

Table 1 Details of 24 elite Indian rice varieties used in the study

Variety	Year of Release	Parentage
ADT 43	1998	IR 50 x White ponni
ASD 19	1995	Lalnakanda x IR 30
BPT 5204 (Samba mahsuri)	1986	GEB 24 x TN 1 x Mahsuri
GEB 24	1929	Mutant of Konmani
IR 64	1992	IR 5657-33-2-1 x IR 2061-465-1-5-5
JGL 384 (Polasa prabha)	2002	WGL 48684 x BPT 5204
JGL 1798 (Jagtial sannalu)	2002	BPT 5204 x WGL 48684
Mahsuri	1972	65 x Mayang Ebos 6080 x 2
MTU 1001 (Vijetha)	1995	MTU 5249 x MTU 7014
MTU 1010 (Cottondora sannalu)	2000	MTU 2067 x IR 64
MTU 2067 (Chaitanya)	1988	Sowbhagya x ARC 5984
MTU 2077 (Krishnaveni)	1989	Sowbhagya x ARC 5984
MTU 4870 (Deepthi)	2000	MTU 4569 x ARC 6650
MTU 5249 (Vajram)	1986	Sowbhagya x ARC 6650
MTU 7029 (Swarna)	1982	Vasishtha x Mahsuri
RDR 7555(Rudrama)	1991	HR 19 x TN 1
RDR 763 (Indur samba)	1997	BPT 5204 x WGL 13400
WGL 14 (Warangal sannalu)	-	BPT 5204 x ARC 5984 / BPT 3291
WGL 13400 (Surekha)	1976	IR-8 x Siam 29
WGL 20471 (Erra mallelu)	1991	BC 5-55 x W 12708
RPW6-17 (Phalguna)	1977	IR-8 / Siam 29
RNR 23064 (Taramathi)	-	BPT 5204 x Tellahamsa
Tellahamsa	1971	HR 12 x TN 1
Kalajeera	-	Land race

Table 2 Plant morphological traits among elite Indian rice varieties

Variety	Leaf intensity of green Colour	Leaf pubescence of blade surface	Attitude of culm	Flag leaf attitude of blade (early observation)	Flag leaf attitude of blade (late observation)	Panicle curvature of main axis	Panicle awn	Panicle exertion	Leaf length of blade	Leaf width of blade	Time of heading	Stem length	Stem thickness	Panicle length of main axis	Panicle number per plant	Time of maturity (days)
ADT 43	Light	Weak	Semi-erect	Erect	Erect	Semi-straight	Absent	Exserted	Long	Medium	Early	Very short	Thick	Medium	Medium	Early
ASD 19	Dark	Medium	Semi-erect	Horizontal	Deflexed	Drooping	Absent	Well exerted	Long	Medium	Medium	Very short	Thick	Short	Medium	Medium
BPT 5204	Medium	Medium	Open	Erect	Semi-erect	Semi-straight	Absent	Exserted	Long	Narrow	Late	Very short	Thick	Short	Medium	Late
JGL 384	Medium	Medium	Semi-erect	Semi-erect	Semi-erect	Semi-straight	Absent	Exserted	Long	Medium	Late	Very short	Thick	Long	Medium	Late
JGL 1798	Medium	Medium	Semi-erect	Erect	Horizontal	Semi-straight	Absent	Well exerted	Medium	Medium	Medium	Very short	Thick	Long	Medium	Medium
GEB 24	Light	Medium	Open	Horizontal	Deflexed	Deflexed	Absent	Well exerted	Long	Narrow	Early	Very short	Medium	Long	Medium	Early
Mahsuri	Dark	Medium	Semi-erect	Erect	Semi-erect	Semi-straight	Absent	Exserted	Long	Narrow	Medium	Very short	Thick	Long	Medium	Medium
IR 64	Medium	Strong	Semi-erect	Erect	Semi-erect	Drooping	Absent	Exserted	Long	Medium	Medium	Very short	Thick	Long	Medium	Medium
MTU 1010	Medium	Medium	Erect	Semi-erect	Deflexed	Drooping	Absent	Well exerted	Long	Narrow	Medium	Short	Thick	Long	Medium	Medium
MTU 2077	Medium	Very strong	Erect	Semi-erect	Horizontal	Drooping	Absent	Exserted	Long	Medium	Late	Very short	Thick	Long	Medium	Late
MTU 5249	Dark	Strong	Erect	Semi-erect	Horizontal	Drooping	Absent	Exserted	Long	Medium	Late	Short	Thick	Long	Medium	Late
MTU 4870	Medium	Medium	Semi-erect	Erect	Semi-erect	Semi-straight	Absent	Exserted	Long	Medium	Late	Short	Thick	Medium	Medium	Late
MTU 1001	Medium	Weak	Semi-erect	Erect	Horizontal	Drooping	Absent	Well exerted	Long	Medium	Late	Short	Thick	Long	Medium	Late
MTU 2067	Medium	Medium	Semi-erect	Semi-erect	Horizontal	Semi-straight	Absent	Exserted	Long	Medium	Late	Very short	Thick	Long	Medium	Late
MTU 7029	Dark	Strong	Semi-erect	Semi-erect	Horizontal	Drooping	Absent	Partly exerted	Medium	Medium	Late	Very short	Thick	Long	Medium	Late
WGL 14	Medium	Medium	Semi-erect	Semi-erect	Semi-erect	Drooping	Absent	Exserted	Long	Medium	Late	Very short	Thick	Long	Medium	Late
RPW 6-17	Dark	Medium	Semi-erect	Semi-erect	Horizontal	Drooping	Absent	Exserted	Long	Narrow	Late	Very short	Thick	Long	Medium	Late
WGL 13400	Medium	Medium	Erect	Semi-erect	Semi-erect	Drooping	Absent	Well exerted	Long	Medium	Medium	Very short	Medium	Long	Medium	Late
WGL 20471	Medium	Medium	Semi-erect	Semi-erect	Horizontal	Drooping	Present	Exserted	Long	Medium	Early	Very short	Thick	Long	Medium	Early
RDR 7555	Medium	Medium	Semi-erect	Semi-erect	Horizontal	Drooping	Absent	Exserted	Medium	Medium	Early	Very short	Thick	Long	Medium	Very early
RDR 763	Medium	Very strong	Erect	Erect	Horizontal	Drooping	Absent	Well exerted	Long	Medium	Medium	Very short	Medium	Long	Medium	Medium
Tellahamsa	Medium	Absent	Semi-erect	Semi-erect	Horizontal	Semi-straight	Absent	Well exerted	Long	Narrow	Early	Short	Medium	Long	Medium	Very early
RNR 23064	Medium	Medium	Semi-erect	Semi-erect	Horizontal	Drooping	Absent	Well exerted	Short	Medium	Medium	Very short	Medium	Long	Medium	Medium
Kalajeera	Dark	Weak	Open	Semi-erect	Horizontal	Deflexed	Absent	Well exerted	Long	Narrow	Late	Very short	Medium	Long	Few	Late

