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Separation of quality seeds by density grading in stored seed lot of rice (*Oryza sativa* L.) hybrids

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ABSTRACT

A study was carried out to standardize a suitable method to separate quality seeds from stored seed of rice hybrids. The results revealed that various physical and physiological seed quality parameters of stored seed lot of rice hybrids viz., 100 seed weight, free from insect infestation, seed germination, seedling length, dry matter production and vigour index were significantly improved by both specific gravity separation and salt solution upgradation at four per cent concentration. Hence it is concluded that for immediate sowing purpose salt upgradation may be followed and specific gravity separation may be followed for further storage of seeds.

Key words: *Hybrid rice, seed storage, quality seed, recovery*

Maintenance of seed vigour and viability during storage is a matter of prime concern in seed production programme. In India owing to the prevailing sub-tropical climate in major parts of the country, seeds of most crop species show rapid deterioration; and hybrid rice is no exception. In addition, hybrid rice seeds are highly susceptible to storage insects due to the occurrence of split husk seeds with mild aroma, which reduces the germination of seed to below the minimum seed certification standard within a short period of four to five months under ambient storage condition. Since hybrid seeds are costlier, discarding entire seed lot due to reduced germination during storage caused by insect damage may be avoided by removing insect infested and low density seeds by density separation. Hence, an investigation was carried out to standardize a suitable upgrading method to separate quality seeds from stored seed of hybrid rice to help the hybrid rice seed growers.

MATERIALS AND METHODS

Experiment was conducted during 2003 at Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India. Ten months old seeds of rice hybrids ADTRH 1 and CORH 2 stored in cloth bag under room temperature were subjected for density grading by adopting the following methods:

One kilogram of stored seeds was upgraded by using laboratory model specific gravity separator (WESTRUB, Germany). It removed low density seeds such as badly damaged, diseased, immature and insect damaged seeds. The seeds were vertically stratified in layers on the gravity deck according to density. The oscillating movement of the gravity table made the heavy seeds walk uphill the deck. The air flew the light seed down the slope. The seeds travelled to the edge of the table range from light at the lower end, to heavy at the upper end. The discharge was divided into three density grades: product (heavy), middlings and rejections (light). The middlings were reseparated and the light rejections were discarded.

About 500 g of seed samples were poured into the salt solution at four per cent concentration and stirred well. Upon settling, the floating fraction (floaters) was removed by sieve and the sinkers were collected after decanting the solution. The sinkers were then washed

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thoroughly with water to remove all the traces of salt adsorbed on the seeds. The seeds were then dried back to their original moisture content and used to assess the seed quality traits.

Seed recovery of each fraction was worked out using the following formula and expressed in percentage:

$$\text{Seed recovery (per cent)} = \frac{\text{Weight of graded seed}}{\text{Weight of bulk seed}} \times 100$$

Eight replicates of 100 seeds each were weighed in a sensitive electronic balance and expressed in gram. Four replicates of 100 seeds each were taken at random and observations on insect infestation were made. The insect infested seeds were separated, counted and expressed in percentage.

Four replicates of 100 seeds from each density fraction taken at random were placed for germination in roll towel in the germination room maintained at a temperature of 25$\pm$1°C and 95$\pm$3 per cent relative humidity (RH) and evaluated on the 14th day. All normal seedlings were counted and expressed as germination percentage.At final count, ten normal seedlings in each replication were taken at random and the length of root was measured from collar region to tip of the primary root and the mean values were expressed in cm. Ten normal seedlings selected for shoot measurement were again measured from collar region to tip of the primary leaf and the mean values were expressed in cm.

After measuring the root and shoot length, the ten normal seedlings were shade dried for 24 h and then in hot air oven maintained at 85 $\pm$ 1°C for 72 h. Then, they were cooled in a silica gel desiccator for 30 min, weighed in digital balance and expressed in mg seedling^{-1}.

The vigour index of the seedling was computed using the formula suggested by Abdul-Baki and Anderson (1973) and expressed in whole number.

