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Population dynamics on mealy bug *Phenacoccus solenopsis* tinsley and thrips *Thrips tabaci* lindeman on cotton

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Abstract
The present investigation were carried out on ''Population dynamics on Mealy bug *Phenacoccus solenopsis* Tinsley and Thrips *Thrips tabaci* Lindeman on cotton'' Field experiment was carried out at Department of Entomology, College of Agriculture, JAU, Junagadh during *Kharif*-2017. Incidence of mealy bug and thrips commenced in 29th standard meteorological week *i.e.* 3rd week of July month (0.2 mealy bug index) and (0.6 thrips/ 3 leaves). Population of Mealy bug index was gradually increased and attained a peak at 4.0 mealy bug index during 37th SMW *i.e.* 2nd week of September and second peak with 4.0 mealy bug index in 45th SMW *i.e.* first week of November and remained constant up to 47th standard meteorological week of November. When thrips population gradually increased and attained a peak at 30.5 thrips/3 leaves during 34th standard meteorological week 3rd week of August. Again, the thrips population increased and reached on second peak with 40.2 thrips/3 leaves in 36th standard meteorological week *i.e.* first week of September. Thereafter, it started to decline slightly toward with 1.6 mealy bug index and 1.8 thrips/3 leaves during 51th Standard meteorological week *i.e.* 3rd week of December.

Among all the meteorological parameters, population of mealy bug showed highly significant positive correlation with bright sunshine hours (r = 0.714) and evapotranspiration (r = 0.622). Whereas, maximum temperature (r = 0.451) found significant positive correlation and population of thrips showed significant positive correlation with minimum temperature (r = 0.458) and maximum temperature (r =0.449)

In regression studies, coefficient of multiple determinants were indicating that the when decrease evapotranspiration also decrease the population of mealy bug by 0.452. This revealed that there was decrease in one-unit evapotranspiration of the percent mealy bug index decrees by unit 0.452, respectively. When, maximum temperature had positive effect 1.28 increased the development of thrips population per plant. This was indicating that the increase in maximum temperature 1 °C increased the thrips population per plant by 1.58.

Keywords: Population dynamics, Mealy bug *Phenacoccus solenopsis* Tinsley, Thrips *thrips tabaci* Lindeman

Introduction

Cotton is a principle cash crop belong to the family Malvaceae. Every part of the cotton plant is useful. The seed provide oil and are also used as cattle feed. The stalk is used as fuel and the leaves falling on the ground increase organic matter in the soil. It sustains the country's cotton textile industries. In 2016-2017 India earned foreign exchanges to the tune of more than ₹ 9499.87 crore from export of cotton yarn, thread, fabrics and garment. At present cotton account for 44 per cent of all fibers use in the world. Such a crop has a pride of place in the farming of Gujarat's Agriculture. The economy of the entire state is very much dependent on success or failure of this cash crop. In India, cotton was cultivated in 105.00 lakh ha with a production of 351.00 lakh bales and productivity of 568 kg/ha.) In Gujarat cotton cultivated in 24.00 lakh ha with a production of 95 lakh bales and productivity is 673 kg/ha during 2016/2017 (Anon., 2017a). In India, 162 species of insect pests have been reported to attack the cotton crop right from germination till the final harvesting of cotton crop (Hargreaves, 1948). Among these pests few of them are considered as key pests causing serious damage to cotton crop all over country which results in an annual loss of 50 to 60 per cent of the total production (Anon., 1995). The mealy bug and thrips are polyphagous pest infesting many plants, herbs, shrubs and trees. Fourteen species of mealy bug and thrips have been recorded in Saurashtra (Gujarat) which infests custard apple, citrus, coffee, sugarcane, pineapple, plums, guava, papaya, mango, okra, teak, mora, pigeon pea, peanut, grape vines, maize, asparagus, chrysanthemum, beans, cotton, soybean, cocoa, chilli, onions, garlic, cabbage, cotton, celery, tomatoes, cucumber and many other plants. The infection of the mealy bug appears to be started from June to November in the field. The adult females and nymphs were severe damage by suck the cell sap from young plant twigs, leaves, flower buds and fruits there by devitalize the plant and reduce the yield considerably. Honeydew excreted by the pest encourages the growth of black sooty mould, which adversely affects the photosynthesis of the plants. The most important species of thrips like *Thrips tabaci* Lindeman belong to family Thripidae. These have rasping and sucking type of mouthparts. The life cycle has six distinct stages: egg, two larval stages, pre-pupa, pupa and adult. The two active immature stages are first and second stage larvae and the inactive stages are pre-pupa and pupa. Nymphs and adults lacerate the tissue and suck the sap from the upper and lower surfaces of leaves. They inject saliva and suck the lysed contents of plant cells resulting in salivary or brown necrotic spots of 3-5 mm. Seedling infested with thrips grow slow and the leaves become wrinkled, curl upwards and distorted with white shiny patches. Rusty appearances in patches in develop on undersurface of leaves. Thrips infested crop in field presents rusty appearance from a

