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INTEGRATED MANAGEMENT OF WILT COMPLEX OF *COLEUS FORSKOHLII*

YASHODA R. HEGDE*, R. AMMAJAMMA AND C. K. VENUGOPAL[1]
*Department of Plant Pathology, [1]Department of Horticulture
University of Agricultural Sciences, Dharwad - 580 005, Karnataka, INDIA
e-mail: uasyashoda@rediffmail.com

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***Corresponding author**

ABSTRACT
Wilt of *Coleus forskohlii* is a disease complex caused by *Rhizoctonia bataticola* (Taub.) Butler, *Fusarium chlamydospourm* (Frag. and Clif.), *Sclerotium rolfsii* Sacc. and *Ralstonia solanacearum* (Smith) Yabuuchi. Field experiments were conducted for two years (2007-08 and 2008-09) to develop the integrated management strategies for wilt complex. Results indicated that wilt complex was effectively managed by dipping the cuttings in 0.1% carboxin + thiram before planting followed by drenching the same fungicide at 30 days after planting. This treatment recorded maximum yield and next best treatment was soil application of FYM @ 10 t/ha + *Trichoderma harzianum* @ 25 kg/ha.

INTRODUCTION

Coleus forskohlii (Wild.) Briq. (Syn *Coleus barbatus* Benth. = *Plectranthus barbatus* Ander.) is an important medicinal plant which is of Indian origin (Valdes *et al.,* 1987)and belongs to the family Lamiaceae. It is the most important species of genus Coleus and is popularly known as 'Manganiberu' or 'Makhandi beru' (Kannada), Patharchur (Hindi), Pashan Bhedi (Sanskrit), Garmai (Gujarati), Koorkan Kilangu / Marundu Koorkan (Tamil) and Maimnmul (Marathi). It is a subtropical and warm temperate crop naturally grown at an altitude of 2500 MSL elevation. It is cultivated in Arabia, Brazil, Egypt, Ethiopia, India, Nepal, Pakistan, Sri Lanka, and Tropical East Africa. In India, the crop is cultivated in parts of Gujarat, Rajasthan, Maharashtra, Karnataka and Tamil Nadu on a large scale. It is the only known source of forskolin, an important diterpenoid used in the treatment of glaucoma, asthma, hypertension, congestive cardiomyopathy and certain types of cancers (Shah *et al.,*1980) However, the commercial cultivation and production of this important medicinal plant has been hampered due to the occurrence of wilt complex.(Ammajamma, 2010; Ramaprasad, 2005; Boby and Bagyaraj, 2003). Hence, field studies were conducted to develop the integrated management strategies for management of wilt complex by using biocontrol agents, organic amendments and fungicides.

MATERIALS AND METHODS

A field trial was undertaken for two years, *i.e.* during *Kharif* 2007-08 and *Kharif* 2008-09 at Medicinal and Aromatic plants Unit, Saidapur farm, University of Agricultural Sciences, Dharwad (UAS), Dharwad. In the experimental plot, the wilt causing fungal pathogens (*R. bataticola, F. chlamydosporum and S. rolfsii*) were added to the soil to make the soil wilt sick. Eight treatments were laid out in randomized block design (RBD) with plot size of 3.0 m x 3.0 m (gross size). Three replications were maintained for each treatment. Planting of coleus cuttings was done at a spacing of 45 x 30 cm. Rooted coleus cuttings of 15-20 cm with 4-5 pairs of leaves were taken for planting. Fertilizers were applied @ 10: 24: 20 kg N: P: K /ha. Treatments were imposed by dipping the rooted cutting in the fungicides and bioagents solution just before planting and the second treatment was done at 30 days after planting by drenching the soil with fungicide and biocontrol agents solution, FYM was applied to the soil only once before transplanting.

Treatment details

Soil application of Farm yard manure (FYM) @ 10 t/ha
Soil application of FYM @ 10 t/ha + *T. harzianum* @ 25 Kg/ha
Soil drenching of *T. harzianum* @ 25 Kg/ha
Soil drenching of propiconazole @ 0.1%
Soil drenching of carboxin + thiram @ 0.1%
Soil drenching of mancozeb @ 0.2%
Soil drenching of carbendazim + mancozeb @ 0.1%
Untreated control

Observations were recorded for per cent disease incidence at 60 and 120 days after planting (DAP) and yield. Results were analyzed statistically.

RESULTS AND DISCUSSION

Per cent disease incidence (PDI)

Experiment was conducted for two years and per cent disease incidence was recorded twice i.e. 60 and 120 days after planting (DAP) and pooled analysis was done.

PDI at 60DAP

Results presented in Table 1 indicate that wilt incidence was more at 120 days after planting compared to 60 days after planting. All treatments have reduced disease incidence significantly compared to untreated control except FYM. Carboxin + thiram treated plot recorded minimum of 4.10 per cent disease, this was followed by FYM + *T. harzianum* treatment (6.10%) which was at par with carbendazim + mancozeb. (8.10%)

