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Resistance to Anthracnose Disease in Commercial Cultivars and Advanced Hybrids of Mango

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ABSTRACT
Mango (*Mangifera indica* L.) production is drastically reduced by *Colletotrichum gleosporoides*, is one of the most damaging pathogen causing mango anthracnose. In order to find sources of resistance to this disease, forty mango cultivars were screened under natural epiphytotic conditions in horticulture research centre at Pantnagar for the last two years (viz., 2013 and 2014). Grouping of cultivars for disease intensity, infection rate and AUDPC showed that 5% cultivars were resistant, 30% moderately resistant, 22.5% moderately susceptible and remaining 42.5% susceptible to highly susceptible. Nariayal and Chenna Swarnarekha exhibited the minimum infection rate (0.018, 0.036) and AUDPC (427.98, 476.75) resulting in 16.67 and 19.17% disease intensity. Nine were moderately susceptible while rest of the cultivars were either susceptible or highly susceptible. Bada Malda cultivar showed the highest AUDPC (3294.14%) and the maximum percent disease intensity (92.34%). Other cultivars, however, exhibited intermediate range of infection rate and AUDPC. The disease progress curves clearly depicted the levels of disease in each cultivars during the observational periods. These resistant to moderately resistant mango cultivars can be used in breeding programme for developing varieties adapted to the region against anthracnose blight.

Key words: Mango anthracnose, AUDPC, infection rate, disease reaction

INTRODUCTION

Mango (*Mangifera indica* L.) an important fruit crop of subtropical countries and its production is drastically reduced by *Colletotrichum gleosporoides*, is one of the most damaging pathogen causing mango anthracnose. It was first reported in India in 1933 by Stevens and Pierece (1933). Since then, it has also been reported from several countries in Puerto Rica (Collins, 1903), Hawaie (Higgins, 1906), Florida (Fawcett, 1907), Cuba (Cardin, 1910), Phillipines (Wester, 1911), Columbia (Taro, 1929), South Africa (Doidge, 1932), Brazil (Bitancounrt, 1938), United States (Traub and Robinson,1938) and Pakistan (Sattar and Malik,1939), which caused a significant impediment in increasing mango production in these countries, In India, it is a widely distributed in entire mango growing states of India causing huge economic loss. It attacks leaves, twigs, inflorescence and fruit. It is recognised as most important field and post harvest disease as to cause economic loss to a tune of 15-39% (Dodd *et al*., 1997; Ploetz and Prakash, 1997; Prabakar *et al*., 2005; Prakash, 1996). It directly effects marketable fruit rendering it worthless. During storage, important losses as high as 47.9% in July and 51.7% in August, were reported by Prabakar *et al*. (2005). This phase is directly linked to the field phase where initial infections usually starts on the young twigs, leaves and later spreads to the flowers causing blossom blight, destroys the inflorescence and finally prevent fruit set. The field phase is directly linked to the post harvest phase and considered as the most damaging and economically significant phase of the disease worldwide. The disease is spread with in the tree canopies as water borne conidia during the rainfall and is particularly severe on young leaves (Fitzell and Peak, 1984). It is enormous loss in terms of quality and quantity. Control of these diseases through chemicals is quite expensive, needs extra labour and also not ecofriendly. To date, there is no satisfactory chemicals that can completely check this disease in the field. In the absence of

any efficient protection measure, breeding for resistance has become the mainstay to combat the anthracnose menace. Developing a variety resistant to disease provide an easy, cheaper, stable and effective means of disease control. Therefore, the efforts were made to identify sources of stable and multiple disease resistance.

MATERIALS AND METHODS

Forty mango cultivars in randomized block design with three replications were screened against the anthracnose disease under natural epiphytotic conditions at the Horticulture Research Centre (HRC), Pattarchatta, G.B. Pant University of Agriculture and Technology, Pantnagar, for two consecutive years during 2013 and 2014. Observations on percent disease intensity were recorded for each replicate separately at ten days interval starting from first week of march till harvest. The disease reaction was recorded according to Sundravadana *et al*. (2007) and Akhtar and Alam (2002) with slight modifications on 0-5 rating scale based on leaf area covered where, 0 denotes no spots on leaves per shoot per tree and 5, more than 25 spots on leaves per shoot per tree. Percent disease intensity was worked out according to McKinney (1923) and cultivars were classified in immune (0%), resistant (1-20%), moderately resistant (21-40%), moderately susceptible (41-60%), susceptible (61-80%) and highly susceptible (>80%) categories (5). Further, apparent infection rate (unit/day) an area under disease curve (AUDPC) values for each cultivars were worked out by following the method described by Van der Plank (1963) and Shaner and Finney (1977), respectively.

