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PERFORMANCE OF TEN SCENTED RICE GENOTYPES

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ABSTRACT

Scented rice, valued for its fragrance, is one of the most important types of rice grown worldwide. Studying genotypic variability in rice becomes essential in the context of initiatives to increase agricultural yield and meet growing food shortages. In this study, seeds were sown in the Regional Research Station, C-Block Seed farm in the year 2021-22 to investigate the characteristics of ten genotypes of scented rice, focusing on seed quality criteria for maximising crop production and performance. The superiority of the genotypes was determined by various physicochemical characters. For germination and seedling quality measurements, water absorption and water holding capacity, germination %, TR values, root length, shoot length, vigour index (VI), fresh weight, and dry weight were considered. The biochemical profile of the seedlings was measured by quantifying total carbohydrate, peroxidase activity and alpha-amylase activity. For seed quality and yield several parameters like seed length, seed breadth, length/ breadth ratio, seed volume and 1000 seed weight were investigated. The analysis of germination, growth parameters, seed quality parameters, and biochemical characteristics revealed significant differences between genotypes, particularly in seedling growth, yield parameters, and biochemical parameters. From this study, the genotype Harinakhuri produced the highest germination %, shoot length, vigour index, fresh weight, dry weight and 1000-grain weight followed by Kataribhog, and Tulaipanji, while the lowest was recorded from the genotype Gobindabhog. Furthermore, it is inferred that genotypes Harinakhuri, Kataribhog, and Tulaipanji are suitable under specific conditions in terms of yield.

(Key words: Scented rice, Harinakhuri, Kataribhog, Tulaipanji, seed quality, biochemical parameters

INTRODUCTION

One of the most important cereal crops in the world, rice (*Oryza sativa* L) is a staple food for a sizable section of the world's population. Because of its fragrant qualities, which add to its unique flavour and appeal to customers, scented rice is unique among the different types of rice. Many cultures and cuisines hold scented rice types in high regard due to their aromatic qualities, which enhance the eating experience (Custodio *et al*., 2019).

For an extended period, researchers have been investigating the genetic variability present in distinct rice genotypes to augment agricultural output and satisfy the growing consumer demand for superior rice (Koli *et al*., 2015). A better understanding of genetic diversity and how different genotypes perform are essential first stages in developing breeding plans and crop management techniques that will ultimately guarantee food security (Saini *et al*., 2020).

With a focus on the qualitative criteria of the seeds, the current study looks into the variabilities within ten genotypes of scented rice. Given that it directly affects germination, seedling vigour, and overall plant performance, seed quality is a crucial factor in determining crop production (Mandal and Bala, 2023). Furthermore, a variety of morphological, physiological, and biochemical characteristics are included in seed quality, and each of these factors is crucial in determining the crop's final yield and quality.

Assimilates are essential for the growth and development of plants, and they are produced by photosynthesis, the process by which plants transform light energy into chemical energy. The number and quality of the harvested seeds are greatly influenced by the effective assimilation of photosynthates during the grain-filling stage (Chen *et al*., 2020). Predicting the results of seed quality thus requires an awareness of the ability of various rice genotypes for photosynthesis and absorption.

The association between seed shape, seedling traits, and biochemical parameters like total carbohydrate, peroxidase activity, and Q-amylase activity in genotypes of fragrant rice is also investigated in this study. Seed size and shape can impact seedling establishment and early growth. Morphological parameters, including seed length, breadth, volume, and weight, are indicative of seed size and form. Furthermore, biochemical data shed light on the metabolic

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activities taking place inside the seeds, which are essential for germination and the development of the plant afterwards. The research is important due to its possible effects on breeding initiatives and agricultural techniques that try to improve crop production and seed quality. Scientists can create focused breeding plans to create enhanced varieties with desired features by identifying high-performing genotypes and comprehending the fundamental causes of their superiority. The results of this study also have wider ramifications for food security and sustainable agriculture increasing yields with fewer resources by optimising crop performance and seed quality.

