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GROWTH PERFORMANCE OF *CASSIA FISTULA* L. SEEDLINGS AS AFFECTED BY FORMULATED MICROBIAL INOCULANT

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Abstract

Microbial inoculant as effective microorganisms (EM) was applied to *Cassia fistula* to study its influence on growth and development of seedlings. EM solution at different concentrations (0.1, 0.5, 1, 2, 5 and 10%) were added in polybags a week before and after sowing seeds. Both germination and physical growth parameters of seedlings were found significantly higher in the treatment compared to control. Maximum growth was found at 2% EM solution. There was a higher amount of pigments in leaves of the treated seedlings.

Cassia fistula L. (Family: Leguminosae) locally known as 'Sonalu' is a medium-sized, multipurpose, deciduous tree species, which can grow on poor shallow to fairly good soil and in a wide range of temperature and rainfall conditions (Luna 1996). It is indigenous to Sri Lanka, Myanmar, Nepal and South India. This species has been introduced in different plantation programs like, agroforestry, community forestry, social forestry, village and farm forestry in different parts of Bangladesh. To fulfill the demand in these plantation programs many organizations are producing *C. fistula* seedlings in the nurseries but the initial growth potentiality under the influence of microbial inoculants like "Effective Microorganisms" or EM has not been studied so far.

The microbial inoculant used in this study, with a commercial name as EM, was developed at the University of Ryukyus, Okinawa, Japan, in the early 1980's (Kyan *et al*. 1999). The main components comprising EM are lactic acid bacteria, photosynthetic bacteria, beneficial fungi, yeast, ray fungi and others. The density of most of the above mentioned microbes are in the range of 10^6 to 10^8 cells per ml (Xu 2000). EM has been used with considerable success to improve soil quality and growth, yield and quality of crops, particularly in natural and organic farming systems (Xu 2000). The objective of this study was to observe the effectiveness of different concentrations of EM inoculants on germination and growth of *C. fistula* seedlings.

The experiment was carried out in the nursery of the Institute of Forestry and Environmental Sciences, University of Chittagong, Chittagong, Bangladesh. The seeds of *C. fistula* were collected from the seed orchard division of Bangladesh Forest Research Institute (BFRI). The soils, collected from the degraded hills of the University Campus was sieved (< 3mm) and mixed with decomposed cowdung in a ratio of 3 : 1. The brown hill soils are sandy loam to sandy clay loam, moderately to strongly acidic (pH <5.5), organic matter < 2.0%, CEC < 10 me/100g, BSP < 40% (Osman *et al*. 2001). Polybags of 15 × 10 cm size were filled with soil mixture and a 1 cm layer of coir was on top to reduce evaporation and to supply a source of organic matter. There were seven treatments including control, and there were three replications for each treatment while in a replication there were 20 polybags. Seeds sown in polybag soil without EM but with water only was considered as control. In the treatment polybag soils 0.1, 0.5, 1, 2, 5 and 10% of EM solution

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were added. In each polybag 50 ml solution of EM was added to soil one week before sowing the seeds. Three seeds were sown in a polybag and after germination only one seedling per polybag was allowed to grow. Partial shade was provided in the nursery to protect the seedlings from strong sunlight and rain.

Germination characteristics were recorded daily. The seedlings were allowed to grow for three months (April to June 2002). After three months, five representative seedlings from each replication of a treatment (15 seedlings for each treatment) were selected for measuring growth parameters. For recording dry weight, shoots and roots were oven dried at 70°C for 72 hours. Vigor index was calculated according to Abdulbaki and Anderson (1973) as germination per cent × seedling total length (total shoot and root length). Total dry biomass increment (%) was also calculated.

Chlorophyll a, chlorophyll b and carotenoid were determined from the second, third and fourth fresh leaves of seedlings from the top. Ten leaf discs were cut with a cork borer (5 mm), weighed and dipped in 5 ml 100% acetone in a test tube with stopper. After 24 hrs of incubation, the supernatant colored solution was decanted carefully in 25 ml volumetric flask, crushed with a blunt glass rod and 5 ml fresh acetone was added to the test tube and left for 15 min. Then the supernatant solution was again decanted to the same volumetric flask very carefully. The process was repeated until the leaf fragments became colorless. Finally the volume was made up to 25 ml with fresh acetone. Chlorophyll a, chlorophyll b and carotenoid were measured at 662, 644 and 440.5 nm wavelength, respectively, with Spectronic-20 spectrophotometer. The concentration of pigments in the extract was calculated following Wettstein (1957). Data were analyzed statistically by DMRT.

