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Survey of Bacterial blight of Pomegranate caused by *Xanthomonas axonopodis* pv. *punicae*

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Roving survey was conducted during 2011-12 to assess the incidence and severity of bacterial blight of pomegranate caused by *Xanthomonas axonopodis* pv. *punicae*. Maximum fruit infection of 33.33 per cent was recorded in Bellary district followed by Koppal (16.50%) and Belagavi (13.59%) districts. Mean severity of the disease on fruits was observed as maximum in Bellary district (22.22 PDI). Mean disease severity on leaves ranged between 0.00 to 6.16 PDI with the highest leaf severity of 6.16 PDI in Raichur district. Total severity on pomegranate tree was ranged between 0.00 to 53.00 PDI. Maximum disease severity of (52.40 PDI) on tree was recorded Karatagi village of Gangavathi taluk. Among the varieties, Bhagwa was found to be more susceptible with highest disease severity on leaf, stem and fruit. With respect to seasons, Mrigbahar crop was more vulnerable for bacterial blight.

Key words: Survey, bacterial blight, *Xanthomonas axonopodis* pv. *punicae*

INTRODUCTION

Pomegranate (*Punica granatum* L.) is an ancient fruit belonging to family Punicaceae. It is regarded as the "Fruit of Paradise". Pomegranate is a native of Iran, where it was first cultivated in about 2000 BC, but spread to the Mediterranean countries occurred at an early date. It is extensively cultivated in Spain, Morocco and other countries around the Mediterranean Egypt, Iran, Afghanistan, Arabia and Baluchistan. Apart from these countries, it is also grown in Myanmar, China, Japan, USA, USSR, Bulgaria and southern Italy. In India, it is grown as a commercial crop in Maharashtra, Karnataka, Andhra Pradesh, Gujarat, Madhya Pradesh and Uttar Pradesh. In Karnataka, this crop has spread across different district viz., Bagalkote, Bengaluru, Belgavi, Bellary, Vijayapura, Chitradurga, Davanagere, Gadag, Kalaburgi, Koppal, Raichur and Tumkur.

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Pomegranate is a good source of carbohydrates and minerals such as calcium, iron and sulphur. It is rich in Vitamin C and citric acid (Malhotra *et al.* 1983). The fruits are known to possess pharmaceutical and therapeutic properties and are used as components of many fold medical practices.

Cultivation of pomegranate in recent years has met with different traumas such as pest and diseases. Major diseases of pomegranate are bacterial blight, wilt, anthracnose, leaf and fruit spots pest like fruit and stem borer, fruit sucking moth, shot hole borer and sucking insect pests. Among the diseases infecting pomegranate, the bacterial disease popularly known as 'bacterial blight' caused by *Xanthomonas axonopodis* pv. *punicae* (Hingorani and Singh, 1959; Vauterin *et al.* 1995) is a major threat for successful cultivation of pomegranate in India.

From 2002 to till date the disease has reached the alarming stage and hampering the Indian economy

vis-a-vis export of quality fruits. In Karnataka, the survey report of Ravikumar *et al.* (2006) revealed 20-90 per cent of disease severity in Vijayapura and Bagalkote districts. They observed 71.14 per cent severity in Bellary district. Under sever conditions it destroyed the entire orchard and caused heavy economic losses up to 70-80 per cent (Benagi *et al.* 2011; Raju *et al.* 2012 ; Yenjerappa *et al.* 2014).

Now, it is well proved that bacterial blight of pomegranate is wide spread and is a major production constraint. Systematic survey for the incidence and severity of the disease in different growing regions is essential for designing the appropriate management strategies. Hence, in the present investigation, roving survey was undertaken for three seasons during the year 2011-12 in major pomegranate growing areas of Karnataka and border villages of Maharashtra.

