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# Investigation on Effect of Mycoflora of Paddy Seed on Weight of Seed, Germination of Seed and Vigour Index of Seedling

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**ABSTRACT: Paddy seed mycoflora, which causes glume discoloration in paddy, was considered a minor disease and is gaining importance in almost all paddy growing areas of the world. The present investigation was taken up to investigate on seed mycoflora of paddy in Eastern Vidarbha with respect to impact assessment of associated mycoflora on germination of seed, length of root and shoot length, seedling vigour index and seed weight loss. Seed samples of 7 paddy varieties viz. PKV Kisan, D100, Sindewahi, RPN 7, RPM, MTU 1001 and 1010 were assessed and categorized into 6 grades viz. 0, 1, 3, 5, 7 and 9 on the basis of Standard Evaluation System for paddy. The results on weight loss due to discolouration revealed that increase in discolouration intensity on seed leads to decrease in 1000 seed weight (g) in all 7 varieties. In all the 7 varieties, per cent weight loss was the highest in grade 9 viz. PKV Kisan (29.96%), Sindewahi (22.50%), D100 (43.61%), RPN 7 (44.32%), RPM (11.64%), 1010 (28.12%) and MTU 1001 (10.33%). Reduction in germination per cent, length of shoot, length of root and seedling vigour with the increase in discolouration intensity on seed was observed. The seedling vigour index was reduced with the increase in discolouration of seeds. Variety Sindewahi showed the least seedling vigour index (343.73) and MTU 1001 (1345.68) showed the highest seedling vigour index among the 7 varieties of paddy.Thus, the results indicate that increase in discolouration intensity leads to reduction in thousand seeds weight, germination per cent and seedling vigour index in all the 7 varieties. Therefore, care should be taken regarding production and post production activities for healthy, disease free quality paddy seeds and to minimize crop failure.**

**Keywords:** Paddy, mycoflora, paper towel method, seedling vigour index.

## INTRODUCTION

Paddy (*Oryza sativa* L.) forms the staple food for about half the humankind on the planet. It is a part of the culture and forms the heritage of many Asian countries. 65 per cent of Indian population consumes paddy as the staple food and it is pivotal to food and livelihood security of people, directly contributing to attainment of SUSTAINABLE DEVELOPMENT GOAL (SDG). Paddy cultivation is the primary source of income for the countries in the developing world (Muthayya *et al*., 2014). Globally, paddy production amounts to approximately 508.7 million tonnes (Anonymous, 2020[a]). In India, paddy crop easily succumbs to various foliar, soil, seed borne and seed transmissible diseases.

Paddy easily succumbs to a number of diseases caused by mycoflora such as *Alternaria alternata*, *Aspergillus flavus*, *Curvularia oryzae*, *Bipolaris oryzae*, *Fusarium solani*, *F. semitectum*, *Alternaria padwickii*, *C. lunata*, *Pyricularia oryzae*, *F. moniliforme*, *Phoma* sp., *Sclerotium* sp., *Chaetomium* sp., *Penicillium* sp., *Myrothecium* sp., *Colletotrichum* sp. and *F. graminearum*. The monoculture type of farming and growth of only economical crops like paddy have led to discoloration of seed which is gradually turning out to be a major problem (Bala and Pannu, 2017). Some of the mycoflora are extensively disseminated causing significant yield as well as economic loss particularly blast, brown spot, and bakanae disease (Bashyal *et al*., 2020). Reduction in seed viability is caused by *F. moniliforme*, *F. graminearum*, *S. oryzae* and *Curvularia oryzae* leading to pre or post emergence death seedlings (Duraiswamy, 1982). Seed-borne mycoflora were attributed for reduction in germination, rot of stem, rot of foot and paddy seedling blight, especially *Penicillium* spp., *Helminthosporium oryzae* and *Fusarium moniliforme* (Ashfaq *et al*., 2017). *Alternaria alternata* causes ashy grey discolouration and *Bipolaris oryzae* causes black discolouration with dark brown spots on seeds. Fungal pathogen in combination or alone causes eye shaped spots, *Fusarium* spp. (*Fusarium oxysporum*, *Fusarium moniliforme*) are responsible for light brown discolouration. Majority of the fungi are found in the embryo, seed coat and endosperm of the seeds and caused infection which varies in degree (Sachan and Agrawal, 1995). The paddy husk was more prone to infection by mycoflora compared to other parts (Rao *et al*., 2018). The

