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Influence of Different Inoculums and Nutrients on Formation and Growth of Ectomycorrhiza in Tropical Moist Deciduous *Shorea Robuta .Gaertn* of Northern Chattisgarh

KEYWORDS

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ABSTRACT *The present investigation deals with the suitability of different inoculums and fertilizer application on mycorrhiza formation and initial growth of Shorea seedling .The study revealed soil inoculums are more effective than the other inoculums which gave higher shoot length value (41.34 cm),followed by root based inoculums and spore based inoculums (32.70cm and 27.11 cm) respectively over control. Root length value was also higher in soil based inoculums over control (19.21 cm), followed by root based inoculums (14.45 cm) and spore inoculums (12.09cm). The same trends were found in case of live and total mycorrhizal count because soil based inoculums become highly in infective and its viability as well as suitability are more.*

The interaction effects of fertilizers and compost was noticed in Shorea robusta. In soil, the increase in root length was directly proportional to the fertilizer dosages. Significantly better lengths were obtained in soil and compost Significantly better root lengths were obtained in soil and compost (2:1) without fertilizer (33.6cm). In soil and compost (1:1) root length were poor and showed no significant differences at different fertilizer dosages though the tendency for increases in root length was observed at higher fertilizer dosages.

The result in Table-3 shows that addition of compost to soil (1:1) was not significant in Shorea robusta, addition of two part of soil and one part of composed soil (2:1) significantly improved shoot heigth (12.9cm) in Shorea robusta.

Addition of fertilizer at dosages 1N and above increased shoot height though such increase was significant only at 1N (14.6cm) and 4N levels (14.5cm) in Shorea robusta.The result shows that mycorrhizal development and dry weight of seedling was best in 1/2 normal NPK (63.75%) and moderate (26.60%) in 1/4 normal NPK and in treatment without Phosphrus (22.5%).

Introduction-

Mycorrhizal fungi are An integral part of practically all plant communities, natural or managed, and form the link by which mineral nutrients are transferred from the soil to the plant, while carbon compounds are transported in the opposite direction. Thus, They have a fundamental role in determining plant productivity and in the functioning of ecosystems. (Bethlenfalvay & Linderrnan,1992). Mycorrhizae are important for optimal root function. The symbiotic association increases uptake of relatively immobile nutrients, such as P, Cu and Zn (Faber *et al.,* 1990; Kothari *et al*., 1991; Li *et al*.,1991). Mycorrhizae also enhance uptake and transport of N (Hamel *et al.,* 1991; Johansen *et al.,* 1992,1993; Tobar *et al.,* 1994) and in contrast, often reduce Mn uptake (Kothari *et al*., 1991; Posta *et al.,* 1994).

Inoculation will be necessary if the presence of infection and effective mycorrhizal fungi are not adequate to ensure the proper growth of seedling. Several inoculation techniques have been developed for VA- mycorrhizal fungi (Hayman, 1987) and ecto-mycorrhizal fungi (Sylvia *et.al*.1987). Despite the fact that under many conditions, the benefits of inoculation are clear and the option technically exercisable, use of ecto-mycorrhiza fungi in plantations is not as widespread . Apart from natural soil and litter a wide range of inoculums forms have been used which include spores, crushed sporophores and mycelium. Inoculation with spores has been widely practiced, as spores are relatively easily applied by mixing in to nursery soils prior to planting in to nursery bed and seedling containers. Spore coating of seeds has been used in order to increase ectomycorrhiza formation (Theodorou and Bowen, 1973; Lamb and Richards, 1974; Marx *et.al*., 1989a ; De La Cruz *et. al*., 1998). Soil inoculum are more effective than spores in colonizing roots and they allow large scale production of single strains of fungi (Cordell *et. al.,* 1987, Marx *et. al.,* 1989b) are reported.

The high fertilizer application to nursery soils results in better plant growth and large root stock but development of mycorrhiza is poor. When such seedlings are planted in the field where fertilizers are not normally applied, the plants may die. Particulary in infertile soils due to poor development of mycorrhiza. With a view, to understand the relation between available soil nutrients at different level and development of mycorrhiza the experiment was conducted.

