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Screening of Eucalyptus Planting Stock for Cylindrocladium Leaf Blight In Tarai Region, Uttarakhand

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ABSTRACT

Screening of the planting stock of 24 clones belonging to *Eucalyptus camaldulensis* (7 number), *Eucalyptus tereticornis* (15 number) and urograndis (2 number) along with a seedling population of *E. tereticornis* (control) for *Cylindrocladium* Leaf Blight (CLB) was carried out at R&D Centre of WIMCO Ltd. Bagwala, Rudrapur, Uttrakhand. Results revealed significant variation in the studied parameters viz., plant height, collar diameter, number of leaves completely infected, number of leaves partially infected, number of leaves without infection, disease rating, and mortality of the seedling and clonal planting stock. The locality received excessive rains during the year of study (2008) which favored heavy infestation of the disease. Categorization of clones according to mortality and disease rating indicated clonal plants of *E. tereticornis* to be more susceptible to CLB in comparison to that of other clones.

Keywords:
Eucalyptus, *Cylindrocladium* leaf blight, disease rating, infestation,

INTRODUCTION

India with 3.9426 million ha planted eucalypts leads the world with 20% share in its plantations (www.git.forestry.com). The species is planted through out the length and breadth of the country except in very high hills and a few other locations. Grower's preference to plant eucalypts is based on its wide adaptability to varying soil and land types, fast growth, high productivity, relatively low maintenance in comparison to some other farm grown species, narrow crown of trees favoring its integration with agricultural crops mainly in rows or lines along agricultural fields and ready local market for the sale of its timber. The species has now become a back bone and in some locations a life line for paper and pulp industry, besides, it is also used for numerous other purposes. For farmers, the tree is a source of economic security against crop failures, readily available resource for immediate urgencies and a cash crop to supplement their meager earnings from the limited agricultural holdings.

Cylindrocladium species are wide spread, damaging and well documented fungal pathogens of eucalypts in many countries (Keane et al., 2000, Old et al., 2003). These cause a variety of diseases to eucalypts including root and collar rot, shoot blight, leaf blight and foliar spots (Crous et al., 1991; Sharma and Mohanan 1982, 1991b). Out of 39 documented *Cylindrocladium* species, 24 are listed as pathogens of *Eucalyptus* species and 15 of these have been found in South-East Asia (Crous, 2002). Sharma and Mohanan (1982) have reported 6 *Cylindrocladium* species viz., *C.*

quinqueseptatum, *C. ilicicola, C. floridanum, C. parvum, C. curvatum and C. scoparium* that were found to be associated with various diseases of *Eucalyptus* spp. in the state of Kerala, India. *C. quinquesaptatum* Boedijn & Reitsmo (syn. *C. reteaudii* (Buga) Boesew is the most serious and casual organism of eucalypts, cause *Cylindrocladium* leaf blight (CLB) in nurseries and plantations and has been responsible for epidemic infestation in several countries including India, Australia, Vietnam, Laos and Thailand (Old et al. 2003). According to Whyte (1993), CLB is becoming recognized as the greatest threat to eucalypt plantations in South-East Asia.

CLB is common in the nurseries where conditions favour its culture and spread. In India, the CLB has been frequently reported from the state of Kerala (Sharma et al. 1984) and occasionally from Punjab (Rattan and Dhanda 1985). In the state of Uttarakhand, CLB has invariably been observed on planting stock of eucalypts especially that of *E. citridora* grown at R&D Centre, Bagwala, Rudrapur. Year 2008 had unusual high rainfall during the greater period of warm months (Fig. 1). These warm and humid weather conditions favoured CLB infestation on the planting stock of different eucalypts species grown at the center. This report is based on the screening of the eucalypts planting stock (both seedlings and clonal) grown for its supply to the farming community.

