Indian J.Sci.Res. 4(1) : 155-158, 2013
ISSN : 0976-2876 (Print)
ISSN : 2250-0138 (Online)

EFFECT OF SOIL MOISTURE AND TEMPERATURE ON THE SEVERITY OF *Macrophomina* CHARCOAL ROT OF SORGHUM

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ABSTRACT

Charcoal rot, caused by *M. Phaseolina*, is one of the most important diseases of sorghum in India. The organism is also known to cause root & stem diseases of many economic crops, notably charcoal rot of soyabean (*Glycine max*) corn (*Zea mays*) etc. The epidemics of *M. Phaseolina* in relation to environmental factors has been discussed in Sorghum. We reported that at different moisture level's height of plant was effected. As soon as the moisture level increased from 40 to 100% average disease rating decreased. At different temperature level's 25, 30, 35 and 40, maximum % infection was recorded at 40°C (21.3%) while minimum were recorded at 25°C (13.8%). The data's were pooled. Similarly maximum numbers of internodes were crossed at 40°C where disease rating is 1.57 & minimum at 25°C maximum length is also effected at 40°C.

KEYWORDS : Soil Moisture, *M.phaseolina*, charcoal rot , Environmental effects

Sorghum bicolor, commonly called Sorghum and also known as durra or Jowari, is a grass species cultivated for its edible grain. Sorghum originated in Northern Africa, and is now cultivated widely in tropical and sub tropical regions. *S. bicolor* is typically an annual, but some cultivars are perennial. It grows in clums that may reach over 4m high. The grain is small ranging from 3 to 4 mm. in diameter. *S. bicolor* is cultivated species of sorghum, its wild relative's makes up the botanical genus.

With the current area under sorghum, India is the largest grower in the world with USA ranking second. In the case of production the situation is reverse on productivity. India ranks seventh among the nine countries growing more than 1 million hectors under sorghum.

Sorghum is mainly cultivated in states of Maharashtra, Karnataka, Andhra Pradesh, M.P., Gujarat, Chennai, Rajasthan & U.P. In Rajasthan sorghum is gron in an area of about 556000 hectares.

Sorghum crop suffers from many diseases out of which charcoal rot is a major disease in the dry sorghum growing region. It is particularly distribution high yield sorghum that mature during hot and dry whether if the vigorously growing crop is subjected to moisture stress during flowering period. Yield losses vary depending on the whether and the growth stage of the cultivars at the time of infection by fungi causing this diseases. There are several environmental factors which plays an important role in disease spreading High temperature and low moisture are important for stalk rot development . The symptoms include root rot, soft stalks, lodging of plants, premature drying of stalk and poorly development panicle with small inferior quality grain

Survey of litrature revels that the disease charcoal rot has been found very serious in Sorghum causing varying degree of losses in terms of grain & fodder yield.

It plays a dominant role in damaging the crop in Rajasthan but no serious attempts has so far been made for battle array against the disease. An attempt was therefore made to study the effect of soil moisture & temperature on the extent of disease to increase & stabilizing the production of sorghum.(Dhingra and Sinclair 1974 & 1975; Edmunds,1954)

MATERIALS AND METHODS

Effect of environmental factors such as temperature & soil moisture were studied through artificial inoculation of host plant for successive two years during Kharif 2000 & 2001 on the development of charcoal rot of sorghum.

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 earthen pots of 9' diameter with 4 replications. When the plants were sixty days old these were inoculated with toothpicks and kept in green house

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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.

Soil Moisture

Sorghum seeds were sown in earthen pots of 12" diameter in polythene bags containing weighed soil. The pots were arranged in complete. Randomized design and were replicated 4 times. When the plants were days old, they were 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 20 days of inoculation.

RESULTS

Charcoal rot of Sorghum is a major problem in tropical areas. The effect of temperature and soil moisture on the occurrence of charcoal rot disease on many crops such as sorghum, cotton, soya bean etc. (Dhingra and Sinclair 1974 &75) have been investigated and these factors have been found to be the quite important for the disease.

Effect of Soil Moisture

At different moisture levels height of the plants was effected. As soon as the moisture level increased from 40 to 100%, average disease rating decreased. So at 40% moisture level plant height was very much affected with a disease rating 3.46 and ant 100% average diseased rating was reduced to 1.72.

In case of internodes crossed highest disease rating was noted at 40% while lowest at 100%. Similarly percent infection showed similar affect i.e. 21.4% at 40% moisture level and reduced to 12.2% at 100%.

Thus it concluded that soil moisture level was inversely proportionate to average disease rating (Table 1.1, 1.2, 1.3).

Effect of Temperature

At different temperature levels 25, 30, 35 and 40 maximum percentage infection was recorded at temperature 40°C (21.3%) while minimum were recorded at 25°C (13.8%). The data's were pooled. Similarly maximum numbers of internodes were crossed at 40°C 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 at is 2.16 and minimum at 25°C (0.82) these ratings were at % with checks (30°C) & (35°C).

