however, the seed showed variegation for normal sectors. These were classified into five types of sectors as $S_2$, $S_3$, $S_4$, $S_5$ and $S_6$, depending on the area of the normal (translucent) tissue. Among these five, the $S_5$ and $S_6$ types have the maximum normal area than the other S-types. In $S_5$ the opaqueness is restricted to only half of the kernel, the other half being normal (translucent) which is similar to ½ opaque : ½ normal described earlier[3]. But in $S_6$, in addition to the basal half being opaque it also has an opaque spot on the top of the kernel (Fig. 1). The whole opaque seed ($S_1$) is used as control.

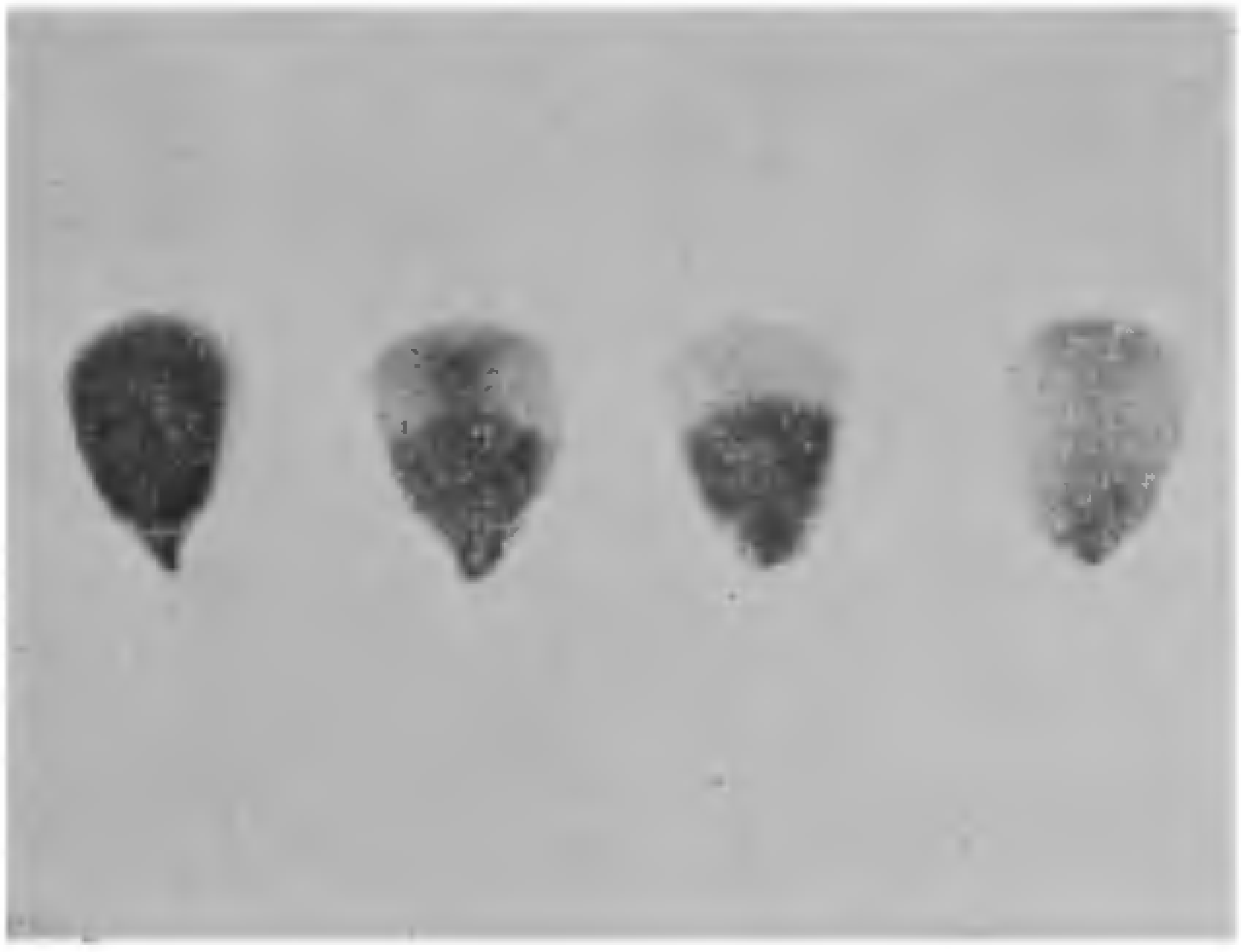

FIG. 1. The four types of kernels (from L to R). whole opaque ($S_1$). $S_6$, $S_5$ and normal tranlucent (viewed over a frosted glass illuminated from below).

