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Assessment of seed quality of different commercial lots of PRH 10 produced at different locations

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ABSTRACT Indian Agricultural Research Institute released the world's first superfine grain aromatic rice hybrid PRH10 for commercial cultivation in 2001, which yields 20-25 per cent more than the high yielding Pusa Basmati-1. Farmer's entire crop depends upon the quality of the seed he sows. Hence, it is necessary to check the quality of seeds made available to the farmers. For the present study, twelve commercial seed lots of superfine aromatic rice hybrid Pusa RH10 were collected from ten private seed companies and two public sector undertaking (IARI, New Delhi and IARI-Regional Station, Karnal) located in different agro-climatic zones. All the seed lots were examined for physical purity (i.e. pure seed, inert matter, other crop seed, weed seed, objectionable weed seed and ODV), genetic purity (using grow-out test), germination percentage, seed moisture content and seed health following ISTA rules. Perusal of data revealed that three seed lots were exceeding the prescribed limit of 20 ODV per kg as per Indian Minimum Seed Certification Standards (IMSCS). The pure seed and inert matter varied from 98.8 to 100 per cent and 0.0 to 1.2 per cent respectively, which was within prescribed limit. The other crop seed, objectionable weed and weed seed were not found in any of the seed lots. The 1000 seeds weight varied from 18.59 to 21.30 g. The per cent germination was recorded less than 80 per cent in two seed lots *i.e.* below the IMSCS. In case of moisture content, one seed lot had higher moisture content (9.95 per cent) than the limit prescribed by IMSCS for moisture proof container. Three seed lots failed to meet the Minimum Standard of genetic purity *i.e.* 95 per cent. Paddy bunt, the designated disease of rice, was not found in any of the seed lots.

Keywords: Seed quality, rice hybrid, GOT, genetic purity, seed health

Rice (*Oryza sativa* L.) is the most important staple food for a large segment of world's human population. Globally, rice is the second most important crop after wheat. Therefore, rice plays an important role in ensuring global food security. The adoption of hybrid rice with an average yield advantage of 15-20 per cent over high yielding varieties provides an effective strategy for ensuring better crop production. The major problem in the hybrid rice seed production programme is the maintenance of seed quality of parental line and hybrid in terms of genetic purity, vigour, viability, seed health *etc.* Hence, assessment and maintenance of seed quality of the parental line and hybrid is crucial for successful adoption of hybrid rice technology.

Quality seed is extremely important for harvesting crop's full potential. It has been emphatically shown that 10-20 per cent increased yield could be attained by the use of good quality seeds alone. The success of hybrid rice in India can be achieved only if adequate quantities of quality seeds are made available to farmers for cultivation. The seed quality is governed by variety of factors prevailing during growth, flowering, seed development and maturation, seed harvesting, seed processing and storage. Production of good quality seed depends on multiple factors involving interactions between the genetic makeup of the seed and the environment under which it is produced, harvested and stored. Under tropical ambient conditions, longevity of rice hybrid and CMS line seeds is reported to be poorer than that of pollen parent and maintainer lines [1-2].

Generally the hybrid rice seeds have glumes which do not close completely at the tip of grain, which increase the chance of infection and disease and thereby cause loss of seed quality. Hence, present study was aimed to assess the quality status of the commercial seed lots of Pusa RH10 produced and marketed by different private and public sector seed companies.