Maximum disease rating as observed at 40°C and

Table 1.1
SOIL MOISTURE
Length of Plant

S. No.	Moisture Level (%)	Age of plant after inoculation 60 days onward	Average Disease rating of Plant height		
			Kharif 2000	Kharif 2001	Pooled Analysis
1.	40	1-30	3.68	3.25	3.46
2.	60	1-30	3.08	2.65	2.96
3.	100	1-30	1.83	1.62	1.72
4.	80 (Check)	1-30	2.70	2.94	2.82

Average disease rating of 4 replication
Total Number of plants / replication-5
Total Number of plants / treatment-20

Table 1.2
INTERNODES CROSSED

S. No.	Moisture Level (%)	Age of plant after inoculation 60 days onward	Average Disease rating of Internodes crossed		
			Kharif 2000	Kharif 2001	Pooled Analysis
1.	40	1-30	1.73	1.53	1.63
2.	60	1-30	1.17	1.21	1.19
3.	100	1-30	0.37	0.29	0.33
4.	80 (Check)	1-30	0.74	0.89	0.81

Average disease rating of 4 replication
Total Number of plants / replication - 5
Total Number of plants / treatment - 20

Table 1.3
PERCENTAGE INFECTION

S. No.	Moisture Level (%)	Age of plant after inoculation 60 days onward	Average Disease rating of Internodes crossed		
			Kharif 2000	Kharif 2001	Pooled Analysis
1.	40	1-30	21.5	21.2	21.4
2.	60	1-30	19.4	18.2	18.8
3.	100	1-30	12.3	11.9	12.2
4.	80 (Check)	1-30	17.7	15.1	16.4

Average disease rating of 4 replication
Total Number of plants / replication - 5
Total Number of plants / treatment - 20

Table 1.4
TEMPERATURE
Length of Plant

S. No.	Moisture Level (%)	Age of plant after inoculation 60 days onward	Average Disease rating of length of Plant		
			Kharif 2000	Kharif 2001	Pooled Analysis
1.	25	1-30	0.80	0.84	0.82
2.	35	1-30	1.07	1.18	1.12
3.	40	1-30	2.45	1.88	2.16
4.	80 (Check)	1-30	0.89	0.93	0.19

Average disease rating of 4 replication
Total Number of plants / replication-5
Total Number of plants / treatment-20

Table 1.5
INTERNODES CROSSED

S. No.	Moisture Level (%)	Age of plant after inoculation 60 days onward	Average Disease rating of Internodes crossed		
			Kharif 2000	Kharif 2001	Pooled Analysis
1.	25	1-30	0.78	0.82	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

Average disease rating of 4 replication
Total Number of plants / replication - 5
Total Number of plants / treatment - 20

Table 1.6
PERCENTAGE INFECTION

S. No.	Moisture Level (%)	Age of plant after inoculation 60 days onward	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	18.9	17.8	18.1
3.	40	1-30	22.2	20.3	21.3
4.	30	1-30	15.8	15.8	15.8

Average disease rating of 4 replication
Total Number of plants / replication - 5
Total Number of plants / treatment - 20

DISCUSSION

Charcoal rots of sorghum is the most destructive disease in sorghum growing areas.In Rajasthan due to Soil-climate-plant relationship environmental factors viz temperature & soil moisture are very critical for the cultivation of sorghum crops. Because of their sorghum is only a Kharif crop & 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 in the present investigation to explore the effect of temperature, soil moisture disease development separate experiments were set up to test the effect of each of these factor in vitro & in view.

Soil Moisture

A study on the effect of soil moisture of all the three parameters showed that maximum disease occurred at low soil moisture level (40%) and disease incidence decreased as the moisture level increased (100%). In other words dry soil are more favourable for the disease.

The past work carried out by several workers on different crops also support our observation (Livengston, 1945 ; Gaffar et al., 1969& 1971; Dhingra & Sinclair, 1975) The susceptibility of Sorghum to charcoal rot interaction in Karnataka and found that most of the activated varieties and hybrid were equally susceptible to the disease when moisture stress condition coupled with soil temperature preveled during grain filling period.

Temperature

The 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.

Our result are in good agreement with those reported by Uppal (1936), working on hollow stem and blight stem of sorghum in last 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.

Some workers 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. Phaseolina*.

However other reports differed. Livengston, (1945) while working with 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 favoured for rot disease.

According to Pareek ,(1991) 40°C temperature is suitable for the growth of *M. Phaseolina* on Maize The conditions very well apply in case of Sorghum charcoal rot disease, occurring in Rajasthan.

SUMMARY

Some experiments were performed for two years to test the affect of temperature & soil moisture on sorghum plants grown in pots and inoculated by toothpick & with charcoal rot pathogen at maturity.

Field study revealed that maximum disease development was observed at 40°C. The temperature 40, 35 and 30 proved to be maximum, optimum & 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 soon as the water level increases up to 100% disease incidence is minimum. In other words hot and dry conditions favoured the disease.

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