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Management of soft rot of banana caused by *Erwinia carotovora* sub sp. *Carotovora*

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ABSTRACT :

Banana a fruit of poor and rich is source of food and fibre. It has multiple uses of its all plant parts. However, its cultivation is hampered by many diseases like in other crops. The least known soft rot disease among farmers caused by *Erwinia carotovora* subsp. *Carotovora* has become a threat to banana cultivation. The present study was aimed to identify suitable control measures of soft rot to avoid plunging banana yield. A field experiment was conducted for two years during 2014 and 2015 by imposing eight different treatments with three replications on 25 plants in each treatment in an orchard severely affected by soft rot. Results obtained were statistically analysed and yield was subjected to cost benefit ratio analysis. Among the treatments imposed, drenching and foliar spray of copper oxychloride 50WP at 3g/l + streptomycin sulphate 0.5g/l at 15 days interval, beginning from 15 days after planting and application of bleaching powder 25g/plant/month two inches away from pseudostem around the collar region upto four months was found most effective and recorded lowest soft rot disease incidence of 7.67 per cent during 2014 and 9.28 per cent during 2015. This treatment also recorded highest bunch yield of 32.9kg/plant during 2014, 30.03kg/plant during 2015. The pooled disease incidence was 8.47 per cent and yield of 31.47kg/plant. This treatment showed highest cost benefit ratio of 3.54 compared to control which had 1.6. Neither copper oxychloride nor the streptomycin sulphate alone or in combination could give better results as earlier reported. But their mixed application both by drenching and foliar spray had better impact and most effective when coupled with application of bleaching powder. The results conclude effective control of soft rot can be done without compromising the yield by following best treatment of the experiment.

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INTRODUCTION

Fruits and vegetables are the main source of essential minerals, vitamins, proteins, growth hormones and immunity inducing substances. Because of these

advantages they are integral part of our daily diet. Banana is one such fruit having multiple uses and advantages. It is grown and consumed almost worldwide. The crop is a source of livelihood in many developing countries and also known as ready to eat naturally wrapped food. Banana cultivation has increased over the last two decades. With the introduction of tissue culture techniques, the ease of multiplication of banana planting material has been supporting increased area and production. Adoptions of drip irrigation, scope of fertigation and round the year market are other driving forces responsible for attraction of farmers towards banana cultivation. The difficulties in propagation of elite cultivars have also been overcome by alteration of growth regulators through *in vitro* propagation. However, like other crops banana also suffers from multiple diseases such as sigatkokka, panama wilt, root lesion nematode, burrowing nematode, cigar end rot, bunchy top, streak virus, cucumber mosaic virus and bacterial soft rot also known as tip over disease are major hurdles to banana cultivation. Soft rot is becoming very severe and challenge to growers.

Though, tissue culture seedlings will be disease free but, their genetic homogeneity, uniform growth and maturity (Habtamu Tegen and Wassu Mohammed, 2016) make them prone to disease attack in field. In recent times across many states of south India where banana is commercial horticultural crop is suffering from bacterial soft rot caused by *Erwinia carotovora* sub sp. *Carotovora*. The soft rot caused by this bacteria was first time noticed in Israel during 1965 (Zutra and Volcani Zafrira, 1971). In India, Wardlaw (1950) for the first time reported the nature of Bacterial head rot/rhizome rot of banana from Allahabad in Utara Pradesh. The disease was also noticed as tip over disease of banana in Basarai cultivar nearby Yamuna river during 1968 (Edward *et al*., 1973). Subsequently, Chattopadhyay and Mukherjee (1986) detected a bacterial soft rot disease on the pseudostem and corm of Giant Governor Cultivar of Cavendish banana in 1983 in the orchards of Mondouri farm of the Viswa Vidhyalaya. Lakshmanan and Mohan (1986) observed Tip-over or head rot caused by *Erwinia carotovora* in Tamil Nadu in North Arcot and Trichy districts. In Karnataka, first time this disease was reported by Khan and Nagaraj (1998) as of tip-over or Rhizome rot of banana first time in Kolar and Bangalore districts. Since for the past five years in northern part of Karnataka, majority of tissue culture seedling planted and sucker planted banana orchards are succumbing to this disease causing heavy yield losses. The disease was noticed in major banana growing locations of north Karnataka ranging from 4.25 to 65.28 per cent in Bijapur, Bagalkot, Belgaum and Dharwad districts (Vijayalaxmi *et al*., 2014). For the past three years disease is appearing in Koppal, Bellary, Davanageri, Gadag, Chitradurga and Haveri districts also. A survey of tip over disease conducted by Thiyagarajan *et al*. (2017) also revealed incidences of disease in Koppal (12.99%), Shivmogga (9.15%), Chitradurga (6.75%) and Bellary (3.22%) districts of Karnataka.

