EFFECT OF ENVIORNMENTAL FACTORS ON CHARCOAL ROT OF SORGHUM BICOLOR CAUSED BY MACROPHOMINA PHASEOLINA (TASSI) GOID

MANJEET KOUR ARORA

Abstract: Sorghum bicolor (L) Kinect is a common crop in. India for Rabi season .it spread worldwide. Lots of diseases were. seen in this crop out of which charcoal rot is very common disease caused by Macrophophomina phasolina .In. Rajesthan state there are symptoms noted for the same. disease and thus work has been. done on the effect of en viournmental factors on.disease. We. found that the as. the temperature increase the disease sevoirity increases.same.is in.7th case of Ph also disease rating is. minimum at 7.5 and maximum at 9.5

Keywords : Macrophomina, charcoalrot, Environment factors, temperature, Ph.

Introduction: Sorghum bicolor (L.) Moench commonly known as "Jowar" is the most important Rabi and Kharif crop of India belonging to the family "Poaceac". 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. More than .- 90% of India's productions is accounted by these states (Anahosur and patil ,1982). 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). There are several environmental factors which plays an important role in disease spreading. High temperature and low moisture are important for stalk rot development (Merriaen and Blyries, 1981).

A survey of literature reveals that the disease charcoal rot has been found very serious in Sorghum causing varying degree of losses in terms of grain and fodder yields. The disease is reported to be quite prevalent in India especially in Karnataka, Gujarat and Andhra Pradesh. It plays a dominant role in damaging the crop but no serious attempts has so for been made for battle array against the disease. In Rajasthan state there is no published report about the extent and various aspects of the disease. So, looking to the paucity of the information on the disease in Rajasthan state an immediate attention from the research side was needed. Therefore, it was felt necessary to take up this problem. Hence the present investigation was aimed to undertake a thorough study on the Effect of temperature on it.

Review of Litrature: Different workers traced a number of environmental factors responsible for disease development. Ludwig (1925) reported that root or stem rot of Beans caused by M. phaseolina was dependent on abundant soil moisture and concluded that dry weather did not encourage the disease.

Uppal et al., (1932-1936) found that Rhizoctonia bataticola was pathogenic to Sorghum under certain conditions of soil moisture in the Bombay presidency. They reported that blight and hollow stem of Sorghum were severe under high soil moisture conditions. They also observed that high soil moisture was favourable to infection. They further observed that the fungus was becoming completely inactive when the water holding capacity fell to 50% and confirmed that the disease became severe in the periods of heavy rains and high temperature. Sundararaman (1933) found pH 4.6 and 6.2 are better for the growth of Mphaseolina.

Livingston (1945) in Nebraska reported that either low soil temperature or high soil moisture throughout the growing season prevent the occurrence of the disease. seedling blight was favoured by low soil moisture with pH ranges from 5.0 - 8.0 or more. Very little seedling blight was observed with high soil moisture content although, many seedlings had infected roots.

Kavoor (1954) reported that Rhizoctonia bataticola was capable of growing in unsterilized soil. He also disclosed that an increase in soil moisture decreased the disease by way of increasing the population of bacteria that attack the hyphae of the fungus in soil. The activity of Rhizoctonia bataticola was directly co-related with soil Inicroflora, which was in turn related to soil moisture (Anonymous, 1958).

M phaseolina infected slash pine were seldom killed as long as an adequate supply of water was available. Mortality of infected seedlings was highest if water supply was act off to harder the seedlings, before lifting for transplantation (Hadge, 1962).

Edmunds (1964) reported that in Sorghum supplied with 80% or more of available soil moisture at 4 to 7 days before inoculation did not show any infection whereas with 25% available soil moisture, the plants that bloomed 14-28 days before being inoculated were

