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Survey for fungal fruit spots and fruit rots of pomegranate in central dry zone of Karnataka

Pruthviraj[1*], Suresh D Ekabote[2], Divyajyothi U[3], Nandappa Chorgasti[4]
[1] PhD Scholar, Department of Plant Pathology, College of Agriculture Shivamogga, UAHS, Shivamogga, Karnataka, India
[2] Professor and Head, Department of Horticultural Crop Protection, College of Horticulture, Hiriyur, UAHS, Shivamogga, Karnataka, India
[3] Research Associate, Department of ZBNF, ZAHRS, Babbur farm, Hiriyur, Shivamogga, Karnataka, India
[4] Department of Plant Pathology, College of Agriculture, Shivamogga, UAHS, Shivamogga, Karnataka, India

Abstract
Among the different fungal diseases, fruit spots and fruit rots pomegranate caused *Colletotrichum gloeosporioides*, *Alternaria alternata*, *Curvularia geniculata* and *Pestalotiopsis microspora* are the most important. Survey for the fungal fruit spots and fruit rots of pomegranate (*Punica granatum*) was conducted during 2017-2018 in major pomegranate growing areas in central dry zone of Karnataka to assess the severity of fungal fruit spots and fruit rots of pomegranate in Chitradurga, Tumkur, Davanagere and Hassan districts. The per cent disease index was recorded using 0-5 scale. The maximum per cent disease index (49.78 %) was recorded in Tumkur district followed by Davanagere (46.58 %) and the mean least severity (30.70 %) was noticed in Hassan district.

Keywords: Per cent disease index, *Colletotrichum gloeosporioides*, *Alternaria alternata*, *Curvularia geniculata* and *Pestalotiopsis microspora*

Introduction
The pomegranate (*Punica granatum* L.), is one of the ancient and highly praised favorite fruit belongs family Lythraceae of Myrtales order which is mainly grown in tropical and subtropical regions of the world. The crop is originated from Iran and then is extended to other parts of the country and also to India through Afghanistan and Pakistan. It is cultivated in arid, semi-arid and tropics (Prasad *et al.*, 1996) [9]. Among the different states growing pomegranate, Maharashtra is the largest producer along with the total area in the country followed by Karnataka, Gujarat, Andhra Pradesh, Telangana, Tamil Nadu and Rajasthan. Karnataka state has the distribution of cultivating pomegranate under tropical conditions in an area of 27,260 ha with a production of 3, 28,920 tons (Anon., 2017). In Karnataka, this crop has spread across different districts *viz*., Bengaluru, Vijayapura, Bellary, Bagalkot, Belagavi, Chikkamagalur, Chitradurga, Davanagere, Gadag, Gulbarga, Hassan, Koppal, Raichur, and Tumkur (Anon., 2005).

Fruit spots and fruit rots are the common diseases of pomegranate and they are reported from different parts of the world. More than 25 fungal species have been reported causing fruit spots and fruit rots.

Among the various fungal pathogens *Colletotrichum gloeosporioides* (Penz.) Penz. And Sacc. And *Alternaria alternata* (Fr.) Keisser. are the important disease causing pathogens along with these pathogens like *Curvularia lunata* (Wakker) Boedijn, *Fusarium* sp (Link), *Phytophthora nicotianae* (Breda de Han), *Cercospora punicae* (Fresen.) and *Phomopsis acubicola* (Sacc. and Roum.) also involved in causing diseases. Therefore, a survey was conducted to record the per cent disease Index of diseases in major pomegranate areas of the central dry zone of Karnataka. Efforts were also made to isolate and identify the pathogens associated with some important diseases.

