International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Seed Discoloration of Some Important Rice Varieties and their Effect on Seed Germination

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Abstract: ***Most of the rice diseases are transmitted by seeds which are the important limiting factor getting good quality seeds and good yield. Stored and freshly harvested rice seed of different varieties were collected from Agricultural farm of Orissa University of Agriculture and Technology, Bhubaneswar, Odisha. The seeds were graded on the basis of intensity of discoloration. Stored seeds possessed higher seed discoloration (39.0-55.6%) than freshly harvested seeds (32.0-44.8%). Seed germination decreased with increase in discoloration intensity in both stored and fresh seeds. Germination was lowest in highest grade discoloration (>75%) in stored seed (14-39%) and also in freshly harvested (43-58%). Germination was below seed certification standard (80%) when intensity was >50% in fresh seed and when >25% in stored seed.***

Keywords: Rice seeds, seed discoloration, fresh and stored seeds, germination

1. Introduction

Rice is one of the most important staple foods for more than half of the world's population (IRRI, 2006) and influences the livelihoods and economies of several billion people, and is grown in almost all the tropical and subtropical regions of the world. Rice is cultivated in an area of 165 million hectares, the world rice production is now touching to 744.4 million tonnes (496.4 million tonnes, milled basis), (FAO, 2014). Seed is the vital input in Agriculture. Good quality and viable seed is required for healthy and synchronous seedling which is prerequisite for successful crop establishment and uniform crop growth and development and finally the yield. The three major aspects of seed quality are, a) genetic and physical purity, b) high germination percentage and vigor, and c) free from seed-borne diseases and insects (Seshu and Dadlani, 1988).

Moreover, seeds of rice are imported and being sold without testing of health. Therefore, it is necessary to understand the problem properly which affect the seed germination and take necessary steps need to be taken to overcome this huge amount of loss. Brief literature cited above shows that information regarding seed discoloration of rice in Odisha state of India is not sufficient. Therefore following investigation was carried out to update existing literature on seed discoloration of rice.

2. Material and Methods

This study was performed in the year of 2014 and 2015 at the Laboratory of Seed Pathology Research, Department of Seed Science and Seed Technology, Bhubaneswar; Odisha, India on stored and freshly harvested some rice varieties. A total of 25 working samples of 18 varieties were collected from both store and field of the farm. One sample of each variety was collected randomly from rice experiments trails according to International Seed Testing Association (1976) rules (Table 1). Each sample was about 0.5 kg. The samples were enclosed in polythene bags with proper labeling, brought directly to Seed Pathology laboratory and kept in the refrigerator at 5±1° C until used for subsequent studies and analyzed for seed health using standard moist blotter, and roll paper towel method.

Different type of seed discoloration in collected seed samples

Inspection of dry seed was applied to detect seed-borne pathogens which were present in the seed. All Ten varieties of rice in each variety having 1000 seeds were observed for different grade of discoloration and percent disease incidence was calculated. Each variety of a seed samples were examined carefully by naked ayes or with the help of magnifying lens and non seed matters are identified. Depending upon the extent of discoloration the seeds were categorized in five groups as (1) healthy (no seed discoloration), (2) small spots, (3) minor (more than 25% discoloration), (4) medium or partial discoloration (more than 50% discoloration) and (5) sever discoloration (more than 75% discoloration).

Germination test

Three whatman filter papers herein called as blotter were kept on each other to form a layer at the bottom of a nine cm diameter well labeled plastic Petri dishes. The filter papers were soaked in distilled water and sterilized at 15, p.s.i. for 15 minutes. Representative samples from a seed lot were placed on a blotter @ 25 seeds Plated in a Petri dish. The Petri dishes were placed in incubation room maintaining the temperature at 25±2°C. Seeds produced both plumule and radicle after incubation of sprouted seeds. Germination was recorded at 4, 7 and 14 days after sowing. Normal seedlings, abnormal seedling and dead seeds were counted separately and expressed in percentage. Rate of germination index (RGI) was calculated by the following formula:

$$RGI=\frac{\text{Number of seedling at 7 days}}{\text{Number of seedling at 14 days}}X100$$

3. Result and Discussion

The study of symptoms of discoloration on rice seed was done by visual observation. The observation revealed that the symptoms varied in seeds of the varieties in terms of

color as well as the extent of surface area discolored. The color varied from brown to dark brown, necrotic spots, black dots, depressed lesion, tip discoloration and streaks. The extent of surface area discolored was from few dots, to small patches, to large discolored patches, to complete discolored surface.

Inspection of seeds for different grades of discoloration

The detail study of the different categories of discoloration under stored condition revealed that all the seeds exhibited at decreasing trend in number of seeds manifesting higher severity grades. Variety Hema showed maximum number of seeds with highest grade (5) of discoloration. Taking all the grades of discoloration it was observed that seeds of variety Hema had maximum number of discolored seeds (PDI=55.6) followed by Heera (PDI=50.3). (Table 1a) The incidence of rice seed discoloration in TN-1 (6.6%), Manhar (52.8%), Jarga (58.7%), PR-106 (23%), IR-8 (19%), Narendra-80 (54.7%), Saket (45.3%) and Pant Dhan-16 (40%) were reported by Sinha (1999), Sharma et al. (1987), Mishra et al. (1991) and Negi et al. (2003). These finding are very close to our results.

