academicJournals

Vol. 5(4), pp. 48-52, May, 2013
DOI 10.5897/JHF12.035
ISSN 2006-9782 © 2013 Academic Journals
http://www.academicjournals.org/JHF

Journal of Horticulture and Forestry

Full Length Research Paper

Evaluation of garlic (*Allium sativum*) genotypes for yield and susceptibility to purple blotch

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Accepted 16 April, 2013

Twenty one genotypes of garlic (*Allium sativum* L.) were screened for yield and purple blotch susceptibility under field conditions for two years. Reaction of genotypes to purple blotch disease differed significantly during both years but the pooled analysis revealed that most of the variations were due to genotype × environment interaction. Nine genotypes viz., G-1, G-50, G-323, PGS-4, PGS-14, G-313, PGS-99-1, PGS-98 and PGS-99-2 fell into the category of resistant, five showed moderately resistant reaction to disease (PGS-13, PGS-17, KGS-1, HG-17 and PGS-99-3), four were mild susceptible (G-41, DG-2, DARL-52 and DARL-53) whereas three (G-282, DG-1 and RAUC-5) were susceptible. Genotype PGS-313 exhibited maximum yield (199.6 quintal/ha) followed by PGS-99-2 (154.9 quintal/ha). A strong and negative correlation was observed between purple blotch incidence and bulb weight at genotypic level (-0.99).

Key words: Garlic, purple blotch, correlation, yield, genotype × environment interaction.

INTRODUCTION

Purple blotch (*Alternaria porri* L.) has been identified as an important, yield limiting disease in garlic (*Allium sativum* L.) (Miller, 1983; Bisht and Thomas, 1992). In India, early symptoms can be seen in the last week of January which gets severe as the temperature rises (Figure 1). Under acute disease pressure, plants are almost devoid of leaves due to drying of diseased leaves leading to heavy losses. A foliar infection of up to 90% has been reported in susceptible cultivars of garlic (Bisht and Agarwal, 1993) with a significant reduction in bulb yield ranging between 25 to 60% due to varying degrees of defoliation (Bisht et al., 1993). Considering the poor economic condition of farmers, high cost of disease control and environmental concerns, it is necessary to select germplasm with resistance or tolerance with purple blotch disease as a pre-requisite to carry out a successful breeding and crop improvement programme. Therefore, the present study is aimed at to screen the garlic germplasm for yield and susceptibility to purple blotch disease and correlation among the traits.

MATERIALS AND METHODS

The experiment was conducted at the Vegetable Research Centre, Patharchatta of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India during the winter season of 2000 to 2001 and 2001 to 2002. The material comprised 21 genotypes of garlic (Table 1) grown in randomized block design r season of 2000 to 2001 and 2001 to 2002. The material comprised 21 genotypes of garlic (Table 1) grown in randomized block design with 3 replications in each year. The crop was planted

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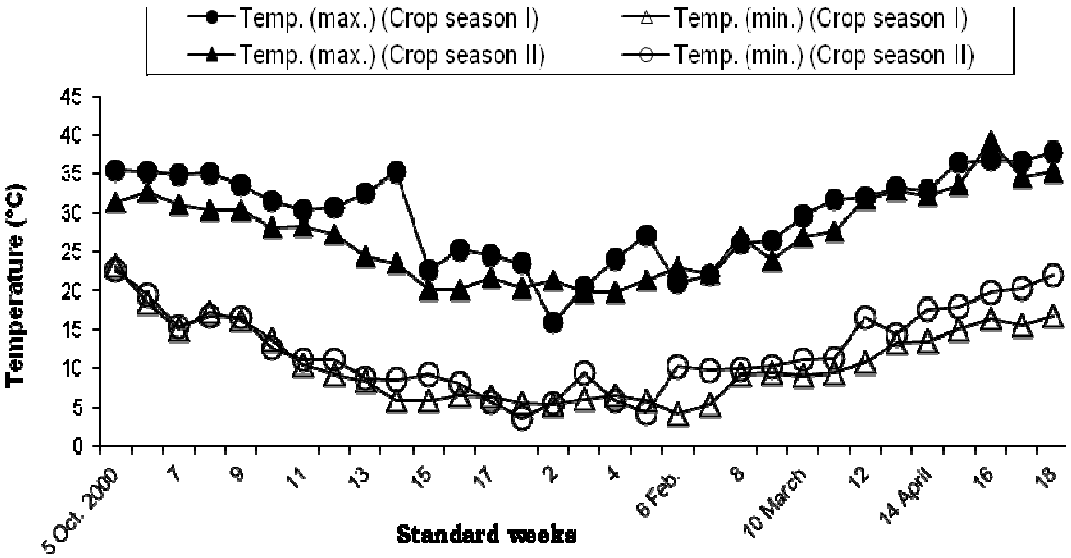

