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Population dynamics of defoliator pests and two spotted spider mite of ash gourd

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Abstract
In present study, field experiment on population dynamics of insect pests of ash gourd was conducted in farmer's holdings in Tamil Nadu during 2015-2016. Result revealed that that the major defoliator pests such as pumpkin caterpillar, red pumpkin beetle, leaf miner and two spotted spider mite. Peak population of *Diaphania indica* (7.5 larvae / plant) was recorded in third week of February and first week of March. The maximum population of red pumpkin beetle, *Raphidopalpa foveicollis* was recorded in second week of December (2.20 / plant). The leaf damage by *Liriomyza trifolii* was recorded to be highest (23.7 per cent) during third week of March. Number of *Tetranychus urticae* was recorded to be the highest during fourth week of March (18.20 / cm^2 leaf area). Correlation analysis between weather parameters and abundance of insect pests of ash gourd revealed that temperature and relative humidity played a major role with significant positive influence on the population build-up of defoliator pests and two spotted mite.

Keywords: Population dynamics, defoliator pests, two spotted spider mite, ash gourd, Tamil Nadu

1. Introduction
Ash gourd (*Benincasa hispida* (Thunb. Cogn.) Belongs to the family Cucurbitaceae is one of the vegetable crops of the world, widely cultivated throughout humid tropical and sub-tropical climates and used as a food source in India and China. It is also known as white gourd, winter melon, white pumpkin and wax gourd (Robinson and Decker-Walters, 1999) [13]. Ash gourd is actually a fruit, but it is referred to as a vegetable because it is cooked and eaten as a vegetable. It is an excellent source of vitamin B1 (thiamine), a good source of vitamin B3 (niacin) and vitamin C and also rich in many minerals like calcium. Its high potassium content makes this a good vegetable for maintaining healthy blood pressure. In India, ash gourd occupies an area of about 2,497 hectares with the production of 15,326 tonnes and productivity of 6.13 tonnes per hectare (Anon, 2006) [2]. In Tamil Nadu, it is cultivated in an area of 204 hectares with the production and productivity of 3,876 tonnes and 19 tonnes / ha, respectively (Anon, 2012) [3]. Insect abundance can change over time for a variety of reasons, including macroclimatic and microclimatic changes and variation in the availability of food resources (Wolda, 1988) [15]. The said relationship has been worked out in the present study in order to understand the metrological interactions. The seasonal incidence of the pest has been recorded and impact of some of the weather factors *viz.* Maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, sunshine hours and rainfall had been analysed. Overall, field experiment on population dynamics of insect pests of ash gourd was conducted in farmer's holdings in Tamil Nadu. This will help in preparation of management design of the pest.

2. Materials and Methods
2.1 Study period and area
A field experiment was conducted in the farmer's holdings at Kalathupudhur, Pollachi and Coimbatore District in the Rabi season of ash gourd crop during December 2015- March 2016. The area is located on latitude 10˚39'26.11" N and longitude 77˚00'38.41" E 293m above sea level. The design was randomized complete block, replicated seven times and area of one hectare.

2.2 Observations recorded
In the field experiment weekly observations were made on ten randomly selected plants**.** Defoliator pests such as red pumpkin beetle, (*Raphidopalpa foveicollis* (Lucas) and pumpkin caterpillar (*Diaphania indica* (Saunders), recorded on as number of insect per plant.

Leaf miner (*Liriomyza trifolii*. (Burgess) were expressed as per cent leaf damaged. For assessing the population of red spider mite (*Tetranychus urticae*. (Koch), number of mites present in one cm^2 leaf area was recorded. Weekly counts on pest population were correlated with weekly weather parameters viz., maximum temperature (T_{max}), minimum temperature (T_{min}), relative humidity (RH), rainfall and solar radiation obtained from the automatic weather station installed at Tamil Nadu Agricultural University, Coimbatore

2.3 Statistical analysis
Correlation analyses were carried out to assess the relationship between seasonal abundance of insect pests infesting ash gourd in the field and weather parameters viz., maximum temperature (T_{max}), minimum temperature (T_{min}), relative humidity (RH), rainfall and solar radiation using SPPS Statistics ver.17.0. (Gomez and Gomez, 1984) [6].

