

Phytoreources from North Cachar Hills district of Assam: I. rice genetic resources and their characterization

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Abstract

North Cachar Hills district of Assam state is inhabited mainly by 10 major ethnic groups namely *Dimasa*, *Jeme Naga*, *Hmar*, *Kuki*, *Karbi*, *Beite*, *Jaintia(Pnar)*, *Hrangkhoh*, *Khelma*, *Vaipei*, etc. The area lies between 24° 58' N and 25° 47' N latitudes and 92° 27' E and 93° 43' E longitudes. The altitude ranges from 140 to 1866 m above msl. The paper deals with the findings of extensive exploration and collection emphasizing the study of Rice germplasm from 14 localities/ villages of the district during 2007 – 2008. Sampling method was made randomly and/or in bulk for the collection of the germplasm according to the availability and population of sample. Mostly the emphasis was given for collection of local land races and primitive cultivars of Rice germplasm during the survey. The agricultural practice followed by the local people in the area is *Jhum* (shifting) cultivation. However, wet paddy cultivation is also practiced in some localities depending upon the nature of terrain and sources of water. A total 56 accessions, including 9 rare rice germplasm were collected and submitted to NBPGR Regional Station, Umiam, Meghalaya-793103, India for multiplication and conservation. Recording of local indigenous technical knowledge practiced by the farmers was also a part of the study.

Key words: Rice genetic resources, characterization, Indigenous knowledge, North Cachar Hills, Assam

INTRODUCTION

Paddy (*Oryza sativa* L., Poaceae) crop originated in India and about 96 % of paddy grown all over the world is cultivated only in Asia (Jayashankar *et al* 2002). Paddy can grow even in certain environmental conditions where other crops cannot grow i.e. in terms of altitude, rainfall, etc. Rice is the staple food and dominant crop in N.C. Hills district of Assam. The richness of the rice diversities in north-east region can be perceived from some earlier works like Singh *et al* (2007), Sharma & Hore (1993, 2007), Hore & Sharma (1993), Barua *et al* (2006), Kaul (1981) and Elwin (1969).

Singh *et al* (2007) reported that the nature of climate, soil and physiography have made northeastern hill region of India as one of the biodiversity hotspot in the world and the center of origin of many cultivated plants. Due to gradual introduction of high yielding varieties of different crops, the local indigenous germplasms are disappearing gradually. A total of 39 accessions of upland paddy genotypes, including 5 accessions of sticky rice landraces along with accessions of other crops were documented from southern parts of Mizoram by Singh *et al* (2007). Sharma & Hore (1993) reported that a large number of paddy genotypes grown in Mizoram have been introduced mostly from Myanmar, Bangladesh, Manipur, Nagaland and various parts of Assam. However, all these have lost their original identity over time acclimatized locally and now may be called as landraces. Hore & Sharma (1993) reported the extent of variability in rice germplasm resources from Nagaland. Barua *et al* (2006) collected 32 paddy genotypes and other crop germplasms from Nagaland. Kaul (1981) reported 6,730 rice accessions from many parts of northeastern region of India under the Assam Rice Collection (ARC) project. Elwin (1969) also reported many rice variability from Nagaland and provided details about the sugar and gluten content.

Vavilov (1951) showed the importance of genetic variability in crop improvement and Hawkes (1983) has extensively worked on crop genetic resources and variation of plant biodiversity.

