*Agric Res J* **60** (3) : 484-491, *June* 2023
*DOI No. 10.5958/2395-146X.2023.00070.4*

# DISEASE PREVALENCE, OPTIMUM MEDIA AND ELITE GENOTYPES AGAINST STEMPHYLIUM BLIGHT OF GARLIC UNDER PUNJAB CONDITIONS

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Stemphylium leaf blight (SLB) is the major disease of garlic throughout the world and in India, it was first reported by Rao and Pavgi (1975). Later, it was reported from other parts of the world, i.e. South Africa, Spain, and Australia (Aveling and Naude, 1992;Basallote *et al.,* 1993;Suheri and Price, 2000). Apart from garlic, the disease has also been reported on many other crops i.e onion, pear, asparagus, alfalfa, parsley and many other horticultural crops (Falloon *et al.,* 1987; Koike *et al.,* 2013; Lamprecht *et al.,* 1984;Llorente and Montesinos, 2006; Mehta, 1998; Miller *et al.,* 1978). It was reported that the yield losses due to this disease were upto 90 percent in northern parts of India (Zheng *et al.,* 2008) and the disease appears as extended, small white flecks usually spindle shaped and enlarges to produce recessed purple lesions, surrounded by a border of yellow to light brown colour. These lesions cause immense necrosis, resulting in premature leaf drying and halting bulb development (Hill, 1995;Basallote *et al.,* 1999).This disease gives a blighting appearance to field making it an economically important disease. Due to lack of resistant cultivars, the evaluation of prevalence of disease and reaction of different genotypes was conducted.

## Survey of garlic growing areas to determine the prevalence of Stemphylium blight

Surveys of garlic growing areas of Punjab (Ludhiana, Jalandhar, Sangrur, Barnala, Patiala, Moga, Muktsar, Pathankot, Gurdaspur, Amritsar, Hoshiarpur) was undertaken during February-April 2017 and 2018 for the collection of diseased samples and to record the incidence and severity of SLB. The disease intensity was measured by selecting 50 plants randomly from the fields which were assessed by keeping in view the percent leaf area damage by the pathogen. The disease intensity was measured by following 0-5 rating scale given by Sharma (1986):

| Score | Disease description |
|---|---|
| 0 | No disease symptom |
| 1 | A few spots towards tip covering 10 percent leaf area |
| 2 | Several purplish brown patches covering up to 20 percent of leaf area |
| 3 | Several patches with paler outer zone covering upto 40 percent leaf area |
| 4 | Leaf streaks covering up to 75 percent leaf area or breaking of the leaves from center |
| 5 | Complete drying of the leaves or breaking of leaves from center |

The percent disease index (PDI) was calculated by the formula given by Wheeler (1969)

PDI = 100 [ΣSNR] [(N) (MDR)]-1

where,

ΣSNR is the sum of numerical ratings

N is the number of observations

MDR is the maximum disease rating based on 0-5 scale

## Effect of different media on the growth and sporulation of *Stemphylium vesicarium*

Synthetic and semi-synthetic media were used to test the most suitable media that supported the best growth (mycelial) and sporulation of the fungus *Stemphylium vesicarium.*

### (i) Potato dextrose agar (PDA) medium

The potatoes (200g) were peeled and chopped into small pieces and were boiled in distilled water for making potato extract. Further, the extract was filtered by using double layered muslin cloth. The agar (15g) and dextrose (20g) were added to the filtered extract and the final volume of the media was made upto one litre.

### (ii) Oat meal agar (OMA) medium

Flakes of Oats (30g) were boiled in distilled water and filtered by using muslin cloth. Further, agar (15g) was added into it and the final volume of the media was made upto one litre.

### (iii) Czapek's Dox agar medium

Sodium nitrate (NaNo3) - 2 g ; Dipotassium hydrogen phosphate (K2HPO4) - 1 g ; Magnesium

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Date of receipt: 03.03.2022, Date of acceptance: 30.06. 2023

sulphate (MgSO4. 7H 2O) - 0.50 g; Ferrous sulphate (FeSO4.7 H2O) - 0.01 g ; Sucrose (C12H22O11) - 30 g ; Agar agar - 15 g ; Distilled water - 1000 ml

### (iv) Richard's agar medium

Potassium nitrate (KNO3) - 10 g; Potassium monobasic phosphate (KH2 PO4) - 5 g; Magnesium sulphate (MgSO4. 7H2O) - 2.5 g; Ferric chloride (FeCl3. 6H2O) - 0.02 g; Sucrose (C12H22O11) - 50 g; Agar agar - 15 g; Distilled water - 1000 ml

**Preparation:** Sucrose was steam sterilized in an autoclave for three consecutive days. The agar and other constituents were dissolved in distilled water and autoclaved separately. Further, sterilized sugar solution was mixed aseptically into it.