3. Results and Discussion
Results from monitoring studies of seasonal abundance of insect pests by direct counting revealed that the major defoliator pests were red pumpkin beetle, *Raphidopalpa foveicollis*, pumpkin caterpillar *Diaphania indica*, leaf miner *Liriomyza trifolii* and two spotted spider mite *Tetranychus urticae*. Maximum number of 7.5 *Diaphania indica* larvae per plant was recorded during seventh standard week, while the larval population was recorded to be nil during fifty second standard week (Table 1). These results are in accordance with the findings of Barma and Jha (2014) [4] in pointed gourd, who reported the peak incidence of D. indica during first week of March. In the present investigation, the population of red pumpkin beetle, *Raphidopalpa foveicollis* was recorded to be maximum during fifty second week (2.20 / plant) as against nil population during fifth standard week (Table 1). While, Purohit *et al*. (2010) [12] reported that the population of red pumpkin beetle reached its peak with the maximum of 4.0 beetles / 5 plants during October, 2008 and decreased thereafter till first week of December. Number of *Tetranychus urticae* was recorded to be the highest during twelfth standard week (18.20 / cm^2 leaf area) and was recorded to be nil during fifty second standard week (Table 1). These results are in agreement with the findings of Meena *et al*. (2013) [9] who reported that the mite population declined in an inconsistent manner as the atmospheric relative humidity increased with the lowest population during first fortnight of December due to very low temperatures. The leaf damage by *Liriomyza trifolii* was recorded to be the maximum (23.7 per cent) during ninth standard week while there observed no leaf damage during fifty second standard week (Table1). Lukhoi Singh and Jiten Singh (2013) [7] reported that the highest seasonal incidence has been recorded during March in every year and percentage of infestation is also highest during March. The minimum incidence has been recorded during January and minimum Infestation has also been recorded during January every year. Aawathanarayana Reddy and Ashok Kumar (2004) [1] found that the peak infestation of leaf miner was noticed during March - April and the population declined during November – December.

Table 1: Population dynamics of defoliator pests and two spotted mite of ash gourd 2015-2016

Year/ Month	SMV	Number of insects / plant			
		Diaphania indica	*Raphidopalpa foveicollis*	*Tetranychus urticae* / cm^2 leaf area	Per cent leaf damage by *Liriomyza trifolii*
December	SMW 52	0.00	1.90	0.00	0.00
	SMW 53	0.00	2.20	0.80	0.00
January	SMW 01	0.00	1.20	0.80	0.00
	SMW 02	0.00	0.90	0.40	0.00
	SMW 03	0.00	0.80	1.20	1.80
	SMW 04	1.50	0.20	3.80	2.70
February	SMW 05	1.40	0.00	9.40	3.50
	SMW 06	0.70	0.00	6.20	9.20
	SMW 07	2.00	0.00	12.20	14.00
	SMW 08	1.20	0.00	13.30	17.50
March	SMW 09	2.00	0.00	13.40	23.70
	SMW10	1.90	0.00	17.10	13.00
	SMW11	1.20	0.00	17.50	9.50
	SMW12	1.10	0.00	18.20	4.20

* Mean of observations taken on 10 plants; SMW - Standard Metrological Week

3.1 Correlation between weather parameters and population dynamics of defoliator pests and two spotted mite of ash gourd 2015-2016
Results on the correlation analysis between weather parameters and bore pests and mite of ash gourd revealed that the T. urticae had significant positive correlation with maximum temperature and morning relative humidity and had negative correlation with evening relative humidity and rainfall (Table 2). Priyanka *et al*. (2017) [11] reported that the morning relative humidity and Sunshine hours showed negative correlation but significant relationship with incidence of mites on Withania somnifera. Mahato *et al*. (2008) [8] and Rajakumar *et al*. (2005) and [14] who reported that maximum temperature was positively correlated with the population dynamics two spotted spider mite. Minimum temperature, evening relative humidity and rainfall had significant positive correlation with the population of pumpkin caterpillar and red pumpkin beetle, while, the correlation was found to be negative with the maximum temperature and morning relative humidity (Table 2). Bharma and Jha (2014) [4] reported that the minimum temperature and evening relative humidity had significant positive correlation with the population build-up of D. indica. Correlation between weather parameters and leaf damage by L. trifolii revealed that only maximum temperature had significant negative correlation with the r value of - 0.554. In contrast, the influence of the minimum temperature, evening relative humidity and sunshine hours was found to be negative on the population dynamics of bores pest viz., red pumpkin beetle, pumpkin caterpillar, leaf miner and red spider mite. This might be due to the influence of above parameters on the availability of host plants and reproductive potential of the above said defoliators. Das (2001) [5] reported that relative humidity and rainfall had no significant role on the leaf roller, D. indica population in pointed gourd (Table 2).

