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Screening of Garlic Genotypes for Yield and Yield attributing Traits against Stemphylium Blight

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A B S T R A C T

Present field experiment was conducted during *Rabi* seasons of 2016-17 at research farm of BAU, Sabour to study the screening of the best genotype of garlic for yield and yield attributing traits against Stemphylium Blight in Agro-climatic zone IIIA of Bihar. Garlic (*Allium sativum* L.) is considered as one of the most important species in the family Alliaceae and as an important bulb crop next to onion. It is attacked by a number of diseases of which, in field condition, stemphylium blight is the most economically important diseases. The results revealed that, the maximum plant height (49.04 cm) was recorded in genotype BRG-13 and lowest (34.49 cm) in RG-463. The maximum number of leaves per plant was observed in WG-73 (9.22) and minimum in BRG-3 (6.57). The maximum length was recorded in genotype 507 (42.91 cm) and minimum length (31.35 cm) of leaf was found in genotype 569. The maximum breadth of leaf was obtained in genotype BRG-10 (1.52 cm) and minimum in the genotype 507 (0.98 cm). Genotype 644 had thick neck (0.81cm) and less thicker neck was obtained in genotype G 323 (0.80 cm). The minimum was recorded with the genotype IC 375005 (2.23 cm) and maximum polar diameter of bulb with genotype WG-73 (3.35 cm). The highest and lowest equatorial diameter of bulb was recorded with genotype BRG-13 (4.79 cm) and IC-375005 (2.74 cm) respectively .The longest clove length recorder in genotype BRG-13 (2.36cm) while smallest clove was observed in genotype G-50 (1.93cm). Genotype 650 produced thickest clove (0.98 cm) while BRG-13 was thinnest clove (0.78cm). The maximum number of cloves per bulb was recorded in genotype BRG-3 (52.03cm) and minimum was in 4 (15.48 cm). The maximum average weight of cloves was observed in BRG-8 (1.60 g), while the minimum average weight of cloves was exhibited in BRG-7 (0.39 g). The higher bulb yield per plant was obtained in line BRG-13 (34.65 g) and, while the lowest bulb yield was found in G-1 (20.63 g). The least percent disease index of Stemphylium blight was recorded in genotype BRG-13 (10.55%) and, while the highest percent disease index of Stemphylium blight was found in BRG-3 (48.71%).

Introduction

Garlic (*Allium sativum* L.) is one of the most important bulb crops grown and used as a spice or a condiment throughout India as well as apart of it. It is grown throughout the world and used as spices and flavouring agent for many delicious foods (Velisek *et al.,* 1997). The area under garlic cultivation in India is 280.95 thousands hectares producing 1617.34 thousands metric tonnes with an average national productivity of 5.76 tonnes/ha. In Bihar the area, production and productivity are 4.25 thousands ha, 4.00 thousands metric tonnes and 0.94 t/ha (DOGR, 2015-16). It is mostly used for culinary purposes and as a condiment for different food items. It is also chiefly used for pungent flavouring and seasoning vegetable dishes. This cash crop is one of the important foreign exchange earner crops of India because of the good quality and quantity of garlic exported every year from the country. Garlic bulb is the most commonly used part of the plant.

With the exception of the single clove types, garlic bulbs are normally divided into numerous fleshy sections called cloves. Garlic cloves are used for consumption (raw or cooked) or for medicinal purposes. More recently, it has been found from a clinical trial that a mouthwash containing 2.5per cent fresh garlic shows good antimicrobial activity, although the majority of the participants reported an unpleasant taste and halitosis (Groppo *et al.,* 2007).

Garlic cloves are used as a remedy for infections (especially chest problems), digestive disorders, and fungal infections such as thrush. Garlic can be used as a disinfectant because of its bacteriostatic and bactericidal properties (Lemar *et al.,* 2005). It is a rich source of protein, phosphorus, calcium, magnesium, potash and ascorbic acid.