distance. Higher infestation during vegetative crop growth results in late bud formation. During the fruiting phase there is premature dropping of squares, and the crop maturity is delayed combined with yield reductions. The feeding by thrips on the developing boll late in the season cause spots or wounds on the pericarp but that do not affect the ripening of the boll or the quality of the seed (Mohan *et al.*, 2014) [5].

Materials and Methods

A study on population dynamics of cotton mealy bug and thrips were carried out on variety RCH-2 BG-II. In order to record absolute population of cotton mealy bug, all the recommended agronomical practices were followed to raise the crop. The plot was kept unsprayed throughout the season. The crop area was divided into 6 quadrated of size 2 m × 2m. To find out the incidence of cotton mealy bug, randomly selected five plants were tagged from each plot. Observations were recorded on tagged plant at weekly interval starting from the first week of germination till the maturity of crop. Generally, it was observed that cotton mealy bug sit in overlapping manner and hence, it was difficult to record mealy bug on numerical basis. The grading has been done on the basis of mealy bug incidence on the cotton plant according to Dhawan *et al.* (2010) [3].

The average mealy bug index will be worked out by using the following formula.

0- Grade- No mealy bug Population on Plant
1- Grad- Presence of mealy bug on plant
2- Grade- Presence of mealy bug on central shoot of plant
3- Grade- Presence of mealy bug on stem, leaves and reproductive parts of plant
4- Grade- Appearance of honey dew secretion and stunted growth of plant and almost all plants with mealy bug showing white appearance.

The average of mealy bug index was worked out adopting following formula,

$$\text{Average mealy bug index} = \frac{0N+1N+2N+3N+4N}{\text{Total number of plants observed}}$$

Where,
0, 1, 2, 3, 4 are mealy bug grade
N = Number of plants showing respective mealy bug grade

A study on population dynamics of cotton thrips were carried out on variety Gujarat RCH-2 BG-II. The crop was raised after following standard agronomical practices in large plot (18x18 m) and it was divided into 6 quadrates of size 2 m x 2 m from which 5 plants were selected randomly tagged it. Population of thrips were recorded by observing three leaves from upper, middle and lower portion of each tagged plant weekly interval from appearance of pest till harvest.

Plate 1: Average mealy bug index and thrips damage on cotton

Plate 2: Experimental site of population dynamics of mealy bug and thrips

Result and discussion

The result presented in Table 2 and Fig.1 revealed that the incidence of mealy bug population commenced in 29th standard meteorological week *i.e.* 2nd week of July. Initially the nymphal population was recorded 0.2 mealy bug index, which was gradually increased and attained a peak 4.0 mealy bug index during 37th standard meteorological week *i.e.* 2nd week of September and remained constant in 38th standard meteorological week. Thereafter, it started to decline slightly in 39th standard meteorological week and remained continue up to 43th standard meteorological week *i.e.* 4th week of October. Then again the mealy bug population was increased and reached on second peak with 4.0 mealy bug index in 45th standard meteorological week *i.e.* 1st week of November and remained constant up to 47th standard meteorological week *i.e.* 3rd week of November. Thereafter, Population of mealy bug started to decline slightly toward with 1.6 mealy bug index during 51th standard meteorological week *i.e.* 3rd week of December. The correlation co-efficient between meteorological Parameter values showed in Table-3 indicated that Population of mealy bug showed highly significant positive correlation with bright sunshine hours (r = 0.714) and evapotranspiration (r = 0.622). Whereas, maximum temperature (r = 0.451) found significant positive correlation. However, pest population showed highly negative significant correlation with rainy days (r = - 0.672), wind speed (r = 0.720) and evening relative humidity (r = - 0.543). Mealy bug population also shown negative significant correlation with morning relative humidity (r = - 0.530) and rainfall (r = -0.448). Result showed population of mealy have non-significant negative correlation with minimum temperature (r = -0.345)

Regression coefficient revealed that there was decrease in one-unit evapotranspiration of the percent mealy bug index decreases by unit 0.4520.

