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Short Communication

Effect of grain-infecting fungi on seed health of sorghum (*Sorghum bicolor*)

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Sorghum [*Sorghum bicolor* (L.) Moench] is a major staple food in the third world countries. It is emerging as the fourth most important crop after rice, wheat and maize. Sorghum is cultivated widely throughout the tropical, subtropical and temperature regions. It suffers from a number of fungal diseases. Among them, grain-infecting molds have become a major constraint for early-maturing, high-yielding hybrids and improved varieties grown in the rainy season [1]. Grain mold is a problem of early-maturing sorghum in regions where flowering and grain-filling occur during periods of high relative humidity and warm temperatures (28°-37°C). Scientific information on various aspects related to fungi infecting sorghum ears in middle Gujarat is quite lacking. Hence, present experiment was conducted to find out the effect of grain-infecting fungi on seed health of sorghum.

Seed germination was carried out by the paper towel method [2]. Seedling vigour index was determined on the basis of seed germination as well as shoot and root length of seedlings. Vigour index was calculated by using the formula of Thippeswamy and Lokesh [5].

Vigour index (VI) = (mean root length + mean shoot length) x seed germination %.

Healthy grains of sorghum variety GJ 38 were artificially inoculated with each of 10 fungal species separately. For artificial inoculation, grains moistened by sterilized water were mixed thoroughly with 10 days old respective fungal culture growth obtained at 25°±2°C on PDA plates. The inoculated grains were kept in Petri plates containing moist blotter papers for 24 hr. These grains were used to study the seed germination and seedling vigour index. Uninoculated grains were used as the control.

The fungi used to artificial inoculation of grains were: *Fusarium moniliforme*, *Curvularia* sp., *Aspergillus niger*, *A. flavus*, *Alternaria alternata*, *Bipolaris* sp. *Macrophomina phaseolina*, *Penicillium* sp. and *Chaetomium* sp.

The artificial inoculation of sorghum grains individually by 10 different fungi and their mixture showed significant effect on seed germination, shoot length, root length and seed vigour index (Table 1). Overall fungi induced 12.33-60.28, 54.02-85.07 and 46.00-79.10% reduction in seed germination, shoot length and root length over healthy seeds, respectively. The grains inoculated with a mixture of 10 fungi induced maximum adverse effects significantly as evident from maximum reduction in seed germination, shoot length and root length over the control (healthy uninoculated grains). This can be attributed to cumulative adverse effects of 10 fungi used for inoculation.

On the other hand, highest seed germination (91.25%), shoot length (3.35 cm) and root length (3.26 cm) were obtained in healthy grains. Seed inoculated by to mixture of fungi showed lowest seed germination (36.25%), followed by *Aspergillus niger* (66.75%), *Alternaria alternata* (67.00%),

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Table 1. Seed germination, shoot, root length and seedling vigour index of sorghum GJ 38 as affected by various fungi

Fungi inoculated	Seed germination (%)*	Decrease in seed germination (%)	Shoot length (cm)*	Decrease in shoot length (%)	Root length (cm)*	Decrease in root length (%)	Seedling vigour index (SVI)*
Fusarium moniliforme	77.25	15.35	1.40	58.20	1.73	46.93	240.99
F. sp.	79.00	13.43	1.54	54.02	1.50	53.98	241.00
Curuularia sp.	76.50	16.19	1.15	65.67	1.63	50.00	212.79
Aspergillus niger	66.75	26.85	0.88	73.73	1.31	69.32	146.03
A. flauus	71.25	21.87	1.33	60.29	1.02	59.50	167.06
Alternaria alternata	67.00	26.58	0.93	72.23	0.96	70.55	126.54
Bipolaris sp.	72.25	20.83	1.08	67.76	0.90	72.39	142.50
Macrophomina phaseolina	80.00	12.33	1.23	63.28	1.20	63.19	194.06
Penicillium sp.	71.25	21.92	1.00	70.14	0.88	73.00	133.55
Chaetomium sp.	74.00	18.91	1.26	62.38	1.24	61.96	185.24
Mixture of 10 fungi	36.25.	60.28	0.5	85.07	0.7	79.10	43.87
Control (Healthy)	91.25		3.35		3.26		602.72
SEm ±	1.36		0.07		0.07		8.06
CD (0.05%)	2.75		0.13		0.14		16.34
cv (%)	2.67		7.15		7.32		5.61

*Average of four replications

Aspergillus flavus (71.25%), *Penicillium* sp. (71.25%), *Bipolaris* sp. (72.25%) and *Chaetomium* sp. (74.00%) treated seeds.

Similarly, significantly lower shoot length (0.5 cm) was observed in seeds inoculated with mixture of fungi, followed by seeds inoculated with *Aspergillus niger*. Thus, both the treatments induced 85.07 and 73.73% reduction in shoot elongation, respectively. However, *A. niger* was on par with *Alternaria alternata* and *Penicillium* sp. Seeds inoculated with *Fusarium moniliforme*, *F.* sp., *Curvularia* sp., *Aspergillus flavus*, *Bipolaris* sp., *Macrophomina phaseolina* and *Chaetomium* sp. showed shoot length reduction from 54.02 to 67.76% as compared to the control.

Seeds inoculated with *Pencillium* sp. showed 0.88 cm root length which was on par with *Bipolaris* sp. (0.90 cm), *Alternaria alternata* (0.96 cm) and *Aspergillus flavus* (11.02 cm). Cumulative adverse effects of fungi on seed germination, shoot and root length was reflected in respect of vigour index as evident from the lowest vigour index (43.87). In the present study, it is possible that fungal inocula located in or near to seed embryo might have induced more adverse effects on seed germination which needs to be investigated. Synergistic effect of 2-3 fungi infecting seeds need further study. Further, Mathur *et al.* [3] opined that proximity of inoculum to embryo could easily render germination inhibition of infected seeds. Ravindranath [4] reported that all the fungi isolated from molded sorghum grains reduced the seed germination.

Thus, the study by artificial inoculation of sorghum grains individually by 10 different fungi and their mixture showed significant adverse effects on seed germination as well as shoot and root length. Overall, fungi induced 12.33-60.28, 54.02-85.07 and 46.00-79.10% reduction in seed germination, shoot length and root length over the untreated control seeds, respectively. Grains inoculated with the mixture of 10 fungi induced maximum adverse effects. Grain-infecting fungi are serious sorghum [*Sorghum bicolor* L. *Moench*] crop grown in *kharif* season, particularly when grain formation stage coincides with high field humidity.

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