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Asiya Kowser R

Department of Vegetable
Science, College of Horticulture,
Kolar, Karnataka, India

Amarananjundeswara H

Horticultural Research and
Extension Station,
Somanahallikaval, Hassan,
Karnataka, India

Doddabasappa B

Department of Entomology,
College of Horticulture, Kolar,
Karnataka, India

Aravinda Kumar JS

Department of Vegetable
Science, College of Horticulture,
Mysore, Karnataka, India

Aarti Pannure

Department of Entomology,
College of Agriculture,
Chinthamani, Karnataka, India

Correspondence**Asiya Kowser R**

Department of Vegetable
Science, College of Horticulture,
Kolar, Karnataka, India

Reaction of garlic genotypes to thrips and purple blotch in South India

Asiya Kowser R, Amarananjundeswara H, Doddabasappa B, Aravinda Kumar JS and Aarti Pannure

Abstract

Field experiments were conducted to screen different garlic genotypes against thrips damage and purple blotch disease during *rabi* 2016-2017. The infestation of thrips (5.78 to 9.55 thrips/ plant) and purple blotch disease incidence (4.00 to 65.20 PDI) varied among twenty-six garlic genotypes. Among genotypes, none showed highly resistance reaction against thrips infestation. Yamuna Safed, Ranebennur Local, Jamnagar Local, Mandsaur Local, GN-14-01, Ooty Local and Baram Local-06 recorded thrips population (less than 6.93 per plant) were categorized as resistant. Yamuna Safed-8, Yamuna Safed-4, Bhima Purple, GN-14-27 and DWG-1 were highly susceptible against thrips (Mean population between 8.12 and 10.50 thrips per plant). While, 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 DWG-1 were found resistant against purple blotch disease. The similar performance was observed against thrips and purple blotch under laboratory conditions.

Keywords: Garlic, thrips, purple blotch, resistance

1. Introduction

Garlic (*Allium sativum* L.) is the second most widely cultivated vegetable-cum-spice crop after onion, under the genus *Allium* (Alliaceae). India is the second largest garlic producing country with production of 12.52 lakh tonnes from 2.31 lakh hectare area, with an 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* in 5.19 thousand ha with production of 5.47 thousand ton and a productivity of 1.05 tons/ha (Anonymous, 2015) [3]. Many factors affecting the production and productivity of garlic, of which infestation of insect pests and disease are major ones. Of the insect pests, Thrips (*Thrips tabaci* Lindman) is a serious and major biotic factor in garlic production causing heavy economic losses (Patel and Patel, 2012) [9]. Thrips prefers to feed on newly emerged leaves in the center of neck so a majority of thrips are found at the base of the youngest leaves in the lower center of the neck. Purple blotch (*Alternaria porri* Ellis) is a major foliar disease causing a major damage to the foliage up to 90% in susceptible varieties. Screening of varieties with combined resistance to insect pests and diseases act as preventive measure and are free from environmental pollution problems. From the above facts, the study was designed to screen garlic genotypes against thrips and purple blotch disease.

2. Material and Methods

Experiments were conducted in the Department of Vegetable Science, College of Horticulture, Kolar, Karnataka (78° 10' 32.59" long, 13° 08' 00.52" lati, 752.15 m amsl). Twenty-six garlic genotypes *viz.*, 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 experiment was laid out in Randomized Complete Block Design (RCBD) with two replications. Sowing of cloves was done in beds (2m × 1.5 m) of 15 × 10 cm in last the week of September 2016. Agronomic practices such as application of recommended doses of fertilizers, irrigation and weeding etc., were carried out.

Thrips population was counted at seven day intervals starting from the first appearance of infestation. Number of thrips (nymphs and adults) was recorded from 20 randomly selected plants each plot by keeping a white paper below the plant and then shaking the plants with fingers. The disease assessment of purple blotch was effected tagging ten randomly selected plants and plant growth parameters such as plant height (cm), Number of leaves/ plant, Bulb diameter (cm), Ten bulb weight (g) and Bulb yield (t/ha) were recorded.

