Pattern of Pigmentation in Ahu Rices of Assam

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Pigmentation pattern in 142 Ahu rice genotypes/varieties of Assam showed wide range of variation in colour of 14 plant parts. Out of 142 entries 125 was pigmented in one or more parts while 17 were completely non-pigmented. Frequency of genotypes/varieties with pigmented plant part was highest for pericarp (70.42%) followed by lemma-palea at maturity (61.27%) and apiculus (33.0%). Pigmentation in leaf blade, collar, ligule and auricle was observed in very few cases. Coefficient of variation for colour was highest for apiculus (80.63%) followed by lemma-palea at maturity (75.78%), stigma (59.79) and nodal septum (58.69%). The genotypes/varieties were classified into 47 groups based on the number of parts pigmented. Correlation studies among the pigmented plant parts revealed significant and positive association of basal leaf sheath colour with colour of sheath pulvinus, clum internode, nodal septum, ligule, sterile lemma, apiculus and stigma. Positive and significant correlation of sheath pulvinus was also observed with culm internode, apiculus, stigma and lemma-palea at maturity. Except collar and paricarp colour all other plant parts were positively significantly correlated with clum internode colour. Apiculus colour was positively and correlated with all other parts under study except leaf blade, collar and lemma-palea at anthesis. Apiculus, lemma-palea at maturity and pericarp colour were positively and significantly correlated with each other.

Key Words: Ahu Rice, Pigmentation, Plant Parts

Pigmentation is one of the most important characters in rice for identification of varieties and their classification (Misro *et al.*, 1960). Assam and adjoining parts of North-East India are well known for richness in rice genetic resources. Rice germplasm of the region is not only endowed with genetic diversity but also represents a wealth of valuable genes (Sharma *et al.*, 1971). Although several reports on collection and evaluation of Assam rices are available, in the past very little attention was paid towards characterisation and evaluation of Ahu rices of Assam. Ahu rices, generally poor yielders, are grown during March/April to June/July either as dry broadcast or transplanted and are characterised by their photoinsensitivity, eary maturity and tolerance to periodic moisture stress. Detailed characterisation of these traditional rice genotypes/varieties appears to be a prerequisite for their improvement and better utilisation. As a part of detailed characterisation, the present investigation was carried out to study the pattern of pigmentation in 142 traditional Ahu rice genotypes/ varieties of Assam.

Material and Methods

The material for the present investigation comprised 142 traditional Ahu rice genotypes/varieties of Assam, procured from the Regional Rice Research Station, Titabar, Assam and B.N. College of Agriculture, Biswanath Chariali (Assam Agricultural University), Assam. The genotypes/varieties were grown in three row plots of two-meter length with a spacing of 15x20 cm during wet season of 2001. Observation on colour of 14 plant parts, *viz.* basal leaf sheath (BLS), sheath pulvinus (SP), culm internode (CI), nodal septum (NS), leaf blade (LB), collar (C), ligule (L), auricle (Ar), sterile lemma (SL), apiculus (Ap), stigma (S), lemma-palea at anthesis (LPa), lemma–palea at maturity (LPm) and pericarp (P) were recorded following Chang and Bardenos (1965) and standard evaluation system (IRRI, 1996). Modification of colour classification was done wherever standard evaluation system was not satisfied. Colours were identified with the help of colour illustrations of Hutchinson *et al.* (1938). Frequencies of genotypes/ varieties in different colour classes were worked out. Coefficient of variation in colouration was calculated for each of the plant parts based on the colour scores of different classes. Genotypes/varieties were grouped on the basis of presence or absence of pigmentation in different plant parts. Simple correlation coefficients of pigmentation pattern among the different plant parts were computed. Presence or absence of colour irrespective of intensity was scored as '1' and '0', respectively.