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MATERIALS AND METHODS

To study seed quality status, 12 commercial seed lots of Pusa RH 10 were procured from market as detailed in Table 1. The seed lots were evaluated for various seed quality parameters. To analyze physical purity of seed lot, the working sample (70 g) was manually separated into four fractions *viz.*, pure seed, inert matter, other crop seeds and weed seeds. Each fraction was weighed accurately and expressed in percentage [3]. The other distinguishable varieties of paddy in each seed sample of 700 g was manually separated, based on the morphological variations, with the help of hand lens and expressed as number of seeds kg^{-1} [4]. Seed weight was determined by counting 100 seeds manually in 8 replicates from pure seed fraction and expressed as mean of 1000 seeds in gram [3]. The moisture content was determined by air-oven method as prescribed by ISTA [3]. Four replicates of 100 seeds each selected at random from pure seed fraction were used for germination in roll towels maintained in the germination room at a temperature of 25 ± 1°C and 95 per cent relative humidity (RH) for 14 days. All normal seedlings were counted and expressed as germination percentage. At final count, ten normal seedlings were taken at random from each replication and root and shoot length of each seedling was measured and the mean value was expressed as seedling length in cm. Ten normal seedlings per replication which were picked up at random for observing total seedling length were dried in a hot air oven maintained at 80 ± 1°C for 24 hrs and then cooled in desiccators. Seedling dry weight was expressed as mg/10 seedling. The vigour indices of the seedling were computed using prescribed procedure [5].

Entire submitted sample (700 g) of each seed lot was used for the determination of husk-less seed. Completely dehusked seeds were removed and counted and per cent of husk-less seeds was calculated. Seed health test was carried out using standard blotter method [3]. The genetic purity of the different commercial lots of Pusa RH10 was determined by grow-out test as per standard method used for Seed Certification under Seed Acts [6]. The off-types were mainly differentiated from Pusa RH10 on the basis of DUS characteristics.

RESULTS AND DISCUSSION

The quality of seed is routinely assessed by testing its attributes such as physical purity, germination and vigour, moisture content, seed health and genetic purity. Government of India has fixed Minimum Seed Standards to ensure the quality of seeds made available to farmers. As per the seed act 1966, seed of a notified variety should conform to the Indian Minimum Seed Certification Standards (IMSCS) [6]. The quality status of the seed lots is being discussed as under:

Physical Quality

The result of physical purity analysis (Table 2) revealed that pure seed component in the 12 seed lots ranged from 98.8 to 100 per cent. Highest pure seed percentage

Table 1. Details of seed producing companies of different commercial seed lots of Pusa RH10

S. No.	Name of Seed Lots & Packaging Material	Seed producing companies	Lot No.
1.	**VNR**(Poly bag)	VNR Seeds, Raipur	G-127-7071/59
2.	**Spriha**(Poly bag)	Spriha Bioscience, Hyderabad	29823004
3.	**Mahyco**(Cloth bag)	Mahyco Seeds, Jalna	XKE 100013
4.	**Manisha**(Cloth bag)	ManishaAgribiotech, Hyderabad	May-08-MAB-721(P)-82099
5.	**Dhaanya**(Poly bag)	Dhaanya Seeds, Bangalore	C-194705
6.	**Bioseed**(Poly bag)	ShriramBioseed, Hyderabad	PNPG 8708
7.	**Kamboj**(Poly bag)	Kamboj Export, Karnal	Not Mentioned
8.	**Jaikisan**(Poly bag)	Zuari Seeds, Bangalore	70024449
9.	**JK Seed** (Poly bag)	JK Seed, Hyderabad	9012-45252
10.	**Krishidhan**(Polybag)	Krishidhan Seeds, Jalna	HHR 201133
11.	**Karnal**(Cloth bag)	IARI Regional Station, Karnal	IARI/RSK/KH-08
12.	***Farmer Seed**(Cloth bag)	SPU, IARI, New Delhi	IARI/SPU/ 08

*Farmer produced seed under participatory programme of SPU, IARI, New Delhi.

was observed in case of Dhaanya and Bioseed and lowest in Manisha (98.8 per cent). Thus, the seed lots of Pusa RH10 conform to the Indian Minimum Seed Certification Standards (IMSCS) with respect to physical purity analysis, since pure seed fraction was more than 98 per cent whereas inert matter was in the range of 0.0 to 1.2 per cent. The possible reason may be that the seed lots were collected from public and private seed companies having good seed processing facilities and also due to proper handling of seed lots at post-harvest stages. Seed samples of rice hybrid ADTRH 1 collected from 25 locations spread over two different agro-climatic zones of Tamilnadu had shown considerable variation in pure seed fraction of hybrid seed samples [7]. The quality is considered to be good, if pure seed percentage is above 98 and inert mater is as low as 0-1 per cent [8].

