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Field screening of different garlic genotypes against thrips, *Thrips tabaci* Lind.

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Abstract
A field experiment on screening of different garlic genotypes against thrips, *Thrips tabaci* Lind. was conducted at All India Co-ordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri during *Rabi* 2014 and *Rabi* 2015 to ascertain relative susceptibility/resistance of different garlic genotypes to thrips, *T. tabaci*. The incidence of thrips varied among different garlic genotypes and mean thrips population ranged from 4.70 to 32.53 thrips per plant. Minimum mean number of thrips per plant was recorded in the genotype BG-110 (4.70 thrips/plant) whereas, maximum of 32.53 thrips per plant was recorded in the genotype AGSDRB-905. Considering the categorization for different garlic genotypes, BG-110, Phule Nilima and CG-113 had least mean thrips population of 4.70 to 5.53 thrips per plant and were grouped as highly resistant genotypes. The genotypes RHRG-53, RHRG-12, RHRG-33, CG-115, CSRG-1140, RHRG-30 and RHRG-14 were categorized as resistant genotypes with 10.33 to 16.54 thrips per plant. Besides these, the genotypes namely, CGSD-1263, RHRG-38, BGSD-1225, BGSDRB-906, CGSD-1249 and RHRG-25 recorded 17.87 to 25.02 thrips per plant and grouped as susceptible genotypes whereas, RHRG-1, CGSD-1245, RHRG-21 and AGSDRB-905 were graded under the highly susceptible category with 28.80 to 32.53 thrips per plant.

Keywords: Garlic, thrips, *thrips tabaci*, susceptibility, resistance, genotypes

1. Introduction
Garlic (*Allium sativum* Linnaeus) is believed to originate from Central Asian mountain regions. *Allium cepa* L. and *Allium longicuspis* Regal are known to be its nearest wild relatives. Garlic (*A. sativum*) belongs to the family *Alliaceae*, genus *Allium* and species *sativum*, which is commercially grown in tropical and subtropical countries. The garlic is the second most important *Allium* species grown worldwide as an important spices and medicinal plant (Stavelikova, 2008) [10]. Garlic (*A. sativum*) is one of the important bulbous crop grown and used as a spice or a condiment throughout India. It has been widely recognized as a valuable spice and a popular remedy for various ailments and physiological disorders. In worldwide China ranks 1st in production of garlic (12.09 lakh tones) followed by India (6.45 lakh tones) and South Korea (3.25 lakh tones) (Patel and Patel, 2012) [6]. Madhya Pradesh ranks first in area and production of garlic followed by Gujrat, Rajasthan and Tamil Nadu. (Anon., 2015) [1]. There are several factors limiting the garlic bulb yield, of which attack of insect pests is one of the important key factor which causes considerable yield losses of garlic. Important insect pests attacking garlic are; thrips (*Thrips tabaci* Lindeman), groundnut thrips (*Caliothrips indicus* Bagnall), cutworm (*Agrotis ipsilon* Roth), onion fly (*Delia antique* Meigen), armyworm (*Spodoptera exigua* Hubner) and leaf miner (*Liriomyza trifolii* Burgess), Hill (1983) [3]. Out of these thrips, *T. tabaci* family "Thripidae" and order "Thysanoptera" is an important one and major biological constraint in garlic production causing heavy economical loss if infestation starts at bulb initiation stage. Thrips (*T. tabaci*) is the well known pest of onion and garlic throughout the world and almost all types of vegetables, including weeds are affected by this pest. Cosmopolitan nature, polyphagous, transmits plant pathogens, high rate of reproduction (more generations at high temperatures), reproduce asexually (parthenogenesis), high survival *via* cryptic (non feedingprepupa) instars and development insecticide resistance are the major constraints in management of this pest. *T. tabaci* is thought to have originated from Mediterranean region but have gradually spread throughout the world. In India, *T. tabaci* is a pest of national significance widely distributed in all onion-garlic growing regions. This pest is active throughout the year and breeds on onion and garlic from

November to May. Later on, migrates to alternate summer host plants including weeds. Development of resistant variety is an ideal component against buildup of pest population at no additional cost, compatible with other methods of pest control with no environmental pollution. Because of these factors an emphasis is always being given to develop insect resistant varieties. Success of breeding programme depends on screening of available germplasms for resistance source and successful use of identified resistance sources to the existing high yielding varieties. Keeping in view, the present study was undertaken to screen the available garlic genotypes against *T. tabaci*.

2. Materials and Methods

Experiments on screening of different garlic genotypes against thrips, *Thrips tabaci* Lind. were conducted at All India Co-ordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri (19^{0}23' North latitude, 74^{0}39' East latitude, 511m amsl), Maharashtra, India during two consecutive seasons of *Rabi* 2014 and 2015. Twenty different garlic genotypes *viz.,* RHRG-14, RHRG-33, RHRG-38, RHRG-12, RHRG-1, BG-110, AGSDRB-905, CSRG-1140, RHRG-21, RHRG-53, RHRG-25, CG-113, CGSD-1249, BGSD-1225, CGSD-1263, CG-115, BGSDRB-906, CGSD-1245, RHRG-30 and Phule Nilima were obtained from All India Co-ordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra). The experiment was laid out in Randomized Block Design with three replications. Sowing of cloves was done in bed (3.0 m x 2.0 m) at 15 cm x 10 cm spacing in third week of September. Agronomic practices such as application of recommended doses of fertilizers, irrigation, weeding etc., were carried out as per requirement. No control measures were applied against any insect pest in order to screen the genotypes for their susceptible/resistant reaction against *T. tabaci* under field conditions.

