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RESEARCH ARTICLE

Using Liquid Manure in Nursery for Stimulating Growth & Reducing Mortality in Forestry Plantations

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ABSTRACT: Decreased forestation over the past century as a consequence of increased civilization and the growing industrial sector has created worldwide demand for forestry plantations. The decreased forest cover has an impact on diversity of micro and macro fauna. Many species have been exterminated and many are on the verge of extinction. This has added to global climate change effects which in turn is affecting the survival of plantations in natural conditions.

Nutrient management plays a very crucial role in the healthy growth of plants. The plants grown with chemical inputs, which are a readymade food, makes them weak in facing the biotic and abiotic stress when transplanted from nursery to open degraded landscapes.

The present study showed that the use of liquid manure as organic growth promoter and a locally prepared seed coating formulation makes the plant stronger than those grown with readymade chemical inputs. The study began with a survey of commercial nursery growers by telephone as it was not possible to meet in person due to COVID – 19 situations. Then actual comparative experimental trials were undertaken to observe the growth differences. Finally, the 20-days young seedlings were planted to observe their survival in natural conditions.

The study clearly indicates that the plants grown with liquid manure are greater in height and also developed stronger root systems than the plants grown with chemical inputs. Experiments using a plantation in degraded forest land showed the highest survival rates with plants treated with liquid manure.

KEYWORDS: Liquid manure, nursery, forestry plantation.

Introduction

The world's forests are crucially important for both biodiversity conservation and climate mitigation. Biodiversity conservation efforts may need to give greater attention to ecosystem processes than to ecosystem products.[1,2]

Realizing the importance of forests and trees in curbing global warming, global initiatives have been taken up such as the World Economic Forum's plan to plant a trillion trees; and the United Nations' Bonn Challenge to bring 350 million hectares of the world's deforested and degraded land into restoration by 2030. Overall, it was found that tree growth, mortality and farmers' preferences in harvesting timber in species-rich plantations is influenced by both abiotic and biotic factors including anthropogenic influences.[3]

Fertilizer application is vital for today's agricultural crop production system as it restores soil nutrients and promotes crop production and yield.[4,5] In fact, recent research findings showed that manure substitution of chemical fertilizer improved soil physicochemical properties and nutrient capacity as well as promoted microbial growth and activity.[6] Similarly, studies have shown that chemical fertilizers are used in nurseries to boost plant growth.[7] Indeed, fertilizer application is widely used in nurseries to improve plant vigour and productivity.[8] Though the chemical fertilizer increases plant growth and vigour, hence meeting the food security of the world, the plants grown in this way do not develop good plant characteristics such as, good root systems, shoot systems, nutritional characteristics. In addition, they do not get time to grow and mature properly.[9]

Roots of such container-grown plants are subjected to temperature and moisture extremes not normally found in field production.[10] Water stress after transplanting is probably the most limiting factor for plant growth and the major factor responsible for transplanting failure.[11] Much of the abiotic decline and death above ground occurring in the landscape of woody plants is the result of root problems and the destruction of the absorbing organs of the plant. With increasing amounts of nursery stock being produced in containers, optimizing root growth and function and minimizing abiotic stress is important in ensuring the long-term success of the nursery/landscape industry.[10]

Microbes play an important role in converting unavailable forms of nutrients into water soluble forms which plant roots can take up. These beneficial microbes are present in liquid manure.[12] Some studies showed that soil inoculation with a mixture of mycelium fungi improved plant growth and nutrition, without the need of fertilizer in nursery pots.[13] A comparative study with chemical and organic inputs in nursery systems confirmed that organic manure originating from livestock by-products and sawdust not only promoted the growth of yellow poplar but also improved soil conditions.[14] The study on the use of human urine as a fertilizer showed that human urine compared well with urea as a source of N for crops but optimum rates depended on the sensitivity of the crops to soil

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salinity.[11] The population of bacteria increases with the addition of liquid dairy and swine manure.[10] Studies on the use of liquid manures supported in the present study on crop productivity have shown that they increases soil microbial populations which helps in the mineralization of nutrients in turn enhancing crop yields.[12]

From ancient time cow dung extract has been used as manure for boosting crop growth as it contains humic compounds and fertilizing bio elements.[15] Cow dung was observed to suppress mycelia growth of plant pathogenic fungi like *Fusarium solani, F. oxysporum and Sclerotinia sclerotium*.[14] It has been found that soil microbial population and soil enzyme activities have been increased with application of poultry litter.[16] Moreover, there are many reports suggesting that manure application had enhanced effects on the biological parameters[17, 18] and the availability of nutrients in the dissolved form.[19]

The study on beejamrutha (prepared using the ingredients viz cow dung, cow urine, water and lime) contains not only general microflora, but also certain beneficial biochemical groups such as free living N2-fixers, P- solubilizers, and bacteria producing plant growth promoting substances as well as bacteria having biological deterrent activities. The presence of such beneficial microbial biomass and improved nutrient status might have resulted in improved seed germination, seedling length, and seed vigour in soybean indicating beejamrutha as an efficient plant growth stimulant.[20]

Use of these locally prepared liquid manures can replace chemical inputs during nursery growth so that plants become strong enough to survive when replanted in natural conditions.

