

A NEW FACTOR DETERMINING THE TINT OF RED AND YELLOW GRAIN COLOURS IN SORGHUM

BY

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In a previous publication (Rangaswami Ayyangar, *et al*, 1933) the inter-relationships between red, yellow and white grain colours in sorghum have been pursued. Yellow (factor Y) is the basic colour. With R, red grains are produced. A factor W determines the manifestation of colour in wholeness on the pericarp. Without W, R gives a white grain with a red base. Similarly Y gives a white grain with an yellow base, the red and yellow bases being within the protection of the covering glume. Dry anther colours run parallel to grain colours and help in the separation of the white grains into their respective allelomorphs to coloured grains. A factor—I—determines the intensity of colour manifestation and is unmistakably noticeable in good red grains. W being present, R, without the—I—factor, gives a pink grain.

It was noted that the yellow grains with and without the—I—factor are difficult of separation. The lightness of the colour and the quick reaction to weather conditions coupled with a brown wash found in most of the yellow varieties added to this difficulty. Even so, with the help of the R factor the yellow allelomorphs could be separated. It was thus clear that there were two shades of yellow colour, the typical yellow with the—I—factor and the light yellow without this intensification factor.

Since 1933 a number of varieties of sorghum have come under examination at the Millets Breeding Station, Coimbatore, and this article presents the occurrence and inheritance of certain types of sorghum characterised by a wash of colour on their pericarp. The occasion for noticing this character was provided by the existence of a type of irrigated sorghum called the *Makkattai* or *Manjakkattai cholam* (*Sorghum subglabrescens* Schweinf. et. Aschers; var. *rubidum* (Burkill, Snowden) from the Madura tract of the Madras presidency. This sorghum could neither be called red, nor yellow, nor easily white. The Tamil name definitely groups it with the yellow. This variety has its grain base red or yellow, according as the wash is red or yellow. When there is a red wash, as in the case of a red base, the dry anther colour shows the existence of this red. It is therefore obvious that this red wash is an aspect of the sap colour red of the red-yellow-white colour series; similarly the yellow wash. To determine the nature of this

peculiar tint of pericarp colour a number of crosses were made between this *Makkattai cholam* and other sorghums, both yellow and white, of known genetic constitutions. *Makkattai cholam* has this advantage in its favour namely that it lacks the B factors and therefore has a pericarp free from the complications of a brown wash. The finer shades of red and yellow could therefore be pursued with a fair amount of ease. Moreover, the pearly nature of the grain affords a convenient background for reading the shades of colour.

The first cross was between *Makkattai cholam* (white grain with a red grain base and a red wash on the pericarp), and A. S. 2095 (white grain with a red grain base and without wash on the pericarp Y Y R R w w). The F₁ had a white grain with a red grain base and a red wash on the pericarp. In the F₂ there was a simple monogenic segregation for red wash on the pericarp, the segregation being 90 with red wash and 28 without red wash on the pericarp.

The second cross was between this *Makkattai cholam* and A. S. 3681 (white grain with an yellow grain base and without wash on the pericarp—Y Y r r w w.) The F₁ was white grained with a red grain and a red wash on the pericarp. The F₂ segregations are presented below :—

TABLE I

Family No.	Red grain base		Yellow grain base	
	With Red wash.	Without Red wash.	With Yellow wash.	Without Yellow wash.
A. S. 5261	100	36	29	12
„ 5262	111	35	26	11
Total	211	71	55	23
Calculated 9:3:3:1	202.5	67.5	67.5	22.5
	$\chi^2 = 2.85$	P > 0.05		

From the above segregations it will be noticed that the wash factor could be super-imposed on a red or yellow grain base colour, it behaving independently of these grain base colours.

The third cross was between the same *Makkattai cholam* and A. S. 837, which has a pink grain without a red wash on the pericarp (Y Y R R W W ii). In the first generation the grain was pink with a red wash on the pericarp and therefore of a tint deeper than the pink parent. An F₂ generation of five families was raised and the segregations are presented below :—

TABLE II

Family No	Segregations.			
	Pink Grain With Red wash.	Without Red wash.	White Grain With Red wash.	Without Red wash.
A. S. 5254	72	24	24	9
" 5255	107	37	29	10
" 5256	98	26	40	12
" 5257	61	23	21	8
" 5258	64	20	24	9
Total	402	130	138	48
Calculated 9:3:3:1	403.875	134.625	134.625	44.875
	$\chi^2 = 0.55$	$P > 0.05$		

It will be seen that the two characters red wash and pink colour on the pericarp behave independently of each other giving a clear dihybrid ratio.

