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Screening of onion and garlic genotypes for resistance against *Thrips tabaci* Lindeman in mid-hill regions of Himachal Pradesh

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Abstract

In order to explore the possibility of sources of resistance and relative tolerance of cultivars based upon the damage inflicted, studies were undertaken to evaluate onion and garlic entries/ genotypes during February-April, 2016. The screening of the genotypes revealed thrips population to remain low till the end of March which attained peak in the first week of April. Mean thrips population count on onion was maximum on ON-14-01 being at par to ALRO 213, ON14-04 and minimum on genotype OLR 1352 which being at par with ON 15-16 and OLR 1372. Among the garlic genotypes AVT-2/GRL-1351 and AVT-1/GN-14-25 showed maximum thrips population whereas GRL-1349 and AVT-1/GN14-23 sustained minimum population. Foliar damage varied from 4.90 to 25.40 per cent and 0 to 6.6 per cent in onion and garlic, respectively. Correlation of population build-up with environmental factors showed positive correlation with prevailing temperature but negative with rainfall, relative humidity, wind speed and sunshine hours for both the crops but correlation with maximum relative humidity and wind speed was significant for onion crop only.

Key words: *Allium cepa*, *Allium sativum*, thrips, germplasm, screening.

Onion (*Allium cepa* L.) and garlic (*Allium sativum* L.) are the most important bulb crops for the farming community in India as well as in Himachal Pradesh. The bulb size and yield, both are reduced by biotic and abiotic factors. Also among various biotic factors attacking the crop, insect-pests are equally important which severely infest them and one associated key pest is *Thrips tabaci* Lindeman (Thysanoptera: Thripidae). It is the major pest with cosmopolitan distribution and abundance (Lewis 1997). It is polyphagous in nature and has been reported on cotton, cucurbits, tobacco, tomato, garlic, onion and leek (Akhtari *et al.* 2013). It has attained a status of major pest due to high reproductive rate, short generation time, parthenogenetic mode of reproduction and inherent ability to develop resistance to insecticides (Gill *et al.* 2015). The thrips inflict damage to leaves as well as flowers (Imai *et al.* 1998; Murai 2000) of onion. The feeding results in drying of leaves from the apical end towards the neck region and reduced bulb weight (Fournier *et al.* 1995; Nault and Shelton 2008). The damage causes leaves to succumb as a result of disrupted physiological processes of plant. The important cultivars of onion are known to be susceptible to this pest. However, the reduced yield of bulb tends to vary depending on the region, pest population and correlation with the environmental factors (Gill *et al.* 2015). Currently there is no onion and garlic cultivar that are completely resistant to thrips feeding but some cultivars are tolerant to minor feeding damage thereby compensating the reduction in onion yield. These cultivars differ in their colour and waxiness that affect onion thrips population. The semi-glossy cultivars are with yellow- green leaves with fewer thrips population whereas the blue-green leaves have high wax content in their epicuticle are more prone to thrips damage (Boateng *et al.* 2014; Diaz-Montano *et al.* 2012). Apart from biotic factor mentioned above, the abiotic factors such as temperature, wind velocity and atmospheric pressure also have a major role in thrips population dispersal (Pelligrino *et al.* 2013). However, adult thrips do make short dispersal from weeds to their main host. In addition, thrips also make trivial and long- distance flight during the onion growing season (Smith 2010; Smith *et al.* 2015).

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The host plant resistance has thus potential to reduce the growth and development of pests and can be used as an important, economical and environment friendly tool in an integrated pest management programme. Thus, our objective to carry out this study was to screen different entries/ genotypes against the thrips and select the most tolerant genotypes in terms of number of thrips population and foliar damage.

Materials and Methods

Crop raising

A total of 40 onion and 18 garlic genotypes supplied by the Directorate of Onion and Garlic Research, Rajgurunagar, Pune along with two local checks, Palam Lohit and GHC-1 LOCAL were evaluated during 2015-16. Thirty day old seedlings were transplanted in plots of 1 m^2 at row to row and plant to plant spacing of 15 and 5 cm on December 15, 2015, following all the agronomic practices for raising onion crop except the use of pesticides. The experiment was set up in randomized block design replicating twice.