RESULTS AND DISCUSSIONS

Anthracnose disease intensity ranged from 16.27- 92.34%, infection rate from 0.108-0.142 unit/day and AUDPC from 488.57-3294.14 in the two years of evaluation of mango cultivars. An average disease intensity was 52.98%, infection rate 0.129 unit/day and AUDPC 1797.88 during the two years. Year to year variation showed that highest intensity of disease was in 2014 and lowest in 2013. The variation may be due to due to different cultivar and climatic condition prevalent in both years. Grouping of cultivars for disease intensity, infection rate and AUDPC presented in Table 1

Table 1: Disease intensity, apparent infection rate and area under disease progress curve in mango cultivars

	Disease intensity			Infection rate (rate unit^{-1} day^{-1})			AUPDC			
Cultivars	2013	2014	Mean	2013	2014	Mean	2013	2014	Mean	Disease reaction
Pulgoa dharbhanga	60.02	83.33	71.68	0.13246	0.14069	0.13657	2058.01	2925.57	2491.79	S
Makram	63.21	91.67	77.44	0.13450	0.14257	0.13853	2301.85	3260.60	2781.23	S
Maharaja of mysoor	20.00	28.33	24.17	0.11135	0.11959	0.11547	637.27	763.93	700.60	MR
Bijoragarh	60.06	70.00	65.03	0.13349	0.13696	0.13522	2045.67	3076.17	2560.92	S
Kala Hapus	83.33	48.33	65.83	0.14144	0.13001	0.13573	2940.60	1562.09	2251.34	S
Papat Peri	44.08	66.67	55.37	0.12757	0.13617	0.13187	1565.07	2421.55	1993.31	MS
Neelum x yora malgoa	19.92	25.00	22.46	0.10878	0.11858	0.11368	550.12	787.42	668.77	MR
Thanking amadi	53.33	55.00	54.17	0.13147	0.13314	0.13230	1805.47	1908.60	1857.03	MS
Naliyora	56.79	65.00	60.89	0.13307	0.13546	0.13426	1911.32	2122.94	2017.13	S
K.B. karel	24.90	50.00	37.45	0.11565	0.12976	0.12271	826.67	1653.58	1240.12	MR
Sona kullu	16.67	28.33	22.50	0.10807	0.11828	0.11317	497.27	921.53	709.40	MR
Bada malda	90.01	94.67	92.34	0.14177	0.14262	0.14220	3219.06	3369.21	3294.14	HS
Neelum×Himayuddin	61.50	81.67	71.58	0.13395	0.14012	0.13703	2152.94	2904.11	2528.53	S
Braniko	48.33	71.67	60.00	0.12985	0.13708	0.13346	1720.60	2587.27	2153.93	MS
Asadio	16.88	35.00	25.94	0.10833	0.12257	0.11545	478.53	1095.39	786.96	MR
Police	50.00	75.00	62.50	0.13114	0.13801	0.13457	1625.65	2748.59	2187.12	S
Nx panchandia kalasa	28.39	45.00	36.70	0.12054	0.12815	0.12434	977.61	1669.36	1323.48	MR
Kazalic	46.69	89.00	67.84	0.12870	0.14194	0.13532	1707.39	3277.93	2492.66	S
Duddha Peda	63.18	80.00	71.59	0.13485	0.13943	0.13714	2146.37	2809.83	2478.10	S
Sahir	31.86	58.33	45.10	0.12416	0.13358	0.12887	908.41	2028.21	1468.31	MS
Chenna Swarnrekha	26.67	11.67	19.17	0.12046	0.10254	0.11150	733.93	330.77	532.35	R
Karutha Colamban	47.25	70.00	58.63	0.12938	0.13635	0.13286	1581.27	2456.73	2019.00	MS
Fernandin	63.33	75.00	69.17	0.13455	0.13944	0.13699	1207.65	2577.64	1892.64	MS
Yakuti	61.74	88.33	75.04	0.13498	0.14158	0.13828	2219.05	3152.07	2685.56	S
Banarasi Betali	57.33	18.33	37.83	0.13289	0.11066	0.12178	1931.27	543.76	1237.52	MR
Batganga	41.67	81.67	61.67	0.12632	0.14024	0.13328	1437.27	2933.93	2185.60	S
Salem Banglora	66.67	81.67	74.17	0.13624	0.13999	0.13812	2237.27	2922.98	2580.12	S
Cheena Swarnarekha×Neelum	35.00	48.33	41.67	0.12321	0.12901	0.12611	1103.09	1616.07	1359.58	MS
Mundapa	45.67	75.00	60.33	0.12925	0.13950	0.13438	1581.27	2551.80	2066.53	S
Panchandia kalasa	40.06	58.33	49.20	0.12594	0.13256	0.12925	1207.65	2042.77	1625.21	MS
Kalapaddi	36.67	45.00	40.83	0.12348	0.12899	0.12623	1288.44	1526.49	1407.46	MR
Neelumx Himayudin	30.00	31.67	30.83	0.12016	0.12108	0.12062	834.42	1176.33	1005.37	MR
Nariyal	13.33	20.00	16.67	0.10415	0.11194	0.10804	350.54	626.60	488.57	R
Tamancha	61.67	78.33	70.00	0.13461	0.13939	0.13700	2188.83	2787.29	2488.06	S
Hazur Pasand	23.38	71.67	47.52	0.11722	0.13776	0.12749	744.20	2507.27	1625.74	MR
Rahri	36.68	70.32	53.50	0.12358	0.13728	0.13043	1098.44	2440.23	1769.33	MS
Gurwani	35.00	45.00	40.00	0.12392	0.12954	0.12673	1087.27	1558.98	1323.13	MR
Mulgoa desi	48.00	90.00	69.00	0.12977	0.14214	0.13595	1624.22	3117.27	2370.74	S
Rahaman Pasand	56.58	73.33	64.96	0.13228	0.13797	0.13513	1950.07	2440.42	2195.25	S
KO-07	20.00	45.00	32.50	0.11376	0.12779	0.12078	520.47	1625.32	1072.89	MR