PDI at 120 DAP

The lowest wilt incidence was recorded in carboxin + thiram treatment(8.90%)which was on par with FYM + *T. harzianum* treatment(11.8%). These two treatments were statistically on par with each other.Next best treatment was carbendazim + mancozeb (14.8%) and was followed by *T. harzianum*(18.7%). Among the treatments, maximum disease incidence of 24.40 per cent was observed in FYM. Untreated control plots recorded highest disease incidence of 32.20 per cent and it is statistically superior over all other treatments. Results clearly indicated that maximum suppression of disease was observed in carboxin + thiram treatment and FYM + *T. harzianum* and was followed by carbendazim + mancozeb treatment. Application of fungicides like carboxin and carbendazim and biocontrol agents for management of wilt complex in different crops was documented by different scientists. (Singh *et al*., 2011**;** Tariq *et al*., 2012) *In vitro* and in *vivo* studies on efficacy of six fungicides against *Fusarium oxysporum* f sp. *lentis* causing wilt of lentil revealed that carbendazim and carboxin completely inhibited the growth of fungus (Singh *et al*., 2010). Result of Merkuz and Getachew (2012) showed that the potential of *Trichoderma* in reducing chickpea wilt incidence and delaying disease onset. They concluded that biological control agents such as *Trichoderma* can be a useful component of integrated management strategy. Application of *T. viride* + Neem based product applied to the soil resulted in lowest wilt complex in coleus (Kulkarni *et al.*, 2007). Application of Trichoderma was very effective in managing wilt in different crops like lentil, potato and tomato. (Said *et al*., 2013; Farkhondeh and Masoud, 2012; Nirupamadevi *et al*., 2013; Christopher *et al*., 2010). Nigam (1997) pointed out mycoparasitism when intimate association exists between the pathogen and the biocontrol agent and involves coiling of hyphae around the pathogen, penetration, production of haustoria and lysis of hyphae. Use of FYM in this treatment provided food base for multiplication of *T. harzianum* which is an effective biocontrol agent against wilt complex (Garret,1965; Montealegre and Henrique, 1990).

Table 1: Effect of biocontrol agents, organic amendments and chemicals on disease incidence in *Coleus forskohlii*

Tr. No.	Treatments	Per cent Disease Incidence at 60 DAP			PDI At 120 DAP		
		2007-08	2008-09	Pooled data	2007-08	2008-09	Pooled data
1	FYM @ 10 t/ha	15.56(23.19)*	15.48 (23.16)	15.90(23.45)	28.89(32.47)	18.89 (25.73)	24.40(29.57)
2	*Trichoderma harzianum* @ 25 kg/ha	11.11(19.42)	9.52 (17.96)	10.20(18.63)	23.33(28.84)	15.57 (23.14)	18.70(25.66)
3	FYM @ 10 t/ha + *T. harzianum* @25 kg/ha	8.89(17.27)	3.57 (10.89)	6.10(14.19)	13.33(21.14)	11.00 (19.36)	11.80(20.17)
4	Propiconazole @ 0.1%	12.22(20.41)	4.76 (12.60)	7.70(16.19)	21.11(27.24)	12.22 (20.41)	17.10(24.38)
5	Carboxin + thiram @ 0.1%	7.78(16.11)	1.19 (6.26)	4.10(11.64)	10.00(18.27)	9.00 (17.45)	8.90(17.41)
6	Mancozeb @ 0.2%	12.22(20.41)	7.04 (15.34)	9.60(18.02)	25.55(30.22)	13.33 (21.31)	18.60(25.51)
7	Carbendazim + mancozeb @ 0.1%	11.11(19.42)	4.76 (12.60)	8.10(16.51)	17.78(24.91)	12.22 (20.41)	14.80(22.61)
8	Untreated control	17.78(24.91)	21.11 (27.24)	18.80(25.72)	33.33(35.25)	28.89 (32.47)	32.20(34.57)
SEm		1.69	2.00	1.54	2.59	1.92	1.52
CD at 5%		3.63	5.50	4.68	5.56	4.12	4.61

*Figures in parenthesis indicate arc-sine transformed values; DAP = Days after planting; PDI = Per cent disease incidence

Table 2: Effect of biocontrol agents, organic amendments and chemicals on yield of *Coleus forskohlii*

Tr. No.	Treatments	Yield(Fresh wt. q/ha)		
		2007-08	2008-09	Pooled data
1	FYM @ 10 t/ha	30.00	58.17	44.33
2	*Trichoderma harzianum* @ 25 kg/ha	28.00	53.24	41.75
3	FYM @ 10 t/ha + *T. harzianum* @ 25 kg/ha	42.82	72.56	55.13
4	Propiconazole @ 0.1%	28.71	60.71	43.47
5	Carboxin + thiram @ 0.1%	44.29	75.47	58.25
6	Mancozeb @ 0.2 %	27.78	42.76	34.51
7	Carbendazim + mancozeb @ 0.1%	37.04	67.87	53.27
8	Untreated control	13.89	30.48	22.12
SEm		2.60	2.49	5.56
CD at 5%		5.57	5.32	16.86

DAP = Days after planting

Yield

Pooled data analyses indicate that all treatments have increased the yield significantly compared to untreated control. Yield in 2008-09 was more in general compared to 2007-08. Maximum yield was recorded in carboxin + thiram(58.25q/ha) and was on par with FYM + *T. harzianum* treatment(55.13q/ha), carbendazim +mancozeb (53.27q/ha). (Table 2). Similar results were observed in bellpepper by Tariq *et al*., 2012. Yield was minimum in untreated control (22.12q/ha) and was at par with mancozeb (34.51q/ha).

Results indicated that wilt complex in coleus can be managed effectively by soil drenching with carboxin+thiram @0.1% or soil application of FYM + *Trichoderma harzianum* @25kg/ha and increased the yield significantly.

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