

Variability assessment of Navara (*Oryza sativa* L.) germplasm—the traditional medicinal rice of Kerala for quantitative traits

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ABSTRACT

Navara a rice cultivar of Kerala is considered as a land race with specific attributes making it suitable in traditional ayurvedic medical system of Kerala. However, the different medical practitioners use different types of *navara* and they attribute the medicinal property to the one they are using. In order to assess the variability in *navara* germplasm, the entries were raised in replicated trial at Regional Agricultural Research Station, Pattambi. Detailed morphological characterization for quantitative traits based on IRRI descriptors was undertaken. Of the seventeen quantitative traits considered, the entries differed among themselves in fifteen characters. Only in the case of grain width and straw yield there was no significant difference between the entries tested. Hierarchical clustering using between group linkage as the clustering method and squared Euclidean distance as the interval in the dendrogram, showed three major clusters at 10 units.

Key words: *Navara*, medicinal rice, variability, clustering

Oryza sativa - rice is a crop which is endowed with rich genetic diversity and diversified uses. Much of this diversity is contributed by land races. Genetic variation is exhibited by this crop in almost all the characters like yield and yield contributing characters, biotic or abiotic stress tolerance and grain quality. *Navara* is one among those diverse germplasm of rice with short duration, tolerance to moisture stress, and a peculiar grain quality which makes its use in the traditional medical system of Kerala – the Ayurveda. This particular rice is indigenous to Kerala and was described in the ancient texts of Ayurveda like, *Ashtangahrydayam* (*Ashtangahrydayam - Sootrasthanam Chapter 6 sloka 7-10, Annaswaroopavigyani*). The rice of *navara* is used as an effective therapeutic measure for various degenerative conditions and rejuvenative purposes. It is also useful to improve muscle strength and bulk of muscle where there is wasting due to various reasons (Nair *et al.*, 2004).

Two distinct types of *navara* black and white, based on grain color were in cultivation from ancient times (*Ashtangahrydayam - Sootrasthanam Chapter 6 sloka 7-10 Annaswaroopavigyani*). The germplasm collected from various parts of Kerala revealed that there were variable types with respect to

other morphological characters as well. Assessment of variability based on quantitative traits were attempted as a preliminary step of evaluation of different types of *navara*.

MATERIALS AND METHODS

Seven *navara* types collected from different parts of Kerala were evaluated in a replicated trial for morphological characters during Rabi 2003-2004 at Regional Agricultural Research Station, Pattambi. The entries are listed in Table 1. A detailed morphological characterization based on the IRRI descriptors developed for characterization of rice (IRRI 1980), was

Table 1 Entries of Navara used for evaluation of qualitative characters.

Entry no	TRV no
Entry 1	2002
Entry 2	2058
Entry 3	2092
Entry 4	2093
Entry 5	2201
Entry 6	2202
Entry 7	2203

undertaken for quantitative characters. Observations were taken from 10 plants from each replication. For characters like leaf length, culm length *etc.*, where multiple observations are possible from a single plant, five observations were recorded and mean values were used for statistical analysis. Variability was assessed for seventeen quantitative traits. These included both vegetative and reproductive characters taken at various stages of crop growth.

Hierarchical clustering analysis was carried out using between group linkage as the clustering method and squared Euclidean distance as the interval. Software package for social sciences (SPSS V10) was the statistical programme used for data analysis.

RESULTS AND DISCUSSION

Seventeen quantitative characters were recorded from seven entries of *navara* collected from different localities of Kerala. Mean plant height of the entries differed from 86.57 cm to 101.59 cm (Table 2). Leenakumary (2004) observed *navara* plants with height varying between 64.7 cm and 127.1cm. Thomas *et al.*, (2004) classified *navara* types into two groups as plants having height less than 100 cm as intermediate

type and plants having height more than 100 cm as tall types. As per this classification only two entries in the present study were tall having height more than 100 cm.

Number of total tillers and productive tillers plant⁻¹ varied significantly between the entries tested. There was significant difference between the entries for culm length also. Leenakumary (2004), reported that golden yellow glumed *navara* types were having culm thickness of 1.5cm, whereas the black glumed types were having thin culms of thickness of 1.3 cm. In the present study the thickest culm was found in the Entry 2 with a thickness of 1.506 cm and the Entry 6 had thinnest culm of 1.04 cm.

Different entries exhibited maturity duration ranging between 87 to 101 days. Leenakumary (2004) suggested a maturity duration ranging between 72 days to 128 days for *navara*. However, Anilkumar (2004) considered *navara* as a group of very early maturing rice type. In his opinion, if the crop is grown in a proper field and there is no fault in cultural practices it matures in 60 days. He confirms that in no case its duration will exceed 90 days. The increase in the total duration observed in the present study can be attributed

Table 2. Mean values of different metric characters in *Navara* germplasm

Character	Entries						
	1	2	3	4	5	6	7
Plant height (cm)	100.47	101.59	87.20	93.30	86.57	89.53	88.73
Total tillers (no)	8.9	10.9	12.4	11.46	14	12.1	11.67
Productive tillers (no)	8.4	9.97	11.4	10.7	13	11.57	10.47
Culm length (cm)	71.05	66.82	60.24	64.96	59.88	62.22	60.7
Culm diameter (cm)	1.262	1.506	1.112	1.152	1.058	1.04	1.203
Leaf length (cm)	26.68	33.41	36.56	30.88	27.48	27.41	29.02
Leaf width (cm)	0.902	0.869	0.732	0.844	0.713	0.882	0.823
Ligule length (cm)	1.293	1.382	1.590	1.270	1.125	1.140	1.195
Days to maturity	90.0	91.0	101.0	88.0	101.0	99.0	87.0
Panicle length (cm)	21.36	21.42	19.69	19.67	18.69	18.65	19.77
Spikelets panicle ⁻¹ (no)	83.40	85.75	69.01	73.83	70.93	66.86	73.61
Sterility %	11.71	13.85	13.37	10.65	12.68	16.80	13.32
Grain length (cm)	0.795	0.814	0.769	0.799	0.783	0.797	0.778
Grain width (cm)	0.307	0.290	0.268	0.307	0.279	0.302	0.284
Grain yield plant ⁻¹ (g)	11.61	13.53	9.43	1060	9.03	7.80	9.12
Straw yield plant ⁻¹ (g)	15.10	16.58	12.00	12.80	15.80	11.20	11.57
Test weight (g)	2.539	2.409	2.018	2.245	1.991	2.147	2.210