The result presented in Table 5 and Fig 2 revealed that the incidence of thrips population commenced in 29th standard meteorological week *i.e.* 3rd week of July. Initially the thrips population was 0.6 thrips per three leaves, which was gradually increased and attained a peak at 30.5 thrips per tree leaves during 34th standard meteorological week *i.e.* 3rd week of August. Then after, it started to decline slightly in 35th standard meteorological week *i.e.* 4th week of August. A Then again the thrips population wad suddenly increased and reached at second highest peak with 40.2 thrips per three leaves in 36th standard meteorological week *i.e.* first week September. Thereafter, it started to decline slightly toward with 35.6, 28.2, 26.6 and 24.3 thrips peer three leaves during 37th 38th, 39th and 40th standard meteorological week i.e. 2nd,3rd and 4th week September and first week of October, respectively. Then after the thrips population suddenly increases and reached of peak level 17.2 thrips per three leaves during 45th standard meteorological week. Then it starts gradually decline up to harvest of crop noted during 46, 47, 48, 49, 50 and 51 standard meteorological week *i.e.* 2nd week of November to December.

The correlation co-efficient values depicted in Table-6 indicated that population of thrips showed significant positive correlation with minimum temperature (R = 0.458) and maximum temperature (r = 0.449). Population of thrips showed non-significant positive correlation with evapotranspiration (r = 0.328) and bright sunshine hours (r = 0.268) However, thrips population showed non-significant positive correlation with morning relative humidity (r = 0.215) and evening relative humidity (r = 0.149). Result showed population of thrips have non-significant negative correlation with rainy days (r = - 0.223), wind velocity (r = - 0.213) and rainfall (r = - 0.067).

Regression coefficient revealed that the increases in maximum temperature 1°C increased the thrips population per plant by 1.58 during *kharif*, 2017.

Table 2: Population of melay bug *P. solenopsis* on cotton during Kharif 2017

Month	Week after germinations	Std. week	Mealy-bug index	Max. Temp.	Min. Temp.	Max. RH	Min. RH	BSS	W.V.	Evapo-transpiration (mm)	Rain fall	Rainy days
July	3	29	0.2	30.1	25.1	95	85	0.8	5.2	0.7	197.5	6
	4	30	0.6	28.1	25.2	93	87	0.0	7.2	0.7	34.2	4
	5	31	1.0	30.5	25.1	90	74	1.0	8.8	2.7	2.7	2
August	6	32	1.2	32.0	24.6	90	71	1.3	7.7	3.6	3.6	3
	7	33	0.8	31.8	24.7	90	76	2.5	7.6	3.9	3.9	1
	8	34	2.0	31.3	24.8	93	82	2.4	4.9	2.2	2.2	2
	9	35	2.6	29.4	23.7	92	87	0.8	5.7	1.9	1.9	4
September	10	36	3.6	31.9	24.3	90	63	5.9	4.8	3.9	3.9	0

	11	37	4.0	34.0	25.5	85	72	5.9	4.1	4.5	4.5	1
	12	38	4.0	31.6	24.6	91	79	1.8	4.0	2.9	2.9	2
	13	39	3.8	33.4	23.9	82	62	9.5	4.0	4.9	4.9	0
October	14	40	3.6	36.0	25.3	76	41	9.4	5.1	6.1	6.1	0
	15	41	3.0	36.6	24.6	75	42	7.8	3.5	5.2	5.2	0
	16	42	3.0	37.3	22.7	62	31	9.4	3.6	6.1	6.1	0
	17	43	2.8	36.2	21.0	69	27	9.5	3.7	6.4	6.4	0
	18	44	3.8	36.0	18.0	56	18	8.7	2.6	5	5	0
November	19	45	4.0	35.1	18.0	71	25	8.9	2.4	4.7	4.7	0
	20	46	4.0	31.9	18.0	62	27	7.7	4.2	4.3	4.3	0
	21	47	4.0	31.1	15.1	70	30	8.7	4.1	4.6	4.6	0
	22	48	3.8	32.6	14.4	67	30	8.4	2.8	4.2	4.2	0
December	23	49	3.0	27	17.9	73	63	1.5	4.8	2.8	2.8	0
	24	50	2.4	27.9	14.6	72	38	7.2	4.4	3.6	3.6	0
	25	51	1.6	29.9	15.8	67	32	3.0	3.4	3.4	3.4	0

