



E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(6): 546-548
Received: 10-09-2019
Accepted: 12-10-2019

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Screening of onion (*Allium cepa* L.) germplasm against purple blotch disease

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Abstract

Purple blotch disease, caused by *Alternaria porri* is the most common devastating disease of onion under field conditions throughout the globe. In the present study, 23 genotypes of onion were screened against purple blotch disease where none of the genotypes were found to be immune. Based on the results, the genotypes were grouped into five categories. Five genotypes viz., Akola Safed, Arka Niketan, Punjab Naroya, Arka Lalima, Arka Kirtiman exhibited resistance to this disease. Eight genotypes viz., Bhima Subhra, Arka Bheem, PRO-6, Bhima Raj, Kalyanpur Red Round, L-28, Bhima Dark Red, Bhima Shakti were found to be moderately resistant with 11-20% leaf area infected. A total of ten genotypes were grouped under moderate susceptible category (21-40% leaf area infected). The identified resistant genotypes can further be used for commercial cultivation or may be used as parents in future onion improvement programmes.

Keywords: Onion, *Allium cepa* L., germplasm, purple blotch disease

Introduction

Onion (*Allium cepa* L.), a member of Alliaceae family, is a crop of global importance for its health-protective, nutritive and medicinal value. It is known as “Queen of Kitchen” as it is commonly used cooking item by all the community of people (Mandloi 2017) [5]. Allyl-propyl-di-sulphide which is the chief ingredient for pungency in onion bulbs has got anticarcinogenic property, besides which, it has antibacterial, antifungal, antihelminthic, anti-inflammatory, antiseptic, antispasmodic properties. In addition, antioxidant compounds such as quercetin have been reported to be present in onion (Baghizadeh *et al.*, 2009) [2]. Onion, is an export oriented crop in which, out of total export, 50% of the earning comes from *Rabi* onion followed by 30% and 20% from late-*kharif* and *kharif* onions respectively (Mandloi 2017) [5]. *Kharif* onion has got poor productivity due to constant drizzling and cloudy weather which leads to occurrence of downy mildew and basal rot diseases (Kale and Ajjappalavara, 2014) [4]. On the other hand, severity of purple blotch (caused by *Alternaria porri*) and *Stemphylium* blight (caused by *Stemphylium vesicarium*) disease shuts down the productivity during *Rabi* season. Nolla (1927) [7] was first to name this disease as “Purple blotch”. Initially, he named the causal organism as *Alternaria alli* and later changed it to *Alternaria porri*. Ponnappa (1970) [9] was the first person to observe purple blotch disease in Karnataka and the pathogen was then named as *Alternaria cepulae* (Ravichandran *et al.*, 2017) [10]. Under congenial environment, the disease appears as brown-black spots on leaves. Two to four weeks after initial infection, small sunken purple-coloured centric lesions appear on leaves. As a result of progressive infection, the leaves start drooping downwards. Sometimes the seed stalks are also girdled. With the advancement of the disease, the infection starts spreading towards the bulb which results in decay. Keeping in view the tendency of pathogen of developing resistance towards many fungicides, the greater cost of cultivation and environmental concerns of chemical management of this devastating pathogen, the most reliable way one can opt is to search for immunity or resistance from among the already existing open pollinated varieties or hybridsto bring them directly in cultivation or to exploit them as parent through an improvement programme. In spite of the wide prevalence of a couple of named varieties/hybrids, very little information has so far been generated in this agroclimatic region especially on purple blotch resistance. Hence, the present investigation was carried out to evaluate the available onion germplasm against purple blotch disease.

Materials and Methods

The experiment was laid out with three replications in a Randomized Block Design and was conducted at ‘C’ Block farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West

Bengal during *Rabi* season of 2017-18 and 2018-19 with twenty three onion genotypes (Table 1) which included twenty open-pollinated varieties, two hybrid varieties and one local variety as a standard check. Seven weeks old seedlings were transplanted to the main field at an optimum spacing of 15cm row to row and 10cm plant to plant with plot size of 2m × 1m accommodating 133 plants. The disease scoring was done at 90 days after transplanting. The disease scoring of each genotype was recorded by observing all the plants following 0-5 scale of Bhangale and Joi (1985) [3] as follows-

Grades	Reactions	Per cent leaf area covered
0	Immune	No disease
1	Resistant	Up to 10%
2	Moderately resistant	11-20%
3	Moderately susceptible	21-40%
4	Susceptible	41-60%
5	Highly susceptible	More than 60%

Disease severity index (%) was calculated by using the formula given by McKinney (1923) [6]:

$$\text{Disease severity index (\%)} = \frac{\text{Sum of all disease ratings}}{\text{Total number of rating} \times \text{maximum disease grade}} \times 100$$

