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Seasonal incidence of *Thrips tabaci* in onion (*Allium cepa* L.) agro-ecosystem of Kymore Plateau and Satpura Hill region of Madhya Pradesh

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ABSTRACT
The seasonal incidence of Thrips tabaci on onion revealed that the major activity in relation of leaf infestation was during 9th and 10th standard meteorological weeks. The initial population gradually increased and remained confirmed to vegetative growth but it rapidly increased during bulb development and enlargement stages and attained its peak in 9th standard meteorological week (1st week of March) in all respective years. Thereafter, the pest population declined. Rainfall and relative humidity were negative correlated with the thrips activity. However, the thrips multiplication faster under hot and dry weather. Likewise, maximum temperature and sunshine hours were positively associated in enhanced the thrips population builds up. In the year 2009-10, the weather parameters were found more favorable for the development and population buildup of Thrips tabaci. Hence the damage caused by thrips was noted more in 2009-10 as compared to the 2010-11 and 2011-12.
Keywords: Agro-ecosystem, *Thrips tabaci, Allium cepa*

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INTRODUCTION
The onion, *Allium cepa* L. ranks third in terms of world vegetable production. India in a traditional grower second to China in area and production and occupies number one position in world exporter. Country produces 16.81 million tonnes of onion from 1.06 m ha of area (1). The growth and yield of the crop is subjected to significant stress by various factors, among which infestation by *Thrips tabaci* is one of the main causative factors world wide. Thrips attack in onion at all the stages of crop growth, but their number increase from bulb initiation and remains high up to bulb development till maturity (2). Both nymph and adult cause direct damage by puncturing the leaves and sucking the sap resulting in silvering curling and eventually reduction in bulb size and weight. In addition to direct damage, thrips is responsible for the spread of purple blotch (*Alternaria* pori) and stemphyllium leaf blight (3). The *Thrips tabaci* also vectors iris yellow spot virus (IYSV) (4), a distinct tospo virus that reduces the quality of bulb and reduce viable seed yield (5). The population buildup of the insect pests mainly depends on temperature, relative humidity, rain fall and sunshine are the key weather parameter that largely affect the activity of the insects. Keeping in view of the above facts, a filed experience was carried out to study the impact of weather parameter on incidence of thrips on onion crop to know the insect population pattern under ecological situation of eastern Madhya Pradesh.

MATERIALS AND METHODS
Fieldtrials were conducted at Vegetable Research Farm, JNKVV, Jabalpur, M.P. during *rabi* season of 2009-10, 2010-11 and 2011-12. Onion cv. Agrifound light red was sown in nursery on last week of October and first week of November during all experimental years. Fifty five days old seedlings were transplanted in the plot size of 3X2 m. with row to row and plant to plant distance was kept as 15X10 cm, respectively. Two dates i.e. 20 December and 5 January were selected for transplanting of onion crop in Randomized Block Design with three replications. The filed were well prepared and leveled having good drainage and

adequate irrigation facilities. All agronomical practices (e.g. raising of nursery, transplanting, fertilizer application, irrigation and cultural practices) were done as per recommendations. No pesticide was applied on the plants. The meteorological observations during entire period of investigation were recorded from the observatory, collage of Agriculture Engineering, JNKVV, Jabalpur. To assess the nymph and adult population in onion field during the crop season, random sampling was done in three replications. In each replication, ten plants were randomly selected. Population fluctuation per plant of *Thrips tabaci* was recorded at weekly interval from 30 days after transplanting to harvested of crop. The average number of thrips/plant were worked out by the following formula:

Mean number of thrips = $n_{1+}n_{2+}n_{3}$..................n_n/ Total number of plant

Where n= number of thrips/plant

The average number of thrips thus obtained was correlated with prevailing meteorological conditions viz., rainfall, temperature, relative humidity and sunshine hours to significance the impact of environmental factors on the pest activity.

For testing the significance of correlation co-efficient 't' test was applied which is expressed as:

$t = rx\ n\text{-}2/1\text{-}r^2$

regression tools were used to work out the inter-relationship between the thrips incidence and weather parameters. Regression equation for different variables were also worked out.

All the regression co-efficient were tested for their significance by applying 't' test.

$t = bi/S.E$

where, bi is the regression co-efficient and S. E. is standard error of the regression co-efficient. Since the interaction of climatic factors is complex, the multiple regression analysis was worked out between independent weather factors for the dependent factor (thrips population). The regression equation were filled for all variables between weather factors (x) and thrips population (y)