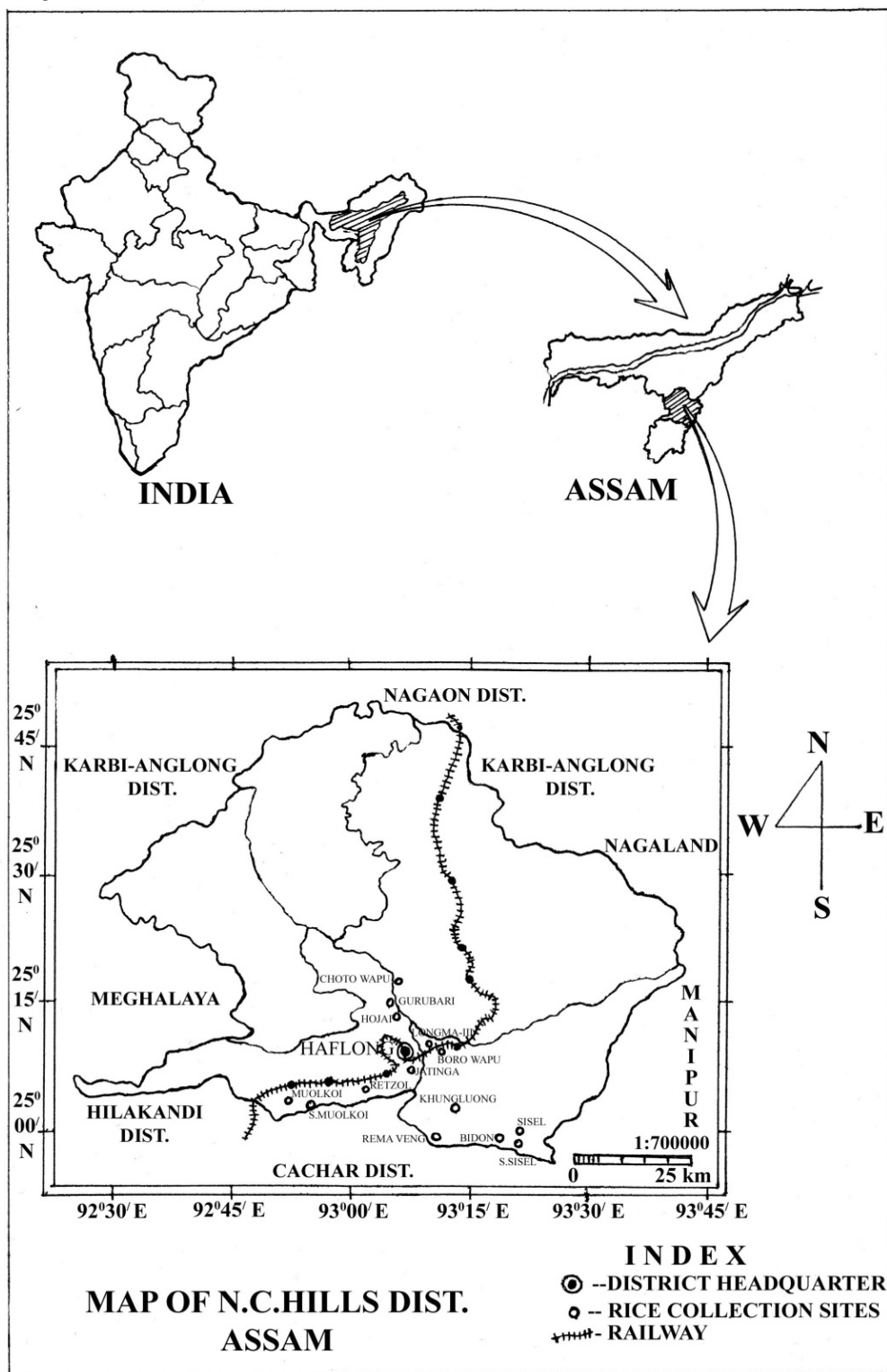


Fig. 1: Map showing the study area and rice collection sites.[N.C. Hills district map, Source: N.E.R. Institute of Water and Land Management, Tezpur, Assam]

Study area: North Cachar Hills district of Assam is bounded by Nowgong and Karbi Anglong districts on the north, Cachar district on the south, in the east by Nagaland and Manipur states and in the west Khasi and Jaintia Hills of Meghalaya state. The district is located in between 25° 58' N and 25° 47' N latitudes and 92° 27' E and 93° 43' E longitudes (Fig. 1).

The altitude ranges from 140 to 1866 m above msl. The annual rainfall is 1454 mm to 4767 mm and characterized by sub-tropical humid conditions with average Relative humidity of 73 % - 84 %. The average mean temperature during summer ranges between 33° C to 24° C and during winter between 14° C to 10° C.