All things considered, the study of genotype variability in fragrant rice provides important new information on what influences crop performance and seed quality. This work advances rice breeding and farming practices, which benefit farmers, consumers, and global food security in the long run by clarifying the connections between genetic, morphological, physiological, and biochemical traits.

MATERIALS AND METHODS

Materials

The total 10 (ten) genotypes of aromatic land races *viz.,* i) Radhatilak (V1), ii) Lalbadshabhog (V2), iii) Kalonunia (V3), iv) Gobindabhog (V4), v) Kalojira (V5), vi) Radhunipagal (V6), vii) Tulaipanji (V7), viii) Kataribhog (V8), ix) Harinakhuri (V9) and x)Badshabhog (V10) were collected from Dr M. Ghosh, Dept. of Agronomy, Bidhan Chandra KrishiViswavidyalaya, West Bengal. Study of germination, growth and biochemical parameters were analysed in the laboratory while yield-related parameters were collected from seeds cultivated experimentally in the Regional Research Station, C-Block Seed farm in the year 2021-22. The experiment was conducted on comparative low land, well-drained alluvial soil (order-Entisol) that belonged to the textural class of clay-loam in plot area – 2m x 1m having a row to row distance of 20 cm and the plot to plot distance of 3 m following Randomise Block Design (RBD). Plants were fertilized with the recommended dose of fertilizer (RDF 50:25:25). Statistical analysis was performed in the RBD fashion as per the method suggested by Panse and Sukhatme (1967).

Water absorption potential and water holding capacity

A total of 50 seeds were soaked in distilled water and seed weight was measured in one-hour intervals up to six hours. The average of 6 hours of water absorption was presented as water absorption potentiality hour^{-1} for each genotype. After 24 hours of seed soaking, the differences in the final and initial weight of the seeds were expressed as water-holding capacity.

Seedling quality parameters

Twenty-five (25) seeds were randomly selected from each seed sample. Seed quality parameters were analysed in laboratory conditions according to standard methods (Singh *et al.*, 2018). Germination percentage (%) was calculated on the 10th day by the formula, Germination % = Number of seeds germinated leading to normal seedling/ Total number of seeds used in the experiment x 100 (Mandal and Bala, 2023). The first count (TR value) was calculated by counting the number of germinated seeds (leading to normal seedlings) 3 days after placing them for the germination test. The average length of the root and shoot of the normal seedlings were measured and expressed in centimetres (cm). Vigour Index was calculated with the help of the formulae VI = SL × G, where, VI = Vigour Index, SL= Seedling Length (root length + shoot length), and G = Standard Germination Percentage (Abdul-Baki and Anderson, 1973). The weight of 10 seedlings for each genotype replication^{-1} was measured and expressed in grams (g) as fresh weight and the weight of 10 seedlings dried at 95°C -100°C for 2 days were treated as dry weight after 14 days.

Biochemical activity during germination

Total carbohydrate contents in each genotype were measured as per the method suggested by Nielson (2010). The amount of carbohydrate present was expressed as milligrams per 100 mg (mg 100 mg^{-1}) of the sample. Peroxidase activity was measured according to Nakano and Asada (1981) using o-dianisidine as the substrate. Absorbance was recorded at 430 nm in Systronics- 105 Spectrophotometer. Peroxidase activity = ÄA min.$^{-1}$ g^{-1} of imbibed seed. Where ÄA = difference in absorbance (0 min. to 1 min.). The extraction of á- amylase and the estimation of enzyme activities were done as per the method suggested by Bernfield (1955). The enzyme activity was expressed as mcg (microgram) of maltose formed min.$^{-1}$ g^{-1} of fresh weight.

Yield and seed quality parameters

A total of 50 paddy seed samples of every genotype were selected randomly from each replication and the average length and width of the seed were measured by Vernier calliper equipment. The average values of these samples were used to calculate the ratio by the formula, length to width ratio (L/W) = Average paddy length /Average paddy width. In a measuring cylinder, 50 seeds of each genotype were submerged in 10 ml of water, and the increased volume of water was the volume of the 50 seeds and expressed in millilitres (ml). A total of 1000 seeds from each genotype was considered to calculate the weight of these seeds from each replication.

