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Sources of multiple Resistances to foliar diseases of mango

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Abstract
Twenty five cultivars were evaluated against various foliar diseases of mango under natural field conditions during 2013- 2014 and 2014- 2015. None of cultivars showed complete resistance to all the diseases. Most of the cultivars showed resistant to malformation and sooty mould except Arka Nilkiran, Pusa Surya, Pusa Arunima,, Sensation, Dushehari and Pant Sinduri were found to be succeptible to malformation and Pantchandra, Arunika, Langra, Dudhehari, Neelgoa to sooty mould. All the cultivas were found to be succeptible to anthracnose except Sindhu+P+S which was found to be moderately resistant. Langra, Sensation, amarpali and Neeleshan were moderately resistant to red rust. Late Maturity, Langra, Amarpali and Neeleshan to Red rust, Tommy Atkins+ Zill, Arka Nilkiran, Swarna Jahagir and Neeleshan to Phoma blight and Arunika, Pusa Surya, Sindhu+P+S, swarna Jahagir and Neeludin to bacterial spot.

Keywords: foliar diseases, *Mangifera indica*, hybrids cultivars, *Fusarium moniliforme*

1. Introduction
The horticulture crops especially mango (*Mangifera indica* L.) play a pivotal role in agriculture economy of the world. It is one of the important fruit crops grown in Tarai region of UP and Uttarakhand. Production of mango is increasing day by day to its hybrids cultivars. The yield potential of these crops is affected by several foliar diseases. Among them, Anthracnose (*Colletotrichum gloeosporioides* Penz and Sacc.), Malfomation (*Fusarium moniliforme* Sheld), Powdery mildew (*Oidium mangiferae* Berthet), bacterial spot (*Xanthomonas campestris* pv. *Mangiferae indica*) and sooty mould (*Meliola mangiferae)* are the major diseases of mango in Uttarakhand. Besides Phoma blight (*Phoma glomerata* (Cords) Woll. Hochapf) and red rust (*Cephaleuros virescens* Kunze) considered to be a minor disease in the state. The disease situation in mango varies with the regions. These diseases cause severe losses both in terms of quality and quantity (Khalid and Alam, 2002)[7]. Management of these diseases through chemicals is quite expensive, need extra labour and also not ecofriendly. In recent past there has been awareness about extensive use of chemicals which cause environmental hazards and also had residual toxicity. Developing a variety resistant to disease provides an easy, cheaper, stable and effective means of diseases management. Keeping this in view, the present study was undertaken to identify source of stable and multiple disease resistance.

Materials and Methods
Twenty five hybrids planted at horticulture research station, Patharchatta, Pantnagar Uttarkhand were evaluated against foliar diseases under natural epiphytotic conditions during 2014 and 2015 growing cycles in a five year old experimental orchard. Screening of orchards was done during reproductive (spring summer month to harvesting) stage. For each of the hybrids, three replications were maintained. Data on severity for all the diseases were recorded as per the scale suggested by Sundravadana *et al*. (2007) [13] and Khalid and Alam (2002)[7] for anthracnose, 0-5 scale given by Chakraborti and Mishra in 2014 [6] for malformation, 0-4 scale for sooty mould (Akthar,1998; Iqbal, 2000) [1, 4] and 1-4 scale by Purvost *et al.*, in 1991 [11] for bacterial spot, red rust and phoma blight were recorded on 0-9 scale (Jamadar and Desai, 1997) [5]. The hybrids with a disease score of < 3.0, 3.1 to 6.0 and 5.1 to 9.0 were designated as resistant (R), moderately resistant (MR) and susceptible (S), respectively.

Table 1: Disease rating scale for assessment of mango malformation

Rating	Disease Reaction	Range of panicle infected (%)
0	Immune/ Resistant	0.00
1	Highly Resistant	0.10-5.00
2	Medium Resistant	6.00-10.00
3	Medium susceptible	11.00-20.00
4	Susceptible	21.00-40.00
5	Highly susceptible	41.00-100.00

Table 2: Disease rating scale for assessment of Sooty mould

Disease rating	Reaction	Type of symptoms
0	Highly Resistant	Clean leaf
1	Medium Resistant	1-10 % leaf area covered
2	Medium susceptible	1-25 % leaf area covered
3	Susceptible	26- 50% leaf area covered
4	Highly susceptible	>50% leaf area covered

