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RESEARCH ARTICLE

Characterization of Rice Landraces from Dibrugarh District of Assam

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Twenty five different traditional rice landraces from Dibrugarh district of Assam were characterized. In case of morphological characters, high heritability coupled with high genetic advance was recorded for number of grains per plant and number of panicle per plant. For biochemical parameters, high heritability coupled with high genetic advance was recorded for amylose and fat contents. Correlation coefficient analysis revealed that number of grains per plant, plant height, stem length and panicle length exhibited positive correlation with grain yield per plant. Thus, stem length and numbers of grains per plant can be considered in breeding programme. The landraces were with low to intermediate gelatinization temperature range (55-74 ºC) indicating good cooking quality. The study identified Kolajoha, Miatong, Bor Aijung, Ronga Bordhan, Bor Salpona, Dolkochi, and Athabora as promising landraces that could be utilized in the development of high yielding landraces.

Key Words: Biochemical, Genetic variability, Morphological, Physicochemical, Rice.

Introduction

Rice (*Oryza sativa* L.) is the second most widely grown cereal crop in the world after wheat. North East India including Assam is considered as one of the primary centre of origin of rice representing a rich source of genetic diversity and reservoir of valuable rice gene pool. Due to favourable agro-climatic conditions, people in this region cultivate both local and high yielding varieties of rice including non-glutinous, glutinous as well as scented ones. There are various communities of Assam, who prefer and are mainly dependent on traditional local rice cultivars/ landraces. All the districts of Assam have their own traditional local rice cultivars. One of the districts of Assam is Dibrugarh, located at upper Brahmaputra Valley Zone extending from 27º5'38" N to 27º42'30" N latitude and 94º33'46"E to 95º29'8"E longitude inhabiting different communities. The rice cultivars grown in this area are of indigenous type and are not generally grown in other parts of Assam. The rice varieties grown are mostly scented and glutinous. However, there is lack of compilation depicting the key diagnostic characters of these cultivars that are essential to carry out scientific seed production and certification. India is the signatory of World Trade Organization (WTO) and as an obligation, the Protection of Plant Varieties and Farmers' Rights Act (2001) has been implemented in India from January 2005 (Yadav, 2004). Under this Act, Plant Varieties and Farmers' Rights Protection Authority has been established (Anonymous, 2005). Enforcement of these international agreements is possible only if the identity and ownership of the plant genotypes are established. Therefore, characterization of the cultivars is very essential from the view point of Plant Variety Protection of the farmers' varieties.

Genetics plays a decisive role in determining the chemical or physical characteristics of a plant and its products. Morphological traits, SDS-PAGE and rapid chemical tests have been used extensively for germplasm characterization and classification in rice and other crops (Chauhan and Nanda, 1984; Devi and Hazarika, 2000; and Patra, 2000). The conduct of DUS tests for distinctness, uniformity and stability of new varieties of plants is essential for the purpose of granting the breeder's right. In this light, the present investigation aimed for proper characterization of traditional rice landraces of Dibrugarh district, Assam based on DUS criteria coupled with biochemical evaluation.

Materials and Methods

In the present investigation, twenty five rice cultivars, traditionally cultivated in Dibrugarh district of Assam were collected and three rice varieties, one each from

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non-glutinous (Ranjit), glutinous (Aghoni Bora) and scented type (Keteki Joha) were taken as standards (Table 1). The field experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Observations were recorded for the morphological characters as per the International Union for the Protection of New Varieties of Plants guidelines (IUPOV), 1985 and National guidelines for DUS test. Observations were recorded for leaf characters viz., coleoptiles colour, basal leaf sheath colour, leaf anthocyanin colour, presence or absence of auricle, anthocyanin colour of auricle, presence or absence of ligule, anthocyanin colour of the ligule, leaf collar, flag leaf attitude, length and width of the leaf blade; panicle characters *viz.,* panicle attitude of branching, panicle exertion, colour tip of lemma, number of panicle per plants and panicle length; grain character like grain length, grain width, decorticated grain length, decorticated grain width, decorticated grain shape, decorticated grain colour, grain length/grain width ratio, decorticated grain length/ decorticated grain width ratio, 1000 grain weight, number of grains per panicle, number of grains per plant; plant characters *viz.,* stem length, stem thickness, time of heading, time of maturity and yield per plant. The cultivars were also tested for biochemical and physiochemical parameters, such as starch content (Chopra and Konwar, 1976), amylose content (Juliano, 1971), fat content (AOAC, 1970), crude protein content (Scales and Harrison, 1920), phenol test (Walls, 1965), aroma test (Sood and Siddique, 1978) and gelatinization temperature (Little *et al*., 1958).