RESULTS AND DISCUSSION

The result presented in Table 1 and Fig. 1, the Seasonal incidence of *Thrips tabaci* L. was recorded on the basis of population of nymphs and adult of thrips at weekly interval. The occurrence of *Thrips tabaci* nymph was recorded in 3^{rd} standard week (3^{rd} week of January). The initial mean population was noticed to a low i. e. 3.06thrips/plant. During three year of experimentation thrips population was lower from January to February and remained confirmed on vegetative growth. The pest attempted its peak i.e. 38.02 and 36.91 thrips per plant in 9^{th} and 10^{th} standard week (1^{st} and 2^{nd} week of March), respectively. After 2^{nd} week of April, the population when to decline till harvest of crop. The present finding was found in agreement with the findings of several earlier workers. Kannon and Mohammed (6) observed that there was a steady increase of thrips population from February and March and a sharp decline in April in 1992/93 and 1993/94 growing seasons. In 2010 the November transplant had a peak population of onion thrips in late February (176 thrips/plant); December (416 thrips/plant) and January (608 thrips/plant) transplants peaked in March, and February (148 thrips/plant) and March (86) transplants had peaks in April (7). After the meteorological week of March, the thrips population was decline in trend up to harvest due to low availability of green vegetation and high temperature. The present results support the finding of the Reuda and Shelton (8) who reported that at the end of the season, however, thrips might not be able to survive in abundance because there is not sufficient green vegetation in the surrounding areas, April and May being the driest months of the year. According to conducted at NRCOG, Pune, population peaks one in the month of August and the January February occur in western Maharashtra (2). While considering the impact of environmental factor in regulating the pest population, it is evident from the table than rainfall (X_1) played a non significant negative (r=-0.305) role in the pest population build. However, maximum temperature (X_2) exhibited positive and significant (r=0.914) impact in enhancing the nympal and adult population build up during three consecutive year. Likewise, minimum temperature (X_1) also exhibited positive and significant role (r=0.0 and 0.0) in increasing the population of thrips. As regards the impact of relative humidity (X_4) surprisingly it manifested statistically significant negative role during the year of experimentation. While accounting the impact of abiotic factors studied by the present author in combination with each other. It may be seen from the table 4 that rainfall demonstrated a non significant negative association with maximum temperature in all the year of study. Likewise, minimum temperature also did not exhibit any significant role against this pest. However, it was positively significant in association with morning relative humidity (r=0.796). The negatively correlation was seen in X1X4 (-0.204) X1X5 (-0.895), X1X6(-0.820) X1X7(-0.469), X2X5(-0.909), X2X6(-0.623), X2X7(-0.266), X3X4 (-0.533), X3X5(-0.248), X3X6(-0.576), X3X7(-0.396), X4X8(-0.305), X5X6(-0.162), X6X8 (-0.257) and X7X8(-0.098) with weather parameters against thrips population and it exhibited non-significant. The present finding was found in agreements with findings (9) the views of present author who also found the impact of temperature positively associated with the population build up of thrips on onion crop. The findings of also revealed that maximum temperature (25.9-27.5^{0}C) is conductive in enhancing the population of adults. The maximum temperature was positively responsible for the development of thrips population in onion crop (10). The population of thrips after regression analysis with weather parameter found that on Std. week 9th the highest 26.79 % followed by 24.56 % on Std. week 10th thrips population predicted in per plant with residuals effect -1.57 % and -1.12. However, the lowest on 3rd Std. week (16.08 %) predicted having 8.92 residual effect from the Fig 2.

Table 1: Seasonal incidence of *Thrips tabaci* on onion in relation to weather parameters during 2009 to 2012

Mean of three consecutive years

Standard week No.	Temperature (^{0}C)		Relative humidity (%)		Rainfall (mm)	Sunshine (hr.)	Mean number of thrips/plant
	Max.	Min.	Morn.	Even.			
3	22.7	6.6	91.5	36	0	8.6	3.06
4	25.55	8.7	88.5	35	0	9.05	13.74
5	26.2	10.15	89	37.5	0.4	7.75	6.19
6	28.9	10.1	84	32	0	7.8	12.04
7	30.05	13.1	83.5	35.5	0	7.3	17.89
8	27.5	10.1	84.5	33	0.7	9.05	21.28
9	31.1	12.55	84.5	31.5	2.1	8.9	38.02
10	32.25	14.35	79	30	0	9.15	36.91
11	33.8	13.5	77.5	21.5	1.4	8.85	28.50
12	37.35	17.1	57.5	14.5	0	9	26.31
13	37.95	18.5	49	13	0	8.85	21.32
14	37.4	17.1	53.5	12	0	9.15	21.37
15	39.15	20.05	50	16	0.15	7.85	14.96
16	40.35	23.15	43.5	17	0.2	8.7	10.14