reduction in grain yield quality due to sheath blight caused by *Rhizoctonia solani*, leads to reduction of quality and increased lodging (Gangopadhyay and Chakrabarti, 1982; Savary *et al*., 1997). *Bipolaris oryzae* causes light brown discolouration to black spots in rice cultivar (Ibrahim and Abo El-Dahab, 2014). Rice blast (*Pyricularia oryzae*) and brown spot (*Bipolaris oryzae*) are economically important. Outbreaks of rice blast and brown spot diseases are a serious and recurrent problem in all rice growing regions of the world. It is estimated that each year enough of rice is destroyed by rice blast alone to feed 60 million people (Zeigler *et al.*, 1994). Brown spot disease causes severe yield loss in 1942 in West Bengal popularly known as Bengal famine and yield loss reaches up to 90 per cent in certain areas (Sarkar *et al*., 2014). Thus, mycoflora cause reduction in the yield of rice as much as 75 per cent in severely affected regions due to reduction in weight of grain, sterility of floret, seed germination inhibition as well as the year-to-year transmission because of the nature of the pathogen which is seed borne (Trung *et al.*, 1993). They have direct influence on both quality and quantity of seeds. Infected seeds were not preferred over quality seeds and they are a hurdle in seed certification and marketing (Pham *et al*., 2001). Moreover losses of approximately 2.5 million tons of paddy annually is caused by seed mycoflora due to diseases (Alam *et al*., 2014).

## MATERIAL AND METHODS

*A. Assessment of paddy seed weight loss due to discoloration*

The seed of 7 paddy varieties viz. PKV Kisan, D100, MTU 1001, Sindewahi, RPN 7, RPM and 1010 were examined critically and grouped into six categories on the basis of scale given by Standard Evaluation System for Rice (Anonymous, 2002) as 0, 1, 3, 5, 7 and 9. After categorization, 1000 seeds in five replicates in each category were counted, weighed and per cent loss in weight for the respective category was calculated . The weight of apparently clean and healthy seed without any symptoms was considered as check. The seed weight of each category was recorded (in grams) and the calculation of average weight was done. The weight of respective cultivars of healthy seed was used to calculate weight loss in each category of seed discoloration.

*B. Impact assessment on seedling vigour index influenced by paddy mycoflora*

The calculation of seedling vigour index was done by using the formula i.e. seedling vigour index= (Mean root length + mean shoot length) X % seed germination (Thippeswamy and Lokesh, 1977). From the germination test, ten normal seedlings were selected at random and measurement of root length was done by measuring from collar region to the tip of the primary root. The mean root length was expressed in centimetres. The measurement of shoot length was done by measuring from collar region to point of junction of the cotyledon. The mean shoot length was expressed in cm. Germination per cent, length of root and length of shoot were recorded.

*C. Impact assessment on seed germination influenced by seed mycoflora*

The effect of seed borne inoculum on seed quality parameters of paddy i.e. to carry out germination and vigour test of seeds lot of paddy was studied by employing Paper Towel Method as per the International Seed Testing Association rules (Anonymous, 1996). Four replication of seeds placed on two layers of moist germination papers, which were placed on a polythene paper. The seeds were covered with another layer of moist germination paper and rolled carefully to avoid any excess pressure on seeds. Incubation of seeds were done in seed germinator by maintaining a temperature of 25°C for 7 days. The rolled paper towels were unrolled at the end of incubation and germinated and ungerminated seeds were counted. All morphologically normal seedlings were counted and germination was expressed in percentage. The present investigation was carried out during year 2020-21 at Plant Pathology Section, College of Agriculture, Nagpur. Experiment was laid out in completely randomized design and data were statistically analysed to determine significant treatment differences.