The area of the district is 4,890 sq km and population is 1, 86,189 with population density of 38 per sq km (*Census 2001*). More than 70 % of the tribal population of the district belonging to Indo-Mongoloid racial stock and mainly consist of *Dimasa, Jeme Naga, Hmar, Kuki, Karbi, Beite, Jaintia(Pnar), Hrangkhoh, Khelma* and *Vaipei*, etc.

Forest cover of the district can be summarized as Reserved Forests namely Langting-Mupa, Krungming and Borail covering an area of 711.80 sq km; proposed Reserved Forests i.e. Hatikhali-Manderdisa, Panimur and Borail covering an area of 64.36 sq km; and the Unclassed State Forest/Jhumland covering an area of 3854.00 sq km.

Soil Texture of the area is sandy loam and sandy clay loam. Soil is acidic in reaction and P^H ranges from 4.1 – 6.2 and with high organic carbon content, medium to poor Phosphorus, medium to high Potash. The soil type is red & laterite soil.

Jhum cultivation is the major agricultural practice and settled agricultural land is only 63 sq km i.e. 1.29 % of the total geographical area of the district. Total suitable land for cultivation is only 1.88 lakh hectares. The gross cropped area is 30,991 hectares, of which a total area of 23,698 hectares covered by field crops and 7,293 hectares covered by horticultural crops (Doungel 2008).

METHODOLOGY

Rice germplasm were collected during 25th November to 21st December 2007. The collection sites were Khungluong, Hojai, Gurubari, Choto-waphu, Natun basti, Jatinga, Retzol, Boro-waphu, Longma-III, Muolkoi, S.Muolkoi, S.Saisel, Bidon and Rema-veng of N.C. Hills district of Assam. The collection was concentrated in the area where the possibilities of maximum diversities are available depending upon the local information (Village headmen and local farmers). The remote and unexplored localities were given priority for the collection. Population sampling method was made randomly and/or in bulk for the collection of the germplasm. The desired genotypes were collected and the variability was critically observed and recorded following the guidelines of NBPGR descriptors (for characterization and evaluation) of agri-horticultural crops (Sharma 2000). The sampling was done both from household store and crop fields. Seeds were collected according to the mode of propagation. Passport data on each accession was recorded at the time of collection, following the standard procedure. All the collected rice germplasm accessions were submitted to NBPGR Regional Station, Meghalaya-793103, India for multiplication towards further conservation.

During the survey, emphasis was mostly given to collect the rice germplasm of local landraces and traditional varieties and also their wild relatives. Local indigenous techniques practiced by the farmers were also recorded.

RESULTS AND DISCUSSION

A total of 56 paddy genotypes were collected during the survey period which includes 29 upland paddy/ *Jhum* cultivars (IC No. 560759 to 560761, 560763, 560765 to 560767, 560770 to 560776, 560779 to 560781, 560789, 560796, 560797, 560808 to 560816), and 27 lowland paddy/ Wet/ Terrace cultivar (IC No. 560762, 560764, 560768, 560769, 560782 to 560788, 560790 to 560795, 560798 to 560800, 560803 to 560805, 560817 to 560820). A total of 23 sticky rice, (i) upland sticky paddy (IC No. 560761, 560765, 560766, 560770, 560771, 560772, 560773, 560774, 560775, 560780, 560781,

560796, 560797, 560808, 560809, 560811, 560812) and (ii) lowland sticky paddy (IC No. 560768, 560787, 560792, 560798, 560805, 560818) have been collected. Again, among the 5 rice accessions, 2 were having aroma (IC No. 560760, 560785) and 3 were both sticky & scented (IC No. 560796, 560797, 560798) characteristics (Fig. 2). The kernel colour of the characterized genotypes are grouped in three distinct types: white (IC no. 560759 to 560764, 560766, 560767, 560770, 560772, 560774 to 560776, 560779, 560795, 560798, 560803, 560804, 560808, 560810, 560812 to 560817, 560820), red (IC no. 560780, 560784, 560785, 560788, 560791, 560793, 560797, 560809) and golden brown (IC no. 560768, 560773, 560794, 560818). In terms of Frequency, 5 accessions were abundant, 20 frequent, 22 occasional and 9 rare rice genotypes/ germplasms have been assembled from the studied area (Fig. 5).

