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Survey on incidence of banana rhizome rot disease caused by *Pectobacterium carotovorum* subsp. *carotovorum* in major banana growing parts of Karnataka

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Abstract

Banana and plantain constitute a major staple food crop for millions of people in developing countries. Banana plant is one of the most versatile plant that every part of it is useful to cure different types of disorders rhizome rot disease (tip-over) of Banana caused by *Pectobacterium carotovorum* subsp. *carotovorum* is found to be a serious disease and cause considerable yield loss. Common cultivars which occupy major proportion viz., Grand Naine, Rasthali and Nendran are extremely prone to this disease. Conducting survey in major cultivating areas helps to identify the intensity of the disease and in turn helps in carrying out suitable management practices. A roving survey was conducted in the year 2020 to assess the incidence of tip over disease of banana in some major banana growing parts of Karnataka viz., Belagavi, Dharwad, Davangere, Haveri, Shimogga and Uttar Kannada districts, reveals that the incidence of rhizome rot/tip-over disease in surveyed areas ranged 5 to 55%. Among the villages surveyed Gokak village of Belgavi district had shown the highest incidence with 55% whereas, least incidence was observed in Shiralkoppa village of Shimogga district. Among taluks surveyed of Gokak taluk of Belgavi district recorded maximum incidence of 42.34% on other hand least incidence of 10.67% was observed in Sagarataluk of shimogga district. Among the districts Belgavi recorded maximum incidence with 35.22% and least incidence of 9.67% was observed in Shimogga district. Incidence of disease is high in black soils with 55% compared to red soils in which maximum incidence recorded was 33%.

Keywords: *Pectobacterium carotovorum*, rhizome rot, Karnataka, survey and Banana

Introduction

Banana (*Musa* spp.) is one of the oldest cultivated tropical fruit crops known to mankind and in India is next to mango in both area and production. It was known from the time immemorial as cheapest, plentiful and most nourishing of all the fruits. Banana is generally grown throughout the country all-round the year and grows much better in warm humid climates. Banana have been called the world's most perfect fruits, as they are high in potassium, low in fat and good source of vitamins and fiber.

Banana and plantain constitute a major staple food crop for millions of people in developing countries. Banana plant is one of the most versatile plant that every part of it is useful to cure different types of disorders. Banana is delicious and usually seedless and is available in all seasons and it is very hygienic and nutritious. Banana is a staple starch for many tropical populations. Depending upon cultivar and ripeness, the flesh can vary in taste from starchy to sweet and texture from firm to mushy. Both skin and inner part can be eaten raw or cooked. Banana belongs to family *Musaceae* of order *Scitaminae*. The center of origin of this tropical fruit has been considered to be the Malayan archipelago also called as Garden of Paradise. Banana contains nearly all the essential nutrients including minerals, vitamins and has several medicinal properties. It is a rich source of energy and each banana weighing around 100 g would provide the energy requirement (2,400 cal/day) of a sedentary man. It contains 27 per cent carbohydrates, 70 per cent moisture, little amount of proteins and fat. The best known bananas of commercial type all over the world belong to the pure *Musaacuminata* AAA group. In India, banana growing states are Karnataka, Kerala, Maharashtra and Tamil Nadu. In India, area under Banana cultivation is 8.58 lakh ha with a production of 29.16 mT during 2016-17. In Karnataka, area under cultivation is 1.01 lakh ha with a production of 2.49 mT (Anon., 2017).

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Several factors are attributed to the constraints for high production of banana and the major being the occurrence of diseases. Banana is subjected to many serious debilitating diseases caused by fungi, viruses, bacteria, nematodes and non-parasitic diseases. Among the bacterial diseases, tip- over or bacterial rhizome rot of banana is gaining significance in recent years in Karnataka though earlier the disease was considered as of minor importance.

Wardlaw (1950) [7] for the first time reported the bacterial nature of head rot/ rhizome rot of banana from Allahabad in Uttara Pradesh. Khan and Nagaraj (1998) [3] reported the same disease from several banana growing regions of Karnataka. There are conflicting reports pertaining to the exact identity of the causal organism. Several researchers in the past have reported it to be *Erwinia carotovora* (Jones) from Holland and *Erwinia chrysanthemi* from across the world. While, Khan and Nagaraj (1998) [3] from Karnataka in their preliminary work, they have reported it as *Erwinia carotovora*. But, Chattopadhyay and Mukherjee (1986) [1] from West Bengal implicated *Erwinia chrysanthemi* as the causal agent.