Vigour index = Germination (per cent) x Mean full seedling length (cm)

RESULTS AND DISCUSSION

Separation based on various physical properties of seed *viz*., size, weight and density resulted in improvement of seed quality as measured by germination, emergence and early seedling performance. Singh *et al*. (1977) observed a positive correlation between seed weight and seedling growth. Ferguson and Turner (1971) concluded that seed separation should be based on density rather than on size. In hybrid rice seed production, initial seed quality is important for obtaining uniform, healthy and vigorous crop stand. Size grading alone may not give satisfactory result since hybrid rice seeds are highly varied in density due to the presence of ill filled, immature, insect infested and split husk seeds. These undesirable seed fractions could be removed based on their density during processing by specific gravity separator or by salt upgradation technique so as to improve the quality.

The stored seed of rice hybrids suffer from higher percentage of insect infestation along with lower germination and vigour. All seed quality parameters *viz*., 100 seed weight, germination, seedling length, dry matter production, vigour index and free from insect infestation were improved significantly by both specific gravity separation and salt upgradation at four per cent concentration. Seed recovery was about 62 per cent, irrespective of density grading methods and hybrids. Seed weight improved by 33 per cent in the product / sinkers of density grading methods over ungraded bulk seeds (Table 1). Similarly, 97 per cent reduced insect infestation, 57 per cent higher germination (Table 2), 10-13 per cent increased seedling length, six per cent more dry matter production (Table 3) and 78 per cent increased in vigour index (Table 4) were observed in the product / sinkers of both the methods. Patil and Sarode (1988) inferred that specific gravity separation results in improving seed quality in wheat; heavier seeds are better in seed weight, germination and vigour as compared to lighter seeds. Roy *et al*. (1996) also found that in rice, mean seed weight, germination rate and seedling vigour increased with increasing seed weight; and therefore suggested selecting larger seeds for good stand establishment. Similarly many authors described the importance of specific gravity separator for upgrading seed quality in different crops (Baudet and Misra, 1991 in maize; Podlaski and Wzorek, 1993 in barley; Vimala, 1997 in rice; Chowdhury, 2000 in sorghum, sunflower, soybean and delinted cotton; Menaka *et al*., 2001 in amaranthus). Sinha *et al*. (2001) also opined that specific gravity separator was efficient and effective in improving seed quality of infested rice seed lot.

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Table 1. Separation of quality seed by density grading from stored seed lot of rice hybrids– seed recovery and 100 seed weight

Seed grades (G)	Seed recovery (%)							100 seed weight (g)						
	ADTRH 1			CORH 2			Mean-G	ADTRH 1			CORH 2			Mean-G
	Specific gravity separation	Salt upgra-dation	Mean	Specific gravity separation	Salt upgra-dation	Mean		Specific gravity separation	Salt upgra-dation	Mean	Specific gravity separation	Salt upgra-dation	Mean	
Feed / Ungraded	-	-	-	-	-	-	-	1.439	1.501	1.470	1.081	1.131	1.106	1.288
Product / Sinkers	75.17	65.86	70.52	56.52	49.19	52.86	61.69	1.938	1.933	1.936	1.889	1.875	1.882	1.909
Rejects / Floaters	24.83	34.14	29.48	43.48	50.81	47.14	38.31	0.814	1.140	0.977	0.729	0.842	0.786	0.881
Mean	-	-	-	-	-	-	-	1.397	1.525	1.461	1.233	1.283	1.283	
	M	H	G	MxH	HxG	MxG	MxHxG	M	H	G	MxH	HxG	MxG	MxHxG
SEd	NS	NS	0.40	NS	0.60	0.60	NS	0.21	0.21	0.26	NS	0.37	0.37	0.52
CD (P=0.05)			0.82		1.30	1.30		0.46	0.46	0.56		0.80	0.80	1.13

M : Method of density grading H : Hybrid

Table 2. Separation of quality seed by density grading from stored seed lot of rice hybrids – insect infestation and seed germination