The local landraces of paddy collected during the collection trips from the area are: *Lokhamu*, *Mezamew*, *Uithao* (**Kuki**), *Banglaisha*, *Barlum*, *Betguti*, *Biring*, *Dimri-maisa*, *Maiju-walao*, *Maijau-di-gajao*, *Maiju-maijhilum*, *Maiju*, *Maiju-guphu*, *Maiju-gajao*, *Maijau-di-guphu*, *Maijau-di-gidiba*, *Mai-nagaland*, *Maiju-walao-gidiba*, *Maiju-hadi*, *Maiyen-maiju*, *Maisha* (**Dimasa**), *Tezi*, *Tingne* (**Jeme Naga**), *Batia-chara* (**Jaintia-Pnar**), *Biron/Buman*, *Batei*, *Sangailo*, *Basa-buh*, *Buh-chang*, *Buh-Sei*, *Changman*, *Jurai*, *Kawng-toi*, *Mai-basa*, *Nepal-buh*, *Tei-buh*, *Thangmanon*, (**Hmar**).

Traditional Knowledge related to the accessioned rice during the present study indicates that *Maijau-di-gajao* (Red husk, IC No. 560767) and *Maijau-di-guphu* (light brown husk, IC No. 560775) are always sown by mixing the both in Jhum field. Both the varieties are always eaten mixed and much preferred types. *Jhum* cultivar *Banglaisha* (IC No.560793) is grown well in red-acidic soil and considered as locally suited variety.

Considering the duration of maturity of rice in *Jhum* cultivation by the Dimasa's *Mai-Nagaland* (IC No.560795) is early maturing within 75 days. *Maiju-walao-gidiba* with sticky & mild aroma (IC No.560797) matures in 120 days i.e. June - September, showing the medium maturing period. *Maijau-di-gidiba*, with tall plant, long panicle (IC No.560794) and *Dimri-maisa* (IC No.560804) are late maturing ones require about 180 days and are the late harvesting rice. These local varieties are sown for better production taking advantage of the climate, time and space in the area.

The *Jhum* cultivar sticky rice *Biring* (IC No. 560771) is preferred for local beer *Biron-Judima* preparation during occasional festivals and the wet cultivar *Maiyen-maiju* (IC No. 560803) is used for preparation of beer *Judima* for regular consumption in day-to-day life. The 3 accessions *Maiju-walao* (IC No.560796), *Maiju-walao-gidiba* (IC No.560797) and *Maiju-hadi* (IC No.560798) are sticky with aroma are significant for the ethnic people of the area as they use these local landraces for preparation of local cake and beer during different festivals like *Bushu Dima* (Harvesting Festival) by the Dimasa's and even marriage and other ceremonies. The *wet/terrace*, sticky rice cultivar *Changman* (IC No. 560818) is used for preparation of *Kangpok* (local stuffed rice) and local cake by the *Hmar* people of the south-western part of the district.

Paddy in the district is sown during April/ May and harvested during September/ October and even extended to November for the late varieties. Maximum and minimum value recorded (among the accessions recorded shown in Table 2) during field/ laboratory study of rice accessions from the district are:

1. **Plant height:** Maximum in *Dimri-maisa*, 178 cm (IC No. 560804) & minimum in *IR-8*, 52 cm (IC No.560764).
2. **Panicle length:** Maximum in *Mai basa*, 35 cm (IC No. 560808) & minimum in *Biring*, 17 cm (IC No.560766).

