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Climatic factors influencing whiteflies infesting chilli

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Abstract
During *Kharif* season of 2016-17 the field experiment was conducted at the Research Farm of Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani to study the influence of cliamatic factors on whitefly population on chilli cv., PBN C-1 in non-replicated design. The incidence of Whitefly *Bemisia tabaci* (Gennadius), initiated from 34th Standard Meteorological Week (2.72 whiteflies/plant) and then the population gradually increased and attained peak during 39th SMW (6.86 whiteflies/leaf) when the corresponding maximum and minimum temperature, morning and evening relative humidity, evaporation, bright sunshine hours and wind velocity were 30.2 and 21.7 ^{0}C, 91 and 73 per cent, 3.3 mm, 3.7 hrs and 4.7 kmph, respectively. Thereafter the population decreased up to 41st SMW and again population increased with second peak (5.12 whiteflies/leaf) during 42nd SMW, since then population showed decreasing trend up to 52nd SMW and thereafter it was disappeared up to end of season. As regard the correlation studies, whitefly had significant and positive correlation with minimum temperature (r=0.628*), morning relative humidity (r=0.576*) and evening relative humidity (r=0.606*), while the negatively significant correlation of whitefly was noticed with bright sunshine hours (r=-0.487*).

Keywords: Seasonal incidence, whitefly and chilli

Introduction
Chilli, (*Capsicum annuum* L.) is one of the important Solanaceous crops cultivated widely throughout the world, especially in tropical and subtropical regions. Several sources concordantly put the origin of chilli in Bolivia or Brazil (Andrews, 1984 and Paterson, 2000) [1, 11]. It was first introduced to India from Brazil by the Portuguese towards the end of fifteenth century and its cultivation became popular in the Seventeenth century and since then, it has gained importance as an important spice and vegetable crop and also become a key element in many cuisines (Greenleaf, 1986) [7]. In India almost all the states produce the crop, Andhra Pradesh is having largest area followed by Telangana, Karnataka, West Bengal, Gujarat and Maharashtra. (Geetha and Selvarani, 2017) [6].
Among the different insect pests of chilli, thrips is the dominant one which can cause 50 to 90 per cent yield loss (Borah, 1987, Varadharajan, 1994 and Patel and Gupta 1998) [5, 15, 10]. Reddy and Reddy (1999) [13] reported that the fruit borers also cause losses to the extent of 90 per cent. The yield of green chilli is also affected by aphid, jassid, whitefly and mite under field conditions (Anon., 1979) [2].
Whitefly (*Bemisia tabaci* Gennadius) has become a major threat to agriculture worldwide. It causes damage to plants directly by sucking the cell sap from leaves and also induces physiological disorders by injecting some phytotoxins into leaves. Besides, whitefly also acts as vector for many of viral diseases in various crops like leaf curl virus in chilli (Mahalakshmi *et al.*, 2015) [8]. Continuous cropping of chilli in certain locality of Maharashtra has increased this pest severity. Because of high pest pressure on chilli, farmers resort to frequent applications of insecticides of different group which leads to resistance development in insects and increase cost of cultivation enormously, making cultivation of chilli crop highly risky.
Therefore for knowing seasonal incidence of Whitefly (*Bemisia tabaci* Gennadius) present study was undertaken with following materials and method.

Materials and Methods
The field experiments were conducted during *Kharif* season of the year 2016-17 to study seasonal incidence of Whitefly and it's correlation with weather parameters in Non-replicated

design at the Research Farm of Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The seedlings of chilli cv., PBNC-1 were transplanted in 10 X 10 m^2 plot with 60 cm x 45 cm spacing which was divided in four quadrants. No insecticidal treatment was applied at any stage of the crop growth.
Observations were recorded from five plant from each quadrant to assess white flies population from five leaves, one from top and two each from middle and bottom of randomly selected five plants from each net plot for mites, whitefly and aphids whereas from five terminal leaves for thrips. (Pathipati *et al*. 2012) [12]. Data so recorded was subjected to correlation and multiple regression between white flies and weather parameter by Panse and Sukhatme (1967) [9] metedology and by using WASP software.

