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Epidemiological studies on leaf spot disease of *Aloe vera caused by Alternaria alternata*

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Abstract
Aloe vera is one of the important medicinal plants in India and is known for its various nutritive and therapeutic values. The Leaf spot is a very serious destructive disease of *Aloe vera* causes loss to crop. Weekly percent disease intensity was recorded from the date of initiation of disease and weather data was recorded from meteorological observatory of the university. Correlation coefficient of percent disease intensity and weather parameter was calculated and recorded that disease severity was significantly and positively correlated with temperature. The disease severity was found to increase with increase in temperature. Maximum disease severity was recorded in the month of June followed by April and March whereas least disease severity was recorded in the month of December and January.

Keywords: *Aloe vera*, leaf spot, temperature

Introduction
Aloe vera (Syn. *Aloe barbadensis Miller*) popularly known as Indian Aloe is a perennial drought resistant succulent plant belongs to family Liliaceae. The *Aloe vera* plant has been known and used for centuries for its health, beauty, medicinal and skin care properties. There are over 300 species of *Aloe vera* grown around the world. However, only three species *viz.*, *Aloe barbadensis*, *Aloe ferox* and *Aloe arborescence* are more popular for herbal drug. According to Adodo (2009) [1], over 325 species of the genus *Aloe* have been identified but *Aloe vera* is more popular all over the world because it propagates itself faster than any other known species. *Aloe vera* plays vast traditional role in indigenous system of medicine like ayurveda, siddha, unani and homoeopathy because of its marvellous medicinal properties. *Aloe vera* is commonly referred to as "miracle plant" for its numerous uses particularly in the area of man's health (Daodu, 2000) [3]. Many herbal drugs and drinks have been formulated from *Aloe vera* plants for the maintenance of good health (Davis and Moro, 1989) [4]. *Aloe vera* gel has been reported to be very effective for the treatment of sore and wounds, skin cancer, skin disease, cold and cough, constipation, pile, fungal infection etc. (Gill, 1992; Kafaru, 1994; Daodu, 2000; Djeraba and Quere, 2000; Olusegun, 2000) [7, 8, 3, 5, 9]. Despite its therapeutic potential, *Aloe vera* is susceptible to various foliar diseases caused by fungi like leaf spot, tip rot, base rot and leaf rot etc. The leaf spot disease caused by *Alternaria alternata* is one of the most serious fungal diseases affecting commercial cultivation of *Aloe vera* (Rukhsana *et al*., 2010) it reduces the quality and quantity of mucilaginous gel used for medicinal and commercial purposes. Weather factors like temperature, relative humidity and rainfall plays vital role in the development and spread of disease, considering the economic importance of the disease present investigation was carried out on epidemiological aspect of leaf spot disease that can helps in its management.

Materials and methods
The experiment on *Aloe barbadensis* was conducted during the course of investigation in 2017-18 and 2018-19 at MAP (Medicinal and Aromatic plant) Experiment Station of Horticulture Farm, NDUA&T, Ayodhya. Weekly Percent disease intensity was recorded from the date of initiation of disease. Weather data was recorded from Meteorological Observatory of the University. Correlation coefficient of percent disease intensity and weather parameter was calculated. Percent disease intensity was calculated by following formula-

$$\text{Per cent disease intensity (PDI)} = \frac{\text{Sum of all numerical ratings}}{\text{Total number of leaves examined x Highest rating}} \text{ x } 100$$

