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Linear reduction of propagules of *Ralstonia solanacearum* in soil by cake and chemicals

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ABSTRACT: In Alfisol of east India plateau soil application of karanj (*Pongamia glabra*) cake, bleaching powder ($CaClO_3$), lime ($CaCO_3$) and seedling dip and spray of streptocycline resulted in reduction of initial population of *Ralstonia solanacearum* (*R.s.*) in soil in post monsoon seasons of 1998-99 to 2001-02. The percent reductions in initial population of *R.s.* noted at 90 d after transplanting of tomato were 30.5 and 33.2 at 10 and 20 q karanj (*Pongamia*) cake ha^{-1}; 31.9 and 35.0 at 30 and 45 kg bleaching powder ha^{-1}; 28.6 and 27.9 at seedling dip and spray of streptocycline (500 ppm) and a mild reduction of 18.7 at 25 q lime ha^{-1} . The natural control process resulted in to 14.6% reduction as evident from untreated control. Based in linear equation reduction of initial population, it is suggested that bleaching powder and karanj cake are stronger bacteriostatic substance than lime and streptocycline.

Key words: Linear reduction, *Ralstonia solanacearum*, cakes, chemical

Ralstonia solanacearum (Smith) Yabuuci is a serious soil borne pathogen of solanaceous vegetables in summer, rainy and winter season. Among them, tomato (*Lycopersicon esculentum*) is one of the important vegetables, which suffers badly, because high temperature (28-36^{0}C) and high moisture (50-100%) favour the disease. The pathogen is wide spread on solanaceous vegetables in several states (Rao and Sohi, 1977). A total destruction of plant has been reported during rainy season in Asia and Pacific region (Persley, 1985). In India, the loss varied from 31.47 to 81.7% and 36.88 to 91.06% in fruit number and weight respectively (Ramkishun, 1987). However, the plant mortality and loss in yield ranged from 10 to 100 and 10.83 to 92.62% at different stages (Mishra *et al.,* 1995). Very little information on management of bacterial wilt has been reported through cakes as soil amendment (Miah *et al*., 1995), antibiotics (Rao, 1990; Rao and Ramkishun, 1986) and chemicals (Michel *et al.,* 1997). No information on mode of action of cake and chemical on bacterial propagalules of *Ralstonia solanacearum in vivo* is available and hence the study was done and the result is reported here.

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MATERIALS AND METHODS

The experiment was conducted in Randomized Block Design (R.B.D.) with 3 replications in plot size of 5 m^2 during post monsoon seasons of 1998-99 to 2001-02 on cv Pusa Ruby with eight treatments (i) Karanj (*P. glabra*) cake @ 10 q/ha (100g/plot) (ii) Karanj cake @ 20 q/ha (200g/plot) (iii) bleaching powder ($CaOCl_2$) @ 30 kg/ha (15g/plot) (iv) bleaching powder @ 45 kg/ha (22.5g/plot) (vi) streptocycline sulphate spray @ 500 ppm (5mg in one litre /plot (vii) streptocycline sulphate seedling dip @ 500 ppm (5mg in one litre suspension) for 30 minutes (v) lime ($CaCO_3$) @ 25 q/ha (1250g/plot) and (viii) untreated (control). The cake and chemicals were applied 15 days earlier to transplanting. Twenty-one days old seedlings were transplanted and recommended doses of NPK (100:70:60) was applied. The soil samples were collected at 0, 30, 60 & 90 days after transplanting and the bacterial count was made on 2,3,5-triphenyltetrazolium chloride (TTC) media (Kelman, 1954) by dilution method. The bacterial counts at different days were converted to Logit transformation (Van Der Plank, 1963) and the apparent infection rate (r) was calculated by the formula given below:

Apparent infection rate (r) = 1 / t_2-t_1 [log e (x_2 / (1-x_2) - log e (x_1/ (1-x_1)]

where t_1= initial time (in days), t_2 = final time (in days), x_1= initial count, x_2 = final count. The disease incidence and severity was noted as per scale of AVRDC (1991). The yield was recorded. The data were statistically analyzed and reported hereunder.