Results and Discussion

Data on seasonal incidence of Whitefly (*Bemisia tabaci* Gennadius), insect pests of chilli is presented in Table 1.
The incidence of thrips was in the range of to 0.00 and 6.86 whiteflies/plant during 2016-17.
During 2016-17, whitefly incidence was first noticed during 34th SMW with intensity of 2.72 whiteflies/plant. Then the population gradually increased and attained peak during 39th SMW (6.86 whiteflies/leaf) when the corresponding maximum and minimum temperature, morning and evening relative humidity, evaporation, bright sunshine hours and wind velocity were 30.2 and 21.7 ^{0}C, 91 and 73 per cent, 3.3 mm, 3.7 hrs and 4.7 kmph, respectively. Thereafter the population decreased up to 41st SMW and again population increased with second peak (5.12 whiteflies/leaf) during 42nd SMW, since then population showed decreasing trend up to 52nd SMW and thereafter it was disappeared up to end of season.

Table 1: Seasonal incidence of Whiteflies on chilli and Weather Parameter during 2016-17

Std. Met. Week	Duration	Whiteflies (No./Leaf)	Temprature (^{0}C)		Humidity (%)		Rainfall (mm)	EVP (mm)	BSS (Hrs.)	WV (Kmph)
			Max	Min	Morning (I)	Evening (II)				
32	08-14 Aug	0.00	31.7	22.1	84	56	0.0	5.2	5.9	6.2
33	15-21 Aug	0.00	31.8	21.4	85	58	11.2	5.0	6.6	5.4
34	22-28 Aug	2.72	32.4	21.4	87	52	13.0	5.2	8.0	4.4
35	29-04 Sep	3.28	31.0	22.5	92	68	71.5	4.2	4.2	3.6
36	05-11 Sept	5.48	30.9	20.7	80	58	1.5	5.3	8.8	5.0
37	12-18 Sep	5.52	29.3	22.4	88	78	101.6	3.6	1.7	4.6
38	19-25 Sep	5.96	29.6	22.3	96	85	109.1	2.9	2.5	3.4
39	26-02 Oct	6.86	30.2	21.7	91	73	96.9	3.3	3.7	4.7
40	03-09 Oct	4.12	29.4	21.3	93	72	109.5	3.4	5.3	3.9
41	10-16 Oct	4.04	32.0	21.2	88	52	56.9	4.7	7.5	2.9
42	17-23 Oct	5.12	32.2	16.9	77	33	0.0	5.5	9.6	2.2
43	24-30 Oct	4.80	32.3	16.1	74	31	0.0	5.9	9.0	2.7
44	31-06 Nov	2.32	31.2	14.4	75	32	0.0	5.1	9.5	3.8
45	07-13 Nov	2.14	30.6	11.0	74	26	0.0	4.3	9.5	1.9
46	14-20 Nov	2.04	30.3	12.1	76	32	0.0	4.1	8.2	2.5
47	21-27 Nov	2.00	30.3	9.6	77	25	0.0	4.7	9.6	2.8
48	28-04 Dec	1.84	31.5	10.1	77	25	0.0	4.7	9.1	2.2
49	05-11 Dec	1.78	30.0	11.9	74	36	0.0	4.6	9.1	3.3
50	12-18 Dec	1.08	29.7	12.7	74	30	0.0	4.7	8.5	3.9
51	19-25 Dec	1.02	29.6	8.8	75	24	0.0	4.6	9.8	2.3
52	26-31Dec	0.00	25.9	6.9	66	25	0.0	3.7	8.6	2.4
1	1-7 Jan	0.00	29.2	8.5	78	27	0.0	4.2	9.3	2.0
2	8-14 Jan	0.00	27.6	7.7	77	36	0.0	4.0	9.0	3.0
3	15-21 Jan	0.00	28.9	11.5	75	37	0.0	4.2	7.0	2.8
4	22-29 Jan	0.00	31.1	13.1	72	31	0.0	4.3	8.9	3.6