The tested genotypes were also grouped into four categories viz., highly resistant, resistant, susceptible and highly susceptible based on number of thrips per plant. For the grouping purpose, mean value of individual genotype (\bar{X}_i) was compared with the mean value of all genotypes (\bar{X}) and standard deviation (sd) following the modified scale of Patel and Patel (2012) [9] was adopted. The transformed data were used for computation of \bar{X} , \bar{X}_i and sd in case of the parameter. The scale was used for categorizing genotypes as under.

Category	Scale
Highly resistant (HR)	$\bar{X}_i < (\bar{X} - sd)$
Resistant (R)	$\bar{X}_i > (\bar{X} - sd) < \bar{X}$
Susceptible (S)	$\bar{X}_i > \bar{X} < (\bar{X} + sd)$
Highly susceptible (HS)	$\bar{X}_i > (\bar{X} + sd) < (\bar{X} + 2sd)$

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

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

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) [4].

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

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

3. Results and Discussion

Performance of garlic genotypes for yield traits, thrips and purple blotch resistance was recorded (Table 1). The infestation of thrips varied from 5.78 to 9.55 thrips/ plant. The lowest thrips population was recorded on Jamnagar Local (5.78 thrips/plant)) and highest thrips population was

observed in Yamuna Safed-3 (9.55 thrips/ plant.

The incidence of purple blotch disease was ranged from 4.00 to 65.20. The lowest percent disease index was observed in Bhima Local -06 (4.00) and highest was in Bhima Omkar (65.20). The results revealed that the genotype Yamuna Safed-3 (14.51 t/ha) recorded the highest yield and was on par with Yamuna Safed-2 (12.94 t/ha). 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 the check variety DWG-1 (4.25 t/ha). The susceptible genotypes produced higher yields compared to resistant cultivar which might be due to environmental conditions during the growth phase and varietal characters.

The data pertaining to the genotype reaction against susceptibility to thrips infestation presented in Table 2. The none of the genotypes was highly resistant to thrips infestation. However, 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 category. While, 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 susceptible by recording thrips population (more than 6.93 but less than 8.12 per plant). Whereas, Yamuna Safed-8, DWG-1, Yamuna Safed-4, GN-14-27 and Bhima Purple recorded thrips population more than 8.12 but less than 10.50 per plants were grouped into highly susceptible category. Similar results were reported by Hossain *et al.* (2014) who reported that cultivar GC-0034 recorded significantly lowest thrips population (6.97 thrips/plant). The highest thrips population (15.18, 14.10 and 15.96 thrips/plant) was documented from the GC-0013, GC-0028 and GC-0030, respectively.

The data related genotype reaction to purple blotch incidence indicated in Table 3. The none of the genotypes was found immune. However, 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 DWG-1 (6.00%) were found to resistant. Five genotypes, viz., Yamuna Safed (11.60%), HG-17 (14.40%), GRS-1345 (14.40%), GN-14-27 (14.00%) and GN14-01(12.40%) reacted as moderately resistant. GRS-1328 (22.40%) reacted as moderately susceptible and GN14-05 (54.80%). However, BhimaOmkar (65.20%) was found highly susceptible. These findings are in accordance with findings of Pandey *et al.* (2000) [7], Alam *et al.* (2007) [2], Patel and Patel (2012) [9], Mishra *et al.* (2009) [6] and Agarwal and Tiwari (2013) [1]. The similar performance of garlic genotypes to thrips infestation and purple blotch incidence was observed under laboratory experimentation.