RESULTS AND DISCUSSION

Effect of karanj cake

The mean of four year's data revealed that there was a significant effect of treatments on reduction of *Ralstonia solanacearum* population in soil. At initial stage the *Ralstonia* population was (85.03 x 10^4 colony forming unit (cfu) /g soil) but the population decreased later on to 59.08 cfu x 10^4/g soil (Table 1). Karanj (*Pongamia*) cake resulted in 30.5 and 33.2% reduction in initial population at 10 and 20 kg /ha doses in which the apparent infection rate (r) was -0.0476 unit/day and r = -0.0535 unit / day, respectively at 30 day whereas the apparent infection rate was decreased to -0.0049 and 0.0112 unit/day at 90 day respectively. Further the incidence and severity of wilt was low, showing resistant reaction, and yield was 66.0 q/ha and 88.66 q/ha in respective doses indicating 95.7% and 162.9% increase in yield over control. The trend was of linear reduction type in both the doses (Fig: 1). Sharma and Kumar (2000) reported that karanj cake is effective in reducing the *Ralstonia* population, maximum plant survival and increase the yield (60.6 q/ha). *Pongamia* possess karanjin as active component responsible for insecticidal and antibacterial properties (Anonymous, 1982) which is toxic to gram negative bacteria and the cake has been reported to reduce the incidence of root knot nematode (*Meloidogyne javanica*) which is closely related with *Pseudomonas* wilt (Anonymous, 1982).

Effect of bleaching powder

At initial stage the *Ralstonia* population was (76.7. x 10^4 cfu /g soil) but the population decreased later on to 52.16 x 10^4 cfu /g soil at 90 day (Table 1). Soil application of bleaching powder @ 30 and 45 kg/ha also resulted in 31.9 and 35.0% reduction, respectively over in initial population. The apparent infection rate (r) = -0.0021 and -0.0293 unit per day was recorded at 30 day whereas it reduced to r = -0.0039 and -0.0104 unit/day at 90 day, respectively. Further the incidence and severity of wilt was low showing resistant reaction and yield was 68.52q/ha and 83.2 q/ha in respective doses indicating 103.1% and 146.7% increase in yield over control. The trend was found to be linear reduction in both the doses (Fig: 1). Sharma and Kumar (2000) reported that bleaching powder is effective in reducing the *Ralstonia* population. Bleaching powder ($CaOCl_2$) at the rate of 50 g/m^2 is reported to reduce bacterial wilt by 68.4% in potato (Verma and Shekhawat, 1991), 10 g and 5 g/litre in tomato (Mazumder, 1998), whereas in the present investigation it was used at the rate of 3 g/ m^2 which resulted in significant reduction of the pathogen.

Effect of streptocycline

At initial stage the *Ralstonia* population was (85.0. x 10^4 cfu /g soil) but the population decreased later on to 60.66 x 10^4 cfu /g soil at 90 days in seedling dip treatment whereas in spray treatment it was 77.49 x 10^4 cfu /g soil at initial stage and it reduced to 55.83 x10^4 cfu /g soil at 90 days (Table 1). These data indicate reduction in *Ralstonia* population by 28.64 and 27.95% respectively. Seedling dip treatment of Streptocycline @500 ppm resulted reduction in the apparent infection rate (r = -0.0497 unit/day) and spraying @500 ppm resulted in reduction of apparent infection rate (r = -0.1776 unit/day). Further the incidence and severity of wilt was low showing moderately resistant and resistant reaction and yield was 64.13q/ha and 54.13q/ha respective doses indicating 90.1%and 60.5% increase in yield over control. The trend was found to be linear in reduction in both the doses (Fig. 1) whereas the infection rate in control was higher (r = -0.0409 unit/day). Rao (1990) reported that streptocycline was most effective in reducing the *Pseudomonas solanacearum* in soil.

Effect of lime

At initial stage the *Ralstonia* population was 70.41. x 10^4 cfu/g soil but the population decreased later on to 57.24 x10^4 cfu /g soil at 90days (Table 1). Soil application of lime @ 25 q/ha also resulted in 18.7% reduction over in initial population. The apparent infection rate r = -0.0192 and -0.0051 unit per day at 30 and 90 days respectively. Further the incidence and severity of wilt was low showing

Table 1. Effect of organic and inorganic treatment against *Ralstonia solanacearum* during 1998-99 to 2001-02

