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EFFECT OF DIFFERENT WEATHER PARAMETERS ON BLAST DISEASE SEVERITY OF PEARL MILLET UNDER NORTH GUJARAT CONDITION

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Abstract– A study was conducted to find out the effect of weather factors on the progress of pearl millet blast disease during *Kharif* seasons 2018 and 2019. The first leaf blast intensity was recorded from the initiation of disease fifteen days after sowing and gradually increased up to harvesting on all different dates of sowing in both crop seasons. All the weather parameters (max temp. (-0.358), min temp. (-0.795), morning relative humidity (-0.524), evening relative humidity (-0.327), rainfall (-0.543), and rainy days (-0.535)) exhibited a negative correlation in the D_1 date of sowing. While in D_2, D_3, and D_4, maximum temperature (0.314), (0.506), and (0.608) showed positive relationships, other weather parameters (min. temperature (-0.840), (-0.510), and (-0.917), morning relative humidity (-0.563), (-0.615), and (-0.735), evening relative humidity (-0.606), (-0.700), and (-0.775), rain fall (-0.659), (-0.439), and (-0.392), and rainy days (-0.526), (-0.514), and (-0.594) exhibited negative relationships with blast disease intensity, respectively, during 2018.In 2019, D_1, D_2, and D_3 morning relative humidity (0.790), (0.683) and (0.253), evening relative humidity (0.747), (0.595) and (0.302), rain fall in mm (0.445), (0.189) and (0.071), and rainy days (0.697), (0.535) and (0.413) showed a positive relationship, while maximum temperature (-0.774), (-0.643) and (-0.404) and minimum temperature (-0.662), (-0.711) and (-0.602) exhibited a negative relationship with disease intensity. In D_4, the minimum temperature (-0.674), morning relative humidity (-0.617), evening relative humidity (-0.480), rain fall (-0.048), and rainy days (-0.096) showed negative relationships, while only the maximum temperature (0.289) exhibited a positive relationship with disease intensity.

INTRODUCTION

The pearl millet crop is infected by many diseases at different growth stages, which cause yield reduction and economic losses to the grower. Several important diseases affect pearl millet, including downy mildew (*Sclerospora graminicola*), rust (*Puccinia substriata*), smut (*Tolyposporium penicillariae*), and ergot (*Claviceps fusiformis*), but in recent years, blast (*Pyricularia grisea*) disease has emerged as a serious disease that affects both forage and grain production of pearl millet (Thakur *et al*., 2011). During the last five years, there have been outbreaks of blast disease (*Pyricularia grisea*) in severe form in some states of India. In its 2009 Consortium Consultation Meeting (CCM), ICRISAT discussed and identified the blast of pearl millet as a major problem with a serious threat to pearl millet productivity. It is considering the devastating nature of disease and economic crop losses. Looking at the threat of pearl millet blast and subsequent damage to pearl millet cultivation, it felt worthwhile to study this disease.

Weather parameters play an important role in disease development. Various weather variables such as temperature (T), relative humidity (RH), and rainfall influence different stages of the infection process and disease development. Interaction between these weather variables (independent variables) and disease development (dependent variables) paves the way for the development of prediction models for adopting timely protection measures.

[3]Deputy Manager

MATERIALS AND METHODS

A field experiment with four different sowing dates and five replications was conducted in a randomized block design (RBD) during the *Kharif* seasons of 2018 and 2019. Between two sowings, a one-week interval was maintained. After seed germination, 10 plants from each plot were randomly selected and tagged. Blast disease infection on susceptible varieties was recorded at weekly intervals, adjusting the meteorological standard for the field. Then we observed the leaves of the labeled plant weekly and recorded the blast disease intensity using a 0–9 scale at intervals until harvest.

Experimental details

a) Experimental design:Randomized Block Design
b) Replications : 5
c) Plot size : Gross : 3.6 m x 4.0 mNet : 2.70 m x 3.0m
d) Spacing : 45 x 10 cm
e) Treatments : 4:T_1 = 27/06/2018 and 2019 T_2 = 04/07/2018 and 2019 T_3 = 11/ 07/2018 and 2019 T_4 = 18/07/2018 and 2019

RESULTS AND DISCUSSION

Progressive disease development

In season 2018, disease started on 12th July(4.33%), and maximum disease intensity (71.36%) was observed on 13th September on the first date of sowing (D_1: 27th June). On the second date of sowing (D_2: 4thJuly), disease started on 19th July (5.91%), and maximum disease intensity (60.02%) was observed on 20th September. On the third date of sowing (D_3: 11thJuly), the disease started on 26th July (2.93%), and maximum disease intensity (68.22%) was observed on 27th September. On the fourth date of sowing (D_4: 18th July), disease started on 2ndAugust (1.51%), and maximum disease intensity (69.20%) was observed on 4thOctober. The disease gradually increased throughout the season of sowing.

