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MANAGEMENT OF GRAIN INFECTING FUNGI OF SORGHUM THROUGH SPRAY ON EARHEAD BY CHEMICAL AND NON CHEMICAL MEANS

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ABSTRACT
Grain infecting fungi are important constraints for the sorghum crop grown during *Kharif* season particularly when grain formation stage is synchronized with high field humidity, as well as when harvesting of matured earhead is delayed. Different phytoextracts, bio agents and one chemical were used for spray purpose. Three sprays of thiram @ 0.2% on earhead at an interval of 15 days starting from 50% emergence of earhead effectively reduced grain mold infection (23.3%) and thereby improved seed health status. Phytoextracts viz., Dhatura, Tulsi, Garlic and Neem 10 per cent were found promising for reducing grain mold incidence which showed only 16.9 to 21.9 per cent incidence of fungi.

INTRODUCTION

Sorghum (*Sorghum bicolor* (L.) Moench) is a vital life-sustaining food crop for human being as well as for livestock in many parts of world. Sorghum is grown in both *Kharif* as well as *Rabi* season. Microbial seed deterioration is one of the most serious biotic constraints to the quality production of grain sorghum for both feed and food purposes. Sorghum suffers from a number of fungal diseases. Among them, the grain-infecting molds have become a major constraint of early maturing high yielding hybrids and improved varieties that are grown during the rainy season (Thakur *et al*., 2006). 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 to 37ºC). Many a times, harvesting of earheads is delayed because of unavoidable prevailing circumstances. Recently, increase the use of pesticides as well as fungicides for management insect, pest and pathogens which degrade the environment. It is very promising to manage fungi by other agents. Phyto extracts and bioagents are only one options is remains to manage grain infecting fungi which are easily and cheaply available (Ghante *et al*., 2006). So it is very important to manage the fungi under field condition because to avoid damage due to various fungi during storage. Very scanty information available on this aspect particularly spraying of different phytoextracts, bioagents and chemical on sorghum earhead under field condition. Keeping this point in a view following study undertaken for consideration.

MATERIALS AND METHODS

Several plants are known to contain antifungal compounds such as alkaloids, tannins, quinines, coumarines, phenolic compounds, phytoalexins etc. phytoextracts having antifungal activity means that prevent the growth and sporulation of pathogen at 10 percent concentration.

Preparation of plant extracts

Fresh and healthy leaves of Garlic, Tulsi, Dhatura, Tamarind, Nagod, Turmeric, Neem and Ardusi plant species were washed thoroughly with tap water. These leaves were cut into small pieces and then macerated separately in sterile distilled water (1:1 w/v basis) by blender. Thus, prepared extracts of each were filtered through double layer sterilized muslin cloth to remove extraneous material and were considered 100 per cent extracts. Standard extracts were further diluted to the required concentration using sterile distilled water.

Mass culturing of *Trichoderma viride*

The pure culture of *Trichoderma viride* available in the Department of Plant Pathology. B A College of Agriculture, AAU, Anand was used. It was mass cultured on PDA for one week at 25ºC resulting fungal growth was harvested from Petri plates into sterile distilled water so as to obtain 10^8CFU/mL suspension. This spore suspension was used for spray purpose.

Mass culturing of *Pseudomonas fluorescens*

For obtaining formulation of *Pseudomonas fluorescens,* the bacterial bioagent were inoculated in Kings B broth, incubated

at 26 ± 1ºC in a BOD incubator for 48h and centrifuged at 10000g for 5 minutes. The supernatants were discarded. Then the pellets were suspended in sterile water so as to obtain the 10^8 CFU/mL.

The experiment was conducted at College Agronomy Farm, BACA, AAU, Anand with Randomized Block Design and variety selected as GJ 38. Following phytoextracts, bioagents and chemical were used to manage the fungi that damage to sorghum under field condition during rainy season 2009.

