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Influence of weather parameters on incidence of thrips and mite on *Bhut Jolokia* (*Capsicum Chinense* Jacq.) in Assam condition

SS Bora[1], DK Saikia[2], BA Gudade[3], Amit Kumar[4], Ingudam Bhupenchandra[5], AB Aage[6], TN Deka[7]
[1, 3, 7] ICRI, Regional Research Station, Spices Board, Tadong, Gangtok, Sikkim, India
[2] Department of Entomology, Assam Agricultural University, Jorhat, Assam, India
[4] ICAR-National Organic Farming Research Institute, Gangtok, Sikkim, India
[5] ICAR-KVK, Tamenglong, Manipur Centre, Lamphelpat, Imphal, Manipur, India
[6] Department of Soil Science, Dr. PDKV, Akola, Maharashtra, India

Abstract
Bhut Jolokia an important cash crop of North eastern part of India. However, insect pest dominant factor causing damage to the crop among the insect pest thrips and mites are the important one. Weather plays a significant role in appearance of these two important pests and it was observed that highest incidence of thrips in 4th week of March in both 2018 and 2019, while mite population reaches its peak during 4th week of March in 2018 and 2nd week of April, 2019, respectively. Multiple regression analysis Reveled that weather parameter plays crucial role in total variation in the population of thrips by 58.70 and 50.60 per cent, while in case of mite it contributed for 54.10 and 47.70 per cent in *Bhut Jolokia* during 2017-18 and 2018-19. Correlation study on influence of weather factor on population build up revealed that Av. RH had significant negative effect on both thrips (-0.661** and -0.576**) and mite (-0.618** and -0.527**) while, maximum temperature had significant positive effect population buildup of both thrips and mite (0.408* and 0.504*) during 2018-19 only. Among the weather factors average relative humidity had the profound effect in suppressing the population growth of thrips and mites infesting *Bhut Jolokia*.

Keywords: *Bhut Jolokia*, thrips, mites, average relative humidity and temperature

Introduction
Bhut Jolokia (*Capsicum chinense* Jacq.) is an important commercial crop cultivated specially in Assam, Nagaland and Manipur of north eastern region of India. It is most sought after chilli, cultivated in this region because of its titillating pungency and aroma. Archaeological data revealed that since past 7000 years human civilization cultivating *Capsicum* (Basu and De, 2003) [2] and *Bhut Jolokia* has also been cultivated in a traditional manner since time immemorial in North Eastern India (Bhagowati and Changkija, 2009). Most of the chilli species and varieties/cultivars cultivated in Indian subcontinent contain around one per cent capsaicin but Bhut Jolokia has around 2–4 per cent capsaicin as reported by various researchers (Mathur *et al*., 2000) [7]. It came to limelight after it was reported as World's hottest chilli during 2006 by Guiness Book of World Record (Guiness record, 2006) and demand increases several folds, although later it was replaced by other and at present in the list of hotness it occupies 7th position. Although, the crop has got great export potential besides huge domestic and international demand its production and productivity found to be low. A number of limiting factors had been attributed for low productivity in the growing areas among them occurrence of viral diseases as well as damage caused by insect pests were significant one. Bhut Jolokia, known to be affected by many insects and non-insect pests of which yellow mite, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) and thrips, *Scirothips dorsalis* were major destructive sucking pests and invariably considered as major pests (Buragohain, 2015) [5]. Chilli thrips and mites infestation leads to typical damage symptoms on leaves curl "upward" and "down ward" resulting in loss of production because of hampering photosynthetic activity. As *Bhut Jolokia* being cultivated in different location of North Eastern India there is great variation in agro climatic conditions in various regions, the pests showed varying degree and trends in their distribution, incidence, nature and extent of damage to the crop. Knowing the distribution and peak period of incidences could help in adopting pest management practices more effectively with less dependence on highly toxic chemical insecticides in the field.
Keeping the formulation of effective pest management practices in view, an investigation was carried out to study the influence of various weather parameters like rainfall, temperature, relative humidity, bright sun shine hours etc. on incidence of thrips and mite on *Bhut Jolokia*.