Results and Discussion

It is evident from the data (Table. 1 & 2) that the leaf spot disease symptoms were started with 52th week and continue to 20th standard weeks during both year 2017-18 and 2018-19. The relationship of disease severity (dependent variable) with weather parameter was studied by employing simple correlation. The correlation coefficients were presented in table no. 3 revealed that disease severity was significantly and positively correlated with minimum temperature (0.938, 0.952) and maximum temperature (0.937, 0.935) during both years and significantly and negatively correlated with relative humidity (-0.844, -0.847). The disease severity was significantly and positively correlated with rainfall in first year (0.440) while negatively correlated in second year (-0.171). The disease severity was found to increase with increase in temperature. Maximum disease severity was recorded in the month of June followed by April and March whereas least disease severity was recorded in the month of December and January. Concurrent with the present findings, Ghosh *et al.* (2018) studied epidemiology of leaf spot disease of *Aloe vera* and found that, the PDI peaked during the hot and humid conditions of May to September (76.57%-98.57%) but decreased during the winter, December-January (35.71-46.66%). High relative humidity coupled with temperature of 27–28 °C is most favourable for the disease development (Sharma *et al*., 2016) [10]. Borkar and Patil (1995) [2] studied the weather in relation to *Alternaria* leaf blight disease development in Maharashtra. Temperature of 25.9 ^{0}C to 33.7 ^{0}C with a relative humidity of 89 to 95 per cent favoured disease development.

Table 1: Effect of meteorological factors on severity of leaf spot disease of *Aloe vera* during 2017-2018

Month	Standard week	Temperature (^{O}C)		Relative humidity (%)	Rainfall (mm)	PDI
		Min.	Max.			
December	51	8.1	23.3	78.2	0	0
	52	8.4	19.4	85.6	0	5.5
	1	4.7	15.1	84.3	0	9.9
January	2	5.2	13.8	87.8	0	11.1
	3	4.8	21.8	74.1	0	13.3
	4	5.9	21.3	74.8	1	15.5
	5	7.2	24.3	70.0	0	18.8
February	6	8.1	24.3	60.7	0	26.6
	7	10.7	24.7	72.2	0	33.3
	8	11.8	28.7	66.3	0	37.7
	9	14.1	30.1	67.3	0	42.2
March	10	12.3	31.1	64.7	0	48.5
	11	13.7	32.8	58.2	0	52.5
	12	14.2	34.2	54.5	0	55.0
	13	15.5	35.2	54.4	0	60.0
April	14	18.7	35.3	58.0	0	62.9
	15	18.3	35.4	53.2	0	65.5
	16	20.5	39.2	41.9	0	68.8
	17	19.7	37.6	46.4	0	71.5
May	18	28.8	35.2	61.6	8.8	77.7
	19	23.7	39.5	46.6	0	78.2
	20	25.2	36.5	64.6	11	82.5

Table 2: Effect of meteorological factors on severity of leaf spot disease of *Aloe vera* during 2018-2019

Month	Standard week	Temperature (^{O}C)		Relative humidity (%)	Rainfall (mm)	PDI
		Min.	Max.			
December	51	5	23.2	71.3	0	0
	52	3.5	21.1	70.8	0	4.9
	1	5.3	22.2	72.2	0	8.8
January	2	5.7	21.8	72	0	11.9
	3	5	22.5	70.5	0	13.1
	4	10.6	21.1	76.1	4.1	14.4
	5	7.1	21.7	74.9	0	17.7
February	6	8.9	22.3	75.1	1	24.4
	7	10.5	21.8	76.6	0	31.1
	8	11.2	25.3	69.1	0	35.5
	9	10	22.9	72.7	0	39.9
March	10	10.6	29.5	66.9	0	47.5
	11	12.7	30.0	61.4	0	50.0
	12	14.2	31.9	60.5	0	52.5
	13	17.4	34.0	62.1	0	54.3
April	14	18.9	34.8	61.3	2	57.2
	15	21.2	37.5	56.6	0	62.5
	16	19.2	35.0	66.6	0	64.4
	17	23.2	40.1	53.07	0	68.8
May	18	24.5	40.0	54.6	0	71.0
	19	24.9	42.0	45.5	0	73.3
	20	24.2	39.5	45.8	0	77.5

Table 3: Correlation coefficients between percent disease intensity of leaf spot of *Aloe vera* and meteorological factors during 2017-18 and 2018-19.

S. No.	Weather parameters	Correlation coefficient	
		2017-18	2018-19
1	Minimum temperature	0.938**	0.952**
2	Maximum temperature	0.937**	0.935**
3	Relative Humidity	-0.844**	-0.847**
4	Rainfall	0.440*	-0.171

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