Figure 1. Weekly temperature variation during crop season I and II.

Table 1. Names and sources of genotypes under study.

S/N	Genotypes	Name after release	Source of collection
1	DARL-52	-	Agricultural Research Unit of Defence Research Laboratory, Almora
2	DARL-53	-	Agricultural Research Unit of Defence Research Laboratory, Almora
3	G-1	Yamuna Safed	National Horticultural Research and Development Foundation, Nashik
4	G-41	Agrifound White	National Horticultural Research and Development Foundation, Nashik
5	G-50	Yamuna Safed-1	National Horticultural Research and Development Foundation, Nashik
6	G-323	G-323	National Horticultural Research and Development Foundation, Nashik
7	G-313	Agrifound Parvati	National Horticultural Research and Development Foundation, Nashik
8	G-282	Yamuna Safed-3	National Horticultural Research and Development Foundation, Nashik
9	HG-17	-	C.C.S. Haryana Agricultural University, Hisar
10	KGS-1	-	C.S. Azad University of Agriculture and Technology, Kanpur
11	PGS-4	-	G.B. Pant Univ. of Agric. and Tech., Pantnagar
12	PGS-13	-	G.B. Pant Univ. of Agric. and Tech., Pantnagar
13	PGS-14	Pant Lohit	G.B. Pant Univ. of Agric. and Tech., Pantnagar
14	PGS-17	-	G.B. Pant Univ. of Agric. and Tech., Pantnagar
15	PGS-98	-	G.B. Pant Univ. of Agric. and Tech., Pantnagar
16	PGS-99-1	-	G.B. Pant Univ. of Agric. and Tech., Pantnagar
17	PGS-99-2	-	G.B. Pant Univ. of Agric. and Tech., Pantnagar
18	PGS-99-3	-	G.B. Pant Univ. of Agric. and Tech., Pantnagar
19	DG-1	-	Agricultural Research Station, Durgapur, Rajasthan
20	DG-2	-	Agricultural Research Station, Durgapur, Rajasthan
21	RAUC-5	-	Rajendra Agriculture University, Sabour

in the last week of October at a spacing of 15 (row to row) × 10 cm (plant to plant). Fertilizer application of 100:50:50 kg NPK/ha in form of urea, diammonium phosphate and muriate of potash, respectively was applied. Total phosphorus and potassium and half of the nitrogen was applied before planting and rest amount of nitrogen was top dressed in two equal splits 30 and 45 days after planting when hand weeding was carried out in the experimental plots. Five flood irrigations were given to the crop except fungicide or insecticide spray to ensure a good crop. Plot size was 2.0 × 1.5 m. Disease severity was assessed 120 days after planting during both seasons.

Ten plants from each plot were randomly tagged for disease assessment on the following 0 to 5 rating scale: 0 (Immune) = No infection; 1 (Resistant) = 1 to 10% leaf area infected (LAI); 2 (Moderately resistant) = 11 to 20% LAI; 3 (Mild susceptible) = 21 to 50% LAI; 4 (Susceptible) = 51 to 75% LAI; and 5 (Highly susceptible) = 76 to 100 LAI (Anonymous, 1987). Observation on bulb weight and bulb yield per plot was also taken at the time of

Table 2. Performance of garlic genotypes for purple blotch susceptibility (0-5 scale) bulb weight and yield.