Table 1a: Percent incidence of discoloration in stored seed samples of different varieties harvested in *Kharif* 2014

Sample No.	Variety	Severity of discoloration (score 1-5)					PDI
		1	2	3	4	5	
1	Annapurna	44.0	25.2	19.0	8.0	3.8	40.4
2	Heera	17.6	40.6	19.0	14.0	9.0	50.3
3	Hema	13.6	31.4	23.3	16.0	13.6	55.6
4	Jyotirmayee	29.6	38.6	17.4	9.8	4.6	44.2
5	Mandakini	46.4	27.2	14.2	9.5	2.7	38.9
6	Lalitgiri	26.0	31.3	23.5	13.2	6.0	48.3
7	Pathara	24.2	36.4	18.4	12.4	8.6	48.9
8	Rudra	24.7	27.8	26.3	15.6	5.6	49.9
9	Shankar	37.6	29.1	20.1	10.1	3.1	42.4
10	Subhadra	31.9	28.4	25.8	10.3	3.6	45.0

*Calculated on the basis of 1000 seeds *PDI= Percent disease incidence 1=No discolouration, 2= Small spots, 3=Minor discolouration > 25%, 4=Medium discolouration >50%, 5=Sever discolouration >75%

Among freshly harvested seeds variety Lalat was having maximum number of seeds with highest grade of discoloration (6.5%) whereas variety Bhoi recorded the minimum. Taking all the grades of discoloration it was observed that seeds of variety Lalat had maximum number of discolored seeds (PDI=44.8) followed by Swarna (Table 1b). These result were consist with previous studies by Ou (1983), Nghiem and Hoang (1993) and Sachan and Agarwal. Awadhiya (2009) reported that check variety Kranti recorded maximum discolored seeds (32.95%) followed by IR-36 (30.26%), Swarna (29.39%) and Mahamaya (29.46%).

Table 1b: Percent incidence of discoloration in freshly harvested seeds of Kharif 2015

Sample No.	Variety	Severity of discoloration (score 1-5)					PDI
		1	2	3	4	5	
1	Bhoi	65.0	18.0	10.5	4.8	1.7	32.0
2	Konark	58.0	16.5	14.5	6.5	4.5	36.6
3	Lalat	24.0	50.5	9.5	9.5	6.5	44.8
4	Manaswini	60.1	17.8	13.9	5.8	2.4	34.5
5	Swarna	31.4	42.0	18.0	6.0	4.6	43.2
6	Sarathi	43.8	34.8	13.5	4.8	3.1	37.7
7	Daya	48.0	25.2	13.2	10.9	2.7	39.0
8	Hiranmayee	51.0	21.3	13.5	11.0	3.2	38.8

*Calculated on the basis of 1000 seeds *PDI= Percent disease incidence 1=No discolouration, 2= Small spots, 3=Minor discolouration > 25%, 4=Medium discolouration >50%, 5=Sever discolouration >75%

Effect of different grades of discoloration on seed germination

It was observed that seed germination in stored varieties varied from 14% to 94% while in freshly harvested seed varied from 43% to 98%. Among all the stored seed Hema variety with highest (13.6%) (Table 1a) sever discoloration found to possessed lowest germination 14% followed by Heera variety contained 9.0 sever discoloration and possessed 19% germination. Rice varieties of Annapurna, Jyotirmayee and Rudra were recorded with more than 70 per cent germination in the highest categories of discoloration (Table 2a).

Table 2a: Effect of severity of discoloration on percentage seed germination in stored seed

Disease score	Annapurna	Heera	Hema	Jyotirmayee	Mandakini	Lalitagiri	Pathara	Rudra
1	93	94	76	92	88	90	84	91
2	86	81	45	88	79	83	77	84
3	72	70	32	76	63	68	69	71
4	51	47	24	58	49	49	49	55
5	32	19	14	39	32	20	21	34

*Score 1-5 is seed discolouration categories, 1=No discolouration, 2= Small spots, 3=Minor discolouration > 25%, 4=Medium discolouration >50%, 5=Sever discolouration >75%

Among the freshly harvested seed studies Lalat variety with highest (6.5%) sever discoloration found to possessed lowest germination (43%) followed by Konarak variety contained 4.5% sever discoloration and possessed 47% germination. Rice varieties of Bhoi and Sarathi were recorded with more than 80 percentage germination in the highest categories of discoloration (Table 2b). Phat *et al* (2005) reported reduced germination rate of discolored rice variety of Jasmine 85.

Table 2b: Effect of severity of discoloration on seed germination percentage in freshly harvested seed

Disease score	Bhoi	Konark	Lalat	Manaswini	Swarna	Sarathi	Daya
1	96	95	90	89	20	98	92
2	87	89	86	83	15	89	83
3	81	79	78	76	12	80	78
4	74	70	76	68	0	71	66
5	58	47	43	51	0	53	57

*Score 1-5 is seed discolouration categories, 1=No discolouration, 2= Small spots, 3=Minor discolouration > 25%, 4=Medium discolouration >50%, 5=Sever discolouration >75%

4. Conclusion

The study of severity of discoloration in rice seed samples of 15 varieties both stored and freshly harvested and their impact on seed germination revealed that the samples having lower incidence of discoloration possessed higher percentage of germination and samples with higher discoloration possessed lower percentage of seed germination.

Stored seeds possessed higher seed discoloration (39.0-55.6%) than freshly harvested seeds (32.0-44.8%). Seed germination decreased with increase in discoloration intensity in both stored and fresh seeds. Germination was lowest in highest grade discoloration (>75%) in stored seed (14-39%) and also in freshly harvested (43-58%). Germination was below seed certification standard (80%) when intensity was >50% in fresh seed and when >25% in stored seed. Stored seed carried more fungal infection (33-55%) than fresh seed (25.5-33%).

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