to the method of planting. The seedlings were transplanted after raising them in a nursery. Usually direct sowing is followed in the case of very short duration varieties of rice.

Panicle length of the tested entries varied between 18.65 cm and 21.42 cm. Only two entries had panicles having length more than 20 cm. According to Leenakumary (2004), panicle length of *navara* types varied between 16.6 cm and 26.2 cm. In the present study number of spikelets panicle⁻¹ varied from 66.86 to 85.75 numbers. Earlier report by Leenakumary (2004) reported that number of spikelets panicles⁻¹ of this cultivar ranged from 55 to 125 numbers. Percentage ratio of number of sterile spikelets to fertile spikelets was more than 10 % in all the entries evaluated.

When the size of the grain was considered, longest grain had an average grain length of 0.814 cm and the shortest grain was having length of 0.769 cm. Even though grain width ranged from 0.268 cm to 0.307 cm, there was no significant difference between the entries in this character.

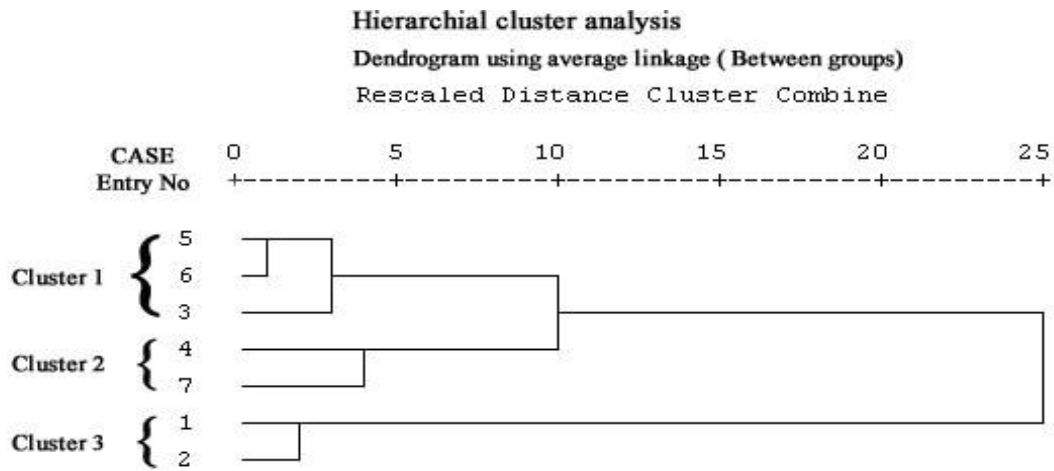
Grain yield plant⁻¹ varied from 7.8 g to 13.53 g. The range of grain yield of *navara* observed in this

study is narrower compared to the range observed by Leenakumary (2004) (7 g to 24.8 g). Straw yield plant⁻¹ did not exhibit any significant variability between the entries tested. Mean values for test weight ranged from 1.991 g to 2.539 g. Leenakumary (2004) reported the range of test weight of these cultivars as 1.67 g and 3.04 g. Here again the range observed in the present study was narrower. Based on the calculated value for critical difference and significance, it is clear that, there exists significant difference between entries for the characters studied except in grain width and straw yield (Table 3).

Variability assessment in *navara* germplasm based on quantitative traits reveals that most of the characters exhibited difference between the entries. Seven *navara* types could be classified into three major clusters (Fig.1) at 10 rescaled cluster units based on the dendrogram using average linkage between groups. This result points to the fact that the germplasm of rice designated as Navara can be considered as a mixture of different morphotypes. Further studies on the therapeutical value of these different types has to be undertaken to validate the medicinal efficacy of each type.

Table 3. Error Mean squares and CD values of different metric characters in *Navara* germplasm

Character	EMS	F value	Significance	CD
Plant height	41.385	28.156	0.00**	8.400
Total tillers	10.854	6.654	0.00**	4.300
Productive tillers	9.727	6.355	0.00**	4.070
Culm length	20.526	25.098	0.00**	5.920
Culm diameter	3.136E.02	24.310	0.00**	0.230
Leaf length	17.108	23.423	0.00**	5.400
Leaf width	7.645E.03	21.331	0.00**	0.110
Ligule length	7.056E.02	11.153	0.00**	1.000
Days to maturity	0.048	2398	0.00**	0.3898
Panicle length	2.151	19.522	0.00**	1.920
Spikelets panicle ⁻¹	392.353	4.886	0.00**	25.870
Sterility %	8.035	14.452	0.00**	2.680
Grain length	5.399E.04	12.338	0.00**	0.304
Grain width	4.785	1.028	0.41 ^{NS}	2.860
Grain yield plant ⁻¹	11.429	9.668	0.00**	4.420
Straw yield plant ⁻¹	6.153E.05	2.360	0.32 ^{NS}	0.010
Test weight	2.361E.02	50.217	0.00**	0.200



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