Trial data were analyzed using ANOVA and the genetic parameters such as phenotypic and genotypic coefficient of variation (PCV and GCV) were worked out as suggested by Johnson *et al.* (1955). Correlation coefficients were calculated according to Al-Jibouri *et al.* (1958). Path coefficient analysis was calculated according to Wright (1921).

Results and Discussion

The present investigation aimed to identify the diagnostic characteristics both morphological and biochemical, of twenty five indigenous rice cultivars traditionally grown by the farmers of Dibrugarh district of Assam with three notified cultivars (Keteki Joha, Aghoni Bora and Ranjit) as control for determining varietal identity and purity and to provide assurance to the farmers about seed quality of the cultivars.

The analysis of variance revealed that all the landraces under investigation exhibited significant variation (Table 2). Morphological traits are being used as potential markers for identification of genotypes. Forty-six morphological traits were studied, out of which twenty eight traits were qualitative and eighteen traits were quantitative. Variations were observed in several qualitative characters like basal leaf sheath colour (Fig. 1), leaf anthocyanin colouration, pubescence of blade surface, leaf anthocyanin colouration of collar (Fig. 2), panicle exertion, panicle attitude of branching, colour tip of lemma (Fig. 3), density of pubescence of lemma, lemma anthocyanin colouration of apex, presence or absence of awn, awn colour, distribution of awn, decorticated grain shape and gelatinization temperature (Table 3). Of the twenty eight rice germplasm under study, twenty one was found to have green basal leaf sheath colour. Parikh *et al.* (2012) investigated 71 rice germplasms and found that majority of genotypes (84.5%) had green basal leaf sheath colour. Such variations in qualitative traits in rice landraces were also reported by Moukoumbi *et al.* (2011) and Sarawgi *et al*. (2013).

Mean performance of different quantitative traits are shown in Table 4. Leaf blade length and width of the rice germplasm were found to vary between 40.07–56.50 cm and 1.12–1.87 cm respectively. Wide range of variations regarding leaf length (38.0-76.3 cm) and leaf width (0.76-1.72 cm) were also reported by

Table 1. Rice genotypes used in the study

S. No.	Genotype Name	S. No.	Genotype Name	S. No.	Genotype Name	S. No.	Genotype Name
1	Johadhan	8	Cheni Lahi	15	Mainajan	22	Dolkochi
2	Kolajoha	9	Bor Malbhog	16	Malbhog	23	Dharia
3	Bor Aijung	10	Nalsati	17	Boga Bordhan	24	Athabora
4	Ranga Bordhan	11	Lakhman Dhan	18	Bora Dhan	25	Miatong
5	Sadiya Lahi	12	Ranga Bas	19	Bor Salpona	26	Aghoni Bora
6	Suwag Moni	13	Aibing Sali	20	Joybangla	27	Ranjit
7	Haldhar sali	14	Saru Salpona	21	Sagar Sali	28	Keteki Joha

Table 2. Analysis of variance for quantitative traits of rice land races of Dibrugarh district of Assam

Source	Degrees of freedom	LLB	LWB	PH	PL	SL	ST	PNP	TH	TM	NG Plant	LG	WG	LG/WG	LDG	WDG	LDG/WDG	Seed weight	Yield/plant	Starch	Amylose	Fat	Crude Protein
Replication	2	1.4680	0.0001	0.4672	0.0830	3.1691	0.0011	4.2512	0.1570	0.5830	55654.4201	0.0007	0.0007	0.0014	0.0006	0.0020	0.0013	0.2624	47.8321	0.79	37.03	0.005	0.005
Genotype	27	62.2751*	0.1016*	575.8220*	9.1771*	480.4513*	0.0025*	55.6691*	154.3863*	117.4401*	1034191.1501*	1.9240*	0.4941*	0.5921*	0.8197*	0.3673*	0.5414*	38.3712*	571.6511*	13.98*	137.33*	0.91*	0.55*
Error	54	0.2240	0.0004	2.5031	0.0709	1.0780	0.00002	0.2481	0.0111	0.2871	3832.7220	0.0007	0.0004	0.0004	0.0009	0.0006	0.0004	0.0170	2.4702	0.50	0.06	0.004	0.002
CV		1.0319	1.4091	0.4880	0.9710	0.8497	1.0185	2.9678	0.0892	0.3271	2.99	0.31	0.63	0.69	0.47	0.95	0.81	0.52	3.03	3.81	33.37	10.07	10.86

* P≤0.5 and ** P≤0.01

LLB: Length of leaf blade, LWB: Width of leaf blade, PH: Plant height, PL: Panicle length, SL: Stem length, ST: Stem thickness, PNP: Panicle no. per plant, TH: Time of heading, TM: Time of maturity, NGPlant: No. of grains per Plant, LG: Grain length, WG: Grain width, LDG: Length of decorticated grain, WDG: Width of decorticated grain

Fig. 1. Representative variations in basal leaf sheath colour of some rice cultivars.

