INFLUENCE OF SEED DISCOLOURATION ON SEED QUALITY IN PADDY

K. KANAKA DURGA, N. V. NAIDU, V. BHARATHI, M. SUDHA RANI

Abstract: In paddy grain discolouration is considered as one of the important problem affecting quality of the apddy seed used for planting. To study the effect of level of grain discolouration on germination and vigour of BPT 5204, field experiment was initiated at Seed Research and Technology Center, Rajendranagar, Hyderabad, AP during 2011-13. The data recorded revealed that with increased levels of seed discolouration decline in germination per cent and seedling vigour was observed. Different levels of discoloured seed treated with quintal (iprodione + carbendazim) and carbendazim resulted in increased seedling growth rate and speed of germination and quality seeds. Further significant reduction in test weight of the discoloured seed was noticed as compared to the normal seed. The harvested produce of the iprodione + carbendazim treated discoloured seed resulted in maximum germination and increased vigour.

Key words: Rice, discoloured seed and seed quality.

Introduction: Rice is one of the most important cereal crop of the country. One of the causes for increased damage by insect pests and diseases is due to increased fertilizer application and climate change. Grain discolouration has been considered as one of the important problem which affects quality of the paddy seed used for planting and also affects rice yield and its market value.

Fungal infections such as *Helmithosporium, Cercospora, Gerlachia, Fusarium, Phoma, Curvularia, Trichoconiella* and *Pseudomonas* are responsible for seed discolouration (Misra *et al.,* 1994). Some of these fungi may not intrude the kernel or the embryo but will contaminate only the outer husk and may not affect seed viability. Some may infect even the embryo during the seed storage. Baldacci and Corbetta (1964) reported that in addition to fungi, bacteria are also responsible for discolouration of seed. Seed discolouration not only affects the quality of the seed but also decreases the germinability of the seed due to fungal and bacterial infections (Sumangala *et al.,* 2009). Discoloured grains also recorded higher endosperm chalkiness and low gelatinization temperature and poor organoleptic values like good aroma, slight tender, less cohesiveness, white and glossy appearance. With this backdrop, an experiment was initiated to know the effect of fungicidal seed treatment with two fungicides on different levels of discoloured seed on seed quality parameters like germination and seedling vigour.

Material and Methods: Discoloured seed samples of BPT 5204 paddy were collected from the farmers field of Ranga Reddy district, A.P. and were categorized into four seed lots based on the percentage of seed discolouration *i.e.*, score 1 (0 to 25% of the discoloured seed), score 2 (26 to 50% of the discoloured seed), score 3 (51 to 75% of the discoloured seed) and score 4 (76 to 100% of the discoloured seed). Distinguished discoloured seed lots were categorized into various levels on the percentage of seed discolouration and distinguished as lots treated with fungicides (Quintal and Carbendazim) and not treated as control. Before initiation of the field experiment, data was recorded on various seed quality parameters like germination (ISTA, 1996), root length, shoot length, seedling length, seedling vigour index on length basis (Abdul Baki and Anderson, 1973), seedling growth rate (SGR) and speed of germination. The field experiment was laid out in a 4 x 3 factorial RBD design in three replications with a spacing of 15 x 10 cm at SRTC, Rajendranagar, Hyderabad during *Kharif*, 2011-13. Data was recorded on yield and yield attributing characters. After harvest of the seed from the respective levels from all the treatments, seed of all the treatments was categorized into healthy and discoloured seed separately. Healthy and discoloured seed of different treatments were tested for various seed quality parameters as mentioned above.

