

## Effect of *Fusarium moniliforme* Cultural Filtrate on Seed Quality Parameters of Paddy Cultivars

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(Received 13 August 2021, Accepted 25 October, 2021)

(Published by Research Trend, Website: [www.researchtrend.net](http://www.researchtrend.net))

**ABSTRACT:** *Fusarium moniliforme* is one of the important seed borne fungi responsible for bakane or foot rot disease in paddy in India as well as across the globe. The study was conducted at the Plant Pathology Section, College of Agriculture, Nagpur in 2020 to find out the level of infection of *F. moniliforme* against seed quality parameters viz, germination per cent, shoot and root length and seedling vigour in four different varieties of paddy maintaining three replications by paper towel method. The results revealed that, higher seed quality parameters were observed with MTU-1010 cultivar recorded germination per cent (62.00%), shoot length (6.32 cm), root length (12.50 cm) and seedling vigour (1166.84) in inoculated seeds with *F. moniliforme* culture. While it was 84.25 per cent, 7.40 cm, 12.57 cm and 1682.47 respectively in uninoculated seeds. Least germination per cent, shoot length, root length and seedling vigour in inoculated seeds were 58.00 per cent, 4.11 cm, 7.19 cm and 655.40 respectively and in uninoculated seeds were 75.57 per cent, 7.35 cm, 10.80 cm and 1371.59 respectively in variety PKV-Kisan. Thus, the results indicated that seeds inoculated with *Fusarium moniliforme* cultural filtrate recorded reduction in seed germination, shoot length, root length and seedling vigour compared to uninoculated seeds of paddy.

**Keywords:** Paddy, *Fusarium moniliforme*, Paper towel, Seed quality parameters.

### INTRODUCTION

Paddy (*Oryza sativa* L.) is the seed of grass species and it is one of the principle food grain crop for more than half of the world's population mainly in Asia and Africa. It is the most widely cultivated as staple food crop ranks second after wheat. India grows paddy in 43 M ha with production of 112 million tons (Mt) of milled paddy and average productivity of 2.6 t ha<sup>-1</sup> (Anon, 2020<sup>a</sup>). Among states, Maharashtra is one of the important paddy growing state where it was grown over an area of 1.45 million hectares with an annual production of about 4.10 million tonnes. The state's average productivity is 2.82 t/ha (Anon, 2020<sup>b</sup>). Losses of approximately 2.5 million tonnes of paddy annually is caused by seed mycoflora due to diseases (Alam *et al.*, 2014). Some of the mycoflora viz., blast, brown spot and bakanae disease (Bashyal *et al.*, 2020) are extensively disseminated causing significant yield as well as economic loss. Paddy seeds are infected by large number of fungi that are reported to perpetuate from one season to another through infected seeds (Zope and Thrimurthy 2004). Fungi have been shown to

play a role in reducing germination and seedling vigour (Subramanyam 1991, Gupta and Chouhan 1970, Dharamvir 1973). Bakanae or foot rot disease caused by *Fusarium fujikuroi* Nirenberg is an important emerging disease of paddy across the world. The "bakanae" is derived from Japanese word which means "Foolish". Bakanae disease also known as "Foolish seedling disease" is come out as a seriously important disease in paddy growing country in Asia. It is one of the first disease of paddy described scientifically responsible for yield losses ranging from 3.0 - 95.4% varied with regions and cultivars grown (Pavgi and Singh, 1964; Kanjanasoon, 1965; Ou, 1987; Hajra *et al.*, 1994; Singh and Sunder, 2012). The disease has been reported from the South East Asia, Africa, America and European countries (Desjardins *et al.*, 2000). It is economically important in the Asian paddy growing areas owing to the significantly large amount of yield losses estimated at approximately 20% in epidemic areas (Cumagun *et al.*, 2011). The disease is seed borne and soil borne which can survive for many years by forming resting spores during dormant period

and becomes active when conditions are favourable. As regards with the severe losses caused by *F. moniliforme* in paddy, the present study was carried to record the effect of *F. moniliforme* cultural filtrates on seed quality parameters of paddy cultivars to pertain the management strategy as well as relation of infective fungus with seeds of paddy.

## MATERIAL AND METHODS

The present study was carried out at the Plant Pathology Section, College of Agriculture, Nagpur (Dr. PDKV), Maharashtra in 2020 to find out the level of infection of *F. moniliforme* against seed quality parameters viz., germination per cent, shoot and root length and seedling vigour in four different varieties of paddy viz., PKV-Kisan, RPM, MTU-1010 and Swarna by Paper Towel method.

**Isolation of Seed borne fungi.** The different structures of seed borne fungi grown over each variety of incubated seeds are isolated by Standard blotter paper method and Agar plate method and were observed under stereoscopic microscope.

**Identification of seed mycoflora.** The identification of isolated fungus on incubated seeds was done based on morphological characters of fungal mycelial growth, colony characters *i.e.* their colour, texture, growth habit, size, shape colour, septations etc of the conidia with the help of microscope and by using description book on "Hand book of seedborne fungi" by T.W. Mew and P. Gonzales, 2002. (IRRI Publication).

