ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 5, Issue 1, pp: (25-28), Month: January - March 2017, Available at: www.researchpublish.com

Assessment of the Growth of Leucaena (*Leucaena leucocephala*) Seedlings on Amended Tailings

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Abstract: **The study basically sought to find a substitute to the overburdened topsoil stockpile; the only source of soil for nursing seedlings in Noble Gold Bibiani Limited. Tailings were collected from the mine tailing storage facility (TSP)and filled into 15 polybags, tailings amended with topsoil in 1:1 ratio were also filled into 15 polybags as well as topsoil from stockpile were also filled into 15 polybags. Seedlings of *Leucaena leucocephala* were raised on the three media and observed for ten weeks with readings on height and diameter taken each fortnight. The dry matter weight was taken on the tenth week. A comparison of the treatments showed that seedlings on tailings amended with topsoil had the highest growth in terms of height, diameter and dry weight, recording an average of 54.7cm, 0.5cm and 2.04g for height, diameter and dry weight respectively as against 36.3cm, 0.5cm and 1.57g in seedling on the topsoil. In conclusion, amended tailing soil significantly support the growth of *L. leucocephala* seedlings and could be used as substitute to topsoil from stockpile.**

Keywords: **Tailings, Amended tailings, Topsoil, *Leucaena leucocephala*.**

I. INTRODUCTION

Re-vegetation of disturbed lands following land disturbance is essential for effective and successful reclamation. Plants stabilize the soil by root growth and water uptake. This reduces water and wind erosion. A vegetative cover also improves the aesthetic value of degraded sites [1]. Forest tree nursery is a prerequisite for reforestation and reclamation of disturbed land from mining activity. This is to ensure that enough tree species are raised for transplanting on land which has been stabilized after disturbance from mining activity. The major material needed in establishing nursery is topsoil. This is so because topsoil contains the essential nutrient needed for proper plant growth. *Leucaena leucocephala* is the most dominant seedlings raised at Noble Gold Bibiani Limited for reclamation purpose due to its ability to fix nitrogen to the soil. Several volumes of top soil are however required to ensure that *L. leucocephala* seedlings are raised well for its purpose and due to that contribute to the reduction of the amount of stockpile soil available for reclamation and revegetation of disturbed surfaces.

Continuous dependent on topsoil stockpile will lead to shortage when required in large quantities during rehabilitation of disturbed land. Amendments such as composting, in-situ green manuring and liming, as well as irrigation have been suggested to help plant establishment on tailings [2]. It was therefore necessary to research on other materials within mining waste like tailings to ascertain how various seedlings will respond in terms of growth when these tailings are amended with topsoil. Hence, the study was done to assess the possibility of using amended tailings for nursing seedlings of *L. leucocephala* and also assess its growth under amended tailings as compared to topsoil from Noble Gold Bibiani Limited.

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II. MATERIALS AND METHODS

Tailings were collected from NGBL tailings dam using shovel and wheel barrow while having the appropriate PPE's on. The topsoil was collected from NGBL topsoil stockpile. After collection, tailings were mixed thoroughly with topsoil in a ratio of 1:1 in a very clean head pan using hand trowel. The mixture was then filled into 15 polybags. Tailing soil and topsoil were also filled into 15 polybags respectively, making a total of 45 filled polybags. The treatments use for the study were as follows; Tailings + topsoil (TT), Tailings soil (RT) and Topsoil (TS). Three replicate plots were laid out and each plot was laid with 5 polybags of TT, RT and TS.

Seeds of *L. leucocephala* were collected from a mother tree located on areas of the concession which has not been mined. Dried seeds were then placed in water to separate the good seeds. The seeds were broadcasted and nursed on topsoil nursery bed until the first two leaves appear. Seedlings were then transplanted into the various treatments polybags. The plots were fenced with net to prevent lizards and snails from feeding on seedlings. Shade was also provided for the first three weeks as in conformity at NGBL nursery practices, to reduce the intensity of sunlight on seedlings. Watering was done twice daily throughout the ten weeks.

Below is the layout of the experimental plots

Five polybags of TT	Five polybags of RT	Five polybags of TS

A. Data collection:

Simple random sampling was used to select species to be measured. Data on total height and diameter of seedlings were collected at two weeks' interval except for the fresh and dry weight determination. The parameters that were considered were; total height, diameter and dry matter weight.

B. Measurement of Total height:

Total height of a plant is its vertical distance from the ground to the apex on the plant. This was done by laying the ruler along the stem of the seedling and recording the height measurement in the Field note book in centimeters

C. Measurement of Diameter:

A pair of calipers was used in taking seedling diameter every two weeks for the ten weeks. These were also recorded in the Field note book in centimeters.

D. Determination of Dry matter weight:

Seedlings were removed carefully from the poly pot and the growth media were washed off from the roots (carefully). They were then pat dry with paper towel and then planted in a 75-degree Celsius oven and heat for 72 hours. Seedlings were then placed in a plastic bag and allow it to cool. Finally, seedlings were weighed when it was completely cool.

E. Data Analysis:

Means were calculated for the measurement of height and diameter and determination of dry weight. Data from this study were analyzed using MS EXCEL ANOVA 2010 and also used to detect significant differences among the treatments at significance levels of $P\_ 0.05$.

