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Role of meteorological factors on development of stem and root rot of sesame

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Abstract
The influence of various meteorological factors *viz.* bright sunshine hour, wind speed, temperature, relative humidity and rainfall on the development of *Macrophomina phaseolina* causing stem and root rot of sesame were studied. Sesame variety Gujarat Til 2 was sown on five different dates at seven days intervals begun from 07 July during *Kharif* 2016. The stem and root rot was more progressive during 37th and 39th standard meteorological week when the bright sunshine (8.70 and 9.10 hrs) and maximum temperature (34.50 and 33.30 ^{0}C) increased, minimum temperature (24.90 and 24.20 ^{0}C) and relative humidity (Rh_1) decreased (90.70 and 93.60%), respectively and there was no rainfall.

Keywords: Sesame, stem and root rot, *Macrophomina phaseolina*, bright sunshine hour, wind speed, temperature, relative humidity and rainfall

Introduction
Sesame (*Sesamum indicum* L.) is an ancient and traditional oilseed crop of India, cultivated in about. 74 million hectare area and producing 0.82 million tons. The main reason for the low productivity of sesame is due to the attack of various diseases. Among the fungal diseases, stem and root rot also called charcoal rot caused by *Macrophomina phaseolina* (Tassi) Goid. is widely distributed and highly destructive right from the establishment phase of crop (Dinakaran and Mohammed, 2001) [2], causing up to 50 percent or more disease incidence in field resulting in heavy yield losses (Chattopadhyay *et al*., 2002) [1]. Yield losses have been estimated up to 57 percent when there is about 40 percent infection (Maiti *et al*., 1988) [5] and about 5-100% yield loss as estimated by Vyas (1981) [10]. Further loss in yield at the rate of 1.8 kg/ha due to 1 percent increase in the incidence has been reported (Murugesan *et al*., 1978) [6]. *Macrophomina phaseolina* (Tassi) Goid is one of the most destructive necrotrophic fungal pathogens that infect more than 500 plant species across 75 families. Under moisture stress condition, the fungus causes many diseases like seedling blight, collar rot, stem rot, charcoal rot and dry root rot. The most common symptoms of the disease are the sudden wilting of plants throughout the crop growth mainly after the flowering phase. The pathogen attacks mostly at the basal region of the plant (Kumar *et al*., 2011) [4].
In this study, role of various meteorological factors on the development of *Macrophomina phaseolina* causing stem and root of sesame were evaluated and the results are presented hereunder.

Materials and Methods
Sesame variety Gujarat Til 2 was sown on five different dates at seven days intervals begun from 07 July during *kharif*: 2016. For each date of sowing, four replications were maintained. Recommended agronomical and other cultural practices were also followed (Table1.).
The disease incidence in the field was recorded when the first infection appeared in the sesame plant at seven days interval following standard meteorological week up to harvest and correlate with weather parameters (temperature, bright sunshine hour, relative humidity, rainfall and wind speed), to determine the role of weather variables in the development of the stem and root rot epidemic. Seed yield (kg/ha) was also recorded at crop harvest.
The percent disease incidence was calculated by using the following formula:

$$\text{Disease incidence (\%)} = \frac{\text{Number of diseased plants}}{\text{Total No. of plants}} \times 100$$

Table 1: Experimental details

1	Location	Agronomy farm, BACA, AAU, Anand
2	Year and season	*Kharif:*2016
3	Crop & variety	Sesame, Gujarat Til 2
4	Replications	4 (Four)
5	Treatments	5 (Five) Dates of sowing (at seven days interval) D_1- 07 July 2016 D_2- 14 July 2016 D_3- 21 July 2016 D_4- 28 July 2016 D_5- 04 August 2016
6	Plot size	Gross: 2.25 x 1.80 m, Net: 1.65 x 0.90 m
7	Spacing	45 x 15 cm
8	Seed rate	3 kg/ha
9	Fertilizer	25-25-00 NPK kg/ha

Results and Discussion

The comparative weekly observations were recorded and tabulated in Table 2 revealed that disease initiated at later stage (25th August, 2016) and gradually increased and progressed up to harvesting stage (29th September, 2016). The rate of disease incidence was fluctuated according to weather condition.

The stem and root rot was more progressive (Table 2) during 37th and 39th standard meteorological week when the bright sunshine (8.70 and 9.10 hrs) and maximum temperature (34.50 and 33.30 ^{0}C) increased, minimum temperature (24.90 and 24.20 ^{0}C) and relative humidity (Rh_1) decreased (90.70 and 93.60%), respectively and there was no rainfall. Hence, there was a moisture stress condition, which played an important role in disease development.

Correlation matrix worked out (Table 3) which showed that in first date of sowing (7th July) bright sunshine hour was highly significant and positively correlated, average rainfall, maximum temperature, and relative humidity at morning (Rh_1) was positively correlated, wind speed was negatively correlated, while the minimum temperature was significantly and negatively correlated. In second date of sowing (14th July), bright sunshine hour was highly significant and positively correlated, maximum temperature and average rainfall were positively correlated, while the wind speed, relative humidity (Rh_1 and Rh_2) and minimum temperature were negatively correlated. The third date of sowing (21st July) was also correlated in similar trends as second date of sowing, except bright sunshine hour, which was correlated significantly and positively. In fourth date of sowing (28th July), bright sunshine hour and maximum temperature were positively correlated, while the minimum temperature, relative humidity, rainfall and wind speed were negatively correlated. Fifth date of sowing (4th August) was correlated similarly as fourth date of sowing with all weather parameters.

