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Integrated management of Rhizome wilt of ginger with special reference to *Ralstonia solanacearum* (E F Smith) Yabuuchi *et al.*,

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Present investigation was carried out to evaluate commercially available antibacterial chemicals to find out their effectiveness against the growth of *Ralstonia solanacearum* (E. F. Smith) Yabuuchi *et al.* under *in vitro* condition and the results indicated that streptocycline had showed significantly superior efficacy over other treatments with highest inhibition (2.59 cm) at 500 ppm followed by K-cycline at 500 ppm (2.05 cm) and plantomycine (1.51 cm). All other chemicals *viz.*, copper oxychloride, copper hydroxide, plantguard and bromophol were least effective. The effectivity of streptocycline was found to be effective over a longer period. To test the efficacy of these chemicals,. A field experiment was conducted during *kharif* 2010 on the integrated management of ginger rhizome rot with special reference to *R. solanacearum* (E.F.Smith) Yabuuchi *et al.* The results indicated that among the different treatments, rhizomes of ginger treated with streptocycline at 0.5 g per lit + copper oxychloride at 2.0 g per lit + soil application of carbofuron + drenching with metalaxyl MZ 1 g per lit and drenching the streptocycline at 0.5 g per lit of water twice at 20 days interval starting with initiation of the disease recorded very less incidence (20.70%) when compared to control (49.85%). The maximum yield was 224.00 q per ha., whereas in control the yield was only 37.60 q per ha.

Key words: Rhizome wilt, antibacterial chemicals, *R.solanacearum,integrated management*

INTRODUCTION

India is considered as a *"magical land of spices"*. No other country in the world has such a diverse variety of spice crops as India. Indian spices are known for their excellent aroma, flavour and pungency not easily matched by any other country. India has been a leading spice-producing, consuming and exporting country of the world. Ginger (*Zingiber officinale* Rosc.) is one of the important spice crops of India. Commertially the dry rhizome derived from *Zingiber officinale* Rosc. It is an herbaceous perennial, but grown as an annual. It is the member of the family Zingiberaceae. Rhizome wilt has been an important threat to the cultivation of ginger since, it has been reported in 1907 by Butler from Surat area in Gujarat. The disease is usually caused by a fungus, bacteria, and plant parasitic nematode *Meloidogyne*. The wilts caused by fungi and bacteria are ultimately lead to rhizome wilt which are reported to be caused by *Fusarium oxysporium* f. sp. *zingiberi* Trugello and bacteria *Ralstonia solanacearum* (Smith) Yabuuchi *et al.*, in early stage of the crop (Joshi and Sharma, 1982,McRae, 1911). *Pythium* sp. is also noticed.(Rajan and Agnihotri, 1989)

MATERIALS AND METHODS

Chemicals each at three concentrations were evaluated for their efficacy against the growth of

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Ralstonia solanacearum by inhibition zone method. The bacterium was multiplied by inoculating the culture into 20 ml of nutrient broth taken in Earleyenmayer's flask. The inoculated flasks were incubated at 30°C for 72 h. The bacterial suspension was then seeded to the lukewarm nutrient agar medium (1000 ml). The seeded medium was poured into the sterilized Petriplates and plates were allowed to solidify.

The bactericides were prepared at different concentrations. The filter paper discs (Whatman no-44) measuring 5 mm in diameter were soaked in the respective chemical concentrations for 5 min and transferred onto the surface of seeded medium in the Petriplates. The inoculated plates were kept in refrigerator at 5°C for 4 h. to allow for the diffusion of chemicals into the medium. The plates were then incubated at 30°C for 72 h. The observations were made for the production of inhibition zone around the filter paper discs. The results obtained were analyzed statistically.

Chemicals were screened for their efficacy to check the incidence of rhizome wilt of ginger. This experiment was conducted in *kharif* 2010 (May-December) in farmer's field, Banavasi village in Sirsi taluk (Uttara Kannada district). The trial was laid out in completely Randomized block design (RCBD) with four replications in each treatment. The variety grown was *Himachal*. The land was prepared as per the requirements by addition of farm yard manure and fertilizers.

