

Screening of germplasm for disease resistance against anthracnose of chilli caused by *Colletotrichum capsici*

Abstract

~~chili~~Chilli (*Capsicum annum* Linn.) is an important extensively grown spice crop. It belongs to the family Solanaceae. Approximately 20-27 species of ~~chili~~chilli are found, ~~out~~ of which five are domesticated viz., *C. annum*, *C. baccatum*, *C. chinense*, *C. frutescens*, and *C. pubescens* in different parts of the world. Chilli ~~crops suffer~~ ~~crop suffers~~ from various diseases, ~~of~~ in which anthracnose caused by *Colletotrichum capsici* is a very serious ~~disease~~ ~~one that~~, causes huge yield losses in India. Severely infected fruits ~~appear straw coloured~~ ~~look straw colour~~ and bear numerous acervuli in concentric rings. ~~At approximately 27 °C~~ ~~Around 27°C temperature~~, 80% relative humidity and soil pH 5-6 promote infection and disease ~~progression~~ ~~progress~~. The average disease incidence level ranges between 66 and 84% which results in yield loss up to 12-50%. This investigation was carried out at the Main Experiment Station Vegetable Science and Department of Plant Pathology, Acharya Narendra Deva University of Agriculture & Technology Kumarganj, Ayodhya (U.P) during the year 2021 -2022. Twenty genotypes of chilli were screened and none one genotypes are found resistant, nine genotypes namely, Mahycojalna, Arkalohit, Phulemukta, Arkaharita, Madhurima, Classica 152, Arkameghna, Sonakshi 44 and Divyajyoti were found moderately resistant and rest of the genotype were susceptible and highly susceptible.

Keywords-chilli, anthracnose, Screening, Resistance, Susceptible

Introduction

Chilli (*Capsicum annum* Linn.) is an important extensively grown spice crop. It belongs to the family Solanaceae. It occupies an important place in ~~the~~ daily diet and ~~is~~ used as a ~~principal~~ ~~principle~~ ingredient in various curries and dishes. Chilli fruits are also used for making pickles, sauces, ~~and~~ ~~essences~~ ~~sketchup~~ ~~essence~~, and oleoresins. Chilli is a good source of Capsaicin, Vitamin A, Vitamin C,

Riboflavin and Thiamine. It contains approximately about 8.8g carbohydrates, 5.3g sugar, 1.9g protein, and 534 micro-mg beta carotene/100g of chili. The alkaloid capsaicin, which has medicinal properties, is also extracted from chili. Approximately 20-27 species of chili, five of which are domesticated, viz., *C. annuum*, *C. baccatum*, *C. chinense*, *C. frutescens*, and *C. pubescens* in different parts of the world. Among these, *C. annuum* is one of the most commonly cultivated species worldwide, followed by *C. frutescens* (Bosland and Votava, 2003). In India, the total area under chili cultivation is 377 thousand ha with production of 3783 thousand mt during 2019-20 (Anonymous, 2019-20). The major growing states are Andhra Pradesh, Karnataka, Maharashtra, Orissa, Tamil Nadu, Madhya Pradesh, West Bengal, and Rajasthan, that accounting for more than 80% of the total area and production. It can grow well in warm and humid climate, with an optimum temperature of 20–25 °C. Sandy loam, clay loam and loamy soils are best suited for its cultivation. It comprises numerous chemicals, including steam-volatile oils, fatty oils, capsaicinoids, carotenoids, vitamins, proteins, fibres and mineral elements (Bosland and Votava, 2003). Chili constituents are important for their nutritional value, flavour, aroma, texture, and colour. Fresh green chili contains more vitamin C than citrus fruits, and fresh red chili has more vitamin A than carrots (Osuna-Garcia et al., 1998; Marin et al., 2004).