RESULTS AND DISCUSSION

The suitability of qualitative and quantitative characteristics of seed facilitates crop production directly correlated to the genotypic nature of the particular cultivar. The variable nature of diverse cultivated genotypes was grouped into various manners, where non-aromatic high-yielding and aromatic landraces were most prominent. The study on seed morphology in addition to the seed quality indicators like activity in seedling motion and bio-molecular action specified for a particular genotype may be valuable for qualitative upgradation of the produce (Samantara *et al.*, 2023). Seed is the most vital component in the plant life cycle as well as basic input in agriculture though categorization of this component on different crops was meagre. The strategic approach in different research especially in cultivation practices and breeding programmes was very much dependent on seed specification, where the variable nature of seed on a crop genotype should be informative. The present study was an effort to fulfil the objectives partially on a crop, rice. The observation of seedlings and the activity of a few bio-molecules may emphasize the knowledge in this aspect.

Water absorption potential and water holding capacity

Imbibition was an essential process for germination, initiation of seedling development etc. where a couple of bio-chemical activity was observed. In such a case, the appearance of water uptake may play a significant role in directing metabolic activity appropriately (El-Maarouf-Bouteau, 2022). The total mean water adequacy values varied significantly between genotypes. Water absorption potential in immediately harvested seeds varied significantly by genotypes. The highest values were observed in genotypes Kalonunia (V3) and Tulaipanji (V7). Genotypes Harinakhuri (V9), Kataribhog (V8), Radhatilak (V1), Lalbadshabhog (V2), Radhunipagal (V6), and Badshabhog (V10)showed moderate water potential, whereas Gobindabhog (V4) and Kalojira (V5) had the least and lowest values, respectively. The highest water-holding capacity was found in V4. V9, V6, V1, and V3 indicated moderately higher levels. V2, V8, and V5 produced the least favourable results, with V7 performing lowest.

Seedling quality parameters

The genotypic specificity of the seed can be determined by the seedling characters initiated at the seed germination stage. Potential seeds showed good performance by expressing their superiority in seedling parameters measurable under laboratory conditions (Finch-Savage and Bassel, 2016). There was a significant difference among different genotypes scheduled for study (Table 1). The highest germination rate was recorded in genotype Harinakhuri (V9) followed by Kalonunia (V3), Badshabhog (V10) and Kalojira (V5). The least germination was recorded in genotypes Gobindabhog (V4), Kataribhog (V8), Lalbadshabhog (V2), Tulaipanji (V7) and Radhatilak (V1), while moderate result was observed in Radhunipagal (V6). The germination percentage is converted to TR value for conducting the statistical calculation where V8, V6 and V10 showed higher TR values. V9, V5 and V4 displayed lowest values respectively. Moderate TR values were observed in V1, V2, V3 and V7.The potentiality of seedlings can be judged through their seedling length, particularly in the light of roots necessary for establishment in field conditions. Different genotypes showed variable nature in a significant manner where the highest result was observed in V8 along with V7 and V9. The lowest root length was recorded in V5. The different interacted values of water accessibility indicated a significant distinct variation among them. In shoot length, the variable nature of aromatic landraces showed distinct demarcation among them though mean values of all genotypes were maintained parity except genotypes V5 and V9 by demonstrating the lowest and highest assessment respectively. The imperative quality assessment through seedling fresh weight showed significant differences among genotypes. genotypes V9 and V8 showed the highest result respectively while the performance of genotypes V1 was the lowest compared to other genotypes. Similar results were observed in the case of dry weight of seedlings. The ultimate seedling strength, as well as the excellence of the seed, was determined by the quality parameter Vigour Index during the measurement of seedling strength and per cent (%) of germination. The mean value showed significant variation among different genotypes. The highest and lowest Vigour Index were observed in genotypes V9 and V1 respectively. In moderate genotypes, a higher value was noted in V8 while V10 delivered the lowest result.

