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Response of Onion (*Allium cepa* L.) Genotypes to Purple Blotch (*Alternaria porri*) Disease under Gird Region of Madhya Pradesh

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ABSTRACT: The present investigation was conducted during *rabi* 2023–24 at the Research Farm, College of Agriculture, RVSKVV, Gwalior, to evaluate thirty-five onion genotypes for their reaction to purple blotch incidence. The results revealed significant variation among the genotypes, which allowed their categorization into four distinct disease response groups. Out of thirty-five genotypes, six genotypes *viz.*, Arka Kalyan (12.80 %), 1783 (13.73 %), 1774 (17.87 %), Bhima Red (19.47 %), Bhima Kiran (20.20 %) and Bhima Shakti (20.73 %) were classified as moderately resistant. Sixteen genotypes, including 1772 (22.33 %), Bhima Light Red (23.07 %), 1773 (23.40 %), Arka Pragati (24.13 %), Bhima Super (26.13 %), W-125 (29.53 %), Bhima Safed (30.07 %), 1769 (30.67 %), GL-2 (33.13 %), N-2-4-1 (33.47 %), N-53 (36.73 %), GL-1 (37.27 %), 1771 (37.40 %), 1770 (39.60 %), Bhima Shweta (40.07 %) and W-344 (40.73 %) were grouped as moderately susceptible. Twelve genotypes such as Bhima Shubhra (43.00 %), W-355 (43.47 %), GL-3 (43.93 %), Bhima Dark Red (44.00 %), Bhima Raj (46.07 %), W-504 (46.20 %), 1768 (49.53 %), W-085 (49.60 %), W-043 (50.07 %), W-401 (50.07 %), W-361 (54.60 %) and W-500 (56.67 %) were identified as susceptible, while W-507 recorded the highest pooled incidence (63.93 %), it was placed in the highly susceptible group. Based on these findings, the study confirmed the moderately resistant genotypes identified herein represent valuable sources of tolerance that can be exploited in future breeding programmes to develop onion cultivars.

Keywords: Onion, Purple Blotch, *Alternaria porri*, screening, genotypes.

INTRODUCTION

Onion (*Allium cepa* L.), often referred to as the "queen of the kitchen," is among the oldest and most economically significant bulbous vegetable crops, cultivated extensively across the world (Havey, 2018). Its importance stems not only from its universal use as a culinary ingredient but also from its contribution to the global economy through large-scale domestic consumption and international trade. The distinct pungency of onion arises from the volatile compound allyl-propyl disulphide, which not only enriches flavor but also exhibits notable therapeutic properties (Shamyuktha *et al.*, 2020).

India is recognized as one of the leading onion-producing countries, accounting for nearly 28–30% of global production. The crop currently occupies about 1.74 million hectares, yielding more than 30.21 million metric tonnes annually, with an average productivity of 1.73 tonnes per hectare (Anonymous, 2023). Within India, Madhya Pradesh after Maharashtra represents a major onion-producing state, where cultivation extends over approximately 213.75 thousand hectares, producing nearly 5.26 million metric tonnes per year (Anonymous, 2023). Notably, in the Gird region, comprising Gwalior, Morena, Bhind, Sheopur and Shivpuri districts, serves as an important onion-growing belt during the *rabi* season. This zone is characterized by semi-arid, sub-tropical conditions, typified by extreme summer heat, cold winters, irregular precipitation and loamy to alluvial soils of moderate fertility—factors that collectively create favorable conditions for onion cultivation.

Despite its economic prominence, onion production is constrained by several challenges, ranging from abiotic stresses such as water scarcity and nutrient imbalances to severe biotic pressures. Among the latter, foliar, bulb, and root diseases are particularly damaging, often reducing both yield and post-harvest storability (Cramer, 2000). Of these, purple blotch (PLB) caused by *Alternaria porri* (Ellis) Cif., is regarded as one of the most devastating foliar diseases worldwide.

The significance of purple blotch disease lies in its profound impact on crop productivity. The pathogen infects plants during both vegetative and bulb development stages, producing necrotic lesions that restrict functional leaf area, diminish photosynthetic efficiency, and substantially reduce yield potential.

Under conducive conditions, yield losses typically range between 40–60%, though complete crop failure has been reported in both seed and bulb production systems, depending on environmental factors and disease intensity (Cramer, 2000; Karar *et al.*, 2014; Osman *et al.*, 2024).
The disease is particularly favored by warm and humid climates, where it manifests as oval to elliptical, sunken, concentric lesions on leaves and scapes that progressively enlarge and coalesce, resulting in blighting (Suheri and Price 2000a and b). Severe epidemics cause premature leaf senescence, undersized and shriveled bulbs, and poor storage quality, posing a significant threat to both farm-level profitability and the stability of onion supply chains.