3. **5 panicle weight:** Maximum in wet cultivar *Maiju-hadi*, 36.85 gm (IC no. 560798) & minimum in *Kali-jeera*, 14.72 gm (IC No.560785).
4. **100 grain weight:** Maximum in *Tingne*, 4.67 gm (IC No.560780) & minimum in *Maisha*, 1.70 gm (IC No. 560776).
5. **Number of grains per panicle:** Maximum in *Dimri-maisa*, 373 nos. (IC No. 560804) & minimum in *IR-8*, 88 nos. (IC No.560764).
6. **Grain length:** Maximum in *Tingne*, 1.02 cm (IC No.560780) & minimum in *Uithao*, 0.64 cm (IC No. 560761).
7. **Grain width:** Maximum in *Maiju-guphu*, 0.40 cm (IC No.560772) & minimum in *Kali jeera*, 0.25 cm (IC No. 560785).
8. **Leaf length:** Maximum in *Jurai*, 57 cm (IC No. 560814) & minimum in *Lokhamu*, 20 cm (IC No.560759).
9. **Leaf width:** Maximum in *Uithao*, 2.5 cm (IC no. 560761) & minimum in *Biring*, 1.0 cm (IC no. 560766).

Table 2: Morphological variation among the characterized rice genotypes.

Sl. No.	Characters observed	Statistical computations			
		Range	Mean	SD	CV (%)
1.	Plant height (cm)	52-178	118.98	21.69	18.23
2.	Panicle length (cm)	17-35	25.44	2.78	10.87
3.	No. of grains per panicle	120-373	219.75	53.30	24.25
4.	05 Panicle weight (gm)	14.72-36.85	24.66	4.52	18.33
5.	100 grain weight (gm)	1.70-4.67	2.71	0.64	23.73
6.	Grain length (cm)	0.64-1.02	0.81	0.11	13.21

Statistical computations of collected rice genotypes, among the accessions recorded in Table 1, in respect to their plant height, panicle length, number of grains per panicle, 5 panicle weight, 100 grain weight and grain length have been presented in Table 2, followed by the histogram representation (Fig. 6).

CONCLUSION

Poor communication network in the district and the ethnic people inhabiting largely in secluded places and not exposed to modern agricultural practices, marketing opportunity is also limited and hence the economy of the people of district is almost self sustained. Farmers are traditionally contributing to the productivity by selecting the genotypes for the better crop yield, and also for controlling diseases and pest problems (Alteieri & Merrik 1987). Thus locally suited indigenous better crop germplasms which are resistant to pests and less vulnerable to stress conditions and which requires less farm inputs have been conserved and cultivated by the farmers.

The indigenous crop germplasms of the ethnic groups of the area needed to be documented in detail to rescue them from being lost forever (Prance & Elias 1977). Only the systematic approaches with scientific inputs would help in collection of gene pool which can provide the basic genetic material

Table 1: Characterization of collected superior rice germplasms.