Table 3: Disease rating scale for assessment of Anthracnose

Grade	Disease Intensity (%)	Description	Reaction
0	0	No spots on leaves per shoot per tree	Immune
1	1-20	1-5 spots on leaves per shoot per tree	Resistant
2	21-40	6-10 spots on leaves per shoot per tree	Moderately Resistant
3	41-60	11-15 spots on leaves per shoot per tree	Moderately Susceptible
4	61-80	16-25 on leaves per shoot per tree	Susceptible
5	>80	More than 25 spots on leaves per shoot per tree	Highly Susceptible

Table 4: Disease rating scale for assessment of Bacterial Black spot

Disease rating	Type of symptom	Reaction
1	No disease symptom	Resistant
2	1-10 spots per leaf	Moderately Resistant
3	11-25 pots per leaf	Succeptible
4	> 25 spots	Highly succeptible

Data for two years were pooled and analyzed by analysis of variance method as suggested by Gomez and Gomez (1984) using a completely randomized design. The hybrids that showed resistant or moderately resistant to foliar diseases during 2014 were retested during 2015 to confirm their reactions.

Table 5: Disease rating scale for assessment of Phoma Blight and Red rust

Phoma Blight and red rust		
Rating	**Description**	**Reaction**
0	No infection observed	Immune
1	1-10 % infection	Resistant
3	10.1- 15.0 % infection	Moderately Resistant
5	15.1-25.0 % infection	Moderately susceptible
7	25.1- 50.0 % infection	Susceptible
9	More than 50 % infection	Highly susceptible

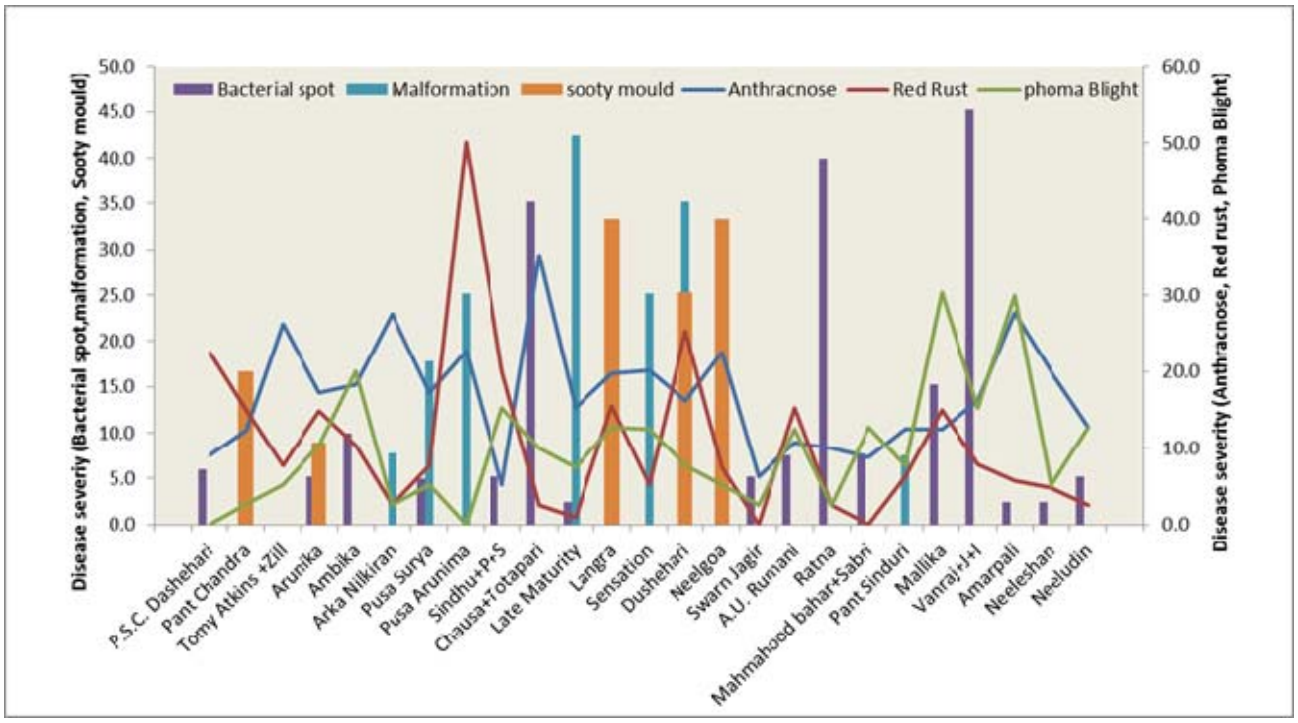

Fig 1: Reaction of mango cultivars against preharvest diseases of mango under orchard conditions (Pooled)