MATERIAL AND METHODS

The field experiment was conducted during the *rabi* seasons of 2023–24 at the Research Farm, College of Agriculture, RVSKVV, Gwalior (Madhya Pradesh). In this study thirty-five onion genotypes were Bhima Shubhra, Bhima Red, Bhima Raj, Bhima Shweta, Bhima Shakti, Bhima Super, Bhima Kiran, Bhima Safed, Bhima Dark Red, Bhima Light Red, Arka Pragati, Arka Kalyan, N – 53, N – 2-4-1, 1768, 1769, 1770, 1771, 1772, 1773, 1774, 1783, W-043, W-085, W-125, W-344, W-355, W-361, W-401, W-500, W-504, W-507, GL – 1, GL – 2 and GL – 3 Selected. Forty-five-day-old healthy and uniform onion seedlings, each having three to four true leaves, were selected for transplanting. Crop was transplanted on first week of November 2023-24 with plot size of 2.0 X 1.5 m and replicated three times with spacing of 15 cm between rows and 10 cm between plants. Five plants were selected randomly in each plot for observations.

Incidence of diseases

The observation on disease incidence will be recorded using 0-5 scale (Table 1) at seven days intervals (when the disease development is at maximum extent).

Table 1: Scale adopted for scoring of purple blotch diseases in onion.

Score	Disease Symptom
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 up to 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 the center.

Source rating scale, as per Sharam *et al.* (1986).

Percentage disease index (PDI) will be calculated by using the formula given by (Wheeler, 1969).

$$\text{PDI} = \frac{\text{Total sum of numerical rating}}{\text{Number of observations}} \times \frac{100}{\text{Maximum disease rating}}$$

The genotypes were graded as per rating scale followed by Sharma *et al.* (1986). The level of resistance and/or susceptibility of each line was determined by using 0-5 rating scale (Table 2).

Table 2: 0-5 scale adapted to indicate degree of resistance against diseases of onion.

Score	PDI (%)	Category	Disease Reaction
0	< 5 %	0	Immune or Free (F)
1	5 -10	I	Resistant (R)
2	10-20	II	Moderately resistant (MR)
3	21-40	III	Moderately susceptible (MS)
4	41-60	IV	Susceptible (S)
5	>61	V	Highly Susceptible (HS)

RESULT AND DISCUSSION

The evaluation of thirty-five onion genotypes for their reaction to purple blotch disease revealed considerable variation, enable their classification into different categories. None of the genotype was found in immune and resistant categories, six genotypes were found in moderately resistant category with disease incidence ranging from 12.80 to 20.73%. Sixteen genotypes were grouped as moderately susceptible, showed disease incidence between 22.33 and 40.73%. Twelve genotypes fell into the susceptible category, with incidence ranging from 43.00 to 56.67%, while only one genotype was classified as highly susceptible with disease incidence above 60% (Table 3 and 4).
Genotypes Arka Kalyan (12.80 %), 1783 (13.73 %), 1774 (17.87 %), Bhima Red (19.47 %), Bhima Kiran (20.20 %) and Bhima Shakti (20.73 %) consistently recorded the lowest incidence (Table 3). These findings are in line with Shilpakumari *et al.* (2011), who identified several genotypes within the moderately resistant range (11–20 %), and with Kavitha *et al.* (2017), who also categorized Arka Kalyan as moderately resistant. Bal *et al.* (2019a) placed Bhima Red and Bhima Shakti in this group, while Muthaiah *et al.* (2021) reported Bhima Red (14.67) as moderately resistant.
Sixteen genotypes, including 1772 (22.33 %), Bhima Light Red (23.07 %), 1773 (23.40 %), Arka Pragati (24.13 %), Bhima Super (26.13 %), W-125 (29.53 %), Bhima Safed (30.07 %), 1769 (30.67 %), GL-2 (33.13 %), N-2-4-1 (33.47 %), N-53 (36.73 %), GL-1 (37.27 %), 1771 (37.40 %), 1770 (39.60 %), Bhima Shweta (40.07 %) and W-344 (40.73 %) were classified as moderately susceptible (Table 3). These results correspond with Shilpakumari *et al.* (2011), who reported 132 genotypes in this category (21–40 %). Kavitha *et al.* (2017) also reported Arka Pragati as moderately susceptible, corroborated the present findings. Bal *et al.* (2019a) identified 10 genotypes in this group, further validated this classification.
Twelve genotypes fell into the susceptible group, with purple blotch incidence values from 43.00 to 56.67 %. Genotypes Bhima Shubhra (43.00 %), W-355 (43.47 %), GL-3 (43.93 %), Bhima Dark Red (44.00 %), Bhima Raj (46.07 %), W-504 (46.20 %), 1768 (49.53 %), W-085 (49.60 %), W-043 (50.07 %), W-401 (50.07 %), W-361 (54.60 %) and W-500 (56.67 %) were categorized as susceptible (Table 3).

Table 3: Screening of different genotypes of onion against purple blotch disease.