Many farmers are unaware of the cause and control measures due to poor knowhow about the disease. Indirectly it is discouraging growers due to complete death of affected seedlings and plants. The disease caused rotting of rhizome and pseudo stem, following marginal necrosis or scorching of leaves ultimately leading to toppling of affected plants (Nagaraj *et al*., 2012). Sometimes the fruit bearing trees topples before maturity or before bunch harvesting due to splitting and internal rotting of rhizome, pesudostem and peduncle (Thammaiah *et al*., 2005; Saygili *et al*. 2005; Chattopadhyay, 1987 and Cetinkaya-Yildiz and Aysan, 2007). In order to address this deadly disease of banana, present investigation was undertaken with an aim to identify suitable management strategies.

MATERIAL AND METHODS

The experiment on management of soft rot of banana also known as tip over disease of banana was implemented in disease prone field planted with tissue culture banana seedlings. Since, the bacteria is soil borne and infests many crops such as carrot, potato, tomato, onion, cabbage, brinjal and groundnut (Vijayalaxmi *et al*., 2014), could be the reason for rapid infestations of this pathogen to banana. The study was conducted for two years during 2014 and 2015. Eight different treatments were imposed along with control involving drenching and foliar spray with copper oxychloride 50WP at 3g/l + streptomycin sulphate 0.5g/l for four months at 15days interval, application of bleaching powder 25g/plant and drenching with 0.1 % Bordeaux solution. These measures were imposed alone and in combination with each other in to eight different treatments. Each treatment had three replications and each treatment was imposed on 25 banana plants. Complete Randomized Block Design was

followed. The treatments were imposed starting from 15 days after planting of fresh seedlings in main field. In subsequent, season (during 2015) treatments were imposed on newly emerging suckers at 15 days after harvest of the first season yield. During the course of experiment, observations on disease incidence and yield were recorded and subjected to suitable statistical analysis. The results of 2014 and 2015 were pooled, analysed and cost benefit ratio was calculated taking the average yield, cost of cultivation and price to derive the conclusion.

RESULTS AND DISCUSSION

The experiment on management of soft rot of banana caused by *E. carotovora* implemented over two seasons involving different treatments had varied response on soft rot incidence. Among the treatments, treatment number five comprising drenching and foliar spray of copper oxychloride 50WP at 3g/l + streptomycin sulphate 0.5g/l at 15days interval, starting from 15 days after planting and application of bleaching powder 25g/plant/month two inches away from pseudostem around the collar region for upto four months recorded lowest disease incidence of 7.67 per cent during 2014 and 9.28 per cent during 2015. The pooled incidence was 8.47 per cent. This treatment recorded highest bunch yield of 32.9kg/plant during 2014, 30.03kg/plant during 2015 with pooled yield of 31.47kg/plant. In case of control maximum incidence of soft rot of 68.33 per cent was recorded during 2014, 65.33 per cent was recorded during 2015 and pooled incidence was 66.83 per cent. Lowest yield of 13.67kg/plant during 2014 and 11.37kg/plant during 2015 with pooled of 12.52kg/plant was recorded in control compared to other treatments imposed (Table 1). The

Table 1 : Effect of different treatments on soft rot of banana disease and its yield during 2014 and 2015

Sr. No.	Treatment	Disease incidence (%)			Yield (kg/plant)			Yield (t/ha)		
	Year	2014	2015	Pooled	2014	2015	Pooled	2014	2015	Pooled
T_1	Drenching with CoC 3g/lit + Streptomycin sulphate 0.5g/lit for four months @ 15days interval	39.67 (39.02)	42.60 (40.73)	41.13 (39.87)	14.67 (22.51)	14.10 (22.05)	14.38 (22.28)	44.0	42.30	43.15
T_2	Drenching with CoC 3g/lit followed by foliar spray with CoC 3g/lit @ 15days interval for four months	33.67 (35.45)	37.83 (37.94)	35.75 (36.71)	16.00 (23.57)	16.83 (24.21)	16.42 (23.90)	48.0	50.50	49.25
T_3	Drenching with CoC 3g/lit + Streptomycin sulphate 0.5g/lit@ 15days interval followed by foliar spray for four months	24.33 (29.54)	30.37 (33.43)	27.35 (31.52)	21.00 (27.26)	19.47 (26.17)	20.23 (26.72)	63.0	58.40	60.70
T_4	Drenching with CoC 3g/lit followed by foliar spray with CoC 3g/lit @ 15days interval for four months + application of bleaching powder once in a month of 25g/plant	11.67 (19.97)	13.27 (21.35)	12.47 (20.67)	24.00 (29.32)	22.43 (28.26)	23.22 (28.80)	72.0	67.30	69.65
T_5	Drenching with CoC 3g/lit + Streptomycin sulphate 0.5g/lit@ 15days interval followed by foliar spray for four months + application of bleaching powder once in a month 25g/plant	7.67 (16.07)	9.28 (17.73)	8.47 (16.91)	32.90 (34.99)	30.03 (33.22)	31.47 (34.11)	98.7	90.10	94.40
T_6	Drenching with bleaching poder 2g/lit followed by foliar spray with CoC 3g/lit + Streptomycin sulphate 0.5g/lit@ 15days interval for four months	11.33 (19.66)	13.67 (21.69)	12.50 (20.70)	28.90 (32.51)	24.50 (29.66)	26.70 (31.10)	86.7	73.50	80.10
T_7	Drenching with 0.1% Bordeaux solution	17.67 (24.85)	21.67 (27.73)	19.67 (26.32)	24.33 (29.54)	21.83 (27.84)	23.08 (28.70)	73.0	65.50	69.25
T_8	Control	68.33 (55.73)	65.33 (53.91)	66.83 (54.81)	13.67 (21.69)	11.37 (19.70)	12.52 (20.71)	41.0	34.10	37.55
	Co-efficient of variance (CV)	11.23	13.47	10.41	11.77	13.25	10.67			
	Critical difference (C.D. P=0.05) @ 0.05	5.11	6.69	4.95	3.51	3.61	3.07			

