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RESEARCH ARTICLE

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Effect of grain smut incidence on crop growth, seed yield and quality parameters of *Rabi* sorghum

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ABSTRACT

The field cum laboratory experiments was carried out to assess the effect grain smut incidence on crop growth, seed yield and quality of *Rabi* sorghum. The seeds were inoculated with smut spores @ 3 g kg^{-1} then treated with different fungicides @ 3 g kg^{-1} of seeds. The seeds sown without any fungicidal treatment (control) recorded minimum number of leaves per plant (7.5), plant height at maturity (188.1 cm), ear head length (15.2 cm), seed weight per plant (28.0 g), seed yield (945.4 kg ha^{-1}), 1000 seed weight (29.5 g), seed germination (85.3 %), seedling length (34.1 cm) and seedling dry weight (123.0 mg^{-5} seedlings) as compared to treated seeds. This might be due to the higher per cent of smut incidence (8.27) recorded in control.

KEY WORDS : Grain smut, Fungicides, Seed yield, Sorghum

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INTRODUCTION

Sorghum [*Sorghum bicolor* (L.) Moench] is an important cereal in the world next to wheat, rice, maize and barley. Sorghum is usually grown in both *Kharif* and *Rabi* season, especially growing of sorghum in *Rabi* season is unique to India and particularly to the southern states like Maharashtra and Karnataka. It is advisable to take seed production during *Rabi* or *summer* season as the yields are higher and the quality of seed is better compared to *Kharif* seed production. Obviously, there is a good scope to evolve suitable seed production technology for *Rabi* season. Productivity of sorghum crop in India is much less, this is because of sorghum is prone to several diseases and pests which cause considerable reduction in seed yield. Depending upon climatic condition and intensity of cultivation practices adapted the occurrence of sorghum.

Grain smut of sorghum is one among the major diseases. The incidence of grain smut is quite common and destructive in almost all sorghum growing areas of the world. In India, it is one of the most serious diseases of the crop in states of Tamil Nadu, Karnataka, Andhra Pradesh, Uttar Pradesh, Madhya Pradesh and Maharashtra. It causes direct loss of grains by replacing grain with smut sori. The incidence of grain smut ranged from less than 1 per cent to more than 40 per cent infected panicles. Most (>90 %) of the panicle were severely infected, and all grains were replaced by smut sori (Pande *et al.,* 1997). The smut pathogen is externally seed borne. During threshing the sori break releasing the spores which adhere to the surface of healthy seeds and remain dormant till next season. Sori/spores also fall down in the soil at time of harvest but soil borne inoculum plays insignificant role in the epidemiology of the disease. The infected plants appear to be normal till the emergence of ears when the diseased kernels are individually replaced by dark brown powdery masses of chlamydospores (sorus) covered by grayish brown membrane. With these ideas in view, a study was carried out to evaluate the different fungicides to control of grain smut incidence and its effect on crop growth, seed yield and quality parameters of *Rabi* sorghum.

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MATERIALS AND METHODS

Field studies were carried out at MARS, University of Agricultural Sciences, Dharwad during *Rabi* season from October 2009 to March 2010. The seeds of sorghum variety M 35-1 produced during 2008-09 *Rabi* season were obtained from the farmer were thoroughly mixed with viable spores of smut @ 3 g kg^{-1} of seeds then treated with different fungicides @ 3 g kg^{-1} of seeds two days after inoculation . The treated seeds were stored for five months (June, 2009 to Oct., 2009). The required quantity of sorghum seeds were inoculated with smut spores and treated with fungicides as per the treatments were packed in cloth bag and stored under ambient condition for five months and T_9 and T_{10} treatments were fresh seeds treated just before sowing. The experiment was laid out in randomized complete block design and replicated thrice. The details of observations recorded on crop growth, seed yield and seed quality. The collected data on various parameters were analyzed statistically as described by Sundararaj *et al.* (1972) and Panse and Sukhatme (1978). The data were subjected to the test of significance ('F' test) by analysis of variance method.