MATERIALS AND METHODS

Roving survey was conducted during 2011 and 2012 to know the incidence and severity of bacterial blight in major pomegranate growing areas comprising Bagalkote, Vijayapur, Koppal, Gadag and Raichur districts of Karnataka and border villages of Maharashtra (Sangli and Solapur districts). Survey was taken up in the three cropping season's *viz.*, Ambiabahar, Mrigbahar and Hastbahar on major varieties, Bhagwa and Ganesh. Totally 56 villages of 16 taluks and 9 districts were surveyed. Incidence and severity of the disease on fruit, foliage and stem was recorded. Severity of bacterial blight pomegranate was recorded by using 0-5 on leaf and 0-6 scale on fruit, stem respectively (Anon., 2006).

Grade	Per cent infection	
	Leaf	Fruit and Stem
0	0.00	0.00
1	Up to 1	Up to 1
2	>1- 10	>1-10
3	>10-20	>10-20
4	>20-40	>20-40
5	>40-100	>40-70
6	-	>70-100

Per cent incidence and Per cent disease index (Wheeler, 1969) on leaves, stem and fruit was calculated by applying the formula. Severity on a tree was calculated by using the formula, as per the NRC pomegranate, Solapur, Maharashtra (Anon., 2006). Severity on tree = 0.10LB + 0.70 FB + 0.20

SC. Where, LB- Severity on leaves, FB- Severity on fruits, SC- Severity on stems

RESULTS AND DISCUSSION

Results showed that, in general, disease incidence on fruit was more than its severity in all the areas surveyed. The data on severity and incidence of disease recorded on various plant parts in different locations are presented in Table 1.

Disease incidence on leaf ranged from 0 to 50 per cent with highest disease incidence was recorded on Kesar variety during Hastabahar in Karatagi village of Koppal district followed by 41 per cent in Neermanvi of Raichur district and 39 per cent in Kadlas of Solapur district. Per cent disease index on leaf ranged from 0 to 20.00. The highest per cent disease index of 20.00 was observed on Kesar variety during Hastabahar in Karatagi village of Koppal district followed by 19.20 in Neermanvi and 16.00 in Pandarpur village of Raichur and Solapur districts respectively. Among 99 fields surveyed 67 fields showed no disease incidence on leaves of different varieties.

The disease incidence on stem ranged from 0 to 100 per cent. Highest disease incidence of 100 per cent was recorded on Kesar variety during Ambiabahar season in Navali village of Koppal district and also during Mrigbahar in Manjari village of Solapur district followed by 98.33 per cent in Navali (Koppal), 95.83 per cent in Kothabala (Gadag) and 94.75 per cent in Kadagmmanadoddi (Raichur) village. With reference to disease severity on stem, the per cent disease index ranged from 0.00 to 76.66. Highest per cent disease index was recorded on Kesar variety during Mrigbahar in Kadurukoppa of Bagalkote district followed by 59.99 in Bhirampur (Raichur) 58.33 in Atharga (Vijayapur), 57.22 in Manjari (Solapur) and 53.33 in Yelabunachi village (Koppal). No disease incidence on stem was recorded in 31 fields during the survey.

Disease incidence on fruit was in the range of 0.00 to 100.00 per cent. The highest disease incidence on fruit was noticed on Kesar variety in Ballahunasi (Bellary) followed by 90.00 per cent in Hanumasagar and 75 per cent in Anekal and Karatagi villages of Koppal district. Whereas, the disease severity on fruits in terms of per cent disease index ranged from 0.00 to 66.66. Highest PDI

Table 1: Survey on the incidence and severity of bacterial blight of pomegranate caused by *Xanthomonas axonopodis* pv. *punicae* in major areas of northern Karnataka and border areas of Maharashtra during 2011-12