Sl. No	Coll. no.	IC no.	Vern. name	Agronomic features					Characteristics of Earhead		Characteristics of Grain							Special features
				Dry/ wet cultivar	No. of tillers	Plant Height (cm)	Leaf Length (cm)	Leaf Width (cm)	Panicle Length (cm)	05 Panicle Wt. (gm)	100 Grain Wt. (gm)	No. of grains/ Panicle	Grain Length (cm)	Grain Width (cm)	Kernel color	Husk color	Awn (present/ absent)	
1.	PM-01	560759	<i>Lokhamu</i>	Dry	5.20	134.60	34.80	2.40	26.60	23.10	1.90	308.60	0.64	0.34	White	Mottled reddish-brown	Absent	Grains oval, rare in the district
2.	PM-02	560760	<i>Mezamew</i>	Dry	4.8	135.60	35.34	2.20	25.40	23.70	2.25	274	0.74	0.34	Silvery white	Reddish brown	Absent	Scented rice, rare in the district
3.	PM-03	560761	<i>Uithao</i>	Dry	6	128.40	48.20	2.20	26.80	22.3	2.35	295.20	0.64	0.32	Silvery white	Mottled purple	Absent	Sticky rice, Grains oval, rare in the district
4.	PM-04	560762	-	Wet	14.3	101.40	23.32	1.50	27.70	18.70	3.72	180.60	0.84	0.34	White	Light brown	Absent	Up & lowland cultiv., rare in the district
5.	PM-05	560763	<i>Pankaj</i>	Wet	12.60	97.80	28.40	1.86	21.60	25.95	2.72	217.40	0.85	0.32	White	Brown	Absent	Hybrid type
6.	PM-06	560764	<i>IR-8</i>	Wet	12.60	62.64	24.28	1.36	20.18	21.98	2.88	104.20	0.82	0.30	White	Brown	Absent	Hybrid type
7.	PM-08	560766	<i>Biring</i>	Dry	3.40	100.80	38.20	1.30	23.80	22.12	2.70	181.80	0.66	0.36	White	Dark brown	Absent	Sticky rice; tip of grain is black
8.	PM-09	560767	<i>Majjau-di-gajao</i>	Dry	5.20	154	44	2.1	26	26.80	2.98	271	0.72	0.32	White	Red	Present	Awns 0.1 to 0.6 cm long
9.	PM-10	560768	<i>Majju-majhilum</i>	Wet	10.20	131.82	28.38	1.60	26.26	21.95	2.91	193.20	0.98	0.34	Golden brown	Reddish brown	Present	Sticky rice; up & lowland cultiv.; awns 0.2 to 1 cm long
10.	PM-12	560770	<i>Majju</i>	Dry	3.6	105.60	34	1.76	25	22.75	3.58	208.20	0.92	0.32	White	Shaded brown	Absent	Sticky rice; tip of grain is black
11.	PM-14	560772	<i>Majju-guphu</i>	Dry	5	99	29	2.2	23.50	25.83	4.05	175	0.88	0.44	White	Light brown	Absent	Sticky rice; grains flat
12.	PM-15	560773	<i>Majju-walao</i>	Dry	4.20	101.60	31.80	1.66	24.80	23.05	3.85	193.20	0.92	0.32	Golden brown	Brown	Absent	Sticky & scented rice; grain with black tip & stripe on each side
13.	PM-16	560774	<i>Majju-gajao</i>	Dry	5.80	116.60	36	1.82	25.80	22.01	1.75	175.80	0.70	0.30	Silvery white	Red	Absent	Little sticky rice
14.	PM-17	560775	<i>Majjau-di-guphu</i>	Dry	7.60	146	49.80	1.96	28.80	31.85	2.97	286	0.74	0.28	White	Light brown	Present	Little sticky rice; awns 0.1 to 0.7 cm long
15.	PM-18	560776	<i>Maisha</i>	Dry	5	111.60	39	1.80	24.60	18.92	1.70	214.40	0.66	0.28	White	Brown	Absent	Tip of the grain is black
16.	PM-21	560779	<i>Tezi</i>	Dry	6	123	30.25	1.70	22.91	24.90	2.69	197	0.90	0.27	White	Mottled red-brown	Absent	Red patches on husk
17.	PM-22	560780	<i>Tingne</i>	Dry	6	128	23	1.80	28	20.50	4.67	120	1.02	0.30	Red	Mottled purple brown	Absent	Sticky rice; 2 purple stripes on each side of grain; longest grain among collected genotypes
18.	PM-26	560784	<i>Ranjit</i>	Wet	14	91.80	26.80	1.98	22.80	29.10	2.18	208	0.80	0.30	White	Brown	Absent	Hybrid type