### (v) Rye agar B medium

Rye - 60 gm; Beta-sitosterol - 0.05 gm; Sucrose - 20 gm; Agar agar - 15 gm; Distilled water - 1000 ml

**Preparation:** Grains of Rye were boiled in distilled water and filtered by using muslin cloth. The agar, beta-sitosterol and sucrose were mixed into it and the final volume was made upto one litre.

### (vi) V8 juice agar medium

V-8 juice - 8.3 ml; L-Asparagine - 10 g ; Calcium carbonate - 2 g; Glucose - 2 g; Agar agar - 20 g; Yeast extract - 2 g; Distilled water - 1000 ml

**Preparation:** V8 powder (24.3gm) and agar agar (20gm) were suspended in 1000ml of water and boiled for 20 minutes and then sterilized in the autoclave.

After the preparation of media, each of them was poured in 250 ml flasks and then plugged with non-absorbent cotton plugs. Sterilization of media was done in autoclave at temperature of 121ºC with pressure of 15 psi (per square inch) for 20 minutes. Further, 20 ml of each autoclaved medium was poured aseptically into the Petri plates (sterilized) in a laminar air flow. The mycelial disc of 5mm was cut from ten days old actively growing culture mycelia of *S.vesicarium* with the help of sterilized cork borer and seeded on Petri plates containing PDA with the help of sterilized inoculating needle. Each treatment comprised four replications under randomized design. These inoculated Petri plates were incubated at 25±1ºC in BOD incubator and the growth of the fungus was measured in (millimeter) at 24 hrs interval for ten consecutive days.

## Screening of garlic genotypes against SLB both under natural and artificial epiphytotic conditions

Twenty genotypes of garlic were grown under natural field conditions (without spray of conidial suspension) and under artificial epiphytotic conditions in the polyhouse (by spraying the conidial suspension $1\times10^4$ conidia/ml) in RBD with three replications for determining the relative response of these genotypes to disease.Twenty plants were randomly selected from each plot for the assessment of disease severity. The genotypes were further placed in different categories on the basis of susceptibility/resistance to SLB. The scale used for indicating the degree of resistance against SLB (Pathak *et al.,* 1986) is presented below:

| Disease severity | Category | Reaction |
|---|---|---|
| <5% | 0 | Immune (I) |
| 5-10% | I | Resistant (R) |
| 11-20% | II | Moderately Resistant (MR) |
| 21-40% | III | Moderately Susceptible (MS) |
| 41-60% | IV | Susceptible (S) |
| >61% | V | Highly Susceptible (HS) |

The observations on yield (q/ha), average bulb weight (gm) and number of cloves were also recorded for different genotypes and compared with the disease severity and reaction for SLB. The different genotypes used were PG-18, PG-17, PG-101, PG-102, PG-103, PG-104, PG-105, PG-106, PG-107, PG-108, PG-109, PG-110, PG-111, PG-112, PG-113, PG-114, PG-115, PG-116, PG-117, PG-118.

## Disease survey and collection of diseased samples

The survey for SLB concluded that the incidence varied from 41- 72 per cent and 53- 97 per cent during the year 2017 and 2018, respectively. The disease severity varied from 23.56- 56.45 per cent and 38.96- 73.46 per cent during the year 2017 and 2018, respectively. The highest incidence (72 per cent) and severity (56.45 per cent) of disease was recorded on local variety at Kadrabad in Patiala district and the lowest incidence (39 per cent) and severity (23.56 per cent) was recorded on PG-18 at Goniana in Muktsar district during the year 2017. During 2018, the highest incidence (97 per cent) and severity (73.46 per cent) was recorded on local variety at Dadhahoor, Moga district and the lowest (59 per cent) with severity (38.96 per cent) on var. PG-17 at Moonak in Sangrur district. The mean incidence (76.70 per cent) and severity (53.22 per cent) of disease were recorded to be higher (55.51 per cent) during the year 2018 as compared to 2017 (40.13 per cent) (Table 1). The present investigation indicated variable disease incidence and severity at different locations of Punjab.

