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SEEDLING GROWTH RESPONSE OF *ALBIZIA LEBBECK* (L.) BENTH. IN HOOK. IN DIFFERENT SOILS OF KARACHI RAILWAY TRANSPORTATION SITE

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ABSTRACT. The different types of automobile activities produce negative impact on the immediate environment all around the world. Railway transportation is an economic mode of land transportation of goods and public. In recent years the problem of environmental pollution due to railway transportation activities at regional and global concern is increasing. The various kinds of pollutant were released from locomotives diesel engines ultimately affect soil properties and vegetation found near railway tracks. The method utilizes for the seedling growth variable measurement of *Albizia lebbeck* (L.) Benth. in Hook. was soil of nearby railway line and compared with soil of University Campus area in pots. The results in this paper provides information on comparison about the maximum increase in seedlings height, root and shoot growth of *A. lebbeck* raised in soil of Landhi Junction. The Cantonment Station soil found responsible for significantly ($p<0.05$) decreased in some growth characteristic of root, area ratio and root dry weight of *A. lebbeck.* The negative and positive correlation values with some variation with different growth parameters of *A. lebbeck* was also recorded. The practical advantages of the seedling growth study of *A. lebbeck* in different soil types discussed with the influence of passing trains on the soil properties thereby build up a database that would be helpful for increase of a vegetation cover near railway landscape.
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Keywords: leaves, locomotive engine, pollution, soil types, tree

1. Introduction

Railways transport system served for the economic growth of every country (Djordjević *et al.*, 2021). There are four types of locomotives, steam, diesel, electric, and diesel electric. Diesel locomotives used kerosene and gasoline and negatively influence on immediate environment. Diesel locomotives widely used in Pakistan Railway system. The transportation sectors also entering toxic effluents, ultrafine particles directly into the environment and responsible for threating the urban environmental quality, reduction in the leaves size, total biomass and inhibiting growth of the plants (Shukla *et al.*, 1990; Abedullah, 2006; Li *et al.*, 2007; EPA, 2021). Combustion of fuel along railway line generate several kinds of pollutants likewise, particulate matter, volatile organic compounds, SO_2, NO_x and CO_2 can negatively influence on environment and biochemical and physicochemical characteristics of soils (Bailey and Solomon, 2004). The presence of PCBs and some heavy metals due to railway transport on the territory of Serbia reported (Stojic *et al.*, 2017). Metals derived from railroad are an environmental contaminant (Rousk and Rousk, 2018; Goth *et al.*, 2019). The transportation of passenger and goods by railways has many environmental pollution issues remain intact in developed and under developing countries (Elbir and Dincer, 200; Yadav *et al.*, 2019).

The railway transportation apart from roads is serious source of environmental pollution (Lacey and Cole, 2003). Traffic activities create an environmental pollution problem and is damaging urban environment and as well as plant growth. The tree species used for monitoring the air pollution (Sen *et al.*, 2017). Few reports have found that pollutants from railway activities affects plant growth. The research on diesel locomotives has attracted relatively little interest (Park *et al.*, 2012). The problem of environmental pollution

due to railway activities is a regional and global concern and little is known about this aspect in the country. The impact of railway traffic activities on soil seems not been investigated in the past.

Albizia lebbeck (L.) perennial multipurpose deciduous shade tree locally known as Siris or Woman's Tongue and is a member of family *Mimosaceae.* Siris is prefer to grow on a wide range of soil types (Prinsen, 1986). *A. lebbeck* has fairly shallow root system and serve as good soil binder (PFAF, 2020). *A. lebbeck* is distributed in Tropical Asia; N. Australia and Tropical Africa (eflora, 2020). *A. lebbeck* native to Australia and cultivated as shelter tree for cash crop and can tolerate wide range of climate and soil types (Datasheet, 2020).