## RESULT AND DISCUSSION

*A. Assessment of weight loss of 1000 seeds (g) in different paddy cultivars due to paddy mycoflora*

The studies on weight loss of paddy seeds due to mycoflora is presented in Table 1 and Fig. 1. It was observed that with increase in discolouration intensity on seed, 1000 seed weight was significantly decreased in all 7 cultivars. Maximum 1000 seed weight (g) in all categories was observed in healthy categories. In all categorization of variety, D100, MTU 1001, PKV Kisan, RPN 7, Sindewahi, RPM and 1010, 1000 seeds weight decreased from 11.12 g to 6.27 g, 23.80 g to 21.36 g, 15.90 g to 11.13 g, 19.40 g to 10.80 g, 20.31 g to 15.74 g, 16.31g to 14.41 g and 25.33 g to 18.21 g respectively. In variety D100, highest 1000 seed weight was observed in healthy (11.12 g) category followed by grade 1 (10.56 g) and grade 9 (6.27 g). In variety MTU 1001, highest 1000 seeds weight was observed in healthy (23.80 g) category followed by grade 1 (21.96 g) and grade 9 (21.36 g). In variety PKV Kisan, highest 1000 seed weight was observed in healthy (15.90 g), followed by grade 1 (15.52 g), grade 3 (14.80 g), grade 7 (11.85 g) and grade 9 (11.13 g). In variety RPN 7, lowest 1000 seeds weight was observed in grade 9 (10.8 g) category, followed by grade 7 (12.30 g), grade 3 (17.98 g) and healthy (19.40 g). In cultivar Sindewahi, 1000 seeds weight of healthy, grade 1, grade 7 and grade 9 were 20.31 g, 17.31 g, 16.22 g and 15.74 g. In RPM, highest 1000 seeds weight was observed in healthy grade (16.31 g) followed by grade 7 (15.60 g) and grade 9 (14.41 g). In variety 1010, lowest 1000 seed weight was observed in grade 9 (18.21 g) followed by grade 3 (20.10 g) and grade 0 (25.33 g).

**Table 1 : Weight loss in 1000 seeds weight (g) in different paddy varieties influenced by seed mycoflora.**

| Sr. No. | Variety / Scale | PKV KISAN | | MTU 1001 | | D100 | | RPM | | RPN 7 | | SINDEWAHI | | 1010 | | Avg. wt. loss Per cent |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Wt. (g) | Per cent Wt. loss | Wt. (g) | Per cent wt. loss | Wt. (g) | Per cent wt. loss | Wt. (g) | Per cent wt. loss | Wt. (g) | Per cent wt. loss | Wt. (g) | Per cent wt. loss | Wt. (g) | Per cent wt. loss | |
| 1. | 0 | 15.90 | 0.00 | 23.80 | 0.00 | 11.12 | 0.00 | 16.31 | 0.00 | 19.40 | 0.00 | 20.31 | 0.00 | 25.33 | 0.00 | 0.00 |
| 2. | 1 | 15.52 | 2.30 | 21.96 | 7.70 | 10.56 | 5.03 | -- | -- | -- | -- | 17.33 | 14.67 | -- | -- | 7.42 |
| 3. | 3 | 14.80 | 6.90 | -- | -- | -- | -- | -- | -- | 17.98 | 7.30 | -- | -- | 20.10 | 20.64 | 11.61 |
| 4. | 7 | 11.85 | 25.47 | -- | -- | -- | -- | 15.60 | 4.35 | 12.30 | 36.59 | 16.22 | 20.13 | -- | -- | 21.63 |
| 5. | 9 | 11.13 | 29.96 | 21.36 | 10.33 | 6.27 | 43.61 | 14.41 | 11.64 | 10.80 | 44.32 | 15.74 | 22.50 | 18.21 | 28.12 | 27.21 |
| Total | | 69.20 | 64.63 | 67.12 | 18.03 | 27.96 | 48.64 | 46.32 | 15.99 | 60.48 | 88.21 | 69.60 | 57.30 | 63.64 | 48.76 | |
| Average | | 13.84 | 10.77 | 22.37 | 6.01 | 9.32 | 16.21 | 15.44 | 5.33 | 15.12 | 22.05 | 17.40 | 14.32 | 21.22 | 16.25 | |