Materials and Methods
The present experiment was carried out at Horticultural Research Farm of Assam agricultural University located at Jorhat, Assam during 2017- 19 for two consecutive years. The geographical details of the site were 26°47′ N latitude and 94°12′E longitude at an elevation of 86.8 m above mean sea level and the area conducted. The topography of the experimental plot was uniform with mostly alluvial and sandy loam soil and the region falls under Upper Brahmaputra Valley Zone of Assam.
The experiment was conducted in a Randomized Block Design (RBD) with five treatments and replicated four times. *Bhut*

Jolokia cultivar "King" was used for the study which was more predominantly used by the farming community in Jorhat district of Assam. Seedling was raised in V type nursery than maintained secondary nursery in poly bag covered with nets to protect from initial infestation at seedling stage. Seedlings age of 6 week transplanted in the raised bed of main field with plot size 3m x 2m at plant spacing of 90 cm between plant and rows, respectively. All other the recommended agronomic practices adopted while raising the plants except application of pesticides to manage the incidence of pest. Incidence of yellow mite and thrips were recorded at an interval of seven days during morning hours. Pest counts of thrips were made from recorded from ten leaves randomly selected from plants in each plot, considering upper, middle and lower leaves of each selected plant. The leaves thus selected were collected from the field were put in a zip lock polypropylene bag with proper marking and without much disturbance to the laboratory for recording the mite population under stereo zoom binocular microscope at 4x magnification. The number of thrips and mite recorded from ten leaves was summed up and converted to numbers per three leaves basis.

Meteorological data *viz.*, maximum and minimum temperature (^{0}C), rainfall (mm), average relative humidity (%) and Bright Sun shine hours (BSSH) during the study period were collected from the Department of Agro meteorology, Assam Agricultural University, Jorhat. Correlation and multiple regressions were made between thrips and mite population with the collected weather parameters.

Results and Discussion

Thrips (Scirtothrips dorsalis)

Thrips incidence in *rabi* season *Bhut Jolokia*, ranged from 0.40 to 6.45 and 0.20 to 4.50 numbers per three leaves appeared from 6th standard meteorological week (SMW) *i.e.* 2nd week of February and 2nd SMW *i.e.* 2nd week of January, 2019 of 2017-18 and 2018-19, respectively and which persist up to May 2nd week *i.e.*19th SMW of 2018 and 18th SMW *i.e.* 1st week of May, 2019. The population of thrips fluctuated with time maximum incidence (6.45 per three leaves) was observed during 13th SMW *i.e.* 4th week of March, 2018 and 4.50 numbers per three leaves was also observed during 13th SMW *i.e.* 4th week of March, 2019 (Fig.1a and Fig.1b). Meena *et al.* (2013) [8] revealed similar trends, that the incidence of thrips, *S. dorsalis* (Hood) appeared on the chilli crop in Rajasthan soon after transplanting. The appearance of thrips on *Bhut Jolokia* was in accordance with earlier research worker Begam *et al.* (2016) [3] on *Bhut Jolokia*, in Assam condition, where she found that thrips appeared from 4th week of February with a mean population of 0.4 per leaf and the maximum average population (1.4 thrips/leaf) was recorded during the 1st week of April and the lowest population (0.2 thrips/leaf) was observed during last week of April to 1st week of May. However, Thangjam (2017) [11] reported from Jorhat, Assam, that on *Bhut Jolokia S. dorsalis* appeared from 1st week of March to 2nd week of May with a maximum peak incidence of 0.27 per leaf during 2nd week of April.