During 2019, disease began on 12th July (2.58%), with the highest disease intensity (70.18%) observed on 13th September in the first date of sowing (D_1: 27th June). On the second date of sowing (D2: 4th July), disease started on 19th July (1.46%), and maximum disease intensity (66.51%) was observed on 20th September. On the third date of sowing (D_3: 11th July), disease started on 26th July (3.76%), and maximum disease intensity (72.71%) was observed on 27th September. On the fourth date of sowing (D_4: July 18), disease started on 2nd August (7.57%), and maximum disease intensity (75.78%) was observed on 4th October. The disease gradually increased throughout the season of sowing.

Weather parameters

During the cropping period of *Kharif* season 2018, maximum temperatures showed a range from 30.50 °C to 39.50 °C. The minimum temperature ranged from 20.90 °C to 25.80 °C. The morning relative humidity ranged from 68 to 86 percent. Evening relative humidity showed a range of 27 to 83 percent. However, ten rainy days and 293.5 mm of rain were noted during the cropping period.

In *Kharif* season 2019, cropping period maximum

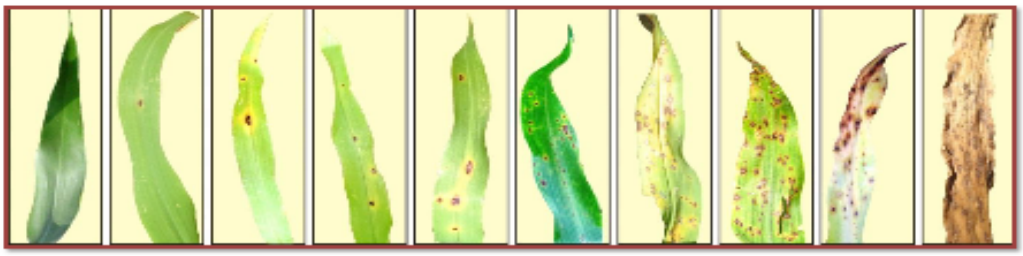

Plate I: 0-9 scale for disease evolution

Table 1. Effect of meteorological parameters on blast development on highly susceptible cultivar (ICMB 95444) of pearl millet (*kharif* 2018)

Sr. No.	Date of Observation	Meteorological Standard Week	Atmospheric Temperature (ºC)		Relative Humidity (%)		Rainy days	Total rainfall (mm)	Disease intensity (%)			
			Max	Min	Morning	Evening			D_1	D_2	D_3	D_4
1.	12/07/2018	28	34.1	25.4	85	70	2	97.7	4.33	-	-	-
2.	19/07/2018	29	31.0	25.8	86	83	2	101.5	12.89	5.91	-	-
3.	26/07/2018	30	30.5	25.3	82	77	1	2.8	18.67	11.82	2.93	-
4.	02/08/2018	31	32.7	25.8	82	70	0	0.0	25.02	16.73	11.27	1.51
5.	09/08 /2018	32	33.4	25.0	79	67	1	3.0	29.60	20.33	16.13	6.62
6.	16/08 /2018	33	31.9	25.2	83	79	2	68.0	49.49	35.51	26.91	16.00
7.	23/08 /2018	34	30.8	24.8	83	78	1	4.5	58.84	43.69	37.04	31.73
8.	30/09 /2018	35	31.6	24.4	82	72	1	16.0	63.16	49.16	45.64	41.02
9.	06/09 /2018	36	31.9	24.1	81	73	0	0.0	67.67	53.67	53.42	50.62
10.	13/09 /2018	37	31.5	22.6	80	56	0	0.0	71.36	57.29	59.64	58.71
11.	20/09 /2018	38	35.1	21.8	74	45	0	0.0	-	60.02	63.47	64.98
12.	27/09 /2018	39	36.6	21.3	68	35	0	0.0	-	-	68.22	66.36
13.	04/10/2018	40	39.5	20.9	68	27	0	0.0	-	-	-	69.20

Table 2. Effect of meteorological parameters on blast development on highly susceptible cultivar (ICMB 95444) of pearl millet (*kharif* 2019)