III. RESULTS AND DISCUSSIONS

A. Height growth:

From Table 1, *L. leucocephala* seedlings growing on RT recorded the least height growth (26.3cm) which was significantly different from the control TS (36.3cm) at 0.05 significant level. This difference in height might have been due to the low pH of tailings soil (RT) s (pH=5.9) which led to less macronutrient and hence less height growth. According to Hodge [3], macronutrients tend to be less available in soil with low pH. Also low growth in height could have been due to undeveloped soil structure as stated by Henriques and Fernandes [4] that mine tailings soil usually have an undeveloped soil structure resulting in a low water retention capacity.

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TABLE 1. MEAN HEIGHT GROWTH OF *Leucaena leucocephala* IN THE TREE MEDIA

Treatments	Week 2(cm)	Week 4(cm)	Week 6(cm)	Week 8(cm)	Week 10(cm)
TS	13.066 **a**	16.000 **a**	21.330 **a**	26.000 **a**	36.330 **a**
TT	14.000 **a**	21.833 **b**	26.330 **b**	31.000 **b**	54.500 **b**
RT	8.433 **b**	13.833 **bc**	17.160 **bc**	19.833 **bc**	26.660 **bc**
(LSD)	**(1.292)**	**(2.104)**	**(1.819)**	**(1.941)**	**(0.941)**

Mean values in the same column followed by the same letter are not significantly different 0.05 level according to Excel ANOVA Test.

Seedlings on TT on the other hand recorded an average height growth of 54.5 cm as against 36.3cm on TS. This difference in height could be attributed to the clayey nature of the topsoil from NGBL stockpile. Mixing topsoil (TS) and tailings soil (RT) to form topsoil + tailings (TT) improve the structure of the soil which contributed to the height attained by seedlings on TT (54.5 cm). Meanwhile seedlings showed significant difference in height right from the second week and it continued through the fourth, sixth, eighth and tenth week in respect to the different media due to the fact that height growth is very sensitive factors that encourage seedling growth such as soil nutrient and pH. This is in agreement with [5] that "in young trees, height growth is easily measured and may be more sensitive to treatment and site factors than diameter or volume growth." This explains why were clearly distinguished in terms of height based on the different media which provided different conditions to the seedlings.

TABLE 2. MEAN DIAMETER OF *L. leucocephala* IN THE TREE MEDIA

Treatments	Week 10 (cm)
TS	0.466 **a**
TT	0.500 **a**
RT	0.400 **b**
(LSD)	**(0.0006)**

Mean values in the same column followed by the same letter are not significantly different 0.05 level according to Excel ANOVA Test

TABLE 3. MEAN DRY WEIGHT OF *L. leucocephala* IN THE TREE MEDIA

Treatments	Weight (g)
TS	1.567 **a**
TT	2.029 **b**
RT	0.567 **bc**
(LSD)	**(0.00012)**

Mean values in the same column followed by the same letter are not significantly different 0.05 level according to Excel ANOVA Test

B. Diameter Growth:

Plants directly depend on the soil characteristics and conditions necessary for their successful growth. Soils of industrial areas particularly tailing soil mostly affected the growth of *L. leucocephala* as compared to the control thus fresh stockpiled topsoil. High organic matter caused improved growth in plants as determined by [6]. He observed that in those plant communities (group of plants) which had a higher percentage of soil organic matter, the water holding capacity of soil was consequently increased due to the colloidal nature of the organic matter. Tailing soils have been found to be extremely low in organic matter [7]. This could account for RT recording the minimum diameter growth (0.4 cm). There was no significant difference between the various diameters of *L. leucocephala* seedlings until the tenth week. This may be attributed to the idea that diameter growth in stems especially seedlings tend to start in the latter stages of plant growth as it depends greatly on the formation and growth of the xylem tissues. Kozlowski [8] stated that, ten weeks may elapse between the beginning of xylem formation in the twigs and in the root of trees in same species. This confirms why diameter of *L. leucocephala* seedlings growing on RT, TT, and TS recorded 0.4 cm, 0.5 cm, and 0.5 cm respectively on the tenth week which were significantly different at 5% significant level and no significant difference on the second, fourth, sixth and eighth week.

C. Dry matters weight:

From table 3, seedlings of *L. leucocephala* seedlings on TS, TT and RT recorded an average dry weight of 1.6671g, 2.0397g, and 0.5671g respectively. Compared to the various height growth (TS =36.3cm, TT =54.5cm, RT =26.3cm), it was observed that when seedlings on TT attained the greatest height, it corresponds to its dry weight and it follows for seedlings on TS and RT. This may be due to the fact that, the greater the height, the greater the biomass hence the higher the dry weight of the species.

IV. CONCLUSION

From the study, tailings amended with topsoil (TT) and tailings soil from NGBL tailings dam and stockpile can support the growth of *L. leucocephala* seedlings and could be used as substitute to topsoil TS. Considering results from the fortnight readings of height and diameter growth of *L. leucocephala* seedlings on the various growth media (TS, RT, TT) it can be concluded that seedlings on TT have a higher growth compared to those on TS and seedlings of *L. leucocephala* on RT have a lower rate of growth as compared to those on TS.

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