J. Mycopathol. Res. **43**(1) : 117-119 (2005)

Chemical control of bacterial wilt of ginger (*Zingiber officinale*) in hilly region of Darjeeling district of West Bengal

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Six antibiotics and three fungicides were evaluated for control of bacterial wilt of ginger in different doses. Out of six antibiotics tested as seed protectant terramycin @ 500 ppm was found to be most effective in terms of per cent plant mortality (11.11%), and yield (175 q ha^{-1}) followed by streptocycline and chloramphenicol @ 500 ppm over untreated control. Griseofulvin, ledermycin and penicillin also reduced the plant mortality but the efficacy was less than terramycin and streptocycline. In all the treatments good results were obtained at higher doses (500 ppm) as compared to lower doses (100 & 250 ppm). Fungicides viz blitox, bavistin and Bordeaux mixture were also effective in reducing plant mortality in ginger but the effect was not as good as antibiotics.

Key words : Chemical control, bacterial wilt, ginger, Darjeeling district

INTRODUCTION

India is the largest producer of ginger amongst the countries where it is commercially cultivated and contributes about 50% of the production of the world (Shanmugavelu *et al.*, 2002). It covers 80.71 thousand hectares of land devoted to ginger cultivation with a total production of 284.22 thousand tonnes (Shanmugavelu *et al.* 2002). West Bengal occupies about 8.01 thousands hecters of land under ginger cultivation with a production of 16.66 thousands tonnes (Shanmugavelu *et al.* 2002) of which hilly region of Darjeeling district occupies only 1.1 thousands hectare of land with a total production of 9.68 thousands tonnes (NARP report, ICAR Research Review Committee, BCKV 1982). The export potential of ginger from India is nearly 6.58 thousand tonnes worthing Rs. 2295 lakhs during 2000-2001 (Rabindran and Manoj Kumar 2001). The crop suffers from several diseases among them bacterial wilt (*Ralstonia solanacearum)* is a serious problem in Kerala and North-East specially in Sikkim and West Bengal (Sarma and Anandaraj 2000). Total crop loss due to this disease have been reported by Sarma and Anandaraj (2000) where as in West Bengal severity of disease is 1.05-25% (Chatterjee *et al.*, 1997).

In Darjeeling district this disease appears at its severe from causing total loss of the crop but very little has been done so far to combat the disease. Therefore, a control programme taking various antibiotics and fungicides has been undertaken to find out a suitable one for protection against the disease and enhancement of the crop yield.

MATERIALS AND METHODS

The experiment was conducted for two consecutive years i.e., during 1993 & 1994 at RR-SS, Pedong, Darjeeling, UVKV (Erstwhile B.C.K.V.). For this experiment randomized block design (RBD) was followed using 22 treatments. Cultivar used was Garubathan. The pieces of rhizomes weighing about 25-30 g were sown in 2 m × 2 m plot giving a spacing of 25 × 25 cm. Fertilizer used was F.Y.M. @ 40 tonnes/ha and N : P : K @ 50 : 40 : 80 kg/ha. Immediately after sowing the plots were covered with forest leaves. Six antibiotics viz. streptocycline, terramycine, griseofulvin, chloramphenicol ledermycin and penicillin were used @ 100, 250 and 500 ppm respectively. Three fungicides viz. blitox @ 3g/lit, bavistin @ 1g/lit and Bordeaux mixture (1%) were used. All the chemicals used as seed protectant for 2 h before sowing except 1% Bordeaux mixture which was used as soil drench 2 times at 15 days interval after emergence of plantlets.

The disease was assessed as per 0-4 scale ; where 0 = no infection ; 1 = 1-2 leaves from basal part sowing pale yellowing and slight rolling of leaves downward (25%) ; 2 = 3-4 leaves from collar region showing yellowing, rolling and drooping of leaves downwards (50%) ; 3 = 5-6 leaves showing yellowing, rotting and softening of basal stem, drooping of leaves, wilted but stem remain erect (75%) ; 4 = 7-10 leaves showing yellowing & drooping of leaves, stem rotted but broken from collar region, emits bad ordour (100%). The disease was recorded at fortnight intervals starting from onset to harvest of the corp. Disease control was calculated as suggested by Das and Raj (1995).

