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Grain Yield Losses Due to Charcoal Rot of Sorghum Infected By Macrophomina Phaseolina

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Introduction

Sorghum bicolor (L.) Moench commonly known as "Jowar" is the most important Rabi and Kharif crop of India belonging to the family "Poaceae". It is among one of the four major cereal crop of the world, the other three being wheat, rice and maize.). The five largest Sorghum producing countries in the World are the United States (25%), India (21.5%), Mexico (11%), China (9%) and Nigeria (7%). These countries accounts for 73% of World production. Sorghum is mainly cultivated in the states Maharastra, Karnataka, Andhra Pradesh, Madhya Pradesh, Gujarat, Chennai, Rajasthan and Uttar Pradesh. In Rajasthan Sorghum is grown in an area of about 556'000 hectares. It is being cultivated as rainy season crop (Kharif, June to October). The data on grain yield losses clearly exhibit the economic importance of the disease. Improved high yield cultivar's succumbed to be susceptible to stalk rot, with 100% lodging in severe cases (Anahosur and Patil 1983; Mughoho and Pande 1983; Choudhari et.al. 1987; Seetharam et.al. 1987; Bramel , Cox et al. 1989; Pedgaonkar and Mayee 1990; Hiremath and Palakshappa, 1994 and Narayan Rao et al. 1997- 1998). Looking to the paucity of the work an attempt has been made .

Review of Literature

Loss in Sorghum Crop Due to the Disease

Charcoal rot caused by fungus M phaseolina is a root and stalk rot disease and has a great destructive potential agent in most Sorghum growing region during rainy and post rainy season. The literature replete with many reports on the destructive status of the disease in Sorghum crop. Uppal et al., (1936) determined that the disease was of "sufficient economic importance" on post rainy crops in Maharashtra state.

A survey of literature reveales that the pathogen causes losses in grain yield of Sorghum. (Hoffmaster et al., 1943; Leukel et al., 1943; Padwick, 1956; Hsi, 1956; Anahosur and Rao, 1977; Anahosur and Patil, 1983; Seetharma et al., 1987; Pedgaonkar and Mayee 1990; Hiremath and Palakshappa, 1994 and Narayan Rao et al., 1998).

Leukel et al., (1943) showed the "serious losses" due to the disease in several states of USA. Harris (1962) reported that in Kano, Nigeria, charcoal rot caused considerable losses in Sorghum yield. Similarly, he obtained 100% lodging and grain yield losses of 23-64% in CSH-6 at three locations in India and one in Sudan.

At Dharwad 35% reduction in grain weight was recorded by Mughogo and Pande (1983). Similarly Anahosur and Patil (1983) reported .15-55% loss in grain weight in their experiment at Dharwad. Improved high yielding cultivars tends to be ultra susceptible to charcoal rot. Improved varieties and hybrids that revolutionized Sorghum production in India proved to be very susceptible to the disease with 100% lodging in severe cases (Avdhani and 4, Ramesh, 1978, Rao et al., 1983, Hiremath-1994).

The most recent estimations described the U.S. production loss, attributed to the charcoal rot at more than 30 million bushels per annum (Kansas State University, 1999).

Experimental Results

Estimation of Losses

Charcoal rot of Sorghum induced by Macrophomina phaseolina is becoming an important disease in Sorghum growing areas of Tonk district and may be responsible for causing heavy losses in grain yield. Therefore, the present study on estimation of losses was undertaken during Kharif 2001. The method described by Savita Pareek (1991) on charcoal rot of maize induced by M phaseolina was followed.

The trend of disease rating in the infected plants showed a close and direct relationship with the disease incidence. Data on estimation of losses recorded during Kharif 2001 were highly significant. A positive correlation was observed between disease rating and percent loss in yield. It was noticed that as the disease rating increased, the percent loss in grain weight also increased (Table 1).

Plants having different disease rating were grouped accordingly to the disease rating scale. It was observed that the losses in yield were quite evident in all disease rating except disease rating zero which represented the check.
Maximum loss (46.6%) in yield was recorded for disease rating of 4.9 where complete wilting and lodging of plants also occurred and the minimum losses (14.2%) were record at rating 3.7.

Table 1: Estimation of losses in grain yield of sorghum CSH-5 artificially inoculated with Macrophomina phaseolina during Kharif 2001.

S. No.	Disease Rating (0-5)	Loss due to disease %	Loss due to disease Value	Dry grain wt. of fruit (gms) Disease	Dry grain wt. of fruit (gms) Healthy	Yield (Kg/ha)
1	4.9	46.6	43.05	710.16	1500	250.12
2	4.3	34.0	35.67	811.91	1220	270.15
3	4.1	24.4	29.60	970.08	1140	390.40
4	3.7	14.2	22.14	1050.52	1090	470.16

Correlation coefficient D.W 0.97656, % 0.655447, 0.96328

Discussion

Estimation of Losses

The disease charcoal rot of Sorghum has attained a destructive status. Although the literature contains the reports regarding the destruction status of the charcoal rot in Sorghum crops but sound and reliable quantitative data on yield loss has always been obscured. Therefore, experiments were conducted in the field in order to find out the estimation of losses in infected plants of Sorghum. First, a disease rating scale was determined for the infected plants (0-5). It depicted the severity of disease and grain loss as per formula.

The result showed that as the disease rating increased the percent loss in dry grain weight increased (Table 6). The disease rating '0' showed no infection and losses thus it represent the healthy plant where as disease rating '5' represent heaviest infection in Sorghum plant. This experiment also established that the disease rating of Sorghum plants in Milk and other districts of Rajasthan did not reach the peak i.e. 5 but it varied from 1-3.

Since, there is no systematic data on the 'estimation of losses' our results can not be directly compared. However, there are some reports, the first was given by Mughogho and Pande (1984), who estimated yield losses of 23-64% in CSH-6 hybrid under their experimental conditions. Similarly, Anahosur and Patil 0983) estimated losses due to charcoal rot on Sorghum seeds.

According to them, the losses ranged from 15.18 to 54.57 percent in different genotypes depending upon the percent lodging to the plants. They established a direct correlation between percent lodging and seed weigh losses. Our results partly support their observation.

In the present study a Similar Correlation between lodging of the plants and weight loss of the seeds was also observed. Our results are significantly from the point that they form the first report of this type for the Sorghum crop in Rajasthan. Uppal et al.,(1936) from Maharashtra state and Harris (1962) from Kano, Nigeria' charcoal rot caused "sufficient to considerable loss in yield" saw severe symptoms of charcoal rot and estimated yield losses upto 50%. Similarly "serious losses" several states in USA were reported but no quantitative data on crop loss were given (leukel et al., 1943). Jardin (2002) reported 100% loss in Soyabean field in Kansas. 1 to 4%.

Summery

Experiment on yield losses showed a positive correlation between disease rating and percentage loss in the grain yield i.e. percent loss in dry weight increased in direct Proportion to the increase in disease rating. The disease rating 4.9 showed maximum loss IA, 4) in Yield coupled with infection of all the intemodes with complete wilting and lodging of plants. On the contrarily the disease rating 3.2 showed minimum loss of 14.2% coupled with confinement of the process of infection upto two internodes with slit drying.

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