Biochemical activity during germination

Total carbohydrate was the important quality estimating bio-molecule in the case of cereal seed, particularly rice. The amount of carbohydrates may have an influential role in the maintenance of seed quality that may directly participate in the process of germination in addition to retaining good storability. The different genotypes showed significant variability in total carbohydrate content. Total carbohydrate was highest in the seed of Gobindabhog (V4)followed byKalojira (V5), Kalonunia (V3), Kataribhog (V8), Radhunipagal (V6) and Lalbadshabhog (V2). Genotype Harinakhuri (V9) and Tulaipanji (V7) showed moderate results. In contrast to these, lowest carbohydrate content was recorded in genotype Badshabhog (V10) followed by Radhatilak (V1). In case of peroxidase activity genotypes Kataribhog (V8) and Tulaipanji (V7) showed the highest and lowest results. All other genotypes displayed moderate results. The highest alpha-amylase activity was observed in genotypes V8 followed by genotypes V9, V2 and V3. Moderate activity was noted in genotypes V10, V5, V6 and V4 while the lowest alpha amylase activity was observed in genotype V1.

Yield and seed quality parameters

The freshly harvested seeds of ten (10) aromatic genotypes were collected from plants under field conditions. After proper cleaning, these were evaluated considering their seed morphology crucial for the continuation of seed purity and quality. The initial level of variability was observed on seed morphology consisting of different numerical parameters in association with some visible signs though a few definite characters were measured for this current study (Table 2). The genotypes Kataribhog (V8) and Harinakhuri (V9) showed superiority over all other landraces for seed length. Lower seed length was observed in genotypes Lalbadshabhog (V2), Radhunipagal (V6) and Badshabhog (V10) while the lowest size was noted in Kalojira (V5) genotype. All other landraces *viz.,*Radhatilak (V1), Kalonunia (V3), Gobindabhog (V4) and Tulaipanji (V7) belong to the moderate range where Harinakhuri (V9) with the highest values. Table 2 indicated another morphological measurable parameter, seed breadth which is noticeably variable in a significant manner allowing for all the genotypes. The topmost value was observed in genotypes V9, V5 and V7. A lower range of seed breath was observed in genotypes V4, V3, V8, V6, V2 and V10 landraces. The breadth of the seed was not influenced by seed length. The significant demarcation was observed though in some cases these were non-significant. The length-breadth ratio of the seed acted as a signal point for the specific seed marker related to the definite cultivar. The highest ratio was recorded in V8. Genotypes V7, V9, V3 and V10 showed moderate values. The lower length-breath ratio was noted in genotypes V4, V2, V1 and V6 but the lowest value was observed in genotype V5. The seed volume was expressed in millilitres due to its observation based on the measurement of water rise considering the specific amount. Seed volume showed a parallel nature in the appearance of genotypes as the earlier seed length character. The extreme value was observed in genotypes V8 and V9 in a non-significant manner though other values were significant among the considerable cultivars. Lower values were observed in genotype V5 followed by V10, and V2 while the lowest volume was observed in genotype V3. Moderate ranges of values were recorded in genotypes V1, V6 and V7.

Table 1. Germination, growth and biochemical parameters of scented cultivars of rice