MATERIAL AND METHODS

The present screening of the eucalypt planting stock was carried out at R & D center of WIMCO Limited, Bagwala, Rudrapur, Udham Singh Nagar, Uttarakhand. The site is situated at 28°N latitude, 78°E longitude and at altitude of 200 m above mean sea level and lies near the foothills of Uttarakhand in a narrow strip called Tarai which receives around 1500 mm average rainfall per annum. Cuttings of 24 eucalypts clones (7 of them belonging to *Eucalyptus camaldulensis*, 15 to *Eucalyptus tereticornis* and 2 to urograndis: *Eucalyptus urophylla* X *Eucalyptus grandis*) procured from different sources (Table 1) were placed in 90 cc root trainers filled with vermiculite under the mist chamber conditions. On successful rooting in 30 days period, these were shifted into 270 cc root trainers filled with a potting mixture containing one part of soil, two parts of sand and two parts of compost. Seedling population of *E. tereticornis* was also raised and treated as control. Seedlings of another eucalypt species viz., *E. citridora* raised at the center had 100% mortality due to CLB infection and therefore these were not included in the present analysis.

Sever infection of *CLB* was noticed during July- August 2008. Observations on per cent mortality, number of leaves completely infected, number of leaves partially infected, number of leaves without infection, disease rating (overall and each for upper, middle, lower portions), height and collar diameter of plants were recorded on 4th of August 2008 from 10 plants maintained in each of four replicated plots in a randomized block design. The disease rating was assessed as per the scale (Kolte, 1985) given in Table 2. The data of the study were statistically analyzed by using analysis of variance (ANOVA) for Randomized Block Design (RBD).

Table 1: Eucalypts clones along with their source used in the study

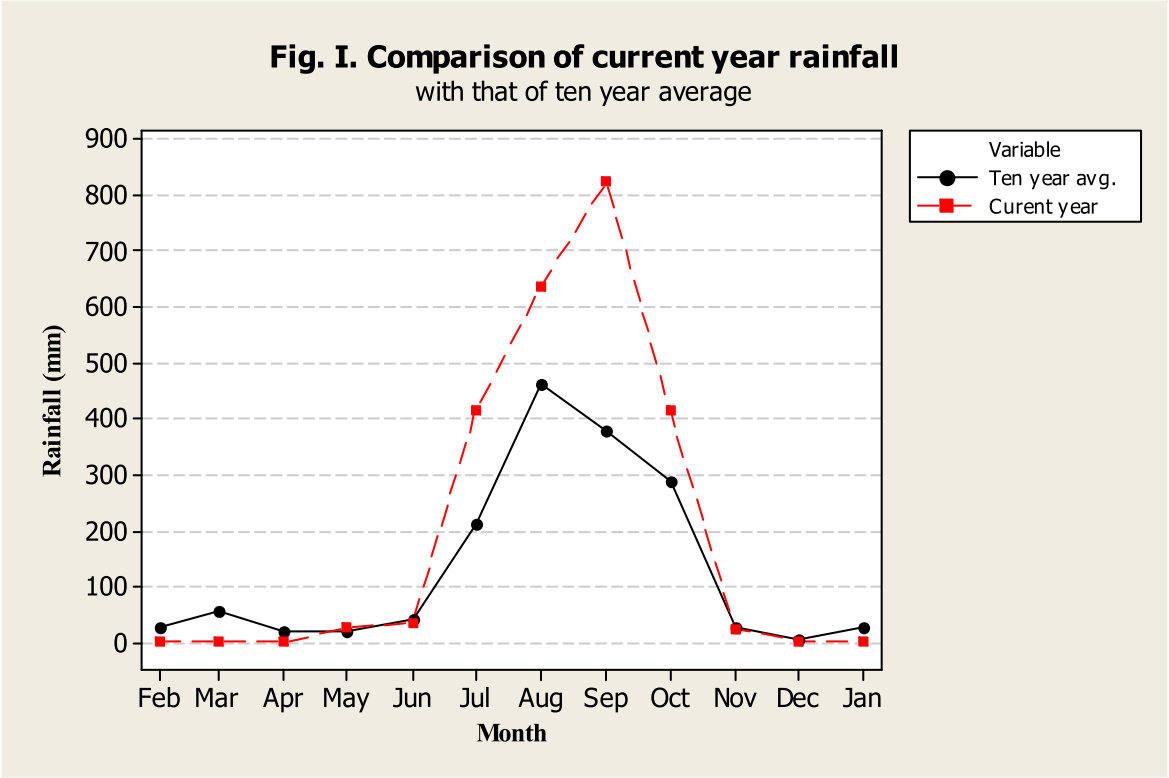
Sr. No.	Species	Clone	Source
1	E. camaldulensis	413, 411, 2045, 3, 7, 10	ITCB
2	E. camaldulensis	K25	KFRI
3	E. tereticornis	W36, WT165, 316, W104, WT51, WT37, W - B7, WB10, WB6, WB33, WB4, WB9, WB35, W231, W231	WIMCO
4	Urograndis	2135, unnamed	ITCB
5	E. tereticornis	Seedlings	Local

(ITCB: ITC Badhrachalam, WIMCO: WIMCO Ltd., Rudrapur, KFRI: Kerala Forest Research Institute, Peechi, Kerala).