Garlic is grown a under wide range of climatic condition. However, it cannot with stand too hot or too cold temperature. It requires cool and moist period during growth and relatively dry period during maturity of bulb. It is also affected by many diseases caused by fungi, bacteria, nematode and viruses but Stemphylium blight is the major and serious disease affecting the productivity adversely. It is caused by a fungus species *Stemphylium vesicarium* (Wall). It is a foliar disease of garlic and it was reported in Kullu, Himanchal Pradesh during 1997 (Singh and Sharma). The pathogen survives in infected plant debris. A foliar infection up to 90 per cent has been reported in susceptible cultivar of garlic (Bisht and Agrwal, 1993). Leaves being the only photosynthetic organ directly affect the bulb yield. Significant reduction in bulb yield (25-60 per cent) has been observed. The foliar diseases that appear in a severe form are Stemphylium leaf blight and Alternaria leaf blight. The severity of disease is much more where crop is predisposed by thrips injury. Stemphylium leaf blight appears every year in a moderate to severe form in garlic growing areas of Bihar. Severe outbreak of leaf blight of garlic was reported from Bihar during 1995 on varieties Vanarshi and P-49 (Patna selection), ranging the disease severity from 25.6 to 76% and 20.16 to 75% respectively (Anon. 2013a). The symptoms of this disease is characterized by small, light yellow to brown and water soaked lesions, which develops on all ages of leaves especially on older leaves. These small lesions grow into enlarged spots that frequently coalesce resulting in blighting of leaves. In advanced stages lesions may girdle and kill leaves. This disease adversely affects the garlic production in other states too particularly Bihar. Thus in spite of being a disease of significant importance, no detailed study on Stemphylium blight has been conducted so far. Since it is an important limiting factor for garlic production,

comprehensive studies on disease development, its severity and management are essential. Screening is the first step towards resistance breeding. Selection of resistant / tolerant variety is a viable option for managing these diseases.

Materials and Methods

Field evaluation of thirty eight genotypes were selected out of the collections maintained at the Department of Horticulture (Vegetable and Floriculture) BAU, Sabour during the rabi season of 2016-17 (Table 2). The experiment was laid out in randomized block design (RBD) with 38 treatments replicated three times and situated at 15º40' N latitude, 87˚2'42''E longitude and at an altitude of 46 meter above mean sea level. The climate of the experimental site is tropical to sub-tropical with slight semi-arid nature and is characterized by very dry summer, moderate rainfall and very cold winter. Meteological data was procured from the Agro- observatory meterological department of the university.

The crop was planted in the third week of October at a spacing of 15 cm × 10 cm. The recommended dose of fertilizers N, P_2O_5 and K_2O was applied 120, 80 and 40 kg ha^{-1} in the form of urea, diammonium phosphate and muriate of potash, respectively was applied. One third dose of nitrogen was applied along with full dose of phosphorous and potash at the time of final field preparation and remaining dose of nitrogen was applied in two split doses as top dressing at an interval of one month from date of sowing. A random sample of ten plants of each cultivar was collected from each plot to measure the plant height (cm) and number of leaves per plant, length of leaf (cm), neck thickness (cm), breadth of leaf (cm) at 90-85 days after planting. However, diameter of bulb (cm), Equatorial diameter of bulb (cm), Length of clove (cm), diameter of clove (cm), number of clove per bulb, average weight of clove (g) and Yield per plant (g) were recorded at the time of harvesting. The data were analyzed statistically by applying ANOVA technique of randomized block design (RBD) as suggested by Panse and Sukhatme (1967).

Screening was done on 0-9 point rating scale based on leaf area covered by the pustules (Mayee and Datar, 1986). Five plants at bulb developmental stage were randomly selected for scoring the disease at fortnightly intervals. Percent disease index (PDI) was calculated on the basis of rating scale and the total number of plants observed as given below.