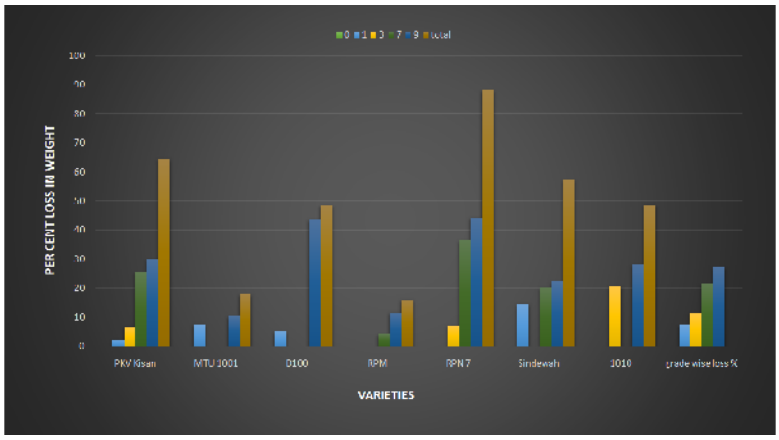



**Fig. 1.** Weight loss in 1000 seed weight (g) in different paddy varieties influenced by seed mycoflora.

Interestingly it was found that 1000 seed weight (g) decreased as discolouration intensity on the seed increased. The findings are similar to the works of Phat *et al.*, (2005) who reported that highest reduction in 1000 g seed weight of rice seed having 51-100 per cent area discolouration. Also, Pham *et al*. (2001) surveyed on effect of discoloured grains of paddy cultivars on quality of paddy cultivars, and reported that among the yield components, 1000 grain weight (g) was found to be mostly affected.

*B. Impact assessment on seedling vigour influenced by seed mycoflora*

Seedling vigour index (SVI) was worked out by multiplying the seedling length with per cent germination of seed. Results on seedling vigour index as influenced by seed mycoflora depicted significant differences as indicated by Table 2, Fig. 2. Maximum seedling vigour index was observed in healthy category in all 7 varieties and least vigour index in grade 9. In variety Sindewahi, highest seedling vigour was observed in healthy category (943.90) and lowest seedling vigour was observed in grade 9 (343.73). In variety D100, seedling vigour index of 1050.47 was recorded in grade 0 and grade 9 recorded a seedling index of 373.90. In variety PKV Kisan, grade 0 recorded seedling vigour index of 1096.96 and grade 9 recorded vigour index of 417.65. In variety RPN 7, highest vigour index was observed in grade 0 (1349.99) and lowest vigour index was observed in grade 9 (502.33). In variety RPM, lowest vigour index was observed in grade 9 (644.98) and highest vigour index was observed in grade 0 (1404.98). In variety 1010, grade 0 recorded vigour index of 1745.47 and grade 9 recorded a vigour index 986.27. In variety MTU 1001, highest vigour index was observed in grade 0 (2032.80) and lowest in grade 9 (1345.68).