Population buildup of thrips and screening of genotypes

The thrips population was recorded at fixed interval of ten days along with the foliar damage. Population count including both larva and adult feeding on leaf blade started with first appearance of the pest and continued till 80 per cent of plants in the field were lodged down. A total of six observations were taken at ten days interval and a single observation was taken in terms of percentage to rank the leaf blade damage. For counting thrips population, five plants were selected randomly for each replication and thrips per plant were counted with the help of 10X magnifying lens. In order to assess the damage done to onion genotypes as a result of thrips feeding, five plants per replication were observed for the percentage of foliar damage inflicted to plants and was rated in 1-5 scale (Anonymous 2015). Foliar damage ranging from 0-20, 21-40, 41-60, 61-80 and 81-100 was rated as 1, 2, 3, 4 and 5, respectively.

Effect of weather parameters on thrips population

In order to analyse the effect of abiotic factors such as temperature, rainfall, relative humidity, wind speed and sunshine hours on population build up of *T. tabaci*, a relationship was worked out between mean thrips population and these meteorological factors. Meteorological data was procured from the Department of Agronomy of the university.

Design and data analysis

The experiment was conducted in randomized block design (RBD) and the data pertaining to mean thrips population and foliar damage was subjected to analysis of variance.

Results and Discussion

Thirty nine onion genotypes of onion were screened for resistance under field conditions during the Rabi season in the year 2016 against onion thrips, *Thrips tabaci* Lindeman (Table 1). The first appearance of the pest was noticed in first fortnight of February till first week of April, 2016. A similar trend of population build up has been recorded by Hossain *et al*. (2015) for *T. tabaci* infesting the bulb onion. Perusal of data revealed that thrips population showed an increasing trend from the month of February till April and the population per plant in April was recorded highest and varied significantly with the thrips population count taken on previous dates. The seasonal mean population of thrips on different genotypes varied from 1.1 to 9.8 thrips per plant with minimum population in genotype, OLR-1352 which was on a par to ON15-16 and OLR 1372. The maximum thrips population corresponded to ON 14-01 being on a par to ALRO-213 and ON14-04. Beside these genotypes, the overall thrips population remained very low in all the other genotypes evaluated throughout the growing season.

Eighteen garlic entries/ genotypes were also screened simultaneously with the onion genotypes. The observation on population build up (Table 2) showed increasing trend from the month of February till end of the March. April month recorded highest thrips population. The seasonal mean population of thrips on different genotypes varied from 0.8 to 3.8 thrips per plant with maximum population corresponded to AVT-2/GRL-1351 and AVT-1/GN-14-25. Minimum thrips population was recorded on GRL-1349 and AVT-1/GN14-23. Population levels to the extent of 47.6 and 13.2 were observed on ON14-01 genotype of onion and AVT-2/GRL-1351 and AVT-1/GN-14-25 genotypes of garlic, respectively in the first week of April. This suggests the thrips population remained high during the genotype screening. Sanjta (2014) recorded thrips population to vary between 2.5 to 21.0 thrips/ plant in mid hill region (District Solan) of Himachal Pradesh being lower to the population count recorded in our study.

Table 1. Screening of different genotypes of onion against the infestation of thrips