19.	PM-27	560785	<i>Kali-jeera</i>	Wet	11.60	128	30.40	1.24	27.40	14.72	2.50	250.40	0.68	0.25	White	Black	Absent	Scented rice, minimum grain width among collected genotypes
20.	PM-30	560788	<i>Thangman on</i>	Wet	9.20	85.80	22.70	1.28	21.20	20.85	2.60	208	0.80	0.35	White	Brown	Absent	Rare in the district
21.	PM-33	560791	<i>Barlum</i>	Wet	12.20	78.18	33.60	1.68	21.50	26.52	2.58	200.80	0.80	0.32	White	Dark brown	Present	Awns 0.1 to 0.3 cm long
22.	PM-35	560793	<i>Banglaisha</i>	Wet	9.40	138.28	33.20	1.80	24.90	29.78	2.10	222	0.80	0.30	White	Light brown	Absent	Locally suited; grow well in red-acidic soil
23.	PM-36	560794	<i>Majju-di-gidiba</i>	Wet	7.6	151.80	31.60	1.50	28.04	21.62	3.17	158.20	0.98	0.27	Golden brown	Dark brown	Absent	Sticky rice; tip of grain is black; up & low land cultiv.
24.	PM-37	560795	<i>Mai Nagaland</i>	Dry & wet	6	140.50	33.40	2.20	28	35.67	3.25	301	0.76	0.34	White	Brown	Absent	Dry & wet cultivar; easy to thrash; matures within 75 days
25.	PM-39	560797	<i>Majju-walao-gidiba</i>	Dry	7.9	126	33	1.9	24	31.85	3.13	203	1.00	0.35	Red	Mottled purple brown	Absent	Sticky & scented rice; tip of grain is black
26.	PM-40	560798	<i>Majju-hadi</i>	Wet	13	122	40	1.80	24.50	36.85	3.18	285	0.76	0.34	White	Brown	Absent	Sticky with little aroma; good yield in any weather condition
27.	PM-45	560803	<i>Maiyen majju/maisha</i>	Wet	5.60	113.60	29.06	1.30	22	18.33	2.27	183.20	0.68	0.28	White	Reddish brown	Absent	Tip of grain is black
28.	PM-46	560804	<i>Dimri-maisha</i>	Dry & wet	11	171	44.5	2.10	29.50	30.83	2.20	369	0.72	0.29	White	Light brown	Absent	Dry & wet cultivar; late maturing, ± 180 days
29.	PM-50	560808	<i>Mai-basa</i>	Dry	4.2	133.40	43.40	1.32	33	22.65	2.70	201.60	0.82	0.30	White	Reddish brown	Absent	Tip of grain is black
30.	PM-51	560809	<i>Kwang-toi</i>	Dry	4.60	111.40	38.40	1.70	27.20	23.05	2.25	173.40	0.90	0.32	Red	Dark brown	Absent	Little sticky rice; Tip of grain is black
31.	PM-52	560810	<i>Nepal-buh</i>	Dry	5.80	114.20	31.80	1.68	27.40	26.92	2.80	284.20	0.72	0.34	Silvery white	Light brown	Absent	Grains oval
32.	PM-54	560812	<i>Buman/Biron</i>	Dry	4.60	140.40	36.40	1.92	28	24.61	2.76	193.40	0.80	0.34	White	Brown	Absent	Sticky rice; Tip of grain is black
33.	PM-55	560813	<i>Batei</i>	Dry	10.40	133.60	44	1.76	26.60	25.75	2.45	277.60	0.81	0.32	Silvery white	Brown	Present	
34.	PM-56	560814	<i>Jurai</i>	Dry	6	135.20	43.80	1.88	30.80	23.95	1.95	239.20	0.70	0.30	Silvery white	Light brown	Absent	
35.	PM-57	560815	<i>Sangailo</i>	Dry	5	125.40	30	1.94	23.40	21.20	1.90	208.40	0.75	0.32	White	Brown	Absent	
36.	PM-58	560816	<i>Basa-buh</i>	Dry	5.20	114.40	38.60	1.86	27.60	25.95	2.10	209.40	0.84	0.34	Silvery white	Light brown	Absent	
37.	PM-59	560817	<i>Tej-buh</i>	Wet	20.20	99	32	2.02	24	25.98	2.08	230.80	0.87	0.26	White	Light brown	Absent	
38.	PM-60	560818	<i>Changman</i>	Wet	12	106	32.40	1.82	25.30	26.30	2.51	206	0.96	0.28	Golden brown	Light brown	Present	
39.	PM-62	560820	<i>Buh-sei</i>	Wet	12.20	101.80	25	1.54	21.2	23.04	2.92	163	0.90	0.29	White	Brown	Absent	