Material and Methods
The intensive roving survey was conducted during 2017-2018 from October to November to assess the severity of fungal fruit spots and fruit rots of pomegranate in farmer's orchard in Chitradurga, Tumkur, Davanagere and Hassan districts. In each district two taluks were selected, in each taluk two villages were selected and in each village two fields were surveyed. Plants were selected in zigzag manner, and the severity of fungal fruit spot and fruit rot diseases of pomegranate on fruit were recorded by following 0 to 5 scale which was recommended by All India Co-ordinate Research Project on Sub-tropical Fruit Crops, Lucknow, India based on the percentage of fruit area affected by the diseases.

Table 1

Grade	Percent area of infection
0	No infection
1	1-10
2	11-25
3	26-50
4	51-75
5	>75

Per cent disease index (PDI) was calculated by using following formula proposed by Wheeler (1969).

$$\text{Per cent disease index (PDI)} = \frac{\text{Sum of the individual disease ratings}}{\text{Number of fruits/leaves observed}} \times \frac{100}{\text{Maximum disease grade}}$$

Results and Discussion

The data on survey revealed that the per cent disease index ranged from 21.15 to 68.9 in different locations. Maximum disease index (68.90 %) was recorded in Rudrakkate village of Davanagere taluk followed by Chikbyaladakere (68.15 PDI) a village of Hosadurga taluk. Minimum disease index (21.15 %) was recorded in Babbur (Hiriyur). In Chitradurga district maximum disease index was recorded in Chikkabyaladakere village (68.15 %) while that of least disease index was noticed from Babbur village (21.15 %). In Tumkur district maximum disease was recorded in Thammadihalli (67.15 %) while least disease was recorded in Melukunte (31.00 %). In Davanagere district maximum disease was recorded in Rudrakatte (68.90 %) while least disease was recorded in Yeralakatte (25.30 %). In Hassan district maximum disease index was recorded in Shankaranahalli (31.26 %) while least disease was recorded in Mathrahalli (30.15 %).

Among the districts surveyed, the mean maximum disease severity (49.78 %) was recorded in Tumkur district followed by Davanagere (46.58 %) and the mean least severity (30.70 %) was noticed in Hassan district respectively.

Four pathogens *viz.*, *Colletotrichum gloeosporioides*, *Alternaria alternata*, *Curvularia geniculata* and *Pestalotiopsis microspora* were obtained in the surveyed places. *C. gloeosporioides* was obtained in all the surveyed places except Mathrahalli village of Arsikere taluk. *A. alternata* was obtained from eleven villages among the places surveyed and *P. microspora* was obtained from five villages *viz.*, Chikkabayladakere, Suvarnapura, Thammadihalli, Yeralakatte and Rudrakatte but only *C. geniculata* was obtained in three villages *viz.*, Babbur, Suvarnapura and Mathrahalli.

In general, the disease incidence and severity vary from season to season in different agro-climatic zones and varieties, which may be due to variation in pathogen, host varieties or climatic condition. Mandhre *et al.* (1996) in their survey recorded the highest severity of anthracnose of pomegranate to an extent of 40 to 60 per cent in the Nashik district (Maharashtra). It seems that environmental conditions particularly rainfall, temperature and humidity influence the disease incidence and severity. Soil texture and water table also affect the growth and development of fruit spots and fruit rots of pomegranate. Imran-ul-Haq (2013) [6] reported that Sheiekhypura district of Pakistan had with favourable environmental conditions showed maximum PDI and severity of anthracnose disease on Guava. Jamadar *et al.* (2011) [7] reported that anthracnose disease was serious during period July-October and he reported that rains, high humidity and temperature of 20 to 27 °C favours to disease.

Alternaria leaf spot and fruit rot were observed to be prevalent throughout the year in Ahmednagar (Maharashtra) during August 2007 and Koppal district during February 2008. Survey report of 2008-09 revealed similar situation of these fruit rot causing fungi with higher incidence of *Alternaria alternata*, *Colletotrichum gloeosporioides* and *Cercospora punicae etc.* during rainy season from July to September (Anon., 2009). Fruit rot caused by *Alternaria* sp. has previously been reported in USA, Mexico (Farr *et al.*, 2007). *C. geniculata* and *P. microspora* caused fruit spot of pomegranate. The results are in conformity with Harlapur *et al*. (2016) [5] and Utikar *et al*. (1980) [10] respectively.