killed within 5-7 days (at 35°C soil temperature) and 3-5 days (at 40°C soil temperature after inoculation).
Charcoal rot of Sorghum advanced well in plants stressed for moisture for a period of two weeks or less before inoculation. Extent of rot varied widely among the plants. Sclerotial formation was shown in plants irrigated after inoculation (Edmund et al., 1964). Ghaffar and Erwin (1969) showed that cotton plants subjected to water stress developed severe charcoal rot, whereas the plant growing under adequate moisture conditions were less affected at soil temperature between 20-40°C.
Dhingra and Sinclair (1974),reported that the recovery of M phaseolina from infected soyabean stem pieces (mixed in the two soil types used by them), decreased with increasing soil moisture from 20-100% moisture holding capacities. They also found that the fungus could not be recovered in both types of soil when they had 100%
Material and Methods: Effect of environmental factors such as temperature, soil moisture and soil pH were studied through artificial inoculation of host plant for successive two years during Kharif, 2000 and 2001 on the development of charcoal rot of Sorghum.
The exact pH- and water holding capacity and electric conductivity of KVK farm is noted to be
pH 8.0 - 8.5
WHC 18-20
EC2 0.36 ds/m
Effect Of Temperature: A pot experiment was set in Complete Randomized Design (CRD) in order to study the effect of different temperatures on disease development. Sorghum seeds were sown in earthern pots of 9" diameter with 4 replications. When the plants were sixty days old these were inoculated with toothpick and kept in green house maintained at 25°C, 30°C, 35°C, 40°C respectively. For check pots were kept at room temperature. Twenty days after inoculation plants were split open for disease rating.
Sorghum were sown in earthernaip, pots of 12^{th} diameters in polytheme bugs containing weighed soil. The posts were arranged in complete randomized. Design and were replicated 4 times. When the plants were 60 days old,they wer inoculated with toothpicks. Four moisture levels 40%, 60%, 80% and 100% were maintained by irrigating them with a measured amount of water. Results were recorded after twenty days of inoculation.
Soil Ph: sorghum seeds were sown in 12" earthern pots. Soil of the pots was kept polythene bags so as to maintain desired pH of the soil. The pots were arranged in Complete Randomized Design and were replicated 4 times. Moisture holding capacity for 4 weeks. In addition to this they observed that the reduction in the number of viable Sclerotia may be brought in the field by keeping soil moisture above 60% of its moisture holding capacity at 30°C or above for 3-4 weeks. Singh et at, (1974) reported that the fungus grew and produce abundant Sclerotia at pH7 and 30°C temperature. Anahosur et al., (1977) reported that charcoal rot of Sorghum appeared even under low irrigated conditions and also under high soil moisture. CSV-7R, which is a highly susceptible variety, was severely affected. manici et at, (1995) found 30-35°C temprature as the better temprature for M phaseolina in Sunflower.
Results
Effect of Temperature: At different temperature levels 25, 30, 35 and 40, maximum percentage infection as recorded at temperature 40°C (21.3%) while minimum were recorded at 25°C (13.8%). The datas were pooled. Similarly maximum number of internodes were crossed at 400c Where disease rating is 1.57 and minimum at 25°C (0.80). On the contrarily the Maximum length of plant is also effected at 40°C with disease rating is 2.16 and minimum at 25°C (0.82). these ratings were at per with check (30°C) & 35°C
Maximum disease rating as observed at 40°C and minimum at 25% (Table 1.1,1.2,1.3)
Effect of Ph: At different p1-1 levels plant height was effected. At pH 7.5 disease rating was 3.07 which was at par with check (8.3), 8.5, 9.5. In case of internodes crossed highest disease rating was noted at 7.5 and lowest at 9.5. At 8.5 and 9.5 average disease rating comparatively at per. Similarly percent infection showed similar effect. Maximum percentage was recorded at pH 7.5 (21.7%) and minimum at 9.5 (13.1%) (Table2.1,2.2,2.3).

Temprature: TABLE - 1.1 Length of Plant

S.No.	Temperature level C	Age of plant after inoculation 60 days onwards	Average Disease rating of Plant height		
			Kharif 2000	Kharif 2001	Pooled analysis
1.	40	1-30	0.80	0.84	0.84
2	60	1-30	1.07	1.118	1.12
3	100	1-30	2.45	1.88	2.16
4	80 (check)	1-30	0.89	0.93	0.91

A verage Disease Rating of 4 replications
Total Number of Plants/replication 5
Total Number of Plants/treatment 20

TABLE - 1.2
Internodes crossed

S. No.	Temperature level C	Age of plant after inoculation 60 days onwards	Average Disease rating of Plant height		
			Kharif 2000	Kharif 2001	Pooled analysis
1.	25	1-30	0.78	0.83	0.80
2	35	1-30	1.12	0.89	1.00
3	40	1-30	1.71	1.43	1.57
4	30 (check)	1-30	0.96	0.89	0.92

A verage Disease Rating of 4 replications
Total Number of Plants/replication 5
Total Number of Plants/treatment 20

TABLE - 1.3
Percentage Infection (ARC)

S.No.	Temperature level C	Age of plant after inoculation 60 days onwards	Average Disease rating of Plant height		
			Kharif 2000	Kharif 2001	Pooled analysis
1.	25	1-30	13.9	13.8	13.8
2	35	1-30	18.4	17.8	18.1
3	40	1-30	22.2	20.3	21.3
4	30 (check)	1-30	15.8	15.8	15.8

A verage Disease Rating of 4 replications
Total Number of Plants/replication 5
Total Number of Plants/treatment 20

pH
TABLE 2.1
Length of Plant

S.No.	PH level	Age of plant after inoculation 60 days onwards	Average Disease rating of Length Plant		
			Kharif 2000	Kharif 2001	Pooled analysis
1.	7.5	1-30	3.13	3.01	3.07
2	8.5	1-30	1.68	1.56	1.62
3	9.5	1-30	1.08	1.05	1.06
4	8.3 (check)	1-30	2.21	2.66	2.43