Table 1: Performance of garlic genotypes for yield traits, thrips and purple blotch damage

Sl. No.	Genotypes	Thrips per plant	PDI (%)	Plant height (cm)	Number of leaves/ plant	Bulb diameter (cm)	Ten bulb weight (g)	Bulb yield (t/ha)
1	Bhima Purple	9.30	10.40	54.13	8.50	3.30	151.50	7.06
2	BhimaOmkar	7.20	65.20	56.27	8.50	2.38	108.65	5.45
3	Yamuna Safed	5.85	11.60	66.87	8.70	4.05	210.70	9.87
4	Yamuna Safed-2	7.40	6.40	69.27	8.60	4.15	238.05	12.94
5	Yamuna Safed-3	7.88	4.40	69.04	9.60	4.42	284.10	14.51
6	Yamuna Safed-4	9.55	5.20	67.45	9.50	4.14	249.35	10.71
7	Yamuna Safed-5	7.58	6.80	68.41	8.80	4.10	255.35	12.05
8	Yamuna Safed-8	8.45	4.80	67.82	8.70	3.82	226.10	8.73
9	Yamuna Safed-9	7.75	8.40	70.44	8.00	3.83	245.60	12.10
10	Baram Local-06	6.00	4.00	61.04	9.00	3.81	193.25	7.54
11	HG-17	7.08	14.40	64.86	7.70	3.72	178.95	8.69
12	Jamnagar Local	5.78	5.60	65.91	9.40	2.91	179.10	7.84
13	Mandsaur Local	5.95	7.60	69.29	9.40	3.59	171.05	9.18
14	Ranebennur Local	5.90	4.00	48.48	7.50	2.14	117.45	5.57
15	Maharashtra Sangam	7.75	9.60	68.54	9.50	2.92	150.45	8.15
16	Ooty Local	5.93	6.80	67.92	9.50	2.72	212.90	9.20
17	GRS-1328	7.13	22.40	49.80	8.30	2.45	127.05	6.00
18	GRS-1345	7.88	14.40	53.67	7.60	3.24	142.80	6.37
19	GRS-1330	6.95	10.00	65.36	9.40	3.93	220.70	10.46
20	GN-14-27	9.45	14.00	54.03	8.20	3.50	127.50	6.23
21	GN-14-01	5.85	12.40	55.64	7.70	3.94	160.85	7.71
22	GN-14-25	7.45	10.00	56.09	7.00	2.98	155.95	7.51
23	GN-14-15	7.75	9.20	55.64	7.60	2.63	126.10	5.27
24	GN-14-05	6.95	54.80	47.21	8.90	3.36	129.15	5.60
25	DWG-2	7.65	7.60	58.56	7.20	2.93	101.05	5.85
26	DWG-1 (Check)	8.80	6.00	53.80	7.00	3.50	119.60	4.25
	SEm±	-	-	3.47	0.53	0.34	18.36	0.80
	CD at 5%	-	-	10.11	1.57	1.00	53.48	2.34

Table 2: Categorization of garlic genotypes for susceptibility to thrips

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
3	Susceptible (S)	$\bar{X}_i > 6.93 < 8.12$	Baram Local-06	6.00
			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			
4	Highly Susceptible (HS)	$\bar{X}_i > 8.12 < 10.50$	DWG-2	7.65
			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) on garlic genotypes

S. 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
2	Moderately Resistant (MR)	11-20%	GRS-1330	10.00
			Bhima Purple	10.40
			GN-14-25	10.00
			Yamuna Safed	11.60
			GRS-1345	14.40
3	Moderately Susceptible (MS)	21-40%	HG-17	14.40
			GN-14-27	14.00
			GN-14-01	12.40
			GRS-1328	22.40
4	Susceptible (S)	41-60%	GN-14-05	54.80
5	Highly Susceptible (HS)	61% and above	BhimaOmkar	65.20

4. Conclusion

The infestation of thrips (5.78 to 9.55 thrips/ plant) and purple blotch disease incidence (4.00 to 65.20 PDI) varied among twenty-six garlic genotypes. Among genotypes, none was found highly resistant against thrips infestation. Yamuna Safed, Ranebennur Local, Jamnagar Local, Mandsaur Local, GN-14-01, Ooty Local and Baram Local-06 recorded thrips population (less than 6.93 per plant) were categorized as resistant. Yamuna Safed-8, Yamuna Safed-4, Bhima Purple, GN-14-27 and DWG-1 were highly susceptible (Mean population 8.12 and 10.50 thrips per plant). 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 against purple blotch. The categorization of garlic genotypes to thrips infestation and purple blotch incidence were based on confirmatory tests made under laboratory and field experimentation.

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