Treatments	*Ralstonia solanacearum*/g soil at day					%	Apparent infection rate (unit /day)			Incidence	Yield
	0	30	60	90	Av. of 30, 60 &90	reduction by 90 day	30	60	90	(%wilt)/ Severity	(q/ha)
Karanj cake	$85.03X10^4$	$57.62X10^4$	$62.58X10^4$	$59.08X10^4$	$59.76X10^4$	30.5	-0.0476	-0.0070	-0.0049	8.65	66.00
@10q/ha	[5.696]	[5.637]	[5.690]	[5.670]	[5.673]					(15.88)	
	(1.735)	(0.306)	(0.515)	(0.368)						R	
Karanj cake	$91.15X10^4$	$67.49X10^4$	$52.45X10^4$	$60.83X10^4$	$60.25X10^4$	33.2	-0.0535	-0.0210	0.0112	9.88	88.66
@20q/ha	[5.577]	[5.638]	[5.600]	[5.710]	[5.631]					(15.70)	
	(2.338)	(0.738)	(0.100)	(0.439)						R	
Bleaching	$76.7X10^4$	$63.41X10^4$	$55.12X10^4$	$52.16X10^4$	$56.89X10^4$	31.9	-0.0214	-0.0115	-0.0039	12.8	68.52
powder@	[5.495]	[5.657]	[5.579]	[5.575]	[5.576]					(18.65)	
30 kg/ha	(1.191)	(0.549)	(0.205)	(0.088)						R	
Bleaching	$83.49X10^4$	$69.74X10^4$	$61.79X10^4$	$54.24X10^4$	$61.92X10^4$	35. 0	-0.0294	-0.0086	-0.0104	7.8	83.2
powder@	[5.612]	[5.662]	[5.643]	[5.653]	[5.642]					(13.67)	
45 kg/ha	(1.621)	(0.740)	(0.481)	(0.168)						R	
Lime @25q/ha	$70.41X10^4$	$67.05X10^4$	$60.95X10^4$	$57.24X10^4$	$61.74X10^4$	18.7	-0.0192	-0.0090	-0.0051	14.75	54.46
	[5.727]	[5.641]	[5.649]	[5.722]	[5.685]					(18.96)	
	(1.289)	(0.713)	(0.443)	(0.290)						R	
Streptocyline	$85X10^4$	$56.04X10^4$	$54.62X10^4$	$60.66X10^4$	$57.10X10^4$	28.6	-0.0498	-0.0019	0.0083	22.25	64.13
(Seedling dip)	[5.604]	[5.628]	[5.539]	[5.699]	[5.617]					(26.39)	
	(1.735)	(0.241)	(0.185)	(0.435)						MR	
Streptocyline	$77.49X10^4$	$66.87X10^4$	$50.33X10^4$	$55.83X10^4$	$57.67X10^4$	27.9	-0.0177	-0.0230	0.0074	13.78	54.13
(Spray)	[5.549]	[5.750	[5.555]	[5.659]	[5.628]					(19.07)	
	(1.237)	(0.704)	(0.012)	(0.233)						R	
Control	$91.37X10^4$	$75.66X10^4$	$72.91X10^4$	$77.95X10^4$	$75.50X10^4$	14.6	-0.0409	-0.0489	0.0090	44.90	33.73
	[5.774]	[5.743]	[5.764]	[5.781]	[5.765]					(41.88)	
	(2.363)	(1.136)	(0.990)	(1.260)						MS	
CD (P0.05)	Days (A)	Treatment (B)	Interaction (AXB)		$20.46X10^4$					(10.34)	18.94
	NS	[0.0643]	NS								

Figures in parenthesis are [Log10] and (Logit value) of bacterial count (cfu), R = Resistant (0-20% wilt), MR = Moderately Resistant (21-40% wilt) MS = Moderately Susceptible (31-70% wilt) and S = Susceptible (71-90% wilt) and angular transformed value of incidence percentage

