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Correlation of seasonal incidence of major pests and diseases of chilli with weather parameters in old alluvial zone of West Bengal of India

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Abstract

The present investigation was carried out at Instructional Farm, COA (Extended Campus), UBKV, Majhian, Dakshin Dinajpur, West Bengal to study the seasonal incidence of major pest and diseases of chilli. Among various diseases and insect pests, anthracnose, Cercospora, wilt, thrips, whitefly and *Helicoverpa armigera* was found to be more prevalent. The disease severity (PDI) of the dominant diseases and incidence of major pests were recorded at seven days interval up to the harvesting of the crop. It was observed that the onset of the diseases was at 52 SMW which progresses significantly and reached peak at 20 SMW. The thrips, whitefly and *H. armigera* were observed to be initiated at 2 SMW, 6 SMW and 9 SMW, respectively and reached its peak at 10 SMW, 10 SMW and 14 SMW, respectively during 2016-17. During 2017-18, the population was initiated at 4 SMW, 4 SMW and 8 SMW for thrips whitefly and *H. armigera*, respectively and reaches its peak at 12 SMW, 14 SMW and 12 SMW, respectively. The record of the metrological parameters was also taken and statistically correlated with the disease incidence and pest population.

Keywords: Anthracnose, Cercospora, wilt, thrips, whitefly, *Helicoverpa armigera*

Introduction

Chilli, *Capsicum annum* L. is an annual herbaceous vegetable and spice grown in both tropical and sub-tropical regions. The crop is grown in almost all states of India, such as Andhra Pradesh, Maharashtra, Karnataka, Gujarat, Tamil Nadu West Bengal and Orissa. India accounts for 25% of the world's total production of chilli. The sustainability of chilli-based agriculture is threatened by a number of factors. Main biotic stresses such as bacterial wilt, anthracnose, collar rot, twig blight, leaf spot, viruses and several insect pests have been reported to impair the crop productivity (Reang *et al.*, 2018) ^[1]. Besides these insect pests are also the major factor that causes inferior growth and low yield of chilli. The damages ranging of about 50-90 percent have been reported (Moanaro and Choudhary, 2018) ^[2] which can be even higher if favoured by suitable environmental factor. Among various pests, whitefly, thrips, and *Helicoverpa armigera* are of major concern (Rao and Ahmed, 1985; Reddy and Puttaswamy, 1983; Sahu *et al.*, 2018) ^[3, 4, 5]. The Anthracnose disease is also a major problem in India and one of the more significant economic constraints to chilli production worldwide, especially in tropical and subtropical regions. Apart from anthracnose and viral diseases, presently twig blight and leaf spot of chilli has becoming the major constraints in chilli production. Disease and pest management in chilli has been largely dependent on host plant resistance or, in chemical control. Management of the disease and pest under the prevailing farming systems in India has become a recurrent problem to chilli growers as most of the farmers depend on chemical control. Therefore, in the present investigation efforts were made on the region-oriented study to analyze the population dynamics of sucking pest complex and major disease incidence under old alluvial zone of West Bengal and also to analyze the factor affecting the disease incidence and pest population so that the results will get benefit in implementing various management practices.

Materials and Methods

The field experiment was laid out in Randomized Block Design (RBD) with three replications during two Rabi seasons (2016-17 and 2017-18) at Instructional Farm, COA (Extended Campus), UBKV, Majhian, Dakshin Dinajpur. The seeds of a local variety of Chilli (Akashi)

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were sown in small beds for raising nursery and 35 days old seedlings were transplanted into the field with 60 cm inter and 60 cm intra row spacing in plots measuring 5.0 m x 4.0 m following the recommended package and practices. No plant protection chemicals were applied during the experiment. The insect pest and disease complex associated with chilli crop were monitored and recorded right from germination till the harvest of the crop at weekly interval. Plants were tagged for taking the observation on disease incidence of Anthracnose on fruits and leaves, Cercospora leaf spot and wilt. The Percent disease incidence (PDI) was recorded at every seven days interval up to the harvesting of the chilli crop. The scoring of anthracnose disease severity assessment on fruits was done based on 0-5 scale and converted to percent disease index as described by Mckinney (1923) and the estimation of disease on chilli leaves was done following 0-9 scale as suggested by Mckinney (1923). For taking the observations on thrips and whiteflies, five plants were randomly selected from each plot and the number of insects (thrips/whiteflies) were counted on top, middle and bottom leaves per plant. The *Helicoverpa armigera* populations were recorded from five randomly selected plants per plot. The data on weather parameters viz., maximum temperature, minimum temperature, morning relative humidity, evening relative humidity and rainfall were obtained from Agrometeorological Field Unit, Regional Research station, UBKV, Majhian and were correlated with the recorded populations of the major insect pest and diseases in the region i.e., Anthracnose (in fruits and leaves), cercospora, wilt, thrips, whitefly and *H. armigera*. The mean of the seven days weather parameter data are taken except for the rainy day where entire period of the rainy days are worked out for assessment of disease.