Table 2: Influence of weather parameters population dynamics of defoliator pests and two spotted mite of ash gourd 2015-2016

Variables	Correlation coefficient			
	Raphidopalpa foveicollis	***Diaphania indica***	***Liriomyza trifolii***	***Tetranychus urticae***
Maximum temperature (T_{max}) (°C)	-0.821**	-0.753**	-0.554*	0.713**
Minimum temperature (T_{min}) (°C)	0.484	0.425	0.441	-0.373
Morning Relative humidity (%)	-0.809**	-0.566*	-0.583	0.638*
Evening Relative humidity (%)	0.443	0.453	0.300	-0.513
Sun shine (hours)	-0.082	-0.294	-0.363	0.463
Rainfall (mm)	0.284	0.197	0.191	-0.191

* Correlation coefficient significant at 1% level

**Correlation coefficient significant at 5% level

3.2 Multiple linear regression analysis between weather parameters and abundance of population dynamics of defoliator pests and two spotted mite of ash gourd

Results of multiple linear regression analysis between weather parameters and abundance of D. indica population revealed that the maximum temperature had significant contribution towards the population of pumpkin caterpillar with the R^2 value of 0.612. When the maximum temperature increased by 1 °C, mean number of D. indica decreased by 0.71 per plant (Table 3). Maximum temperature had significant contribution towards the population of red pumpkin beetle with the R^2 value of 0.819. When the maximum temperature increased by 1 °C, mean number of R. foveicollis decreased by 0.642 per plant. Maximum temperature, morning relative humidity and sunshine hours had significant contribution towards the population of leaf miner with the R^2 value of 0.542 (Table 3). When the maximum temperature increased by 1 °C, the leaf damage by L. trifolii decreased by 0.695 per cent. When the morning relative humidity increased by 1 per cent, the leaf damage by leaf miner decreased by 0.766 per cent. When the sunshine increased by 1 hour, the leaf damage decreased by 2.751 per cent (Table 3). Maximum temperature and morning relative humidity had significant contribution towards the population of mites with the R^2 value of 0.652. When the maximum temperature increased by 1 °C, mean number of T. urticae increased by 0.685 per cm^2 leaf area. When the morning relative humidity increased by 1 per cent, the mites population decreased by 0.427 per cm^2 leaf area (Table 3).

Table 3: Multiple linear regression analysis for the prediction population dynamics of defoliator pests and two spotted mite of ash gourd 2015-2016

Variables	Regression coefficient			
	Raphidopalpa foveicollis **(Y_1)**	***Liriomyza trifolii*** **(Y_2)**	***Diaphania indica*** **(Y_3)**	***Tetranychus urticae*** **(Y_4)**
Intercept (a)	6.528	-5.348	15.394	-12.278
Maximum temperature (T_{max}) (°C) (X_1)	-0.642**	-0.695**	-0.710**	0.685**
Minimum temperature (T_{min}) (°C) (X_2)	0.275	0.794	0.327	0.257
Morning Relative humidity (%) (X_3)	-0.142	-0.766**	0.065	-0.427*
Evening Relative humidity (%) (X_4)	0.087	0.208	-0.064	-0.125
Sun shine (hours) (X_5)	-0.032	-2.751**	-0.029	0.074
Rainfall (mm) (X_6)	0.104	0.374	0.163	-0.174
R^2	0.819	0.542	0.612	0.652

Regression equations

$Y_1 = 6.528 - 0.642X_1** + 0.275X_2 - 0.142X_3 + 0.087X_4 - 0.032X_5 + 0.104X_6$

$Y_2 = -5.348 - 0.695X_1** + 0.794X_2 - 0.766X_3** + 0.208X_4 - 2.751X_5** + 0.374X_6$

$Y_3 = 15.394 - 0.710X_1** + 0.327X_2 + 0.065X_3 - 0.064X_4 - 0.029X_5 + 0.163X_6$

$Y_4 = -12.278 - 0.685X_1** + 0.257X_2 - 0.427X_3* - 0.125X_4 + 0.074X_5 - 0.174\ X_6$

**Regression coefficient significant at 5% level

*Regression coefficient significant at 1% level

4. Conclusion

From the thorough analysis of the present findings it can be concluded that regarding abundance of pumpkin caterpillar *Diaphania indica* (7.5 larvae / plant) was maximum during third week of February and first week of March. The maximum population of red pumpkin beetle, *Raphidopalpa foveicollis* was maximum during second week of December. The leaf damage by leaf miner *Liriomyza trifolii* was maximum during third week of March. Number of two spotted spider mite *Tetranychus urticae* was maximum during fourth week of March. Based on this analysis was helpful to develop the pest management strategy against defoliator's pest and two spotted spider mite of Ash gourd.

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