The five types of sectored seeds were selfed along with the control $S_1$. The selfed $S_1$, $S_2$ and $S_4$ gave mostly $S_1$ kernels. However, $S_3$, $S_5$ and $S_6$ kernels upon selfing segregated for more than one S-type. The selfed $S_5$ gave four to eleven types of sectored seed including six new types whereas the $S_6$ gave mostly $S_5$ and $S_6$ types. The genetic behaviour of these sectors will be published elsewhere. The five types of sectored seed including control ($S_1$) were analysed for protein and lysine content at the National Institute of Nutrition, Hyderabad (Table I).

The thousand grain weight of control (non-opaque) is about 254·0 gm and American opaque-2 (white) is about 184·0 gm, whereas the synthetic yellow opaque-2 weighs about 215·0 gm. The $S_5$ and $S_6$ sectored types weigh 234·0 gm and 219·0 gm, respectively. Among the four opaque varieties, $S_5$ has the highest grain weight, $S_6$ being the next highest. This may be obviously due to the extent of translucent sector in opaque phenotype.

TABLE I
*Protein and lysine content of sectored and yellow opaque-2*

| Types of sectors | Lysine (gm/100 gm protein) | Crude protein (N × 6·25) |
|---|---|---|
| $S_1$ (Control) | 3·410 | 10·04 |
| $S_2$ | 3·417 | 10·39 |
| $S_3$ | 3·523 | 9·55 |
| $S_4$ | 3·530 | 9·96 |
| $S_5$ | 2·915 | 12·68 |
| $S_6$ | 3·375 | 9·24 |

The present study suggests that lysine content of the opaque kernel is independent of the sector size. This is evident from $S_3$ and $S_6$ which have different sectored areas but almost the same lysine content. Among the two selfed S-types, $S_5$ and $S_6$, the latter segregated for less number of sector types than the former. In addition, the selfed $S_5$ also gave whole opaque seed ($S_1$) which is usually absent in $S_6$.

Considering the average grain weight, lysine content and the segregation for different sectored seed, the $S_6$ type seems to be more promising than either $S_5$ or $S_1$.

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## TISSUE ANALYSIS, AS AN AID IN ASSESSING THE NITROGEN REQUIREMENTS OF COTTON (*GOSSYPIUM HIRSUTUM* L.)

TISSUE analysis is successfully used to determine the nutritional requirements in sugarcane[1] and pineapple[2]. Similar attempts have been made in cotton[3,4]. In assessing the nutritional requirements of cotton, the plant part to be assayed and age of the crop deserve careful study. Several workers[3,5,6] used nitrate in petioles of recently matured leaf as an index to evaluate nitrogen status of the plant and to predict the nitrogen need. The aim of the present study was to find the relationship between the N content of leaves at two growth stages and seed cotton yield and further to aid in nitrogen fertilization based on tissue test.

This experiment was conducted under irrigation at Agricultural Research Station, Arabhavi, for two seasons (1969–71). The soil was medium black with a pH of 8·2. The fertility status was low with respect to total N (0·036%) and available P (9·31 ppm). Split plot design was employed with three replications. Three varieties belonging to *G. hirsutum* L., *i.e.*, AS-6, MCU-5 and MCU-2 were in subplots while nitrogen and spacing combinations constituting 12 treatments were in main plots. The levels of N were 0, 30, 60 and 90 kg/ha and the spacing levels were 75 × 15, 75 × 25 and 75 × 35 cm. A basal dressing of 30 kg/ha each of $P_2O_5$ and $K_2O$ was given. About 7–8 irrigations were given at intervals of 20–25 days and regular plant protection measures were taken. It was sown on 11th and 14th July in 1969 and 1970 seasons respectively. Recently matured leaves from the main stem (4th or 5th leaf from top) were taken at two growth stages, *viz.*, first at squaring, *i.e.*, 60–75 days after sowing and second at peak vegetative phase, *i.e.*, 100–110 days after sowing. About 50–100 leaves were dried in oven at 70° C. Nitrogen estimation was by the modified Kjeldahl method and per cent N was reported on dry weight basis.

The relationship between N content of recently matured leaves and seed cotton yield at peak vegetative phase is given by the regression equations along with the standard errors for slopes in Fig. 1.