Entries/ Genotypes	Thrips population per plant							Foliar damage (%)
	17th Feb	27th Feb	8th March	18th March	28th March	7th April	Mean	
ON15-01	0.2 (1.08)	0.4 (1.16)	0.6 (1.25)	0.6 (1.20)	1.8 (1.66)	14.6 (3.81)	3.0 (1.70)	13.8 (3.80)
ON15-04	0.2 (1.08)	0.2 (1.08)	0.0 (1.00)	0.2 (1.08)	3.8 (1.94)	10.6 (3.29)	2.5 (1.60)	8.8 (3.10)
ON15-45	0.2 (1.08)	0.6 (1.23)	0.2 (1.08)	0.2 (1.08)	9.0 (2.98)	8.4 (2.88)	3.1 (1.70)	12.0 (3.60)
ON15-06	0.2 (1.08)	0.2 (1.08)	0.2 (1.08)	0.4 (1.16)	2.0 (1.71)	9.2 (3.12)	2.0 (1.50)	11.0 (3.50)
ON15-11	0.2 (1.08)	0.8 (1.31)	0.4 (1.16)	0.0 (1.00)	1.6 (1.52)	6.6 (2.72)	1.6 (1.50)	9.2 (3.20)
ON15-13	0.2 (1.08)	0.2 (1.08)	0.0 (1.00)	0.4 (1.15)	1.6 (1.59)	9.0 (3.07)	1.9 (1.50)	8.4 (3.00)
ON15-16	0.2 (1.08)	0.2 (1.08)	0.2 (1.08)	0.2 (1.08)	0.8 (1.31)	5.6 (2.36)	1.2 (1.30)	5.6 (2.50)
ON15-18	0.2 (1.08)	0.0 (1.00)	0.2 (1.08)	0.2 (1.08)	0.4 (1.16)	20.2 (4.23)	3.5 (1.60)	14.0 (3.90)
ON15-20	0.2 (1.08)	0.0 (1.00)	0.6 (1.23)	0.4 (1.16)	1.2 (1.46)	9.6 (3.15)	2.0 (1.50)	13.4 (3.80)
ON15-23	0.4 (1.16)	0.2 (1.08)	0.2 (1.08)	0.4 (1.16)	1.0 (1.39)	21.8 (4.04)	4.0 (1.70)	8.4 (3.00)
ON15-27	0.2 (1.08)	0.6 (1.25)	0.4 (1.16)	0.8 (1.28)	2.2 (1.70)	13.6 (3.53)	3.0 (1.70)	10.6 (3.30)
ON15-37	0.2 (1.08)	0.4 (1.15)	0.4 (1.16)	0.0 (1.00)	9.0 (2.72)	8.8 (2.97)	3.1 (1.70)	9.0 (3.10)
ON15-42	0.2 (1.08)	0.6 (1.25)	0.0 (1.00)	1.0 (1.33)	2.0 (1.68)	23.6 (4.75)	4.6 (1.80)	8.4 (2.90)
ON14-01	1.8 (1.64)	0.8 (1.31)	0.0 (1.00)	0.0 (1.00)	8.6 (2.90)	47.6 (6.85)	9.8 (2.50)	25.4 (5.10)
ON14-11	0.2 (1.08)	0.4 (1.16)	0.0 (1.00)	0.4 (1.16)	2.4 (1.76)	9.2 (3.04)	2.1 (1.50)	17.4 (3.90)
ON14-04	0.4 (1.16)	0.4 (1.16)	0.8 (1.25)	0.4 (1.16)	16.0 (3.51)	12.0 (3.24)	5.0 (1.90)	25.0 (5.10)
ON14-15	0.2 (1.08)	0.4 (1.16)	0.4 (1.15)	0.2 (1.08)	0.2 (1.08)	17.6 (3.98)	3.2 (1.60)	8.0 (2.90)
ON14-06	0.4 (1.16)	0.8 (1.31)	0.2 (1.08)	0.0 (1.00)	2.0 (1.66)	15.2 (3.18)	3.1 (1.60)	10.2 (3.00)
ON14-09	0.2 (1.08)	0.8 (1.29)	0.0 (1.00)	0.8 (1.31)	1.0 (1.38)	9.4 (2.95)	2.0 (1.50)	5.6 (2.40)