Mite (Polyphagotarsonemus latus)

During the study it was found that the incidence of mite ranged in between 0.30 to 8.68 and 0.25 to 6.65 numbers per three leaves during 2017-18 and 2018-19, respectively where population build-up of mite started from 5th SMW (1st week of February, 2018) with 0.80 numbers per three leaves and sustained up to nineteenth SMW *i.e.* 2nd week of May, 2018 and from 3rd SMW (3rd week of January, 2019) with 0.80 numbers per three leaves and retained up to 18th SMW (1st week of May, 2019). The highest incidence of 8.68 numbers per three leaves was observed during 13th SMW *i.e.* 4th week of March, 2018 and 6.65 numbers per three leaves was observed during 15th SMW *i.e.* 2nd week of April, 2019 (Fig. 2a and Fig. 2b). The result of the present investigation was in similarity with those of findings of Meena *et al.* (2013) [8] who reported that the incidence of mites, *P. latus* appeared on the chilli crop soon after transplanting in Rajasthan on chilli. Similar findings also reported by Pathipati *et al*. (2014) [10] on chilli that in Andhra Pradesh, peak population of mite was recorded in 3rd SMW of 2007-08 and 52nd SMW of 2008-09 in chilli. Begam *et al*. (2016) [3] from Assam, also reported that mite appeared in the *Bhut Jolokia* from 4th week of January with a population of 0.4 per leaf, which was seen to be steadily increased upto a mean population of 26.6 mites per leaf in 3rd week of March. However, Thangjam (2017) [11] from Jorhat, Assam also revealed that the mite appeared on *Bhut Jolokia* from 3rd week of February to 2nd week of May with a maximum peak incidence of 2.60 per leaf during 2nd week of April.

Correlation and regression of thrips (S. Dorsalis) with abiotic factors

Population of thrips during 2017-18, exhibited a significant negative correlation with av. RH (-0.661**) and non-significant positive correlation with maximum temperature (0.321), minimum temperature (0.129) and BSSH (0.069), whereas a non-significant negative correlation with rainfall (-0.153) (Table 4.9). However, during 2018-19, thrips population indicated a significant positive correlation with maximum temperature (0.408*) and significant but negative correlation with average relative humidity (-0.576**), whereas, in case of minimum temperature (0.088) and BSSH (0.083) there was a non-significant positive correlation. However, in case of rainfall, it showed non-significant negative correlation (-0.225) (Table 1).

The multiple regressions between weather parameter and thrips population during 2017-18 and 2018-19 were presented (table 2) and regression equations were:

$Y=37.568 + (-0.146)\ X_1 + (0.132)\ X_2 + (-0.404)\ X_3 + (-0.016)\ X_4 + (-0.337)\ X_5$ (R^2=0.587)

$Y=23.664 + (0.009)\ X_1 + (0.050)\ X_2 + (-0.270)\ X_3 + (0.003)\ X_4 + (-0.252)\ X_5$ (R^2= 0.506)

Where,

X_1= maximum temperature, X_2 = minimum temperature, X_3= av. RH, X_4= rainfall, X_5= BSSH and R^2= coefficient of determination

Multiple regressions revealed that the weather parameters contributed for 58.70 and 50.60 per cent of total variation in the population of thrips in *Bhut Jolokia* during 2017-18 and 2018-19. It was also found that average relative humidity has significant impact on population build-up of thrips.

The investigation was found in agreement with Misal *et al*. (2016) who revealed that positive significant correlation with maximum temperature (r =0.782*) and a significant negative correlation with relative humidity (r =-0.741*), whereas other factors such as minimum temperature and BSSH had non-significant positive relation in Pune. In *Bhut Jolokia* similar trend was reported by

Begam *et al*., 2016 [3] where maximum temperature showed a positive and significant correlation with the thrips population, while significant but negative correlation was observed with relative humidity and total rainfall, respectively. Thangjam (2017) [11] also reported from Assam that on *Bhut Jolokia* maximum temperature exhibited positive correlation with the thrips population whereas, average relative humidity and total rainfall showed negative correlation.