BSS = Bright sunshine hours; WV = Wind Velocity; RH = Relative humidity

Table 3: Correlation coefficient between meteorological parameters and population of mealy bug on cotton

Weather parameter								
Temperature °C		Relative humidity (%)		Mean bright sunshine hours	Wind Velocity	Evapotranspiration	Rainfall	Rainy days
Max.	Min.	Morning	Afternoon					
X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
0.451*	- 0.345	-0.530*	-0.543*	0.714**	- 0.720**	0.622**	-0.448*	-0.672**

*Significant at (p=0.05) level (R value 0.423), n = 21
** Significant at (p=0.01) level (R value 0.537)

Table 4: Multiple regression equation for population of mealy bug on cotton crop

Meteorological parameter	Regression coefficient 'r' value
Constant (Intercept)	5.999
Maximum Temperature (X_1)	-0.092
Minimum Temperature (X_2)	-0.045
Morning Relative humidity (X_3)	-0.022
Evening Relative Humidity (X_4)	0.049
Sunshine hour (X_5)	0.166
Wind speed (X_6)	0.315
Evapotranspiration (X_7)	-0.452*
Rainfall (X_8)	-0.003
Rainy days (X_9)	-0.121
R Square (R^2)	0.741
Adjusted R Square	0.561

*Significant at (p=0.05) level (R value 0.423), n = 21
** Significant at (p=0.01) level (R value 0.537)

Table 5: Population of thrips *T. tabci* on cotton during Kharif 2017

Month	Week after germinations	Std. week	No. Thrips/plant	Max. Temp.	Min. Temp.	Max. RH	Min. RH	BSS	W.V.	Evapo-transpiration (mm)	Rain fall	Rainy days
July	3	29	0.6	30.1	25.1	95	85	0.8	5.2	0.7	197.5	6
	4	30	2.6	28.1	25.2	93	87	0.0	7.2	0.7	34.2	4
	5	31	4.9	30.5	25.1	90	74	1.0	8.8	2.7	7.9	2
August	6	32	8.4	32.0	24.6	90	71	1.3	7.7	3.6	25.9	3
	7	33	18.2	31.8	24.7	90	76	2.5	7.6	3.9	11.2	1
	8	34	30.5	31.3	24.8	93	82	2.4	4.9	2.2	71.0	2
	9	35	25.5	29.4	23.7	92	87	0.8	5.7	1.9	185.4	4
September	10	36	40.2	31.9	24.3	90	63	5.9	4.8	3.9	2.1	0
	11	37	35.6	34.0	25.5	85	72	5.9	4.1	4.5	13.7	1
	12	38	28.2	31.6	24.6	91	79	1.8	4.0	2.9	12.5	2
	13	39	26.6	33.4	23.9	82	62	9.5	4.0	4.9	0	0
October	14	40	24.3	36.0	25.3	76	41	9.4	5.1	6.1	0	0
	15	41	26.6	36.6	24.6	75	42	7.8	3.5	5.2	0	0
	16	42	20.5	37.3	22.7	62	31	9.4	3.6	6.1	0	0
	17	43	13.7	36.2	21.0	69	27	9.5	3.7	6.4	0	0
	18	44	12.7	36.0	18.0	56	18	8.7	2.6	5.0	0	0
November	19	45	17.2	35.1	18.1	71	25	8.9	2.4	4.7	0	0
	20	46	15.7	31.9	18.0	62	27	7.7	4.2	4.3	0	0
	21	47	12.3	31.1	15.1	70	30	8.7	4.1	4.6	0	0
	22	48	10.4	32.6	14.4	67	30	8.4	2.8	4.2	0	0

December	23	49	4.2	27.0	17.9	73	63	1.5	4.8	2.8	2.5	0
	24	50	3.7	27.9	14.6	72	38	7.2	4.4	3.6	0	0
	25	51	1.8	29.9	15.8	67	32	3.0	3.4	3.4	0	0

BSS = Bright sunshine hours; WV = Wind Velocity; RH = Relative humidity

Table 6: Correlation coefficient between meteorological parameters and population of thrips on cotton

