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Short Communication

Effect of meteorological parameters on population dynamics of thrips (*Thrips tabaci* Lindeman) in bulb onion

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Onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae) is one of the cosmopolitan pest of onion and causes significant yield loss globally (Gill *et al.*, 2015). The pest can cause up to 60 per cent of yield loss *via* direct feeding or indirectly *via* transmitting viral diseases and fungal disease in onion (Arantha, 1980). Both nymphs and adults' sucks sap and remove leaf chlorophyll causing white to silver patches, consequently shows curling of leaves. Reduction in photosynthetic area ultimately results in the formation of undersized bulbs. The attack of onion thrips in onion is prevailed at all the stages of crop growth. However, weather activity appears to be an important factor that regulates thrips population build-up (Kumar *et al.*, 2017). A basic understanding of the relationship of these climatic factors with thrips population is important for developing an integrated pest control strategy for thrips in onion for a given climatic trend.

Several studies have confirmed that temperature has pronounced effect on population dynamics of onion thrips (Murai, 2000; Singh *et al.*, 2017; Karuppaiah *et al.*, 2018). Several climate models for thrips prediction has also been developed (Stacey and Fellows, 2002). Most models developed mainly focused on temperature while not much consideration were given to factors like relative humidity. Apart from temperature, *T. tabaci* population is also significantly influenced by relative humidity on onion crop (Leite *et al.*, 2004). Interactive effect of temperature and relative humidity (RH) on thrips population dynamics is also not much explored. However, weather based regression models is developed and successfully employed for assessing seasonal occurrence of some other sucking pests like mango thrips and mustard aphid (Gundappa *et al.*, 2016; Narjary *et al.*, 2013).

The purpose of this study was not to create a predictive model for *T. tabaci* rather to understand the impact of temperature and relative humidity on seasonal incidence of *T. tabaci* in onion using humid thermal ratio.

The study was conducted during *rabi* 2016-17 and 2017-18 with onion variety Bhima Kiran at ICAR-Directorate of Onion and Garlic Research (DOGR), Pune, Maharashtra, India. The study site (18.32° N 73.51° E; 553.8 m above mean sea level) is characterized by a blend of semi-arid climate bordering with tropical wet and dry weather conditions. The soil type of study site is very much suitable for onion cultivation (32-35% clay, 20% silt and 40% sand; soil pH-7.9 and bulk density 1.4 mgcm^{-3}). Onion nursery was grown in raised bed and forty-days old onion seedlings were transplanted with 10 x 15 cm spacing in flatbeds of 2 × 3m. Recommended dose of NPK (110:40:60 Kg ha^{-1}) was applied in basal and top-dressing. Irrigation was given regularly at 10 days interval till maturity. Except plant protection, all other management practices were followed as per ICAR-DOGR recommendation.

Data on thrips population was recorded on weekly basis from five randomly selected plants at five randomly selected spots in the field. The visual counts were made to observe the number of thrips (nymphs and adults) present at top five leaves of each plant. Total of 25 plants were observed for sampling. For analysis, mean count per plant was taken and expressed as number of thrips per plant. The occurrence of thrips on onion was recorded throughout the cropping period starting from 48th standard meteorological week (SMW) to 13th SMW during 2016-18. The population data obtained were subjected to normalization using log transformation.

Onsite daily weather parameters like temperature (maximum and minimum) and relative humidity (morning and evening) were recorded at the Meteorological Observatory located at ICAR-DOGR, Rajgurunagar Research Farm. The data was further used for computing humid thermal ratio (HTR) using following formula (Gundappa *et al.*, 2016)

$$\mathrm{HTR} = \mathrm{RHmean}/\mathrm{Tmean}$$

Where, HTR is humid thermal ratio, RH_{mean} is mean relative humidity and T_{mean} is mean temperature.