Treatments	Water absorption potential (g hr^{-1})	Water holding capacity (g hr^{-1})	Germination (%)	TR value	Root length (cm)	Shoot length (cm)	Vigour index (VI)	Fresh weight (g)	Dry weight (g)	Carbohydrate content (mg 100 mg^{-1}))	Peroxidase activity (ÄA $min.^{-1}$ g^{-1})	Alpha-amylase activity (ìg^{-1} min^{-1})
V1	0.024	0.163	78.99	18.790	10.263	10.225	1,628.1	0.170	0.033	38.593	0.747	57.127
V2	0.022	0.123	79.83	18.720	11.250	11.515	1,799.1	0.190	0.033	43.980	0.952	67.622
V3	0.034	0.186	83.49	20.053	10.310	12.235	1,844.1	0.267	0.053	45.587	1.058	66.447
V4	0.020	0.137	81.50	17.830	9.747	10.665	1,647.9	0.163	0.040	46.600	1.025	61.443
V5	0.015	0.164	82.50	18.007	6.997	10.020	1,411.3	0.220	0.040	45.920	1.022	62.825
V6	0.022	0.148	82.00	20.693	12.087	11.885	1,928.6	0.197	0.050	44.153	0.860	61.656
V7	0.034	0.167	79.83	20.040	14.053	11.835	2,029.2	0.220	0.050	42.467	0.635	57.451
V8	0.026	0.203	81.33	20.880	14.260	14.670	2,325.6	0.243	0.050	45.500	1.145	69.600
V9	0.027	0.232	84.17	18.203	13.523	15.395	2,429.3	0.253	0.063	42.473	1.072	69.013
V10	0.021	0.137	82.61	20.503	10.787	11.200	1,825.5	0.200	0.040	38.680	0.860	64.800
SE(m) ±	0.002	0.012	0.725	0.230	0.402	0.594	15.453	0.011	0.003	1.067	0.012	1.508
CD at 5%	0.006	0.035	2.171	0.688	1.205	1.781	46.269	0.033	0.009	3.196	0.035	4.522

Table 2. Seed quality and yield parameters of scented cultivars of rice

Treatments	Seed length (mm)	Seed breadth (mm)	Length/ breadth ratio	Seed volume (ml)	1000 seed weight (g)
V1	5.920	1.793	3.297	0.600	12.250
V2	5.617	1.703	3.303	0.500	11.967
V3	6.703	1.757	3.813	0.467	14.283
V4	5.917	1.777	3.343	0.433	11.440
V5	5.503	1.820	3.037	0.533	14.193
V6	5.547	1.707	3.243	0.600	12.170
V7	7.890	1.813	4.350	0.622	15.033
V8	8.033	1.720	4.673	0.733	15.263
V9	7.610	1.923	3.960	0.733	16.883
V10	5.553	1.653	3.360	0.533	12.143
SE(m)±	0.108	0.043	0.10	0.041	0.140
CD at 5%	0.322	0.129	0.29	0.122	0.419

The preliminary quality sign, 1000 seed weight of a particular crop was also an indicative feature for a particular genotype. It was coupled with a genotypic marker that can be considered for agronomical characterization in productivity as well as qualitative measure of seed. Different varieties showed a variable nature in a significant manner where the topmost and lowest effects were observed in genotypes V9 and V4 respectively. All other genotypes performed moderate results but the highest place among them was achieved by the V8 genotype.

In any seed product on system, the capacity of photosynthesis in a crop plant and its proper assimilation in plant growth activities particularly at the stage of grain filling ensure the quality of production. Accumulation of photosynthates into the sink in the proper way can enrich the seed quality with its quantity (Chen *et al*., 2020). Proper accumulation and its ultimate stabilization may be expressed in the morphological, physiological as well as biochemical activity of the seed that enhances the initial action of the seed at germination (Purane *et al*., 2020). The nature of seedlings was also a vital factor for analysing the quality of seeds developed at different genetic and environmental backgrounds (Finch-Savage and Bassel, 2016). Characterization of seed may have an influential role in future research to standardise the strategy of cultivation schedule as well as the incorporation of other treatments which may be incorporated as a part of the breeding strategy.

In the present study, the performance of ten scented genotypes was compared considering the 3 groups of characteristics *viz.,* seedling quality, biochemical characters and yield parameters. The significant variable nature was prominent for all genotypes. The findings indicates that there was heterogeneity in the ten aromatic rice genotypes examined with respect to germination, growth characteristics, biochemical, yield, and yield-contributing features. Comparing all the parameters it can be concluded that genotypes Harinakhuri (V9), Kataribhog (V8) and Tulaipanji (V7) are the appropriate aromatic cultivars in this condition.

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