Barnwal *et al.* (2003) conducted survey in Kanke (Jharkhand) for SLB of onion in 1998-99 and reported

**Table 1. Prevalence of Stemphylium blight of garlic in different districts of Punjab state during 2017 and 2018**

| S.No | District | Location | Variety | 2017 | | 2018 | |
|---|---|---|---|---|---|---|---|
| | | | | Incidence (%) | Severity (%) | Incidence (%) | Severity (%) |
| 1 | Sangrur | Sajuma | PG 18 | 54.00 | 38.67 | 85.00 | 57.89 |
| | | Nagra | Local | 58.00 | 42.67 | 87.00 | 60.44 |
| | | Khedhi | Local | 58.00 | 43.33 | 93.00 | 67.43 |
| | | Mastvana Sahib | PG 18 | 50.00 | 34.33 | 80.00 | 53.32 |
| | | Moonak | PG 17 | 41.00 | 27.33 | 59.00 | 38.96 |
| | | Kakra | PG 18 | 54.00 | 39.67 | 84.00 | 59.44 |
| | | Malerkotla | Local | 68.00 | 54.67 | 95.00 | 69.35 |
| | | Dirba | PG 18 | 49.00 | 33.33 | 82.00 | 58.98 |
| 2 | Barnala | Kattu | PG 18 | 49.00 | 33.67 | 65.00 | 45.77 |
| | | Harigarh | PG 17 | 45.00 | 32.33 | 75.00 | 50.95 |
| 3 | Ludhiana | PAU vegetable farm | PG 18 | 46.00 | 28.39 | 53.00 | 34.67 |
| | | Ladowal | PG 18 | 49.00 | 33.45 | 62.00 | 40.35 |
| | | Jagroan | Local | 54.00 | 38.98 | 65.00 | 44.23 |
| 4 | Pathankot | Khiala | PG 18 | 56.00 | 40.36 | 80.00 | 53.88 |
| | | Majra | Local | 62.00 | 44.63 | 71.00 | 49.78 |
| | | Shadipur | Local | 67.00 | 47.89 | 82.00 | 57.93 |
| | | Jugial | PG 18 | 50.00 | 34.38 | 64.00 | 42.76 |
| 5 | Gurdaspur | Behrampur | Local | 58.00 | 41.35 | 62.00 | 39.69 |
| | | Dinanagar | Local | 64.00 | 46.79 | 75.00 | 50.87 |
| | | Paniar | Local | 72.00 | 49.65 | 78.00 | 52.76 |
| 6 | Patiala | Lang | PG 18 | 50.00 | 34.65 | 64.00 | 42.37 |
| | | Kadrabad | Local | 72.00 | 56.45 | 93.00 | 68.23 |
| 7 | Moga | Bhekha | Local | 63.00 | 51.32 | 90.00 | 63.28 |
| | | Dadhahoor | Local | 68.00 | 54.44 | 97.00 | 73.46 |
| 8 | Muktsar | Bhullar | PG 18 | 44.00 | 27.78 | 68.00 | 46.35 |
| | | Goniana | PG 18 | 39.00 | 23.56 | 71.00 | 49.88 |
| 9 | Jalandhar | Nakodar | PG 18 | 54.00 | 39.35 | 78.00 | 51.23 |
| | | Lohian | Local | 68.00 | 54.78 | 84.00 | 60.23 |
| 10 | Hoshiarpur | Alampur | Local | 63.00 | 51.27 | 93.00 | 67.77 |
| 11 | Amritsar | Dashmeshnagar | PG 18 | 50.00 | 34.23 | 68.00 | 47.36 |
| | | Bhakna | PG 18 | 46.00 | 30.45 | 75.00 | 50.42 |
| | | | Mean | 55.51 | 40.13 | 76.70 | 53.22 |



that the disease intensity and disease incidence varied from 33.70 - 46.00 per cent and 54.30-75.00 per cent, respectively. Basallote *et al.* (1993 &1999) reported severe attack of Stemphylium blight in Southern and Central Spain. Sugha and Kumar (2005) conducted surveys of garlic at 103 localities of Himachal Pradesh (Chamba, Kangra, Mandi, Sirmour, Una, Bilaspur, Hamirpur, Kullu, Shimla and Solan) during 2003 and reported that the disease severity ranged from 37.8-65.5 per cent in Shimla and Kullu, respectively. The incidence of SLB upto 62.0 per cent was reported from Chitegaon Research farm in Nasik during November 2010 (Anonymous, 2011). Jakhar *et al.* (1994) recorded disease incidence of 5, 41.40 and 43.20 per cent from Karnal, Gurgaon and Hisar, respectively.