**Table 2: Seedling vigour index in different paddy varieties influenced by seed mycoflora.**

| Sr. No. | Variety / Grade | PKV Kisan | MTU 1001 | D100 | RPM | RPN 7 | Sindewahi | 1010 |
|---|---|---|---|---|---|---|---|---|
| 1. | 0 | 1096.96 | 2032.80 | 1050.47 | 1404.99 | 1349.99 | 943.9 | 1745.47 |
| 2. | 9 | 417.658 | 1345.68 | 373.90 | 644.98 | 502.33 | 343.73 | 986.27 |
| 'F' test | | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. |
| S.E. (m)± | | 8.77 | 11.68 | 11.68 | 9.61 | 8.16 | 10.49 | 8.49 |
| C.D. (0.01) | | 37.02 | 50.46 | 50.46 | 41.52 | 35.26 | 45.32 | 36.67 |

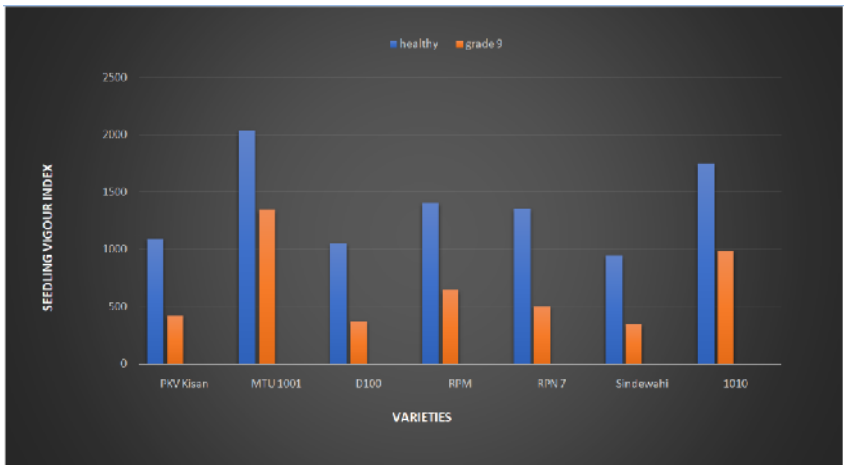
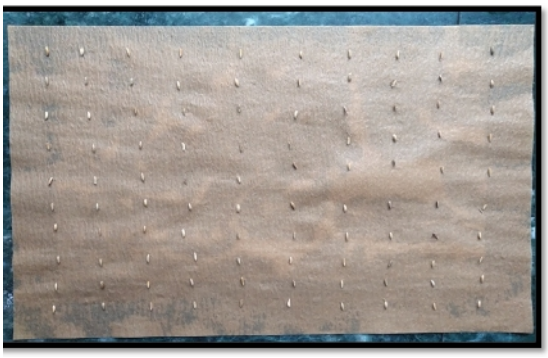



**Fig. 2.** Seedling vigour index in different paddy varieties influenced by seed mycoflora.



(a) Plated seeds (Day 1 of sowing).

(b) Rolled paper towels.

(c) Germinated seeds (8 days after sowing).

**Plate 1:** Germination test by paper towel method.

It was observed that with increase in discolouration intensity on seed, seedling vigour indices in all 7 paddy cultivars were significantly decreased. It is evident form the data that increase in seed discolouration has detrimental effect on seed germination and seedling length which ultimately leads to poor seed vigour index. The results are similar to the findings of Ora *et al*. (2011). It was also corroborated by the works of Utobo *et al.* (2011) who found that reduction in seedling vigour was found to be directly proportional to seed infection by pathogen. Deb and Khair (2018) reported that seeds with highest level of fungal association was responsible for lower vigour index in paddy varieties. Yusuf *et al.* (2018) reported that seeds of rice varieties infected with seed borne mycoflora resulted in poor seedling vigour.

*C. Impact assessment of seed germination due to seed mycoflora*

Result on seed germination using paper towel method is represented in Table 3 and Fig. 3 and plate 1. It was observed that increase in discolouration intensity on seed reduces the germination rate considerably. Maximum germination in all 7 varieties were observed in the healthy grades and minimal germination was observed in maximum discoloured grade.