Fig. 2. Representative variations in anthocyanin colouration of collar of some rice cultivars.

Fig. 3. Representative colour tip of lemma of some rice cultivars.

Table 3. Performance of different qualitative characters

Landraces & varieties	BLSC	LAC	PBS	LACC	PE	PAB	CTL	DPL	ACA	AWN	AC	DOA	DGS	GT
Johadhan	Green	Absent	Absent	Absent	Well exserted	Erect to semi erect	Black	Weak	Strong	No	Absent		Long Slender	High
Kolajoha	Green	Absent	Absent	Absent	Well exserted	Erect to semi erect	Black	Weak	Strong	No	Absent		Long Slender	High
Bor Aijung	Green	Absent	Medium	Absent	Well exserted	Semi erect	Yellowish	Absent	Absent	No	Absent		Long Bold	High
Ranga Bordhan	Green	Absent	Absent	Absent	Well exserted	Semi erect	Black	Weak	Medium	Yes	Reddish Brown	Upper half only	Long Bold	High
Sadiya Lahi	Green	Absent	Weak	Absent	Well exserted	Semi erect	Yellowish	Weak	Absent	No	Absent		Short Bold	High
Suwag Moni	Green	Absent	Medium	Absent	Well exserted	Erect to semi erect	Yellowish	Weak	Medium	Yes	Yellowish White	Upper half only	Long Bold	High
Haldhar Sali	Green	Absent	Weak	Absent	Well exserted	Erect to semi erect	Black	Weak	Absent	Yes	Yellowish Brown	Tip only	Long Bold	High
Cheni Lahi	Green	Absent	Medium	Absent	Well exserted	Erect to semi erect	Yellowish	Weak	Absent	Yes	Brown	Tip only	Long Slender	High
Bor Malbhog	Light Purple	Absent	Medium	Absent	Well exserted	Erect to semi erect	Yellowish	Weak	Absent	No	Absent		Long Bold	Low
Nalsati	Light Purple	Absent	Medium	Absent	Well exserted	Semi erect	Purple	Weak	Strong	Yes	Black	Upper half only	Long Bold	High intermediate
Lakhman Dhan	Green	Absent	Weak	Absent	Well exserted	Erect to semi erect	Yellowish	Weak	Absent	Yes	Yellowish White	Tip only	Long Bold	High
Ranga Bas	Green	Absent	Medium	Absent	Well exserted	Erect	Brown	Medium	Absent	No	Absent		Medium Slender	High
Aibing Sali	Light Purple	Absent	Weak	Absent	Well exserted	Erect to semi erect	Yellowish	Weak	Absent	Yes	Yellowish White	Tip only	Long Bold	High
Saru Salpona	Light Purple	Absent	Weak	Present	Well exserted	Semi erect	Purple	Weak	Strong	No	Absent		Long Slender	High
Mainajan	Green	Absent	Weak	Absent	Mostly exserted	Erect to semi erect	Brown	Medium	Absent	No	Absent		Short Bold	High
Malbhog	Light Purple	Absent	Medium	Absent	Well exserted	Semi erect to spreading	Yellowish	Weak	Absent	No	Absent		Long Bold	Inter-mediate
Boga Bordhan	Green	Absent	Weak	Absent	Well exserted	Erect to semi erect	Yellowish	Weak	Absent	No	Absent		Long Bold	High inter-mediate
Bora Dhan	Green	Absent	Weak	Absent	Well exserted	Semi erect to spreading	Brown	Weak	Absent	No	Absent		Long Bold	Inter-mediate
Bor Salpona	Light Purple	Absent	Weak	Present	Well exserted	Semi erect	Purple	Weak	Strong	No	Absent		Long Bold	High
Joybangla	Green	Absent	Medium	Absent	Well exserted	Erect to semi erect	Yellowish	Weak	Absent	No	Absent		Long Bold	High
Sagar Sali	Green	Absent	Absent	Absent	Mostly exserted	Erect to semi erect	Purple	Weak	Absent	No	Absent		Short Bold	High inter-mediate