S/N	Genotypes	Mean purple blotch severity index		Average Bulb weight (g)		Bulb yield (quintal/ha)	
		2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002
1	G-1	0.2	0.6	25.3	20.6	110.2	93.6
2	G-323	0.2	0.6	28.9	24.0	150.0	125.9
3	PGS-14	0.2	0.6	25.2	22.3	130.5	122.0
4	PGS-4	0.2	0.7	24.7	21.7	128.2	120.5
5	G-313	0.1	0.8	36.5	33.3	213.1	186.0
6	PGS-98	0.2	0.9	29.4	24.7	150.2	126.4
7	PGS-99-1	0.3	0.9	23.1	19.1	112.7	97.7
8	G-50	0.3	0.9	23.3	20.4	116.6	102.6
9	PGS-99-2	0.3	1.0	31.8	28.1	169.8	140.2
10	HG-17	0.2	1.3	24.9	21.3	119.7	107.6
11	PGS-13	0.3	1.4	23.1	20.0	197.6	98.5
12	PGS-17	0.2	1.5	22.9	20.9	112.1	110.3
13	PGS-99-3	0.4	1.5	21.5	17.2	105.7	85.7
14	KGS-1	0.3	1.7	21.2	16.9	95.8	86.0
15	DG-2	0.3	2.3	19.3	15.6	96.7	68.7
16	DARL-52	0.3	2.5	21.7	17.7	112.6	90.8
17	DARL-53	0.4	2.5	20.8	17.8	109.1	94.7
18	G-41	0.5	2.5	23.0	17.0	96.6	78.2
19	DG-1	0.5	3.4	18.7	15.3	92.3	65.9
20	G-282	0.3	3.5	27.0	20.3	134.1	102.5
21	RAUC-5	0.6	3.6	19.8	14.4	97.9	65.8
General mean		0.3	1.6	24.4	20.5	121.5	103.3
SEm±		0.06	0.22	0.72	1.38	6.39	7.50
LSD		0.18	0.63	2.06	3.89	18.27	21.45

harvesting. Average bulb weight was recorded on ten randomly selected plants. Plot yield was recorded for all the lines in all replications and bulb yield for a hectare was extrapolated in quintals. Metrological data was procured from the Agro-meteorological Department of the university.

RESULTS AND DISCUSSION

In the first year (2000 to 2001) trial, disease was very mild and all genotypes showed a disease index value <1 (range 0.1 to 0.5) or as environment was not conducive for disease development (Table 2). In the second year 2001 to 2002 trial environment was more conducive for disease development and genotypes expressed their potential to tolerate the disease. Nine genotypes viz., G-1, G-50, G-323, PGS-4, PGS-14, G-313, PGS-99-1, PGS-98 and PGS-99-2 fell into the category of resistant, five showed moderately resistant reaction to disease (PGS-13, PGS-17, KGS-1, HG-17 and PGS-99-3), four were mildly susceptible (G-41, DG-2, DARL-52 and DARL-53) whereas three (G-282, DG-1 and RAUC-5) were susceptible (Table 2). Bulb weight and yield were negatively correlated with disease severity and variations were attributed to genotypic differences (Table 3). Bisht and Thomas (1992) found only nine accessions among 900 as resistant against purple blotch and stemphyllium blight. Bisht and Agarwal (1993) also categorized G-41 as highly susceptible genotype. Pandey et al. (2000) screened 35 genotypes of garlic and reported resistance in G-1, G-323 and G-282 with percent disease index (PDI) value from 5.4 to 10.0 % while four lines (G-41, RAUC-5, IC-53282 and IC-11983) showing PDI values from 84.3 to 96.8 % were highly susceptible. Poor bulb weight and yield during the second year can be attributed to the severe infection of purple blotch disease at full grown stage of plant which gradually killed the leaves and reduced the leaf area index of plants. The yield reduction from a given percentage of foliage removal has been found maximal when defoliation of foliage occurs during the early stages of bulb development (Baker and Wilcox, 1961). Brewster et al. (1986) also reported that bulb yield depends critically on leaf area index established during bulb development. Higher bulb yield in genotypes with higher leaf area index might be attributed to their ability for higher net assimilation rate resulting into higher production of photosynthates. During 2011 to 2002, the trial of environmental conditions also favored the disease by regular rainfall (Figure 2) and cloudy weather,

Table 3. Analysis of variance for purple blotch and bulb yield in garlic.