Material and Methods

1.Selection of suitable inocula

The experimental work were carried out in nursery of Department of Forestry ,Guru Ghasidas University, Bilaspur (C.G.).Fresh seeds of *Shorea* were immediately sterilized and sown in sterilized sand bed. Sand bed was fully covered with polythene sheet to prevents attack of air borne fungi and was regularly watered with distilled water until two leaved stage was attained.

Selection of suitable inoculam of ectomycorrhiza was made in pot experiments. The capacity of plastic pots, which were used for this experiment were of 5 litres and filled with mixture of sand + soil (1:1 v/v). The seedlings of *Shorea robusta* were carefully transferred to the plastic pots. The experiment was setup in randomized design. Each treatment was replicated thrice. The experiment was conducted for 120 days. In first treatment spore inculum was applied. Fresh sporocarps of *seleroderma geaster. fries*

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were collected. Each sporocarp was gently brushed to remove soil and organic matter, cut in to pieces (1-3cm) and blended at high speed for 1 minute in 200 ml of distilled water in a blender, dilutions were made in 100 ml distilled water to deliver the appropriate number of spores.. For inoculation 10 ml. of spore slurry was deposited at the top of the soil (Ingham & Massicottee, 1994).

Second treatment was made with 100 mycorrhizal root bits of 1/2 cm in each pot while third treatment was given by taking 25 gm of soil inocula having spores and root bits etc. Control was also setup simultaneously. After 120 days the shoot length, root length, mycorrhizal roots and numbr of spores were observed.

Seedlings Vigour Index (SVI) and seedling Vigour Index in Nursery (SVIN) Abdul-baki and Anderson (1973) and Mycorrhizal inoculation effect(MIE) Bagyaraj *et.al.,* (1989) was calculated.

2.Effect of the NPK level on development of mycorrhiza

An experiment was conducted in acid washed sand to ensure that no free nutrients was available at the outset. A nutrient solution containing NaH_2Po_4, 0-5g, Kcl-0.075g, $MgSo_4$.- 0.15g, and Ca $(NO_3)^2$ - 0.75g. in 1 liter distilled water was prepared and designated as 1 normal which contained 130 each of N and P and 39 of K parts per million. Different concentrations namely 1/4, 1/2 1, 2, 4 and 6 normal were prepared. In other lots one of each of the 3 elements, namely N or P or K was varied from nil to 6 N, keeping the other two elements at the normal level the concentration of which is indicated in the normal solution. Control experiment without nutrients was also maintained. The treatment of NPK level 1/4, 1/2, 1, 2, 4 and 6 Normal was given with 25 gm soil inoculum. After 5 month the dry weight of seedling, total number of short root, including uninfected and infected both and ectotrophic mycorrhizal growth was recorded .

3.Effect of Compost and fertilizer on growth of *Shorea robusta*-

An experiment was conducted using natural substrate like - soil, soil and compost in the ration 2:1 and 1:1. NPK fertilizer mixture containing 1.5 parts of nitrogen, 1 part of phosphorus and 1 part of potassuim was designated as 1 normal. The normal NPK dosage contained 67.5 g Nitrogen in the form of Ammonium Sulphate (20% N), 56.2 g of Phosphorus in the form of Superphosphate (16% P) and 15 g Potassium in the form of murate of Potash (60% K). The each of the 3 substrates, NPK fertilizers at the rate of 0, 1/4, 1/2, 1, 2, 4 and 6 N were added total 15 treatments and 6 replicates were kept for each treatment. The experiment was setup in randomized design. The *Sal* sedling raised in pots as test plants. 25 g soil inoculum containing active mycorrhiza was introduced with the transplant. Control was also setup simultaneously. After 1 years the shoot length, root length, number of short roots and number of infected roots were observed.

Results

Mycorrhizal colonization is a complex multi-step processes, in which the mycorrhizal association is influenced not only by both the host plant and the AM fungi, but also by soil and other environmental conditions (Barea, 1991). If any one of these factors is inhibitory to AM fungi, the symbiosis will be inhibited even if other factors are optimum.

It is clear from Table -1 soil based inoculums was highly infective and its viability and suitability are more which gave higher shoot length value(41.34 cm),followed by root based inoculum and spore based inoculums(32.70cm and 27.11 cm)respectively over control. Root length value was also higher in soil based inoculums over control (19.21 cm),followed by root based inoculums(14.45 cm)and spore inoculums(12.09 cm). The same trends were found in case of live and total mycorrhizal count . Jammaluddin and Chandra (1999) reported that the inoculum with soil, spore and roots were found effective for growth and biomass of *Bambusa nutens* .