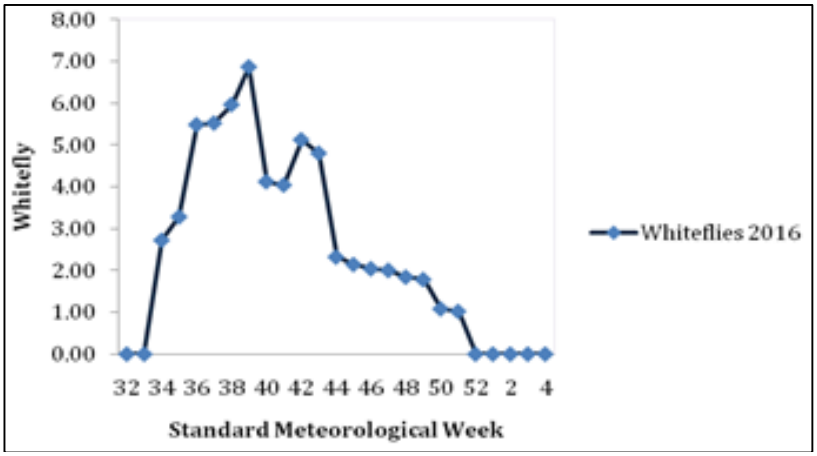

Fig 1: Seasonal incidence of Whiteflies on chilli

Correlation studies

The correlation of whitefly infesting chilli with weathers parameters was worked out to estimate correlation coefficient ('r' value) during 2016-17 and presented in Table 2.

During 2016-17, population of whitefly had significant and positive correlation with minimum temperature (r=0.628*), morning relative humidity (r=0.576*) and evening relative humidity (r=0.606*), while the negatively significant correlation of whitefly was noticed with bright sunshine hours (r=-0.487*). Maximum temperature, rainfall and wind velocity were correlated positively non-significant and evaporation had negatively non-significant correlation.

Multiple regression studies

The partial regression coefficients during 2016 was worked out for different weather parameters with whitefly population and presented in Table 3. The multiple regression equation fitted with weather parameters in order to predict population on chilli as given below

Regression equation 2016-17

$Y = -1.448 + (-0.032)\ X_1 + (0.083)\ X_2\ (0.273)\ X_3 + (-0.070)\ X_4 + (0.091)\ X_5 + (1.143)\ X_6 + (-0.258)\ X_7 + (-1.066)\ X_8 + 1.228\ (R^2 = 0.7930)$

Where,

X_1= rainfall, X_2 = maximum temperature, X_3= minimum temperature, X_4 = morning RH, X_5= evening RH, X_6 = evaporation X_7 = bright sunshine hours X_8= wind velocity and R^2 = coefficient of determination.

The coefficient of determination (R^2) represents the proportion of common variation in the two variables. The present investigations revealed that the weather parameters contributed for 79.30 per cent of total variation in the whitefly population during 2016 in chilli indicating that the predictions of the whitefly infestation by using weather parameters were more reliable in this years.

The present findings are in accordance with the earlier research workers such as Bokan *et al.* (2015) [4] who reported that the incidence of whitefly started on chilli from 35th SMW and maximum population was recorded up to 42nd MW. Baral (2017) [3] noticed whitefly, *B. tabaci* Genn. Appeared in the third week of August (33rd SMW) and its peak in third week of October (42nd SMW).

Telang *et al.* (2003) [13] who reported that there was significant positive correlation between whitefly population and maximum and minimum temperature and negatively correlated with humidity in okra.

Table 2: Correlation of coefficient (r) between whiteflies population on chilli and weather parameters during 2016-17

Weather parameters	Correlation coefficient (r)
	Whiteflies
	2016
Rainfall (mm)	0.016
Maximum temperature (^{0}C)	0.293
Minimum temperature (^{0}C)	0.628*
Morning relative humidity (%)	0.576*
Evening relative humidity (%)	0.606*
Evaporation (mm)	-0.132
Bright sunshine hours(hrs)	-0.487*
Wind velocity (km/hr)	0.143

* Significant at 5% level, ** Significant at 1% level.

Table 3: Multiple regression of weather parameters and whiteflies on chilli (2016-17)

Weather parameters	Reg. coefficients	SE (b)	'T' Test
	2016	2016	2016
Rainfall (mm)	-0.032	0.010	-3.085
Maximum temperature (^{0}C)	0.083	0.454	0.183
Minimum temperature (^{0}C)	0.273	0.262	1.043
Morning relative humidity (%)	-0.070	0.114	-0.614
Evening relative humidity (%)	0.091	0.100	0.916
Evaporation (mm)	1.143	0.885	1.292
Bright sunshine hours(hrs)	-0.258	0.306	-0.842
Wind velocity (km/hr)	-1.066	0.404	-2.636
Intercept	2016=-1.448		
Coefficient of determination (R^2)	2016=0.793		
T table (0.05)	2.120		

Conclusion

The results concluded that whiteflies was found to be major insect pests of chilli and their presence was moderate to high during the experimental period. Simple correlation and regression studies revealed that there was significant effect of different weather parameters on incidence of whiteflies on chilli. However, these findings are based upon one years studies and for confirmation and validation of results, further studies are necessary.

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