Traits	Source of variation					
	First year			Second year		
	Rep	Genotype	Error	Rep	Genotype	Error
df	2	20	40	2	20	40
Purple blotch	0.002	0.048**	0.012	0.621	3.00**	0.149
Bulb weight	18.80	57.44**	1.55	16.44	62.97**	5.75
Bulb yield	539.0	2600**	122.5	225.8	2336**	168.9

** and *, Significance at 1 and 5% level.

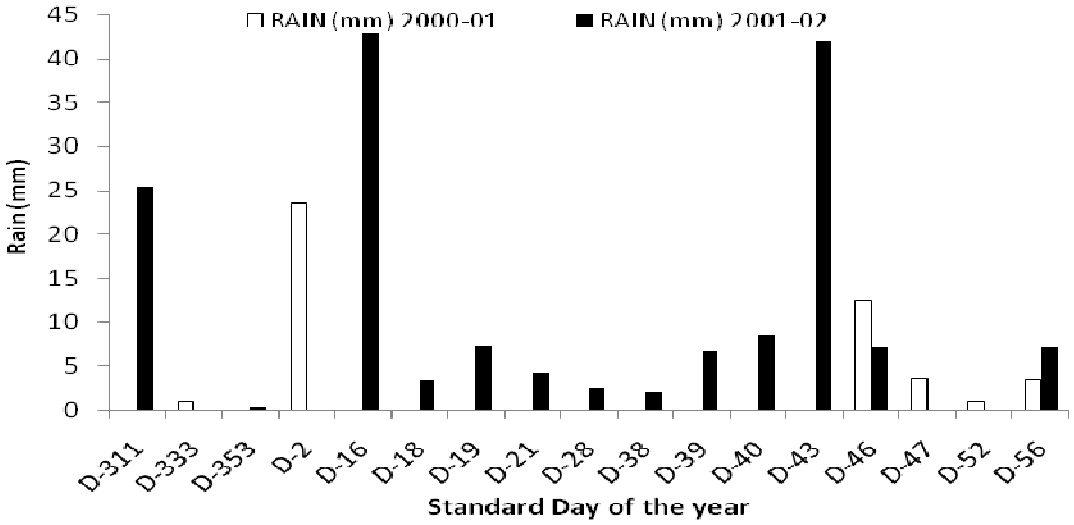

Figure 2. Comparison of daily rainfall during crop season I and II.

Table 4. Correlation among the purple blotch and yield traits.

Traits	Season	Bulb weight		Bulb yield	
		Genotypic	Phenotypic	Genotypic	Phenotypic
Purple blotch	2000-2001	-0.695**	-0.487*	-0.619**	-0.454*
	2001-2002	-0.692**	-0.552**	-0.691**	-0.569**
	Pooled	-0.990**	-0.507*	-0.998**	-0.465*

** and * Significance at 1 and 5% level.

because sporulation of conidia of *A. porri* on affected leaves has been reported to increase after rain (Meredith, 1966) and its subsequent dispersal by winds (Skiles, 1953). Maude (1990) reported that pathogen requires temperature of 21 to 30°C for development and hot humid climate for its severity. Poor weather conditions might also indirectly affect the photosynthetic efficiency of plants because the development of bulbs is mediated mainly by day/night temperature differences and to lesser extent by photoperiod (Abdalla, 1967). Mean performance of genotypes indicated superiority of G-313, PGS-99-2, PGS-98, G-323 and PGS-14 for bulb yield as well as bulb weight also. A strong and negative correlation coefficient was observed between the purple blotch incidence and yield attributing traits (Table 4). Therefore, it is advisable to grow these genotypes in the purple blotch disease prone areas due to their inherent ability of better disease tolerance and high yield potential.

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