Results and Discussion

The seasonal incidence of major disease and pest of chilli were observed for two consecutive Rabi seasons during 2016-17 and 2017-18 and is presented on table 1 and 2. Among the diseases observed anthracnose was recorded highest on both fruits during both the seasons under study. The infection of anthracnose on fruits was recorded highest (14.84 and 12.02) as compared to infection on leaves (4.64 and 4.4) during both the years under study i.e., 2016-17 and 2017-18. The infection leaf spot disease caused by *Cercospora* sp. was recorded maximum (7.78) during 2016-17 as compared to Rabi season during 2017-18 (3.84). The maximum wilt disease incidence (8.31) was also recorded during 2016-17 than in Rabi season during 2017-18 (5.24).

The data on incidence of major pest were also recorded during 2016-17 and 2017-18 and is presented on table 1 and 2.

During 2016-17, the population of *thrips* ranged from 2.46 to 9.12 per 3 leaves throughout the crop growing period. It was first appeared at 2 SMW (standard meteorological week) with the intensity 2.46 no. per three leaves. The *thrips* intensity gradually increased till 10 SMW, attending its peak with a value of 9.12/ 3 leaves and thereafter starts declining. However, during 2017-18 thrips population ranged from 1.86 to 7.14 per 3 leaves with lowest recorded on 4 SMW and highest at 14 SMW. The population dynamics of white fly was also recorded with various level of infestation at different SMW on chilli. The incidence ranged from 1.08 (17 SMW) to 6.48 (10 SMW) during 2016-17 and 1.88 (19 SMW) to 5.86 (12 SMW) during 2016-17 and 2017-18. The incidence of *Helicoverpa armigera* started at 9 SMW with lowest population (0.82/plant) and highest at 14 SMW (2.88/plant) during 2016-17. However, during 2017-18 incidence of *H. armigera* started at 8 SMW with lowest population recorded (0.48/plant) and highest at 12 SMW (3.02/plant).

The correlation of the disease and pest incidence with the prevailing weather parameters during 2016-17 and 2017-18 were also done and is presented in table 2 and 4. A positive and significant correlation of anthracnose disease, cercospora leaf spot and wilt was found with T_{max} , T_{min} , RH_{min} and RF and a negative correlation with RH_{max} . during both the years under study. However only a positive and significant correlation of thrips was found with T_{max} (0.675; 0.874) and T_{min} (0.655; 0.722) during 2016-17 and 2017-18. A positive and significant correlation of white fly population was found with T_{max} (0.626) during 2016-17 and with both T_{max} (0.784) and T_{min} (0.613) during 2017-18. The correlation of *H. armigera* population was found positive and significant with T_{min} (0.560) during 2016-17 and with both T_{max} (0.686) and T_{min} (0.516) during 2017-18.

Similar report of disease incidence of anthracnose, leaf spot and wilt disease have also been reported by Reang et al (2018) [1] and correlation of disease incidence has also been reported by Meenu and Garg (2002) [6] and Begum et al (2017) [7]. in chilli. The report of similar seasonal incidence of thrips, whitefly and *H. armigera* have also been reported by Meena et al. (2013) [8], Roopa and kumar (2014) [9], Bokan et al. (2015) [10] and Moanaro and Choudhary (2018) [2].

In conclusion environmental factor plays a vital role in disease and pest incidence and are used for forecast of different disease severity and pest incidence. A better understanding is indeed required to know the incidence, development, spread of diseases and pests so that a well organised Agro advisory can be provided to the farmers to take up timely management practices.

Table 1: Seasonal incidence of major disease and insect pests of chilli in relation to weather parameters during 2016-17

