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Management of Root Rot Disease in Medicinal Coleus through Integrated Disease Management (IDM) Modules

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Root rot disease in Medicinal Coleus is serious problem in all medicinal coleus growing parts of Tamil Nadu. Hence attempts were made to manage the disease through Integrated Disease Management modules. The field experimental results showed that the module I comprising Field sanitation + Soil application of Zinc sulphate (20kg/ha) + Dipping stem cuttings in *Pseudomonas fluorescens* (20g/lit of water) + Drench with (*Pseudomonas fluorescens* + *Trichoderma viride* + FYM + Neem cake (1:1:20:20). The mixture applied in the soil @ 100g/ plant on 30 DAP + Drenching *P. fluorescens* (0.1%) on 40 DAP repeat the drench 4 times at an interval of 15 days recorded the minimum root rot disease incidence 12.2 and 27.7 per cent on 45 and 90 DAP and recorded the highest tuber yield 5161 kg/ ha^{-1}compared to other modules with the CB ratio of 1:4.5 compared to control with root rot disease 33.0 and 80.0 per cent on 45 and 90 DAP and the lowest tuber yield of 899.7 kg/ ha^{-1}.

Key words: *Pseudomonas fluorescens,* Root rot, Medicinal Coleus, *Trichoderma viride,* Zinc sulphate, Integrated Disease Management modules.

Coleus forskohlii Briq is a perennial aromatic herb with fasciculate tuberous roots. It grows well in loamy and sandy loam soils of 6.4 to 7.9 pH of arid and semi arid climatic zones (Shah, 1989**).** It is cultivated commercially in India, Nepal, Srilanka, Burma and Thailand. In India it is cultivated in of about 2,500 hectares with annual production of 1500 tonnes in parts of Rajasthan, Maharashtra, Karnataka and Tamil Nadu.(Anand *et al* . 2008) In Tamil Nadu alone, it is cultivated in more than 1000 hectares across Salem, Attur, Kallakurichi, Thiruvannamalai, Thichy and Vellore regions (Rajamani *et al*., 1999). Among the many diseases root rot caused by *Macrophomina phaseolina* is the most wide spread in Tamil Nadu.

Many effective fungicides have been tested against soil borne pathogens but not considered as long term solution because of concerns about exposure risks, health and environmental hazards, high cost, residue persistence, development of resistance to pesticides and elimination of natural enemies. Biological control is a potential non-chemical means for plant disease management by reducing the harmful effects of a parasite or pathogen through the use of other living entities. Since the root rot disease is caused by soil borne fungus *M. phaseolina*, soil antagonists play a significant role in reducing the inoculum level in the soil. Hence the present investigations were undertaken to study the efficacy of Integrated Disease Modules to manage the root rot disease caused by *M. phaseolina* in Coleus.

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Materials and Methods

Field experiments were conducted at three disease hot spot areas of Tamil Nadu, India *viz.,* Kallipalayam, Kavunthampadi and Thuraiyur with four modules to manage to root rot disease in Coleus under natural sick plot conditions. The experiment was laid out in Randamized Block Design (RBD)with three replications. The root rot disease was calculated by percentage of infected plants among the total healthy plants on 45 and 90 days after planting. The growth parameters and yield were recorded at harvest. The treatment modules were as follows:-

Module I

Field sanitation + Soil application of Zinc sulphate (20kg/ha) +

Dipping stem cuttings in *Pseudomonas fluorescens* (10g/lit of water) +

Drench with the mixture (*Pseudomonas fluorescens* 1kg+ *Trichoderma viride* 1kg + FYM 20kg + Neem cake20 kg) 100g/plant on 30 DAP

Drenching *P. fluorescens* (0.1%) on 40 DAP repeat the drench 4 times at an interval 15 days interval + Drip Irrigation

Module II

Soil application of *T. viride* 2.5 kg/ha + Dipping stem cuttings in carbendazim (0.1%) +Drench with carbendazim (0.1%) on 45 and 90 DAP.