A verage Disease Rating of 4 replications
Total Number of Plants/replication 5
Total Number of Plants/treatment 20

TABLE - 2.2
Internodes crossed

S.No.	PH level	Age of plant after inoculation 60 days onwards	Average Disease rating of Length Plant		
			Kharif 2000	Kharif 2001	Pooled analysis
1.	7.5	1-30	1.58	1.55	1.56
2	8.5	1-30	1.56	1.16	1.36

3	9.5	1-30	0.95	0.72	0.83
4	8.3 (check)	1-30	1.34	1.40	1.37

A verage Disease Rating of 4 replications
Total Number of Plants/replication 5
Total Number of Plants/treatment 20

TABLE - 2.3
Percentage Infection (ARC)

S.No.	PH level	Age of plant after inoculation 60 days onwards	Average Disease rating of Length Plant		
			Kharif 2000	Kharif 2001	Pooled analysis
1.	7.5	1-30	22.4	17.8	21.7
2	8.5	1-30	14.6	15.8	14.8
3	9.5	1-30	12.9	13.8	13.1
4	8.3 (check)	1-30	20.4	20.3	20.1

A verage Disease Rating of 4 replications
Total Number of Plants/replication 5
Total Number of Plants/treatment 20

Discussion: Charcoal rots of Is the most destructive disease in Sorghum growing areas.

In Rajasthan due to soil-climate-plant-relationship, environmental factors, viz., temperature, soil co moisture and soil pH are very critical for the cultivation of Sorghum crops. Because of this Sorghum is only a Kharif crop and not a Rabi crop.

A number of reports have been published in which the effect of environmental factors on disease development in Sorghum as well as in different crops have been Discussed but there is no report about the Rajasthan state. Therefore, it was felt essential e present investigation to explore the effect of temperature, soil moisture and pH on disease development. Separate experiments were set to test the effect of each of these factor in vitro and in vivo.

Temperature: temperature range tested varied from 25 to 40°C with three different parameters. All the parameters showed that the disease developed at all these temperatures but, maximum disease development occurred at 40°C (Table 1.1, 1.2 and 1.3).

Our results are in good agreement with those reported by Uppal, kolhatkar and patil (1936), working on hollow. stem. and blight stem of Sorghum in East Deccan India, they reported that m. phaseolina disease in jowar usually become serious during and after periods of high temperature. They found 35.5°C as the optimum temperature for infection and less disease development at 30°C.

Honsing et aL, (1942) also reported these observation by remarking that the dry weather in August and September favoured and development of charcoal rot of sorghum and maize. Similarly it has been found that the high temperature of at least 35°C or more always favoured the growth of M phaseolin

However, other reports differed. Livingston (1945) while working on charcoal rot of corn and Sorghum demonstrated that this disease was favoured by high temperature of at least 35°C and a still higher temperature i.e. 42°C was favoured for seedling blight where as soil temperature of 38°C was most favourable for rot diseases.

Shoker et al., (1977) reported that the growth of M phaseolina was maximum at 30°C

According to Dr. Savita Pareek (1991) 40°C temperature is suitable for the growth of M phaseolina on maize. While Rod clerk 1 et al., (1999) found 350C to 39°C as the suitable temperature for the disease incidence. The conditions very well apply in case of Sorghum charcoal rot disease, occurring in Rajasthan.

PH: The pH of soil is equally important for charcoal rot. The results of our e experiment have clearly established that always a neutral pH (7.5) is more favourable for disease development than alkaline soil (pH 9.5) maximum disease development occurred at 7.5c and minimum at 9.5 is shown by all three parameters taken for testing pH (Table 2.1,2.2, 2.3).

Our results are directly compared with the results of different workers. According to Livingston et al., (1945) large number of sclerotia were produced in pH 4)415.0 to 8.0.

Summery: Some experiments were performed for two years to test the affect of temperature, soil moisture and soil pH on Sorghum plants grown in pots and inoculated by toothpicks with charcoal rot pathogen at maturity.

Field studies revealed that maximum disease development was observed at 40°C. The temperature 40, 35 and 30 proved to be maximum, optimum and minimum for the charcoal rot development.

practices have being made to study the effect of soil moisture and it was concluded that when the soil moisture level was 40% than the disease is maximum

as s the water level increases up to 100% disease incidence is minimum. In other words hot and dry conditions favoured the disease. Similarly the results of pH variation study indicated that the disease can occur at pg of 7.5 to 9.5. The former was most suitable for this purpose and the later was unsuitable.

Summary: practices have being made to study the effect of soil moisture and it was concluded that when the soil moisture level was 40% than the disease is maximum as s the water level increases up to 100% disease incidence is minimum. In other words hot and dry conditions favoured the disease. Similarly the results of pH variation study indicated that the disease can occur at pg of 7.5 to 9.5. The former was most suitable for this purpose and the later was unsuitable.

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Manjeet kour Arora
Gujrati Science college, Indore