## Effect of different media on growth and sporulation of *Stemphylium vesicarium*

For studying the effect of different media on growth and sporulation of *S. vesicarium,* six different media *viz.,* potato dextrose agar, V8 juice agar, Richard's agar, Czapek's Dox agar, Oat meal agar and Rye agar B were used. There was significant variation in the mean radial growth and sporulation of *S.vesicarium*on different media. After ten days of incubation, Richard's agar showed maximum radial growth (67.84 mm) which was followed by Potato dextrose agar and Czapek's Dox agar with the mean radial growth of 61.21 mm and 58.03 mm, respectively. Rye agar B and Oat meal agar supported the least radial growth of 54.20 mm and 56.21 mm, respectively. The highest sporulation was recorded on Rye agar B ($9.73\times10^5$conidia/ml)

**Table 2. Effect of different media on growth and sporulation of *Stemphylium vesicarium***

| Media | Radial growth (mm) after incubation (days) | | | | | | | | | | Mean | Sporulation (conidia/ ml) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Day 8 | Day 9 | Day 10 | | |
| Potato dextrose agar | 7.12 | 10.36 | 13.76 | 23.32 | 27.66 | 35.33 | 40.06 | 51.74 | 55.05 | 61.21 | 32.56 | $2.23\times10^5$ |
| V8 juice agar | 6.92 | 13.43 | 18.33 | 26.11 | 30.05 | 34.11 | 41.33 | 46.91 | 53.23 | 59.66 | 33.08 | $9.02\times10^5$ |
| Richard's agar | 7.98 | 12.33 | 16.07 | 21.22 | 29.71 | 36.03 | 43.22 | 53.77 | 59.21 | 67.84 | 34.73 | $2.67\times10^5$ |
| Czapek's Dox agar | 8.98 | 15.53 | 22.49 | 27.11 | 31.24 | 37.54 | 41.93 | 47.37 | 52.73 | 58.03 | 34.29 | $7.02\times10^5$ |
| Oat meal agar | 8.03 | 11.38 | 17.74 | 26.96 | 34.53 | 38.14 | 42.01 | 46.98 | 50.82 | 56.21 | 33.28 | $8.78\times10^5$ |
| Rye agar B | 6.42 | 9.90 | 17.00 | 22.99 | 30.01 | 34.67 | 39.83 | 44.25 | 51.03 | 54.20 | 31.03 | $9.73\times10^5$ |

CD ( p = 0.05)
Media = 0.81
Interval = 1.05
Media x Interval = 2.57



followed by V8 juice agar ($9.02\times10^5$conidia/ml), Oat meal agar ($8.78\times10^5$conidia/ml), Czapek's Dox agar ($7.02\times10^5$conidia/ml) and Richard's agar ($2.67\times10^5$ conidia/ml) whereas, Potato dextrose agar supported the least sporulation ($2.23\times10^5$ conidia/ml). The most effective media for growth and sporulation of *S. vesic arium*was V8 juice agar media with mean radial growth and sporulation of 33.08 mm and 9.02 conidia/ml, respectively. As has been observed in the present studies, Kim *et al.* (2004) examined higher sporulation of *S. lycopersici* and *S. solani*on V8 juice agar media which was followed by potato carrot agar and potato dextrose agar media, respectively. Similar results were also obtained by Kumar (2007) reporting the best sporulation of *S. botryosum*on V8 juice potato dextrose agar media which was followed by V8 juice agar media, V8 juice agar media with 2 per cent of tamarind juice and V8 juice agar media with 4 per cent of tamarind juice, respectively. Chowdhury (2013) reported that the most suitable media for growth and sporulation of *S.vesicarium* was V-7 juice agar and potato dextrose agar mixed with V-7 juice.