Landraces & varieties	BLSC	LAC	PBS	LACC	PE	PAB	CTL	DPL	ACA	AWN	AC	DOA	DGS	GT
Dolkochi	Green	Absent	Medium	Absent	Well exserted	Semi erect to spreading	Brown	Weak	Absent	No	Absent		Long Bold	High
Dharia	Green	Absent	Medium	Absent	Well exserted	Semi erect to spreading	Yellowish	Weak	Medium	No	Absent		Short Bold	High
Athabora	Uniform Purple	Present	Medium	Present	Well exserted	Semi erect to spreading	Brown	Weak	Absent	No	Absent		Long Bold	Inter-mediate
Miatong	Green	Absent	Medium	Absent	Well exserted	Semi erect to spreading	Brown	Medium	Absent	Yes	Yellowish White	Upper half only	Long Bold	Inter-mediate
Aghoni Bora	Green	Absent	Weak	Absent	Mostly exserted	Erect to semi erect	Yellowish	Weak	Absent	Yes	Yellowish White	Upper half only	Long Slender	Low
Ranjit	Green	Absent	Weak	Absent	Well exserted	Semi erect to spreading	Brown	Weak	Absent	No	Absent		Medium Slender	High
Keteki Joha	Green	Absent	Weak	Absent	Well exserted	Erect to semi erect	Brown	Weak	Absent	Yes	Yellowish White	Whole length	Long Slender	High

Table 4. Mean performance of different quantitative traits

	LLB (cm)	PH (cm)	PL (cm)	PNP	TH (days)	TM (days)	NGP	LG/WG	LDG/ WDG	1000 GW (g)	Yield/ Plant (g)	Starch	Amylose	Crude fat	Crude protein
Johadhan	42.63	144.33	27.70	29.03	120.53	169.33	3284.87	3.33	3.04	21.47	70.51	78.61	27.86	3.26	7.55
Kolajoha	42.17	146.47	28.00	25.27	120.37	170.00	2803.27	3.33	3.06	21.70	60.83	78.64	26.43	3.22	7.61
Bor Aijung	46.00	155.87	29.67	13.57	117.93	158.33	2902.93	2.69	2.32	25.54	74.14	72.26	21.25	3.09	7.45
Ranga Bordhan	45.67	160.87	30.70	13.80	124.73	172.33	2208.13	2.35	2.18	30.08	66.42	71.25	23.06	3.77	7.83
Sadiya Lahi	40.37	154.57	26.80	17.10	125.43	160.33	2597.30	2.34	1.97	26.42	68.62	74.40	15.29	3.16	7.41
Suwag Moni	52.60	156.17	28.20	17.40	119.63	161.33	1648.23	2.54	2.41	28.24	46.55	76.09	15.94	2.93	7.65
Haldhar sali	42.80	153.97	30.30	16.97	123.07	175.67	1951.77	2.25	2.09	27.59	53.85	77.00	14.12	2.85	7.51
Cheni Lahi	45.83	176.10	28.53	18.50	125.87	162.67	2664.90	3.25	3.40	23.52	62.69	72.18	27.47	3.51	7.78
Bor Malbhog	43.30	143.27	24.97	17.77	123.97	163.67	1334.57	2.96	2.78	30.11	40.19	75.31	14.51	3.49	7.88
Nalsati	45.80	155.33	26.77	11.23	127.97	166.67	1383.03	3.43	2.91	26.50	36.65	76.45	15.68	2.93	8.08
Lakhman Dhan	49.57	157.53	29.13	13.80	116.07	160.33	1207.07	2.95	2.63	24.43	29.49	75.81	15.29	2.82	7.89
Ranga Bas	45.00	140.13	25.23	23.37	98.10	150.33	2678.60	3.13	2.50	20.27	54.30	78.32	7.52	3.09	7.57
Aibing Sali	45.43	155.33	28.63	20.53	126.90	171.33	2213.43	2.78	2.56	28.47	63.02	74.19	17.88	2.86	7.75
Saru Salpona	44.20	148.03	29.43	20.60	125.17	172.33	1959.93	3.47	3.18	23.33	45.73	75.60	15.94	3.10	7.22
Mainajan	45.50	142.47	26.13	16.57	103.27	155.33	2374.90	2.12	2.08	22.86	54.28	75.75	12.70	2.85	7.60
Malbhog	45.57	144.20	25.23	18.80	122.83	161.33	1472.27	2.76	2.20	32.59	47.99	74.34	13.99	3.66	7.82
Boga Bordhan	44.27	152.10	28.17	13.43	125.00	172.33	1670.63	2.76	2.45	27.67	46.24	75.47	7.52	4.13	7.83
Bora Dhan	52.40	152.37	27.73	10.27	118.00	168.33	2168.87	2.31	2.02	29.67	64.35	76.60	6.22	4.27	7.08
Bor Salpona	40.07	175.03	28.20	14.63	123.17	169.67	3065.90	3.14	2.62	26.24	80.45	73.56	16.58	3.05	7.26
Joybangla	43.23	151.37	25.90	19.50	118.20	166.33	2212.27	2.60	2.21	26.44	58.48	76.20	7.65	3.06	7.26
Sagar Sali	43.60	141.53	29.40	15.33	121.93	160.67	2129.40	1.79	1.72	21.44	45.66	78.57	7.65	2.85	7.74
Dolkochi	44.50	157.90	26.00	14.57	126.97	162.33	1772.57	3.07	2.64	26.64	47.21	74.48	19.18	3.08	7.16
Dharia	43.63	117.47	26.73	15.10	122.70	158.33	2499.73	2.93	2.47	20.23	50.58	78.73	10.88	2.92	7.10