P.D.I. (%) =

$$\frac{\text{Sum of rating (0-9 scale)} \times 100}{\text{Maximum possible score} \times \text{No. of leaves examined}}$$

Grade	Per cent area covered (leaf)
0	Absolutely free from infection
1	Small sized lesions on the leaf covering <1% Area
2	Small sized lesions on the leaf covering <2-5% % Area
3	Small sized lesions on the leaf covering <6-10% % Area
4	Small sized lesions on the leaf covering <11-15% 1% Area
5	Small sized lesions on the leaf covering < 16-25% Area
6	26-40% area covering
7	41-60% area covering
8	61-75 % area covering
9	>75% area covered with spot, most of the leaves dried

Results and Discussion

The ANOVA for all the traits under study revealed that the mean square estimates due to genotypes were highly significant for all the

characters studied (Table.1). In other words, the performance of the genotypes with respect of these characters was said to be statistically different; suggesting that, there exists abundant scope for selection in different traits for garlic genotypes improvement. In the present Study, the selection of thirty eight desirable genotype is primarily based on mean performance.

On the basis of the performance mean data (Table 1), the maximum plant height was observed in genotype BRG-13(49.04 cm) followed by genotype 644 (45.11 cm) and the minimum was recorded in RG-463 (34.49 cm). Similar variability trend for plant height was also observed by Mathur *et al.,* (1985); Nurzynska-Wierdak (1997); Kohli and Prabal (2000), and Sengupta *et al.,* (2007) in garlic.The maximum leaf length (42.91cm) was recorded in genotype 507 which was comparable to BRG-8 (42.38 cm), WG 471 (41.34 cm), G323 (40.92 cm), WG-73 (41.51cm), WG-35 (41.27 cm), BRG7 (40.99 cm) and BRG10 (41.17 cm). However, the lowest leaf length was noted in 569 (31.35 cm) followed by BRG- 14 (32.15 cm) and 644 (32.19 cm). Similar results was finding by Kohli and Prabkal (2000) and Sengupta *et al.*, (2007). The highest number of leaves was exhibited in line WG-73(9.22) which was statically at par with genotypes 650 (9.00), 644 (8.76), BRG-10 (8.61), BRG-13 (8.64), BRG-8 (8.61), G-323(8.72), BRG-14 (8.74), RG464 (8.71), 507 (8.50), G-1 (8.48), G-282 (8.66), IC-375005 (8.63) and WG-39 (8.67) while, it was the lowest in BRG-3(65.7) followed by WG-38 (6.97) WG-376 (7.25). . These results are in agreement with the works of Mehta and Patel (1985), Nurzynska-Wierdak (1997) and Sengupta *et al.,* (2007). The highest breath of leaf was recorded in genotype BRG-10 (1.52 cm) and narrow in genotype 507 (0.98 cm). The results are in close approximation of results of Kohli and Prabal (2000) and Sengupta *et al.,* (2007).

Brewster *et al.,* (1986) also reported that bulb yield depends critically on leaf area index established during bulb development in garlic crop. 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. The genotype 650 (0.98 cm) was observed maximum equatorial diameter of bulb while, the minimum diameter of bulb was recorded in line IC-49387 (0.78 cm). These results of Lommerink (1989); Pandey *et al.,* (1996); Sood *et al.,* (2000),) and Sengupta *et al.,* (2007) are in close accord with the result of the present investigation in garlic crop. The maximum polar diameter of bulb was recorded in genotype WG-73 (3.55cm) and the minimum in IC 375005 (2.53cm). The results of present study are quite similar with research of Pandey *et al.,* (1996); Kohli and Prabal (2000); Sood *et al.,* (2000) and Sengupta *et al.,* (2007). The maximum neck thickness was recorded in genotype BRG-73 (0.81cm) and the minimum in WG-48(0.58cm). Similar findings have been observed by Singh *et al.,* (2015) and Mishra *et al.,* (2013) in garlic.