yields obtained in each treatment were subjected to cost benefit ratio calculation by taking average of two years cost of cultivation and price obtained. The analysis showed highest returns of 3.54 in T_5 which was found most effective in reducing the soft rot compared to other treatments and in control it ratio was 1.6. The next best treatment T_6 had 3.24 (Table 2).

Observations in the study fall in line with reports of copper oxychloride and streptomycin sulphate capable of reducing the *Erwinia carotovorai* causing decays and rots. Both of them were found very effective in reducing the *Erwinia carotovorai* responsible for decays of potato (Nirmalajit Singh *et al.*,1979) and rot of plantain (Salazar and Duque,1994). Number of applications also matters, since the bacteria in diseased plants will be in soil, rhizome, suckers and will be spreading along the pesudeostem. Prophylactic imposition of treatment suppressed the growth and multiplication of bacteria which otherwise might have escaped from previous applications leaving no scope for further spread of the disease. Nagaraj *et al.* (2002) conducted two field trials to evaluate the efficacy of various bactericides and antibiotics. Three times drenching with streptomycin sulphate either alone or in combination with copper sulphate completely suppressed the tip over disease (100%) and increased the yield by 143.37 per cent. Copper is a known bactericide element and invariably found effective either in the form of copper oxychloride or copper sulphate. Often soil borne disease require major attention at soil amendments or treatments, however, in the present study though pathogen is soil borne but shows infection and symptoms on foliage and at the growing tip hence, the name tip over disease. Foliar spray of copper oxcychloride and streptocyclin sulphate were effective in avoiding foliar damage. In a pot culture study done by Vijayalaxmi (2012) drenching of streptocycline 500 ppm + copper oxychloride 3000 ppm gave 61.94 per cent tip over disease reduction over the control this confirms the effectiveness of both the chemicals used in the study and reliability by farmers for field application on large scale.

Drenching alone or combination of drenching and foliar application of copper oxychloride did not give better results compared to mixed application of copper oxychloride and streptocyclin sulphate. The application of bleaching powder also influenced in reducing the soft rot disease which is clearly visible in observations recorded among the treatments imposed. Similar advantages of bleaching powder were recorded by Thammaiah *et al.* (2005), who conducted an experiment and found that maximum survivability of banana plant in field against *Erwinia chrysanthemi* was noticed due to

Table 2 : Cost benefit ratio of banana soft rot management under different management options

Sr. No.	Treatment details	Cost of cultivation /h	Yield kg/h	Gross returns (Rs.)	Cost benefit ratio
T_1	Drenching with CoC 3g/lit + Streptomycin sulphate 0.5g/lit for four months @ 15days interval	248000	43150	431500	1.74
T_2	Drenching with CoC 3g/lit followed by foliar spray with CoC 3g/lit @ 15days interval for four months	243000	49250	492500	2.03
T_3	Drenching with CoC 3g/lit + Streptomycin sulphate 0.5g/lit@ 15days interval followed by foliar spray for four months	261000	60700	607000	2.33
T_4	Drenching with CoC 3g/lit followed by foliar spray with CoC 3g/lit @ 15days interval for four months + application of bleaching powder once in a month of 25g/plant	247500	69650	696500	2.81
T_5	Drenching with CoC 3g/lit + Streptomycin sulphate 0.5g/lit@ 15days interval followed by foliar spray for four months + application of bleaching powder once in a month 25g/plant	266500	94400	944000	3.54
T_6	Drenching with bleaching poder 2g/lit followed by foliar spray with CoC 3g/lit + Streptomycin sulphate 0.5g/lit@ 15days interval for four months	247000	80100	801000	3.24
T_7	Drenching with 0.1% Bordeaux solution	241000	69250	692500	2.87
T_8	Control	235000	37550	375500	1.60

sucker treatment of 2000 ppm bleaching powder for 30 min dip (60.00 mm). Bleaching powder has an ability to release chlorine when comes in contact with water and is lethal to bacteria, thus gives scope for field application at low cost. The experiment unveiled the most suitable, low cost and easy to adopt soft rot management strategy in banana and is certainly rescues the ailing fields across many districts of Karnataka and other states.