RESULTS AND DISCUSSION

The data on crop growth and yield parameters are presented in Table 1. The seeds sown without fungicidal treatment recorded significantly maximum smut incidence (8.27 %) and minimum number of leaves per plant at maturity (7.5), plant height at maturity (188.1 cm) and ear head length (15.2 cm). while, minimum smut incidence (1.10 %), maximum leaves per plant at maturity (9.1 leaves), plant height at maturity (212.4 cm) and ear head length (18.9 cm) were recorded in seeds treated with vitavax power (carboxin + thiram) @ 3 g kg^{-1}. The decreased growth parameters mainly ascribed due to higher incidence of pest and diseases. The lesser number of green leaves and minimum plant height may also be attributed to several factors such as spacing, irrigation, fertilizer application and due to the effect of smut incidence (Gaurav *et al.,* 2008 in wheat). Whereas higher per cent of smut incidence might be due to non influence of fungicides. The results confirmed the findings of Tyagi *et al.* (1976) in wheat, Shah and Mariappan (1988) in sorghum and Jain and Tripathi (2007) in little millet.

The yield parameters also differed significantly with incidence of smut. The control shown lower seed weight per plant (28.0 g), seed yield (945.4 kg ha^{-1}) and 1000 seed weight (29.5 g). whereas maximum yield parameters were recorded in seeds treated with vitavax power (carboxin + thiram) @ 3 g kg^{-1} (36.1 g, 1521.9 kg ha^{-1}, 35.9 g, respectively) (Table 2). The increased yield attributes may be due to the vitavax power (carboxin + thiram) which is systemic fungicide in nature which reduced the percentage of smut incidenced and enhanced the vigorous development of crop (Sharma *et al.,* 2007 and Gothwal, 1972 in wheat). The reduction in seed yield may be attributed due to pathogen induced imbalance in the physiology of host tissue during infection and

Table 1 : Effect of seed treatment with fungicides and per cent smut incidence on number of green leaves and plant height in *Rabi* sorghum

Treatments	Per cent smut incidence	No. of green leaves at maturity	Plant height at maturity (cm)
T_1- Carboxin + Thiram (3g kg^{-1} of seeds) *i.e.* Vitavax Power (stored for five months)	1.55	8.6	207.6
T_2- Sulphur (3g kg^{-1} of seeds) (stored for five months)	2.24	8.3	203.9
T_3- Thiram (3g kg^{-1} of seeds) (stored for five months)	3.76	7.9	195.0
T_4- Captan (3g kg^{-1} of seeds) (stored for five months)	5.40	7.7	193.4
T_5- Carbendazim + Iprodione (3g kg^{-1} of seeds) *i.e.* Quintal (stored for five months)	3.50	7.9	197.1
T_6- Carbendazim (3g kg^{-1} of seeds) *i.e.* Bavistin (stored for five months)	1.90	8.4	205.4
T_7- Captan + Hexaconazole (3ml kg^{-1} of seeds) *i.e.* Takat(stored for five months)	6.35	7.7	191.9
T_8- Sulphur + Thiram (1.5 g + 1.5 g kg^{-1} of seeds) (stored for five months)	2.55	8.1	201.3
T_9- Carboxin + Thiram (3g kg^{-1} of seeds) *i.e.* Vitavax Power (fresh seeds treated just before sowing)	1.10	9.1	212.4
T_{10}- Sulphur (3g kg^{-1} of seeds) (fresh seeds treated just before sowing)	1.38	8.8	209.0
T_{11}- Untreated Control (stored for five months)	8.27	7.5	188.1
Mean	3.46	8.2	200.5
S.E.±	0.07	0.33	8.9
C.D. (P=0.05)	0.20	0.96	NS

NS=Non-significant

Table 2 : Effect of seed treatment with fungicides and per cent smut incidence on ear head length, seed weight per plant, seed yield per hectare and 1000 seed weight in *Rabi* sorghum

Treatments	Ear head length (cm)	Seed weight per plant (g)	Seed yield per hectare (kg)	1000 seed weight (g)
T_1- Carboxin + Thiram (3g kg^{-1} of seeds) *i.e.* Vitavax power (stored for five months)	18.2	34.6	1379.4	35.0
T_2- Sulphur (3g kg^{-1} of seeds) (stored for five months)	17.7	33.7	1251.5	34.2
T_3- Thiram (3g kg^{-1} of seeds) (stored for five months)	17.0	32.3	1120.8	32.8
T_4- Captan (3g kg^{-1} of seeds) (stored for five months)	16.5	31.4	1057.0	32.1
T_5- Carbendazim + Iprodione (3g kg^{-1} of seeds) *i.e.* Quintal (stored for five months)	17.2	32.7	1160.8	33.3
T_6- Carbendazim (3g kg^{-1} of seeds) *i.e.* Bavistin (stored for five months)	17.9	34.0	1309.8	34.6
T_7- Captan + Hexaconazole (3ml kg^{-1} of seeds) *i.e.* Takat(stored for five months)	16.1	30.5	1018.4	31.2
T_8- Sulphur + Thiram (1.5 g + 1.5 g kg^{-1} of seeds) (stored for five months)	17.3	33.4	1221.4	33.8
T_9- Carboxin + Thiram (3g kg^{-1} of seeds) *i.e.* Vitavax Power (fresh seeds treated just before sowing)	18.9	36.1	1521.9	35.9
T_{10}- Sulphur (3g kg^{-1} of seeds) (fresh seeds treated just before sowing)	18.6	35.1	1430.7	35.4
T_{11}- Untreated Control (stored for five months)	15.2	28.0	945.4	29.5
Mean	17.3	32.9	1219.7	33.4
S.E.±	0.8	1.4	117.5	1.2
C.D. (P=0.05)	2.4	4.21	346.63	3.48