Sr. No.	Date of Observation	Meteorological Standard Week	Atmospheric Temperature (ºC)		Relative Humidity (%)		Rainy days	Total rainfall (mm)	Disease intensity (%)			
			Max	Min	Morning	Evening			D_1	D_2	D_3	D_4
1.	12/07/2019	28	36.2	25.7	69	63	0	0.0	2.58	-	-	-
2.	19/07/2019	29	37.6	26.6	61	59	1	20	5.29	1.46	-	-
3.	26/07/2019	30	37.2	25.6	71	66	2	19.2	20.98	15.18	3.76	-
4.	02/07/2019	31	32.5	25.6	81	77	2	28	35.47	30.47	20.20	7.57
5.	09/08 /2019	32	31.3	25.0	83	78	4	105	41.73	37.11	29.46	22.32
6.	16/08 /2019	33	30.3	23.9	82	80	4	103	45.98	40.93	35.21	28.68
7.	23/08 /2019	34	33.2	24.7	78	68	1	24	48.82	43.56	38.29	31.40
8.	30/08 /2019	35	30.3	24.9	81	81	4	150.2	56.38	50.89	45.80	38.69
9.	06/09 /2019	36	33.1	25.2	76	73	3	34.7	59.56	53.78	48.98	41.76
10.	13/09 /2019	37	32.5	25.1	81	75	3	29	70.18	63.38	59.60	52.98
11.	20/09 /2019	38	33.6	24.4	77	72	3	25	-	66.51	65.02	60.89
12.	27/09 /2019	39	31.8	24.1	79	78	4	68.8	-	-	72.71	67.33
13.	04/10/2019	40	32.7	23.3	76	63	1	80	-	-	-	75.78

temperatures showed a range from 30.30 °C to 37.60 °C. The minimum temperature showed a range from 23.30 °C to 26.60 °C. The morning relative humidity ranged from 61 to 83 percent. Evening relative humidity showed a range of 59 to 81 percent. However, thirty-two rainy days and 686.90 mm of rain were recorded during the cropping period.

Correlation study

Correlation coefficient data are presented in Table 3 during 2018. In D_1 date of sowing all the weather parameters max temp. (-0.358), min temp. (-0.795), morning relative humidity (-0.524), evening relative humidity (-0.327), rainfall (-0.543) and rainy days (-0.535) exhibited negative correlation.

In D_2, D_3 and D_4 maximum temperature (0.314) (0.506) and (0.608) showed positive relationship while other weather parameters min. temperature (-0.840), (-0.510) and (-0.917), morning relative humidity (-0.563), (-0.615) and (-0.735), evening relative humidity (-0.606), (-0.700) and (-0.775), rain fall (-0.659), (-0.439) and (-0.392) and rainy days (-0.526), (-0.514) and (-0.594) exhibited negative relationship with blast per cent disease intensity at 5 percent level, respectively.

Correlation coefficient data of 2019 with weather parameters were presented in Table 4. In D_1, D_2 and D_3 morning relative humidity (0.790), (0.683) and (0.253), evening relative humidity (0.747), (0.595) and (0.302), rain fall in mm (0.445), (0.189) and (0.071) and rainy days (0.697), (0.535) and (0.413) showed positive relationship while maximum temperature (-0.774), (-0.643) and (-0.404) and minimum temperature (-0.662), (-0.711) and (-0.602) exhibited negative relation with blast disease intensity. In D_4 minimum temperature (-0.674), morning relative humidity (-0.617), evening relative humidity (-0.480), rain fall (-0.048) and rainy days (-0.096) showed negative relation while only maximum temperature (0.289) exhibited positive relationship with bajra blast per cent disease intensity at 5 per cent level.

Joshi *et al*. (2011) observed that blast was

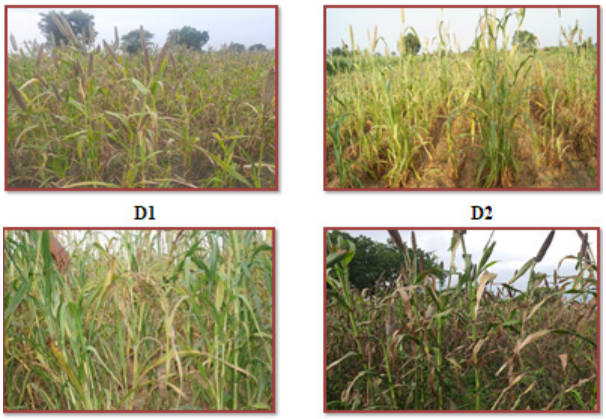

Plate X : Effect of different sowing dates on blast disease intensity of pearl millet

Table 3. Correlation coefficient between blast of pearl millet and weather parameters (*Kharif* - 2018)

