



RESEARCH ARTICLE

EFFECT OF FUSARIAL TOXIN ON SEED GERMINATION OF SORGHUM

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ABSTRACT

Sorghum (*Sorghum bicolor* (L.) Moench) is one of a major cereal crop in world. Sorghum is also known for its nutritional value, but now a day this important cereal crop is suffered from yield loss. This is mainly due to fungal diseases, especially grain mold disease of sorghum. Various field fungi like *Fusarium*, *Alternaria*, *Curvularia*, *Phoma*, *Aspergillus*, *Penicillium* etc are associated with grain mold disease. In Marathwada region Bhagyalakshmi-296, Jk-22 sorghum varieties are commonly cultivated. On which *Fusarium*, *Curvularia*, *Alternaria*, and *Aspergillus* fungi occur very on all the varieties. *Fusarium* is one of most important pathogen associated with this disease. In the present study effect of *Fusarium* toxin were observed on sorghum grain germination in laboratory conditions. It shows several seed abnormalities which mainly includes of germinability, abortive seeds, discoloration etc which reduce the quality of seeds.

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INTRODUCTION

Fusarium is one of most important disease causing agent for plant. It is associated with various diseases in plants like wilt of tur, grain molding, Chlorosis, necrosis, premature leaf drop, browning of the vascular system etc. Grain mold is an important disease of sorghum, *Curvularia*, *Aspergillus*, *Phoma*, *Alternaria*, *Bipolaris*, *Fusarium* etc are the important fungi associated with this disease. Fungi which associate with sorghum produces certain secondary metabolites, it may be harmful to the crop as well as animals which feeding on it. *Fusarium* is one of a member associated with this disease. *Fusarium* species severely affects on the grain of sorghum and reduces the quality of grain, vigor, seed weight and germination of seeds. It infects the sorghum panicle at the anthesis stage; it will lead to arrest the grain to attend the maturity. Secondary metabolites of fungus reduce the seed germination and affect on the radical growth (Rashmi pant, 2011). Secondary metabolite plays an adverse effect on the seed germination and seed vigor. Various biochemical reactions which are essential for the seed germination may be blocked by the toxins at some extent, which leads to decrease in the seed germination. Separation of plasma membrane from cell having vacuoles with irregular shape leads toward the

change in ultra structure of the cell by the effect of toxin (Kritzinger *et al.*, 2006). Production of toxins in the grains is depend on the different incubation period, as increase in the incubation period, more amount of toxins were produced (Wagh and mangonkar, 2012). Various researchers' shows the impact of different secondary metabolites on the seed germinations and seedling growth, and effect of crude toxins on the quality of seed; biochemical contents and germination of seed were also shown by the researchers.

The present investigation is undersigned to show the impact of *Fusarium* toxin on the germination status of sorghum seed.

MATERIALS AND METHODS

1) Isolation of *Fusarium* species

Grain mold infected panicles of sorghum were collected from different localities of Marathwada regions. 15 different samples were tested for the isolation of *Fusarium* species. Isolation was carried out by Agar plate method as well as Blotter method. In agar plate method grains of infected panicle were pre-sterilized with 1% HgCl₂, and inoculated on petriplates containing potato dextrose agar as a basal medium. Growing colonies were further subculture to maintain pure culture. In blotter method samples were placed in a wet blotter paper towel and kept in incubation chamber for incubation at 25±2°C for 6 days.

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Identification of fungi are done on the basis of growth pattern, colony characters, sporulation, conidia, conidiophores, Pigmentation. *Fusarium oxysporum* and *Fusarium moniliformae* was identified.

2) Extraction of crude fusarial toxins

1 cm disc of a fully grown culture of *Fusarium oxysporum* and *F. moniliformae* from PDA medium was taken at the peripheral region. This disc was inoculated in a 250 ml of conical flask containing GN (Glucose nitrate) broth medium under aseptic condition. Flasks were kept for incubation at $27 \pm 2^\circ\text{C}$ for different incubation periods. Mycelial mat along with medium was filter through Whatman filter paper no.1 on 7th day, 14th day and 21th day of inoculation. Filtrate was collected in conical flask and plugged with aluminum foil to avoid the contamination, and kept in aseptic chamber till further use as crude toxins

3) Treatment of seed with Crude toxins

Grains of 2 varieties of sorghum were selected for this study. Healthy seed of both the varieties was screened and use for treatment. 100 seeds of each variety were selected for each treatment. Seed was soaked in crude toxins at different time interval 1hrs, 2hrs and 3hrs respectively. The treated samples were kept in humidity chamber for the germination test of grains at $25 \pm 2^\circ\text{C}$ for 7 days. After Incubation period, germination percentage and percent inhibition in germination were calculated.