Few reports have found that pollutants from railway activities affects plant growth and soil properties. The environmental hazardous problem, enrichment of heavy metals, particle matter emission, organic and inorganic pollution by railway transportation system attracting people's attention (Malawska and Wilkomirski, 2001; Plakhotnik et al., 2005; Lorenzo et al., 2006; Burkhardt et al., 2008; Wiłkomirski et al., 2011; Zhang et al., 2013; Chen et al., 2014b; Jiasheng et al., 2020; Fazio et al., 2023). The researchers have drawn their attention in recent years about the railway activities generating an environmental degradation issues and negatively affecting plant growth. *A. lebbeck* is a multipurpose tree and has significance economic importance for human beings. The reports on the seedling growth of *A. lebbeck* and soil properties of near Karachi railway track is scanty. The aim of this research work was to provide an understanding about the effect of railway track soil on the growth of a native fast growing tree species, *A. lebbeck.*

2. Materials and Methods

Study site

The composite soil samples were taken from 30 cm depth at various railway stations, including Cantonment Station, Drighroad Junction, Malir Station, Landhi Junction, and Karachi University Campus, for seedling growth experiments (Fig. 1).

Study Site

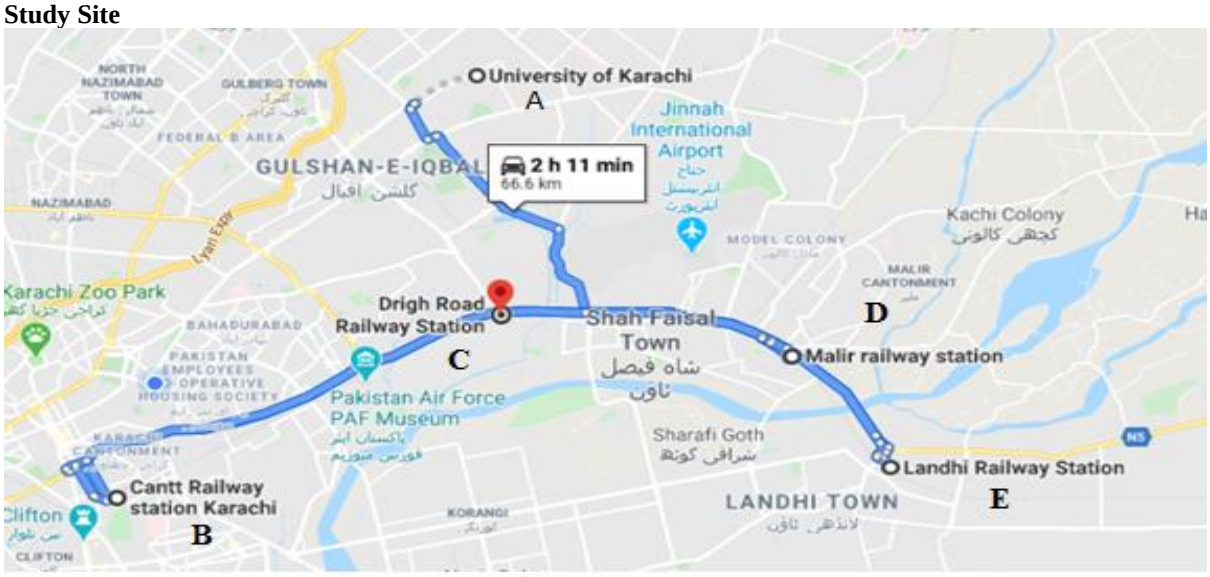

Fig. 1. Sample collection sites [**A** = University of Karachi; **B** = Cantt Railway Station Karachi; **C** = Drighroad Railway Station; **D** = Malir Railway Station; **E** = Landhi Railway Station]. **Source.** 87045 47, 67. 0494904/Cantt+Railway +Station+Inter visited on June 13, 2020.