Seed grades (G)	Insect infestation (%)							Seed germination (%)						
	ADTRH 1			CORH 2			Mean-G	ADTRH 1			CORH 2			Mean-G
	Specific gravity separation	Salt upgra-dation	Mean	Specific gravity separation	Salt upgra-dation	Mean		Specific gravity separation	Salt upgra-dation	Mean	Specific gravity separation	Salt upgra-dation	Mean	
Feed / Ungraded	37.00	24.50	30.75	64.50	56.00	60.25	45.50	54 (47.29)	50 (64.89)	52 (46.15)	8 (16.43)	32 (34.45)	20 (26.56)	14
Product / Sinkers	1.00	0.00	0.50	4.00	0.50	2.25	1.38	82 (64.89)	94 (51.94)	88 (69.73)	62 (51.94)	92 (73.57)	77 (61.34)	70 (56.79)
Rejects / Floaters	8.30	46.00	27.15	89.00	84.50	86.75	56.95	0 (0.83)	12 (11.53)	6 (14.17)	4 (11.54)	4 (11.54)	4 (11.54)	4 (11.54)
Mean	15.43	23.50	19.47	52.50	47.00	49.75	34.61	45 (45.33)	52 (46.15)	49 (44.24)	25 (29.78)	43 (40.79)	34 (35.47)	30 (33.21)
	M	H	G	MxH	HxG	MxG	MxHxG	M	H	G	MxH	HxG	MxG	MxHxG
SEd	2.42	2.36	2.89	3.34	4.09	4.09	5.12	1.84	1.84	2.26	NS	3.19	NS	NS
CD (P=0.05)	5.26	5.15	6.31	7.28	8.92	8.92	10.26	4.01	4.01	4.92		6.95		

M : Method of density grading H : Hybrid Figures in parentheses indicate arc sine values

Table 3. Separation of quality seed by density grading from stored seed lot of rice hybrids – root and shoot length

Seed grades (G)	Root length (cm)							Shoot length (cm)						
	ADTRH 1			CORH 2			Mean-G	ADTRH 1			CORH 2			Mean-G
	Specific gravity separation	Salt upgra-dation	Mean	Specific gravity separation	Salt upgra-dation	Mean		Specific gravity separation	Salt upgra-dation	Mean	Specific gravity separation	Salt upgra-dation	Mean	
Feed / Ungraded	15.3	16.9	19.1	7.5	16.9	17.2	18.2	9.7	9.7	9.7	10.5	11.3	10.9	10.3
Product / Sinkers	18.5	22.0	20.3	20.5	22.0	21.2	20.8	10.5	12.4	11.4	10.8	12.1	11.5	11.5
Rejects / Floaters	-	15.7	7.9	15.7	17.1	16.4	12.2	-	8.1	4.1	7.8	8.0	7.9	6.0
Mean	11.3	18.2	14.7	17.9	18.7	18.3		6.7	10.1	8.4	9.7	10.5	10.1	
	M	H	G	MxH	HxG	MxG	MxHxG	M	H	G	MxH	HxG	MxG	MxHxG
SEd	0.25	0.25	0.31	0.36	0.44	0.44	0.62	0.31	0.31	0.38	0.44	0.53	0.53	0.71
CD (P=0.05)	0.55	0.55	0.67	0.78	0.95	0.95	1.32	0.67	0.67	0.82	0.95	1.16	1.16	1.44

M : Method of density grading H : Hybrid

Table 4. Separation of quality seed by density grading from stored seed lot of rice hybrids – dry matter production and vigour index