Correlation and Regression of Mite (P. Latus) with abiotic Factors

Mite population in 2017-18 showed a significant negative correlation with average relative humidity (-0.618**), whereas it exhibited a non-significant positive correlation with maximum temperature (0.278), minimum temperature (0.112) and BSSH (0.042). However, a non-significant negative correlation was observed with rainfall (-0.154). Whereas, during 2018-19, mite population showed a significant positive correlation with maximum temperature (0.504*) and significant but negative correlation with average relative humidity (-0.527**), while a non-significant positive correlation with minimum temperature, (0.169) and BSSH (0.076) and a non-significant negative correlation (-0.173) was observed with rainfall (Table 1).

Multiple regressions between mite population and weather parameter during 2017-18 and 2018-19 were presented (Table 2) and regression equations were:

$Y=53.136 + (-0.339) X_1 + (0.243) X_2 + (-0.544) X_3 + (-0.019) X_4 + (-0.407) X_5$ (R^2=0.541)

$Y=21.664 + (0.144) X_1 + (0.031) X_2 + (-0.286) X_3 + (0.004) X_4 + (-0.273) X_5$ (R^2= 0.477)

Where,

X_1= maximum temperature, X_2 = minimum temperature, X_3= av. RH, X_4= rainfall, X_5= BSSH and R^2= coefficient of determination

The present finding revealed that the weather parameters cumulatively contributed for 54.10 and 47.70 per cent of total variation in the population of mite in *Bhut Jolokia* during 2017-18 and 2018-19, respectively. During the study it was found that average relative humidity had profound effect on mite population and depicting that the prediction of the mite population by using weather parameters were reliable. The result of present investigation was in agreement with Misal *et al*. (2016) [9] as they reported that mites on organic green chilli had significant positive correlation with maximum temperature, non-significant positive correlation with minimum temperature and BSSH but in case of relative humidity, the correlation was negatively significant. Begam *et al*. (2016) [3] also stated that mites exhibited a significant positive correlation with maximum temperature and a non-significant negative correlation with relative humidity and total rainfall. However, a positive correlation was also registered with minimum temperature and BSSH, respectively. Similar trend also reported by Baral (2017) [1] in an experiment at VNMKV, Parbhani that mite population in chilli exhibited a significant negative correlation with morning relative humidity and evening relative humidity, whereas maximum temperature showed a positive and non-significant effect. Findings of Thangjam (2017) [11] on *Bhut Jolokia* from Assam almost in conformity with the present findings that maximum temperature and BSSH showed non-significant positive correlation whereas, average relative humidity and total rainfall showed negative but non-significant correlation with the mite population.

Table 1: Correlation of Thrips and Mites of *Bhut Jolokia* with abiotic factors during 2017-18 and 2018-19

Weather parameter	2017-18		2018-19	
	Thrips	Mite	Thrips	Mite
Maximum Temperature (°C)	0.321	0.278	0.408*	0.504*
Minimum Temperature (°C)	0.129	0.112	0.088	0.169
Average relative humidity (%)	0.661**	-0.618**	-0.576**	-0.527**
Rainfall (mm)	-0.153	-0.154	-0.225	-0.173
Bright Sun shine (hr)	0.069	0.042	0.083	0.076

*P= 0.05 ** P= 0.01

Table 2: Multiple regressions of Thrips and Mites of *Bhut Jolokia* with abiotic factors during 2017-18 and 2018-19

Weather parameter	2017-18		2018-19	
	Thrips	Mite	Thrips	Mite
Maximum Temperature (°C)	-0.146	-0.339	-0.009	0.144
Minimum Temperature (°C)	0.132	0.243	0.050	0.031
Average relative humidity (%)	-0.404*	-0.544*	-0.270*	-0.286
Rainfall (mm)	-0.016	-0.019	0.003	0.004
Bright Sun shine (hr)	-0.337	-0.407	-0.252	-0.273
Intercept	37.568	53.136	23.644	21.664
Coefficient of determination(R^2)	0.587	0.541	0.506	0.477