The longest clove length recorded in genotype BRG-13(2.36cm) while smallest clove was observed in genotype G-50 (1.93cm). Genotype 650 produced thickest clove (0.98 cm) while BRG-13 was thinnest clove (0.78 cm). The maximum number of cloves per bulb was recorded in genotype BRG-3(52.03cm) and minimum was in 4(15.48cm). Similar, finding has been reported by Pandey *et al.,* (1996), Kohli and Prabal (2000), Shri (2002-2003) in garlic. The maximum average weight of cloves was observed in BRG-8 (1.60g), while the minimum average weight of cloves was exhibited in BRG-7 (0.39 g). The results of present study are quite similar with research of Lammerink (1989), Nurzynska Wierdak (1997), Kohli and Prabal (2000) in garlic crop.

Table.1 Mean performance of different garlic genotype for different traits

No	Character/genotype	PH	NLe	LLe	BrLe	NkT	PoDB	EDB	LC	DC	NCB	AWC	Y/P	PDI %
1	BRG-10	38.61	8.61	41.17	1.52	0.78	2.89	4.01	2.10	0.91	48.50	0.56	32.12	**31.28**
2	BRG-3	41.73	6.57	37.13	1.32	0.70	3.07	3.30	2.19	0.78	52.03	0.51	28.73	**48.71**
3	569	42.36	7.72	31.35	1.29	0.74	3.07	4.64	1.99	0.84	21.49	1.45	31.65	**24.78**
4	644	45.11	8.76	32.19	1.48	0.72	3.16	4.76	1.99	0.96	35.63	1.06	34.18	**21.60**
5	650	42.06	9.00	32.74	1.33	0.67	3.23	3.28	2.18	0.98	37.51	0.74	31.73	**46.15**
6	BRG-1	37.55	8.02	40.43	1.16	0.79	2.92	3.30	2.01	0.91	19.48	1.41	27.88	**42.59**
7	IC-290440	40.65	8.33	38.37	1.34	0.75	2.98	4.05	2.18	0.85	36.52	0.80	29.54	**20.21**
8	BRG-8	40.52	8.61	42.38	1.03	0.70	3.09	3.14	2.29	0.84	17.05	1.60	27.81	**41.45**
9	BRG-13	49.04	8.64	33.68	1.33	0.81	3.16	4.79	2.36	0.98	46.84	0.73	34.65	**10.55**
10	4	38.01	8.33	40.48	1.33	0.64	3.14	3.49	2.30	0.95	15.48	1.34	25.78	**25.60**
11	WG-471	35.04	8.39	41.34	1.21	0.75	2.94	4.09	2.10	0.95	35.62	0.72	26.77	**25.73**
12	WG-7	38.11	8.26	37.89	1.36	0.69	2.96	3.47	2.17	0.91	25.06	0.99	25.06	**43.92**
13	G-323	38.52	8.72	40.92	1.18	0.80	3.18	4.09	2.27	0.92	20.81	1.27	26.93	**39.63**
14	BRG-9	38.20	7.96	38.44	1.43	0.74	3.10	3.41	2.21	0.88	44.47	0.59	29.31	**24.53**
