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Studies on the Depth of Colour in Rice Foliage

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Introduction: In selecting plants or varieties for higher yields, breeders are generally guided by certain external features that are associated with productivity. In rice, for example, selection is based on characters like tillering, number of ears per plant, length of ears and twinning of the grains at the tips of the ears. Another variation observed in rice is with reference to the depth of the green colour of the foliage. Such difference in depth of colour is observed between different varieties and also between strains isolated within a variety.

It is found that environmental and cultural differences also bring about change in colour. Greater age of the seedlings, wider spacing of the plants in the transplant field and heavy dressings of manures, especially nitrogenous, give the plants a dark-green appearance. The colour turns lighter with young seedlings, close spacing and normal or less-than-normal manuring. Small differences in nurture like the above may induce only a temporary change in colour, the colour getting evened out during the growth period itself. Large differences on the other hand, bring about changes which are found to persist till the harvest similar to genetically caused differences.

This paper presents a study made on the agronomic significance of such difference in colour brought by genetical and environmental factors.

Sreenivasan (1926) was the first to record differences in colour of rice foliage and he found that the rice strains which had given higher yields in the variety *Krishnakatukalu* possessed light green foliage in contrast to dark green ones. According to Morinaga (1932) the yellow leaved plants, called by him as *Chlorinas* were of slow growth and less productivity than the normal greens. Ramiah and Ramanujam (1935) working on the chlorophyll deficiencies of rice concluded that the *Chlorina* forms of Morinaga were probably genetically different from those isolated in *Kristnakatukalu*. No other study would seem to have been made regarding the agronomic aspects of this character in rice.

Experimental: In an experiment with different ages of seedlings in two varieties of autumn rices, PTB. 1 (*Aryan*) and PTB. 5. (*Veluthari-kayama*), differences in colour of foliage were observed in all the three years of trial. PTB. 1 has light-green foliage compared to PTB. 5 but

the varieties have other morphological differences. Three durations were given to seedlings in the nursery, namely 72 days, 57 days and 21 days and all the seedlings were transplanted on the same day in the normal season in replicated randomized blocks. In each variety the depth of colour increased with duration in the nursery. PTB. 5. of 72 days was the darkest in colour and PTB. 1. of 21 days had the lightest foliage, PTB. 5. of 21 days appeared to have almost the same colour as PTB. 1. of 57 days. In order to see if and how far the quantitative factors are affected, measurements were taken of the earbearing tillers and the length of the ears. The results are tabulated in table I.

TABLE I.

(a) Ear-bearing tillers.

Summary of results for varieties.

	PTB. 1. (Light green)	PTB. 5. (Dark green)	S.E.	I.
Percentage on General mean	104·3	95·7	3·28	7·00

Significant at 5% level.

Summary of results for ages.

	72 days (Dark green)	57 days (Green)	21 days (Light green)	S.E.	I.
Percentage on General mean	96·6	95·2	108·2	4·02	8·57

Significant at 5% level.

(b) Length of ears.

Summary of results for ears.

	PTB. 1. (Light green)	PTB. 5. (Dark green)	S.E.	I.
Percentage on General mean	97·8	102·2	0·49	1·04

Significant at 5% level.

Summary of results for ages.

	72 days (Dark green)	57 days (Green)	21 days (Light green)	S. E.	I.
Percentage on General mean	103·5	101·3	95·2	0·61	1·30

Significant at 5% level.

The results indicate that in each variety, the length of ear increases with increase in depth of colour while the number of ear-bearing tillers is reduced.

Following this, pure lines differing in greenness of leaf only, were studied quantitatively in order to see if genetically caused colour differences produce results similar to that caused by nurture, as in the above experiment.

Among the winter varieties two cultures 8643 and 8719 isolated in the variety *Muthuchemba* were selected for the study. Culture 8643 has light green foliage compared to the culture 8719. The experiment was laid out in Beaven's reversed pair arrangement in strips of 5″ x 15″ with 12 replications. Planting was done with a spacing of 6″ x 6″ at two seedlings per hole. Statistical analyses of the measurements of the ear-length and the number of ear-bearing tillers of 25 plants in each strip are presented in table II.