There was unusual high rainfall during the year when 2382 mm rainfall occurred in the locality, most of which was distributed between June to September 2008. Ten years average rainfall (Negi, 1998) compared with that of the study year, 2008 is presented in Fig-1.

Table 2. CLB rating according to infection

Scale	Leaf Infection
0	No infection/Incidence
1	1-20% foliage infected with disease
2	21-40% foliage infected with disease
3	41-60% foliage infected with disease
4	61-80% foliage infected with disease
5	81-100% foliage infected with disease



RESULTS AND DISCUSSION

Data given in Table 3 indicates significant differences in the mean values for height and non-significant differences for that of collar diameter of plants among the studied species. Maximum average plant height of 38.7 cm was recorded in *E. camadulensis* clonal plants which was significantly higher than that of clonal and seedling plants of *E. tereticornis* but statistically at par with that of urograndis plants. Species used in this trial have shown varying degree of mortality due to fungus attack, maximum was recorded in clonal *E. tereticornis* followed by that in clonal urograndis, *E. tereticornis* seedlings and minimum in clonal *E. cameldulensis* plants. Clonal *E. camaldulensis* plants have shown significantly less mortality in comparison to other species used in this study. *E. citridora* had a severe infection of CLB resulting in 100% mortality of its seedlings at the center. Partially and

completely infected leaves were significantly higher in *E. teraticornis* than in other species. Disease rating also indicates higher infestation of CLB on *E. tereticornis* followed by that in *E. camaldulensis* and urograndis plants. The study is in agreement with the findings of Sharma and Mohanan (1992) and Whyte (1991) who reported variation in CLB infection in eucalypts species. Sharma and Mohanan (1991) reported linking of susceptibility ranking of eucalypts provenances with the specific physiologically and genetically different strains of *C. quinqueseptatum*.

Table 3: Interspecies variation for CLB infection in eucalypts

Species	Stock type	Plant		Leaves*			Disease rating				Plant mortality (%)
		Height (cm)	Collar dia.(cm)	Completely infected	Partially infected	Not infected	Upper	Middle	Lower	Overall	
E. camaldulensis	Clonal	38.7	0.2	3.2(26.50)	7.7(63.56)	1.2(9.93)	1.8	3.0	4.1	2.9	49.2
E. tereticornis	Clonal	35.3	0.2	4.2(30.71)	7.9(57.72)	1.6(11.57)	2.3	3.5	4.3	3.4	74.5
Urograndis	Clonal	37.6	0.2	2.7(27.73)	56.0(62.27)	01.0(9.99)	1.4	2.3	2.5	2.1	71.5
E. tereticornis	Seedlings	31.1	0.2	6.5(26.97)	12.5(51.87)	5.1(21.16)	3.4	4.8	5.9	4.7	68
Mean		35.7	0.2	4.10	8.5	2.20	2.2	3.4	4.2	3.3	65.8
SEdiff.		0.50	NS	0.29	0.95	0.23	0.27	0.16	0.17	0.16	2.25
CD at 0.05		1.13		0.66	2.15	0.52	0.61	0.36	0.38	0.36	5.09

*Data in parenthesis is percent of total leaves infected and no-infected.

Data given in Table 4 indicates significant variation for all the studied parameters among the clones. Clone 10 produced plants with maximum mean height of 51.9 cm which were significantly taller than that of most other clones including that of E. tereticornis seedlings. Similarly, Clone 7 and Clone W-231 which produced plants with maximum collar diameter of 0.3 cm, were significantly thicker over all other clones including seedling control. Plant mortality was maximum in E. tereticornis clones when compared with clones of other species and in most cases the differences were statistically significant. Table-5 categorized clones according to the mortality per cent and all the clones showing more than 70% mortality belong to E. tereticornis, whereas, those with minimum mortality belong to E. camaldulensis.