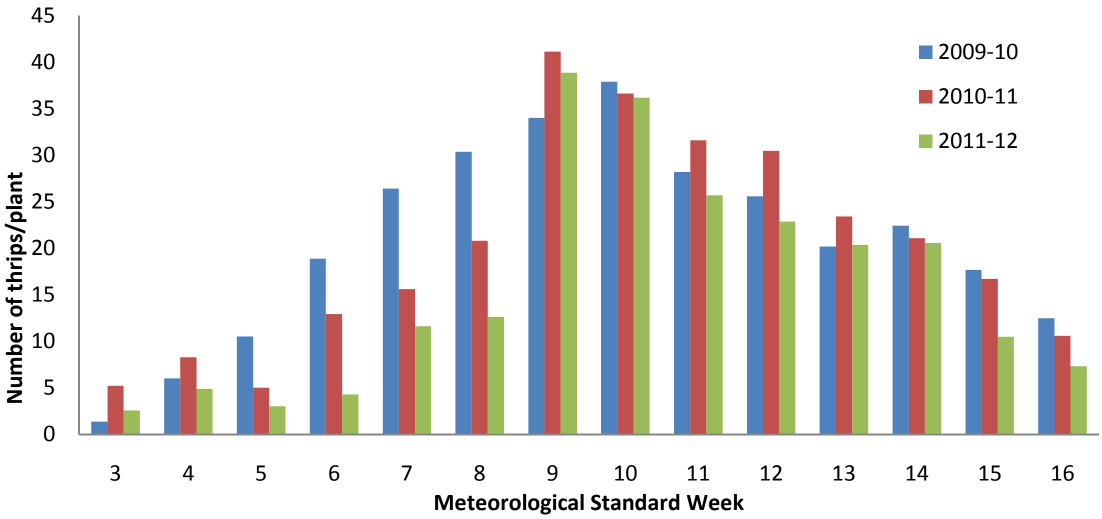

Figure 1: Mean number of thrips per plant during 2009-12

Table 4: Correlation co-efficient between *Thrips tabaci* and weather parameter

Correlation	*X1*	*X2*	*X3*	*X4*	*X5*	*X6*	*X7*	*X8*
X1	1.000							
X2	0.112	1.000						
X3	0.359	0.060	1.000					
X4	-0.204	0.035	-0.533	1.000				
X5	-0.895	-0.909	-0.248	0.207	1.000			
X6	-0.820	-0.623	-0.576	0.644	-0.162	1.000		
X7	-0.469	-0.266	-0.396	0.702	0.358	0.698	1.000	
X8	0.914**	0.020	0.307	-0.305	0.796**	-0.257	-0.098	1.000

****Significant @5% = 0.707**

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X1	**Max temp**
X2	**Min temp**
X3	**Sun shine hour**
X4	**Rainfall (mm)**
X5	**RH Morning**
X6	**RH Evening**
X7	**Rainy days**
X8	**Thrips/plant**

Table 5: Regression with meteorological standard week of thrips incidence of onion

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
X1	0.669571	1.474089	0.454227	0.654557	-2.40532	3.744466	-2.40532	3.744466
X2	-0.56926	1.898409	-0.29986	0.767378	-4.52927	3.390755	-4.52927	3.390755
X3	1.201092	2.063916	0.581948	0.567104	-3.10416	5.506345	-3.10416	5.506345
X4	-0.42723	0.363923	-1.17397	0.254199	-1.18636	0.331897	-1.18636	0.331897
X5	-0.12472	0.34366	-0.36292	0.720476	-0.84158	0.592143	-0.84158	0.592143
X6	0.217019	0.555004	0.391022	0.699915	-0.9407	1.374738	-0.9407	1.374738
X7	3.104644	3.836147	0.809313	0.427859	-4.89742	11.10671	-4.89742	11.10671

Thrips

Regression Statistics	
Multiple R	0.911925
R Square	0.831607
Adjusted R Square	0.731089
Standard Error	10.58005
Observations	27

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	7	11056.03	1579.433	14.10996	2.55E-06
Residual	20	2238.75	111.9375		
Total	27	13294.78			

Standard week No.	*Predicted Thrips/plant*	*Residuals*	*Standard Residuals*
3	16.08661	8.923394	0.979962
4	18.96764	11.33236	1.244513
5	20.67249	20.48751	2.249926
6	16.47176	8.448237	0.92778
7	17.62162	7.988379	0.877279
8	20.17506	3.74494	0.411267
9	26.79462	-1.57462	-0.17292
10	24.56022	-1.12022	-0.12302
11	21.47054	-0.39054	-0.04289
12	22.85757	8.752427	0.961186
13	22.4862	14.1438	1.553264
14	23.12223	-12.0822	-1.32686
15	23.36468	7.105318	0.780302
16	20.58912	0.230878	0.025355

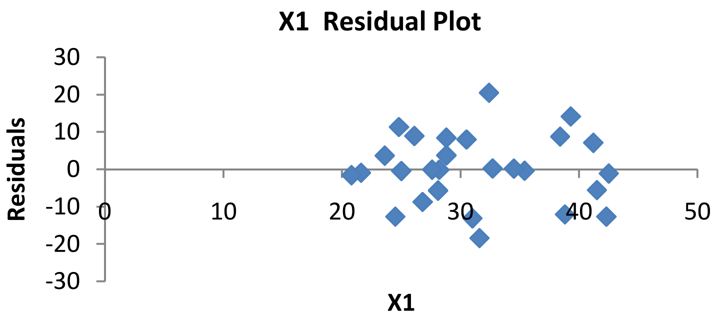

Figure 2: Regression line between *Thrips tabaci* per plant and meteorological week

CONCLUSION

On the basis of three year mean population, the thrips/plant after regression analysis with meteorological standard week found that the highest predicted thrips/plant (26.79%) in 9th standard week followed by 10th standard week (24.56%) with residuals effect -1.57 and -1.12%. however the lowest (16.08%) predicted thrips population was found on 3rd standard week having 8.92% residual effects. The maximum temperature and morning relative humidity were exhibit positive significant correlation with the thrips population.

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