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RESEARCH ARTICLE

Field management package for anthracnose, a destructive disease of *Jatropha curcas* L. - A bio-fuel yielding perennial species

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SUMMARY

In lab assays fifteen fungitoxicants were evaluated against *Colletotrichum gloeosporioides* causing anthracnose of Jatropha. Among six fungicides, carbendazim, chlorothalonil, propiconazole and mancozeb showed cent per cent mycelial growth inhibition at both test concentrations (500 and 1000ppm). In nine fresh leaf plant extracts, *Prosopis juliflora* efficiently inhibited mycelia growth (96.22%) followed by *Azadirachta indica* (86.67%) at 100ppm. In field evaluations under nursery level done with 4 fungitoxicants, 0.2 per cent mancozeb (0.0005) and 0.1 per cent carbendazim (0.0006) were efficient in reducing disease severity index (DSI) over control. Similarly, rate of disease development (r) over initial was very low in 0.2 per cent mancozeb (0.0033) and was high in control (0.0099). Recorded data on per cent defoliation at 60 days of second spray was least in 0.2 per cent mancozeb (12.29%) imposed treatment over untreated (21.92%) indicating timely spraying with 0.2 per cent mancozeb as best management package.

Key Words **:** Anthracnose, Bio-fuel, Defoliation, Fungicide, Plant extract

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Sustained supply of good quality seeds is most essential for successful afforestation or reforestation net works starting from nursery to plantations in majority of forest trees. Seeds of some species are in great demand for their valuable oils as fuel or as a base in soap and cosmetic industries. Our country has potentials to meet only 30 per cent of total fuel demands and loosing huge sums of money on fossil fuel imports. In context of increased fossil fuel, import costs in India, bio-fuel sources like tree borne oil seeds are getting higher importance (Parthiban *et al.,* 2009). Among the biofuel plants, *Jatropha curcas* L. native to South America and Africa has taken a lead in commercial cultivation. Its properties like hardness, rapid growth, easy propagation, wide adaptability, 25-30 per cent bio-degradable oil recovey/kg of seed and other usefulness made it to spread beyond its origin.

Due to commercialization through extensive nursery and plantation networks diseases are becoming one of the bottle necks (Suryanarayana *et al.,* 2010). In northern parts of Karnataka it suffers from nine diseases and anthracnose incited by *Colletotrichum gloeosporioides* cause huge economic loss through premature defoliation, flower and fruit drop (Chavhan, 2008). Considering seriousness of problem, the present investigation on field evaluation of effective fungicides and plant extracts as evidenced from *in vitro* studies was carried out.

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MATERIALS AND METHODS

The field management study was carried out at college of forestry, Sirsi, Karnataka during 2009-2010. In the field management trial, jatropha nursery raised at college of forestry of Sirsi taluk recorded highest incidence and severity in disease survey was selected. The site is situated at a latitude and longitude of 14^0 36.410^1 N and 074^0 50.825^1 E with an annual rainfall of 2500 mm. Based on *in vitro* studies, the best proven fungicides and plant extracts in mycelia growth inhibitions were selected for field evaluations at nursery conditions. The treatments employed were, carbendazin 50% W.P. (0.1 %), tridemorph 80% EC (0.1%), mancozeb 75%W.P. (0.1%) and fresh leaf extract of *Prosopis juliflora* (10%). The experiment was statistically planned in a completely randomized block design (CRBD). Concentration wise three replications were done for each of the treatments and simultaneously a check with 3 replications without any imposition of fungi-toxicants was also maintained. 100 seedlings of same age were selected in each replication with labeling of treatments to be imposed was done. The experiment was planned with two sprays at an interval of 30 days from 15th of April month. Utmost care was taken to do sprayings in the air drift free periods mostly in the early mornings and in avoiding admixtures of planned fungi-toxicants.

Disease severity estimates :

The observations on disease severity and defoliation rate were recorded before initial spray and at 30 days interval after first and second spray up to 3 months. The disease severity grade (DSG) was calculated by following the procedure adopted by Balachandra (2003) with some modifications as given below.

Description	Foliage infection	DSG
No symptoms	Healthy	0
Low (L)	Up to 25 % foliage infected	1 (0.1-1.0)
Medium (M)	26- 50 % foliage infected, more than 10 % defoliation	2 (1.1- 2.0)
Severe (S)	More than 50% foliage infected, more than 20% defoliation	3 (2.1-3.0)

Further, disease severity index (DSI) was calculated by using the below given formula as described by Mohanan and Sharma (1985).

$$\mathrm{DSI} = \frac{(\mathrm{nLx1}) + (\mathrm{nMx2}) + \mathrm{nSx3}}{\mathrm{N}}$$

where nL, nM and nS indicate total number of plants with low, medium and severe disease grades, 1, 2, 3 indicate DSG for low, medium and severe infection, and 'N' shows total number of plants assessed.