Sr. No.	Weather parameters	Correlation coefficient ('r') of different sowing dates			
		D_1	D_2	D_3	D_4
1	Maximum temperature (^{0}C)	-0.358	0.314	0.506	0.608*
2	Minimum temperature (^{0}C)	-0.795*	-0.840*	-0.510	-0.917*
3	Morning relative humidity (%)	-0.524	-0.563	-0.615	-0.735*
4	Evening relative humidity (%)	-0.327	-0.606*	-0.700*	-0.775*
5	Rain Fall (mm)	-0.543	-0.659*	-0.439	-0.392
6	Rainy Days	-0.535	-0.526	-0.514	-0.594

*Correlation coefficient (r) significant at 0.05 level. Critical value 0.632, N= 10

Table 4. Correlation coefficient between blast of pearl millet and weather parameters (*Kharif* - 2019)

Sr. No.	Weather parameters	Correlation coefficient ('r') of different sowing dates			
		D_1	D_2	D_3	D_4
1	Maximum temperature (^{0}C)	-0.774*	-0.643*	-0.404	0.289
2	Minimum temperature (^{0}C)	-0.662*	-0.711*	-0.602*	-0.674*
3	Morning relative humidity (%)	0.790*	0.683*	0.253	-0.617
4	Evening relative humidity (%)	0.747*	0.595	0.302	-0.480
5	Rain Fall (mm)	0.445	0.189	0.071	-0.048
6	Rainy Days	0.697*	0.535	0.413	-0.096

* Correlation coefficient (r) is significant at 0.05 level. Critical value 0.632, N= 10

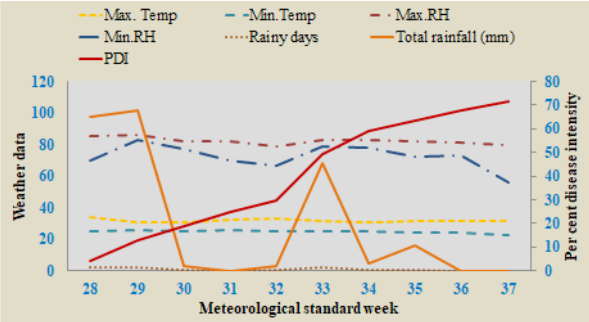

Fig. 4.8a: Effect of different weather parameters on blast of pearl millet in (D_1: 27th June) sowing during *Kharif* 2018

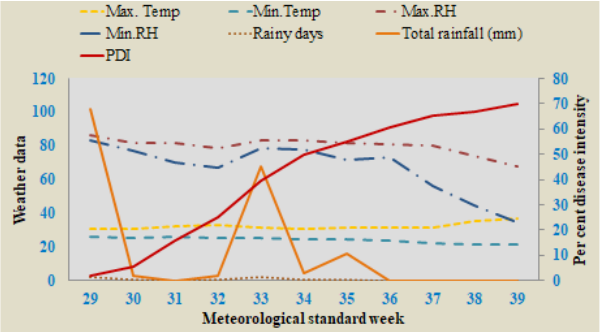

Fig. 4.8b: Effect of different weather parameters on blast of pearl millet in (D_2: 04th July) sowing during *Kharif* 2018

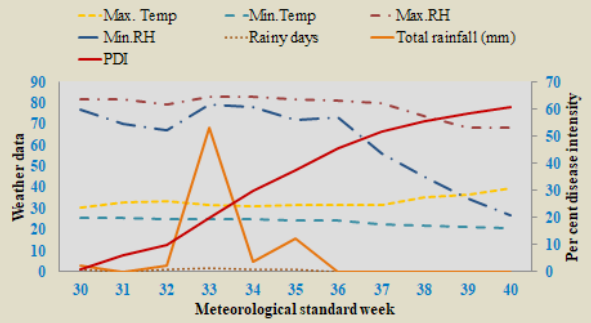

Fig. 4.8c: Effect of different weather parameters on blast of pearl millet in (D_3: 11th July) sowing during *Kharif* 2018

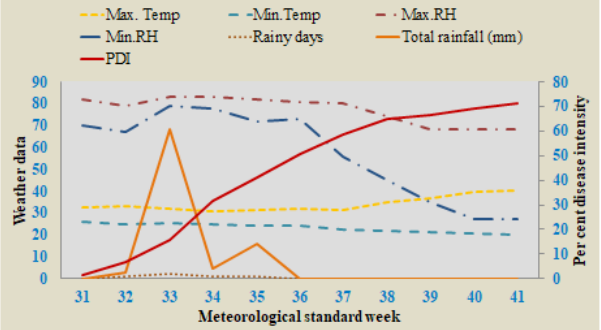

Fig. 4.8d: Effect of different weather parameters on blast of pearl millet in (D_4: 18th July) sowing during *Kharif* 2018

