Height, cover and number of leaves of *Albizia lebbeck* (L.) Benth. and *Leucaena leucocephala* (Lam.) de-Wit in Soils of Korangi and Landhi Industrial Areas of Karachi and University of Karachi, Pakistan.

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Abstract--The effects of soil of industrial areas of Korangi and Landhi and Karachi University campus on growth of *Albizia lebbeck* (L.) benth. and *Leucaena leucocephala* (Lam.) de-Wit was conducted as compared to Garden soil (control soil). There were two separate experiments. In the first experiments, plant height, circumference and no. of leaves of both plants were evaluated in merely 50% soil of Khan Towel, Tanveer garment, One Tech Rubber and One Tech Ply board factories as compared to Karachi University soil (control). In second experiments, same growth parameters of both plants were assessed in different soils compositions (25%, 50% and 75%) of the same factories and Karachi University soils as related to garden soil (control). Soil characters (coarse sand, water holding capacity, organic matter, calcium carbonate, soil pH, total soluble salts and available sulfate) and soil heavy metals (copper, zinc and chromium) were analyzed in factories soil, Karachi University soil and garden soil and compared with growth of plants.

Key words: *Albizia lebbeck*, *Leucaena leucocephala*, industrial areas, industrial soil, Karachi University soil, garden soil, plant growth and soil pollutants.

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1 Introduction

Soil, water and air are three disposals for contamination which are contaminated by anthropogenic activity and are caused environmental pollution. When, an undesirable change occurs in physical, chemical and biological characteristic of air, water and soil due to pollutants and bringing about hazardous impact on all biotic components living in the environment [1].

Karachi is a biggest city as well as largest industrial city of Pakistan where many small and large industrial units producing useful products and dumping off in soil, water and air and causing large range of harmful material. Fast construction of industries, motorization and growth in population were generating an ecological pollution trouble in Karachi city [2]. The increase reasons of elements point to that Ca, Ba, Fe, K, Cu and Mn are principally emanated into the atmosphere from soil sources while Pb is frequently owing to manmade media [3]. These contaminants at first are deposited into soil followed by into plants. Rushdi, *et al.*, [4] made a model by which can guess the evidence of an ecological contaminant on the surface of soil because of the contaminant being added on dust particles, which are afterward set down on the surface of soil.

Soil play basic role in the growth of plants. *Albizia lebbeck* (L.) Benth. and *Leucaena leucocephala* (Lam.) de-Wit are belong to family Mimosaceae and are cultivated for ornamental purposes around roadsides and industrial areas of Karachi [5]. *Albizia lebbeck* (L.) Benth. is most likely inhabitant to tropical and subtropical Asia and East Africa however, introduced and planted throughout the tropics. *Leucaena leucocephala* (Lam.) de-Wit, is indigenous to Central America and introduced in the tropical countries including Pakistan. Contaminated soil via factories is creating detrimental effects on plants.

Many researchers had proved damaging and injurious effects of contaminated soil and deposition of components of soil in misbalanced conditions which travel through soil into plants by plant uptake. Significant growth hindrance was found in *Prosopis juliflora* Swartz and *Peltophorum pterocarpum* (DC.) Baker Ex K. (University of Karachi plants') by Khan Towel and One Tech Ply Board factories soils, respectively [6], [7]. Most of the growth parameters of

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plants were reduced from zinc treatment [8]. Oguntade, *et al.*, [9] found in the greatest deposition of heavy metals were greater as compared to 0.3 mg kg^{-1} permitted limits in vegetables by Food and Agricultural Organization/World Health Organization/Federal Environmental Protection Agency. Physical properties of soil like bulk density, texture, structure and soil strength has noticeable effects on root penetration, growth and yield of various crops [10]. Martins, *et al*. [11] stated that record are displayed poisonous effects in animal fed with plant grown on the increment of sewage sludge. The present study was intended at determining the perilous effects of polluted soil from industrial areas of Korangi and Landhi of Karachi, Pakistan on the growth of *A. lebbeck* and *L. leucocephala* in comparison with University of Karachi and Garden soils.