District	Taluk	Village	Cropping season	Number of field	Variety	Leaf		Stem		Fruit		Severity on plant
						Disease incidence (%)	PDI	Disease incidence (%)	PDI	Disease incidence (%)	PDI	
Badami		Cholachagudda	Hasbathar 1	1	Kesar	0	0	0	0	0	0	0
		Cholachagudda	Hasbathar 1	1	Sindhur	0	0	0	0	0	0	0
		Cholachagudda	Mirigbathar 1	1	Kesar	0	0	0	0	0	0	0
		Khanapur S. K.	Hasbathar 1	1	Kesar	0	35.33	9.27	0	0	0	1.85
		Mean				0.00	0.00	8.83	2.32	0.00	0.00	0.46
		Ankalagi	Mirigbathar 1	1	Kesar	0	0	0	0	0	0	0
		Ankalagi	Mirigbathar 1	1	Sindhur	25	6.2	49.11	8.17	0	0	2.25
		Chikkasamshi	Mirigbathar 3	3	Sindhur	0	45.48	22.84	15.87	9.67	11.33	
		Govindakoppa	Mirigbathar 1	1	Sindhur	0	14.02	4.67	4	1.58	2.04	
		Govindakoppa	Hasbathar 1	1	Sindhur	0	44.4	19.84	0	0	3.96	
Bagalkote		Kadurukoppa	Mirigbathar 1	1	Kesar	0	85	76.66	12	3.33	17.33	
		Kaladagi	Hasbathar 1	1	Kesar	0	69.16	28.05	1.96	0.36	5.86	
		Kaladagi	Hasbathar 1	1	Sindhur	0	67.99	34.99	0	0	6.99	
		Kaladagi	Mirigbathar 2	2	Kesar	20	4	5	1.67	0	0.76	
		Sokanadagi	Mirigbathar 2	2	Sindhur	0	34.51	11.08	11	9	8.51	
		Sokanadagi	Hasbathar 2	2	Sindhur	0	0	0	0	0	0	
		Mean				4.09	0.93	37.70	18.91	4.08	2.18	5.37
		Lokapur	Mirigbathar 1	1	Kesar	3	0.6	76.16	43.5	0	0	8.77
		Mean				3	0.6	76.16	43.5	0	0	8.77
		Range					0-25	0-7	0-77	0-16	0-10	0-18
Mean					2.36	0.51	40.90	21.57	1.36	0.73	4.87	

Table 1a: Taluk-wise mean incidence and severity of bacterial blight of pomegranate in major areas of northern Karnataka and border areas of Maharashtra during 2011-12

District	Taluk	Percent disease incidence on leaf	Percent disease incidence on leaf	Percent disease index on leaf	Percent disease incidence on stem	Percent disease index on stem	Percent disease incidence on fruit	Percent disease index on fruit	Percent disease incidence on tree	Severity on tree
Bagalkote	Badami	0.00	0.00	8.83	2.32	0.00	0.00	0.00	0.46	
	Bagalkote	4.09	0.93	37.7	18.91	4.08	2.18	5.37		
	Mudhol	3.00	0.60	76.16	43.5	0.00	0.00	8.77		
Belagavi	Mean	2.36	0.51	40.90	21.58	1.36	0.73	4.87		
	Athani	1.33	0.27	25.95	14.59	13.59	4.20	5.90		
	Mean	1.33	0.27	25.95	14.59	13.59	4.20	5.90		
Bellary	Hagaribommanahalli	0.00	0.00	24.44	10.74	33.33	22.22	17.7		
	Mean	0.00	0.00	24.44	10.74	33.33	22.22	17.7		
	Fon	15.00	1.50	74.21	30.55	7.00	3.63	8.79		
Gadag	Mean	15.00	1.50	74.21	30.55	7.00	3.63	8.79		
	Gangavathi	7.00	2.80	53.77	23.01	21.51	16.07	16.13		
	Koppal	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Koppal	Kustagi	15.11	5.26	57.93	29.12	28.00	16.07	18.88		
	Mean	7.37	2.69	37.23	17.38	16.50	10.71	11.67		
	Marvi	19.87	9.05	47.96	26.18	0.25	0.08	6.15		
Raichur	Raichur	10.55	3.26	49.34	20.38	8.12	3.33	6.73		
	Mean	15.21	6.16	48.65	23.28	4.19	1.71	6.44		
	Indi	2.57	0.96	28.99	15.39	10.88	3.61	4.87		
Vijayapur	Vijayapur	2.00	0.40	20.6	6.74	7.50	1.63	2.53		
	Mean	2.29	0.68	24.80	11.07	9.19	2.62	3.70		
	Jath	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Sangli (MH)	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Pandarpur	16.5	8.00	0.00	0.00	0.00	0.00	0.80		
	Sangola	8.80	3.16	26.24	12.48	3.73	1.61	3.87		
Solapur (MH)	Mean	12.65	5.58	13.12	6.24	1.87	0.81	2.34		