This crop suffers from many diseases caused by fungi, bacteria, viruses, and nematodes, as well as abiotic stresses. Among the fungal diseases, damping-off (*Pythium aphanidermatum*), powdery mildew (*Leveillulataurica*), anthracnose of fruit rot (*Colletotrichum capsici*), and Cercospora leaf spot (*Cercosporacapsici*) are the major diseases. Of these fungal diseases, anthracnose/dieback/fruit rot caused by *Colletotrichum capsici* is a major obstacle to successful chili cultivation. Typical anthracnose symptoms on fruits include sunken necrotic tissues with concentric rings of acervuli. Fruits with showing blemishes have reduced marketability (Manandhar et al., 1995). During the die-back stage of the disease, the growing tip shows the start of infection as sunken lesions leading to death of the growing tip, and finally the infection proceeds backward on the branch. Severely infected fruits look straw colour and bear numerous acervuli in concentric rings. Around 27°C temperature, 80% relative humidity and soil pH 5-6 promote infection and disease progress. The disease has been observed to occur in

three phases viz., (i) seedling blight or damping offstage, prevalent in the nursery,(ii)leaf spottinganddiebackstagewhichisinitiatedatdifferentstagesofgrowth and

(iii)Fruitfruitrotstageinwhich:theripefruitisareinfected.Theaveragediseaseincidencelevel

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~~ranged~~ between 66 and 84% which ~~resulted~~ in a yield loss of upto 12-50% (Thind and Jhooty, 1985). ~~Extracted~~ capsaicin is used in pain balms, cosmetics, and medicines related to heart ~~disease~~. Oleoresin can also be obtained from ~~chilli~~ and is extensively used in western countries in food preparations, beverage industries, cosmetics, and as medicine for ~~the~~ treatment of inflammation. Chilli also ~~stimulate~~ saliva and gastric juices and ~~aid~~ indigestion. It is used as a counter irritant in prickly ~~heated~~ powders, skin ~~ointments~~, cosmetics, and pain balms. Chilli extracts are used in a wide range of medicines ~~to treat~~ tonsillitis, diphtheria, loss of ~~appetite~~, ~~intermittent~~ fever, rheumatism, sore throat, swelling, and hardened tumours. Twenty genotypes of ~~chilli~~ were screened; for ~~varies/genotypes~~. It is one of the most economically important ~~diseases~~, reducing marketable yields from 10 to 80 per cent in ~~some~~ developing countries (Poonpolgul and Kumphai, 2007). ~~This~~ is a major problem ~~for~~ matured fruits, causing severe losses due to both pre- and ~~post-harvest fruit~~ decay (Bosland Hadden and Black, 1989; Bosland and Votava, 2003).

Materials and methods

A total of ~~20~~ germplasm lines of ~~chilli~~ obtained from ~~the~~ MES Vegetable farm of ANDUAT, Kumarganj, Ayodhya, and some ~~were~~ purchased from a local market and collected during ~~the survey, and~~ were screened against anthracnose disease under natural epiphytotic ~~condition~~ in the field at MES Vegetable Science of University, ANDUAT during Rabi 2021, with ~~the objective of identifying the~~ source or sources of resistance.

Table 1. List of chilli germplasm used for screening

No. of Germplasm	Germplasm
20	Tejas, Jwala, LCA312, Agnirekha, Pant C1, PBN-7, BSS-141, Pant C-2, Mahycojalna, Pusajyoti, Arkalohit, Phulemukta, Arkaharita, Madhurima, Classica152, Arkameghna, Sonakshi44, EC-341075, LAC-434, Divyajyoti



Fig1: Effect of anthracnose at different disease severity.



Fig2: Symptoms of anthracnose at experimental field.

Plotscreening

~~Plots~~The plots showing over 90 percent anthracnose incidence in susceptible cultivars 'Jwala' of ~~chili~~chilli were used ~~to screen~~for screening the test varieties. ~~The chili~~Chilli genotypes ~~genotype, which were~~ screened in this experiment, ~~are shown~~have been given in (Table1).

Table 2: Disease resistance scale ~~for~~of *Coletotrichum capsici* given by Mayee and Datar (1986), 1986.