1)Foliar spray of Garlic (*Allium sativum* L) bulb extracts- T1, 2) Foliar spray of Tulsi (*Ocimum sanctum* L) leaf extracts -T2, 3) Foliar spray of Dhatura (*Dhatura stramonium* L) leaf extracts -T3, 4) Foliar spray of Tamarind (*Tamarindus indica* L) leaf extracts -T4, 5) Foliar spray of Nagod (*Vitex* negundo L) leaf extracts -T5, 6) Foliar spray of Turmeric (*Zinziber officienarium* L) leaf extracts -T6, 7) Foliar spray of Neem (*Azadirachta indica* L) leaf extracts -T7, 8) Foliar spray of Ardusi (*Adhatoda vasica* L) leaf extracts @ -T8, 9) Foliar spray of *Pseudomonas fluorescence* -T9, 10) Foliar spray of *Trichoderma viride* T10, 11) Foliar spray of Thiram -T11, 12) Untreated check-T12. Concentration of all the phytoextracts were 10 %, bioagents were 10^8 CFU/mL and chemical 0.2 percetage.

Application of foliar sprays (Spray details)

Evaluation of fungicides and plant extracts for the management of earhead infecting fungi of sorghum were carried out by foliar spray thrice at an interval of 15 days commencing from 15 days after emergence of earhead in the experimental field.

Earhead grain mold ratting (EGMR)

EGMR was done at physiological maturity using a progressive scale of 1 to 5 (Thakur *et al*., 2006) where, 1 = No mold (healthy earhead), 2 = 1 to 10% grain molded in earhead, 3 = 11 to 25% grain molded in earhead, 4 = 26 to 50% grain molded in earhead 5 = > 50% grain molded in earhead. For this, 20 earhead from each of the plots were randomly selected. Each of the earheads were critically examined with the help of magnifying lens for grain mold severity. Then, on the basis of grain mold severity each of earheads were rated accordingly into1 to 5 scale.

Threshed grain mold ratting (TGMR)

After harvesting, threshing and air drying of grains, representative samples (400 grains) were taken from each plot. Then, grains were assessed visually with the help of magnifying lens for mold infection. Healthy grains and molded grains were counted from each sample. The incidence of grain mold was computed using following equation.

$$\text{Grain mold incidence (\%)} = \frac{\text{Number of moldy grains}}{\text{Total grains observed}} \times 100$$

Grain yield (kg/h)

Grain yield from net plot area was recorded. Yield was further converted into hectare basis using multiple factor.

RESULTS AND DISCUSSION

Results on earhead grain mold rating index (EGMRI) and percent grain mold incidence (GMI) revealed significant differences of treatment effects, while grain yield revealed non significant differences of treatment effects (Table 1 and Figs. 1, 2 and 3).

Overall, EGMRI, recorded at physiological maturity stage of earhead, was low ranging from 1 to 2 EGMRI. Earhead sprayed with thiram @ 0.2% remained free from grain mold as evident 1.0 EGMRI. Thiram was at par with garlic @ 10% spray in

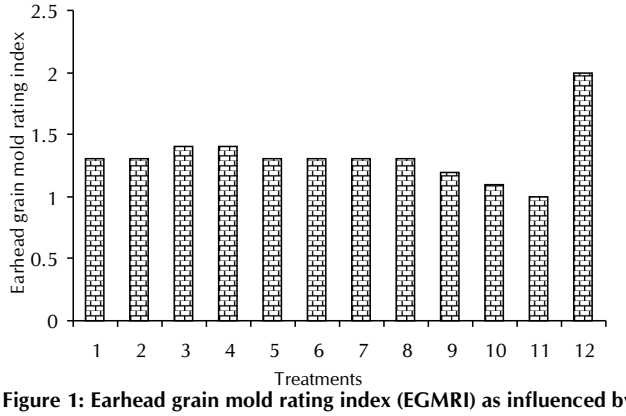

Figure 1: Earhead grain mold rating index (EGMRI) as influenced by field sprays of phytoextracts, bioagents and fungicide

Table1: Earhead grain mold rating, grain mold incidence and grain yield as influenced by earhead sprays of phytoextracts, bioagents and fungicide under field conditions

Treatments	Concentration	EGMRI*(1-5)	Grain mold incidence (GMI)* (%)	Grain yield Kg/ha*
Garlic bulb extracts	10%	1.1	18.0	3206.4
Tulsi leaf extracts	10%	1.3	17.7	3189.4
Dhatura leaf extracts	10%	1.3	16.8	3199.6
Tamarind leaf extracts	10%	1.3	19.9	3157.5
Nagod leaf extracts	10%	1.4	21.8	3034.2
Turmeric leaf extracts	10%	1.3	21.1	3119.7
Neem leaf extracts	10%	1.2	18.2	3155.1
Ardusi leaf extracts	10%	1.4	21.9	2953.5
Pseudomonas fluorescence	10^8CFU/mL	1.3	20.8	3085.5
Trichoderma viride	10^8CFU/mL	1.3	20.0	3124.3
Thiram	0.2%	1.0	7.2	3399.8
Control		2.0	23.3	2934.5
SEm ±		0.09	1.26	256.7
CD 0.05%		0.18	2.61	NS
CV %		8.13	8.19	10.05