2.1 Method of recording observations

Relative susceptibility of different garlic genotypes to *T. tabaci* was evaluated on the basis of number of thrips per plant and garlic bulb yield. For recording observations, five plants were selected randomly from each treatment plot and observations on number of thrips (both nymphs and adults) were recorded by keeping a white paper below the plant and then shaking the plant with fingure. The observations were made at weekly interval starting from the first appearance of infestation and continued till to the last appearance of the pest on the crop. The bulb yield of each genotype/cultivar was recorded at harvest from each net plot and then converted into quintals per hectare. The periodical data on number of thrips per plant recorded at weekly interval were subjected to analysis of variance (ANOVA) after transforming them to square root. The data on thrips were analyzed periodically as well as pooled over periods. However, the data on bulb yield were analyzed without transformation.

2.2. Categorization of genotypes

The genotypes were grouped into four categories of resistance *i.e.* Highly resistant, resistant, susceptible and highly susceptible on the basis of number of thrips per plant. For this, mean value of individual genotype ($\overline{X}_i$) was compared with mean value of all genotypes ($\overline{X}$) and standard deviation (sd) by following the modified scale adopted by Patel *et al.* (2012) [7]. The retransformed data were used for computation of $\overline{X}$, $\overline{X}_i$ and sd in case of this parameter. Following modified scale was used for categorization of different genotypes.

Category of resistance	**Scale**
Highly Resistant (HR)	$\overline{X}_i < \overline{X}$ - sd
Resistant (R)	$\overline{X}_i > \overline{X}$ - sd $< \overline{X}$
Susceptible (S)	$\overline{X}_i > \overline{X} < (\overline{X}$ + sd)
Highly Susceptible (HS)	$\overline{X}_i > (\overline{X}$ + sd) $< (\overline{X}$ + 2 sd)

3. Results and Discussion

The data pertaining to pooled mean number of thrips per plant and garlic bulb yield is presented in Table 1. The results showed the significant variation in thrips incidence among the tested genotypes and pooled mean population of thrips ranged from 4.70 to 32.53 thrips/plant. Minimum mean number of thrips per plant was recorded in the genotype BG-110 (4.70 thrips/plant) and it was followed by the genotype Phule Nilima and CG-113 with 4.87 and 5.53 thrips per plant, respectively which were at par with each other. Maximum of 32.53 thrips per plant was recorded in the genotype AGSDRB-905 and it was at par with the genotypes RGRG-21, CGSD-1245 and RHRG-1 with 31.93, 29.10 and 28.80 thrips per plant, respectively. The genotypes used during the present study could not show the similarities in with the genotypes of earlier studies on relation to number of thrips. However, Singh *et al.* (1977) [9] who screened 34 onion cultivars against *T. tabaci* and found five cultivars namely N-2-4-1, Sel-104-Ratnar, Se1-71, HR Brown and Sel-202 were highly resistant to natural infestation by *T. tabaci* having fewer than 35.7 thrips per 5 plants. Similar results have been quoted by Mote and Sonone (1977) [5] and Shaikh *et al.* (2014) [8] for different genotypes. The data pertaining to the genotype reaction against susceptibility/resistance to garlic thrips presented in Table 2. The genotypes *viz.,* BG-110, Phule Nilima and CG-113 had least mean thrips population of 4.70 to 5.53 thrips per plant and were grouped as highly resistant genotypes. The genotypes RHRG-53, RHRG-12, RHRG-33, CG-115, CSRG-1140, RHRG-30 and RHRG-14 were categorized as resistant genotypes with 10.33 to 16.54 thrips per plant. Besides these, the genotypes namely, CGSD-1263, RHRG-38, BGSD-1225, BGSDRB-906, CGSD-1249 and RHRG-25 recorded 17.87 to 25.02 thrips per plant and grouped as susceptible genotypes whereas, RHRG-1, CGSD-1245, RHRG-21 and AGSDRB-905 were graded under the highly susceptible category with 28.80 to 32.53 thrips per plant. The categorization done during present study is supported by Gupta (2015) [2] who evaluated 49 onion genotypes for their reaction against onion thrips, *T. tabaci* and observed that, out of 49 genotypes, 4 genotypes categorized as highly resistant, 21 genotypes as resistant, 20 genotypes as susceptible and 4 genotypes as highly susceptible. The genotype ON14-6 was found as highly resistant genotype and followed by ON1425, OSK-1364 and ON14-17 because of lowest thrips population score. Whereas, ASRO-1207 was found highly susceptible genotype against onion thrips. The data regarding pooled mean garlic bulb yield (Table 1) revealed that, bulb yield differences among different garlic genotypes were statistically significant. Mean garlic bulb yield harvested from different garlic genotypes was ranged from 39.85 to 91.55 q/ha. Highly resistant genotypes *i.e.* BG-110, Phule Nilima and CG-113 recorded highest garlic bulb yield of 87.46 to 91.55 q/ha as against lowest mean garlic bulb yield of 39.85 to 41.46 q/ha was recorded from highly susceptible genotypes *viz.*, RHRG-1, CGSD-1245, RHRG-21 and AGSDRB-905. Results of the present findings are in good line with Kaur *et al.* (1994) [4] who reported that resistant genotype LCC-1 registered the highest bulb yield of 187.5 q/ha than rest of the genotypes. Similarly, the reports of Patel and Patel (2012) [6] are in conformity with the results of the present finding and further they also reported that, highly resistant genotypes, AGS-06-1-1 (7.96 t/ha) and GG-4 (7.11 t/ha) registered significantly higher bulb yield than rest of the genotypes.