Seed grades (G)	Seed recovery (%)							100 seed weight (g)						
	ADTRH 1			CORH 2			Mean-G	ADTRH 1			CORH 2			Mean-G
	Specific gravity separation	Salt upgra-dation	Mean	Specific gravity separation	Salt upgra-dation	Mean		Specific gravity separation	Salt upgra-dation	Mean	Specific gravity separation	Salt upgra-dation	Mean	
Feed / Ungraded	13.17	11.44	12.31	12.75	11.20	11.98	12.1	1346	1331	1339	224	902	563	951
Product / Sinkers	13.15	12.36	12.76	13.50	12.42	12.96	12.9	2377	3233	2805	1942	3132	2537	2671
Rejects / Floaters	-	9.88	4.94	11.00	12.60	10.80	7.9	-	286	143	94	100	97	120
Mean	8.77	11.23	10.00	12.42	11.41	11.91	11.0	1241	1617	1429	753	1378	1066	1248
	M	H	G	MxH	HxG	MxG	MxHxG	M	H	G	MxH	HxG	MxG	MxHxG
SEd	0.09	0.09	0.11	0.13	0.16	0.16	0.20	70.90	70.90	86.84	NS	122.81	122.81	144.65
CD (P=0.05)	0.20	0.20	0.24	0.28	0.34	0.34	0.41	154.49	154.49	189.21		267.58	267.58	290.06

M : Method of density grading H : Hybrid

In the present investigation, the performance of salt upgradation technique revealed better results for seed quality parameters except for seed recovery, in which specific gravity separation registered nearly 13 per cent higher recovery than in salt upgradation. Keeping in view the cost of hybrid seed, seed recovery also assumes importance. Between hybrids, the performance of ADTRH 1 was found superior to CORH 2 for all the seed quality parameters studied and indicated their differential storability due to genotypic variation under ambient storage condition. For immediate sowing purpose, salt upgradation may be followed and specific gravity separation may be followed for further storage of seeds.

REFERENCES

Adbul-Baki AA and Anderson JD 1973. Viability and leaching of sugars from germinating barley. Crop Sci 1: 31-34

Baudet L and Misra M 1991. Quality attributes of maize seed processed by a gravity table. Revista Brasileria de Sementes 13(2) : 91-97

Chowdhury RK 2000. Post harvest handling seed research in India. In Advanced Course on Post Harvest Handling and Management of Seeds, Sinha JP and Sinha SN (eds.). Indian Agricultural Research Institute, Regional Station, Karnal, pp. 116-120

Ferguson D and Turner JH 1971. Influence of unfilled cotton seed on emergence and vigour. Cop Sci 11: 713-715

ISTA 1999. International rules for seed testing. Seed Sci and Tech 27, Supplement rule, 27-31

Menaka C, Balamurugan P, Natarajan K and Raja K 2001. Improving the sowing quality of seeds by density grading in Amaranthus *(Amaranthus tricolor* L.) cv. CO. 5. Proceedings of 2001-National Seminar on Seed Science and Technology in the New Millennium – Vistas and Vision, University of Mysore, Mysore, 177-178

Patil VN and Sarode SD 1988. Seed quality studies in wheat as influenced by specific gravity separator. Seed Research 16(1) : 114-116

Podlaski S and Wzorek H 1993. Effect of method of upgrading seed on seed quality and yield of spring barley cv. Arts. Aklimaty Zacji, Roslin, No. 185 : 39-48

Ponnuswamy, AS, Srinivasan MR and Ayyasamy M 2000. Hybrid rice seed technology, Tamil Nadu Agricultural University, p. 1

Roy SK, Hamid A, Miah MG and Hashem A 1996. Seed size variation and its effects on germination and seedling vigour in rice. J Agron and Crop Sci 176(2) : 79-82

Singh B Sachan JN and Singh D 1977. Variability and correlation in sunflower (*Helianthus annuus* L.). Pantnagar J Res 2: 27-50

Sinha JP, Atwal SS, Vishwakarma MK and Sinha SN 2001. Retrieval of quality seed from infested paddy seed lot. Proceedings of 2001 – National Symposium on Seed Science and Technology in the New Millennium – Vistas and Vision. University of Mysore, Mysore, August 6-8, 2001, p. 197

Vimala R 1997. Studies on seed production, processing and storage of hybrid rice. M.Sc. (Ag). Thesis, Tamil Nadu Agricultural University, Coimbatore.

Yuan LP 1997. Hybrid development and use : innovative approach and challenges. Hybrid Rice, 6: 1-3