Table 1. Influence of different concentrations of EM on germination and vegetative characters of *Cassia fistula* three months after sowing.

Conc. of EM (%)	Germi-nation (%)	Length (cm)			Vigor index	Leaf no.	Fresh weight (g)			Dry weight (g)			Total dry biomass increment (%)
		Shoot	Root	Total			Shoot	Root	Total	Shoot	Root	Total	
Control	49 c	18.1 b	17.5 c	35.6 c	1744 c	10.0 b	2.54 b	1.32 c	3.86 d	1.26 c	0.76 c	2.02 d	00.00
0.1	53 b	19.3 b	19.1 b	38.4 b	2035 bc	11.2 ab	2.84 b	1.53 b	4.37 c	1.42 bc	0.83 b	2.25 c	+11.39
0.5	57 b	20.7 ab	20.6 b	41.3 ab	2354 abc	11.6 ab	3.07 ab	1.71 ab	4.78 b	1.50 abc	0.87 b	2.37 bc	+17.33
1	59 a	22.9 a	22.7 a	45.6 a	2690 ab	12.6 a	3.31 ab	2.04 a	5.35 ab	1.73 ab	1.21 a	2.94 ab	+45.54
2	64 a	24.4 a	23.1 a	47.5 a	3040 a	13.4 a	4.04 a	1.95 a	5.99 a	2.11 a	1.03 a	3.14 a	+55.44
5	65 a	23.9 a	22.8 a	46.7 a	3036 a	12.0 a	3.64 a	1.63 ab	5.27 ab	1.85 ab	0.86 b	2.71 b	+34.16
10	61 a	22.2 ab	20.6 b	42.8 ab	2611 ab	11.2 ab	3.12 ab	1.41 bc	4.53 b	1.64 abc	0.79 c	2.43 bc	+20.30

Means followed by the same letters in a column do not vary significantly at 5% level.

The highest germination was observed in 5% EM solution followed by 2 and 10%. The lowest germination was found in control. Highest shoot and root growth were observed in 2% EM solution and were significantly different from control and some other treatments. EM treated seedling showed more leaves. Vigor index was highest in 2% EM solution followed by 5% concentration and was significantly different from control and 0.1% EM solution (Table 1).

Total dry biomass increment (%) was highest in 2% EM solution followed by 1 and 5% (Table 1). Lim *et al*. (1999) mentioned that such a promotion might be due to the biological active substances in EM and Chowdhury *et al*. (1994) mentioned that it could be possible by the production of growth enhancing components such as IAA and gibberellins.

Chlorophyll a and carotenoid were highest in 2% EM solution and lowest in control (Table 2). Chlorophyll b was highest in 1% EM solution followed by 2 and 5% and was significantly different from control. Total pigment was highest in 2% EM solution and was significantly different from all other treatments except 1% EM solution. Total pigments increment (%) was positive for all the treatments compare to control.

Table 2. Influence of different concentrations of EM on pigments concentration in fresh leaves of *Cassia fistula* three months after sowing.

Concentration of EM (%)	Concentration of leaf pigments (mg/l)				Total pigment increment (%)
	Chloro-phyll a	Chloro-phyll b	Carotenoid	Total	
Control	16.49 b	7.44 b	13.50 b	37.43 c	00.00
0.1	17.24 ab	9.23 ab	15.24 ab	41.71 b	+11.43
0.5	16.65 ab	10.50 ab	14.34 ab	41.49 b	+10.84
1	19.17 a	12.94 a	16.08 a	48.19 a	+28.73
2	20.54 a	11.56 a	17.21 a	49.31 a	+31.72
5	17.58 ab	11.07 a	15.42 a	44.07 b	+17.73
10	18.03 a	8.99 ab	15.57 a	42.59 b	+13.78

Means followed by the same letters in a column do not vary significantly at 5% level.

The present results are in agreement with the findings of Xu (2000), Wang *et al*. (2000) and Mridha *et al*. (2002), who reported EM applied with organic fertilizers promote root growth and activity, and enhance photosynthetic efficiency and capacity.

It appeared that 2% EM solution could be used for getting maximum seed germination and seedling development of *C. fistula* in similar situation as mentioned in this paper.

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