**Purification and maintenance of fungi.** Seed borne fungi were isolated by lifting the fungal growth with a sterilized needle and were transferred aseptically on PDA media. Each obtained fungal isolates were purified by single spore isolation technique or hyphal tip method and maintained on PDA slants for further studies and preserved in the refrigerator.

**Preparation of *Fusarium moniliforme* cultural filtrate.** Ten days old culture of fungal species on the agar plate was scraped, and was added to 1 ml sterile water which was further diluted so as to have spore suspension.

**Seed inoculation.** Apparently healthy seeds of paddy were surface sterilized soaked in conidial suspension of *F. moniliforme* for 30 min and dried at room temperature overnight. The seeds of control were also surface sterilized and soaked in sterile distilled water.

**Rolled paper towel method.** This method was used to determine the effect of seed borne inoculum on paddy seed quality parameters, *i.e.*, germination and vigour tests of apparently safe and infected paddy seed lots. Two towel papers of equal size jointly soaked in water. 100 seeds were placed between a pair of moist paper towels which were then stacked 10 seeds per row at an equidistance and were placed over a butter paper to avoid water loss. The towel papers along with butter paper were rolled up and ends were closed by rubber bands. The roll was kept slanted inside a medium sized

plastic container containing 2-3 cm deep water and were incubated in dark at 25°C for 7 days. On the seventh day the first count of germination was recorded. All the morphologically normal seedlings were counted and germination was expressed in per cent.

### Germination (%)

Based on the number of normal seedlings, the germination percentage from each sample in each replication were computed as per the formula.

Germination (%)

$$= \frac{\text{No. of normal seedling germinated}}{\text{Total no. of seeds sown}} \times 100$$

**Shoot length (cm).** Ten normal seedlings were taken from each sample in each replication at random on the 7<sup>th</sup> day and the root and shoot length were measured from the tip of the primary leaf to the tip of primary root with the help of scale and mean seedling length was expressed in centimetres.

Seedling vigour was calculated by the following formula given by Abdul Baki and Anderson (1973).

Seedling vigour index = (Mean root length+ Mean shoot length) × Per cent seed germination.

## RESULTS AND DISCUSSION

Effect of *F. moniliforme* cultural filtrate on seed quality parameters of paddy cultivars. (Table 1, Plate 1.) To record the effect of test fungus the observations were recorded on 7<sup>th</sup> day of inoculation for germination per cent, shoot and root length and seedling vigour.

**Identification of test fungus.** On the seventh day of inoculation, inoculated plates were observed for growth and morphological characters of *F. moniliforme* by microscopic examination. Colonies on PDA grow moderately fast, slightly zonate, floccose to slightly felted with pink at the centre. The colony appearance on the reverse side of the agar plate is slightly zonated and white with a purplish centre. Mycelia were hyaline septate. Single micro conidiophore, lateral and subulate phialides. Macroconidiophore consist of basal cell bearing 2-3 phialides that produce macroconidia, hyaline fusiform, ovate and clavate, slightly flattened at both ends, one or two celled and more or less agglutinated in chains. Macroconidia were hyaline, inequilaterally fusoid, slightly sickle shaped or almost straight, occasionally bent into a hook at the apex with 3-5 septate.

**Effect of *F. moniliforme* cultural filtrate on seed germination percent of paddy cultivars.** Difference was observed in inoculated and uninoculated seeds of four paddy cultivars in germination per cent. Highest per cent seed germination of 84.25 per cent was recorded with variety MTU-1010 followed by variety RPM (82.50%), Swarna (79.50%) and PKV-Kisan (75.57%) in uninoculated seeds. Whereas, when the seeds were inoculated with *F. moniliforme* the per cent germination was decreased.

**Table 1: Effect of *Fusarium moniliforme* cultural filtrate on seed germination, shoot length, root length and seedling vigour in four paddy varieties by Paper Towel method.**

| Sr.No. | Variety   | Germination % |       | Shoot length (cm) |      | Root length (cm) |       | Seedling vigour |         |
|--------|-----------|---------------|-------|-------------------|------|------------------|-------|-----------------|---------|
|        |           | In            | Un    | In                | Un   | In               | Un    | In              | Un      |
| 1.     | PKV Kisan | 58.00         | 75.57 | 4.11              | 7.35 | 7.19             | 10.80 | 655.40          | 1371.59 |
| 2.     | RPM       | 60.00         | 82.50 | 4.17              | 7.58 | 9.10             | 11.18 | 976.20          | 1541.10 |
| 3.     | MTU-1010  | 62.00         | 84.25 | 6.32              | 7.40 | 12.50            | 12.57 | 1166.84         | 1682.47 |
| 4.     | Swarna    | 60.50         | 79.50 | 3.27              | 7.22 | 7.37             | 12.13 | 643.72          | 1538.32 |

In= inoculated seeds

Un= uninoculated seeds



Seeds Inoculated with *Fusarium moniliforme* cultural filtrate



Uninoculated seeds

**Plate 1:** Seed germination, shoot length, root length and seedling vigour of inoculated and uninoculated seeds with four paddy varieties by Paper Towel method.