REFERENCES

Cetinkaya-Yildiz, R. and Aysan, Y. (2007). A new seed-borne pathogen on tomato : *Erwinia carotovora* subsp. *carotovora* and some seed treatments. *Acta Hort*., **729** : 63- 68.

Chattopadhyay, P. K. and Mukherjee, N. (1986). A pseudostem rot of banana due to *Erwinia chrysanthemi* pv. *paradisiaca*, *Curr. Sci*., **55** : 789-790.

Chattopadhyay, P. K. (1987). Soft rot, a threat to banana cultivation in West Bengal. *Indian Hort*., **31**(4) : 9.

Edward, J.C., Tripathi, S.C. and Singh, K.P. (1973). Observations on a "tip-over" disease of banana in Allahabad. *Curr. Sci*., **42** : 696-697.

Habtamu Tegen and Wassu Mohammed (2016). The role of plant tissue culture to supply disease free planting materials of major horticultural crops in Ethiopia. *J. Biology, Agric. & Healthcare*, **6** (1) : 122-129.

Khan, A. N. A. and Nagaraj, M. S. (1998). Occurrence of a new bacterial disease on banana in Karnataka, P. 32 : In *Annu. Meet. Symp. on Integrated Disease Management and Crop Loss Assessment*, Indian Phytopathological Society (Southern Chapter), UAS, Bangalore, held on December 10-12, p73.

Lakshmanan, P. and Mohan, S. (1986). Control of tip over disease of Cavendish banana. *South Indian Hort*., **34** : 336-339.

Nagaraj, M.S., Khan, A.N.A., Ravikumar, M.R. and Amarnanjundeswara, H. (2002). Management of tip over disease of banana, *Global Conference on Banana and Plantain*, Bangalore, India Oct., pp. 28-31.

Nagaraj, M.S., Umashankar, N., Palanna, K. B. and Khan, A.N.A. (2012). Etiology and management of tip-over disease of banana by using biological agents. *Internat. J. Adv. Bio. Res*., **2** (3) : 483-486 .

Nirmalajit Singh, B. S., Thind and Singh, Harnam (1979). Control of bacterial rot of potato tubers. *Indian Phytopathol*, **32** : 645-646.

Salazar, P.H. and Duque, S. (1994). Cultural and chemical control of the pseudostem pit (*Erwinia chrysanthemi pv. paradisiaca*) in *Musa* spp. *Fitopatol. Colomb*., **18** : 9- 13.

Saygili, H., Sahin, F., Aysan, Y. and Mirik, M. (2005). New symptoms of tomato soft rot diseases in Turkey, *Acta Hort*., 695.

Thammaiah, N., Kanamadi, V. C., Shirol, A. M., Satyanarayana Reddy, B. (2005). Management of rhizome rot or tip over disease of banana caused by *Erwinia chrysanthemi*, *J. Asian Hort*., **2**(1) : 62-63.

Thiyagarajan, V., Yenjerappa, S.T. Gururaj Sunkad, Aswathanarayana, D.S., Karuppaiah V. and Shaila, H.M. (2017). Survey on tip-over disease of banana caused by *Erwinia carotovora* subsp. *Carotovora* (Jones) Holland in Parts North Eastern Karnataka, India. *Int. J. Curr. Microbiol. App. Sci*,. **6** (6) : 2973-2976.

Vijayalaxmi, S.T. (2012). Studies on tip-over disease of banana caused by *Erwinia carotovora* subsp. *Carotovora* (Jones) Holland and its management. M. Sc. (Ag.) Thesis, University of Agricultural Sciences, Dharwad (Karnatka). India. pp. 54-57.

Vijayalaxmi, S. T., Rajput, Reena, Roopa, R.S. and Jahagirdar, Shamarao (2014). Studies on host-range of tip-over disease of banana caused by *Erwinia carotovora* subsp. *carotovora*. *Internat. J. Plant Protec.*, **7(1)** : 270-271.

Wardlaw, C. W. (1950). Banana diseases VIII, Notes on the various diseases occurring Trinidad. *Trop. Agric.*, **11** : 143-149.

Zutra, D. and Volcani Zafrira (1971). Bacterial soft rot and wilt of banana plants. *Rev. Pl. Pathol*., **50** : 279.