Table 6: Screening/Evaluation of mango cultivars against preharvest diseases of mango under orchard conditions (Pooled)

S. No	Cultivars	Percent disease intensity																	
		Anthracnose[d]			Red Rust[d]			Phoma Blight[d]			Bacterial spot[d]			Malformation[d]			sooty mould[d]		
1	P.S.C. Dashehari	9.0	(17.4)*	S	22.5	(28.3)	S	0.0	(0.0)	R	6.0	(14.3)	S	0.0	(0.0)	R	0.0	(0.0)	R
2	Pant Chandra	12.3	(20.5)	S	5.0	(22.7)	S	2.7	(9.3)	R	0.0	(0.0)	R	0.0	(0.0)	R	14.7	(22.4)	S
3	Tomy Atkins +Zill	26.2	(30.7)	S	7.7	(16.0)	S	5.2	(13.1)	MR	0.0	(0.0)	R	0.0	(0.0)	R	0.0	(0.0)	R
4	Arunika	17.2	(24.4)	S	14.8	(22.6)	S	10.3	(18.7)	S	5.2	(13.3)	MR	0.0	(0.0)	R	8.7	(17.1)	S
5	Ambika	18.3	(25.3)	S	10.3	(18.7)	S	20.0	(26.5)	S	10.0	(18.7)	S	0.0	(0.0)	R	0.0	(0.0)	R
6	Arka Nilkiran	27.5	(31.6)	S	2.5	(9.0)	R	2.5	(9.0)	R	0.0	(0.0)	R	7.8	(16.2)	S	0.0	(0.0)	R
7	Pusa Surya	17.2	(24.4)	S	7.7	(16.0)	S	5.2	(13.1)	MR	5.0	(12.8)	MR	17.8	(24.9)	S	0.0	(0.0)	R
8	Pusa Arunima	22.7	(28.4)	S	50.0	(44.9)	S	0.0	(0.0)	R	0.0	(0.0))	R	25.2	(30.0)	S	0.0	(0.0)	R
10	Sindhu+P+S	5.2	(13.1)	MR	20.0	(26.5)	S	15.2	(22.8)	S	5.2	(13.3)	MR	0.0	(0.0)	R	0.0	(0.0)	R
11	Chausa+Totapari	35.2	(36.3)	S	2.5	(9.0)	R	10.0	(18.4)	S	35.2	(36.4)	S	0.0	(0.0)	R	0.0	(0.0)	R
12	Late Maturity	15.2	(22.8)	S	1.0	(5.7)	R	7.5	(15.8)	S	2.5	(9.0)	R	42.5	(40.6)	S	0.0	(0.0)	R
13	Langra	19.8	(26.4)	S	15.5	(23.1)	MR	12.7	(20.8)	S	0.0	(0.0)	R	0.0	(0.0)	R	30.0	(33.1)	S
14	Sensation	20.2	(26.6)	S	5.21	(3.1)	MR	12.5	(20.6)	S	0.0	(0.0))	R	25.2	(30.0)	S	0.0	(0.0)	R
15	Dushehari	16.2	(23.6)	S	25.3	(30.2)	S	7.7	(16.0)	S	0.0	(0.0)	R	35.2	(36.3)	S	21.8	(27.8)	S
16	Neelgoa	22.5	(28.3)	S	7.5	(15.8)	S	5.2	(13.1)	MR	0.0	(0.0)	R	0.0	(0.0)	R	23.3	(28.7)	S
17	Swarn Jagir	6.2	(14.3)	S	0.0	(0.0)	R	2.5	(9.0)	R	5.2	(13.3)	MR	0.0	(0.0)	R	0.0	(0.0)	R
18	A.U. Rumani	10.8	(19.2)	S	15.2	(22.9)	S	12.5	(20.6)	S	7.5	(16.2)	S	0.0	(0.0)	R	0.0	(0.0)	R
19	Ratna	10.0	(18.4)	S	2.5	(9.0)	R	2.5	(9.0)	R	40.0	(39.2)	S	0.0	(0.0)	R	0.0	(0.0)	R
20	Mahmahood bahar+Sabri	8.7	(17.1)	S	0.0	(0.0)	R	12.7	(20.8)	S	7.5	(16.2)	S	0.0	(0.0)	R	0.0	(0.0)	R
21	Pant Sinduri	12.5	(20.7)	S	6.2	(14.3)	S	7.7	(16.0)	S	0.0	(0.0)	R	7.5	(15.8)	S	0.0	(0.0)	R
22	Mallika	12.5	(20.7)	S	15.0	(22.7)	S	30.3	(33.4)	S	15.2	(23.0)	S	0.0	(0.0)	R	0.0	(0.0)	R
23	Vanraj+J+I	16.2	(23.7)	S	7.8	(16.2)	S	15.2	(22.9)	S	45.2	(42.3)	S	0.0	(0.0)	R	0.0	(0.0)	R
24	Amarpali	27.7	(31.7)	S	5.7	(13.7)	MR	30.0	(33.1)	S	2.5	(9.0)	R	0.0	(0.0)	R	0.0	(0.0)	R
25	Neeleshan	20.0	(26.5)	S	4.8	(12.6)	MR	5.0	(12.9)	MR	2.5	(9.0)	R	0.0	(0.0)	R	0.0	(0.0)	R
26	Neeludin	12.7	(20.8)	S	2.5	(9.0)	R	12.7	(20.8)	S	5.2	(13.3)	MR	0.0	(0.0)	R	0.0	(0.0)	R
Cd at 5%.76 (a) **.37 (b) ** 1.86 (a*b) **																			
Cv 8.47																			
a : Cultivar b: Disease C: Interaction D: mean of three replications *Angular transformed values																			