In variety PKV Kisan, germination percentage in paper towel method was 69.60 per cent and 34.80 per cent germination in grade 0 and 9 were found. In MTU 1001, grade 0 showed 87.50 per cent germination and grade 9 showed 67.62 per cent germination in paper towel method. In variety D100, in paper towel method, grade 0 showed 68.61 per cent germination and grade 9 showed 33.81 per cent germination. In variety RPM, in paper towel method, germination per cent of 81.54 and 45.74 were observed respectively in grade 0 and grade 9 respectively. In variety 1010, in paper towel method, germination per cent of 85.52 % and 63.51% were observed in grade 0 and grade 9 respectively. In variety RPN 7, under paper towel method, germination per cent of 80.54 and 36.93 per cent in grade 0 and grade 9 respectively were observed. In variety Sindewahi, under paper towel method, germination per cent of 67.62 per cent in grade 0 and 32.81 per cent in grade 9 were observed.

Imolehein (1983) reported that *Bipolaris oryzae* led to poor seed germination. Zulkifli *et al*. (1991) and Phat *et al*. (2005) found that loss in germinability was directly proportional to the severity of discolouration. Gopalakrishnan *et al*., (2005) reported that paddy seeds collected from plants infected by *Sarocladium oryzae* recorded lower germination of seed than paddy seeds collected from healthy plants.

## CONCLUSION

The assessement of all 7 varieties into 7 different grades indicated that maximum per cent fungal association was found to associated with the increase in discolouration intensity. The results on thousand seeds weight revealed that increase in discolouration intensity leads to reduction in thousand seeds weight in all the 7 varieties. It was observed that with increase in discolouration intensity, the germination per cent, root length and shoot length decreased significantly in all the 7 varieties. Seedling vigour index was found to be significantly higher in healthy seeds when compared to highly discoloured seeds. Thus, the study has shown that mycoflora associated with seed discolouration are major constraints in production of quality seeds of paddy. Therefore, care should be taken regarding production and post production activities for healthy, disease free quality seed and to minimize crop failure.

**Table 3: Per cent seed germination in different paddy varieties influenced by seed mycoflora (Paper towel. method).**

| Sr. No. | Variety / Grade | PKV Kisan | MTU 1001 | D100 | RPM | RPN 7 | Sindewahi | 1010 |
|---|---|---|---|---|---|---|---|---|
| 1. | 0 | 69.60 (56.55) | 87.50 (69.34) | 68.61 (55.94) | 81.54 (64.57) | 80.54 (63.85) | 67.62 (55.33) | 85.52 (67.63) |
| 2. | 9 | 34.80 (36.15) | 67.62 (55.31) | 33.81 (35.55) | 45.74 (42.55) | 36.93 (37.42) | 32.81 (34.94) | 63.51 (52.84) |
| Average | | 52.20 | 77.56 | 51.21 | 63.64 | 58.73 | 50.21 | 74.51 |
| 'F' test | | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. |
| S. E. (m)± | | 0.37 | 0.43 | 0.50 | 0.40 | 0.36 | 0.49 | 0.33 |
| C.D. (0.01) | | 1.61 | 1.87 | 2.16 | 1.74 | 1.56 | 2.10 | 1.42 |

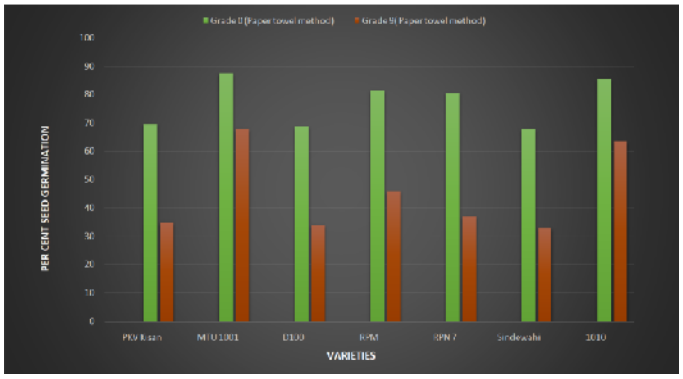



**Fig. 3.** Per cent seed germination in different paddy varieties (Paper towel method).

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