Results and Discussion

Evidence of presence of nutrients in the farm and ant hill soil :

Name of Nutrient	Colour observed in the Bunsen Flame with Ant Hill Soil	Colour observed in the Bunsen Flame with Farm Soil
Potassium	Light purple	
Phosphorus	Blushish green	
Lithium	Red	Red
Rubidium	Pink	
Calcium	Reddish orange	
Sodium	Yellow	
Boron	Bright green	

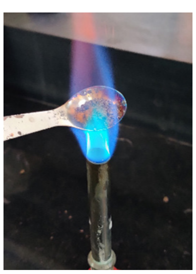

Figure 1: Farm Soil.

Figure 2: Ant Hill Soil.

When the ant hill soil was ignited in the Bunsen flame it gave 7 different colors corresponding to 7 essential nutrients required by plant while only 1 colour corresponding to a single nutrient was visually observed with the sample from the farm (Figures 1 and 2). These observation confirms that ant hill soil has more nutrients than farm soil.

Effect of treatments on growth of plant :

Figure 3: Effect of treatments on growth of plants.

The observations of shoot length were made at an interval of every 6 days before the application of chemical fertilizers and liquid manure. Table 1 reveals that average shoot length of chemically treated seedings is shorter than the average shoot length of seedlings treated with liquid manure. Statistical analysis using T tests reflected the p-value for observations at all intervals was less than 0.05 that indicates the results are statistically significant. The results were in agreement with the results observed with different types of formulations of liquid manures i.e., Sanjeevak experimented on crop growth.[12] The study already suggested the presence of a group of beneficial microorganisms and the required enzyme activities for optimum growth of plants.

Table 1: Observations of shoot length at an interval of every 6 days were statistically significant.

Observation day	Chemical treatment (cm)						Liquid manure treatment (cm)						p Values
	I	II	III	IV	V	AVG	I	II	III	IV	V	AVG	
Day 6th	12	15	13	12	12	12.8	17.5	18	20	18	16	14.4	0.00037
Day 12th	18	22	23	22.5	22.5	21.4	30	30	29	30	30	29.8	0.00061
Day 18th	37.3	32.8	31	35.5	37.9	34.4	47.3	46	43	47	47	46	0.00022

Similar observations were noted with average root growth. Seedlings treated with chemical fertilizer showed less root growth than seedlings treated with liquid manure and coated with formulations of seed treatment. The statistical analysis using T - tests indicates that the difference is significant with the p-value less than 0.05. These results are in accordance with the germination trial study with liquid manure.[12] Similarly the results are in agreement with study on beejamruta which a suggested that the seed treatment with cow dung and cow urine has growth stimulation properties.[21]

Table 2: Observations of root growth on 18th day had statistically significant results.

Treatment	Number of plants						p Values
	I	II	III	IV	V	AVG	
Chemical	9.5cm	7.0cm	8.5cm	8.2cm	7.3cm	8.1cm	0.00055
Liquid manure	14cm	12.6cm	10.6cm	11.5cm	12.6cm	10.06cm	

Figure 4: Rooth growth chemical treatment.

Figure 5: Rooth growth liquid manurel treatment.

The following table (Table 3) shows the percent increase in growth of liquid manure treatment over chemical fertilizer treatment. The analysis showed that an increase percent on

12th day of shoot growth was almost doubled over the 6th day. Furthermore it continued to remain the same on 18th day. The root growth with liquid manure was more by 0.31% than the root growth in plants treated with chemical fertilizer. The root systems of plants treated with liquid manure were stronger than those of chemically treated plants.

Table 3: Comparison of percent increase in shoot and root length.

Observation day	Shoot length		Root length	
	Difference in cm	*Increase %*	*Difference in cm*	*Increase %*
Day 6th	1.6	0.13		
Day 12th	8.4	0.39		
Day 18th	11.6	0.34	2.5	0.31

Plants were observed every day for survival over a period of 9 days. Table 4 shows the results. It was observed that out of the 5 seedlings treated with chemical fertilizers only 1 survived, complete mortality was observed in 3 seedlings and 1 seedling was still struggling for survival. In contrast, out of 5 seedlings treated with liquid manure 4 showed healthy strong growth while mortality was observed in only 1 seedling.