Table 3 : Effect of seed treatment with fungicides and per cent smut incidence on Per cent of seed germination, seedling length and seedling dry weight in *Rabi* sorghum

Treatments	Per cent seed Germination	Seedling length (cm)	Seedling dry weight (mg^{-5} seedlings)
T_1- Carboxin + Thiram (3g kg^{-1} of seeds) *i.e.* Vitavax Power (stored for five months)	90.7 (72.34)*	41.6	138.3
T_2- Sulphur (3g kg^{-1} of seeds) (stored for five months)	89.3 (70.99)	39.4	135.0
T_3- Thiram (3g kg^{-1} of seeds) (stored for five months)	87.3 (69.21)	36.8	130.7
T_4- Captan (3g kg^{-1} of seeds) (stored for five months)	86.7 (68.61)	36.3	129.0
T_5- Carbendazim + Iprodione (3g kg^{-1} of seeds) *i.e.* Quintal (stored for five months)	88.3 (70.00)	37.4	132.7
T_6- Carbendazim (3g kg^{-1} of seeds) i.e. Bavistin (stored for five months)	90.3 (71.96)	40.4	138.3
T_7- Captan + Hexaconazole (3ml kg^{-1} of seeds) *i.e.* Takat(stored for five months)	86.0 (68.03)	35.6	126.3
T_8- Sulphur + Thiram (1.5 g + 1.5 g kg^{-1} of seeds) (stored for five months)	88.7 (70.37)	38.1	135.3
T_9- Carboxin + Thiram (3g kg^{-1} of seeds) *i.e.* Vitavax Power (fresh seeds treated just before sowing)	92.3 (74.06)	43.8	150.7
T_{10}- Sulphur (3g kg^{-1} of seeds) (fresh seeds treated just before sowing)	91.7 (73.37)	42.4	146.7
T_{11}- Untreated control (stored for five months)	85.3 (67.50)	34.1	123.0
Mean	88.8 (70.59)	38.7	135.1
S.E.±	1.2	1.7	2.8
C.D. (P=0.05)	3.46	5.1	8.4

* Figures in the parenthesis are arcsine transformed values

successive growth (Jain and Tripathi, 2007 in little millet) and also adverse effect of smut pathogens on morphology, yield attributing parameters. The similar results were also reported by Shah and Mariappan (1988) in sorghum, Yadav and Duhan (1993) in pearl millet and Jain (2004) in kodomillet. Similarly seed quality parameters like germination, seedling length and seedling dry weight (85.3 %, 34.1 cm and 123.0 mg^{-5} seedlings, respectively) were found to be minimum in control (Table 3). While maximum were recorded in vitavax power (carboxin + thiram) @ 3 g kg^{-1}(92.31 %, 43.8 cm and150.7 mg^{-5} seedlings, respectively). The reduction in germination may be due to the higher infection leads to shriveling of seed in these plants may also have contributed towards reduction of

1000 seed weight and corresponding reduction in germination was reported by Gaurav *et al.* (2008) in wheat. The similar results were also reported by Gothwal *et al.* (1976) in wheat, Haq and Khan (2000) in sorghum and Yadav and Duhan (1993) in pearl millet.

On the basis of results from the study indicates that, if seeds are sown without seed treatment leads higher incidence of grain smut causes reduction in crop growth, seed yield and quality of *Rabi* sorghum. The seeds treated with vitavax power (carboxin + thiram) was found to be effective in controlling the grain smut incidence in *Rabi* sorghum.

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