Module III

Dipping stem cuttings in carbendazim (0.1%) + Drenching carbendazim (0.1%) 30 DAP + Drenching copper oxy chloride (0.2%) at 45 DAP + Drenching carbendazim (0.1%) 60 DAP + Drenching copper oxy chloride (0.2%) 75 DAP

Module IV

Control (without any treatment)

Results and Discussion

The results of the field experiment conducted at Kallipalayam, Coimbatore dt. showed that the Module-I recorded the maximum reduction of root rot disease incidence 72.7 and 83.1 per cent on 45 and 90 DAP and recorded the highest tuber yield of 4050 Kg/ ha^{-1} (77.80% increased yield over control) followed by the Module-III recorded the reduction of root rot disease incidence 67.2 and 78.4 % on 45 and 90 DAP and recorded the tuber yield of 3814 kg/ ha^{-1} (76.40% yield increased over control). These two modules showed better performances compared to control which recorded maximum disease incidence 36.6% on 45 DAP and 85.7 % on 90 DAP with lowest tuber yield of 900 Kg/ ha^{-1}. (Table 1)

Table 1. Effect of treatment modules on root rot disease in Coleus (Kallipalayam)

Treatment	45 DAP		90 DAP			
	* Root rot per cent (%)	Per cent reduction over control (%)	* Root rot per cent (%)	Per cent reduction over control (%)	* Yield kg/ha	Per cent yield increase over control
Module I	10.0 $_a$(18.4)	72.7	15.0 $_a$(22.8)	83.1	4050 $_a$	77.80
Module II	31.0 $_b$(33.8)	15.3	42.8 $_b$(40.8)	50.0	2325 $_c$	61.30
Module III	12.0 $_a$(20.3)	67.2	18.5 $_a$(25.4)	78.4	3814 $_b$	76.40
Control	36.6 $_c$(37.3)	-	85.7 $_c$ (68.1)	-	900 $_d$	-

* Mean of three replications, Figures in parenthesis are arcsine-transformed value.

In a column, means followed by a common letter (s) are not significantly different at 5 per cent level by DMRT

The results of the field experiment conducted at Kavunthampadi, Erode dt. showed that the Module-I recorded the maximum reduction of root rot disease incidence 52.2 and 70.0 per cent on 45 and 90 DAP respectively and recorded the highest tuber yield of 5442 kg/ ha^{-1} followed by the Module-III recorded the reduction of root rot disease incidence 48.1 and 64.2 per cent on 45 and 90 DAP and recorded the tuber yield of 4200 kg/ha^{-1}. These two modules showed better performances compared to control which recorded maximum disease incidence 31.4 % on 45 DAP and % 77.3 on 90 DAP with lowest tuber yield of 949 kg/ha^{-1}. (Table 2)

Table 2. Effect of treatment modules on root rot disease in Coleus (Kavunthampadi)

Treatment	45 DAP		90 DAP			
	* Root rot per cent (%)	Per cent reduction over control (%)	* Root rot per cent (%)	Per cent reduction over control (%)	* Yield kg/ha	Per cent yield increase over control
Module I	15.0 $_a$(22.8)	52.2	24.0 $_a$(29..3)	70.0	5442 $_a$	82.60
Module II	27.7 $_b$(31.7)	11.8	36.6 $_b$(37.3)	53.4	3329 $_c$	43.73
Module III	16.3 $_a$(23.8)	48.1	27.7 $_a$ (31.7)	64.2	4200 $_b$	77.40
Control	31.4 $_c$(34.0)	-	77.3 $_c$(66.6)		949 $_d$	-

* Mean of three replications, Figures in parenthesis are arcsine-transformed value.