The other crop seed, objectionable weed and weed seed were not found in any of the seed lots of Pusa RH10. The possible reason for the absence of other crop seeds and weed seeds might be due to the proper weeding cum rouging operation during seed production, use of good quality seed and good processing equipment. The ODV (Other Distinguishable Variety) seeds were also observed in all the seed lots. Out of 12 seed lots, 3 seed lots were exceeding the prescribed limit of 20 ODV per kg as per IMSCS (Table 2). Improper roguing or contamination during post-harvest handling of seed might have caused higher percentage of ODV.

The 1000 seed weight varied from 18.59 to 21.30 g which may be possibly due to variation in seed production environment as well as agronomic practices and plant protection measures. Out of 12 seed lots only four seed lots had 1000 seed weight above 20 g (Table 2). The coefficient of variation (C.V.) was less than four in all the seed lots (Table 2), which is below the limit for non-chaffy seed [3]. Highest C.V. was recorded in Mahyco (1.36) and lowest in Kamboj (0.51). Similar observations were made for 1000 seed weight in certified seed lots of barley, oat, winter wheat, winter rye and spring wheat produced in different locations [9].

Genetic purity

In spite of all precautions, the contamination of the A line seed with that of B line in the AXB seed production plot cannot be ruled out. Eventually, the contaminated A line enters the hybrid seed production (A X R) chain. Therefore, testing genetic purity of hybrid seeds prior to commercial cultivation is necessary. Grow-Out test was conducted to assess the genetic purity of commercial seed lots of Pusa RH10. The result revealed that 9 seed lots had genetic purity above 95 per cent and three seed lots (Mahyco, Manisha and Farmer seed) had genetic purity below 95 per cent (Table 2). Thus, out of 12 commercial seed lots, three seed lots failed to meet the Minimum Standard of genetic purity as per IMSCS [6]. The reasons may be improper isolation and roguing or contamination during seed production and post-harvest handling of seed.

Table 2. Seed quality analysis of commercial seed lots of Pusa RH10

Seed Lots	Pure Seed (%)	Inert Matter (%)	Other crop seed (No. Kg^{-1})	Weed Seed (No. Kg^{-1})	Objectionable Weed Seed (No. Kg^{-1})	ODV (No. Kg^{-1})	Huskless Seed (%)	1000 Seed weight (g)	Coefficient of Variation (C.V.)	Genetic Purity (%)
VNR	99.9	0.1	0	0	0	8	0.92	21.3	0.89	99.30
Spriha	99.9	0.1	0	0	0	16	0.68	19.99	0.68	98.84
Mahyco	99.9	0.1	0	0	0	17	0.4	18.59	1.36	93.75
Manisha	98.8	1.2	0	0	0	26	0.08	19.2	0.70	94.68
Dhaanya	100	Trace	0	0	0	22	0.2	19.77	1.17	95.14
Bioseed	100	Trace	0	0	0	18	0.12	19.4	1.32	96.71
Kamboj	99.9	0.1	0	0	0	9	0.56	20.13	0.51	97.8
Jaikisan	99.9	0.1	0	0	0	17	0.08	19.49	0.91	98.81
JK Seed	99.9	0.1	0	0	0	13	0.6	20.29	0.93	96.53
Krishidhan	99.7	0.3	0	0	0	12	0.64	20.47	1.13	96.73
Karnal	99.9	0.1	0	0	0	3	0.04	19.33	1.26	99.54
Farmer Seed	99.3	0.7	0	0	0	36	0.04	19.36	1.22	89.35