RESULTS AND DISCUSSION

In vitro evaluation of antibacterial chemicals

The use of chemicals has become an inevitable method in the management of plant disease particularly in ginger in the absence of availability of resistant varieties for Rhizome rot. Rhizome treatment along with soil application of chemicals give maximum protection against Rhizome-borne disease, which can also spread through Rhizome and soil.

In the present investigation, initially *in vitro* evaluation of seven antibacterial chemicals were tested at different concentrations for their efficacy against *Ralstonia solanacearum* using inhibition zone method. Results indicated that streptocycline had showed significantly superior over other treatments with highest inhibition (2.59 cm) at 500 ppm followed by K-cycline at 500 ppm (2.05 cm) and plantomycine (1.51 cm). However, all other chemicals *viz.*, copper oxychloride, copper hydroxide and plantguard were at par with each other, whereas, bromophol was least effective. (Table 1).

Interaction effect among the chemicals and concentrations indicated that streptocycline (500 ppm) and K-cycline (500 ppm) were found significantly superior over other treatments with an inhibition zone of 2.59 cm and 2.05 cm, respectively.

The effect of plantomycin and copper oxychloride were at par with each other at all the concentrations. They showed maximum inhibition zone of 1.51 cm (500 ppm) and 1.45 cm (4000 ppm) concentrations, respectively followed by copper hydroxide at 4000 ppm (1.03 cm).

Whereas, the effect of bromophol found least effective at higher concentrations. Bromophol at concentration of 300 and 400 ppm did not produce any inhibition zone only at 500 ppm it was found to be slightly effective (0.86 cm).

Chakravarti and Rangarajan (1966) studied *in vitro* efficacy of streptocycline on seven isolates of *Xanthomonas*, six isolates of *Erwinia* and one each of *Pseudomonas* and *Agrobacterium*. They found that the chemical was effective against all the pathogens.

Meena *et al.* (2007) evaluated the effect of four antibacterial chemicals like streptocycline, plantomycin, Copper oxy chloride and neem formulations under *in vitro* disc diffusion technique, he found that the streptocycline was most effective antibacterial chemical against *Ralstonia* and *Xanthomonas* spp. at 1000 ppm concentration.

A field experiment was conducted during *kharif* 2010 on the integrated management of ginger rhizome rot with special reference to *R. solanacearum* (E.F.Smith) Yabuuchi *et al.* In the farmer's field located at the hilly tracts of Uttara Kannada district of Karnataka. The soil was infected with the pathogen. Treatments were allocated under Randomized Completely Block Design (RCBD) as described

Table 1 : *In vitro* evaluation of antibacterial chemicals on the growth of *R. solanacearum*

Name of the chemical	Concentration (ppm)	Mean diameter of the inhibition zone(cm)
Streptocycline	300	1.56 (1.59)*
	400	1.67 (1.63)
	500	2.59 (1.89)
K-cycline	300	1.50 (1.58)
	400	1.55 (1.59)
	500	2.05 (1.74)
Plantomycine	300	0.87 (1.36)
	400	1.25 (1.50)
	500	1.51 (1.58)
Bromopol	300	0.00 (1.00)
	400	0.00 (1.00)
	500	0.86 (1.36)
Plant gaurd	1000	0.66 (1.29)
	2000	0.89 (1.38)
	3000	1.30 (1.52)
Copper oxychloride	2000	1.25 (1.50)
	3000	1.30 (1.52)
	4000	1.45 (1.55)
Copper hydroxide	2000	0.70 (1.30)
	3000	0.80 (1.34)
	4000	1.03 (1.42)
Control		0.00
Factor	SEm±	CD at 1%
Chemicals	0.0048	0.0183
Concentration	0.0031	0.0118
Interaction	0.0083	0.0316

*- Figures in the parenthesis are $\sqrt{x+1}$ +1 transformed values.

under Material and Methods and the observations were recorded on the per cent disease incidence and yield.(Table 2).