*Average of three replications, EGMRI = Earhead grain mold rating index

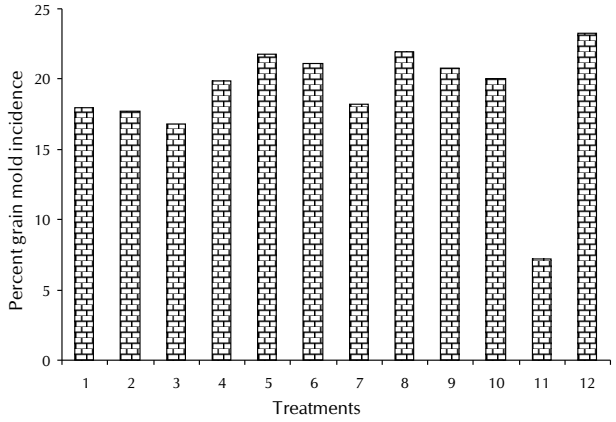

Figure 2: Grain mold incidence as influenced by field sprays of phytoextracts, bioagents and fungicide

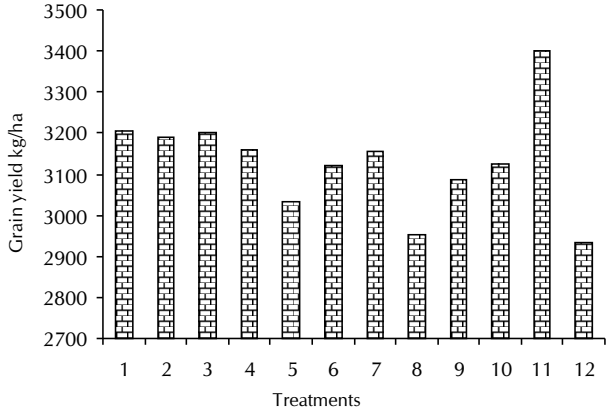

Figure 3: Grain yield as influenced by field sprays of phytoextracts, bioagents and fungicide

respect of EGMRI. Significantly the maximum EGMRI (2.0) was observed in control treatment. EGMRI ranged from 1.1 to 1.4 in remaining treatments including *Trichoderma viride* and *Pseudomonas fluorescence*.

Overall, the grain mold incidence ranged from 7.2 to 23.3%. Significantly, the minimum grain mold incidence (7.2%) was observed in earhead sprayed with thiram as against the maximum incidence (23.3%) observed in control treatment which was at par with Ardusi leaf extracts (21.9%), Nagod leaf extracts (21.8%), Turmeric leaf extracts (21.1%) and *Pseudomonas fluorescence* (20.8%).

Though, the grain yield revealed nonsignificant differences, maximum grain yield (3399.8kg/ha) was obtained from the plots treated with thiram sprays followed by Garlic bulb extract (3206.4kg/ha), Dhatura leaf extracts (3199.6 kg/ha) and Tulsi leaf extract (3189.4kg/ha).

Thus, sprays of thiram @ 0.2% thrice at 15 days interval commencing of earheads under field conditions protected grains from grain mold infection thereby improved seed health status in respect of grain mold infections and their subsequence adverse effects on grain quality. Present investigation indicated the broad sprectum fungicidal activity of thiram. Effectiveness of thiram against different fungi has also been reported earlier. (Singh and Agarwal, 1988; Sharma and Champawat, 2000; Kumudkumar *et al*., 2004). Menaka *et al*. (2003) revealed that maximum germination (80%) was observed in grains of earhead sprayed with Thiram (64.85 %) followed by Tulsi (59.65%), Dhatura (59.41%) and Garlic (58.33%). Phytoextracts viz., Dhatura, Tulsi, Garlic and Neem were found promising reducing grain mold incidence. In present study, only crude extracts of botanicals were evaluated. Therefore, in future it would be desirable to investigate into active ingredients of promising phytoextracts as safe and eco-friendly substitutes of hazardous pesticides. Du and Francis (1975) reported scordine present in the garlic bulb possesses fungicidal activity.

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