PHYSIOLOGICAL QUALITY

Germination

Variation in seed's physiological quality was observed in 12 seed lots. The result revealed that germination percentage varied significantly in different seed lots. The germination per cent was significantly higher (97.5 per cent) in the seed lot of Spriha, while germination was at par in 5 seed lots namely, Bioseed, Jaikishan, JK seed, VNR and Krishidhan (Table 3). In the present study, all the seed lots registered more than 80 per cent germination except two seed lots (Mahyco and Kamboj). Thus, only ten seed lots met the prescribed standard of germination percentage as per IMSCS [6]. Such variation in germination might be due to the influence of agro-climatic conditions prevailing in their respective seed production environment. The variation in seed quality parameters in different seed lots are reported to occur due to various factors such as environmental condition during seed development and maturation, physiological status of the seed at maturity, conditions prevailing during seed harvesting, processing and seed storage [10].

Moisture content

The result indicated that all the seed lots had moisture content within the permissible limit except one seed lot *i.e.*, Kamboj where the moisture content (9.95 per cent) exceeded 8 per cent limit for moisture vapour proof container as per IMSCS [6] (Table 2). This may be due to variation in e-RH of the storage environment or due to improper storage practices. Since seed is hygroscopic in nature, it equilibrates with prevailing relative humidity till the equilibrium moisture content (EMC) is attained. The EMC at a given relative humidity tend to increase as temperature decrease.

Seed vigour

Seed viability and vigour are two important components of seed quality and they go hand in hand while judging the quality of seeds. The study revealed variation in seed vigour as reflected by seedling length, dry weight and vigour index in different seed lots of Pusa RH10. Significant variation in seedling length and seedling dry weight was observed in commercial seed lots of Pusa RH10 (Table 3). The seedling length was significantly higher in three seed lots namely JK seed (15.48 cm) and Krishidhan (15.45 cm), Spriha (15.42 cm). The dry matter production (DMP) was found maximum (8.02 mg) in the seed lots of Sprihaand, JK seed and minimum DMP was recorded in Kamboj (4.70 mg), followed by Mahyco (4.97 mg) as depicted in Table 3.

The vigour indices were determined in 12 commercial seed lots of Pusa RH10 (Table 4). The

Table 3. Physiological quality of commercial seed lots of Pusa RH10

Seed lots Length	Seed germination%	Total seedling length (cm seedling^{-1})	Dry matter production (mg seedling^{-1})	Vigour Index I	Vigour Index II	Seed Moisture Content (%)
VNR	90(71.72)^{B}	13.83^{C}	7.19^{B}	1246^{CD}	647^{C}	6.60
Spriha	98(81.15)^{A}	15.42^{A}	8.02^{A}	1503^{A}	782^{A}	6.76
Mahyco	76(60.55)^{F}	12.57^{DE}	4.97^{E}	951^{F}	376^{H}	10.17
Manisha	83(65.85)^{DE}	14.65^{B}	6.97^{BC}	1220^{D}	580D^{EF}	10.07
Dhaanya	86(68.13)^{CDE}	13.9^{C}	6.40^{CD}	1196^{D}	550^{EFG}	6.57
Bioseed	88(69.64)^{BC}	14.21^{BC}	6.76^{BCD}	1247^{CD}	592DE	5.92
Kamboj	38(37.76)^{G}	11.90^{E}	4.70^{E}	428^{G}	176^{I}	9.95
Jaikisan	89 (70.69)^{BC}	14.81^{AB}	7.37^{AB}	1318^{BC}	655^{C}	6.56
Jk seed	90 (71.85)^{B}	15.48^{A}	8.02^{A}	1397^{B}	723^{B}	6.46
Krishidhan	87(68.98)^{BCD}	15.45^{A}	7.16^{B}	1345^{B}	622^{CD}	6.02
Karnal	83(65.67)^{DE}	14.26^{BC}	6.44^{CD}	1184^{D}	534^{FG}	9.10
Farmer seed	82(65.03)^{E}	12.83^{D}	6.16^{D}	1053^{E}	503^{G}	10.16
Mean	82.42(66.42)	14.11	6.68	1175.58	561.65	7.86
SE(m)	1.19	0.236	0.248	31.76	19.31	0.070
SE(d)	1.65	0.345	0.356	44.92	27.31	0.099
CD(p=0.05)	3.35	0.702	0.724	92.75	53.65	0.217

*Figures given in parenthesis indicate angular transformed values.