The fourth cross was also between the same *Makkattai cholam* and A. S. 817 (yellow grain allelomorphic to pink YYWWrrii.) The F₁ plants had a very light red grain. An F₂ generation was raised and the segregations are presented below:—

TABLE III

Family No.	Segregations.					
	With Red wash	Light Red Without Red wash	Light Yellow With Yellow wash	Without Yellow wash	White With wash	Without wash
A. S. 5263	65	28	26	8	24	8
" 5264	45	17	14	5	21	5
" 5265	58	19	20	8	30	10
Total	168	64	60	21	75	23
Calculated (27:9:9:3:12:4)	173.46	57.78	57.78	19.26	77.04	25.68
	$\chi^2 = 1.42$	$P > 0.05$				

From the above segregations on a three factor basis it will be seen that this wash factor operates on light red, light yellow and white backgrounds.

Sorghum being a naked grain and exposed to all vicissitudes of the weather, this delicate wash factor designated M (after the sorghum variety *Makkattai cholam*) is best pursued in a hot weather crop and in varieties having a sienna coloured dry anther (without brown wash).

Summary. From crosses between the red colour washed *Makkattai cholam* (*Sorghum subglabrescens* Schweinf. et. Aschers. var. *rubidum* (Burkill) Snowden) and other grain sorghums with the colours of the red,

yellow and white sap colour series, it is seen that there is a definite *wash* character associated with the red and yellow sap colour series of pericarp manifestations. This *wash* factor could be superimposed on the other colours. When the basic colours are deep, the *wash* factor will naturally not show off. When the basic colour is devoid of the *I*-factor for intensification and the grains are in consequence pink or light yellow in colour, the superimposition of the *wash* factor, tones up these basic colours by a shade. The best manifestation of the *wash* factor is in the absence of the *W*-factor disabling the expression of the other pericarp colours in wholeness and making the grain white in consequence, with the colours red or yellow confined to the base of the grain. On this white background the red wash and yellow wash show off to advantage.

A new factor designated *M* gives a red or yellow *wash* to the pericarp of the sorghum grain according as the base is red or yellow. The factor operates in the presence of *Y* or *R* factor. In the presence of the factor *W* its expression is too faint to show out. It shows best in the absence of the *W* factor. In conjunction with the factor *I*-(intensification of pericarp colour), this *wash* factor cannot be easily noted. In the absence of the *I*-factor, the *wash* factor *M* slightly tones up the basic light colour.

Reference.

1. Rangaswami Ayyangar, G. N., Vijayaraghavan, C., Sankara Ayyar, M.A., and Panduranga Rao, V. (1933). Inheritance of Characters in Sorghum—The Great Millet—iii—Grain Colours—Red, Yellow and White. *Ind. Jour. Agric. Sci.* 3: 589—604.

SUGARCANE SMUT

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I. General. Smut (*Ustilago scitaminea* Syd.) is a well-known disease of sugarcane having been reported from India, Java, Formosa, the Philippines, Natal, Mauritius, Queensland, Italy, and British Guiana (1).

It is principally a disease of the wild cane *Saccharum spontaneum* (1) and those canes which most nearly approach the wild varieties are more susceptible than the noble canes, though the thicker tropical canes are by no means immune (2). The causal organism is also reported to occur on grasses which may be a source of infection (2). It is reported (1) as very severe on Uba and other varieties of the *Saccharum sinense* group. Some varieties are considered to be immune, Earle mentions Badilia* as being one of these, but in the S. Arcot District in South India Badila has recently proved to be susceptible.

II. Symptoms. Sundararaman (3) describes the symptoms as follows: "The disease is easily recognised in the field. Affected plants are distinguished by the formation of a long, whip-like dusty black shoot from

* Locally known as 'Fiji B'.