Table 1: Average population of thrips on different genotypes of garlic during *Rabi* 2014 and *Rabi* 2015 (Pooled mean)

Sr. No.	Genotypes	No. of thrips/plant			Pooled mean yield (q/ha)
		***Rabi* 2014**	***Rabi* 2015**	**Pooled mean**	
1	CG-113	5.20(2.34)*	5.86(2.46)	5.53(2.40)	87.46
2	RHRG-33	11.39(3.29)	12.00(3.36)	11.69(3.32)	79.79
3	RHRG-38	17.64(4.01)	19.58(4.25)	18.61(4.13)	60.86
4	RHRG-12	11.17(3.22)	11.82(3.42)	11.61(3.29)	81.09
5	RHRG-1	28.29(5.17)	29.31(5.24)	28.80(5.20)	41.46
6	BG-110	4.58(2.22)	4.81(2.25)	4.702.24)	91.55
7	AGSDRB-905	32.21(5.41)	32.85(5.48)	32.53(5.45)	39.85
8	CSRG-1140	12.67(3.41)	13.89(3.65)	13.28(3.17)	72.61
9	RHRG-21	31.21(5.41)	32.66(5.52)	31.93(4.73)	40.29
10	RHRG-53	10.19(3.14)	10.48(3.19)	10.33(2.29)	82.22
11	RHRG-25	24.55(4.70)	25.50(4.76)	25.02(4.42)	42.22
12	Phule Nilima	4.85(2.28)	4.89(2.29)	4.87(2.31)	90.81
13	CGSD-1249	19.43(4.21)	23.96(4.64)	21.69(4.71)	43.52
14	BGSD-1225	18.07(4.01)	22.36(4.51)	20.22(4.26)	59.65
15	CGSD-1263	16.51(3.86)	19.24(4.25)	17.87(4.05)	64.86
16	CG-115	12.51(3.41)	12.99(3.48)	12.75(3.44)	77.46
17	BGSDRB-906	19.12(4.15)	23.08(4.58)	21.10(4.36)	56.36
18	CGSD-1245	29.55(5.22)	28.65(5.21)	29.10(5.22)	40.60
19	RHRG-30	14.24(3.64)	14.50(3.70)	14.37(3.67)	69.32
20	RHRG-14	15.79(3.85)	17.30(4.04)	16.54(3.95)	66.04
SE (m) +		1.89	2.02	1.95	1.98
CD at 0.05%		5.68	6.01	5.84	5.89
		16.32	14.17	15.21	15.47

*Figure in parenthesis are $\sqrt{x + 0.5}$ transformed value

Table 2: Categorization of different garlic genotypes for their reaction to *T. tabaci* (Pooled mean of *Rabi* 2014 and *Rabi* 2015)

Category of resistance	Scale	Genotypes (X_i)	No. of thrips/plant
1	**2**	**3**	**4**
Based on population of thrips/plant: X=17.62 and sd=8.70			
Highly Resistant	$X_i < 8.92$	BG-110	4.70
		Phule Nilima	4.87
		CG-113	5.53
Resistant	$X_i > 8.92 < 17.62$	RHRG-53	10.33
		RHRG-12	11.50
		RHRG-33	11.69
		CG-115	12.75
		CSRG-1140	13.28
		RHRG-30	14.37
		RHRG-14	16.54
Susceptible	$X_i > 17.62 < 26.32$	CGSD-1263	17.87
		RHRG-38	18.61
		BGSD-1225	20.22
		BGSDRB-906	21.10
		CGSD-1249	21.69
		RHRG-25	25.02
Highly Susceptible	$X_i > 26.32 < 35.02$	RHRG-1	28.80
		CGSD-1245	29.10
		RHRG-21	31.93
		AGSDRB-905	32.53

4. Conclusion

Based on the data pertaining to field screening of different garlic genotypes against *T. tabaci*, out of 20 genotypes, 03 genotypes showed highly resistant reaction, 07 genotypes showed resistant reaction, 06 genotypes showed susceptible reaction whereas, 04 genotypes showed highly susceptible reaction to *T. tabaci*.

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