	LLB (cm)	PH (cm)	PL (cm)	PNP	TH (days)	TM (days)	NGP	LG/WG	LDG/ WDG	1000 GW (g)	Yield/ Plant (g)	Starch	Amylose	Crude fat	Crude protein
Athabora	43.70	149.03	27.77	14.90	117.63	155.67	1560.80	2.61	2.44	27.60	43.08	77.80	8.27	4.15	7.23
Miatong	59.93	167.70	27.77	14.60	114.13	157.00	1674.67	3.06	2.62	26.26	43.98	78.65	15.29	2.91	7.11
Aghoni Bora	48.87	116.97	25.17	12.07	130.07	163.67	1311.27	3.29	3.23	25.31	33.19	75.48	1.87	4.39	7.18
Ranjit	56.50	134.50	26.17	11.73	125.93	159.00	1234.67	3.08	2.95	20.33	25.10	76.79	24.36	4.83	9.22
Keteki Joha	43.67	129.60	23.83	19.60	131.03	161.67	2077.10	3.46	3.01	18.04	37.48	72.47	20.21	3.07	7.70
Mean	45.96	149.29	27.44	16.79	121.31	163.80	2073.68	2.85	2.56	25.32	51.82	75.75	15.38	3.71	7.58
S.E.	0.27	0.42	0.15	0.29	0.06	0.31	35.74	0.01	0.01	0.08	0.91	0.58	0.20	2.19	0.04
C.D. 5%	0.78	1.19	0.44	0.82	0.18	0.88	101.34	0.03	0.03	0.22	2.57	1.64	0.57	0.15	0.11
C.D. 1%	1.03	1.59	0.58	1.09	0.24	1.17	134.96	0.04	0.05	0.29	3.43	2.10	0.76	0.20	0.14

Patra (2000). Panicle length in Assam rice was found comparatively in a narrower range (23.83-30.70 cm) than that of rice landraces of Odisha (19.0-34.3 cm) as reported by Patra (2000). Grain length/grain width ratio ranged from 1.79 to 3.47 which were at par with the findings of Siddique *et al*. (2007). Bor Salpona was the highest yielder possessing shortest length of leaf blade (40.07 cm), medium width of leaf blade (1.52 cm), long stem length (144.67 cm), thicker stem (0.43 cm), highest grains per panicle (209.5), decorticated grain width (2.58 mm) and high 1000-grain weight. The cultivar Bor Aijung was the second highest yielder followed by landraces Kola Joha, Sadiya Lahi, Ranga Bordhan, Johadhan, Boradhan, Aibing Sali, Cheni Lahi, Joybangla, Mainajan and Ranjit.

Significant variations were also observed in biochemical parameters studied. Highest amount of starch (78.73%) was found in the cultivar Dharia. Amylose content in rice under study ranged from 1.87 to 27.86 %. Higher amylose contents (above 20%) were observed in five (Johadhan, Kolajoha, Bor Aijung, Ranga Bordhan and Cheni Lahi) of the rice landraces while six rice landraces, viz. Ranga Bas, Boga Bordhan, Bor Dhan, Joybangla, Sagar Sali and Athabora were found to have lower amylose content (6.22–8.27%). The glutinous variety Aghoni Bora had only 1.87% of amylose. The popular rice variety Ranjit had the highest crude fat and crude protein content amongst all the rice genotypes used in the study (Table 4). The observed differences in qualitative and quantitative traits of rice genotypes might be due to the differences in their genetic make-up.