## Natural screening of garlic germplasm against the disease

The mean disease severity of different garlic genotypes for two years (*rabi* 2016-17 and 2017-18) varied from 28.57-67.35 per cent. There was a significant variation in disease severity and disease reaction ranging from moderately susceptible to highly susceptible for the twenty screened garlic genotypes (Table 3). None of the genotype was included in immune, resistant and moderately resistant category. Out of twenty genotypes, six *viz.,* PG-18, PG-17, PG-116, PG-108, PG-110, PG-111 were included under 'moderately susceptible' category and the mean disease severity varied from 28.57 per cent to 40.01 per cent for two consecutive years. Similarly, nine genotypes *viz.,* PG-107, PG-101, PG-106, PG-103, PG-104, PG-112, PG-117, PG-114 and PG-113 exhibited susceptible reaction and the mean disease severity varied from 43.35 per cent to 59.36 per cent for the two consecutive years. The rest five genotypes *viz.,* PG-109, PG-105, PG-102, PG-118 and PG-115 exhibited the highly susceptible reaction and the mean disease severity varied from 61.14 per cent to 71.00 per cent for the two consecutive years (Table 2). The higher disease index in the year 2017-18 was due to the prevalence of more humid and warm conditions which were favourable for the development of the disease.

## Artificial screening of garlic germplasm against the disease

The mean disease severity for two consecutive years (*rabi* 2016-17 and 2017-18) varied from 34.41-74.05 per cent (Table 4). Out of twenty genotypes of garlic, two *viz*., PG-17 and PG-111 were moderately susceptible with 34.41 and 40.14 per cent mean disease severity for two consecutive years, respectively (Table 5). Similarly, ten genotypes of garlic *viz.,* PG-18, PG-104, PG-107, PG-108, PG-103, PG-110, PG-117, PG-114, PG-113, PG-116 exhibited susceptible reaction for SLB and the disease severity (mean) varied from 41.18-59.29 per cent for the two consecutive years (Table 5). The rest eight genotypes *viz.,* PG- 109, PG- 101, PG-106, PG-105, PG-102, PG-118, PG-112 and PG-115 exhibited the highly susceptible reaction for SLB and the disease severity (mean) varied from 62.56-75.08 per cent in both the years (Table 5).

## Comparative performance of garlic genotypes with respect to yield, average bulb weight and number of cloves under natural conditions against Stemphylium blight of garlic.

The bulb yield, average bulb weight and number of cloves of different genotypes of garlic varied from 38.23-91.41q/ha, 9.73-27.70 gm and 11.00-22.00, respectively (Table 6). There was a significant difference

**Table 3. Comparative performance of garlic genotypes against *Stemphylium vesicarium* under natural conditions during *rabi* 2017 and 2018**

| S.No | Genotypes | Disease severity (%) | | | |
|---|---|---|---|---|---|
| | | 2016-17 | 2017-18 | Mean | Reaction |
| 1 | PG-18 | 28.54 | 32.19 | 30.37 | Moderately susceptible |
| 2 | PG-17 | 26.67 | 30.47 | 28.57 | Moderately susceptible |
| 3 | PG-109 | 69.67 | 72.33 | 71.00 | Highly susceptible |
| 4 | PG-108 | 38.33 | 40.32 | 39.33 | Moderately susceptible |
| 5 | PG-107 | 51.33 | 54.67 | 53.00 | Susceptible |
| 6 | PG-101 | 53.46 | 60.45 | 56.96 | Susceptible |
| 7 | PG-106 | 58.33 | 60.38 | 59.36 | Susceptible |
| 8 | PG-105 | 57.39 | 64.89 | 61.14 | Highly susceptible |
| 9 | PG-102 | 63.36 | 71.34 | 67.35 | Highly susceptible |
| 10 | PG-103 | 54.33 | 56.67 | 55.50 | Susceptible |
| 11 | PG-104 | 42.33 | 46.74 | 44.54 | Susceptible |
| 12 | PG-110 | 36.67 | 42.33 | 39.50 | Moderately susceptible |
| 13 | PG-118 | 67.67 | 70.45 | 69.06 | Highly susceptible |
| 14 | PG-112 | 55.33 | 57.88 | 56.61 | Susceptible |
| 15 | PG-111 | 34.33 | 36.45 | 35.39 | Moderately susceptible |
| 16 | PG-117 | 41.33 | 45.36 | 43.35 | Susceptible |
| 17 | PG-114 | 45.38 | 50.78 | 48.08 | Susceptible |
| 18 | PG-113 | 44.67 | 46.45 | 45.56 | Susceptible |
| 19 | PG-115 | 60.25 | 68.56 | 64.41 | Highly susceptible |
| 20 | PG-116 | 38.33 | 40.32 | 40.01 | Moderately susceptible |
| | Mean | 48.58 | 52.61 | | |