To workout the relation between thrips population and humid thermal ratio, linear regression was done by taking humid thermal ratio as independent variables and onion thrips population as dependent variables. Statistical significance of Pearson's correlation coefficients between dependent and independent variables under the study was drawn using t-test at the 0.05 significance level using Microsoft Excel and SPSS v.19 software.

Mean population of onion thrips in different weeks of growing season in 2016-18 and humid thermal ratio (HTR) computed (pooled) for corresponding standard meteorological weeks, 48th to 13th SMW during the study period is given in Table 1. Across the standard meteorological week (48 to 13 SMW), mean temperature ranged from 18.6°C to 27.5°C, while mean relative humidity varied between 54.3 to 66.9 per cent. Humid thermal ratio (HTR) was ranged from 2.2 to 3.5 across the SMW; ratio was > 3 during 49th to 4th SMW (Mid December to Late-January).

Data on weekly thrips population (thrips/plant) revealed fluctuations in pest load throughout the season. Thrips population reached its peak (64.9 thrips/plant) when HTR stretched 3.5 and increased further while HTR is 3.1. Highest population peak was recorded during late-January *i.e.* 4th SMW. Overall, onion thrips load was higher during 3rd (53.4 thrips/plant), 4th (64.9 thrips/plant), 5th (57.3 thrips/plant) and 6th (57.2 thrips/plant) SMW. The 13th SMW of April month registered least number of thrips per plant (5.5 thrips per plant). During early-December, only moderate level of pest incidence was recorded, while maximum thrips infestation coincided during late-January and February months.

Correlation studies (Table 2) between thrips population and weather parameter revealed that thrips population had a significant negative correlation with temperature [maximum ($r = -0.726^{**}$, p=0.01), minimum ($r= -0.670^{**}$, p= 0.01) and average ($r= -0.719^{**}$, p=0.01)]. On the other hand significant positive correlation was found between thrips population and morning relative humidity ($r= 0.566^{*}$, p= 0.05) and non-significant positive correlation with evening relative humidty ($r= 0.313^{ns}$, p= 0.05). Meanwhile it had a significant positive correlation with RH_{mean} ($r= 0.588^{*}$, p= 0.05) and HTR ($r= 0.690^{**}$, p= 0.01). This indicates that activity of thrips population increase with the rise of mean relative humidity, humid thermal ratio and population decrease with the rise of temperature.

Temperature has varying effect on thrips populations. At temperature extremities, thrips development gets arrested, thereby affecting population build-up. Cool weather with moderate temperature increased seasonal thrips numbers. Our findings are in accordance with some previous workers, where increasing temperature throughout the *rabi* season, increases thrips activity, development, and population growth up to the point when winter hosts begin to senesce and thrips flights decline (Lewis, 1997). Similarly, Stacey and Fellows (2002) reported that fall in minimum temperature could arrest the thrips development and shows a negative correlation with thrips population build-up. Evans (1967) reported that dry weather favours thrips population growth. It was suggested by Murai (2000) that the intrinsic rate of growth of *T. tabaci* at the temperatures lower than 25°C is due to the advantage of the lytokous reproduction in western Japan, and the opposite result at 30°C is due to hatchability of *T. tabaci*. Hence, average temperature could be a significant weather factor to predict the seasonal fluctuation of onion thrips.

In the present study, computed humid thermal ratio revealed that during moderate infestation, HTR ranged from 2.71 to 3.16. Gradual increase in thrips population was recorded from 48th SMW and reached peak population by late-January *i.e.* 4th SMW, which coincided with the increase in HTR value around these weeks. Thereafter, a similar trend of decline was noticed in HTR values and pest population from 5–13th SMW. This suggests that combined role of temperature and relative humidity at optimum (HTR= >2.7 and <3.5) had positive influence on thrips population build-up. The thrips population decreased when the HTR was in decreasing trend and it shows that growth and development of onion thrips is dependent on temperature and relative humidity. The correlation analysis between HTR and thrips population revealed a significant positive correlation during 2016-18 ($r= 0.690^{**}$ p=0.01). Therefore, using HTR is added weightage while assessing the population dynamics of onion thrips. Similarly, study by Narjary *et al.* (2013) with mustard aphid and Gundappa *et al.* (2016) with mango thrips had explained a significant positive correlation between pest population development and HTR and also suggested that it could be an efficient index to assess the field development rate and understanding pest population dynamics. Likewise, a study by Roy (2003) also explored HTR as an index to speculate the aphid population dynamics and reported peak population when HTR value ranged from 3 to 4. A