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Results and Discussion

A wide range of color variation was observed in the Ahu rice genotypes/varieties under study. Frequency distribution of colour classes for the 14 plant parts is presented in Table 1. The coefficient of variation for colour was highest for apiculus (80.63%) followed by lemma-palea colour at maturity (75.78%), stigma (59.79) and nodal septum (58.69%). Lowest variation was observed for collar colour (11.5%). Pigmentation in leaf blade, collar, ligule and auricle was observed in very few of the entries. Jones (1929), Nagamutu (1943), Ramiah (1945) reported that in most of the rice genotypes/varieties leaf blade and collar were non pigmented while pigmentation was present in other parts. They speculated that the preponderance of non-pigmented types for these traits may be due to presence of inhibitory gene(s) suppressing the expression of genes of pigmentation, which otherwise is/are dominant.

Based on the presence and absence of pigmentation in various plant parts the 142 genotypes/varieties were classified into 47 groups (Table 2). Similar classification was made by Hector (1922) in rice genotypes/varieties of Bengal and obtained 51 different groups based on pigmentation in 11 plant parts. Jones (1929) grouped 311 Asian rices into 48 classes while Misro *et al.* (1960) obtained 57 different pigmented classes in 796 world genetic stocks of rice. Sinha *et al.* (1988) classified 92 Gora rices of Bihar into 31 groups and observed that 8 of them were pigmented in one or the other parts. In the present investigation 78% of the genotypes/varieties had pigmentation in one or the other parts while only 12% of them were completely non-pigmented, forming the largest group (Group I) comprising 17 members. On the other hand, Rao *et al.* (2001) studied pigmentation in rice varieties of Bastar region of Chhattisgarh and observed that majority of them were non-pigmented. This indicates that the frequency of pigmentation is higher in Ahu rices than the rice varieties of Bastar. The higher tendency of pigmentation pattern is also an indication of presence of primitive types (Sinha *et al.* 1988).

Pigmentation is single plant part in the present study was observed for NS, LPm and P in 10, 1 and 12 entries, falling in group II, III and IV, respectively. Rest of the groups had pigmentation in two or more plant parts, the highest, 11 parts pigmented, being in the group XL VII. Among these groups the highest frequency was

Table I. Frequencies of genotypes against different colour classes for 14 plant parts in Ahu rices

Plant parts/	White	Light Green	Green	Dark green	Yellowish green	Light yellow	Yellow	Pink	Brown	Red	Light purple	Purple line	Purple	Shades of purple	Dark purple	Red apex	Purple apex	Blakish brown furrow
Basal leaf sheath			132								1	8	1					
Sheath pulvinus		75		48										16			3	
Culm inernode		58	76									6	2					
Nodal septum		12		102				7			6		8		7			
Leaf blade		33	63	46														
Collar		140	2															
Ligule	98		25									19						
Auricle		136											6					
Sterile lemma	88	40						3					11					
Apiculus	77	15							2	18			22			3	5	
Stigma colour	127	5					1				3		6					
Lemma-palea (at anthesis)			100		37		3							1				1
Pericarp	42								35	64	1							
Lemma-palea (at maturity)	55	15	3	31	12	4	7	8	2	4	1							
Colour classes for Lemma-palea (at maturity)	Straw	Gold& gold furrow on straw	Brown spot on straw	Brown furrow on straw	Brown	Redish to light purple	Purple spot on on straw	Purple furrow on straw	Purple	Black	Whitish							

Table 2. Classification of Ahu rice genotypes into various groups based on pigmentation in 14 plant parts