Seedling growth experiment

This experiment was place in a greenhouse of the Department of Botany, University of Karachi's Pakistan. Composite soil samples were taken from 30 cm depth at various railway stations, including Cantonment Station, Drighroad Junction, Malir Station, Landhi Junction, and Karachi University Campus, for seedling growth experiments. To eliminate big particles and stones, the air dried soil samples were sieved through a 2.0 mm sieve. A substantial number of *A.*

lebbeck seeds were obtained from the Karachi University Campus. The top ends of the seeds were slit gently with a sharp scissor to remove any possible external dormancy. The seeds were planted in large pots filled with garden soil and watered on a daily basis. Seedlings of uniform height were placed into pots (20 X 9.8 cm in diameter) and irrigated with tap water for these diverse types of soil treatments. Each week, the placements of the pots were switched to avoid the effects of light and shade. With five replicates, the experiment was totally randomized. The seedlings were taken out from the respective pots and thoroughly rinsed with distilled water. The number of leaves, the area of the leaves, and the growth parameter were all recorded. The root, shoot, and leaves were separated and dried in an oven at 80°C for 24 hours. The investigation lasted eight weeks. According to the formula, the root/shoot, leaf weight, leaf area ratio, and specific leaf area were computed (Rehman and Iqbal 2009).

Statistically analysis

At the 0.05 level, all growth data was statistically analysed using analysis of variance and Duncan's Multiple Range Test in SPSS 10.0 (SPSS inc., USA).

3. Results and discussion

There has been little research on the impact of locomotive pollution on plants growth. The diesel locomotives emit different toxic chemicals (Biliaiev *et al.*, 2020) in environment that influence on air, water and polluted soil of the nearby railway track area. The soil contamination ultimately leads to toxicity in seedling growth. The bioassay model took into account which allowed to understand the effect of moving diesel locomotive on seedling growth performance of *A. lebbeck*. This study area comprises of 21 Km and showed that different soil treatment variably affected the seedling growth and dry weight of *A. lebbeck* (Table 1-3; Fig. 1-2). Soil of an area influences on plants (Kim *et al.*, 1995).

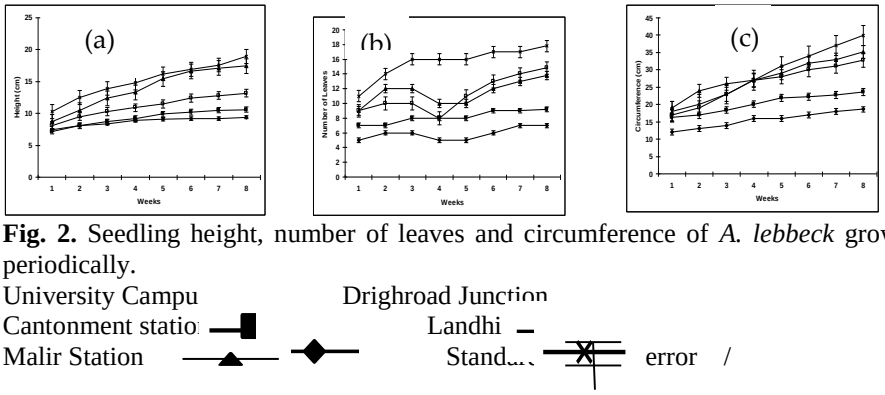

Fig. 2. Seedling height, number of leaves and circumference of *A. lebbeck* grown in soils of different areas periodically.

Soil pollution indices, biotest results, and plant and fungus bioindicators play an important role in environmental assessments of railway transport. Similarly, the soil toxicity was assessed with the Phytotoxkit biotest which measures the inhibition of seed germination and root growth in *Sorghum saccharatum* L. (Radziemska et al., 2021). An immense fluctuation in periodical study was recorded in the number of leaves of *A. lebbeck* seedlings grown in soil of University Campus, Cantonment Station, Drighroad Junction, Malir Station and Landhi Junction (Figure 2). The seedlings of *A. lebbeck* grown in soil of Landhi Junction represented highest number of leaves, while lowest number of leaves were recorded in soil of Cantonment Station. A rapid increase in the number of leaves of *A. lebbeck* seedlings grown in soil of Landhi Junction were observed in first three weeks. After three weeks, number of leaves was not enhanced in 4th and 5th week and then a slight enhance was recorded in 6th, 7th and 8th week in soil of Landhi Junction. High fluctuation was found in the number of leaves of *A. lebbeck* seedlings emerging from the soil of Drighroad Junction and Malir Station. The number of leaves of *A. lebbeck* was greatly increased in 2nd week and no enhancement was found in 3rd week. A reduction was recorded in the number of leaves of *A. lebbeck* seedlings grown in Malir Station soil in 4th week, no increase was observed in 5th week, while gradually increased in 6th, 7th and 8th week. The number of leaves of *A. lebbeck* grown in soil of Drighroad Junction were slightly enhanced in 2nd and 3rd week and a reduction was found in 4th week, after that a large