Table 3 Grain morphological traits among elite Indian rice varieties

Variety	1000 grain weight (g)	Grain length (mm)	Grain width (mm)	Decorticated grain length (mm)	Decorticated grain width (mm)	Decorticated grain shape	Endosperm amylose content	Gelatinization of temperature
ADT 43	Very low	Small	Narrow	Small	Narrow	Medium slender	Medium	High intermediate
ASD 19	Low	Medium	Medium	Small	Narrow	Short slender	Medium	Intermediate
BPT 5204	Low	Small	Narrow	Small	Narrow	Medium slender	Medium	High intermediate
JGL 384	Very low	Small	Narrow	Small	Narrow	Medium slender	Medium	Intermediate
JGL 1798	Low	Small	Narrow	Small	Narrow	Medium slender	Medium	Intermediate
GEB 24	Low	Small	Narrow	Small	Medium	Medium slender	Medium	Intermediate
Mahsuri	Low	Small	Medium	Small	Medium	Medium slender	Medium	High intermediate
IR 64	Medium	Long	Medium	Medium	Medium	Long bold	Medium	High intermediate
MTU 1010	Medium	Long	Narrow	Medium	Medium	Long bold	Low	High intermediate
MTU 2077	Low	Medium	Medium	Small	Medium	Medium slender	Medium	Intermediate
MTU 5249	Low	Medium	Medium	Medium	Medium	Long bold	Medium	Intermediate
MTU 4870	Medium	Medium	Medium	Small	Medium	Medium slender	Medium	Low
MTU 1001	Medium	Medium	Medium	Medium	Medium	Medium slender	Medium	Low
MTU 2067	Low	Medium	Medium	Small	Medium	Medium slender	Medium	Intermediate
MTU 7029	Low	Small	Narrow	Small	Medium	Shot bold	Medium	Intermediate
WGL 14	Very low	Medium	Medium	Small	Narrow	Medium slender	Medium	Intermediate
RPW 6-17	High	Long	Broad	Medium	Medium	Long bold	Medium	Low
WGL 13400	High	Long	Medium	Medium	Medium	Long slender	Medium	Intermediate
WGL 20471	Medium	Long	Very narrow	Medium	Narrow	Long bold	Medium	Low
RDR 7555	Medium	Small	Very broad	Small	Medium	Short bold	Low	Intermediate
RDR 763	Low	Medium	Narrow	Small	Narrow	Short slender	Medium	Intermediate
Tellahamsa	Medium	Very long	Medium	Medium	Medium	Long slender	High	Low
RNR 23064	Low	Medium	Narrow	Small	Medium	Medium slender	Medium	Intermediate
Kalajeera	Very low	Very small	Narrow	Small	Medium	Short slender	Medium	High intermediate

Table 4 Descriptive statistics for 13 morpho-grain quantitative traits among elite Indian rice varieties.