TABLE II.

	8643	8719	S. E.	I.
Ear-length–% on general mean	98·6	101·4	1·13	2·49
Ear-bearing tillers–% on general mean	104·1	95·9	00·7	0·15

Significant at 5% level.

It will be seen from the table that the green type has longer ears and fewer ear-bearing tillers; more tillers and shorter ears are produced by the light green type.

In the autumn season three light green and three green cultures isolated in the variety *Chornali* were studied. Cultures A, B and C belonged to the green group and cultures D, E and F to the light green group. The lay-out was in randomized blocks with four replications. The size of the sub-plot was 5′ x 20′ and the seedlings were planted at a distance of 6″ x 6″ at two seedlings per hole. For counts of tillers, 25 plants were taken at random from each strip and 10 plants for the measurements of ear-length and grain weight. The results are given in table III.

TALBE III.

Summary of results—*Chornali*.

	Green			Light green				
	A	B	C	D	E	F		
	Percentages on general mean						S. E.	I.
I. Ear-length :	102·9	100·0	107·7	95·2	100·0	94·2	1·70	3·62

Significant at 5% level.

	Green			Light green				
	A	B	C	D	E	F		
II. Ear-bearing tillers:	94·2	94·8	82·4	197·2	111·5	109·9	3·96	8·44
						Significant at 5% level.		
III. Yield:	95·1	107·2	107·4	80·9	105·7	103·8	7·78	16·58
						Significant at 5% level.		
IV. Yield–four year average:	92·9	102·6	106·1	99·2	104·5	96·8		

The light-green cultures D, E and F have more ear-bearing tillers than the green cultures A, B and C, the difference being statistically significant. Shorter ears are produced by the light-green cultures, an exception being the culture E which has the same length of ear as the culture B, the shortest-eared one in the green group. The results, in general confirm the finding that the variaties in quantitative factors indicated by colour difference and brought about by nurture, are true in the case of genetical differences in colour.

The behaviour of the culture E is of interest. It has good tillering capacity associated with light-green foliage. It has long ears also, the length being equal to that of the culture B in the green group. Similarly, if more selections are studied, a dark-green culture might be found which combines good tillering as well. It is such combinations that are of practical value to the breeder.

It will also be seen from the results that the most important factors influencing the yield are tillering and the weight of the ears. Of the three factors that go to make up the weight of the ears, the number of grains per ear and the weight of the grains are more important than the length of the ear.

Discussion: If selection is based on the overall yield, the final choice may fall on the green culture C or the light-green culture E. During the four years of trial these two cultures have given the best yields (Vide item IV, table III). It is however necessary to find out how the two cultures would behave under differing soil and climatic conditions. This will probably give an idea of the agronomic significance of the colour difference. It may also be advantageous to combine the capacity for both tillering and length of ear in one strain by artificially crossing the cultures C and E.

The mode of inheritance of the depth of colour of rice foliage has not so far been worked out. But its association with characters like tillering and the length of ear, which are themselves governed by multiple factors would suggest that it is of a complex nature. The effect of all the possible agronomic influences that modify the character have to be studied first. Such a study alone would lead to a clearer insight into the behaviour of this character from generation to generation.

Summary: 1. Differences in the intensity of colour of rice foliage were noticed when the seedlings of the same variety were given different durations in the nursery. The colour could be grouped into dark-green, green and light-green.

2. Measurements of ear-bearing tillers and the length of the ears indicate that longer ears are obtained as the colour gets darker with reduction in the number of tillers. Light foliage groups have better tillering but shorter ears.

3. The study was extended to the genetic differences in colour observed in strains isolated within autumn and winter varieties in order to see if the differences in quantitative factors brought about by nurture and as indicated by shade differences would be true in the case of genetical differences also.

4. The association was found true in the case of tillering and length of ear in two winter strains. When six strains were studied in the autumn season, the association was complete with regard to tillering; one culture in the light-green group was found to have the same length of ear as the shortest-eared culture in the green group.

5. The importance of the association is discussed and future lines of work are outlined so as to get more data on the expression of colour as influenced by genetical and environmental variations and to find out which of the two types is of greater agronomic value.

References:

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