Twenty two landraces showed positive result for the phenol test except for Keteki Joha, Bor Aijung, Ranga Bordhan, Saru Salpona, Mainajan and Bor Salpona. In view of high heritability and stability of phenol colour reaction, it could be used as primary diagnostic character for distinguishing the rice genotypes (Anitalakshmi *et al.,* 2014). Phenol test, in the present study, helped in grouping the rice landraces into two groups. Aroma is an important economic trait of quality rice mostly preferred by the consumers and only three landraces, *viz.*, Keteki Joha, Johadhan and Kola Joha had aroma. The quality and quantity of starch and gelatinization temperature strongly influence the cooking quality of rice. Rice with high gelatinization temperature requires more water and time to cook than with low or intermediate gelatinization temperature. Landraces with intermediate gelatinization temperature are preferred by consumers (Sharma *et al.,* 2008). Intermediate gelatinization temperature was found in five landraces *viz*., Nalsati, Malbhog, Bora Dhan, Athabora and Miatong.

In case of morphological characters, number of grains per plant and number of panicles per plant showed the higher value of GCV, heritability and genetic advance. Time of maturity, time of heading, stem thickness showed high heritability and low genetic advance. Progeny testing might help in the selection process for these traits. In case of biochemical characters, amylose content showed highest GCV with highest heritability and genetic advance. This trait might be helpful in selection for grain quality. The difference between the GCV and PCV were very low for all the characters indicating very low influence of the environment (Table 5).

Correlation coefficient analysis revealed that morphological characters such as grains per plant, plant height, panicle length, width of decorticated grain and stem length exhibited positive correlation with grain yield per plant (Table 6a & 6b). But length of leaf blade and stem thickness was negatively correlated with yield per plant. Of the biochemical character, starch content

Table 5. Variability of quantitative characters of rice land races of Dibrugarh district of Assam

Characters	Genotypic variance	Phenotypic variance	GCV (%)	PCV (%)	Heritability (broad sense) (%)	Genetic advance as % mean	
						5%	1%
Length of leaf blade (LLB)	20.68	9.89	9.89	9.94	98.92	20.27	25.98
Width of leaf blade (LWB)	0.03	0.03	12.46	12.54	98.73	25.51	32.70
Plant height (PH)	191.76	192.29	9.27	9.28	99.75	19.08	24.45
Panicle length (PL)	3.03	3.10	6.34	6.42	97.73	12.93	16.57
Stem length (SL)	159.79	160.86	10.34	10.37	99.36	21.23	27.21
Stem thickness (ST)	8.00 x10^{-4}	9.00 x10^{-4}	6.76	6.84	97.72	13.77	17.65
Panicle no. per plant (PNP)	18.47	18.72	25.6	25.7	98.68	52.39	67.14
Time of heading (TH)	51.45	51.46	5.913	5.914	99.91	12.18	15.60
Time of maturity (TM)	39.05	39.33	3.81	3.82	99.23	7.83	10.03
No. of grains per Plant	343452.80	347285.50	28.26	28.41	98.91	57.89	74.19
Grain length (LG)	0.64	0.64	9.45	9.46	99.87	19.46	24.94
Grain width (WG)	0.16	0.16	13.42	13.43	99.73	27.61	35.39
LG/ WG	0.19	0.19	15.55	15.57	99.82	32.01	41.02
Length of decorticated grain (LDG)	0.27	0.27	8.20	8.22	99.61	16.87	21.63
Width of decorticated grain (WDG)	0.12	0.123	13.80	13.83	99.53	28.36	36.34
LDG/WDG	0.18	0.18	16.58	16.60	99.72	34.12	43.73
Seed weight	12.78	11.80	14.11	14.13	99.83	29.07	37.25
Yield/plant	189.72	192.2	26.57	26.57	98.74	54.4	69.71
Starch	4.49	4.99	2.79	2.95	89.91	5.50	6.99
Amylose	45.75	45.82	43.98	44.01	99.86	86.99	97.17
Amylopectin	45.75	45.82	43.98	44.01	99.86	16.45	21.08
Fat	0.30	0.31	16.55	16.67	98.55	33.86	43.73
Crude Protein	0.18	0.18	5.63	5.66	98.75	11.53	14.77

Table 6a. Estimation of correlation coefficient of morphological characters of rice land races of Dibrugarh district of Assam