Results and Discussion: Decrease in germination per cent and seedling vigor index I was noticed as the intensity of seed discoloration increases (Table 1 and Fig 1). On the other hand root length, shoot length, total seedling length, speed of germination and seedling growth rate were not affected. With increased level of seed discolouration from score I to score 4, decline in seed germination was observed with Quintal treated discolored seed (96 to 72%). However, in Carbendazim treated discolored seed and control, per cent reduction in seed germination ranged from 89 to 65% and 76 to 55%, respectively. The same trend was observed in rice by Phat *et al.,* 2005. Less vigour and germination in discoloured seed was also reported as compared to normal seeds (Harnowo and Baliadi, 1996) in soybean. A decline in seedling vigor with increased intensity of discoloration was observed in BPT 5204 treated with Quintal (1344 to 853), Carbendazim (1332 to 972) and control (1180 to 733). The reduction in seedling vigor was 36.53% with Quintal treated discolored seed (Table 1). The same trend of decline in seedling growth rate in all discoloured lots of rice compared to healthy lots over a period of storage was reported (Mettananda *et al.,* 2001). Irrespective of the levels of discolouration, seed treatment with either quintal or carbendazim had significant impact on germination and seedling vigour. The per cent increase in germination with quintal treated seed was 29.9% while with carbendazim it was 16.42%. Similarly the per cent improvement in seedling vigour with carbendazim and quintal treated seed was 22.20 and 16.34 %, respectively. Seed treatment with neither quintal nor carbendazim improved root length, shoot length, seedling length, SGR and speed of germination. However, seed treatment with quintal has resulted in increased SGR (3.03) and speed of germination (193.30) followed by carbendazim (2.83 and 177.60) when compared to control (2.60 and 112.1, respectively).

Treated discoloured seed resulted in healthy plants as compared to control (Table 1). Discoloured seed treated with quintal exhibited more number of vigorous plants in terms of plant height (59.1 cm) followed by carbendazim treated discoloured seeds (54.4 cm) and control (51.6 cm). Similarly, the plant height decreased from 55.3 cm to 50.9 cm as the intensity of seed discolouration increased from level 1 to level 4. Seed germination and seedling height were much affected by seed discoloration (Thach, 1998). No significant improvement in total number of effective tillers plant^{-1} was noticed when compared to control. The panicle length was more in carbendazim treated plants as compared to Quintal treated plants (1.18 cm) and control (1.19 cm). Post harvest data revealed that there is not much variation in grain yield plant^{-1} with all levels of seed discolouration and much distinctiveness in yield was observed with the discoloured seed (20.37 g) and healthy seed (11.46 g) at the lower levels of seed discolouration (Table 2). However, the Quintal treated seed resulted in more healthy seed (20.41 g) than treated discoloured seed (10.76 g). Irrespective of the different levels of discolouration seed sown, the yield of Quintal treated seed is maximum (20.41 g) when compared to control (13.53 g). On an average, the recovery of the normal seed was more with lower levels of seed discolouration (20.37 g) than increased level (76-100%) of seed discolouration (14.59 g). Decrease in number of filled grains panicle^{-1}, 1000-grain weight and head rice percentage was reported by Phat *et al.,* 2005.

Data on seed quality of the harvested produce from four different levels of seed discolouration revealed significant reduction in test weight of the discoloured seed (1.11 g) as compared to the normal seed (1.20 g) and the per cent reduction in test weight (0.42%) (Table 2). Among the treatments, seed treatment with carbendazim (1.25 g) had higher test weight as compared to the seed treated with quintal (1.18 g) and control (1.19 g). The results are in agreement with the findings of Sumangala *et al*. (2009) with respect to test weight of the discoloured grain and healthy grains**.** Similar results for 100 seed weight were reported by Thach (1998) and Cuong *et al.* (2000) in Vietnam. Fungal infection of grains leads to poor nourishment resulting into loss of grain weight in different categories of grains in the range of 27.78 to 52.28 per cent besides other deteriorating effects on seed health (Ganesh and Patel, 2014). The data presented on seed yield (Table 2) revealed that per cent discoloured seed obtained after the harvest was more in control (56.07%) as compared to quintal (39.62%) and carbendazim (48.65%) treated plots. Among different levels of seed discolouration, recovery of per cent discolured seed increased from lower levels of seed discolouration to higher levels of seed discolouration i.e., from 41.45 % to 53.28%.