0N14-17	1.0 (1.36)	0.6 (1.23)	0.0 (1.00)	0.4 (1.16)	1.0 (1.39)	8.2 (2.74)	1.9 (1.50)	6.2 (2.70)
ON14-23	0.2 (1.08)	0.0 (1.00)	0.8 (131)	0.0 (1.00)	0.4 (1.16)	22.4 (4.43)	4.0 (1.70)	7.2 (2.60)
ON14-27	0.2 (1.08)	0.0 (1.00)	0.8 (1.25)	0.6 (1.23)	1.2 (1.48)	14.8 (3.73)	2.9 (1.60)	4.7 (2.30)
ON14-25	0.4 (1.16)	0.0 (1.00)	0.0 (1.00)	0.0 (1.00)	2.0 (1.72)	15.2 (3.96)	2.9 (1.60)	6.2 (2.60)
ALRO-213	0.2 (1.08)	0.0 (1.00)	0.0 (1.00)	0.4 (1.16)	1.6 (1.56)	43.0 (6.25)	7.5 (2.00)	10.2 (3.30)
OLR-1323	0.2 (1.08)	0.0 (1.00)	0.2 (1.08)	0.0 (1.00)	0.2 (1.08)	23.0 (4.33)	3.9 (1.60)	12.4 (3.60)
OLR-1341	0.2 (1.08)	0.0 (1.00)	0.6 (1.25)	0.4 (1.16)	0.6 (1.25)	18.6 (4.36)	3.4 (1.70)	14.0 (3.80)
OLR-1349	0.2 (1.08)	0.0 (1.00)	0.0 (1.00)	0.6 (1.23)	1.2 (1.45)	14.0 (3.64)	2.7 (1.60)	8.4 (3.00)
OLR-1352	0.2 (1.08)	0.2 (1.08)	0.8 (1.29)	0.0 (1.00)	0.8 (1.29)	4.4 (2.18)	1.1 (1.30)	7.0 (2.80)
OLR-1354	0.4 (1.16)	0.2 (1.08)	0.2 (1.08)	0.4 (1.14)	1.2 (1.46)	8.2 (2.71)	1.8 (1.40)	12.8 (3.70)
OLR-1357	1.8 (1.56)	0.0 (1.00)	1.6 (1.47)	0.0 (1.00)	0.2 (1.08)	7.8 (2.88)	1.9 (1.50)	9.0 (2.90)
OLR-1359	0.4 (1.16)	0.0 (1.00)	0.2 (1.08)	0.0 (1.00)	0.2 (1.08)	13.0 (3.56)	2.3 (1.50)	10.4 (3.40)
OLR-1362	0.4 (1.16)	0.0 (1.00)	0.0 (1.00)	0.8 (1.31)	2.4 (1.81)	15.0 (3.76)	3.1 (1.70)	4.0 (2.20)
OLR-1364	0.2 (1.08)	0.0 (1.00)	0.0 (1.00)	0.0 (1.00)	1.0 (1.39)	8.2 (2.75)	1.6 (1.40)	6.8 (2.70)
OLR-1370	0.2 (1.08)	0.0 (1.00)	0.8 (1.33)	0.2 (1.08)	2.2 (1.74)	23.6 (4.74)	4.5 (1.80)	5.8 (2.60)
OLR-1372	0.2 (1.08)	0 (1)	0.0 (1.00)	0.8 (1.33)	1.0 (1.38)	5.4 (2.36)	1.2 (1.40)	5.2 (2.40)
OLR-1374	0.8 (1.28)	0 (1)	0.2 (1.08)	0.4 (1.16)	1.0 (1.39)	8.6 (2.89)	1.8 (1.50)	6.2 (2.70)
OLR-1381	0.2 (1.08)	0.2 (1.08)	1.6 (1.47)	0.2 (1.08)	0.2 (1.08)	5.4 (2.44)	1.3 (1.40)	6.2 (2.50)
OLR-1388	1.2 (1.37)	0 (1)	0.2 (1.08)	0.0 (1.00)	1.8 (1.60)	7.8 (2.70)	1.8 (1.50)	6.2 (2.60)
OLR-1377	0.2 (1.08)	0.2 (1.08)	0.2 (1.08)	0.8 (1.33)	2.0 (1.65)	11.4 (3.37)	2.5 (1.60)	7.6 (2.90)
CD (P=0.05)	0.26	NS	NS	NS	0.84	1.90		1.02

