RESEARCH ARTICLE

PERFORMANCE OF GARLIC GENOTYPES FOR THRIPS AND PURPLE BLOTCH RESISTANCE

Asiya Kowser, R[1], Amarananjundeswara, H[2], Doddabasappa, B[3], Aravinda Kumar, J. S[4], Veere Gowda, R[5], Soumya Shetty[2], Sandhya G. C[2] , Prasad P. S[2]. and Lavanya V.[1]

[1]Department of Vegetable Science, College of Horticulture, Kolar, Karnataka, India
[2] Horticulture Research and Extension Station, Hassan,Karnataka, India
[3]Department of Entomology, College of Horticulture, Kolar, Karnataka, India
[4] Department of Vegetable Science, College of Horticulture, Mysore, Karnataka, India
[5] ICAR- Division of Vegetable Science, IIHR, Bangalore, Karnataka, India
Email: amar.horti@gmail.com

Received-07.08.2018, Revised-30.10.2018

Abstract: A field experiment was conducted to screen the different garlic genotypes against thrips infestation at Department of Vegetable Science, College of Horticulture, Kolar during *Rabi* season of 2016-17. Out of twenty six genotypes, Yamuna Safed, Ranebennur Local, Jamnagar Local, Mandsaur Local, GN-14-01, Ooty Local and Baram Local-06 were recorded thrips population less than 6.93 per plant and were categorized as resistant. While, genotypes *viz*., Bhima Purple, Yamuna Safed-2, Yamuna Safed-3, Yamuna Safed-4, Yamuna Safed-5, Yamuna Safed-8, Yamuna Safed-9, Baram Local-06, Jamnagar Local, Mandsaur Local, Ranebennur Local, Ooty Local, GRS-1330, GN-14-25, GN-14-15, DWG-2 and DWG-1 (check) were found to be resistant against purple blotch disease.

Keywords: Garlic, Genotypes, Thrips, Purple blotch

INTRODUCTION

Garlic (*Allium sativum* L.) is the second most widely cultivated vegetable cum spice crop after onion, under the genus *Allium* and belongs to the family Alliaceae having chromosome number 2n (2X) = 16. India is the second largest garlic producing country with the production of 12.52 lakh tonnes from 2.31 lakh hectares area with average productivity of 5.44 tonnes per hectare. In India major garlic producing states are Madhya Pradesh, Gujarat, Uttar Pradesh, Rajasthan, Assam, Punjab and Maharashtra. In Karnataka, garlic is grown during *Rabi* season in an area of 5.19 thousand hectares with the production of 5.47 thousand tonnes and a productivity of 1.05 tonnes per hectare (Anon, 2015). However, many factors affecting the production and productivity of garlic, of which infestation of insect pests and disease are the major one. Among different insect pests, Thrips (*Thrips tabaci*) is a serious and major biological constraint in garlic production causing heavy economical loss, if infestation starts at bulb initiation stage (Patel and Patel, 2012). Thrips prefers to feed on newly emerged leaves in the center of neck. Therefore, majority of thrips are found at the base of the youngest leaves in the lower center of the neck. Similarly, purple blotch (*Alternaria porri*) is a serious foliar disease causes major damage to the foliage up to 90 per cent in susceptible varieties. Screening of varieties with combined resistance to insect pest and diseases acts as preventive measure and are free from environmental pollution problems. From the above facts, the study was designed to screen out different resistant genotypes or cultivars of garlic against thrips and purple blotch.

MATERIAL AND METHODS

An experiment was conducted at Department of Vegetable Science, College of Horticulture, Kolar, Karnataka. In the experiment 26 garlic genotypes such as Bhima Purple, Bhima Omkar, Yamuna Safed, Yamuna Safed-2, Yamuna Safed-3, Yamuna Safed-4, Yamuna Safed-5, Yamuna Safed-8, Yamuna Safed-9, Baram Local-06, HG-17, Jamnagar Local, Mandsaur Local, Ranebennur Local, Maharashtra Sangam, Ooty Local, GRS-1328, GRS-1345, GRS-1330, GN-14-27, GN-14-01, GN-14-25, GN-14-15, GN-14-05, DWG-2 and DWG-1 (Check) were collected from different institutions and local cultivated areas across the country. The researchwas laid out in Randomized Complete Block Design (RCBD) with 2 replications. The sowing of cloves was done in beds of 2.0 m x 1.5 m ($3m^2$ area) size at a spacing of 15 cm x 10 cm in last week of September, 2016. The agronomic practices such as application of recommended dose of fertilizers, irrigation and weeding etc., were carried out as per the package of practices of UHS, Bagalkot. The thrips population was counted at seven days interval starting from the first appearance of infestation. The number of thrips (both nymphs and adults) was recorded from 20 randomly selected plants in each plot by keeping a white paper below the plant and then shaking the plants with finger. The tested genotypes were also grouped into four categories of resistance *viz.*, highly resistant, resistant, susceptible