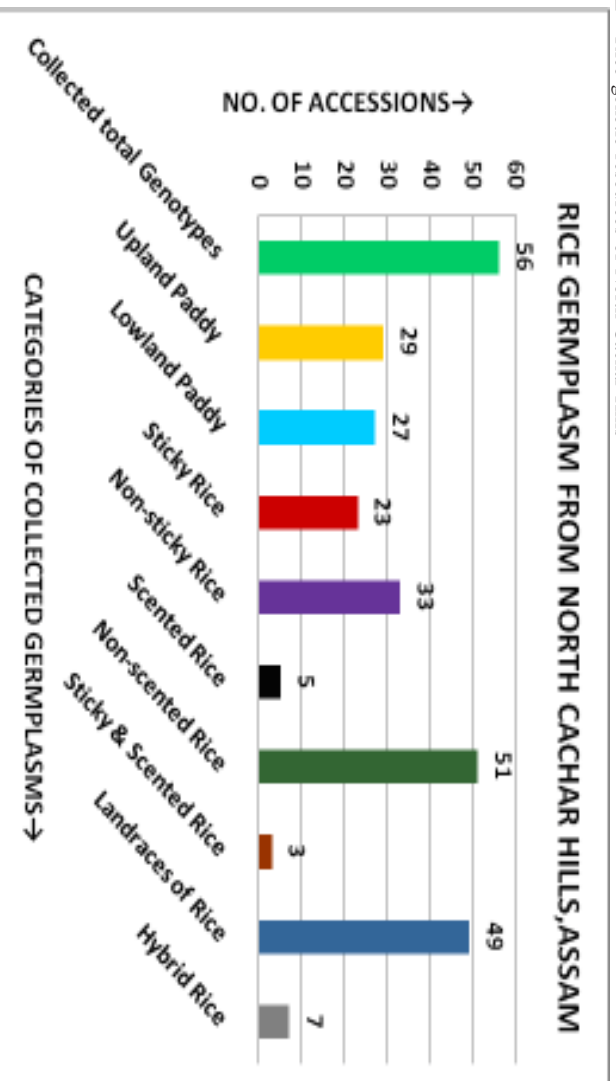


Fig. 2: Analysis of collected rice germplasm.



Fig. 3: Some of collected landraces of rice genotypes showing grains with IC nos.

for developing any other variety in future (Barua *et al* 2006). The base of rich indigenous knowledge is confined to the ethnic people and the cultivation of diverse crops can only ensure food security of the local people in the area.

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Fig. 4: Some of collected rice genotypes showing grains and kernels with IC nos.

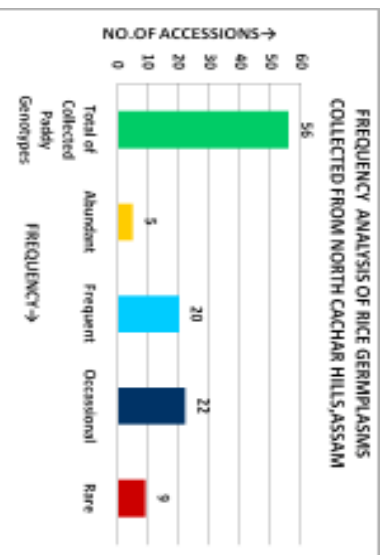


Fig. 5: Frequency analysis of collected rice germiplasms

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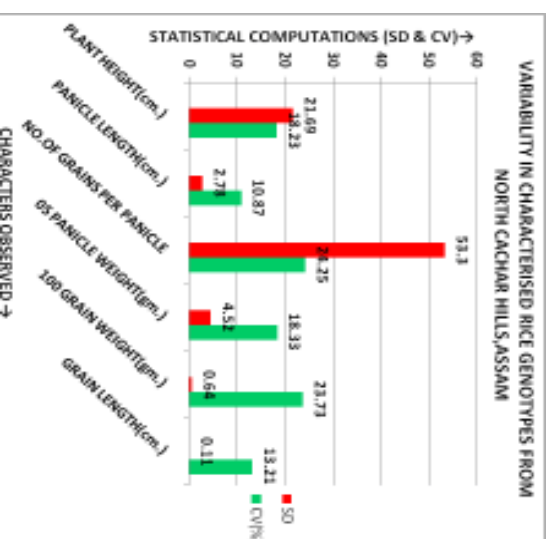


Fig. 6: SD and CV (%) of characterised rice genotypes.

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