Table 2. Screening of different genotypes of garlic against the infestation of thrips

Entries/ Genotypes	Thrips population per plant						Mean	Foliar damage (%)
	17th Feb	27th Feb	8th March	18th March	28th March	7th April		
GRL-1349	0.2 (1.10)	0.6 (1.20)	0.6 (1.20)	1.0 (1.40)	1.0 (1.40)	1.5 (1.53)	0.8 (1.30)	6.6 (2.70)
AVT-1/GN14-19	0.2 (1.10)	2.0 (1.70)	2.0 (1.60)	2.0 (1.70)	1.8 (1.60)	0.0 (1.00)	1.3 (1.40)	3.7 (2.10)
AVT-1/GN14-21	0.6 (1.20)	0.0 (1.00)	0.0 (1.00)	2.4 (1.80)	1.8 (1.50)	5.8 (2.56)	1.8 (1.50)	0.1 (1.00)
AVT-2/GRL-1340	0.0 (1.00)	0.4 (1.20)	2.8 (1.90)	2.3 (1.70)	1.8 (1.60)	10.6 (3.35)	3 (1.80)	3.6 (2.00)
AVT-2/GRL-1337	2.0 (1.70)	1.0 (1.40)	1.1 (1.40)	1.6 (1.60)	2.9 (2.00)	13.0 (3.64)	3.6 (1.90)	0.0 (1.00)
AVT-2/GRL-1351	1.0 (1.40)	2.0 (1.70)	2.0 (1.70)	2.8 (1.90)	2.0 (1.70)	13.2 (3.56)	3.8 (2.00)	0.1 (1.00)
AVT-2/GRL-1335	0.0 (10)	2.0 (1.70)	2.3 (1.70)	1.2 (1.40)	1.6 (1.60)	4.0 (2.04)	1.9 (1.60)	0.0 (1.00)
AVT-2/GRL-1345	1.6 (1.50)	0.0 (1.00)	1.5 (1.50)	1.2 (1.40)	2.1 (1.70)	4.0 (2.09)	1.7 (1.50)	3.4 (2.00)
AVT-2/GRL-1330	0.8 (1.30)	1.6 (1.50)	1.5 (1.50)	3.0 (2.00)	1.0 (1.40)	4.2 (2.19)	2 (1.60)	3.3 (2.00)
AVT-2/GRL-1332	0.0 (1.00)	2.0 (1.70)	0.0 (1.00)	1.2 (1.40)	2.2 (1.70)	6.4 (2.64)	2 (1.60)	1.3 (1.50)
AVT-2/GRL-1328	0.0 (1.00)	0.0 (1.00)	1.6 (1.50)	1.6 (1.60)	1.4 (1.50)	7.4 (2.77)	2 (1.60)	1.4 (1.50)
AVT-1/GN14-23	0.0 (1.00)	1.2 (1.40)	0.0 (1.00)	1.8 (1.60)	1.4 (1.50)	0.6 (1.22)	0.8 (1.30)	0.0 (1.00)
AVT-1/GN14-17	0.0 (1.00)	1.2 (1.30)	2.0 (1.60)	2.0 (1.70)	2.2 (1.70)	11.2 (3.41)	3.1 (1.80)	0.0 (1.00)
AVT-1/GN-14-05	0.0 (1.00)	1.0 (1.40)	2.0 (1.70)	2.0 (1.70)	2.8 (1.90)	8.8 (3.07)	2.8 (1.80)	0.2 (1.10)
AVT-1/GN-14-25	0.0 (1.00)	3.0 (1.90)	2.4 (1.70)	2.5 (1.80)	1.6 (1.60)	13.2 (3.69)	3.8 (1.90)	0.0 (1.00)
AVT-1/GN-14-01	0.4 (1.20)	0.4 (1.20)	2.1 (1.60)	1.3 (1.40)	1.4 (1.50)	4.8 (1.72)	1.7 (1.40)	0.0 (1.00)
AVT-1/GN-14-15	0.0 (1.00)	0.3 (1.10)	0.0 (1.00)	1.2 (1.40)	2.2 (1.80)	4.2 (2.09)	1.3 (1.40)	0.0 (1.00)
AVT-1/GN-14-27	0.4 (1.20)	2.4 (1.70)	1.1 (1.40)	3.2 (2.00)	1.4 (1.50)	3.0 (1.87)	1.9 (1.60)	0.0 (1.00)
CD (P=0.05)	(0.22)	(0.35)	(0.41)	(0.39)	NS	(0.64)		(1.01)