Irrespective of the levels of seed discolouartion (Table 2 and Fig 2), after harvest discoloured seed exhibited significantly lower percentage of germination and seedling vigour (2008) as compared to healthy seed (2134). Not much variation was observed in terms of shoot length, root length and seedling length between normal and discoloured seed. Treatment of discoloured seed with quintal had improved not only germination but also improved root length, seedling length and seedling vigour. Ganesh and Patel (2014) reported that 3 sprays of thiram @ 0.2% at an interval of 15 days starting at 50% emergence of ear head effectively reduced grain mold infection. Percentage germination showed negative correlation to the level of seed discolouration indicating that the fungal infections associated with seed discoloration were responsible for lowering germination. Results of the impact of discolouration on seed quality agrees with the findings of Misra *et al.,* 1994. Seed discolouration in paddy is caused by toxins that are produced by fungi and affect both physical and chemical properties of the grain. Grain discolouartion has a complex etiology and cannot be diagnosed prior to harvest based on symptoms. Frequency of fungi varied in different levels and different fungi recorded were *Curvularia* sps, *Alternaria padwickii*, *Bipolaris oryzae*, *Sarocladium oryzae*, *Cephalosporium oryzae, Nigrospora, Fusarium* and *Alternaria* sps. Similar fungi on discolured grains of paddy was also reported by Phan *et al*., 2001.

From the present study it is evident that increased levels of seed discolouration decreases germination and seedling vigour. Reduction in test weight of the discoloured seed was observed when compared to normal seed weight. Therefore discoloured rice seed due to submergence, fungal infection or any other reason cannot be recommended as seed rice as per the guidelines of ISTA. However, appearance of discoloured seed in rice is a common problem especially due to mite damage and weather conditions which in turn affects the seed production programme in tropical climate areas. Therefore, seed lots with up to 25% discolouration could be safely used as seed paddy if used within two months after harvesting or up to score three (51-75% discolouration) by treating the discoloured seed with Quintal could be safely taken up in paddy seed production. Hence, it can be concluded that seed lots with maximum discolouration i.e., 75% discolouration could be used by chemical seed treatment at the time of sowing in seed production without any detrimental effect on seed germination

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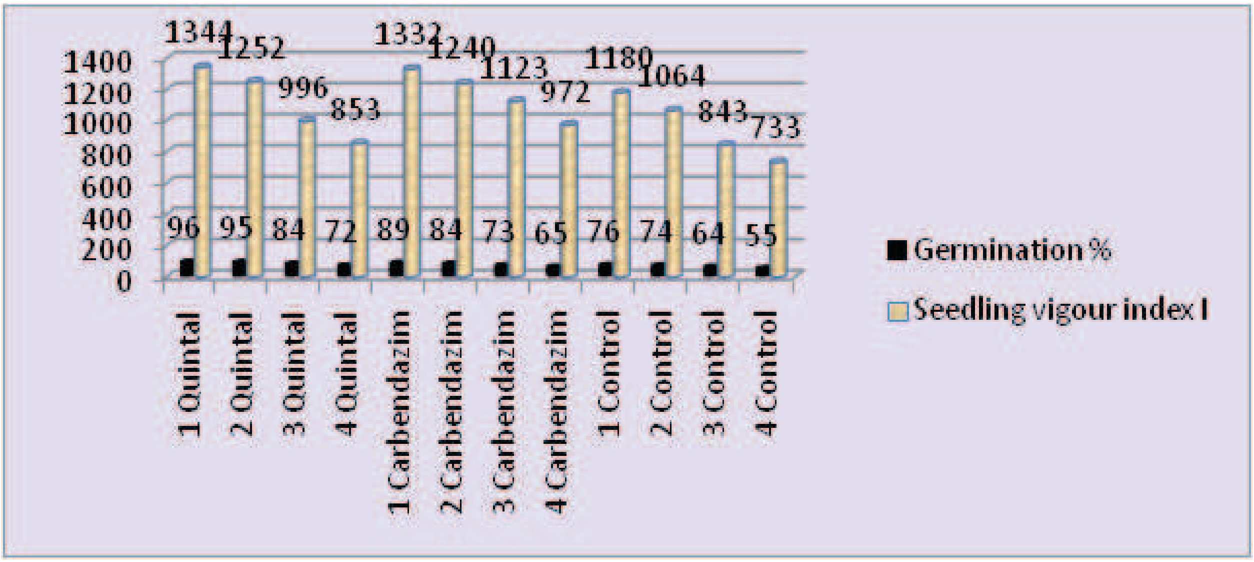