Table 1: List of genotypes used in the current study along with their sources

Sl. No.	Name of the genotype	Sources
1	Arka Bheem	ICAR-IIHR, Bangalore
2	Arka Kirtiman	ICAR-IIHR, Bangalore
3	Arka Lalima	ICAR-IIHR, Bangalore
4	Arka Niketan	ICAR-IIHR, Bangalore
5	Akola Safed	PDKV, Akola, Maharashtra
6	Agrifound Light Red	NHRDF, Nasik, Maharashtra
7	Bhima Dark Red	DOGR, Rajgurunagar
8	Bhima Kiran	DOGR, Rajgurunagar
9	Bhima Raj	DOGR, Rajgurunagar
10	Bhima Red	DOGR, Rajgurunagar
11	Bhima Safed	DOGR, Rajgurunagar
12	Bhima Shakti	DOGR, Rajgurunagar
13	Bhima Subhra	DOGR, Rajgurunagar
14	Bhima Super	DOGR, Rajgurunagar
15	Bhima Sweta	DOGR, Rajgurunagar
16	Hisar-2	HAU, Hisar
17	Hisar-4	HAU, Hisar
18	Kalyanpur Red Round	CSAUAT, Kanpur
19	L-28	NHRDF, Nasik, Maharashtra
20	Onion HO-3	HAU, Hisar
21	PRO-6	PAU, Ludhiana, Punjab
22	Punjab Naroya	PAU, Ludhiana, Punjab
23	Sukhsagar	Local market

Results and Discussion

For development of any disease, favourable environment, pathogen load, stage of crop growth and duration of infection play a pivotal role (Pal *et al.*, 2017) [8]. Under field conditions, to identify the resistance against purple blotch in onion efforts have been made by evaluating 23 genotypes, where none of the genotypes were found to be immune. There were significant differences among all the genotypes for severity of purple blotch disease. The results indicated that five genotypes *viz.*, Punjab Naroya (1.23%), Arka Lalima (1.23%), Arka Kirtiman (1.23%), Arka Niketan (2.46%), Akola Safed (4.93%) exhibited resistance to this disease. A total of eight genotypes *viz.*, Bhima Shakti (11.11%), Bhima Dark Red (12.34%), L-28 (13.57%), Kalyanpur Red Round (13.57%),

Bhima Raj (14.81%), PRO-6 (16.04%), Arka Bheem (16.04%), Bhima Subhra (17.28%), were found to be moderately resistant and the remaining ten genotypes *viz.*, Bhima Safed (22.14%), Bhima Red (22.22%), Bhima Kiran (23.32%), Hisar-4 (23.45%), Sukhsagar (24.55%), HO-3 (24.55%), Hisar-2 (24.68%), Agrifound Light Red (25.92%), Bhima Super (26.89%), Bhima Sweta (28.49%) were moderately susceptible to this disease. The minimum severity of the disease was observed in Punjab Naroya (1.23%), Arka Lalima (1.23%), Arka Kirtiman (1.23%). The maximum severity was observed in Bhima Sweta (28.49%) which was statistically at par with Bhima Super (26.89%), Agrifound Light Red (25.92%), Hisar-2 (24.68%). The highly susceptible genotypes can be utilized as check for future breeding programme. Genotypes rich in vitamin C, pyruvic acid and high phenol are desirable. These compounds hinder the infection development and further development of the pathogen. In addition, vitamin C and Pyruvic acid serves as an antioxidant and pungency principles in onion respectively. Abubakar *et al.* (2008) [11] screened five open pollinated onion cultivars against *Alternaria porri* and reported that the cultivars Koumarsa, Kaharda and Red Creole had lower disease incidence. Out of 8 genotypes evaluated by Sachin and Sharma (2007) [11], only one genotype-409 showed minimum disease severity. Among 310 onion accessions screened by Shilpa kumari *et al.* (2012) [12] against purple blotch disease; none of them were found resistant or immune, while four genotypes *viz.*, Arka Kalyan (AK)-171, AK-172, Ak-173 and MSPBR-120 were found moderately resistant with grade scale of 2, where the per cent of leaf area infection ranged from 11 to 20 per cent.

Table 2: Genotypes and their response to Purple blotch disease

Sl. No.	Genotypes	PDI (%)*	Disease grade	Category of resistance
1.	Bhima Sweta	28.49(32.33)	3	MS
2	Hisar 4	23.45(28.94)	3	MS
3	Punjab Naroya	1.23(3.70)	1	R
4	Bhima Dark Red	12.34(20.52)	2	MR
5	PRO-6	16.04(23.58)	2	MR
6	Bhima Super	26.89(31.21)	3	MS
7	Arka Lalima	1.23(3.70)	1	R
8	Bhima Safed	22.14(28.06)	3	MS
9	L-28	13.57(21.47)	2	MR
10	HO-3	24.55(29.68)	3	MS
11	Akola Safed	4.93(12.66)	1	R
12	Agrifound Light Red	25.92(30.56)	3	MS
13	Bhima Subhra	17.28(24.53)	2	MR
14	Arka Bheem	16.04(23.47)	2	MR
15	Kalyanpur Red Round	13.57(21.57)	2	MR
16	Bhima Raj	14.81(22.63)	2	MR
17	Bhima Shakti	11.11(19.46)	2	MR
18	Hisar 2	24.68(29.77)	3	MS
19	Arka Kirtiman	1.23(3.70)	1	R
20	Arka Niketan	2.46(7.39)	1	R
21	Bhima Red	22.22(28.11)	3	MS
22	Bhima Kiran	23.32(28.85)	3	MS
23	Sukhsagar	24.55(29.68)	3	MS
Overall mean		16.18 (21.98)		
SE(m)±		1.83		
CD (0.05)		5.23		

R-resistant, MR-moderately resistant, MS-moderately susceptible; *Figures in the parentheses are square root transformed.

Conclusion

Based on the findings of this present experiment, the genotypes namely Punjab Naroya, Arka Lalima, Arka Kirtiman, Arka Niketan, Akola Safed can further be deployed for commercial cultivation or may be used as parent in onion improvement programmes aimed at developing purple blotch resistant varieties.

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