The effect of inoculation on different growth parameters of growth in *Shorea robusta* has been tabulated in Table-2 which shows that the germination percent was higher in inoculated plants as compared to control. Inoculation gives 18% gain in germination percentage. Shoot length and root length have been improved by 50.46% and 13.13%, respectively as compared to control (un inoculated). Due to the inoculation, shoot and root weight (fresh) also increases by 60.99% and 31.53%, respectively as compared to control. The same trend was also recorded in improvement of dry weight of shoot (57.67%) and dry weight of root (48.48%) as compared to the control. Survival percentage also increased by 26.47% as compared to control.

The result shows that mycorrhizal development and dry weight of seedling was best in 1/2 normal NPK (63.75%) and moderate (26.60%) in 1/4 normal NPK and in treatment without P (22.5%). In 2N phosphorus (10.1%) and in treatment where N is absent (8.40%) infection was moderate. For other levels, infection was sporadic or absent. Infection was scare or mostly absent at higher dosages of NPK. These results are similar to those found by Hatch, 1937; Mitechel *et. al.,* 1937; Bjorkman, 1942, 1949; Doak, 1993; Fowells and Karuss, 1959; Hacskaylo and Snow, 1959). The lower levels of NPK supported better development of mycorrhizal infections.

The dry weight of seedling in different treatments with fertilizers did not show any significant differences. This is possibly due to the fact that nutrients are readily available to seedlings. In control series with fertilizer (-NPK) with inoculums (0.37%) was higher in comparison to (-NPK) without inoculums. Fertilizer and compost practices can be expectant to have large effects on tree fungus association and to affect tree growth responses to inoculation. Although effects of soil P and N supply on root colonization and host growth have been quantified for seedlings growing under glass house and nursery conditions, there have been few comparable studies on field sites. An experiment was conducted to study the growth parameters and mycorrhizal development through fertilizer compost interaction on the *Shorea robusta* as a test plant.

The result in Table-3, shows that addition of compost to soil (1:1) was not significant in *Shorea robusta,* addition of two part of soil and one part of composed soil (2:1) significantly improved shoot height (12.9cm) in Shorea robusta. Addition of fertilizer at dosages 1N and above increased shoot height though such increase was significant only at 1N (14.6cm) and 4N levels (14.5cm). An extremely high N level in soil may directly repress AM fungi. (Liu *et al*,2000). Onguene and Habte (1995) did not find a correlation between shoot N/P ratio and root colonization level, but they did not consider levels of soil available N limiting or directly suppressing AM fungi.

Interaction effect of different fertilizer dosages varied with substrates. The height growth was directly proportional

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to the fertilizer dosages in soil, with compost at two levels added to the soil, best growth usually occurred at 1N (14.6cm). No significant effect on shoot dry weight has obtained in different substrate.

The result in Table-3 shows that addition of compost to the soil had no effect on root length in *Shorea robusta*. With fertilizers, root length increase with increases in fertilizer dosages and significantly at 4N level (40.9cm).

The interaction effects of fertilizers and compost was noticed in Shorea robusta. In soil, the increase in root length was directly proportional to the fertilizer dosages. Significantly better root lengths were obtained in soil and compost (2:1) without fertilizer (33.6cm). In soil and compost (1:1) root length were poor and showed no significant differences at different fertilizer dosages though the tendency for increases in root length was observed at higher fertilizer dosages.

No significant effect of root dry weight was obtained in different substrates. However, root dry weight increased with increase in fertilizer dosages and was significant at 1N (0.99g) and 4N level (0.74g)The result in Table-3 shows that neither the substrates nor the fertilizer had any effect on nubmer of short roots. The interaction effect showed that in soil the number of short roots decreased with higher dosages of fertilizer. At 1N level the number of short root was highest (142) as compare to other treatments. Infection was inversely related to fertilizer dosages. The decreases are significant at 2N level (262). The interaction effects were not significant in all treatments.