Table 4: Observations of plantation trial showed survival of plants treated with liquid manure.

Observation day	Chemical treatment					Liquid manure treatment				
	I	II	III	IV	V	I	II	III	IV	V
Day 1st	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Day 3rd	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Day 5th	Pale	Pale	Pale	Pale	Green	Green	Green	Green	Green	Green
Day 7th	Pale	Pale	Pale	Pale	Green	Green	Green	Pale	Green	Green
Day 9th	Mortality	Mortality	Mortality	Survival not sure	survived	Survived	survived	Mortality	Survived	Survived

Figure 5: Plantation.

Figure 7: Growing Nursery on large scale.

Growing Nursery on a Large Scale:

The findings of experiments were replicated in growing nurseries of 10,000 drumsticks seedlings. Similar results were noted in the large-scale nursery at Dharamitra, research station, Wardh,

Conclusions

The study showed that liquid manure boosted the growth of nursery plants. (Table 3; Figure 3, Figure 4, and Figure 5) The plants showed early growth of seedlings which had almost equal shoot lengths when compared with seedlings treated with chemical fertilizers. The literature survey and experience of growing nursery on larger scale (Figure 7) showed that the use of seed treatment formulations along with the application of liquid manure can replace the use of chemical fertilizer and fungicide. The plantation trial demonstrated that the plants grown with the liquid manure and seed treatment formulation improved in survival rate in comparison with the plants treated with chemical inputs. (Table 4; Figure 6).

Methods

1. Survey of nurseries :

Personal interaction with nursery owners was done to collect information about nursery management techniques. All of them shared that use of chemical fertilizers and fungicides is common in commercial nurseries.

2. Setting up the experiment:

Figure 8: Setting of Experiment.

• Filling of nursery bags:

Half KG polythene bags were filled with soil, sand and organic manure in 2:1:1 proportion. These were then properly soaked with water before sowing.

• Preparation of seed treatment formulation:

Cow dung, cow urine, and ant hill soil were mixed in equal proportion and homogenized to form a paste. Seeds were coated with this paste and allowed to dry for half an hour in a shade. These seeds were then used for sowing in the nursery bags.

• Flame Test for Comparing the Nutrient Status of Ant Hill Soil and Farm Soil:

The soil sample from agriculture field and sample of ant hill soil was tested to observe the presence of different nutrients with a simple flame test.

• Preparation of liquid manure :

A mixture of 10 kg cow dung, 10 lit cow urine, 1 kg jaggery, 2 kg flour of pulses was added and 1 kg ant hill soil was made to 200 lit using water.

The above solution was allowed to ferment till seizing of bubbles stop while stirring (5 to 7 days) [7]

Figure 9: Preparation of Liquid Manure.

• Setting up replicates :

The experiment was set with 5 replicates for liquid manure treatment and 5 replicates for chemical fertilizers treatment.[7] In each polythene bag 2 drumstick seeds were sown. The following schedule for the application of chemical fertilizers and liquid manure was followed by a Planation trial.

Sr.No.	Name of fertilizer	Dose on day of sowing	Dose on 6th day of growth	Dose on 12th day of growth	Dose on 18th day of growth
01	Chemical fertilizer {13:0:45}	10 gm soil application	Spraying of 2 % solution	Spraying of 2 % solution	Spraying of 2 % solution
02	Chemical fungicide{propaconazol}	1.5ml diluted to 1 lit and 25 ml of diluted solution drenched in each nursery bag	Spraying of 2% solution of diluted fungicide	Spraying of 2% solution of diluted fungicide	Spraying of 2% solution of diluted fungicide
03	Liquid manure	20 ml as soil application	Spraying of 2 % solution	Spraying of 2 % solution	Spraying of 2 % solution

Figure 10: All 10 plants were planted in open degraded forest land for trial and were monitored every day.

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Work plan :

Phase 1 - Literature survey

In the first phase, it was decided to make a literature survey to know about the earlier scientific research conducted with regard to problem undertaken under this investigation study.

Phase 2 - Survey of commercial nurseries

Nearby nurseries were visited to understand the practices in growing commercial nurseries.

Phase 3 – Setting up experiments

As it was recommended to shift the plant of 20 days age for replantation the schedule is designed to conduct experiment over 18 days.[17] The schedule of application of fertilizers was followed up as recommended.

Phase 4 – Conducting plantation trials

After 20 days the plants were shifted to degraded soils and monitored over 9 days for their performance.

Phase 5 – Compilation of promotional video

The video was compiled for promotion of study carried out.

Phase 6 – Drafting of Action Report

The action report was drafted as per the format shared.

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