In a column, means followed by a common letter (s) are not significantly different at 5 per cent level by DMRT

The results of the field experiment conducted at Thuraiyur, Trichy dt. showed that the Module-I recorded the maximum reduction of root rot disease incidence 63.2 and 71.6 per cent on 45 and 90 DAP and recorded the highest tuber yield of 5990 kg/ ha^{-1} followed by the Module-III recorded the reduction of root rot disease incidence 47.4 and 66.0 per cent on 45 and 90 DAP and recorded the tuber yield of 5629 kg/ ha^{-1}. These two modules showed better performances compared to control

Table 3. Effect of treatment modules on root rot disease in Coleus (Thuraiyur)

Treatment	45 DAP		90 DAP			
	* Root rot per cent (%)	Per cent reduction over control (%)	* Root rot per cent (%)	Per cent reduction over control (%)	* Yield kg/ha	Per cent yield increase over control
Module I	11.4 $_a$(14.7)	63.2	21.7 $_a$(27.0)	71.6	5990 $_a$	85.8
Module II	20.6 $_c$(27.0)	33.5	31.0 $_c$(33.8)	59.4	4280 $_c$	80.1
Module III	16.3 $_b$ (23.8)	47.4	26.0 $_a$(30.7)	66.0	5629 $_b$	84.8
Control	31.0 $_d$(33.8)	-	76.5 $_d$(61.0)	-	850 $_d$	-

* Mean of three replications, Figures in parenthesis are arcsine-transformed value.

In a column, means followed by a common letter (s) are not significantly different at 5 per cent level by DMRT

which recorded maximum disease incidence 31.0 % on 45 DAP and 76.5 % on 90 DAP with lowest tuber yield of 850 kg/ ha^{-1} (Table 3)

The results of the field experiments (pooled data) showed that the Module-I recorded the minimum root rot disease incidence 12.2 and 27.7 per cent on 45 and 90 DAP and recorded the highest tuber yield of 5161 kg/ ha^{-1} followed by the Module-III recorded root rot disease incidence 14.76 and 24.0 per cent on 45 and 90 DAP respectively and recorded the tuber yield of 4882.3 kg/. ha^{-1} and in control recorded the maximum root rot disease 33.0 and 80.0 per cent on 45 and 90 DAP and the lowest tuber yield of 899.7 kg/ ha^{-1}. (Table 4). The results are agreement with Prasanthi *et al.* (2000) screened fungicides against the root rot pathogen *R. bataticola* under poisoned food technique and observed carbendazim (500µg/ml), propiconazole (500µg/ml)

Table 4. Effect of treatment modules on root rot disease in Coleus (Pooled data)

Treatment	*Root rot disease incidence (%) 45 DAP	*Root rot disease incidence (%)90 DAP	*Yield Kg/ ha^{-1}	CB ratio
Module I	12.2$_a$	21.7$_a$	5162.66	1:4.5
	(20.44)	(27.72)		
Module II	26.4$_c$	36.8$_c$	3312.00	1:2.3
	(30.93)	(37.32)		
Module III	14.76$_b$	24.0$_b$	4882.83	1:3.9
	(22.58)	(29.35)		
Control	33.12$_d$	80.0$_d$	899.17	-
	(35.13)	(63.45)		
CD(.05)	0.1951	0.1718	3.8937	

* Mean of three replications, # Figures in parenthesis are arcsine-transformed value.
In a column, means followed by a common letter (s) are not significantly different at 5 per cent level by DMRT

and chlorothalonil-SC (200µg/ml) were found to be effective against root rot of safflower. Gupta *et al*. (2002) reported that bacterization of peanut seeds with fluorescent *Pseudomonas* GRC2 resulted in increased seed germination, early seedling growth, fresh nodule weight, grain yield and reduced charcoal rot disease of peanut in *M. phaseolina*-infested soil as compared with control. Shanmugaiah *et al*. (2008) recorded increased dry weight and plant height with *Pseudomonas* sp. MML2212 and *P. fluorescens* on rice and green gram when compared with the control. Minaxi (2010) reported that seed bacterization with *P. fluorescens* BAM-4 reduced moong bean charcoal rot disease (85 percent) in *M. phaseolina* infested soil as compared to control.

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