Table 1: Thrips population trend and weather parameters during 2016-18 (Pooled) at Experimental site, Rajgurunagar, Pune, Maharashtra state of India

Standard meteorological week (SMW)	Avg. relative humidity (RH_{mean}) A	Avg. temperature (T_{mean}) B	Humid thermal ratio (HTR) A/B	Avg. no. of thrips/plant
48	62.7	21.3	2.9	21.5
49	66.9	20.3	3.3	23.4
50	66.0	20.0	3.3	20.0
51	64.2	18.6	3.5	31.7
52	61.8	19.4	3.2	27.1
1	61.3	19.3	3.2	42.1
2	66.0	19.9	3.3	39.7
3	65.4	18.7	3.5	53.4
4	65.0	21.2	3.1	64.9
5	63.7	21.4	3.0	57.3
6	61.3	22.6	2.7	57.2
7	65.9	22.5	2.9	40.5
8	63.1	23.7	2.7	32.9
9	58.2	24.1	2.4	22.6
10	61.1	22.4	2.7	21.8
11	54.3	23.2	2.3	20.8
12	54.3	24.7	2.2	13.0
13	59.1	27.5	2.2	5.5

Table 2: Correlation coefficients of thrips population with weather parameter and HTR (Pooled data)

Weather parameter/indices	Correlation Co-efficient (*r*)
Maximum temperature (Tmax)	-0.726^{**}
Minimum temperature (Tmin)	-0.670^{**}
Average temperature (Tmean)	-0.719^{**}
Relative humidity (RH I)	0.566^{*}
Relative humidity (RH II)	0.313^{ns}
Average relative humidity (RHmean)	0.588^{*}
Humid thermal ratio (HTR)	0.690^{**}

*Significant at p=0.05; *Significant at p=0.01; ns- Non Significant

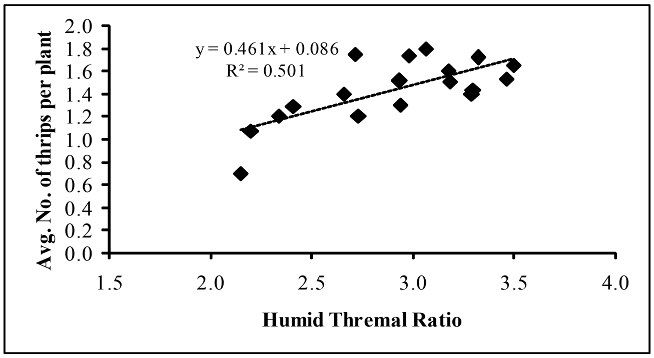

Fig 1: Relationship between onion thrips population and humid thermal ratio (Pooled)

linear, logarithmic and exponential regression between HTR and thrips population had explained 50 per cent variation (Fig. 1). This suggests that, among the different weather parameters, HTR index plays a vital role in regulating population dynamics of thrips in bulb onion under field conditions and in formulating insecticide spray schedules for timely pest management decisions

In the present study, maximum and minimum temperature, average relative humidity and HTR index had significant influence on population dynamics of onion thrips in bulb onion. Therefore, besides using temperature based prediction models, HTR index based models could be a viable tool to assess the population dynamics of onion thrips and in formulating insecticide spray schedules for timely pest management decisions.

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