*P= 0.05 ** P= 0.01

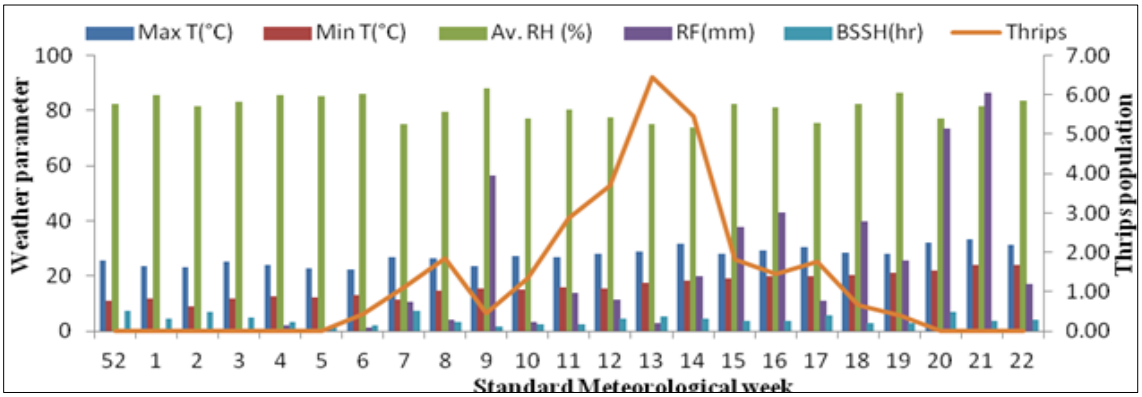

Fig 1: Population fluctuation of thrips during 2017-18

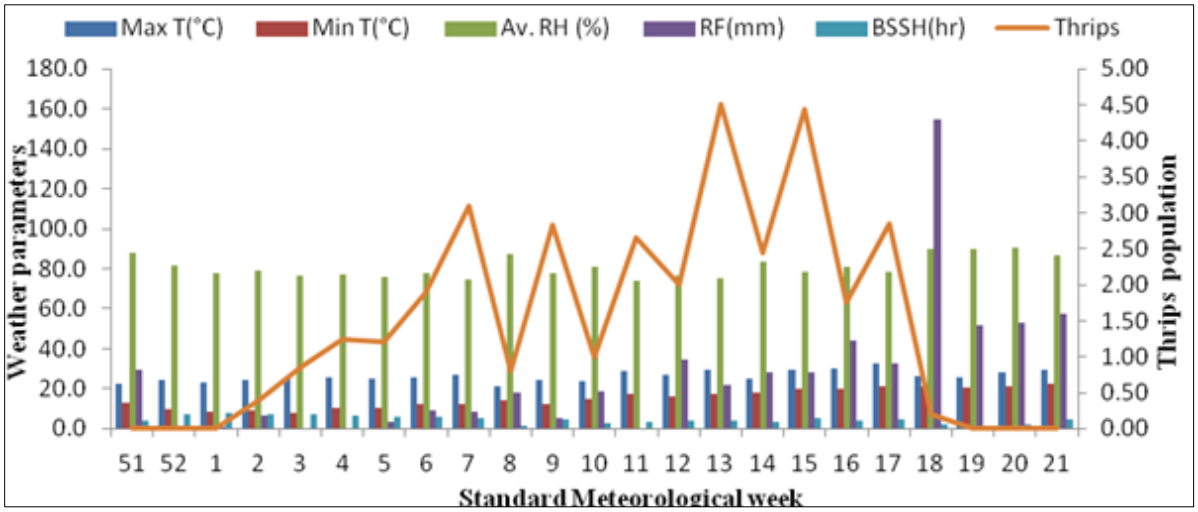

Fig 2: Population fluctuation of thrips during 2018-19

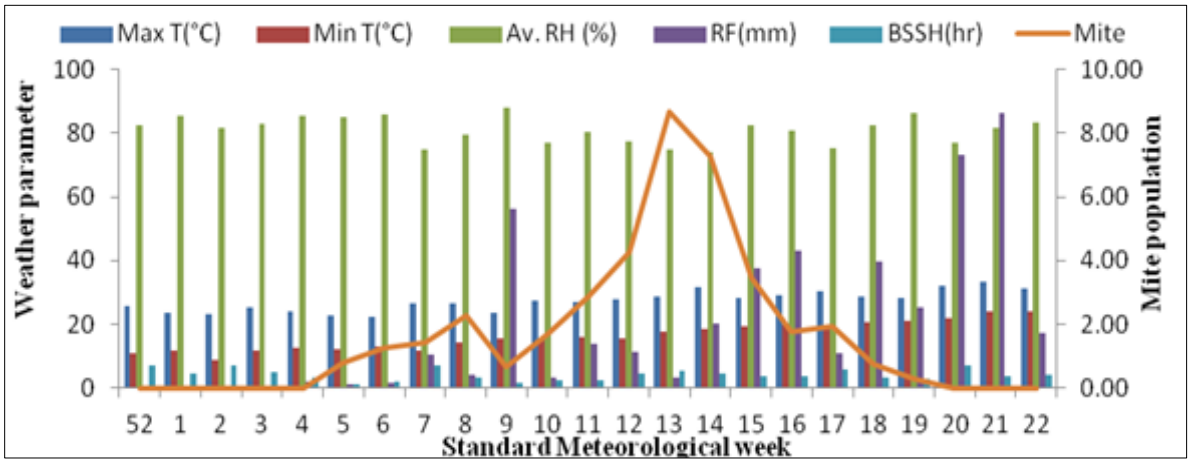

Fig 3: Population fluctuation of mites during 2017-18

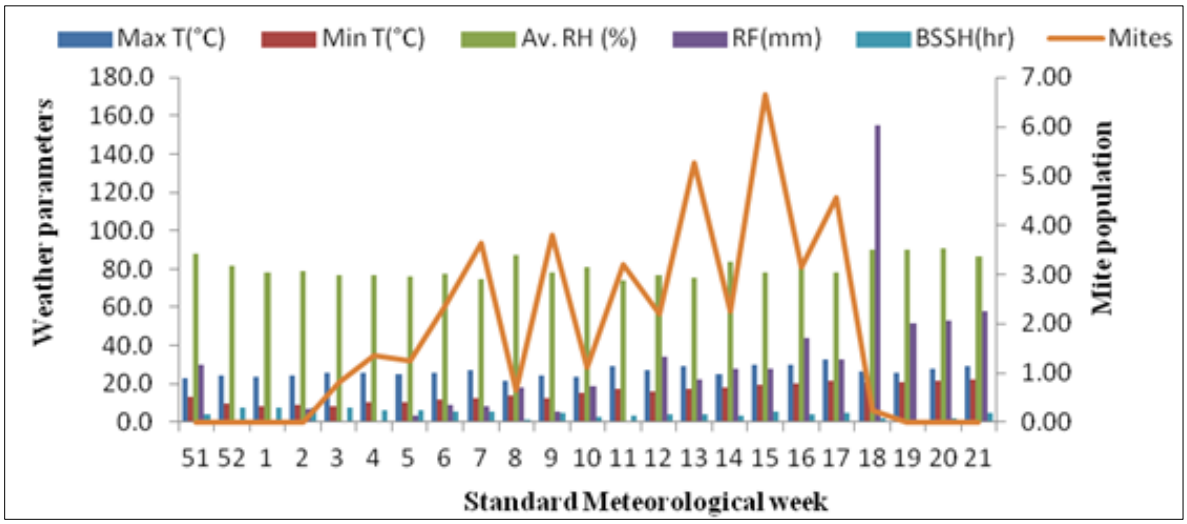

Fig 4: Population fluctuation of mites during 2018-19

Conclusion

It is concluded that the population of thrips and mites were positively significantly influenced by maximum temperature, while negatively significantly influenced by average relative humidity. Other weather parameters had no significant impact on thips and mite population incidence in *Bhut Jolokia* in Jorhat condition. Therefore, weather factors play important role and increase in av. RH suppressed the growth and development of

thrips and mite population while maximum temperature favours the growth and development of the insect.

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