in all the genotypes with respect to yield, average bulb weight and number of cloves. The highest yield was found in PG-18 (91.41 q/ha) followed by PG-111 (87.77 q/ha), PG-110 (73.31 q/ha), PG-17 (72.26 q/ha) whereas it was least in PG-115 (38.23 q/ha). Similarly, the maximum bulb weight was found in PG-17 (27.70 gm) followed by PG-116 (24.76 gm), PG-111 (24.17 gm) and PG-18 (23.77 gm) and it was least in PG-115 (9.73 gm). The number of cloves were observed maximum in PG-18 (22.00) followed by PG-106 (21.30), PG-17 (21.00) and PG-118 (21.00) whereas the least number of cloves were found in PG-103 (11.00).

Mishra *et al.* (2013) screened twenty one promising lines of garlic. Out of these, seven lines (G-294, G-324, G-351, G-368, G-369, G-176 and G-189) were found resistant and five (G-222,G-54, G-213, G-366 and G-264) were susceptible whereas G-266 was highly susceptible. Pandey *et al.* (1989) reported that garlic variety HG1 exhibited the lowest infection by the fungus *S.vesicarium*and the yield was highest (No. of cloves/bulb and weight of bulbs and cloves). Vyas (2000) screened 135 germplasm of onion under natural conditions and the results of this experiment revealed that 42 lines were moderately susceptible, 48 lines were moderately resistant and 21 lines were resistant. Srivastava *et al.* (2005) reported that G-1, G-305 and G-4 cultivars showed less disease incidence among 16 cultivars against the Stemphylium blight and purple blotch of garlic. G-299, G-304, G-324 and G-351 exhibited the lowest disease intensity among various

**Table 4. Reaction(s) of garlic genotypes against Stemphylium blight of garlic caused by *Stemphylium vesicarium*under natural conditions**

| Disease Reaction(s) | Genotypes |
|---|---|
| MS | PG-17, PG-18, PG-108, PG-110, GN-111 and GN-116 |
| S | PG-101, PG-104, PG-106, PG-107, PG-103, PG-112, PG-114, PG-113 and PG-117 |
| HS | PG-102, PG-105, PG-110, PG-118 and PG-115 |

**Table 5. Comparative performance of garlic genotypes against *Stemphylium vesicarium* under artificial epiphytotic conditions during *rabi* 2017 and 2018**

| S.No | Genotypes | Disease severity (%) | | | |
|---|---|---|---|---|---|
| | | 2016-17 | 2017-18 | Mean | Reaction |
| 1 | PG-18 | 39.14 | 43.23 | 41.18 | Susceptible |
| 2 | PG-17 | 31.67 | 37.15 | 34.41 | Moderately susceptible |
| 3 | PG-109 | 73.28 | 76.89 | 75.08 | Highly susceptible |
| 4 | PG-108 | 44.75 | 49.74 | 47.24 | Susceptible |
| 5 | PG-107 | 56.31 | 59.33 | 57.82 | Susceptible |
| 6 | PG-101 | 58.24 | 66.89 | 62.56 | Highly susceptible |
| 7 | PG-106 | 62.77 | 67.49 | 65.13 | Highly susceptible |
| 8 | PG-105 | 65.34 | 69.03 | 67.18 | Highly susceptible |
| 9 | PG-102 | 68.45 | 75.26 | 71.85 | Highly susceptible |
| 10 | PG-103 | 57.36 | 61.22 | 59.29 | Susceptible |
| 11 | PG-104 | 48.37 | 56.33 | 52.35 | Susceptible |
| 12 | PG-110 | 39.56 | 48.32 | 43.94 | Susceptible |
| 13 | PG-118 | 71.23 | 76.87 | 74.05 | Highly susceptible |
| 14 | PG-112 | 58.68 | 64.97 | 61.82 | Highly susceptible |
| 15 | PG-111 | 37.17 | 43.12 | 40.14 | Moderately susceptible |
| 16 | PG-117 | 47.95 | 53.33 | 50.64 | Susceptible |
| 17 | PG-114 | 52.45 | 59.37 | 55.91 | Susceptible |
| 18 | PG-113 | 49.33 | 57.85 | 53.59 | Susceptible |
| 19 | PG-115 | 67.56 | 75.37 | 71.46 | Highly susceptible |
| 20 | PG-116 | 46.17 | 49.94 | 48.05 | Susceptible |
| | Mean | 53.78 | 59.58 | | |