Group No.	Pigmentation in plant parts	Number of genotypes
I.	No pigmentation	17
II.	Nodal septum	10
III.	Lemma and palea at maturity	1
IV.	Pericarp	12
V.	Sheath pulvinus, pericarp	1
VI.	Nodal septum, apiculus	1
VII.	Nodal septum, lemma and palea at anthesis	1
VIII.	Nodal septum, lemma and palea at maturity	5
IX.	Nodal septum, pericarp	9
X.	Auricle, pericarp	1
XI.	Apiculus, pericarp	7
XII.	Stigma, pericarp	2
XIII.	Lemma and palea at anthesis, lemma and palea at maturity	1
XIV.	Lemma and palea at maturity, pericarp	15
XV.	Sheath pulvinus, nodal septum and pericarp	2
XVI.	Sheath pulvinus, lemma and palea at maturity, pericarp	1
XVII.	Nodal septum, auricle, lemma and palea at maturity	1
XVIII.	Nodal septum, apiculus, pericarp	5
XIX.	Nodal septum, lemma and palea at maturity, pericarp	9
XX.	Collar, lemma and palea at maturity, pericarp	1
XXI.	Apiculus, Stigma, lemma and palea at maturity	1
XXII.	Apiculus, lemma and palea at maturity, pericarp	3
XXIII.	Stigma, lemma and palea at maturity, pericarp	1
XXIV.	Sheath pulvinus, nodal septum, lemma and palea at maturity, pericarp	1
XXV.	Nodal septum, sterile lemma, apiculus, lemma and palea at maturity	1
XXVI.	Nodal septum, sterile lemma, apiculus, pericarp	2
XXVII.	Nodal septum, apiculus, lemma and palea at maturity, pericarp	6
XXVIII.	Basal leaf sheath, nodal septum, ligule, sterile lemma, apiculus	1
XXIX.	Basal leaf sheath, nodal septum, apiculus, lemma and palea at maturity, pericarp	1
XXX.	Sheath pulvinus, culm internode, apiculus, lemma and palea at maturity, pericarp	1
XXXI.	Sheath pulvinus, nodal septum, apiculus, lemma and palea at maturity, pericarp	3
XXXII.	Sheath pulvinus, auricle, apiculus, lemma and palea at maturity, pericarp	2
XXXIII.	Culm internode, nodal septum, leaf blade, lemma and palea at maturity, pericarp	1
XXXIV.	Culm internode, nodal septum, auricle, lemma and palea at maturity, pericarp	1
XXXV.	Nodal septum, auricle, apiculus, lemma and palea at maturity, pericarp	2
XXXVI.	Nodal septum, sterile lemma, apiculus, lemma and palea at maturity, pericarp	1
XXXVII.	Nodal septum, apiculus, stigma, lemma and palea at maturity, pericarp	1
XXXVIII.	Sheath pulvinus, nodal septum, collar, apiculus, lemma and palea at maturity, pericarp	1
XXXIX.	Sheath pulvinus, nodal septum, ligule, apiculus, lemma and palea at maturity, pericarp	2
XL.	Nodal septum, sterile lemma, apiculus, stigma, lemma and palea at maturity, pericarp	1
XLI.	Basal leaf sheath, sheath pulvinus, nodal septum, apiculus, stigma, lemma and palea at maturity, pericarp	1
XLII.	Basal leaf sheath, culm internode, nodal septum, sterile lemma, apiculus, stigma, pericarp	1
XLIII.	Basal leaf sheath, sheath pulvinus, culm internode, nodal septum, leaf blade, ligule, apiculus, lemma and palea at maturity	1
XLIV.	Basal leaf sheath, sheath pulvinus, nodal septum, ligule apiculus, stigma, lemma and palea at maturity, pericarp	1
XLV.	Basal leaf sheath, culm internode, nodal septum, sterile lemma, apiculus, stigma, lemma and palea at maturity, pericarp	1
XLVI.	Basal leaf sheath, sheath pulvinus, culm internode, nodal septum, apiculus, stigma, lemma and palea at anthesis, lemma and palea at maturity, pericarp	1
XLVII.	Basal leaf sheath, sheath pulvinus, culm internode, nodal septum, leaf blade, ligule, auricle, sterile lemma, apiculus, stigma, lemma and palea at maturity, pericarp	1

observed for LPm and P (15, Group XIV) followed by NS and P (9, Group IX), NS, LPm and P (9, group XIX), Ap and P (7, Group XII), NS, Ap, LPm and P (6, Group XXVII), NS and LPm (5, Group VIII) and NS, Ap and P (5, Group XVIII).