RESULTS AND DISCUSSION

It is evident from Table 1 that terramycin @ 500

Table 1 : Efficacy of different chemicals in controlling bacterial wilt of ginger.

Treatments	Plant mortality (%) 1993	Plant mortality (%) 1994	Plant mortality (%) (Pooled)
T_1 — Streptocycline — 100 ppm	46.48 (42.97)*	41.02 (39.66)	43.75 (41.40)
T_2 — Streptocycline — 250 ppm	38.75 (38.42)	41.35 (40.01)	40.05 (39.26)
T_3 — Streptocycline — 500 ppm	29.68 (32.99)	30.56 (33.54)	30.12 (33.26)
T_4 — Terramycin — 100 ppm	44.76 (41.98)	41.50 (40.06)	43.13 (41.05)
T_5 — Terramycin — 250 ppm	40.42 (39.37)	38.74 (38.39)	39.58 (38.89)
T_6 — Terramycin — 500 ppm	10.20 (18.18)	12.02 (19.83)	11.11 (19.47)**
T_7 — Griseofulvin — 100 ppm	50.19 (45.12)	45.95 (42.63)	48.07 (43.89)
T_8 — Griseofulvin — 250 ppm	49.55 (44.74)	43.45 (41.22)	46.50 (42.99)
T_9 — Griseofulvin — 500 ppm	47.64 (43.64)	43.52 (41.25)	45.58 (42.45)
T_{10} — Chloramphenicol — 100 ppm	45.76 (42.53)	46.76 (43.13)	46.26 (42.85)
T_{11} — Chloramphenicol — 250 ppm	44.16 (41.62)	41.02 (39.75)	42.59 (40.70)
T_{12} — Chloramphenicol — 500 ppm	35.28 (36.23)	31.38 (33.39)	33.33 (35.13)
T_{13} — Ledermycin — 100 ppm	46.53 (42.94)	40.97 (39.68)	43.75 (41.41)
T_{14} — Ledermycin — 250 ppm	43.52 (41.23)	41.56 (40.04)	42.54 (40.69)
T_{15} — Ledermycin — 500 ppm	37.27 (37.61)	33.31 (35.19)	35.29 (36.42)
T_{16} — Penicillin — 100 ppm	47.82 (43.73)	48.18 (43.96)	48.00 (43.84)
T_{17} — Penicillin — 250 ppm	44.76 (41.98)	45.95 (42.63)	43.35 (42.30)
T_{18} — Penicillin — 500 ppm	39.75 (39.11)	36.35 (37.05)	38.05 (38.08)
T_{19} — Blitox @ 3 g/l	49.23 (44.56)	44.99 (42.11)	47.11 (43.34)
T_{20} — Bavistin @ 1 g/l	48.45 (44.10)	44.31 (41.62)	46.38 (42.90)
T_{21} — Bordeaux mixture	45.50 (42.32)	46.90 (43.22)	46.20 (42.81)
T_{22} — Control (water)	99.00 (86.68)	100.00 (90.00)	99.50 (87.66)
SEm ±	3.093	3.054	2.093
CD (P = 0.05)	8.859	8.745	5.995

* Figures in the parenthesis are average transformed angular values.