15	BRG-14	42.25	8.74	32.15	1.36	0.69	3.13	4.65	2.19	0.95	36.99	0.86	32.68	**12.32**
16	WG-73	39.84	9.22	41.51	1.32	0.77	3.35	3.40	2.14	0.96	20.70	1.31	27.76	**38.31**
17	M-175	37.19	8.24	38.34	1.13	0.66	2.95	3.81	1.93	0.86	38.45	0.54	23.86	**28.82**
18	553	39.17	8.29	39.24	1.25	0.77	3.13	4.21	2.11	0.91	42.10	0.61	27.03	**40.11**
19	WG-2	36.97	8.35	37.64	1.27	0.68	3.14	3.64	2.16	0.94	27.18	0.93	25.67	**28.75**
20	RG-464	37.14	8.71	42.90	1.22	0.60	3.01	4.23	2.02	0.86	38.69	0.59	24.20	**40.51**
21	WG-7	39.48	8.34	39.06	1.52	0.73	3.16	3.73	2.12	0.87	35.26	0.76	29.28	**26.75**
22	507	37.39	8.50	42.91	0.98	0.66	2.80	4.08	1.99	0.90	34.54	0.55	21.89	**28.92**
23	G1	35.78	8.48	40.33	1.38	0.73	2.84	4.34	2.16	0.83	24.36	0.99	26.07	**31.31**
24	IC-375107	37.57	8.08	39.42	1.52	0.68	3.03	3.98	2.08	0.89	20.20	0.72	24.65	**41.40**
25	IC-345585	38.81	7.66	35.45	1.21	0.69	3.04	4.18	2.01	0.86	38.58	0.59	24.70	**43.95**
26	BRG-7	37.15	7.42	40.99	1.32	0.66	3.09	3.79	2.16	0.97	50.22	0.39	22.73	**26.80**
27	G- 282	37.10	8.66	40.31	1.21	0.71	3.16	3.49	2.06	0.91	20.56	1.14	24.04	**30.00**
28	G-50	37.27	7.55	36.05	1.06	0.67	2.93	4.39	2.09	0.89	35.07	0.78	28.21	**46.50**
29	WG-48	38.43	7.49	37.03	1.36	0.58	2.94	2.82	2.09	0.89	25.20	0.86	24.02	**28.23**
30	RG-463	34.49	7.54	36.89	1.34	0.62	2.66	3.35	2.14	0.87	29.99	0.70	24.67	**27.40**
31	IC-141151	34.63	7.76	39.45	1.08	0.73	2.66	4.14	2.16	0.82	26.92	0.91	26.23	**23.80**
32	WG-376	37.67	7.25	37.29	1.22	0.71	2.64	2.75	1.94	0.87	27.21	0.90	26.17	**24.20**
33	IC-375005	38.12	8.63	35.51	1.30	0.65	2.53	2.74	2.18	0.88	27.76	0.74	25.76	**34.60**
34	WG-38	37.01	6.97	37.09	1.41	0.66	2.54	3.14	2.13	0.93	29.61	0.72	24.01	**25.51**
34	WG-35	36.01	8.37	41.27	1.50	0.62	2.98	4.50	2.04	0.84	27.43	0.73	25.31	**25.00**
36	GODAVARI	35.42	7.92	34.51	1.21	0.70	2.94	3.03	2.28	0.79	27.21	0.87	23.81	**24.85**
37	WG-39	38.54	8.67	36.38	1.27	0.66	3.02	2.99	2.13	0.91	21.84	0.97	24.98	**26.91**
38	**0TUR 555**	**36.27**	**7.97**	**36.86**	**1.18**	**0.65**	**2.75**	**2.86**	**2.09**	**0.87**	**23.15**	**0.82**	**25.18**	**33.20**