Table 4: Clonal variation for CLB infection in eucalypts planting stock

Species	Clone No.	Plant		Leaves			Disease rating				Plant mortality (%)
		Height (cm)	Collar dia.(cm)	Completely infected	Partially infected	Not infected	Upper	Middle	Lower	Overall	
E. camaldulensis	413	41.9	0.2	4.1(30.60)	6.8(50.75)	2.5(18.66)	2.3	3.4	4.9	3.5	52
E. camaldulensis	411	25.3	0.2	1.2(13.64)	6.7(76.14)	0.9(10.23)	1.3	2.4	4.4	2.7	28
E. camaldulensis	2045	41.2	0.1	2.2(22.11)	7.7(77.39)	0.05(0.50)	2.0	3.4	4.0	4.1	64
E. camaldulensis	3	27.3	0.2	2.8(33.29)	5.6(66.59)	0.01(0.12)	3.4	4.5	4.6	3.2	63
E. camaldulensis	7	46.6	0.3	4.2(25.45)	11.3(68.48)	1.0(6.06)	1.7	3.4	5.0	2.8	66
E. camaldulensis	10	51.9	0.2	4.2(23.86)	9.4(53.41)	4.0(22.73)	0.4	1.3	2.9	3.1	10
E. camaldulensis	K25	36.6	0.2	3.9(36.76)	6.7(63.15)	0.01(0.09)	1.3	2.4	2.7	3.7	62
E. tereticornis	W183	31.9	0.2	7.7(52.03)	5.8(39.19)	1.3(8.78)	2.0	3.1	4.0	3.5	85
E. tereticornis	W36	28.9	0.1	1.5(19.06)	6.3(80.05)	0.07(0.89)	2.3	3.7	4.7	4.2	80
E. tereticornis	WT165	35.5	0.2	5.1(28.80)	12.6(71.15)	0.01(0.06)	2.0	3.7	4.9	3.4	82
E. tereticornis	316	40.2	0.2	2.8(30.08)	6.5(69.82)	0.01(0.11)	3.5	4.2	4.7	1.5	70
E. tereticornis	W104	46.3	0.2	2.3(7.49)	13.6(44.3)	14.8(48.2)	1.7	3.20	4.8	3.2	73

E. tereticornis	WT51	41.7	0.2	2(22.20)	7(77.69)	0.01(0.11)	3.6	4.5	4.7	4.3	62
E. tereticornis	WT37	39.7	0.2	4.8(40.37)	7(58.87)	0.09(0.76)	3.3	4.7	4.2	4.1	78
E. tereticornis	WB7	31.5	0.2	6.2(38.04)	5.6(34.36)	4.5(27.61)	0.6	1.5	2.6	1.5	79
E. tereticornis	WB10	34.7	0.2	3.9(24.00)	12.3(75.69)	0.05(0.31)	1.6	3.2	4.6	3.1	83
E. tereticornis	WB6	33.1	0.2	4.5(30.61)	8.3(56.46)	1.9(12.93)	1.7	3.2	4.2	3	66
E. tereticornis	WB33	32.2	0.2	4.8(43.64)	5.2(47.27)	1.0(9.09)	3.6	3.4	3.5	3.5	59
E. tereticornis	WB4	31.1	0.1	2.6(32.06)	5.5(67.82)	0.01(0.12)	2.8	3.8	4.4	3.7	72
E. tereticornis	WB9	34.7	0.2	7.6(53.86)	6.5(46.07)	0.01(0.07)	3.0	4.1	4.9	4	79
E. tereticornis	WB35	30.5	0.2	5.7(44.85)	7(55.07)	0.01(0.08)	1.9	3.4	4.6	3.3	88
E. tereticornis	W231	37.7	0.3	1.7(14.98)	9.6(84.58)	0.05(0.44)	1.4	2.8	3.9	2.7	60
Urograndis	2135	34.1	0.2	12.5(21.19)	97.4(62.71)	1.9(16.10)	1.8	2.8	3.9	2.1	73
Urograndis	Unnamed	41.2	0.2	2.8(38.30)	4.5(61.56)	0.01(0.14)	1.1	1.9	1.6	1.5	71
Seedlings		31.1	0.2	6.5(26.97)	12.5(51.87)	5.1(21.16)	3.6	4.8	5.9	4.8	68
Mean		36.3	0.2	4.4	7.9	1.70	2.2	3.3	4.3	3.2	67
SEdiff.		5.6	0.032	1.3	1.7	0.59	0.71	0.58	0.18	0.48	7.01
CD at 0.05		11	0.06	2.5	3.2	1.15	1.39	1.14	0.35	0.94	13.74
CD at0.01		14.4	0.08	3.3	4.3	1.52	1.83	1.49	0.46	1.24	18.06