Highest per cent germination was also reported by variety MTU-1010 of 62.00 per cent germination followed by Swarna (60.50%), RPM (60.00%) and PKV-Kisan (58.00%) in inoculated seeds. Per cent germination was declined in inoculated seeds due to the growth of fungus and its competition for nutrition. Mathur *et al.*, (2004) collected twenty seed samples of rice from Tangali district of Bangladesh, in two different growing seasons which were extremely poor quality showing germination ranging between 60-77% (Average 66%). All samples contained many discoloured and spotted seeds, their frequency ranged from 7-15 per cent. When such seeds were removed manually, the clean seeds showed a remarkable increase in germination to 82-93%. Hoang (2014) reported that, culture filtrate of *Fusarium moniliforme* reduced the seed germination upto 54 per cent. Whereas Pandey *et al.*, (2015) reported seed germination of local and hybrid varieties of rice were ranged from 60.60 to 92.30 per cent. Seed infestation by the fungus had a strong negative correlation with seed germination. Healthy seeds not only gave the maximum germination but also exhibited high seedling vigour when compared to infected seeds (Priyantha *et al.*, 2016; Deb and Abdul Khair, 2018).

**Effect of *F. moniliforme* cultural filtrate on shoot and root length of paddy cultivars.** The vigorous shoots and roots helps to improve drought resistance and post transplanting recovery in rice seedlings. The internal balance between labile nitrogen and carbon in the root and shoot system determines how dry matter is being partitioned in the plant. Healthy growth of plant occurs when the shoot and root length has its

approximate. In uninoculated seeds highest shoot length was observed with variety RPM of 7.58 cm but when the variety inoculated with *F. moniliforme* cultural filtrate its shoot length was decreased and recorded 4.17 cm. In other three varieties, the same trend was noticed and shoot length was decreased due to inoculation of *F. moniliforme* cultural filtrates. The same observations were noticed regarding root length also. Highest root length of 12.57 cm and 12.50 cm was reported in uninoculated and inoculated seeds of variety MTU-1010. The least root length was noticed with variety PKV-Kisan of 10.80 cm in uninoculated seeds and 7.19 cm in inoculated seeds with *F. moniliforme* cultural filtrates. These results clearly indicated that, when the seeds are inoculated or infected with *F. moniliforme* the shoot and root length were decreased and adversely effects growth and ultimately the yield of paddy. Hoang (2014) reported that, cultural filtrates of *F. moniliforme* reduced the shoot and root length upto 7.46 cm and 14.50 cm, respectively. Results of Pandey *et al.*, (2015) are also in line with the present findings. Priyantha *et al.*, (2016) noticed shoot length ranging 4.02-7.48 cm and root length 10.50-15.11 cm of paddy seedlings when the seeds were inoculated with *F. moniliforme* culture.

**Effect of *F. moniliforme* cultural filtrates on seedling vigour of paddy cultivars.** Seed vigour is an important character of seed quality that promotes paddy to germinate rapidly from soil and develop strong seedlings. Higher seedling vigour gave the higher seed quality germination and growth. Several seed-borne fungi deteriorates the seedling vigour of rice and *F. moniliforme* is one of them. In uninoculated seeds of

paddy highest seedling vigour was recorded with MTU-1010 variety (1682.47) and the seedling vigour was decreased when seeds were inoculated with *F. moniliforme* culture of 1166.84. In uninoculated seeds, highest seedling vigour in MTU-1010 variety was followed by RPM (1541.10), Swarna (1538.32) and PKV-Kisan (1371.59) where as in inoculated seeds it was followed by RPM (976.20), PKV-Kisan (655.40) and Swarna (643.72). From the present study it was revealed that, *F. moniliforme* severely affect the seedling vigour of paddy seeds. The same trend of results were reported by Hoang (2014); Pandey *et al.*, (2015); Priyantha *et al.*, (2016); Deb and Abdul Khair, (2018).

## CONCLUSION

Seeds inoculated with *Fusarium moniliforme* cultural filtrate showed reduction in seed germination, shoot length, root length and seedling vigour compared to uninoculated seeds in four varieties of paddy. To improve seed quality parameters further studies will be needed to manage the seed mycoflora of paddy. Among the four varieties tested, MTU-1010 may be the best choice from farmers point of view.

## FUTURE SCOPE

There are various seed borne diseases that occur in paddy among them *Fusarium moniliforme* causing bakane disease is most prominent due to which germination, shoot length, root length are adversely effected. So, we should take care of this pathogen during the growth of paddy crop and further study needs to confirm these conclusions.

**Acknowledgement.** The research assistance provided under Plant Pathology Section, College of Agriculture, Nagpur under the supervision of Associate Dean, College of Agriculture, Nagpur (Dr. PDKV, Akola) are highly acknowledged.

**Conflict of Interest.** None.

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**How to cite this article:** Yellamelli, M.; Patil, M. J.; Pillai, T.S. and Singh, L.B. (2021). Effect of *Fusarium moniliforme* Cultural Filtrate on Seed Quality Parameters of Paddy Cultivars. *Biological Forum – An International Journal*, 13(4): 388-391.