enhancement was found in 5th, 6th, 7th and 8th week. There was no increase in the number of leaves of *A. lebbeck* grown in soil of University Campus in 2nd, 4th, 5th, 7th and 8th week, while a slight enhancement was found only in 3rd and 6th weeks. variation in the number of leaves with a slight increase in 2nd week, while no enhancement was recorded in 3rd week. A reduction in the number of leaves of *A. lebbeck* was found in 4th week, while a slight increase was observed in 6th and 7th week. The circumference of *A. lebbeck* seedlings grown in soil of University Campus, Cantonment Station, Drighroad Junction, Malir Station and Landhi Junction showed a difference in all weeks throughout the study. A slight fluctuation was observed in *A. lebbeck* circumference in soil of Landhi Junction, Drighroad Junction and Malir Station in 3rd, 4th and 5th week. The circumference of *A. lebbeck* in soil of Landhi Junction was less in first three weeks as compared to Drighroad Junction.

The passing of trains and railways activities showed the strong influence and stress on the physicochemical properties of treated soil and in response affected the seedling of *A. lebbeck*. Thus, the significant ($p<0.05$) decline in root growth, total plant height, leaf growth and biomass productivity of *A. lebbeck* in Cantonment Station soil was recorded.

Table 1. Response of seedling growth parameter of *A. lebbeck* to different types of soils.

Sites	Shoot length (cm)	Root length (cm)	Seedling length (cm)	No. of leaves	Leaf area (cm^2)
A	10.68±0.76ab	9.68±0.78b	20.36±1.53b	9.20±0.49a	3.16±0.10b
B	9.46±0.67a	5.68±0.32a	15.14±0.96a	7.00±0.45a	2.63±0.13a
C	13.16±0.72b	10.68±1.09b	23.84±1.78b	14.80±1.36b	3.83±0.11c
D	17.46±1.64c	13.26±0.64c	30.72±2.19c	13.80±1.28bc	4.22±0.12d
E	18.94±0.37c	14.92±0.38c	33.86±0.49c	17.80±1.28c	5.58±0.17e
L.S.D. p<0.05)	**2.76**	**2.08**	**4.48**	**3.11**	**0.38**

Symbol used: **A** = University Campus; **B** = Cantonment Station; **C** = Drighroad Junction; **D** = Malir Station; **E** = Landhi Junction**.** RDW= root dry weight, SHDW= shoot dry weight, LDW= leaf dry weight, SDW seedling dry weight. Numbers followed by the same letter in the same column are not significantly different according to Duncan Multiple Range Test. at $p<0.05$ level; ± Standard Error

In contrast the cultivation of peas with 10% rural railway waste soil composition showed higher root growth along fresh weight as compared to the control (Han *et al.*, 2018). This systemically studies showed the negative impact of locomotive activities on seedling growth of *A. lebbeck* might be due to the availability of toxic pollutants present in Cantonment Station soil. The area is more polluted than rest of side area due to handling and maintenance of locomotives engine and vehicles in workshop. Mamta *et al.*, (2006) found an appreciable change in the number of epidermal cells due to railway engines emission on *Calotropis procera* growing close to the railway tracks. Soil characters play an important role in survival of plants (Caplan and Yeakley, 2006). The results showed that Karachi Cantt station soil is highly polluted due to diesel workshop established for providing maintenance services for cargo and passenger's railway trains. Liu et al., (2009) recorded metal contamination in soil alongside mountain railway in Sichuan, China .