Twenty-nine groups were represented by single genotype each, while others comprised either two or three each. Pigmentation in LPm, NS and Ap was found to occur in 32, 31 and 25 groups, respectively, indicating that these three are the pimgmented parts in most of the Ahu rices. However, Sinha *et al.* (1988) observed in Gora rices of Bihar that all the pigmented genotypes had pigmentation in apiculus (Ap). Although stigma colour (s) exhibited high CV (75.04%), pigmentation on stigma (S) was found in eight groups only, where at least four other parts were also pigmented. The wide grouping observed indicates the relevance of pigmentation pattern in varietal identification and classification in Ahu rices. It also appears that the pigmentation in different plant parts particularly in LPm, Ap, CI and BLS has resemblance with the local names of the land races and has important bearing on varietal identification and maintenance of purity. Such resemblance was also observed in Gora rices of Bihar (Sinha *et al.,* 1988). In the present investigation no case was met with where all the parts studied were pigmented. Such observations were also reported by Misro *et al.* (1960) and other workers with the exeption of Nagamutu (1943) and Sinha *et al.* (1988) where observations were confined to only ten and eight characters, respectively.

The complexity of the pigmentation pattern being expressed in different combinations in different genotypes might be attributed to the involvement of several major genes for pigmentation along with modifiers and inhibitors. Complicated nature of inheritance of pigmentation was reported by Jones (1921) and Ramiah (1945). Detailed study of the inheritance of the pigmentation pattern in crosses involving different sets of parents of Ahu rices is, therefore, essential.

Simple correlation coefficients were computed for pigmentation between plant parts studied (Table 3). Significant and positive correlation of BLS was observed with SP, CI, NS, L, SL, Ap and S. Sheath pulvinus colour (SP) was also significantly and positively correlated with CI, Ar, Ap, S and LPm. Culm internode colour (CI) exhibited positive and significant association with all the traits but C and P. Significant positive association was also observed between NS and L, SL, Ap; LB and L, SL, S; LC and SL, Ap, S; Ar and Ap, LPm; SL and Ap, S and between Ap and S. The higher frequency of positive correlation among these plant parts might be due to the linkage of genes governing anthocyanin pigmentation as also suggested by Ratho and Rao (1972), Hadgal (1980), Misro (1981) and Sinha *et al.* (1988). Lemma palea colour at anthesis (LPa) was correlated positively with only CI, while pericarp (P) colour exhibited positive and significant association with Ap and LPm. Collar (C) colour exhibited no significant association with other parts. From the above study it appears that significantly positively correlated pairs of characters were frequent in the parts other than lemma-palea and kernel. This might be due to the differences in linkage relationships of the genes governing pigmentation in these parts. Lemma-palea colour at maturity (LPm) did not exhibit correlation with LPa but was positively correlated with pericarp (P) colour.

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Table 3. Simple correlation coefficients for pigmentation among 14 plant parts in Ahu rices

Plant parts	BLS	SP	CI	NS	LB	C	L	A	SL	Ap	S	LPa	LPm
SP	0.32*												
CI	0.56**	0.26*											
NS	0.25**	0.13	0.17*										
LB	0.16	0.09	0.38**	0.14									
C	-0.03	0.13	-0.02	-0.01	-0.01								
L	0.52**	0.15	0.25**	0.20*	0.21*	-0.02							
A	0.05	0.24**	0.18*	0.01	0.16	-0.03	0.08**						
SL	0.40**	-0.02	0.31**	0.24**	0.36**	-0.03	0.23	0.05					
Ap	0.36**	0.32**	0.21*	0.22**	0.09	0.03	0.28**	0.17*	0.35**				
S	0.54**	0.18*	0.36**	0.08	0.30**	-0.03	0.18*	0.02	0.33**	0.25**			
LPa	0.16	0.09	0.18*	0.04	-0.02	-0.01	-0.03	-0.03	-0.03	-0.01	0.13		
LPm	0.05	0.27*	0.19*	0.15	0.14	0.12	0.14	0.20	0.03	0.23**	0.15	0.05	
P	0.03	0.20	0.09	0.02	0.09	0.07	-0.02	0.09	0.09	0.28**	0.13	-0.12	0.30**

* Significant at 5% level of probability

** Significant at 1% and 5% level of probability

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