Thrips damage recorded in terms of percent onion foliar damage ranged from minimum of 4 to maximum of 25.4 per cent. Minimum value corresponded to OLR-1362 (4%) and was followed by ON14-27 (4.7%), OLR-1372 (5.2%), ON15-16 (5.60%), ON14-09 (5.6%) whereas, maximum damage was observed on genotype ON14-01 and ON14-04. However, the foliar damage ranged from 1 to 20 for all the genotypes and were ranked 1, except the two genotypes ON14-01 and ON14-04 which were ranked 2 as per the foliar damage rating. Per cent foliar damage to garlic remained low varying from 0 to 6.6% with minimum damage recorded in AVT-2/GRL-1337, AVT-2/GRL-1335, AVT-1/GN14-23, AVT-1/GN14-17, AVT-1/GN-14-25, AVT-1/GN-14-01, AVT-1/GN-14-15 and AVT-1/GN-14-27 and maximum damage was recorded for genotype GRL-1349 (Table 2). The foliar damage remained less than 20% in all other genotypes and hence was ranked 1. The differences in the foliar damage can be attributed to the epicuticular wax layer on leaves (Cramer *et al*. 2014). The foliage with lower amount of waxy surface or which are semiglossy in nature suffers less damage as observed by Damon *et al*. (2014) that the number of immature and adults of *T. tabaci* were significantly less on onion crop accessions with semiglossy texture.

Thrips population build-up was also recorded on cv Palam Lohit (Table 3) as a local check for onion genotypes. Thrips population varied as 0.1 to 18.9 thrips per plant from mid February till the first week of April, suggesting that thrips population build up slowly with a peak population recorded during April month. Among the garlic genotypes, GHC-1 was taken as local check (Table 3). Thrips population for this genotype showed variation from 0.7 to 6.1 thrips per plant from February to April month. The population build up trend followed by thrips was an increasing one with highest population in month of April.

A relationship of mean thrips population build-up in onion and garlic with environmental factors was worked out which revealed a positive correlation with prevailing temperature (Table 4), thus contributing to increased population of the pest on the crop. A negative correlation was established with rainfall, relative humidity, wind speed and sunshine hours. The correlation was found significant only for maximum relative humidity and wind speed in onion crop. A positive correlation between *T. tabaci* incidence and temperature (Hossain *et al*. 2015; Smith *et al*. 2016) has been recorded along with its negative correlation with relative humidity, rainfall and wind speed (Smith *et al.* 2016). The maximum temperature recorded in our study during first fortnight of April was 26^{0}C when the maximum *T. tabaci* population was recorded which correctly justifies this correlation. Also, Murai (2000) recorded a positive correlation between the development rate of *T. tabaci* and temperature ranging between 15^{0}C to 30^{0}C.

Table 3. Population buildup of *Thrips tabaci* on onion cv Palam Lohit and garlic cv GHC-1

Sampling date	Thrips population/ plant		Average mean temperature (^{o}C)		Average rainfall (cm)	Mean relative humidity (%)		Wind speed (m/s)	Sunshine hours
	Palam Lohit	GHC-1	Max	Min		Max	Min		
17th Feb 2016	0.3	0.9	16.7	4.7	0.6	66.1	42.2	4.6	6.8
27th Feb 2016	0.3	0.7	21.5	8.1	1.2	74.9	51.2	4.2	7.8
8th Mar 2016	0.1	0.8	22.5	9.1	4.9	68.2	41.8	4.6	7.3
18th Mar 2016	0.1	1.2	19.6	8.8	8.3	68.9	56.6	4.5	5.0
28th Mar 2016	1.5	1.8	23.3	10.5	0.8	53.1	41.0	1.7	6.0
7th April 2016	18.9	6.1	26.8	13.6	0.1	62.4	39.4	5.8	6.0

Table 4. Simple correlation between weather parameters and mean onion and garlic thrips population

Weather parameters	Correlation coefficient 'r'	
	Onion	Garlic
Maximum temperature	0.57	0.42
Minimum temperature	0.64	0.42
Rainfall	-0.33	-0.37
Max Relative Humidity	-0.90*	-0.51
Min Relative Humidity	-0.40	-0.46
Wind speed	-0.99*	-0.08
Sunshine hours	-0.34	-0.22

*Significant at P= 0.05

Conclusion

From the study conducted, it can be concluded that the thrips population remained low upto March and increased in first week of April under Palampur conditions. The foliar damage inflicted also followed similar trend. The lower thrips population at our location can also be attributed to the abiotic factors which act as a variable for different locations. Thus, among all the genotypes, the one sustaining lowest population and thrips damage can be selected for further evaluation under high infestation zones.

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