Fig 1: Germination (%) and seedling vigour index I for discoloured seed of BPT 5204

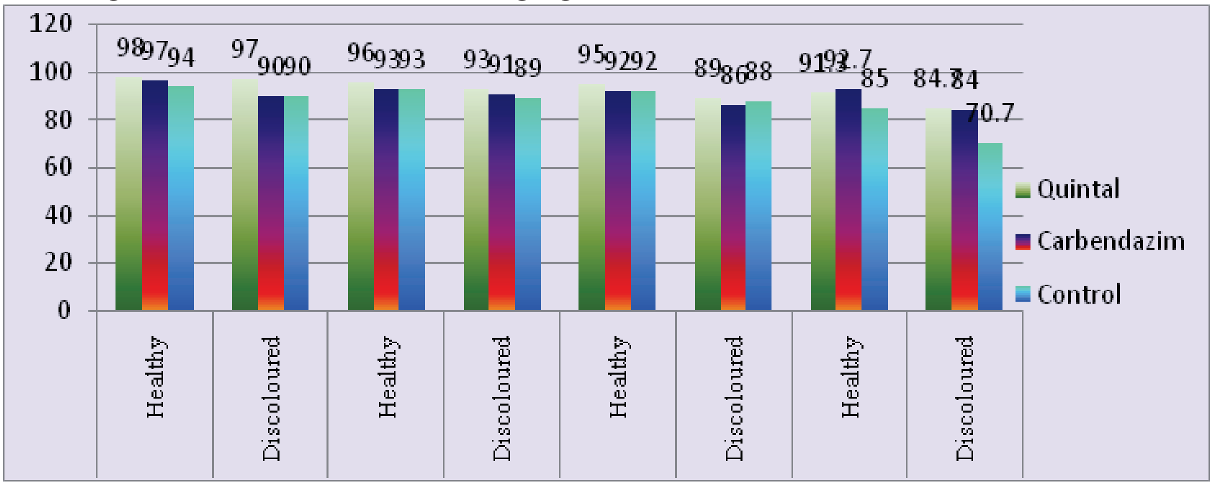

Fig 2. Germination (%) in the harvested produce of the discoloured seed lots of BPT 5204

Table 1: Initial seed quality characters and yield attributes in discoloured seed of BPT 5204

Treatments	Germination (%)					Total seedling length (cm)				
	Score 1	Score 2	Score3	Score 4	Mean	Score 1	Score 2	Score3	Score 4	Mean
Quintal	96	95	84	72	**87**	14.0	13.2	13.6	13.1	**13.5**
Carbendazim	89	84	73	65	**78**	13.0	13.3	13.4	13.2	**13.2**
Control	76	74	64	55	**67**	14.4	14.1	13.3	13.5	**13.8**
Mean	**87**	**84**	**74**	**64**	**77**	**13.80**	**13.53**	**13.43**	**13.27**	**13.50**
	Speed of germination					**Seedling growth rate**				
Quintal	217.30	215.21	168.57	172.14	**193.30**	3.18	2.90	2.94	3.10	**3.03**
Carbendazim	213.69	173.88	124.55	198.25	**177.60**	2.89	2.73	2.79	2.89	**2.83**
Control	76.90	128.48	133.64	109.54	**112.1**	2.47	2.66	2.67	2.61	**2.60**
Mean	**169.30**	**172.52**	**142.25**	**159.98**	**161.00**	**2.85**	**2.76**	**2.80**	**2.87**	**2.82**
	Seedling vigour index I					**Plant height (cm)**				
Quintal	1344	1252	996	853	**1111**	62.2	58.4	58.9	56.9	**59.1**