SMW	T _{max}	T _{min}	RH _{max}	RH _{min}	Rainfall (mm)	Anthracnose (Fruits)	Anthracnose (Leaves)	Cercospora Leaf spot	Wilt	Thrips/ 3 leaves	Whitefly/ 3 leaves	H. armigera /Plant
52 SMW	27.0	13.0	91.0	48	0.0	1.32	1.10	1.84	0.22	0.00	0.00	0.00
1 SMW	26.6	12.3	93.6	56.4	0.0	3.24	1.26	2.20	0.30	0.00	0.00	0.00
2 SMW	26.6	12.8	93.1	47.1	0.0	4.42	1.58	2.51	0.36	2.46	0.00	0.00
3 SMW	27.0	12.7	92.2	63.2	0.0	6.34	1.86	2.94	0.38	3.84	0.00	0.00
4 SMW	28.1	15.0	93.2	50.2	0.8	6.89	2.11	3.22	0.42	2.12	0.00	0.00
5 SMW	27.1	15.1	92.0	49.6	0.0	7.41	2.34	3.46	1.00	2.98	0.00	0.00
6 SMW	29.4	16.1	92.1	68.4	0.0	8.1	2.48	3.74	2.24	3.64	1.22	0.00
7 SMW	31.2	18.1	95.0	56.1	0.0	8.56	2.67	3.91	2.28	3.82	1.46	0.00
8 SMW	31.2	19.7	90.7	45.2	0.0	9.62	2.84	4.22	3.00	4.98	2.86	0.00
9 SMW	32.7	18.1	97.0	62.3	0.0	10.22	2.92	4.54	3.1	7.92	4.16	0.82
10 SMW	32.5	19.3	91.5	59.0	0.0	11.56	3.08	4.76	3.28	9.12	6.48	1.18
11 SMW	30.7	17.1	88.0	60.1	2.9	12.43	3.24	4.90	3.32	8.48	4.28	1.86
12 SMW	29.3	21.5	83.0	73.7	1.9	12.68	3.56	5.13	4.12	8.26	3.98	1.68
13 SMW	28.6	22.4	91.3	78.8	14.3	13.12	3.63	5.76	6.2	6.64	2.14	1.32
14 SMW	28.6	22.4	92.7	77.9	0.3	13.24	3.84	6.32	6.86	7.84	2.64	2.88
15 SMW	34.5	21.6	79.3	45.1	0.8	14.2	3.90	6.44	6.92	8.72	2.48	2.14
16 SMW	30.6	22.2	91.1	77.1	10.6	14.22	4.00	6.94	7.00	6.48	1.86	2.06
17 SMW	30.3	23.5	93.6	69.7	17.0	14.32	4.21	7.65	7.13	4.58	1.08	1.56
18 SMW	32.8	22.3	83.4	68.7	0.1	14.56	4.32	7.72	8.21	5.16	2.11	0.00
19 SMW	31.7	23.2	86.1	76.8	7.6	14.68	4.45	7.74	8.22	4.78	0.00	0.00
20 SMW	27.8	20.5	84.5	72.1	6.3	14.84	4.64	7.78	8.31	4.29	0.00	0.00

Table 2: Seasonal incidence of major disease and insect pests of chilli in relation to weather parameters during 2017-18

SMW	T _{max}	T _{min}	RH _{max}	RH _{min}	Rainfall (mm)	Anthracnose (Fruits)	Anthracnose (Leaves)	Cercospora Leaf spot	Wilt	Thrips/ 3 leaves	Whitefly/ 3 leaves	H. armigera /Plant
52 SMW	25.2	13.1	90.3	61.3	0	0.62	0.49	0.25	0	0	0	0
1 SMW	21.5	9.5	96	63.6	0	0.84	0.62	0.34	0	0	0	0
2 SMW	17	6.8	99.1	68.9	0	1.24	0.94	0.68	0.22	0	0	0
3 SMW	19.8	9.1	100	67.7	0	2.64	1.12	0.82	0.34	0	0	0
4 SMW	23.6	9.5	90.7	46.3	0	2.9	1.34	1	0.6	1.86	0	0
5 SMW	23.2	9.8	97.3	54.3	0	3.56	1.56	1.22	0.72	2.78	0	0
6 SMW	26	12.5	70.1	36.1	0	3.84	1.84	1.34	0.78	2.98	2.46	0
7 SMW	26.6	14	77	42.7	0	4.68	2.2	1.6	0.9	3.46	3.78	0
8 SMW	28.9	15.8	74.3	46.6	0	5.1	2.43	1.84	0.96	4.62	3.92	0.48
9 SMW	29.3	17.9	85.4	51.4	0.1	5.62	2.62	2	1.12	4.74	4.58	1.02
10 SMW	31.3	16.6	67.1	37.1	0	6.42	2.8	2.24	1.24	6.24	5.34	1.84
11 SMW	32	18.8	69.9	45.9	0	6.96	3	2.44	1.28	6.56	4.86	2.52
12 SMW	33.3	19.3	77.7	49	0	7.48	3.12	2.64	1.36	8.48	5.86	3.02
13 SMW	31.1	20.6	79.7	64.6	7.7	7.94	3.36	2.78	1.42	6.44	5.12	2.88
14 SMW	31.9	21.2	75.1	58.9	0	8.54	3.58	2.88	2.2	7.14	5.42	2.24
15 SMW	31.8	22.4	76.9	60.7	0.7	9.1	3.64	3	2.42	6.88	4.12	2.04
16 SMW	31.5	23	82.1	68	0.9	9.54	3.84	3.24	3.52	6.28	4.64	1.36
17 SMW	31.8	22.4	79	67.9	5.3	10.2	3.9	3.46	3.74	5.36	3.36	1.02
18 SMW	28.2	21.1	87	82.1	11.9	10.72	4.12	3.6	4.48	3.98	2.68	0
19 SMW	30.9	22.6	88.6	72.6	4.8	11.42	4.24	3.7	4.86	3.74	1.88	0
20 SMW	30.9	23.4	85.1	77	15.5	12.02	4.4	3.84	5.24	2.12	0	0