Treatments	Disease control (%) (Pooled)	Yield q ha^{-1} 1993	Yield q ha^{-1} 1994	Pooled yield q ha^{-1}
T_1 — Streptocycline — 100 ppm	56.04 (48.48)*	124.40	138.00	131.20
T_2 — Streptocycline — 250 ppm	59.74 (50.62)	149.50	115.50	132.50
T_3 — Streptocycline — 500 ppm	69.69 (56.62)	168.30	154.70	161.50
T_4 — Terramycin — 100 ppm	56.61 (48.80)	141.10	123.90	132.50
T_5 — Terramycin — 250 ppm	60.27 (51.02)	122.10	161.30	141.70
T_6 — Terramycin — 500 ppm	88.81 (70.46)	182.00	168.00	175.00
T_7 — Griseofulvin — 100 ppm	51.61 (45.93)	112.00	132.00	122.00
T_8 — Griseofulvin — 250 ppm	53.25 (46.87)	117.00	131.50	124.25
T_9 — Griseofulvin — 500 ppm	54.20 (47.42)	118.50	137.50	128.00
T_{10} — Chloramphenicol — 100 ppm	53.55 (47.04)	119.30	105.70	112.50
T_{11} — Chloramphenicol — 250 ppm	57.22 (49.19)	133.00	145.00	139.00
T_{12} — Chloramphenicol — 500 ppm	66.51 (54.77)	143.50	156.60	150.00
T_{13} — Ledermycin — 100 ppm	55.94 (48.42)	108.70	121.30	115.00
T_{14} — Ledermycin — 250 ppm	57.20 (49.16)	127.70	142.30	135.00
T_{15} — Ledermycin — 500 ppm	64.49 (53.45)	131.20	153.00	142.10
T_{16} — Penicillin — 100 ppm	51.72 (45.99)	117.30	103.70	110.50
T_{17} — Penicillin — 250 ppm	54.14 (47.35)	137.33	119.17	128.25
T_{18} — Penicillin — 500 ppm	61.45 (51.59)	124.54	146.96	135.75
T_{19} — Blitox @ 3 g/l	52.63 (46.51)	102.80	137.20	120.00
T_{20} — Bavistin @ 1 g/l	53.30 (46.92)	91.00	136.00	113.50
T_{21} — Bordeaux mixture	53.64 (47.10)	123.00	97.00	110.00
T_{22} — Control (water)	—	11.25	5.75	8.50
SEm ±	2.048	14.691	17.339	12.894
CD (P = 0.05)	5.865	42.073	49.657	36.926

* Figures in the parenthesis are average transformed angular values.

ppm was most effective in terms of plant mortality (11.11%), per cent disease control (88.81%) and yield (175 q ha^{-1}) as compared to untreated control treatments where 99.50% plants were affected giving only 8.5 q ha^{-1} yield. But the effect of the antibiotic was less in case of lower doses i.e., 100 and 250 ppm. The next best result was obtained in case of streptocycline @ 500 ppm where 69.69% plant disease control was achieved along with 161.50 q ha^{-1} yield. But at 100 and 250 ppm. the effect was not so good as 500 ppm. Chloramphenicol and ledermycin @ 500 ppm reduced plant mortality by 33.33% and 35.29% respectively and resulted in a good amount of yield 150 and 142.10 q ha^{-1} respectively over control treatment but the effect was less as compared to terramycin @ 500 ppm. The efficacy of griseofulvin and penicillin was better over control treatment but as compared to terramycin its effect was not so good. Though blitox (3g/lit), bavistin (1g/lit.) and Bordeaux mixture (1%) provided some degree of protection (52.63%, 53.30% and 53.64% respectively) and increased in yield (i.e., 120, 113.50 and 110 q ha^{-1} respectively) over untreated control treatment but these fungicides were less effective as compared to terramycin.

It was also evident from the results that though all the antibiotics significantly reduced the incidence of bacterial wilt of ginger as compared to untreated control but efficacy varied with doses i.e., the dose 500 ppm was most effective in case of all the antibiotics tested as compared to 100 and 250 ppm. The present results confirm a similar type findings of Singh *et al.* (2000) in controlling the wilt of ginger caused by *Pseudomonas solanacearum* (*Ralstonia solanacearum*). They reported that antibiotics like streptomycin and streptopenicillin were very effective in controlling the pathogen at higher concentration at 500 & 1000 ppm.

Therefore, considering the results presented in Table 1 it can be concluded that terramyan @ 500 ppm was the most effective antibiotic in reducing the plant mortality and enhancement of yield. Thus, this antibiotic may be used as seed treating chemical for 2 h before sowing in Darjeeling and its adjoining areas.

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(Accepted for publication February 16, 2005)