Trait	Mean±SD	Range	C.V
Leaf length of blade (cm)	36.97±7.9	19.5 – 47.50	21.05
Leaf width of blade (cm)	1.16±0.2	0.85 – 1.45	17.31
Time of heading (days)	104.04±15.2	77.66 – 122.33	12.64
Stem thickness (cm)	0.80±0.2	0. 54 – 1.15	25.67
Stem length (cm)	78.91±12.0	60.5 – 99.0	15.22
Panicle length of main axis (cm)	22.12±1.8	19.62 – 25.49	8.01
Panicle number per plant	16.79±2.1	14.00 – 19.00	12.68
Time of maturity (days)	131.56±13.2	102.66 – 147.33	12.20
1000 Grain weight (g)	18.99±3.7	13.5 – 26.5	19.47
Grain length (mm)	8.27±0.9	6.02 – 10.23	11.46
Grain width (mm)	2.29±0.2	1.80– 3.05	10.89
Decorticated grain length (mm)	5.89±0.6	4.53 - 6.90	9.84
Decorticated grain width (mm)	2.09±0.2	1.78 – 2.7	10.22

Table 5 Contribution percentage and agro morphological traits associated with the seven principal components of elite Indian rice varieties and their Eigenvectors

Factor	1	2	3	4	5	6	7
Contribution percentage (%)	18.32	14.59	12.04	10.99	8.32	6.23	5.39
Characters	Eigenvector						
Length of leaf blade (cm)	1.738	1.342	1.342	-1.815	-2.161	-1.023	0.518
Width of Leaf blade (cm)	1.059	1.527	1.400	1.991	2.345	-1.719	-0.661
Time of heading (days)	3.739	1.785	1.562	-0.927	-0.608	-0.417	0.093
Stem length (cm)	-0.406	0.909	1.289	-1.686	-1.772	1.136	-0.253
Stem thickness (cm)	1.959	-2.893	1.210	1.840	0.263	2.050	-1.238
Panicle length of main axis (cm)	-0.946	-1.347	0.134	-1.240	1.076	-1.495	1.616
Panicle number per plant	-0.233	-3.140	1.845	0.523	-1.226	0.212	0.135
Time of maturity (days)	4.043	1.351	1.332	-0.985	-0.226	-0.937	0.108
1000 grain weight(g)	-2.703	1.324	0.798	1.268	-0.251	0.386	0.772
Grain length (mm)	-3.401	0.197	1.968	-0.538	0.344	0.653	-0.504
Grain width (mm)	-1.135	2.521	-1.137	2.545	-0.781	0.602	0.434
Decorticated grain length (mm)	-3.135	0.342	2.312	-0.541	0.583	0.654	-0.084
Decorticated grain width (mm)	-0.199	2.720	-1.214	2.603	-0.916	0.163	0.962
Intensity of green leaf Colour	2.266	1.303	-0.197	0.760	-0.378	1.242	-1.274
Pubescence of leaf blade surface	2.001	0.406	0.253	0.298	3.636	0.526	0.441
Attitude of culm	0.760	-3.345	-1.647	0.325	-2.050	-2.137	0.363
Flag leaf attitude of blade early observation	-0.442	0.590	-2.633	-1.414	0.345	0.034	0.474
Flag leaf attitude of blade late observation	-0.858	1.320	-2.579	-1.781	0.460	1.557	-0.796
Curvature of main panicle axis	0.082	0.921	-2.866	-1.832	0.818	-0.277	1.069
Panicle awn	-1.170	-1.381	-0.742	-0.549	2.145	-1.972	-2.227
Panicle exertion	-1.014	-0.441	-1.561	-2.109	-1.113	0.335	-2.540
Decorticated grain shape	-2.690	-0.390	2.487	-0.801	-0.059	-0.683	0.691
Endosperm amylose content	-1.214	-0.283	-1.519	3.426	-1.303	-1.536	-1.016
Gelatinization of temperature	2.652	-3.143	-0.793	0.471	0.321	1.617	0.732

Table 6 Estimated membership inference cluster values among rice varieties

Variety	Cluster 1	Cluster 2	Cluster 3
JGL 384	0.016	0.013	0.971
JGL 1798	0.017	0.024	0.959
BPT 5204	0.014	0.005	0.981
WGL 14	0.100	0.078	0.822
RDR 763	0.190	0.146	0.664
RNR 2306	0.402	0.051	0.548
MTU 2077	0.010	0.981	0.009
MTU 4870	0.013	0.98	0.007
MTU 1001	0.027	0.934	0.039
MTU 2067	0.026	0.963	0.011
MTU 7029	0.558	0.077	0.366
MTU 1010	0.123	0.811	0.066
MTU 5249	0.277	0.667	0.055
RPW6-17	0.971	0.02	0.009
WGL 134	0.965	0.008	0.027
WGL 20471	0.946	0.021	0.033
Tellahamsa	0.894	0.034	0.071
RDR 7555	0.838	0.018	0.144
ADT 43	0.385	0.141	0.474
ASD 19	0.253	0.235	0.512
GEB24	0.576	0.023	0.401
Mahsuri	0.655	0.024	0.321
IR 64	0.526	0.044	0.430
Kalajeera	0.961	0.027	0.012