Genotypes		Mean and PDI (%)	Category	Reaction
G1	Bhima Shubhra	2.15(43.00)	IV	S
G2	Bhima Red	0.97(19.47)	II	MR
G3	Bhima Raj	2.30(46.07)	IV	S
G4	Bhima Shweta	2.00(40.07)	III	MS
G5	Bhima Shakti	1.04(20.73)	II	MR
G6	Bhima Super	1.31(26.13)	III	MS
G7	Bhima Kiran	1.01(20.20)	II	MR
G8	Bhima Safed	1.50(30.07)	III	MS
G9	Bhima Dark Red	2.20(44.00)	IV	S
G10	Bhima Light Red	1.15(23.07)	III	MS
G11	Arka Pragati	1.21(24.13)	III	MS
G12	Arka Kalyan	0.64(12.80)	II	MR
G13	N – 53	1.84(36.73)	III	MS
G14	N – 2-4-1	1.67(33.47)	III	MS
G15	1768	2.48(49.53)	IV	S
G16	1769	1.53(30.67)	III	MS
G17	1770	1.98(39.60)	III	MS
G18	1771	1.87(37.40)	III	MS
G19	1772	1.12(22.33)	III	MS
G20	1773	1.17(23.40)	III	MS
G21	1774	0.89(17.87)	II	MR
G22	1783	0.69(13.73)	II	MR
G23	W-043	2.50(50.07)	IV	S
G24	W-085	2.48(49.60)	IV	S
G25	W-125	1.48(29.53)	III	MS
G26	W-344	2.04(40.73)	III	MS
G27	W-355	2.17(43.47)	IV	S
G28	W-361	2.73(54.60)	IV	S
G29	W-401	2.50(50.07)	IV	S
G30	W-500	2.83(56.67)	IV	S
G31	W-504	2.31(46.20)	IV	S
G32	W-507	3.20(63.93)	V	HS
G33	GL – 1	1.86(37.27)	III	MS
G34	GL – 2	1.66(33.13)	III	MS
G35	GL – 3	2.20(43.93)	IV	S
S. Em(+)		1.22		
CD (5%)		3.49		

Table 4: Grouping of different genotypes against purple blotch disease response.

Disease Reaction	No. of genotypes	Genotypes
Immune	0	-
Resistance	0	-
Moderate Resistance	6	Arka Kalyan, 1783, 1774, Bhima Red, Bhima Kiran and Bhima Shakti
Moderate Susceptible	16	1772, Bhima Light Red, 1773, Arka Pragati, Bhima Super, W-125, Bhima Safed, 1769, GL – 2, N – 2-4-1, N – 53, GL – 1, 1771, 1770, Bhima Shweta and W-344
Susceptible	12	Bhima Shubhra, W-355, GL – 3, Bhima Raj, Bhima Dark Red, Bhima Raj, W-504, 1768, W-085, W-401, W-043, W-361, W-500
Highly Susceptible	1	W-507

Kavitha *et al.* (2017) categorized Arka Niketan, Arka Bhima, and Bhima Super as susceptible, while Bal *et al.* (2019a) reported Bhima Raj and Bhima Dark Red in the same group. Chauhan *et al.* (2023) also recorded 20 susceptible genotypes with disease severity up to 70 %.

Genotype W-507 was identified as highly susceptible, with incidence values of 63.93 % (Table 3). This observation is consistent with Shilpakumari *et al.* (2011), who reported 54 genotypes in the highly susceptible group (>61 percent). Muthaiah *et al.* (2021) documented four genotypes with severity levels up to 80 %, while Chauhan *et al.* (2023) reported 10 highly susceptible genotypes exceeding 70 % severity.

The variation in disease incidence across genotypes may be attributed to differences in genetic makeup, biochemical defence mechanisms and environmental influences. Muthaiah *et al.* (2021) emphasized that none of the genotypes screened were immune, with resistance being only partial in nature. Environmental conditions also play a crucial role in disease expression: Sonawane *et al*. (2022) and Anjali *et al.* (2023) noted seasonal fluctuations, while Osman *et al*. (2024) reported greater severity under rainy conditions compared with irrigated environments.

CONCLUSIONS

The study revealed important variation among onion genotypes in their response to purple blotch disease caused by *Alternaria porri*. A subset of genotypes, namely Arka Kalyan (12.80 %), 1783 (13.73 %), 1774 (17.87 %), Bhima Red (19.47 %), Bhima Kiran (20.20 %) and Bhima Shakti (20.73 %) stood out by showing the lowest levels of disease incidence. Conversely, genotypes such as W-507 (63.93 %) registered as the highest disease incidence.

FUTURE SCOPE

Moderately resistant onion genotypes identified in this study serve as important sources of resistance for future breeding programs. Their strategic use can lead to the development of improved varieties that combine resistance with higher productivity and longer storage life, particularly for regions prone to heavy pest and disease incidence. For farmers, the adoption of these varieties can help reduce yield losses, minimize dependence on chemical control, and ensure more sustainable onion production under local field conditions.

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Conflict to Interest. None

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