Weather parameter								
Temperature ℃		Relative humidity (%)		Mean bright sunshine hours	Wind Velocity	Evapotranspiration	Rainfall	Rainy days
Max.	Min.	Morning	Afternoon					
X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9
0.449*	- 0.458	0.215	0.149	0.268	-0.213	0.328	-0.067	-0.223

*Significant at (p=0.05) level (R value 0.423), n = 21
** Significant at (p=0.01) level (R value 0.537)

Table 6: Multiple regression equation for population of thrips on cotton crop

Meteorological parameter	Regression coefficient 'r' value
Constant (Intercept)	-87.24
Maximum Temperature (X_1)	1.585**
Minimum Temperature (X_2)	0.735**
Morning Relative humidity (X_3)	0.507
Evening Relative Humidity (X_4)	0.292
Sunshine hour (X_5)	0.591
Wind speed (X_6)	-2.399**
Evapotranspiration (X_7)	-1.068
Rainfall (X_8)	0.087
Rainy days (X_9)	-7.934**
R Square (R^2)	0.821
Adjusted R Square	0.696

*Significant at (p=0.05) level (R value 0.423), n = 21
** Significant at (p=0.01) level (R value 0.537)

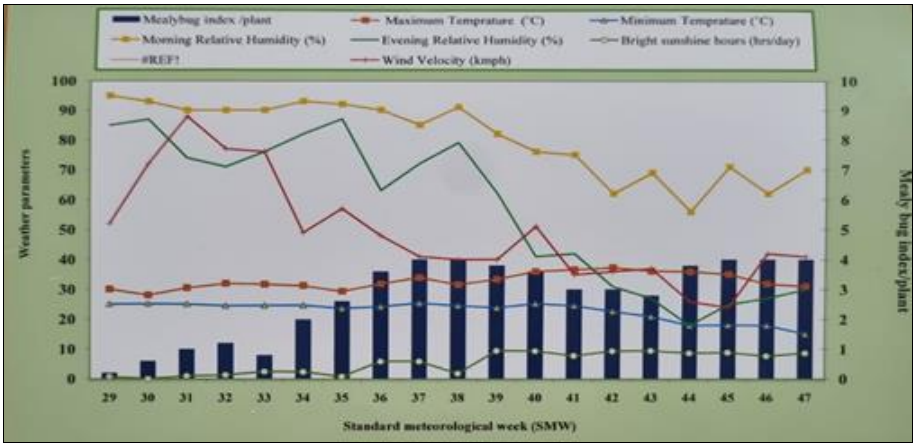

Fig 1: Correlation between cotton mealy bug and Weather parameters at Junagadh during *Kharif*, 2017

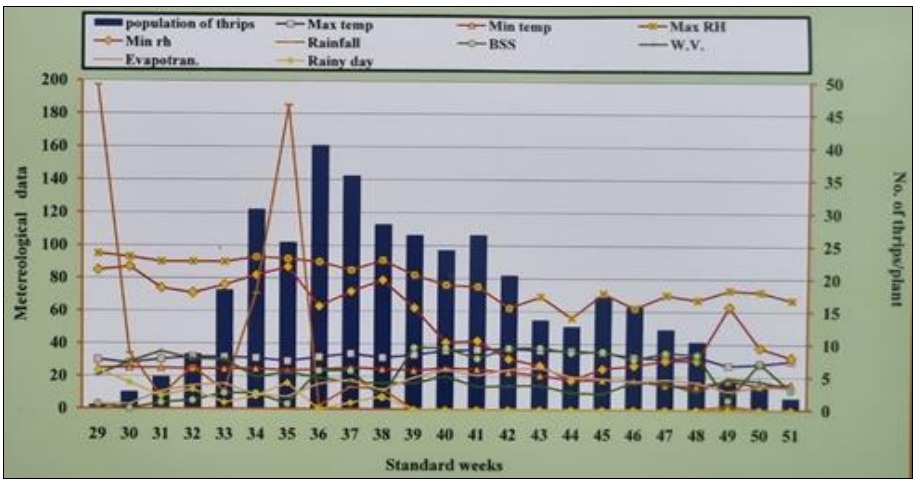

Fig 2: Correlation between cotton Thrips and Weather parameters at Junagadh during *Kharif*, 2017

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