Table 3: Correlation matrix of disease severity and pest infestation with different weather parameter (2016-17)

	T _{max}	T _{min}	RH _{max}	RH _{min}	Rainfall (mm)	Anthracnose Fruits (PDI)	Anthracnose Leaves (PDI)	Cercospora (PDI)	Wilt (PDI)	Thrips/ 3 leaves	Whitefly/ 3 leaves	H. armigera /Plant
T _{max}	-											
T _{min}	0.622**	-										
RH _{max}	-0.361 ^{NS}	-0.438*	-									
RH _{min}	0.057 ^{NS}	0.622**	-0.114 ^{NS}	-								
Rainfall (mm)	0.042 ^{NS}	0.580**	-0.024 ^{NS}	0.579**	-							
Anthracnose Fruits (PDI)	0.626**	0.931**	-0.519*	0.631**	0.529*	-						
Anthracnose Leaves (PDI)	0.571**	0.938**	-0.539*	0.650**	0.552**	0.982**	-					
Cercospora (PDI)	0.543*	0.917**	-0.516*	0.651**	0.596**	0.951**	0.984**	-				
Wilt (PDI)	0.526*	0.923**	-0.548*	0.658**	0.576**	0.922**	0.964**	0.982**	-			
Thrips/ 3 leaves	0.675**	0.655**	-0.346 ^{NS}	0.363 ^{NS}	0.144 ^{NS}	0.747**	0.634**	0.542*	0.529*	-		
Whitefly/ 3 leaves	0.626**	0.390 ^{NS}	-0.105 ^{NS}	0.120 ^{NS}	-0.095 ^{NS}	0.420 ^{NS}	0.291 ^{NS}	0.201 ^{NS}	0.190 ^{NS}	0.838**	-	
H. armigera /Plant	0.335 ^{NS}	0.560**	-0.194 ^{NS}	0.383 ^{NS}	0.328 ^{NS}	0.564**	0.478*	0.441*	0.466*	0.750**	0.565**	-

** Correlation is significant at the 0.01 level

*Correlation is significant at the 0.05 level

Table 4: Correlation matrix of disease severity and pest infestation with different weather parameter (2017-18)

	T _{max}	T _{min}	RH _{max}	RH _{min}	Rainfall (mm)	Anthracnose Fruits (PDI)	Anthracnose Leaves (PDI)	Cercospora (PDI)	Wilt (PDI)	Thrips/ 3 leaves	Whitefly/ 3 leaves	H. armigera /Plant
T _{max}	-											
T _{min}	0.911**	-										
RH _{max}	-0.753**	-0.526*	-									
RH _{min}	-0.071 ^{NS}	0.317 ^{NS}	0.552**	-								
Rainfall (mm)	0.285 ^{NS}	0.534*	0.050 ^{NS}	0.660**	-							
Anthracnose Fruits (PDI)	0.800**	0.936**	-0.411 ^{NS}	0.399 ^{NS}	0.658**	-						
Anthracnose Leaves (PDI)	0.834**	0.946**	-0.482*	0.332 ^{NS}	0.609**	0.993**	-					
Cercospora (PDI)	0.813**	0.940**	-0.436*	0.380 ^{NS}	0.640**	0.997**	0.997**	-				
Wilt (PDI)	0.580**	0.815**	-0.152 ^{NS}	0.599**	0.765**	0.925**	0.886**	0.908**	-			
Thrips/ 3 leaves	0.874**	0.722**	-0.752**	-0.241 ^{NS}	0.001 ^{NS}	0.636**	0.702**	0.671**	0.323 ^{NS}	-		
Whitefly/ 3 leaves	0.784**	0.613**	-0.805**	-0.349 ^{NS}	-0.122 ^{NS}	0.475*	0.563**	0.517*	0.150 ^{NS}	0.929**	-	
H. armigera /Plant	0.686**	0.516*	-0.596**	-0.218 ^{NS}	-0.111 ^{NS}	0.368 ^{NS}	0.432 ^{NS}	0.406 ^{NS}	0.027 ^{NS}	0.858**	0.825**	-

** Correlation is significant at the 0.01 level *Correlation is significant at the 0.05 level

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