Characters and their abbreviation used in table: Plant height in cm (PH), Number of leaves per plant (NLe), Length of leaves in cm (LLe), Breath of leaves in cm (BrLe), Neck thickness in cm (Nk), Diameter of bulb in cm (PoDB), Equatorial diameter of bulb in cm (EDB), Length of clove in cm (LC), Diameter of clove in cm (DC), Number of clove per bulb (NCB), Average weight of clove (g) ,Yield per plant in gram (YP), Percent disease index (PDI %)

Table.2 List of Genotypes of Garlic used under investigation

S.No.	Garlic genotype	Source
1	BRG-10	Local collection maintained at BAU, Sabour
2	BRG-3	Local collection maintained at BAU, Sabour
3	569	Line from DOGR maintained at BAU
4	644	Collection from DOGR maintained at BAU
5	650	Collection from DOGR maintained at BAU
6	BRG-1	Collection from DOGR maintained at BAU
7	IC-290440	Collection from DOGR maintained at BAU
8	BRG-8	Local collection maintained at BAU, Sabour
9	BRG-13	Local collection maintained at BAU, Sabour
10	4	Collection from DOGR maintained at BAU
11	WG-471	Collection from DOGR maintained at BAU
12	WG-7	Collection from DOGR maintained at BAU
13	G-323	Collection from DOGR maintained at BAU
14	BRG-9	Local collection maintained at BAU, Sabour
15	BRG-14	Local collection maintained at BAU, Sabour
16	WG-73	Collection from DOGR maintained at BAU
17	M-175	Collection from DOGR maintained at BAU
18	553	Collection from DOGR maintained at BAU
19	WG-2	Collection from DOGR maintained at BAU
20	RG-464	Collection from DOGR maintained at BAU
21	WG-7	Local collection maintained at BAU, Sabour
22	507	Collection from DOGR maintained at BAU
23	G1	Collection from DOGR maintained at BAU
24	IC-375107	Collection from DOGR maintained at BAU
25	IC-345585	Collection from DOGR maintained at BAU
26	BRG-7	Collection from DOGR maintained at BAU
27	G- 282	Collection from DOGR maintained at BAU
28	G-50	Collection from DOGR maintained at BAU
29	WG-48	Collection from DOGR maintained at BAU
30	RG-463	Collection from DOGR maintained at BAU
31	IC-141151	Collection from DOGR maintained at BAU
32	WG-376	Collection from DOGR maintained at BAU
33	IC-375005	Collection from DOGR maintained at BAU
34	WG-38	Collection from DOGR maintained at BAU
35	WG-35	Collection from DOGR maintained at BAU
36	Godavari	Collection from DOGR maintained at BAU
37	WG-39	Collection from DOGR maintained at BAU
38	0tur 555	Collection from DOGR maintained at BAU

The higher bulb yield per plant was obtained in line BRG-13(34.65 g) which had statistically at par with BRG-14 (32.68 g), 644 (34.18 g) and BRG-10 (32.11 g) while, the lowest yield per plant was obtained in genotype G-1 (20.63g) followed by 507 (21.89 g), RG-464 (24.19 g) and IC-375107 (24.65 g). Higher bulb yield may be attributed to cumulative effects of number of leaves per plant, length and diameter of bulb, number of cloves per bulb and average weight of cloves. Variation in yield amongst the lines was also reported by Pandey *et al.,* (1996), Nurzynska Wierdak (1997), and Shrivastava *et al.,* (2004) in garlic. The least percent disease index of Stemphylium blight was recorded in genotype BRG-13(10.55%) followed by BRG-14 (12.32%), IC-290440 (20.21%) and 644 (21.6%) and, while the highest percent disease index of Stemphylium blight was found in BRG-3 (48.71%) which was significantly at par with 650(46.15) and G-50(46.50). These findings are similar to the study of Mishra *et al.,* (2009) and Veeraghanti (2017).

In conclusions, all the 38 genotypes were grown in Randomized Block Design with three replications maintaining a spacing of 15x10 cm. A total of 150 plants were maintained in each plot. The recommended agronomic practices were adopted for raising a good garlic crop. Observations were recorded on 13 important morphological and disease parameter, viz. plant height (cm), neck thickness (cm), number of leaves per plant, length of leaf (cm),breadth of leaf (cm) ,yield per plant (g), plolar diameter of bulb (cm),Equatorial diameter of bulb (cm), number of cloves/ bulb, length of clove (cm), diameter of clove (cm),average weight of clove (g), percent disease index (PDI) with respect to Stemphylium blight. The conclusion of this investigation is presented here under.

Significant variations among genotypes were observed for all the traits under study. Genotype BRG-13 produced the highest yield per plant and was statistically at par with the genotypes, BRG-14 , 644 and BRG-10. Least disease index per cent was noticed in BRG-13 followed by BRG-14, IC-290440 and 644. Thus these genotypes may be considered promising with respect to different traits mentioned.

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