*Corresponding Author

and highly susceptible based on number of thrips per plant. For the grouping purpose, mean value of individual genotype ($\overline{Xi}$) was compared with mean value of all genotypes ($\overline{X}$) and standard deviation (sd) following the modified scale adopted by Patel and Patel (2012). The retransformed data were used for computation of $\overline{X}$, $\overline{Xi}$ and sd in case of this parameter. The scale was used for categorizing different genotypes as below.

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

Here, $\overline{X}$ = Mean value of all genotype, $\overline{Xi}$ =Mean value of individual genotype, sd =Standard deviation and n= No. of genotypes

$$Sd = \sqrt{E(X - \overline{X})^2 / n - 1}$$

The disease assessment of purple blotch was done by tagging ten randomly selected plants and Per cent Disease Index (PDI) was recorded on a 0-5 class rating scale: **0** = Immune (No infestation), **1** = Resistant (R) (1-10 % Leaf Area Infected), **2** = Moderately Resistant (MR) (11-20 % LAI), **3** = Moderately Susceptible (MS) (21-40 % LAI), **4** = Susceptible (S) (41-60 % LAI), **5** = Highly Susceptible (HS) (61 % LAI and above).The PDI was calculated as given by Dhiman*et al.* (1986).

$$\textbf{Per cent Disease Index (\%)} = \frac{\text{Sum of all class ratings}}{n \times 5} \times 100$$

Where, **n** = Number of leaves examined.
5 = Maximum class ratings in the scale.

RESULTS AND DISCUSSION

The performance of garlic genotypes with respect to vegetative growth, yield traits, thrips and purple blotch resistance is discussed in Table-1, 2 and 3. The results revealed that Yamuna Safed-9 was tallest with a plant height of 70.44 cm and it was at par with Mandsaur Local (69.29 cm) and Yamuna Safed-2 (69.27 cm) and Yamuna Safed-3 (69.04 cm). Whereas, the genotype GN-14-05 (47.21 cm) was found shortest. The results were similar to the findings of Islam *et al.* (2004); Moustafa *et al.* (2009).

The results revealed that none of the genotypes was highly resistant to thrips infestation. However, genotypes Yamuna Safed, Ranebennur Local, Jamnagar Local, Mandsaur Local, GN-14-01, Ooty Local and Baram Local-06 showed thrips population less than 6.93 but more than 5.74 per plant were grouped into resistant. While, genotypes Bhima Omkar, Yamuna Safed-2, Yamuna Safed-3, Yamuna Safed-5, Yamuna Safed-9, HG-17, Maharashtra Sangam, GRS-1328, GRS-1345, GRS-1330, GN-14-25, GN-14-15, GN-14-05 and DWG-2 were found susceptible by recording thrips population more than 6.93 but less than 8.12 per plant. Whereas, genotypes Yamuna Safed-8, DWG-1, Yamuna Safed-4, GN-14-27 and Bhima Purple recording thrips population more than 8.12, but less than 10.50 per plants were grouped into highly susceptible. The similar results were reported by Hossain *et al.* (2014) data revealed that cultivar GC-0034 noticed significantly lowest thrips population (6.97 thrips/plant). While, highest thrips population (15.18, 14.10 and 15.96 thrips/plant) were documented from the garlic genotype GC-0013, GC-0028 and GC-0030, respectively.

The results with respect to purple blotch indicated that, none of the genotypes found to be immune. However, genotypes *viz*., Bhima Purple (10.4 %), Yamuna Safed-2 (6.40 %), Yamuna Safed-3 (4.40 %), Yamuna Safed-4 (5.20 %), Yamuna Safed-5 (6.80 %), Yamuna Safed-8 (4.80 %), Yamuna Safed-9 (8.40 %), Baram Local-06 (4.00 %), Jamnagar Local (5.60 %), Mandsaur Local (7.60 %), Ranebennur Local (4.00 %), Ooty Local (6.80 %), GRS-1330 (10.00 %), GN14-25 (10.00 %), GN14-15 (9.20 %), DWG-2 (7.60 %) and check DWG-1 (6.00 %) were found to be resistant. Where as, five genotypes like Yamuna Safed (11.60 %), HG-17 (14.40 %), GRS-1345 (14.40 %), GN-14-27 (14.00 %) and GN14-01(12.40 %) were found to be moderately resistant. While, GRS-1328 (22.40 %) recorded to be moderately susceptible and GN14-05 (54.80 %) were found to be susceptible. However, one genotype Bhima Omkar (65.20 %) found to be highly susceptible. These findings were in accordance with findings of Pandey *et al.* (2000), Alam*et al.* (2007), Mishra *et al.* (2009) and Agarwal and Tiwari (2013).