Table 2 - Effects of different types of soils on root, shoot, leaf, seedling dry weight sand circumference of *A. lebbeck.*

Sites	RDW (g)	SHDW (g)	LDW (g)	SDW (g)	CIR (cm)
A	0.122±0.004b	0.094±0.005b	0.120±0.003a	0.33±0.04a	23.66±0.50b
B	0.074±0.003a	0.078±0.004a	0.148±0.004b	0.30±0.08b	18.62±0.62a
C	0.186±0.011c	0.182±0.004c	0.208±0.002c	0.57±0.09c	32.86±0.84c
D	0.348±0.012d	0.314±0.006d	0.254±0.001d	0.92±0.01d	35.12±0.91c
E	0.430±0.011e	0.388±0.005e	0.304±0.005e	1.12±0.08e	39.92±0.98d
LSD (p<0.05)	**0.023**	**0.014**	**0.012**	**0.034**	**2.33**

Symbol used: **A** = University Campus; **B** = Cantonment Station; **C** = Drighroad Junction; **D** = Malir Station; **E** = Landhi Junction**.** RDW= root dry weight, SHDW= shoot dry weight, LDW= leaf dry weight, SDW seedling dry weight. Numbers followed by the same letter in the same column are not significantly different according to Duncan Multiple Range Test. at p<0.05 level; ± Standard Error.

The Pearson's correlation was also deployed between seedling growth variables of *A. lebbeck* (Table 3). The shoot length of *A. lebbeck* showed significantly (p<0.05) strong positive correlation with root length, seedling size, number of leaves, leaf area, circumference, seedling dry weight and root shoot ratio whereas, it also showed strong negative correlation with leaf weight ratio. The root length, seedling size, number of leaves, leaf area, circumference and seedling dry weight of *A. lebbeck* were significantly (p<0.05) strong positively correlated with each other while these showed significantly strong negative correlation with leaf weight ratio. The cross correlation of root shoot ratio of *A. lebbeck* was significantly (p<0.05) strong negatively correlated with leaf weight ratio, it also showed significantly (p<0.05) strong positive correlation with specific leaf area. The leaf weight ratio showed significantly (p<0.05) strong negative correlation with specific leaf area and strong positive correlation with leaf area ratio of *A. lebbeck*.

Table 3. Pearson's cross correlation between growth variables of *A. lebbeck*

	St.L.	Rt.L.	S.S.	NoL	L.A.	Cir.	S.D.Wt.	R/S.R.	L.Wt.R.	Sp.L.A.
L.Wt.R	-0.824**	-0.898**	-0.878**	-0.687**	-0.870**	-0.874**	-0.776**	-0.963**		
Sp.L.A.	0.203	0.373	0.287	0.177	0.487*	0.315	0.175		-0.600**	
L.A.R.	-0.094	0.117	0.002	-0.045	0.189	0.031	-0.153	0.383	-0.341	0.904*

Symbol Used: ** Correlation is significant at p<0.05 level (2-tailed), * Correlation is significant at p<0.01 level (2-tailed). St.L. = Shoot Length; Rt.L. = Root Length; S.S. = Seedling Size; NoL = Number of Leaves; L.A. = Leaf Area; Cir = Circumference; S.D.Wt. = Seedling Dry weight; R/S.R. = Root/shoot ratio; L.Wt.R. = Leaf weight ratio; Sp.L.A. = Specific leaf area; L.A.R. = Leaf area ratio.

The shoot height of *A. lebbeck* showed strong positive correlation significantly (p<0.05) with leaves numbers, leaf growth and seedling dry weight. The impact of different railway side soils types on plant growth available in literature. An ecological impact due to various activities of transportation is complex on wild life, soil and plant (Popp and Boyle, 2017; Nyumba *et al.*, 2021; Zhang *et al.*, 2021). These results indicate the remarkable effect of cantonment station polluted soil on growth of *A. lebbeck* and further might be due to basic reason low soil productivity. Ezio, *et al.*, (2016) stated that soil pollutants have a damaging effect on physicochemical and biological properties of soil. Results showed better production of number of

leaves for *A. lebbeck* seedlings emerged with the treatment of soil of Malir Station. The continuous decline in seedling height leads to decrease in seedling dry weight. Ecological indicators likewise leaf growth, dry weight and stress factors decrease the productivity of the whole plant and individual organs (Bussotti and Pollastrini, 2015). The present contribution will be helpful in considering the selection of tree species for plantation near railway track and to improve the native floral values.