It is concluded that addition of compost or fertilizers resulted in better plant growth but the dosages for optimum growth may vary. Compost or fertilizers individually or in combination possessed a depressing effect on the production of short roots and mycorrhizal roots.

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Table:1-Effect of different type of inocula on growth of *Shorea robusta*

Treatment	Shoot length	Root length	Live mycorrhiza
Spore inoculums	27.11	12.09	145
Root inoculums	32.70	14.45	171
Soil inoculums	41.34	19.21	205
Control	13.75	9.55	30
SEM+	5.79	2.05	37.96
CD at 5%	26.03	9.24	170.79

Table:2-Effect of inoculation on growth parameters of *Shorea robusta*

Parameters	Inoculated	Control	% gain in comparison of control
Germination %	46.00	32.00	18.00
Shoot length(cm)	42.80	21.21	50.46
Root length(cm)	33.00	28.60	13.13
Shoot fresh wt(g)	06.64	2.59	60.99
Root fresh wt(g)	2.60	1.78	31.53
Shoot dry wt(g)	2.41	1.02	57.67
Root dry wt(g)	0.99	0.51	48.40
Survival%	94.40	73.53	26.47

Table:3-Effect of N,P and K level on growth of *Shorea robusta*

Group	Treatments	No. of Short root		Dry weight of seedlings(g.)	Ecto-trophic growth of inoculums
		Total	Infected(%)		
A	1/4NPK	210	26.60	0.55	P
	1/2NPK	309	63.75	0.75	P
	1NPK	331	-	0.68	P
	2NPK	205	3.90	0.56	P
	4NPK	156	-	0.41	P
	6NPK	160	3.75	0.53	P
B	-N	119	8.40	0.50	P
	1/4N	142	-	0.60	Ab
	1/2N	142	-	0.64	P
	1N	142	-	0.59	P
	2N	201	-	0.49	P
	4N	155	-	0.31	P
	6N	168	-	0.27	Ab
C	-K	165	-	0.57	P
	1/4K	168	1.19	0.48	P
	1/2K	200	-	0.49	P
	2K	143	-	0.68	Ab
	4K	140	-	0.48	Ab
	6K	162	-	0.57	P
D	-P	213	22.5	0.71	P
	1/4P	216	1.38	0.54	P
	1/2P	124	-	0.46	P
	2P	119	10.1	0.48	P
	4P	133	-	0.51	Ab
	6P	262	1.14	0.76	P
Control (-NPK)with inoculum	214		3.73	0.39	P
Control (-NPK) without inoculum	135		-	0.29	Ab
SE	-			0.24	
CD at 5% level	-			0.12	

P-Present,Ab-Abscent

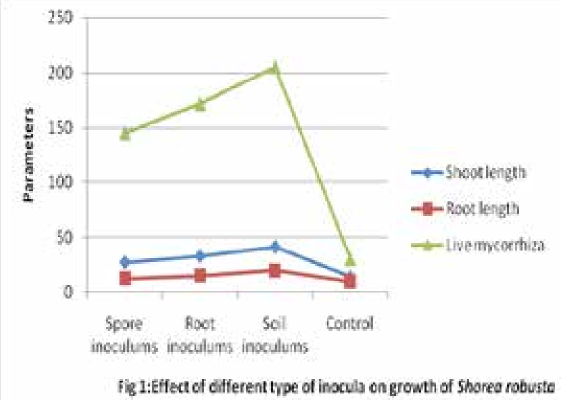

Fig 1:Effect of different type of inocula on growth of *Shorea robusta*

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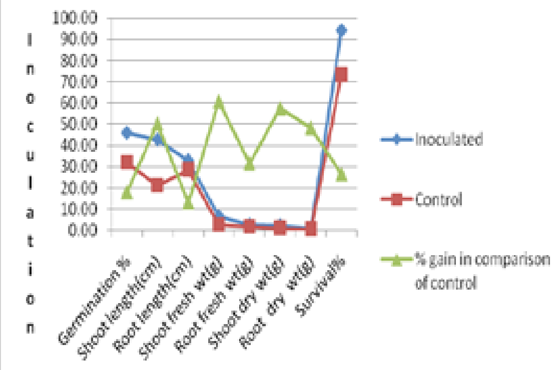

Fig:2-Effect of inoculation on growth parameters of *Shorea robusta*

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