Table 1b: District-wise mean incidence and severity of bacterial blight of pomegranate in major areas of northern Karnataka and border areas of Maharashtra during 2011-12

District	Leaf		Stem		Fruit		Severity on tree
	Disease incidence (%)	PDI	Disease incidence (%)	PDI	Disease incidence (%)	PDI	
Bagalkote	2.36	0.51	40.90	21.58	1.36	0.73	4.87
Belagavi	1.33	0.27	25.95	14.59	13.59	4.20	5.90
Bellary	0.00	0.00	24.44	10.74	33.33	22.22	17.70
Vijayapur	2.29	0.68	24.80	11.07	9.19	2.62	3.70
Gadag	15.00	1.50	74.21	30.55	7.00	3.63	8.79
Koppal	7.37	2.69	37.23	17.38	16.50	10.71	11.67
Raichur	15.21	6.16	48.65	23.28	4.19	1.71	6.44
Sangli (MH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Solapur (MH)	12.65	5.58	13.12	6.24	1.87	0.81	2.34

Table 1c: Variety-wise mean incidence and severity of bacterial blight of pomegranate in major areas of northern Karnataka and border areas of Maharashtra during 2011-12

Varieties	Leaf		Stem		Fruit		Severity on tree
	Disease incidence (%)	PDI	Disease incidence (%)	PDI	Disease incidence (%)	PDI	
Kesar	7.68	2.59	38.97	18.04	11.93	7.16	9.01
Ganesh	4.11	1.87	24.42	12.28	12.58	3.04	4.77
Sindhur	2.78	0.69	28.39	11.29	3.43	2.25	3.90

Table 1d: Season-wise mean incidence and severity of bacterial blight of pomegranate in major areas of northern Karnataka and border areas of Maharashtra during 2011-12

Bahar	Leaf		Stem		Fruit		Severity on tree
	Disease incidence (%)	PDI	Disease incidence (%)	PDI	Disease incidence (%)	PDI	
Ambiabahar	0.00	0.00	33.33	18.89	13.59	4.20	6.73
Mrigbahar	8.08	2.61	39.08	19.77	12.91	7.08	9.15
Hastbahar	5.99	2.18	33.64	13.60	9.16	5.42	6.95

was recorded on Kesar variety in Ballahunasi (Bellary) followed by 62.5 in Karatagi (Koppal) and 53.33 in Kesaratti (Koppal) villages. No incidence of disease on fruit was observed in 54 fields during the survey.

Severity on tree ranged from 0.00 to 53.00. Highest disease severity on entire tree in terms of PDI was recorded on Kesar variety during Hastabahar season at Karatagi village of Gangavathi district followed by 51.11 and 49.86 in Ballahunasi of Bellary district and Hanumasagar of Koppal district respectively.

Among the 99 fields surveyed 27 were completely

free from the disease on leaves, stems and fruits.

Looking into the taluk-wise disease severity on tree (Table 1a), maximum PDI of 18.80 was recorded in Kustagi taluk of Koppal district followed by Hagaribommanahalli (17.70) taluk of Bellary district and Gangavathi (16.13) taluk of Koppal districts. During survey no incidence of disease was observed in Koppal taluk of Koppal district and Jath taluk of Sangli district.