4. Conclusions

The paper evaluated the impact of railway transportation activities of railway track soil on seedling growth of *A. lebbeck*. Overall, locomotive exhaust differently influenced the soil properties of rail side and was confirmed through variable seedling growth performance of *A. lebbeck*. The soil of Malir Station and Landhi Junction was comparatively less contaminated and was found better for seedling growth of *A. lebbeck*. The growth performance of *A. lebbeck* was recorded high in soil of Landhi Junction which indicated that this soil is better than the soil of other study areas.

Author Contributions: M.Z. Iqbal designed, conceptualization and supervised the experiment. Zia-ur-Rehman Farooqi, performed the field experiment and recorded the data. M. Shafiq prepared the manuscript and surveyed the literature. Muhammad Kabir reviewed the manuscript. All authors declare that they have read and approved the publication of the manuscript in this present form.

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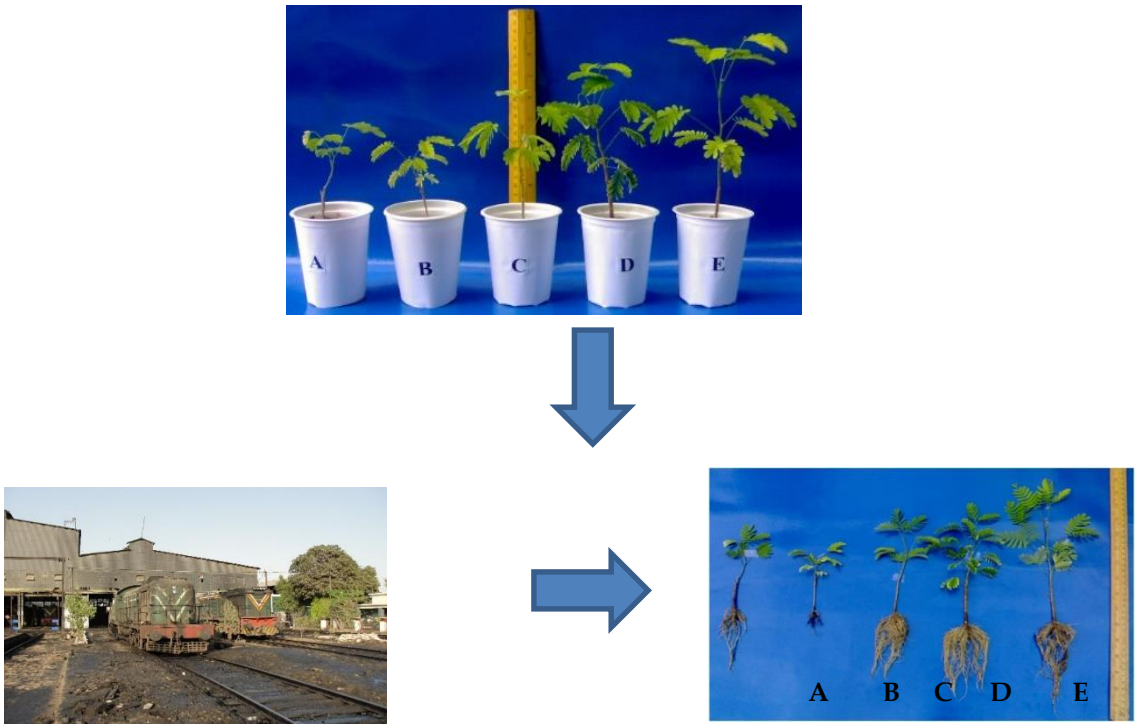
Conflicts of Interest: Nil.

Fig. 2. Graphical Abstract: The method utilizes for the seedling growth variable measurement of *A. lebbeck* was soil of railway line. **A** = University Campus; **B** = Cantonment Station; **C** = Drighroad railway Junction; **D** = Malir Station; **E** = Landhi Junction



The diesel workshop of Karachi Cantt station highly polluted due to maintenance services for cargo and passenger's railway trains. Significant correlation found between soil characteristics and seedling growth of *A. lebbeck* after harvesting at age of ten week of observation.

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