	LLB	LWB	PH	PL	SL	ST	PAN/ PLAN	TH	TM	NG/ RAINS	LG	WG	LG/ WG	LDG	WDG	LDG/ WDG	1000GW	Y/ P
LLB	1.000	-0.046	0.041	-0.003	0.041	0.361*	-0.414	-0.142	-0.286	-0.483**	0.197	0.079	0.033	0.056	-0.091	0.091	0.062	-0.441**
LWB	-0.044	1.000	0.109	0.316	0.071	0.193	-0.565**	0.215	0.315	-0.229	0.150	0.538**	-0.393*	0.021	0.470**	-0.390*	0.555**	0.066
PH	0.041	0.108	1.000	0.533**	0.993**	-0.039	-0.065	-0.049	0.257	0.191	0.267	0.273	-0.091	0.377*	0.327*	-0.085	0.431*	0.459**
PL	-0.003	0.311	0.528**	1.000	0.433*	-0.061	-0.098	0.031	0.462**	0.218	-0.183	0.277	-0.341*	0.010	0.281	-0.219	0.195	0.373*
SL	0.042	0.072	0.988**	0.426*	1.000	-0.044	-0.049	-0.051	0.211	0.163	0.312	0.262	-0.055	0.405*	0.317*	-0.062	0.434*	0.427*
ST	0.355*	0.186	-0.039	-0.065	-0.046	1.000	-0.406*	0.339*	0.191	-0.515**	0.491**	0.079	0.199	0.495**	-0.072	0.281	0.303	-0.371*
PAN/PLANT	-0.411*	-0.561**	-0.065	-0.094	-0.049	-0.394*	1.000	-0.205	0.104	0.524**	-0.084	-0.359*	0.284	0.123	-0.217	0.260	-0.318	0.315
TH	-0.141	0.213	-0.049	0.030	-0.051	0.336*	-0.204	1.000	0.539**	-0.246	0.324*	-0.080	0.269	0.335*	-0.172	0.345*	0.154	-0.150
TM	-0.285	0.313	0.255	0.453**	0.208	0.191	0.103	0.537**	1.000	0.091	0.257	0.139	0.058	0.399*	0.124	0.117	0.328*	0.285
NGP	-0.478**	-0.229	0.189	0.216	0.160	-0.501**	0.527**	-0.245	0.091	1.000	-0.374*	-0.215	-0.012	-0.241	-0.048	-0.057	-0.340*	0.866**
LG	0.196	0.149	0.267	-0.180	0.311	0.485**	-0.083	0.323*	0.256	-0.371*	1.000	0.056	0.505**	0.899**	-0.040	0.451**	0.581**	-0.102
WG	0.079	0.534**	0.273	0.274	0.261	0.078	-0.357*	-0.080	0.137	-0.214	0.056	1.000	-0.829**	-0.042	0.903**	-0.762**	0.764**	0.196
LG/WG	0.033	-0.391*	-0.091	-0.337*	-0.055	0.196	0.282	0.269	0.059	-0.011	0.504**	-0.829**	1.000	0.536**	-0.800**	0.915**	-0.343*	-0.218
LDG	0.055	0.021	0.377*	0.009	0.404*	0.489**	0.122	0.334*	0.398*	-0.240	0.898**	-0.041	0.535**	1.000	-0.088	0.547**	0.490**	-0.016
WDG	-0.091	0.464**	0.326*	0.279	0.315	-0.074	-0.215	-0.171	0.123	-0.048	-0.040	0.900**	-0.798**	-0.088	1.000	-0.874**	0.694**	0.324*
LDG/WDG	0.090	-0.386*	-0.084	-0.218	-0.061	0.278	0.257	0.345*	0.117	-0.057	0.451**	-0.760**	0.913**	0.547**	-0.873**	1.000	-0.359*	-0.265
1000GW	0.061	0.551**	0.430*	0.192	0.432*	0.300	-0.316	0.154	0.327*	-0.337*	0.581**	0.762**	-0.342*	0.489**	0.692**	-0.358*	1.000	0.161
Y/P	-0.437*	0.062	0.454**	0.366*	0.421*	-0.360*	0.320*	-0.149	0.284	0.867**	-0.101	0.194	-0.216	-0.016	0.321*	-0.263	0.161	1.000

* P≤ 0.5 and ** P≤ 0.01

Upper matrix= Genotypic correlation coefficient, Lower matrix= Phenotypic correlation coefficient

Table 6b. Estimation of correlation coefficient of biochemical parameters of rice land races of Dibrugarh district of Assam