*Means with the same letter within the columns are not significantly different.

Table 4. Comparative study of seed mycoflora in commercial seed lots of Pusa RH 10

Seed lots	Fungal incidence percentage (%)										
	B.O	T.P	C.L	A.A	F.M	P	A.F	A.N	Clad.	C.P	Total
VNR	0	0	0	0	0	1	2	0	0	0	3
Spriha	2	0	0	0	0	0	2	1	0	0	5
Mahyco	2	0	10	0	5	4	5	3	0	0	29
Manisha	5	0	0	2	0	0	3	0	2	0	12
Dhaanya	5	0	0	0	0	0	2	0	5	0	12
Bioseed	10	0	0	3	2	0	2	0	0	3	20
Kamboj	3	5	3	5	3	22	32	9	5	0	87
Jai kisaan	11	0	1	1	2	0	2	0	0	0	17
J. K. Seed	4	0	0	0	3	0	0	0	0	0	7
Krishidhan	12	0	0	0	0	0	0	0	0	0	12
Karnal	5	6	12	4	2	2	3	2	3	0	39
Farmer seed	8	5	14	3	4	2	2	0	4	0	42

Legends:

B.O (*Bipolaris oryzae*)
T.P (*Trichoconiell apadwickii*)
C.L (*Curvularia lunata*)
A.A (*Alternaria alternate)*
P (*Penicillium spp.*)
A.F (*Aspergillu sflavus*)
A.N (*Aspergillu sniger*)
Clad. (*Cladosporium spp.*)
C.P (*Cephalosporium spp.*)
F.M (*Fusarium moniliforme*)

vigour index I (Germination % X Total seedling length) varied significantly in the commercial seed lots of Pusa RH10. The highest vigour index I was found in seed lot of Spriha (1503) and lowest was recorded in Kamboj (428). The vigour index II (Germination % X Seedling dry weight) varied from 176 to 782, being maximum in case of Spriha (782), closely followed by JK seed (723) and minimum in the seed lot of Kamboj (176). Mahyco seed lot also recorded very low value (376).

Environmental factors are known to influence the composition [11] and structure of mature seed. Hence, they also affect the performance of seed such as germination, vigour parameters *etc*. Seed storage studies conducted on KRH2 produced at two different locations in Karnataka (Dharwad and Sirsi) revealed that seed quality varied due to location and seeds produced at Dharwad were superior in respect of germination and vigour as compared to seed produced at Sirsi [12]. Our results on variation in seed vigour parameter due to production environment are also in conformation with the findings reported in hybrid rice ADTRH 1 [7].

Seed Health

Seed health is a very crucial factor in any seed production programme. Seed discolouration, caused by several seed borne fungi, is a serious problem in hybrid rice. This may be due to the wider angle of spikelet opening and its partial closure with a wide gap in the CMS line seeds, which provides a natural passage for the invasion of pathogens [13-14]. In the present investigation, 10 mycoflora were found associated with the seeds of 12 commercial lots of Pusa RH10 (Table4). Out of these, three were pathogenic (*Biopolaris oryzae, Trichoconiella padwickii, Fusarium moniliformae)*, two saprophytic (*Curvularia lunata, Alternariaalternata*) and four storage fungi (*Aspergillus flavus, Aspergillu sniger, Penicillium spp., Cladosporium spp.*). Among different species of fungi, *Bipolaris oryzae* (67 per cent) was found most commonly in the seed sample of 11 seed lots. Some of these are known to adversely affect germination, seedling vigour [15] and cause seed rot and seedling mortality [13,16]. The occurrence of higher percentage of fungal incidence in some seed lots may be due to unfavourable environment during seed production. Seeds produced in the area of high relative humidity especially during seed development and maturation show poor quality due to higher pathogen incidence [17], as observed in the present study.

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