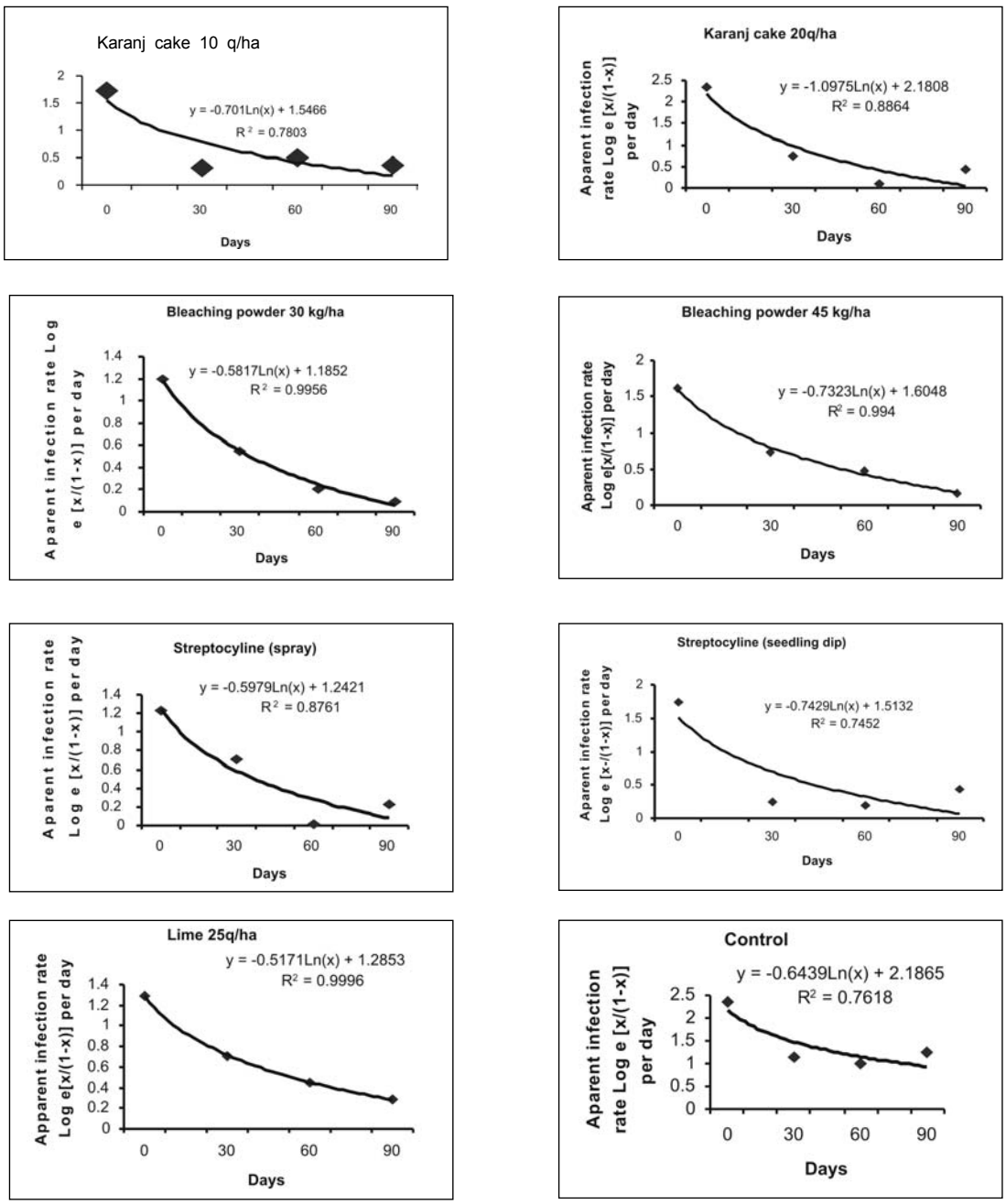

Fig. 1. Logarithmic reduction of *Ralstonia solanacearum* population under various doses of cake and chemicals (1998-99 to 2001-02)

resistant reaction and yield was 54.46 q/ha respective doses indicating 61.5% increase in yield over control. The trend was found to be linear in reduction (Fig. 1). Sharma and Kumar (2000) reported that lime is effective in reducing the *Ralstonia* population. It has been reported that lime ($CaCO_3$) is used for increase the pH towards neutral and increase the availability of nutrients in soil like calcium (Yamazaki *et al.*, 1996) magnesium ,phosphorous, boron and molybdenum which improve the plant health (Singh, 1991).

Hence it was concluded that all the treatments resulted in linear reduction of bacterial propagates

than control. Karanj cake resulted in 30.5 and 33.2% reduction in initial population with 10 and 20 kg/ha doses respectively whereas bleaching powder resulted 31.9 and 35.0% reduction with 30 and 45 kg/ha doses respectively and streptocycline resulted in 28.8 and 27.9% reduction in seedling dip and spray respectively over initial population. Bleaching powder and lime were found to be strong bacteristatis that was better in reduction of bacterial propagules while lime and streptocycline resulted mild bacteristatis.

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