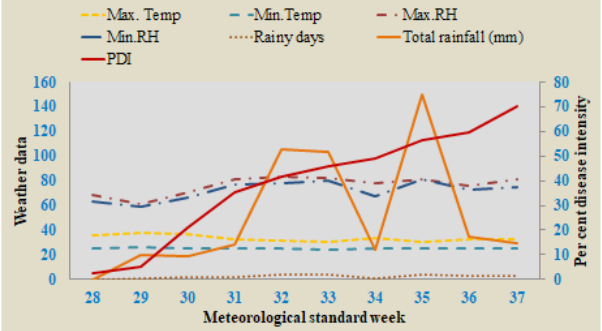

Fig. 4.9a: Effect of different weather parameters on blast of pearl millet in (D_1: 27th June) sowing during *Kharif* 2019

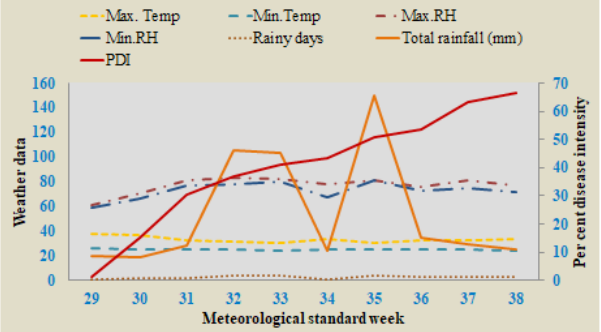

Fig. 4.9b: Effect of different weather parameters on blast of pearl millet in (D_2: 04th July) sowing during *Kharif* 2019

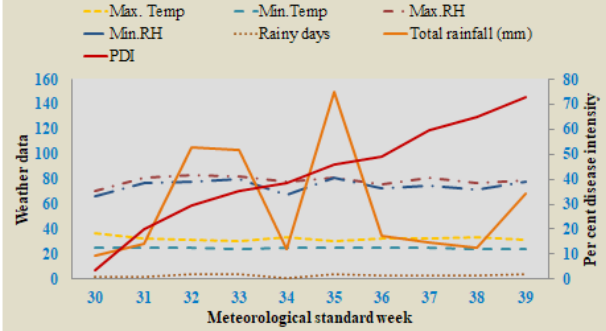

Fig. 4.9c: Effect of different weather parameters on blast of pearl millet in (D_3: 11th July) sowing during *Kharif* 2019

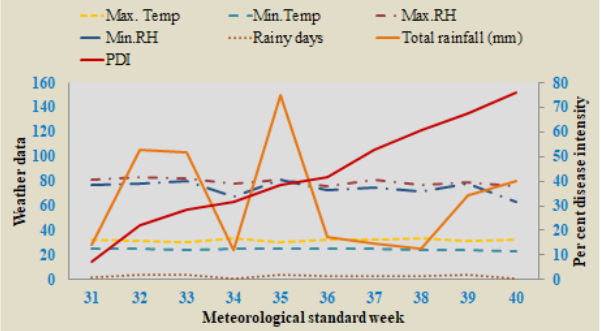

Fig. 4.9d: Effect of different weather parameters on blast of pearl millet in (D_4: 18th July) sowing during *Kharif* 2019

negatively correlated with evening relative humidity (RH_2) and rainfall (RF). While, temperature (max.) and bright sunshine hours (BSS) were significantly positively. Morning relative humidity (RH1) was not significantly positive, but positively correlated with diseased development.

Naqvi and Perveen (2015) revealed that rainfall and relative humidity showed a positive correlation whereas maximum temperature depicted a negative correlation and remained irresponsive in disease development.

Yadav *et al*. (2016) studied that the significant and negative correlation with average maximum temperature (r = - 0.647). In contrast to temperature, the maximum relative humidity and minimum relative humidity showed a significant positive relationship with the disease that is r = 0.764 and r = 0.820, respectively. The total rainfall showed a significant positive relationship with the disease (r = 0.668) indicate that the blast severity increases with the increase in total rainfall.

Kaurav and Pandya (2019) observed that infection and development of blast positively and significantly influenced by maximum relative humidity (r = 0.724), minimum relative humidity (r = 0.650), rainfall (r = 0.884) while it was negatively and significantly influenced by maximum temperature (r = -0.463) and minimum temperature (r = -0.638).

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