	Starch	Amylose	Amylopectin	Fat	Protein	Yield
Starch	1	-0.317*	0.317*	-0.068	-0.108	-0.273
Amylose	**-0.303**	1	-1.000**	-0.127	0.394*	0.264
Amylopectin	**0.303**	**-1.000****	1	0.127	-0.394*	-0.264
Fat	**-0.057**	**-0.126**	**0.126**	1	0.316	-0.243
Protein	**-0.100**	**0.391***	**-0.391***	**0.316**	1	-0.404*
Yield	**-0.258**	**0.262**	**-0.262**	**-0.240**	**-0.398***	1

* P≤ 0.5 and ** P≤ 0.01

Upper matrix = Genotypic correlation coefficient, Lower matrix= Phenotypic correlation coefficient

showed positive correlation with amylopectin and negative correlation with amylose at genotypic level. Amylose showed positive correlation with protein and negative correlation with amylopectin at both genotypic and phenotypic level. Amylopectin showed negative correlation with amylose and protein at both genotypic and phenotypic level. Path analysis revealed that stem length followed by number of grains per plant had maximum positive direct effect with yield per plant (Table 7) and both exhibited positive correlation with grain yield per plant at both genotypic and phenotypic level. Therefore, these two traits deserve consideration in breeding programme to bring about improvement in grain yield. On the other hand plant height followed by panicle per plant had maximum negative direct effect with yield per plant but correlation was positive. So plant height and panicle per plant contributed towards yield through positive indirect effects. The mean performance of the landraces for yield and yield attributing traits along with mean performance of the landraces for biochemical parameters revealed that Kolajoha, Miatong, Bor Aijung, Ronga Bordhan, Bor Salpona, Dolkochi, Athabora were few promising landraces that could be utilized in the development of high yielding landraces.

Conclusion

Identification and characterization of indigenous rice cultivars of Assam is crucial in harnessing their potential in carrying out scientific seed production and certification. A previous knowledge of identity of these varieties is helpful in order to utilize them in rice improvement programmes. Among various morphological characters basal leaf sheath colour, leaf anthocyanin colouration, pubescence of blade surface, leaf anthocyanin colouration of collar, attitude of flag leaf, panicle exertion, panicle attitude of branching, colour tip of lemma, density of pubescence of lemma, lemma anthocyanin colouration of apex, presence absence of awn, awn colour, distribution of awn, decorticated grain shape could very well distinguish rice cultivars. These characters may be used as an index for identification of these cultivars. The cultivars showed a considerable variation in different parameters analyzed. Amongst grain quality attributes, amylose content was found to possess maximum genetic variation apparently controlled by additive genes. Thus, this trait deserves most priority in selection for grain quality. However, it is necessary to study the detailed amino acid composition, mineral content, vitamin content, effect of parboiling on different nutritional components etc. for nutritional evaluation of the cultivars as a whole.

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Table 7. Direct and indirect effects of yield components on grain yield per plant of rice land races of Dibrugarh district of Assam

	PATH matrix of Y/P								
	LLB	PH	PL	SL	ST	PPP	NGP	WDG	1000GW
LLB	**0.0217**	0.0009	-0.0001	0.0009	0.0079	-0.009	-0.0105	-0.002	0.0013
PH	-0.0634	**-1.5313**	-0.8155	-1.5206	0.0592	0.0988	-0.2929	-0.5005	-0.6598
PL	-0.0006	0.111	**0.2084**	0.0903	-0.0128	-0.0203	0.0454	0.0586	0.0406
SL	0.0591	1.4493	0.6326	**1.4595**	-0.0645	-0.0717	0.2375	0.4632	0.6331
ST	0.0096	-0.001	-0.0016	-0.0012	**0.0264**	-0.0107	-0.0136	-0.0019	0.008
PPP	0.0436	0.0068	0.0103	0.0052	0.0427	**-0.1053**	-0.0552	0.0229	0.0334
NGP	-0.5402	0.2142	0.244	0.1822	-0.5762	0.5871	**1.1195**	-0.0533	-0.3801
WDG	-0.0002	0.0006	0.0005	0.0006	-0.0001	-0.0004	-0.0001	**0.0019**	0.0013
1000GW	0.0297	0.2082	0.0941	0.2097	0.1465	-0.1535	-0.1641	0.3353	0.4833
Corr with Y/P	-0.4407**	0.4586**	0.3727*	0.4265*	-0.371*	0.3149	0.866**	0.3243*	0.1613

* P≤0.5 and ** P≤0.01

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