Like other parameters; completely infected leaves, partially infected leaves and those without infection also showed significant variation among clones. Almost all the clones had higher number of completely and partially infected leaves together in comparison to leaves without infection. Clone W130 and WB9 had higher number of completely infected leaves over others, whereas, clone W104, 7, WB10 and seedlings were having over 10 partially infected leaves per plant in comparison to a minimum of 4.5 partially infected leaves per plant in un-named urograndis clone. Number of leaves without infection ranged from nil (around 0%) in many clones to a maximum of 14.8 (48.21%) per plant in W104 clone.

Table 5: Categorization of eucalypts clones according to plant mortality.

Sr. No.	Mortality	Species	Clone/seedlings
	(%)		
1	>80	*E. tereticornis*	W183, W36, WT165,
2	70-80	*E. tereticornis*	316, W104, WT37, WB7, WB10, WB4, WB9, WB35,
		Urograndis	2135, Unnamed
3	60-70	*E. camaldulensis*	2045, 3, 7, K25
		E. tereticornis	WT51, W231, Seedlings
4	50-60	*E. camaldulensis*	413
		E. tereticornis	WB33
5	<50	*E. camldulensis*	411, 10

Disease rating for species, clones and categorization of clones according to disease rating given in Table 4, Table 5 and Table 6 respectively indicates significant variation for the disease rating among species and clones. Lower portion of plants had high disease rating than middle and upper portions of plants. Special characteristics of Tarai Region, viz., high temperature, high humidity, long rainy season, deep and moist alluvial soils with high water holding capacity, high

water table, damp and marshy soil sites at low lying locations (Negi, 1998) could provide favorable cultural conditions for CLB multiplication and infestation. The current year (2008) rainfall of 2382 mm in comparison to 1563 mm of ten year average (Fig.-I) appeared to have created very humid conditions for the development of CLB during the year in the locality.

Table 6: Categorization of eucalypts clones according to overall disease rating.

Sr. No.	Disease		Species	
	Rating	E. camaldulensis	E. tereticornis	Urograndis
1	>4.0	2045	W36, WT151, WT37 WB9, Seedlings	
2	3.0-4.0	413, 3, 10, K-25	W183, WT165, W104, WB10, WB33, WB4, WB35	
3	2.0-3.0	411, 7	WB6, W231,	2135, Unanmed
4	1.0-2.0		316, WB7	

Most biocliamtic studies on CLB report humid weather with high temperature responsible for its increased infestation. Bolland (1985) advocated that the outbreak of CLB occurs when weather is usually showery and humid with high temperature above 24-30°C. Booth et al. (2000) using bioclimatic mapping reported that annual rainfall >1400 mm and minimum temperature of the coldest month >16°C were useful predictors of high hazard. According to Graca et al. (2009), penetration of *C. pteridis* (CLB) occurs through stomata, and the percentage leaf area with lesions and defoliation increased with the increase in inoculum concentration (1×10^2 to 10^5 conidia mL^{-1}), duration of leaf wetness period (6 to 48 h), plant age (60 to 180 days) and the position of the leaves on the branches/stem.

Eucalypts culture in the locality is fast expanding in view of its ever increasing demand from newly established wood based units in and around Tarai Region. Most of the eucalypts seedlings stock is grown by the local small nursery growers in and around Rampur, U.P. who are exposed to CLB infection and its consequences like the ones recorded under this study. Eucalypts planting stock grown in these nurseries could be severely affected, sometimes leading to the death of the whole nursery stock by CLB under humid and warm weather conditions. There is therefore a need for developing resistant clones and seed sources for making future plantations and also devise effective control measures to keep the disease under control.

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