The results indicated that among the different treatments, rhizomes of ginger treated with streptocycline at 0.5 g per lit + copper oxychloride at 2.0 g per lit + soil application of carbofuron +

Table 2 : Integrated management of rhizome wilt of ginger with special reference to *Ralstonia solanacearum* (E.F.Smith) Yabuuchi *et al.*(Pooled data of 2009 and 2010)

Treatment	Treatment details	Per cent disease incidence(PDI)	Yield (Q/hac)	B: C ratio
T_1	Rhizome treatment with Streptocycline @0.5 gm/lit+ COC @2.0 gm/lit +soil application of Corbofuron + Drenching with Metalaxyl MZ 1.0gm/lit.	26.23 (30.79)*	215.53	5.29
T_2	T_1+ Drenching Streptocycline@ 0.5 gm/lit twice at 20 days interval starting from the initiation of disease.	20.70 (27.04)	224.00	5.40
T_3	T_1+Drenching with K-cycline@ 0.5 gm/lit twice at 20 days interval starting from the initiation of the disease.	21.20 (27.39)	220.50	5.30
T_4	T_1+ Drenching with Plant gaurd @2.0gm/lit+COC@ 2.0 gm/lit twice @ 20 days interval from the initiation of disease.	26.35 (30.87)	209.08	5.00
T_5	T_1+ drenching with COC@3.0gm/ lit twice at 20 days interval starting from the initiation disease.	36.65 (37.24)	174.53	4.20
T_6	Control	49.85 (44.90)	37.60	
	SEm ±	0.543	0.875	
	CD at 5%	1.63	2.637	

*arcsine transformed values

drenching with metalaxyl MZ 1 g per lit and drenching the streptocycline at 0.5 g per lit of water twice at 20 days interval starting with initiation of the disease recorded very less incidence (20.70%) when compared to control (49.85%). The next best treatment was rhizome treated with streptocycline at 0.5 g per lit + COC 2 g per lit + soil application of carbofuron + drenching with metalaxyl MZ 1.0 g per lit and drenching with K-cycline 0.5 g per lit twice at 20 days interval starting with the disease initiation which recorded a disease incidence of 21.20 per cent.

Apart from above, better drainage was maintained in the field as a good cultural practice, other cultural practices like proper land preparation, healthy planting materials, application of FYM and other nutrients have resulted in the good germination in treated plots.

Yield

The yield was significantly higher in treatments like rhizome treatment with streptocycline at 0.5 g per lit + COC at 2.0 g per lit + soil application of carbofuron + drenching with metalaxyl MZ 1.0 g per lit and soil drenching of streptocycline at 0.5 g per lit twice at 20 days interval from the onset of the disease, which gave a maximum yield of 224.00 q per ha, followed by T_3 (rhizome treatment with streptocycline at 0.5 g/lit + COC at 2.0 g/lit + soil application of carbofuran + drenching – metalaxyl MZ 1.0 g/lit and drenching with K-cycline at 0.5 g/lit twice at 20 days interval starting from the initiation of disease) which recorded a yield of 220.50 q per ha, whereas in control plot, the minimum yield was only 37.60 q per ha.

Indrasenan *et al.* (1981) suggested selection of healthy rhizomes, eradication of weeds and adoption of crop rotation as control measures to manage the disease effectively.

Ojha *et al.* (1986) observed that treatment of seed rhizomes with Emisan 6 + plantomycine for 30 min followed by three sprayings, 1st at 30th days after planting and other two spraying at an interval of 15 days also gave good control of the disease.

Singh *et al.* (2000) stated that streptomycin + streptopenicilline was superior over other antibiotics against the pathogen (*R. solanacerum*) under *in vitro* and *in vivo* conditions.

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