The results revealed that the genotype Yamuna Safed-3 (14.51 t/ha) was recorded the highest yield and it was on par with Yamuna Safed-2 (12.94 t/ha) and these were significantly higher than Yamuna Safed-9 (12.10 t/ha) followed by Yamuna Safed-5 (12.05 t/ha), Yamuna Safed-4 (10.71 t/ha) and GRS-1330 (10.46 t/ha). However, the lowest yield was documented in check DWG-1 (4.25 t/ha). The

susceptible genotypes produced higher yield compared to resistant cultivar which might be due to environmental conditions during growth phase and varietal characters.

Categorization of genotypes or cultivars

The different genotypes or cultivars of garlic were grouped into four different categories of resistance to thrips *viz*., highly resistant, resistant, susceptible and highly susceptible. The results are presented in Table 2. Among the genotypes evaluated, Yamuna Safed, Ranebennur Local, Jamnagar Local, Mandsaur Local, GN-14-01, Ooty Local and Baram Local-06 were found resistant to thrips infestation. While, genotypes Bhima Omkar, Yamuna Safed-2, Yamuna Safed-3, Yamuna Safed-5, Yamuna Safed-9, HG-17, Maharashtra Sangam, GRS-1328, GRS-1345, GRS-1330, GN-14-25, GN-14-15, GN-14-05 and DWG-2 were found susceptible. Whereas, genotypes Yamuna Safed-8, DWG-1, Yamuna Safed-4, GN-14-27 and Bhima Purple were grouped into highly susceptible.

The different genotypes or cultivars of garlic were grouped into five different categories of resistance to purple blotch such as immune, resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible. The results are presented in Table 3.The results indicated that, none of the genotypes were found to be immune. However, genotypes *viz*., Bhima Purple, Yamuna Safed-2, Yamuna Safed-3, Yamuna Safed-4, Yamuna Safed-5, Yamuna Safed-8, Yamuna Safed-9, Baram Local-06, Jamnagar Local, Mandsaur Local, Ranebennur Local, Ooty Local, GRS-1330, GN-14-25, GN-14-15, DWG-2 and check DWG-1 found to be resistant. Whereas, five genotypes like Yamuna Safed, HG-17, GRS-1345, GN-14-27 and GN-14-01were found to be moderately resistant. While, GRS-1328 revealed to be moderately susceptible and GN-14-05 was found to be susceptible. However, one genotype Bhima Omkar was found to be highly susceptible.

Table 1. Performance of garlic genotypes for growth, yield traits, thrips and PDI (%)

Sl. No.	Genotypes	Plant height (cm)	Bulb yield (t/ha)	Thrips per plant	PDI (%)
1	**Bhima Purple**	54.13	7.06	9.30	10.40
2	**BhimaOmkar**	56.27	5.45	7.20	65.20
3	**Yamuna Safed**	66.87	9.87	5.85	11.60
4	**Yamuna Safed-2**	69.27	12.94	7.40	6.40
5	**Yamuna Safed-3**	69.04	14.51	7.88	4.40
6	**Yamuna Safed-4**	67.45	10.71	9.55	5.20
7	**Yamuna Safed-5**	68.41	12.05	7.58	6.80
8	**Yamuna Safed-8**	67.82	8.73	8.45	4.80
9	**Yamuna Safed-9**	70.44	12.10	7.75	8.40
10	**Baram Local-06**	61.04	7.54	6.00	4.00
11	**HG-17**	64.86	8.69	7.08	14.40
12	**Jamnagar Local**	65.91	7.84	5.78	5.60
13	**Mandsaur Local**	69.29	9.18	5.95	7.60
14	**Ranebennur Local**	48.48	5.57	5.90	4.00
15	**Maharashtra Sangam**	68.54	8.15	7.75	9.60
16	**Ooty Local**	67.92	9.20	5.93	6.80
17	**GRS-1328**	49.80	6.00	7.13	22.40
18	**GRS-1345**	53.67	6.37	7.88	14.40
19	**GRS-1330**	65.36	10.46	6.95	10.00
20	**GN-14-27**	54.03	6.23	9.45	14.00
21	**GN-14-01**	55.64	7.71	5.85	12.40
22	**GN-14-25**	56.09	7.51	7.45	10.00
23	**GN-14-15**	55.64	5.27	7.75	9.20
24	**GN-14-05**	47.21	5.60	6.95	54.80
25	**DWG-2**	58.56	5.85	7.65	7.60
26	**DWG-1 (Check)**	53.80	4.25	8.80	6.00
	SEm±	**3.47**	**0.80**	**-**	**-**
	CD at 5%	**10.11**	**2.34**	**-**	**-**