Scale	Reaction	Disease intensity
0	Immune	0.0%
1	Resistant	<1%
3	Moderately Resistant	1-10%
5	Moderately Susceptible	11-25%
7	Susceptible	26-50%
9	Highly Susceptible	More than 51%

Result and Discussion

Screening of varieties/germplasm of chilli for disease resistance

To identify the source of resistance a total of twenty chilli varieties were screened against *C. capsici* under natural condition as explained in 'material and methods' and the results are presented in table 3. ~~results~~Result revealed that all ~~the 20~~twenty chilli varieties exhibited different ~~responses~~reaction to ~~against~~*C. capsici*. However, Nine test entries *viz*, Mahycojalna, Pusajyoti, Arkalohit, Phulemukta, Arkaharita, Madhurima, Arkameghna, Sonakshi 44 and Divyajyoti were found moderately resistant with mean anthracnose intensity in the range of 08.65% to 10.00% while three test entries *viz*, EC- 341075, LAC-434 and Classica 152 were found moderately susceptible with mean anthracnose intensity in the range of 12.00% to 16.55% whereas, seven test entries *viz*, Tejas, LCA312, Agnirekha, PantC-1, PBN-7, BSS-141 and Pant C-2 were found susceptible with mean anthracnose intensity in the range of 26.53% to 33.35%, whereas, one test entry that is Jwala were found highly susceptible with mean anthracnose intensity of 51.25%. Among the ~~20~~twenty test entries, none ~~were of the~~

~~entry was found resistant or resistant or~~ immune to the disease. Several researchers have studied and screened various genotypes, but none have found a completely resistant or immune variety against *Colletotrichum capsici* of ~~chilli~~ chilli. Setiawati *et al.* (2008) reported only two moderately resistant ~~varieties~~ variety (Tanjung -2 and Lembang 1) ~~for against~~ anthracnose. Gupta *et al.* (2018) observed that varieties Arka Harita, Classica-152 and Madhurima -148 were showing resistance reaction under two drop of conidial suspension after injury the fruit, while EC- 341075, Pusa Jwala, Pant C-1, Arka Meghna, LAC-434 and Sonakshi-44 were shown moderately resistance reaction as compared to rest of varieties after five, seven and ten days of inoculation. Begam *et al.* (2015) evaluated 47 chilli genotype out of which two hybrids and nine open pollinated varieties fall under resistant categories; 25 hybrids and 10 open pollinated varieties as moderately resistant and one pollinated varieties as to be

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susceptible, and none of the tested test genotypes genotype was immune to anthracnose.

Table 3: Screening of germplasm lines for against *Colletotrichum capsici*.

Genotypes	Average PDI	Reaction type
Jwala	51.25	HS
Tejas	30.20	S
LCA312	28.40	S
Agnirekha	26.53	S
Pant C1	32.00	S
PBN-7	31.24	S
BSS-141	32.56	S
PantC-2	33.35	S
Mahycojalna	09.50	MR
Pusajyoti	10.56	MS
Arkalohit	08.65	MR
Phulemukta	10.00	MR
Arkaharita	09.55	MR
Madhurima	08.50	MR
Classica 152	12.00	MR
Arkameghna	10.00	MR
Sonakshi44	09.53	MR
EC-341075	15.22	MS
LAC-434	16.55	MS
Divyajyoti	09.56	MR

HS=Highly susceptible, S=Susceptible, MR=Moderately Resistant,

Table 4: Reaction type and PDI range of various chilli germplasm against *C. capsici*

S.No	Reaction type	PDI range (%)	Genotype/ Varieties
0	Immune	0.0	-
1	Resistance	0.0-1.0	-
3	Moderately	01-10	Mahycojalna, Pusajyoti,

	Resistant		Arkalohit,Phulemukta, Arkaharita, Madhurima,Arkameghna,Sonakshi44, Divyajyoti
5	Moderately susceptible	11-25	Ec-341075,LAC-434,Classica152
7	Susceptible	26.00-50.00	Tejas,LCA312,Agnirekha,PantC1, PBN-7,BSS-141,PantC-2
9	Highly susceptible	Morethan51	Jwala

Conclusion:

Twenty ~~chili genotypes~~ ~~genotypes of chilli~~ were screened ~~for against the~~ anthracnose disease. During the screening none of the genotypes were found resistant whereas **nine** genotypes viz Mahycojalna, Pusajyoti, Arkalohit,Phulemukta,Arkaharita,Madhurima, Arkameghna,Sonakshi44, andDivyajyotiwere moderately resistant ; **three** genotypes viz, EC-341075, LAC-434, and Classica 152 were moderately susceptible; **seven** viz, Tejas, LCA 312, Agnirekha, Pant C1, PBN-7, BSS-141, Pant C-2 were susceptible and **onlyone** genotype namely jwala was highly susceptible.

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