R: Resistant, MR: Moderately resistant, MS: Moderately susceptible, S: Susceptible and HS: Highly susceptible

showed that 5% cultivars were resistant, 30% moderately resistant, 22.5% moderately susceptible and remaining 42.5% susceptible to highly susceptible. The area under disease progress curve values, reflect the real stress seventeen susceptible cultivars showed the maximum AUDPC values 2017.13-3294.14. Nine cultivars showed a moderately susceptible level (1359.58-2153.93). Tamancha, Karutha Colamban, Bada Malda and Thanking Amadi showed the minimum apparent rate of infection (0.108-0.113) and Neelum×Himayudin showed the maximum (0.142). Results revealed that apparent infection rate was of little value in determining relative levels of slow blight ability. This could be due weather conditions, fertilizer doses, growth stages or even the time of start of the epidemic (Gassert, 1978). The AUDPC has been as a more reliable criterion for quantifying slow rusting as compared to apparent infection rate (Wilcoxson *et al*., 1975; Luthra *et al*., 1991).

It is evident from the results that out of forty mango cultivars, Nariayal and Chenna-Swarnarekha were found resistant while twelve cultivars were found to be moderately resistant viz. Maharaja of Mysoor, Neelum×Yora Malgoa, K.B. Karel, Sona Kullu, Asadio, Neelum×Panchandia Kalasa, Banarasi Betali, Kalapaddi, Neelum×Himayudin, Hazur Pasand, Gurwani, KO-07. Among the different cultivars, Nariayal and Chenna Swarnarekha exhibited the minimum infection rate (0.017927, 0.026518) and AUDPC (427.98, 476.75) resulting in (16.67, 19.17%) disease intensity. Nine were moderately susceptible while rest of the cultivars were either susceptible or highly susceptible. Bada Malda cultivar showed the highest AUDPC (3294.14) and the maximum per cent disease intensity (92.34%). Other cultivars, however, exhibited intermediate range of infection rate and AUDPC. The disease progress curves clearly depicted the levels of disease in each cultivars during the observational periods.

One challenge in mango breeding is the improvement of resistance to anthracnose, which is one of the most important mango disease worldwide. Significant differences among cultivars were observed for all components of resistance. A high population of resistant to highly resistant cultivars as observed in this study, showed that anthracnose is probably under the control of a few genes and resistance appears to be dominant as disease incidence trait skewed towards resistance. Cultivars found to be resistant/moderately resistant can be used in the breeding programme to combine this trait with other desired agronomic traits particularly adaptability to this region. Till date, the high yielding resistant cv. Mandelup as well as the highly resistant cv. Tanjil has been used for breeding strategy in Australia to improve anthracnose resistant (Yang *et al*., 2004, 2008). Thus, the findings indicated that the cultivars possess good degree resistance against anthracnose blight under natural epiphytotics at HRC, Pattharchatta, Pantnagar could be further exploited for resistance breeding against this disease.

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