The leaves in the diseased plants appeared pale yellow, lusterless, with marginal necrosis. The young central leaves or shoots visible as scorched giving a burnt appearance and when such plants were uprooted along with the rhizomes, the large part of the rhizome was found massive soft, rotted and turned brown to black discoloration. The rotted area showed tunneling and emits foul smell. Whenever, a strong wind or mild knock was given to severely affected plant, the plant toppled down at much rotted portion just below the soil line, hence the name tip over.

Material and methods

Disease incidence survey

A roving survey was conducted to know the status of the tip over disease in some major banana growing parts of Karnataka viz., Belagavi, Dharwad, Davangere, Haveri, Shimogga and Uttar Kannada districts. The survey was

conducted by Rovers method in the major banana growing areas of the above mentioned districts of Karnataka during 2019 and 2020. Observations like Disease incidence and other observations mentioned in table 1 were taken. Per cent Disease Incidence (PDI) was calculated from the observations taken during survey by using the formulae given below.

$$\text{Per cent Disease Incidence(PDI)} = \frac{\text{No. of plants infected}}{\text{Total no. of plants examined}} \times 100$$

Results

A roving survey was conducted to assess the incidence of tip - over disease of banana in major banana growing districts of Karnataka viz., some major banana growing parts of Karnataka viz., Belagavi, Dharwad, Davangere, Haveri, Shimogga and Uttar Kannada districts.

Incidence of Banana Tip over disease during the year 2020

The data present in the Table 1 reveals that the incidence of Tip-over disease in surveyed areas ranged from 5 to 55%. Among the villages surveyed Gokak village of Belgavi district had shown the highest incidence with 55% whereas, least incidence was observed in Shiralkoppa village of Shimogga district. Among taluks surveyed of Gokak taluk of Belgavi district recorded maximum incidence of 42.34% on other hand least incidence of 10.67% was observed in Sagarataluk of shimogga district. Among the districts Belgavi recorded maximum incidence with 35.22% and least incidence of 9.67% was observed in Shimogga district.

Incidence of Banana Tip- over disease based on soil type and variety

Upon observing the data recorded during survey in the years 2020 it was noticed that incidence of disease is high in black soils with 55% compared to red soils in which maximum incidence recorded was 33%. Maximum disease incidence of 55% was recorded in Grand naine variety (Tissue culture).

Table 1: Incidence of Banana Tip over disease during the year 2020

District	Taluk	Village	Variety	Stage of crop in months	PDI
Belgavi	Gokak	Duradundi	Grand naine	4	33
		Gokak	Grand naine	4	32
		kolavi	Grand naine	3	38
	Ramdurga	Manihala	Grand naine	5	35
		Avaraddi	Grand naine	3	55
		sangolli	Grand naine	2	37
	Rayabag	Kankanwadi	Grand naine	3	30
		Rayabaga	Grand naine	5	27
		Khanapur	Grand naine	3	30
Davanagere	Davanagere	Lingadahalli	Grand naine	5	30
		Kaidale	Grand naine	4	14
		Javalagatta	Grand naine	4	10
	Harihara	Ramatheertha	Grand naine	2	25
		Naganehalli	Grand naine	2	31
		Haraganahalli	Grand naine	3	28
	Honnala	Hiremata	Grand naine	3	32
		Marikoppa	mitli	3	10
		Anjanapura	mitli	4	22
Dharwad	Dharwad	Navalur	Grand naine	3	15
		Govanakoppa	Grand naine	4	13
		Uppinbetageri	Grand naine	2	30
	Hubli	Thimmasagara	Grand naine	4	15
		Karadikoppa	Grand naine	2	10
		InamVeerapura	Grand naine	4	16