Table 2. Categorization of different genotypes of garlic for their susceptibility to thrips (*Thrips tabaci* Lindman)

Sl. No.	Category of resistance	Scale	Genotypes/cultivars ($\bar{X}i$)	
	***Based on population of thrips/plant :** $\bar{X}$= 6.93 and sd = 1.19			
1	**Highly resistant (HR)**	$\bar{X}i$< 5.74	-	-
2	**Resistant (R)**	$\bar{X}i$>5.74<6.93	**Yamuna Safed**	5.85

			Ranebennur Local	5.90
			Jamnagar Local	5.78
			Mandsaur Local	5.95
			GN-14-01	5.85
			Ooty Local	5.93
			Baram Local-06	6.00
3	**Susceptible (S)**	$\bar{X}i>6.93<8.12$	**BhimaOmkar**	7.20
			Yamuna Safed-2	7.40
			Yamuna Safed-3	7.88
			Yamuna Safed-5	7.58
			Yamuna Safed-9	7.75
			HG-17	7.08
			Maharashtra Sangam	7.75
			GRS-1328	7.13
			GRS-1345	7.88
			GRS-1330	6.95
			GN-14-25	7.45
			GN-14-15	7.75
			GN-14-05	6.95
			DWG-2	7.65
4	**Highly Susceptible (HS)**	$\bar{X}i>8.12<10.50$	**Yamuna Safed-8**	8.45
			DWG-1	8.80
			Yamuna Safed-4	9.55
			GN-14-27	9.45
			Bhima Purple	9.30

***** n=20

Table 3. Incidence of purple blotch (*Alternaria porri* Ellis) of different genotypes of garlic

Sl. No.	**Category of resistance**	**Scale (PDI)**	**Purple blotch**	
			Genotypes	**PDI**
1	**Resistant (R)**	1-10 %	**DWG-1**	6.00
			DWG-2	7.60
			GN-14-15	9.20
			Yamuna Safed-2	6.40
			Yamuna Safed-3	4.40
			Yamuna Safed-4	5.20
			Yamuna Safed-5	6.80
			Yamuna Safed-8	4.80
			Yamuna Safed-9	8.40
			Baram Local-06	4.00
			Jamnagar Local	5.60
			Mandsaur Local	7.60
			Ranebennur Local	4.00
			Maharashtra Sangam	9.60
			Ooty Local	6.80
			GRS-1330	10.00
			Bhima Purple	10.40
			GN-14-25	10.00
2	**Moderately Resistant (MR)**	11-20%	**Yamuna Safed**	11.60
			GRS-1345	14.40
			HG-17	14.40
			GN-14-27	14.00
			GN-14-01	12.40
3	**Moderately Susceptible (MS)**	21-40%	**GRS-1328**	22.40

4	**Susceptible (S)**	41-60%	**GN-14-05**	54.80
5	**Highly Susceptible (HS)**	61% and above	**BhimaOmkar**	65.20

CONCLUSION

In the study, genotypes Yamuna Safed, Ranebennur Local, Jamnagar Local, Mandsaur Local, GN-14-01, Ooty Local and Baram Local-06 were found resistant to thrips infestation and genotypes Bhima Purple, Yamuna Safed-2, Yamuna Safed-3, Yamuna Safed-4, Yamuna Safed-5, Yamuna Safed-8, Yamuna Safed-9, Baram Local-06, Jamnagar Local, Mandsaur Local, Ranebennur Local, Ooty Local, GRS-1330, GN14-25, GN14-15, DWG-2 and check DWG-1 were found resistant to purple blotch. Among all the genotypes, Yamuna Safed-3 and Yamuna Safed-2 were proved to be promising genotypes with high bulb yield.

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