District wise intensity of bacterial blight indicated that maximum disease incidence of 15.21 per cent on leaves was observed in Raichur district followed by Gadag (15.00%) and Solapur (12.65%) district

(Table 1b). Maximum disease severity on leaf observed was 6.16 PDI in Raichur district followed by Solapur (5.58) and Koppal (2.69) district. No disease on leaf was observed in the fields of Bellary and Sangli district. Highest per cent infection of stem infection of 74.21 per cent was recorded in Gadag district followed by Raichur (48.65%) and Bagalkote (40.90%) districts.

Highest disease incidence (74.2 %) and severity (30.55) on stem was observed in Gadag district followed by Raichur (per cent incidence of 48.65 and PDI of 23.28) and Bagalkote (per cent incidence of 40.90 and PDI of 21.58) districts. Per cent disease incidence on fruit was maximum in Bellary district (33.33%) followed by Koppal (16.50%) and Belagavi (13.59%) districts. Highest disease intensity on fruit was recorded in Bellary district (22.22) followed by Koppal (10.71) and Belagavi (4.20) districts. Among the 9 districts severity on tree was maximum in Bellary district (17.70) followed by Koppal (11.67), Gadag districts (8.79). No disease was observed in Sangli districts of Maharashtra during the survey period.

Among the varieties, Kesar a popular variety was more severely infected by pathogen. The severity on tree was recorded maximum (9.01) on Kesar variety followed by Ganesh (4.77) and Sindhur (3.90) (Table 1c).

With respect to the seasons, Mrigbahar was found highly favourable for the bacterial blight development (Table 1d) as more disease severity on tree (9.15) was recorded.

The pooled result of three bahar indicated that fruits were more vulnerable to the attack by bacterial blight than leaves as evidenced by more disease incidence and severity on fruits, irrespective of season, location and variety. Similarly, Yenjerappa *et al.* (2014) recorded maximum infection of pomegranate fruit of 38.29 per cent in Chitradurga district followed by Anantapur (36.64%) district of Andhra Pradesh, Koppal (32.40%) and Bellary (32.21%) districts by bacterial blight.

Total severity on pomegranate tree from ranged between 0.00 to 53.00 PDI. During the entire survey, overall mean disease severity of 7.50 PDI was recorded on pomegranate tree. This may be due to less number of rainy days, reduction in

unseasonal rainfall during Hastbahar, Mrigbahar and Ambiabahar in the pomegranate growing areas. This reduction in number of rainy days and reduced unseasonal rainfall might have created unfavourable condition for spread of the pathogen within the orchard and also the long distance.

Among the varieties, Kesar was found more susceptible. Similarly, survey conducted by Yenjerappa *et al.* (2014) revealed that among the varieties, Bhagwa was found more susceptible with more average disease severity on leaf (20.05 PDI), stem (2.08 lesions/branch) and fruits (22.71 PDI). The disease severity on fruit was comparatively less on Ganesh (15.09 PDI). Among the seasons, Mrigbahar was found more vulnerable. Mrigbahar season coincides with south-west monsoon season. The frequent rainfall accompanied with high speed wind during the Mrigbahar season might have supported rapid spread of the pathogen to longer distance and increased relative humidity might have helped in longer survival and fast multiplication of the pathogen outside and inside the host plant respectively. Similar reasons for high disease incidence and severity of bacterial blight of pomegranate in Mrigbahar were attributed by Benagi *et al.* (2009); Raju *et al.* (2012) and Yenjerappa *et al.* (2014). Findings of Sharma (2014) indicated that, less disease incidence in Hastbahar (winter season) crop may be attributed to night temperature below 20 °C for most of the months (November to February) and low humidity and no or scanty rains. Whereas, higher blight and rapid spread in Mrigbahar (rainy season) crop, can be correlated to conducive minimum and maximum temperatures, high humidity and more number of rainy days and high wind speed.

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