Rate of disease development :

For assessing the best field performing efficacy of a fungi-toxicant against any compound interest disease both DSI and rate of disease development are equally important. As anthracnose is compound interest disease, production of inoculum and infection process is continuous and progressive with time from the time of inception of infection. The inoculum load goes on increasing in logarithmic scale and simultaneously the amount of available healthy susceptible tissue goes on decreasing with time. Gradually healthy tissue becomes a limiting factor and with this, production and spread of the inoculum gets lowered. Based on this principle, rate of infection 'r' was calculated by using the formula suggested by Van Der Plank (1963).

$$r = \frac{2.3}{t_2 - t_1}\left(\frac{\log X_2}{1 - X_2} - \frac{\log X_1}{1 - X_1}\right)$$

where, r = Apparent rate of infection spread, X_1= Disease severityindex (DSI) at time t_1, X_2= Disease severity index (DSI) at time t_2, and t_2 -t_1= Time interval in days between two consecutive observations.

Disease induced premature defoliation rate :

For full proof field efficacy assessments, additional parameter of recording premature defoliation rate was done. Number of defoliated leaves were recorded at each time of observation by keeping total leaves in first reading as reference. Defoliation rate of all seedlings at scheduled observation dates was recorded. Finally defoliation rate of all seedlings were pooled and the mean defoliation rate was calculated. Further, it was converted into per cent scale and expressed as per cent defoliation rate.

RESULTS AND DISCUSSION

The results of different management treatments on DSI and rate of disease development (r) under nursery conditions are presented in Table 1. After 30 days of first spray (DAFS), the treatment effects differed significantly with each other for disease severity index (DSI). Among the tested fungicides and plant extracts, mancozeb (Dithane M-45 75% W.P.) [0.1%] recorded highly efficient in reducing DSI (0.0019) followed by 0.1 per cent carbendazim (Bavistin 50%W.P.) [0.0022] and 10 per cent fresh leaf extract of *Prosopis juliflora* (0.0026). Where as, in the observations of 30 days after second spray (DASS) lowest DSI was in 0.1 per cent tridemorph (Calixin 80% EC) [1.08] followed by mancozeb (1.10). The trend remained same even after 60 DASS.

The rate of disease development (r) was found correlated with level of DSI irrespective of 'after spray observation period'. However highest 'r' was in control (0.0028) followed by fresh leaf extract of *Prosopis juliflora* (0.0011) and mancozeb (Dithane M-45 75% W.P.) [0.1%] recorded lowest (0.0005) in the final reading of 60 DASS. The best performance of mancozeb can be attributed to high fungicidal property with long lasting antipathogenic activity in the host. This can further be claimed to vapour phase activity ensuring protection of gaps on leaf surface resulting from weathering or expansion

Disease	Host	Causal organism	Authors
Leaf spot and leaf blight	*Syzigium cuminii*	*Cylindrocladium quinqueseptataum*	Mehrotra and Mehrotra (2000)
Cylindrocladium white mold	*Jatropha curcas*	*Cylindrocladium jatrope*	Chavhan (2007)
Stem canker	*Jatropha curcas*	*Pestalotiopsis mangiferae*	Pandey *et al.* (2006)

Table 1: Influence of management treatments on disease severity and rate of disease progression against anthracnose of *Jatropha curcas* under nursery condition

Treatment detail	DSI and disease progression							Defoliation (%)		
	Before spray	30 DAFS		30 DASS		60 DASS		30 DAFS	30 DASS	60 DASS
	DSI	DSI	r	DSI	r	DSI	r			
T_1 - Control	1.16	1.30	0.0035	1.47	0.0036	1.62	0.0028	9.61	16.76	21.92
T_2 - Mancozeb-75% W. P. @ 0.2%	1.01	1.07	0.0019	1.10	0.0009	1.21	0.0005	6.48	9.60	12.29
T_3 - Tridemorph 80% EC @ 0.1%	0.96	1.04	0.0027	1.08	0.0012	1.19	0.0009	6.72	10.84	14.08
T_4 - Carbendazim 50% WP @ 0.1%	1.02	1.09	0.0022	1.12	0.0009	1.25	0.0006	6.33	9.78	12.79
T_5 - *Prosopis juliflora* @ 10%	0.99	1.07	0.0026	1.13	0.0017	1.24	0.0011	7.29	12.96	17.08
Mean	1.03	1.11		1.19		1.26		7.28	11.99	15.63
SEm ±	0.14	0.06		0.07		0.06		0.45	0.68	0.81
CD at 5%	N.S.	0.18		0.20		0.16		1.18	1.68	1.96

N. S. – Non significant, DAFS –Days after first spray, DASS – Days after second spray, DSI – Disease severity index, r- Rate of disease development

of leaf area. These findings are in accordance with earlier workers as listed below.

The defoliation rate was found to be minimized to the maximum extent by mancozeb (Dithane M-45 75% W.P.) [0.1%] (12.29%) followed by 0.1 per cent carbendazim (Bavistin 50%W.P.) (12.79%) and the highest was in untreated seedlings (21.92). The treatments differed significantly among themselves with respect to defoliation rate. Such evidential reduction of defoliation or delay in defoliation is also observed in leaf spot or blight treated with mancozeb (0.1%) on broad leaved species such as *Poplar, Albizzia* and *Dalbergia* by Nagel (1949). He speculated that the sprays of effective fungicides help to delay the defoliation. Similar findings were reported for *Mycosphaerella* leaf disease of *Eucalyptus* with 19.89 per cent defoliation in treated (2.5kg/ha Chlorothalonil and 0.5kg/ha Benomyl) and 63 per cent in control (Carnegie and Ades, 2002).

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