Conclusion

Although fruit spots and fruit rots were found prevalent in all the pomegranate growing areas surveyed the occurrence of pathogens and severity was probably more influenced by environmental conditions. The increase in disease incidence and severity was observed with increase in humidity and rainfall.

Table 1: Survey for the fungal fruit spots and fruit rots of pomegranate in central dry zone of Karnataka during 2017-18

Sl. no.	District	Taluk	Village	Isolated pathogens	Percent disease index	Mean per cent disease index
1	Chitradurga	Hiriyur	Babbur	*Colletotrichum gloeosporioides*, *Alternaria alternata* and *Curvularia geniculata*	21.15	45.17
			Airshinakunte	*C. gloeosporioides* and *A. alternata*	26.30	
		Hosadurga	Chikkabayladakere	*A. alternata*, *C. gloeosporioides* and *P. microspora*	68.15	
			Suvarnapura	*C.gloeosporioides P. microspora and Curvularia geniculata*	65.10	
2	Tumkur	Sira	Thogalgunte	*C. gloeosporioides* and *A. alternata*	37.50	49.78
			Melukunte	*C. gloeosporioides* and *A. alternata*	31.00	
		Chikknayakanhalli	Thimalapura	*C. gloeosporioides* and *A. alternata*	63.50	
			Thammadihalli	*C. gloeosporioides*, *A. alternata* and *P. microspora*	67.15	
3	Davanagere	Jagalur	Jagalur	*C. gloeosporioides*	34.00	46.58
			Yeralakatte	*C. gloeosporioides* and *P. microspora*	25.30	
		Davanagere	Rudrakatte	*C. gloeosporioides*, *A. alternata* and *P. microspora*	68.9	
			Siddanur	*C. gloeosporioides*	58.15	
4	Hassan	Arsikere	Shankaranahalli	*C. gloeosporioides* and *A. alternata*	31.26	30.70

Table 2: Diagnostic characteristics of disease caused by different pathogens involved

Disease	Pathogen involved	Diagnostic character
Anthracnose	*C. gloeosporioides*	The first evidence of disease appeared on the young fruits from the tip of calyx region as minute dark brown water-soaked lesion later become necrotic depressed spots of one to two millimeter diameter. In advanced stage, these spots coalesced to form necrotic patches over the surface of the fruit.
Alternaria blight	*A. alternata*	Cause early blight symptom on fruits and here disease starts from calyx region in the early stage of the crop development as concentric rings and extend downwards. Small dark brown to black, oval to irregular spots on fruits were observed. Later these spots increased in size and coalesced covering larger fruit area. Each spot consisted of a light green to yellow halo surrounding a necrotic lesion and also observed the rotting of fruits.
Curvularia spot	*C. geniculata*	Symptoms appeared as a small circular brown to black colour spot on the skin of pomegranate fruit which later increased in size and numerous brown to black spot areas formed and the spots are slightly sunken in nature
Pestalotiopsis blight	*P. microspora*	Produces varied symptoms on fruits, initially as small spots on exocarp of young fruits (pinhead size) which progressed as fruits enlarged. Typical symptoms on fruit began with tiny, grey coloured spots. The spots darkened in color and became necrotic. Over time, the tiny spots expanded to discrete, irregular, dark brown to grey spots that coalesced to form an overall blighted appearance. As the fruit developed, the small, corky lesions often tore open, giving blighted appearance.

Fig 1: Symptoms of anthracnose on fruit

Fig 2: Symptoms of *Alternaria* blight on fruits

Fig 3: Symptoms of *Curvlaria* spots on fruits

Fig 4: Symptoms of *Pestalotiopsis* blight on fruits

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