RESULT AND DISCUSSION

In present study effect of crude *Fusarium* toxin on seed germination of sorghum was checked. Highest percent of germination were observed in 7th day old culture filtrate of *Fusarium oxysporum* (90%) followed by 14th day old culture filtrate (85%) and 7th day extracted culture filtrate of *Fusarium moniliformae* (85%). Effect of Fumonisin B1 on germination in cowpea seed were tested and it is found that seed germination in cowpea were reduced drastically at various concentration of Fumonisin B1 (Kritzinger *et al.*, 2006). This is may be due to toxin blocks the various biochemical processes necessary for normal germination process. (Pant Rashmi, 2011) also showed the reduction in seed germination of coriander seed by the effect of various fungal toxins. Highest percent of relative density of fungi shows more reduction in seed germination. While highest percent of germination inhibition were observed in 21th day extracted culture filtrate (37.5%) in both fungi followed by 14th day extracted culture filtrate of *Fusarium moniliformae* (27.5%). (Wagh and Mangaonkar, 2012) showed the effect of various fungal filtrate on seed germination inhibition in mataka. *Aspergillus niger* (85%), *Geotrichum candidum* (70%) and *Rhizoctonia solani* (50%) inhibit the seed germination in mataka. The culture filtrate of different *Fusarium* species inhibits the growth and germination percent in *Pigeon pea* (Jalander and Gachande, 2011). Fungi which are inoculated on liquid medium produces toxins in the medium, which latter on reduces germination in various seed sample. These fungal toxins also affect on vigor of seedling. Severely reduces the length of radical. In (Table 2) it is observed that length of radical reduces as compare to control due to effect of *Fusarium oxysporum* crude toxin.

Table 1. Effect of *Fusarium oxysporum* and *F. moniliformae* on germination of sorghum seeds

S.No.	Crude fungal toxins	Percentage of Germination (%) at different variety		Percent inhibition (%)
		Bhagyalakshmi-296	JK-22	
01	<i>Fusarium oxysporum</i>			
	7 th day extract	90	80	15
	14 th day extract	85	80	17.5
02	<i>Fusarium moniliformae</i>			
	7 th day extract	85	85	15
	14 th day extract	70	75	27.5
03	21 th day extract	60	65	37.5
	Control	90	90	10

Table 2. Effect of crude toxin of *Fusarium oxysporum* on length of radical

S. No.	Name of variety	Crude toxins	Lenth of radical (cm)				Reduction in length (cm) Mean
			1hrs	2hrs	3hrs	Mean	
1	Bhagyalakshmi-296	7 th day extract	6.8	6.3	6.1	6.4	17.64
		14 th day extract	5.8	5.4	5.3	5.5	29.22
		21 th day extract	5.1	4.7	4.2	4.7	35.52
2	JK-22	7 th day extract	5.8	5.5	5.4	5.6	27.93
		14 th day extract	5.2	5.1	4.9	5.1	34.37
		21 th day extract	4.8	4.5	4.0	4.4	43.38
3	Control	Sterile distilled water	7	8	8	7.77	00

Table 3. Effect of crude toxin of *Fusarium moniliformae* on length of radical

S. No.	Name of variety	Crude toxins	Lenth of radical (cm)				Reduction in length % Mean
			1hrs	2hrs	3hrs	Mean	
1	Bhagyalakshmi-296	7 th day extract	6.2	6.0	5.9	6.0	22.08
		14 th day extract	6.0	5.7	5.2	5.6	27.28
		21 th day extract	5.1	4.7	4.1	4.6	40.26
2	JK-22	7 th day extract	5.9	5.7	5.3	5.6	27.28
		14 th day extract	5.2	4.9	4.7	4.9	36.37
		21 th day extract	4.4	4.1	4.0	4.2	45.46
3	Control	Sterile distilled water	7.4	7.8	7.8	7.7	00

Lowest length of radical were observed in 3 hour treated seeds of Jk-22 variety in 21th day extracted toxin (4cm) as compare to control (8cm). While highest percent of reduction was (43.38%) observed in 21th day extracted toxin. Effect of *Sclerotiniasclerotiorum* metabolite on seed germination of Indian mustard was tested (Sharma *et al.*, 2014),

Culture filtrate of *Sclerotiniasclerotiorum* reduces the length of radical as well as plumule of Indian mustard. Crude toxin of *Fusarium moniliformae* also affected on the length of radical of sorghum (Table 3). Maximum reduction was observed in 21th day extracted toxin (45.46%). Similar results were observed in soybean seed, Culture filtrate of *Aspergillus niger*, *Fusarium culmorum*, *Rhizoctonia solani* and *Penicillium* species were tested for seed germination of soybean. Reduction in germination and length of radical was also depending upon the presoaking time; highest time of presoaking shows more reduction in germination of soybean seed (Haikal, 2008). Different incubation period is required for maximum production of toxic substances for different species. Optimum pH plays an important role in inhibition of seed germination (Kunwar and Mehrotra, 1988). Some culture filtrate can completely inhibit the seed germination; the culture filtrate contains more toxins, which shows maximum inhibition of seed germination 9 Andolfi *et al.*, 2005).

Conclusion

Fungi produce number of secondary metabolites at the time when associated with various seeds. Some of them useful for seed metabolisms but along with these secondary metabolite fungi also secretes some toxic substances, which are harmful for seed in case of germination, sprouting and vigour of the seeds. In present study effect of crude *Fusarium* toxin on seed germination of sorghum was checked. It is observed that *Fusarium oxysporum* and *Fusarium moniliformae* secretes some toxins, which shows inhibitory effect on seed germination. A drastic reduction in length of radical was observed due to the effect of these crude toxins. From the results and observations it is concluded that *Fusarium* toxins plays an adverse role in reduction seed germination of sorghum.

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