	Navalgundh	B Gudihal	Grand naine	3	12
		Iyatti	Grand naine	4	9
		Byalala	Grand naine	4	10
Haveri	Hangal	Akkialur	Mitli	3	35
		Balur	Grand naine	5	19
		Havanagi	Grand naine	4	22
	Ranebennur	Hulihalli	Grand naine	4	18
		Honnati	Mitli	5	10
		Kunabevu	Grand naine	3	10
	Hirekerur	Jogihalli	Mitli	4	12
		Koda	Grand naine	2	15
		BasareeHalli	Mitli	4	15
Shimogga	Shikaripura	Shiaralkoppa	Mitli	2	5
		Udugani	Grand naine	3	10
		Sheelavantanakoppa	Mitli	4	10
	Sagar	Lingadahalli	Yallakkibale	2	8
		Avinhalli	Mitli	3	12
		Godekoppa	Yallakkibale	2	12
	Soraba	Ulavi	Mitli	3	13
		Shigga	Mitli	1	10
		Hosabale	Grand naine	3	7
Uttara Kannada	Sirsi	Sirsi	Yalakkibale	4	10
		Byagadde	Grand naine	4	10
		NukaralaKoppa	Mitli	2	15
	Mundgod	Koppa	Grand naine	3	40
		Mundgod	Grand naine	3	39
		Induru	Grand naine	4	38
	Siddapura	Kilara	Mitli	3	10
		Halageri	Mitli	4	8
		Husura	Grand naine	3	20

Discussion

The survey results of the year 2020 reveals that the incidence of Tip-over disease in surveyed areas ranged from 5 to 55%. Among the villages surveyed Gokak village of Belgavi district had shown the highest incidence with 55% whereas, least incidence was observed in Shiralkoppa village of Shimogga district. Among taluks surveyed of Gokak taluk of Belgavi district recorded maximum incidence of 42.34% on other hand least incidence of 10.67% was observed in Sagarataluk of Shimogga district. Among the districts Belgavi recorded maximum incidence with 35.22% and least incidence of 9.67% was observed in Shimogga district. These results are supported by earlier workers who reported that during 2015-2016 tip -over incidence was noticed in all the locations they surveyed viz., Koppal, Shimoga, Chitradurga and Ballari districts, with maximum disease incidence of 12.99 per cent was observed in Muddaballi village of Koppataluk. In contrary to this minimum incidence of 1.15 per cent was observed in Ankammanahal village of Sandurtaluk of district (Thiyagarajan *et al.*, 2016). Vasundhara and Thammaiah (2017) had also recorded the incidence of tip -over disease upto thirty per cent. The highest incidence of the disease was recorded in Salahalli village (30.00%) followed by Dastikoppa (24.39%) on Grand Naine cultivar, Siddapur (26.66%) on Grand Naine cultivar, Lokapur (24.28%) on Rajapuri cultivar and Mudnal (22.00%) on Rajapuri cultivar among districts viz., Belgaum, Bagalkot and Bijapur districts during the year 2012. During the year 2016-17 survey conducted by Soumya (2018) [6] revealed that the incidence of tip -over of banana was ranged from 1.00 to 48.00 per cent in all the locations they surveyed, with the highest mean disease incidence was reported in the Bagalkote district (10.25%) followed by Vijayapura (10.64%) and Haveri (8.59). Lowest mean disease incidence was observed Dharwad district (6.06%). Pradnyarani *et al.* (2019) had

conducted a roving survey during year 2015-2016 in banana growing districts of Karnataka and reported that the disease incidence was found to be the highest in Bagalkot district (49.67%) followed by Belagavi (34.16%), Dharwad (25.75%), Vijayapura (24.81%), Bidar (15.75%), Haveri (13.24%), Koppal (11.07%), Mysore (10.72%) and the least was noticed in Gadag district (8.71%). These results are supported Soumya *et al.* (2018) [6] who reported that Grand naine variety has recorded maximum incidence 13.88% and incidence of 12.55%. Recently, banana plants are commercially produced through micro propagation, by means of tissue culture techniques applying different biotechnological approaches in order to procreate disease-free plants for this purpose G naine variety is most preferable (Wiyono and Widono, 2013) [8]. *Pectobacterium* species is present as an endophytic contaminant in the shoot tip along with the rhizome of explants during tissue culture development and the banana plantlets are more susceptible to pathogen at this stage (Habiba *et al.*, 2002) [2]. In addition, tissue culture technique significantly provides pathogen-free seedlings which adversely eliminate the beneficial organisms found in the plant system too (Rajamanickam *et al.*, 2018) [5].

Conclusion

As discussed above extensive cultivation of a single variety and continuous cultivation of same crop and other related crops in the same field year by year making this disease more severe, to overcome this problem crop rotation with non-hosts, considering about varietal selection and other agricultural practices is needed.

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