Result and discussion

Twenty five cultivars were evaluated against various foliar diseases of mango under natural field conditions during 2013-2014 and 2014- 2015. The cultivars were grouped under different degrees of resistance on the basis of percent area infected. The test hybrids cultivars showed variable reaction to foliar disease. None of cultivars showed complete resistance to all the diseases as per the result presented in Table 6. However Arka Nilkiran, Chausa+Totapari, Late maturity, Swarana Jahagir, Ratana and Neeludin showed resistance to red rust. P.S.C. Dashehari, Pant Chandra, Arka Nilkiran, Pusa Arunima and Swarana Jahagir to Phoma blight. Pant Chandra, Tommy Atkins+ Zill, Arka Nilkiran, Pusa Arumina, Late Maturity, Langra, Sensation, Dushehari, Neelgoa, Mallika, Amarpali, Neeleshan to Bacterial spot. It is clear from the table that most of the cultivars showed resistant to malformation and sooty mould except Arka Nilkiran, Pusa Surya, Pusa Arunima,, Sensation, Dushehari and Pant Sinduri were found to be succeptible to malformation and Pantchandra, Arunika, Langra, Dudhehari, Neelgoa to sooty mould. All the cultivas were found to be succeptible to anthracnose except Sindhu+P+S which was found to be moderately resistant. Langra, Sensation, amarpali and Neeleshan were moderately resistant to red rust. Late Maturity, Langra, Amarpali and Neeleshan to Red rust, Tommy Atkins+ Zill, Arka Nilkiran, Swarna Jahagir and Neeleshan to Phoma blight and Arunika, Pusa Surya, Sindhu+P+S, swarna Jahagir and Neeludin to bacterial spot.

Result of the present study are in accordance with the findings of Sharma and Badiyala (1998) [12] who obseved that none of the cultivars of mango was resistant to anthracnose diseases. Bhagwat *et al*., (2015) [2] screened thiry cultivars and found that Arka Nilkiran, Sensation, Ratna and Mallika were highly succeptible and Ambica was succeptible to anthracnose. Many commercial cultivars are highly susceptible to black spot and infections can result in drastic yield losses associated with premature fruit drop, reduction of fruit quality, and induction of severe defoliation. (Kishun, 1986 and Prakash *et al*., 2000) [9, 10]. Khan and Khan (1960) [8] and Hafiz (2008) [3] reported the varieties like Chaunsa, Langra and Dusehri showed moderately susceptible with more than 30% level of disease incidence under ecological conditions of Central Punjab.

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