Carbendazim	1332	1240	1123	972	**1167**	54.0	55.1	56.8	51.6	**54.4**
Control	1180	1064	843	733	**955**	49.6	53.3	59.2	44.3	**51.6**
Mean	**1285**	**1185**	**987**	**853**	**1078**	**55.3**	**55.6**	**58.3**	**50.9**	**55.0**
	Effective tillers plant^{-1} (no.)					**% discoloured seed after harvest**				
Quintal	34	36	34	37	**35.3**	27.53	40.47	43.14	47.33	**39.62**
Carbendazim	31	43	39	26	**34.8**	42.82	46.72	50.41	54.64	**48.65**
Control	31	53	26	37	**36.8**	53.99	56.13	56.3	57.87	**56.07**
Mean	**32.0**	**44.0**	**33.0**	**33.3**	**35.6**	**41.45**	**47.77**	**49.95**	**53.28**	**48.11**

Table 2. Seed yield, test weight and seed quality characters in discoloured seed of BPT 5204

Treatments	Seed yield plant^{-1} (g)									
	Score 1		Score 2		Score 3		Score 4		Mean	
	Healthy	Dis.	Healthy	Dis.	Healthy	Dis.	Healthy	Dis.	Healthy	Dis.
Quintal	24.39	5.65	22.22	9.87	20.52	13.5	14.52	14.0	20.41	10.76
Carbendazim	22.9	12.5	18.73	17.05	16.77	17.2	16.74	18.5	18.79	16.31
Control	13.83	16.23	14.42	17.2	13.33	20.1	12.52	22.7	13.53	19.06
Mean	20.37	11.46	18.46	14.71	16.87	16.93	14.59	18.40	17.57	15.38
	Test weight (g)									
Quintal	1.25	1.09	1.16	1.03	1.23	1.04	1.08	1.07	1.18	1.06
Carbendazim	1.22	1.16	1.30	1.02	1.19	1.14	1.27	1.25	1.25	1.14
Control	1.29	1.12	1.21	1.20	1.12	1.11	1.12	1.13	1.19	1.14
Mean	1.25	1.12	1.22	1.08	1.18	1.10	1.16	1.15	1.20	1.11
	Seedling length (cm)									
Quintal	19.9	21.3	22.8	23.0	23.1	22.0	23.4	23.9	22.3	22.6
Carbendazim	21.7	21.2	22.7	23.3	23.0	21.8	22.6	22.3	22.5	22.2
Control	22.1	21.0	22.5	22.1	24.0	23.6	23.1	23.0	22.9	22.4
Mean	**21.23**	**21.17**	**22.67**	**22.80**	**23.37**	**22.47**	**23.03**	**23.07**	**22.57**	**22.40**
	Seedling vigour index I									
Quintal	1821	1803	2178	2134	2240	2137	2234	2130	2118.3	2051.0
Carbendazim	2013	1875	2090	2197	2094	2015	2273	2105	2117.5	1992.0
Control	1910	1560	2192	2069	2215	2151	2346	2149	2165.8	1982.3
Mean	**1915**	**1746**	**2153**	**2133**	**2183**	**2101**	**2284**	**2128**	**2134**	**2008**
	Germination (%)									
Quintal	98.0	97.0	95.7	92.7	95.3	89.0	91.3	84.7	95.1	90.9
Carbendazim	96.7	90.2	92.7	90.7	92.0	86.3	92.7	84.0	93.5	87.8
Control	94.0	90.3	93.0	89.0	92.0	88.0	85.0	70.7	91.0	84.5
Mean	**96.2**	**92.5**	**93.8**	**90.8**	**93.1**	**87.8**	**89.7**	**79.8**	**93.2**	**87.7**

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K. Kanaka Durga/ N. V. Naidu/ V. Bharathi / M. Sudha Rani
Seed Research and Technology Center/ Rajendranagar/ Hyderabad/ AP