

Studies on the Headsmut of Sorghum

by

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Introduction: Sorghum forms one of the important food grains of the Madras state. It is grown over an area of 18 lakhs. of acres. Several diseases are known to affect this crop. Of these the smuts are the most damaging. There are four kinds of smuts recorded on this crop in the Madras state. These are the grain smut, the loose smut, the long smut, and the head smut. The head smut is common in several districts in the state and in some years it has been observed to infect about five per cent of the crop in parts of Coimbatore and Salem districts. The entire ear head is transformed into a sorus which is covered by a thin whitish membrane in the early stage. Sooner or later the membrane is ruptured and a black mass of spores mixed with numerous fibres is exposed. The occurrence of this smut has been found to be greater in rainfed crops than in irrigated crop.

This smut has been recorded from America, Africa, and India. The causal fungus has undergone several changes in its nomenclature and is at present called *Sphacelotheca reiliana* Clint. The germination of the spores and the mode of infection of the smut have been studied by Potter (1914). He established that the smut is soil-borne. Kulkarni (1918) working in this disease in India was not able to observe the germination of the spores. He has stated that the disease was not seed-borne and he could not get infection when the seeds were mixed with the spores before sowing. In order to determine the maximum period during which the spores remain viable and also to find out how long the spores can survive in the soil, studies were undertaken and the results are communicated in this paper.

Materials and Methods: The spores were collected from fresh material, dried under shade for 48 hours and stored in envelopes made of butter paper. The germination of the spores was tested by floating the spores on drops of tap water on slides kept inside Petri-dishes lined with moist filter paper. Germination counts were made after 24 hours. The plants were grown in glazed pots of uniform size with 11 inches diameter. The soil used was always sterilised before mixing the spores. The variety of Sorghum used was Co. 5 throughout the experiment as this was susceptible and of

short duration and was not season bound. The plants were examined in the boot leaf stage and the diseased ones were carefully removed without allowing the spores to fall on the soil in the pot. In the experiments where successive crops were raised in the same pots an interval of one week was allowed between the harvest of one crop and sowing of the succeeding one.

Experimental results: Viability of the spores: The germination of the spores collected and stored in the laboratory was tested at monthly intervals for over one year. The results are tabulated below. The material was collected on 8th September 1949 and germination counts were continued for one year.

TABLE 1.
Germination tests at monthly intervals

Date of testing	Percentage of germination	Date of testing	Percentage of germination
8-9-1949	0.8	8-3-1950	0.3
8-10-1949	0.9	8-4-1950	0.5
8-11-1949	1.6	8-5-1950	0.2
8-12-1949	1.8	8-6-1950	...
8-1-1950	1.2	8-7-1950	0.2
8-2-1950	0.6	8-8-1950	...

(Average counts of over three thousand spores were made in each case)

The results indicate that the spores under laboratory conditions remain viable for over ten months. However the germination is limited and the maximum obtained at any time was less than two per cent.

Infection studies: The soil in pots up to a depth of two inches was thoroughly mixed with the spores of the smut and the seeds of Sorghum were sown at the rate of ten seeds per pot. The plants grew up normally. When the ears were formed it was observed that six per cent of the plants were smutted while the rest were free. In the control pots where no spores were added there was no incidence of smut. The results indicated that infection takes place through the spores present in the soil.

In order to find out the effect of the spore load on the intensity of infection, the soil was mixed with weighed quantities of

spores and three levels of sporeload were used. The quantities of spores used per pot were 2 gm. 4 gm. or 8 gm. respectively. The spores were mixed with the top three inches of soil and the seeds were sown immediately. The experiment was carried out in two seasons and the results of infection are given below :—

TABLE 2
Spore Load and Infection

Date of sowing	Date of harvest	2 gm.		4 gm.		8 gm.	
		No. of plants present	No. infected	No. of plants present	No. infected	No. of plants present	No. infected
16-6-1949	8-10-1949	59	3	59	14	58	12
17-10-1949	22-1-1950	54	3	58	19	55	9

Higher infection was evident where the spore load was raised to 4 gm. per pot but there was no improvement in the intensity of infection with still higher spore loads. Four grams per pot appeared to be the optimum spore load.

Survival of the fungus: The duration of time during which the soil once mixed with the spores remains infective was next determined. The soil in the pot was mixed with four grams of spores per pot. Later, seeds were sown. When the ears were formed the crop was harvested. After a lapse of a week fresh sowings were made in the same pots. Thus successive crops were raised to find out the length of time the soil remained infective. The results are recorded below :—

TABLE 3.
Survival of the fungus in the soil
The soil was inoculated on 16-6-1949.

Date of sowing	Date of harvest	No. of plants present	No. infected
16-6-1949	10-10-1949	60	4
17-10-1949	9-2-1950	59	18
16-2-1950	6-6-1950	60	3
15-6-1950	3-10-1950	59	—
10-10-1950	7-2-1951	60	—
15-2-1951	11-6-1951	60	—

The controls were all healthy. The maximum infection was obtained in the second crop i.e., four months after the initial inoculation of the soil. The fungus does not appear to survive in the soil beyond one year.

In another series of experiment the pots were all inoculated with the same spore load on 10th September 1949. The inoculated pots were kept in the open in the potculture house. Sowings were made in different sets of pots at monthly intervals to find out how long the spores remain viable in the soil when no crop is raised in pot. The results obtained are given below:—

TABLE 4.
Time of sowing and intensity of infection

Date of sowing	No. of plants present	No. infected
10—9—1949	97	7
10—10—1949	97	9
10—11—1949	100	8
10—12—1949	97	11
10—1—1950	100	17
10—2—1950	96	8
10—3—1950	98	6
10—4—1950	96	2
10—5—1950	99	—
10—6—1950	100	—
10—7—1950	97	—
10—8—1950	100	—

It is seen from the results that sowings after eight months are not affected by the smut.

Discussion: These studies have revealed that the spores do not freely germinate. The percentage of germination is very low but takes place even when the spores are fresh.

The improvement with age is not very pronounced. Butler (1918) has stated that a few may germinate each time a rain falls but others will be still alive till the next crop is sown. Under laboratory conditions the spores retain their viability only for a year and all evidences go to show that the same may happen in the field

also. But this period is more than the interval between two crops. The fact that three successive crops were infected with one inoculation shows the capacity of the spores to retain their viability even under the conditions of cultivation. This smut is found to be on the increase in certain areas in Coimbatore district. The studies have shown that the intensity of infection increases with the increase of spore load up to a certain extent. The increase in the incidence of the disease should be attributed to successive showers of spores falling on the soil from infected plants in each cropping season.

The only two courses open for the control of this disease which exhibits soil-borne infection are the eradication of the smutted ears in order to prevent the increase of the spore load in the soil or to cultivate resistant varieties of Sorghum. The variety 'Milo' is reported to be resistant. Further tests with the different varieties of Sorghum available in our state are necessary to find out suitable resistant strains. Co. 5 is susceptible. Till such time when resistant varieties are available it is necessary to concentrate on the eradication of smutted ears as the main method of control.

I am highly indebted to Sri T. S. Ramakrishnan for his valuable guidance in carrying out these experiments. I am also thankful to Sri M. Kandaswamy, Government Mycologist, in charge, for his helpful criticisms in the preparation of this paper.

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