Table 2: Correlation of stem and root rot incidence in sesame cv. GT 2 with weather parameters (*kharif:* 2016)

Sr. No	Date of Observations	SMW	Disease incidence (%)*					BSS (hr)	WS (km/hr)	Rainfall (mm)	Atmospheric Temperature (˚C)			Relative humidity (%)	
			D_1	D_2	D_3	D_4	D_5				Max.	Min.	Mean	Rh_1	Rh_2
1	7th Jul. 2016	27th	0	-	-	-	-	3.20	7.40	13.20	34.40	26.00	30.20	89.00	69.70
2	14th Jul. 2016	28th	0	0	-	-	-	2.40	6.10	30.40	33.40	26.20	29.80	91.10	71.40
3	21st Jul. 2016	29th	0	0	0	-	-	2.30	6.10	17.80	32.20	25.60	28.90	88.10	74.30
4	28th Jul. 2016	30th	0	0	0	0	-	2.30	4.80	19.20	33.50	25.60	29.55	91.40	72.10
5	04th Aug. 2016	31st	0	0	0	0	0	1.80	5.70	73.20	31.50	25.20	28.35	97.40	79.40
6	11th Aug. 2016	32th	0	0	0	0	0	1.0	6.00	96.80	30.00	24.50	27.25	95.60	85.00
7	18th Aug. 2016	33th	0	0	0	0	0	5.60	6.40	2.80	32.50	24.70	28.60	92.10	66.10
8	25th Aug. 2016	34th	0.41	0	0	0	0	1.10	5.50	49.60	29.50	24.90	27.20	94.70	90.10
9	01st Sept. 2016	35th	4.58	1.66	0.83	0	0	2.70	4.30	19.60	31.70	25.40	28.55	97.40	77.70
10	08th Sept. 2016	36th	10.41	6.25	4.58	0.41	0	8.80	5.80	8.20	32.40	23.70	28.05	94.60	60.40
11	15th Sept. 2016	37th	22.50	15.41	12.08	2.50	2.08	8.70	4.40	0.00	34.50	24.90	29.70	90.70	54.10
12	22nd Sept. 2016	38th	26.66	18.33	15.41	5.00	4.16	4.10	4.00	159.60	32.30	23.70	28.00	93.60	76.90
13	29th Sept. 2016	39th	38.75	28.75	24.58	10.83	9.58	9.10	5.70	0.00	33.30	24.20	28.75	93.60	64.90
Yield (kg/ha)			651	702	553	482	433								

*Mean of four replications, Rh_1-Relative humidity (Morning), Rh_2- Relative humidity (Evening)
SMW = Standard Meteorological Week, BSS = Bright sunshine hour, WS = Wind Speed

Table 3: Correlation of dates of sowing and weather parameters (*kharif:* 2016)

Dates of sowing	Bright Sunshine hours	Wind speed (km/hr)	Rainfall (mm)	Atmospheric temperature (ºC)			Relative humidity (%)	
			Av.	Max.	Min.	Av.	Rh_1	Rh_2
D1	0.732**	-0.437	0.076	0.321	-0.611*	-0.005	0.049	-0.446
D2	0.720**	-0.369	0.041	0.439	-0.579*	0.106	-0.051	-0.462
D3	0.692*	-0.315	0.042	0.499	-0.572	0.207	-0.105	-0.456
D4	0.567	-0.132	-0.002	0.403	-0.472	0.184	-0.222	-0.318
D5	0.528	-0.163	-0.039	0.482	-0.414	0.317	-0.323	-0.308

*Correlation is significant at the 0.05 level, ** Correlation is highly significant at the 0.01 level
Rh_1-Relative humidity (Morning), Rh_2- Relative humidity (Evening)

Maximum temperature, bright sunshine hour, average rainfall and relative humidity (Rh_1) favoured the disease development. However, among all the weather parameters bright sunshine hour, maximum temperature and rainfall were found to have key role on stem and root rot disease development during *Kharif* 2016.

The yield of sesame was also correlated with date of sowing (Table 2). It revealed that second date of sowing (14th July) gave maximum yield (702 kg/ha) as compared to all other dates of sowing. The percent disease incidence was highest in first date of sowing *i.e.* 7th July (38.75%) followed 14th July (28.75%), 21st July (24.58%), 28th July (10.83%) and 4th August (9.58%)

It is concluded that sowing of sesame on 14th July was proved to be better to the farmer with point of view of minimum disease incidence and highest yield. The first date of sowing (7th July), gave less yield because of highest disease incidence, while the third (21st July), fourth (28th July) and fifth (4th August) date of sowing gave least yield because of the stunted growth of sesame plant.

Similar result was also observed by Jain and Kulkarni (1965) [3]; Rodriguez and Zambrano (1985) [8] and Patel and Patel (1990) while working on root of sesame.

Singh and Gupta (1993) [9] also observed the similar result and reported that severity of stem and root rot of sesame caused by *M. phaseolina* was reduced by sowing sesame on 10-20 July, resulting in increased yield as compared with crop sown on 1st July.

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