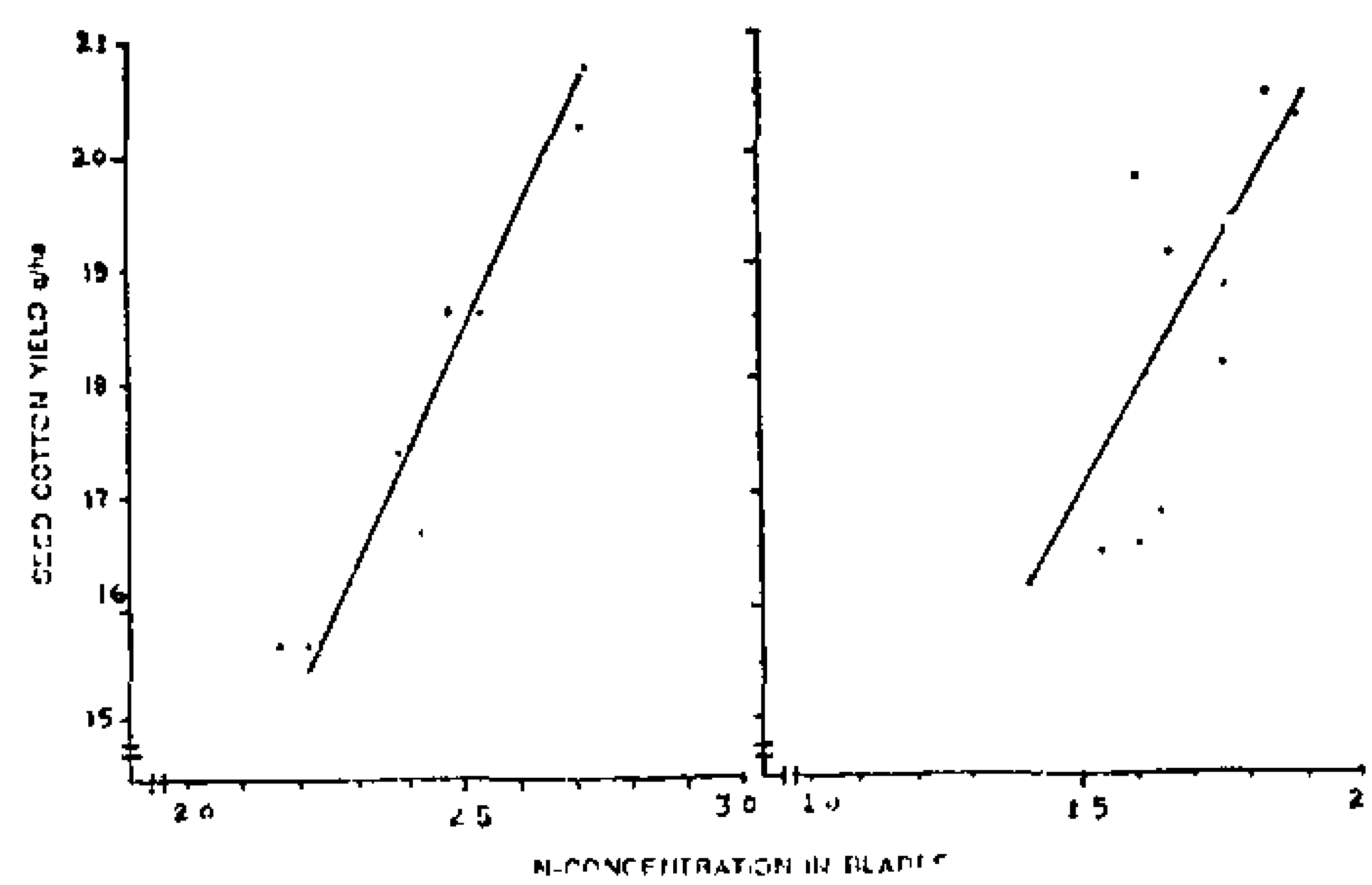


FIG. 1. Seed cotton yield *vs.* N% in leaves at peak vegetative phase *Left*—Season : 1969–70 ; Y = − 7·7 + 10·439 X ; *se* for *b*, *sb* = 1·858 ; *r* = 0·781 (significant at 1%) ; *Right*—Season : 1970–71 ; Y = 3·88 + 3·742 X ; *se* for *b*, *sb* = 0·339 ; *r* = 0·631 at (significant 5%).

The results indicated that N content in leaves at peak vegetative stage could predict the nitrogen need as evidenced by the significant correlation coefficient. The regression coefficient