**Table 6. Reaction(s) of garlic genotypes against Stemphylium blight of garlic caused by *Stemphylium vesicarium* under artificial epiphytotic conditions**

| Disease Reaction(s) | Genotypes |
|---|---|
| MS | PG-17 and PG-111 |
| S | PG-18, PG-104, PG-107, PG-108, PG-103, PG-110, PG-114, PG-113, PG-116 and PG-117 |
| HS | PG-101, PG-102, PG-105, PG-106, PG-109, PG-112, PG-115 and PG-118 |

promising lines of garlic (Anonymous, 2011). Suheri and Price (2000) found that nearly 5 accessions among 26 showed good resistance even in epidemic conditions. Kumar *et al.* (2020) screened twenty four germplasms of garlic under natural conditions and it was concluded that none of the germplasm was found resistant and moderately resistant. Out of twenty four germplasms, only six were found to be moderately susceptible (MS) and the rest were remained in the susceptible category.

The present investigation concludes that SLB was prevalent/endemic to all the garlic growing areas of Punjab. Under the favorable predisposing conditions, this disease causes huge economic losses to the farmers. The recommended fungitoxicants provide only temporary relief against this disease when applied judiciously. The resistant/tolerant varieties are the alternative source for managing the stemphylium blight of garlic. In this study, PG-17 and PG-18 genotypes of garlic showed moderately susceptible reaction in comparison to other susceptible genotypes. These varieties can be used in integrated disease management program along with other useful tactics for managing this disease to the economic threshold level.

## Authors' contribution

Conceptualization and designing of the research work (AS,MS); Execution of field/lab experiments and data collection (PS); Analysis of data and interpretation ( PS); Preparation of manuscript (PS)

**Table 6. Performance of garlic genotypes against Stemphylium blight of garlic.**

| S.No | Genotype | Yield (q/ha) | Average bulb weight (gm) | No.of cloves | Reaction |
|---|---|---|---|---|---|
| 1 | PG-18 | 91.41 | 23.77 | 22.00 | Moderately susceptible |
| 2 | PG-17 | 72.26 | 27.70 | 21.00 | Moderately susceptible |
| 3 | PG-109 | 60.06 | 14.34 | 20.00 | Highly susceptible |
| 4 | PG-108 | 65.87 | 17.32 | 20.30 | Moderately susceptible |
| 5 | PG-107 | 66.44 | 22.54 | 19.10 | Susceptible |
| 6 | PG-101 | 61.83 | 19.77 | 18.92 | Susceptible |
| 7 | PG-106 | 64.80 | 22.99 | 21.30 | Susceptible |
| 8 | PG-105 | 46.92 | 12.48 | 14.60 | Highly susceptible |
| 9 | PG-102 | 45.49 | 12.84 | 12.80 | Highly susceptible |
| 10 | PG-103 | 49.23 | 14.51 | 11.00 | Susceptible |
| 11 | PG-104 | 42.16 | 13.90 | 19.64 | Susceptible |
| 12 | PG-110 | 73.31 | 21.34 | 14.30 | Moderately susceptible |
| 13 | PG-118 | 62.89 | 14.58 | 21.00 | Highly susceptible |
| 14 | PG-112 | 48.97 | 13.40 | 15.30 | Susceptible |
| 15 | PG-111 | 87.77 | 24.17 | 16.10 | Moderately susceptible |
| 16 | PG-117 | 57.08 | 20.95 | 20.36 | Susceptible |
| 17 | PG-114 | 59.89 | 22.23 | 15.93 | Susceptible |
| 18 | PG-113 | 48.09 | 15.28 | 11.81 | Susceptible |
| 19 | PG-115 | 38.23 | 9.73 | 11.37 | Highly susceptible |
| 20 | PG-116 | 62.25 | 24.76 | 18.92 | Moderately susceptible |



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