2 Materials and Methods

The growth of *Albizia lebbeck* (L.) Benth. and *Leucaena leucocephala* (Lam.) De-Wit. was carried out in soils of towel, garment, rubber and ply-bad factories of Korangi and Landhi industrial localities as well as in soil of Karachi University in a green house under natural environmental circumstances. Similar-sized and healthy seeds of *Albizia lebbeck* (L.) Benth., and *Leucaena leucocephala* (Lam.) de-Wit were collected from Karachi University Campus. The seeds were slightly cut at one end on account of tough seed coat and were sown in garden soil (loam soil) in large pots at 1 cm depth. Daily irrigation for seeds was made. After one month, seedlings of similar-sized were transferred into pots of 19.8 cm in diameter and 9.6 cm in depth. There were two experiments and composition of garden soil was one part manure + two parts fine sand in all of the experiments. Because, in the commencement of the experiments, 100% soils of all industries hardly displayed any response to seed germination and seedling growth. So, different fractions of factories soils were used. In first experiment 50% factory soil of each factory was mixed with 50% garden soil. There 50% Karachi University soil was mixed with 50% garden soil and employed as a control. In the second experiment, 25, 50 and 75% soils of towel, garment, rubber and ply board and Karachi University was mixed 75, 50, and 25% garden soil, respectively. There pure garden soil was implemented as a control. There was also kept pure garden soil as a control. There were six replicates for each soil (treatments and control) in all of the experiments, except *A. lebbeck* in the first experiment, there were four replicates. One seedling was grown in each pot in all of the experiments and all the experiments were completely randomized. Reordering of pots was also performed every week to prevent light/shade or any other greenhouse effects. Plants were grown upto five weeks for *A. lebbeck* and eight weeks for *L. leucocephala* in the first experiments and all of the plants of *A. lebbeck* and *L. leucocephala* were grown upto ten weeks in second experiment and watered daily. The growth of plants like height, cover and number of leaves were taken after five weeks for *A. lebbeck* and after eight weeks for *L. leucocephala* in the first experiment and after ten weeks for both plants in second experiment.

All soil was also analyzed, therefore, two soil samples of Khan Towel, Tanveer Garment, One Tech Rubber and One Tech Ply Board factories including Karachi University Campus and garden soil were collected and air-dried, lightly crushed and passed by a 2 mm sieve and kept in the laboratory. At first, soil was mechanically analyzed, hence, coarse sand was measured through sieve method employing 0.05 mm sieve [12]. Method of [13] was applied for determination of maximum water holding capacity. Soil organic matter was estimated in relation to [14]. Amount of calcium carbonate was examined using acid neutralization method, as explained via [15]. Total soluble salts in soil were assayed by the method of [16], whereas**,** a direct pH-reading meter (MP 220 pH Meter) (Mettler, Toledo) was used for soil pH determination. The turbidity method was implemented for available sulfate in soil as stated by means of [17], using a colorimeter (Photoelectric Colorimeter AE-11M). Heavy metals in soil were also analyzed by wet digestion. For this purpose, 5 ml concentrated nitric acid (HNO_3) + 5 ml concentrated perchloric acid ($HClO_4$), was treated with one gram dried soil sample and digested into 50 ml beaker and heated at 90 °C for 2½ hours. After that, small quantity of distilled water was mixed in the digested residue and filtered by Whatman filter paper No. 42 and solution volume was made up to 50 ml utilizing distilled water and solution was diluted 10 times for copper, zinc and chromium analyses through atomic absorption spectrophotometer (Perkin Elmer Model No. 3100).

Statistical analysis of all data was performed by analysis of variance [18] and Duncan's Multipal Range Test [19] ($p < 0.05$) by means of personal computer software packages Costat version 3.0 and SPSS version 10.0.

Decrease in percentage of all data was evaluated in treated soil relative to control soil (control-treatment/control×100) as described by [7].

3 Results

In the first experiment, the height of *Albizia lebbeck* at the final week after five weeks differed in soils of different areas (Table 1). One Tech Ply Board factory soil markedly lessened height as correlated to control soil of Karachi University (Tables 1 & 2) whereas, plant cover and number of leaves were manifestly reduced in the treatment of One Tech Rubber factory soil. In the situation of *Leucaena leucoceohala,* at the final week after eight weeks, all growth variables (height, cover and number of leaves) were notably repressed in soil of Tanveer Garment factory in front of control soil.

In the second experiment, at final week after ten weeks height, cover and number of leaves of *A. lebbeck* and *L. leucocephala* in different soil ratios of factories and Karachi University was noted relatively to garden soil (Table 1). In the case of *A. lebbeck,* when observed in different composition of Karachi University soil, plant height and cover were noticeably hindered in 50% Karachi University soil while no. of leaves in 75% soil as correlated to garden soil (Tables 1 & 2). 75% soil of Khan Towel and One Tech Ply Board factories and 50% of One Tech Rubber factory suppressed whole growth assortments. 75% and 25% soil of Tanveer Garment factory, confined height and number of leaves, respectively whereas all soil compositions enhanced cover over control soil, dramatically at 75% soil.

In the investigation of *L. leucocephala,* height, cover and number of leaves were retarded treating 75% Karachi University soil in contrast of garden soil. 75% Khan Towel and Tanveer Garment factories soil reasoned evident hurdle in height and cover while 50% resulted obstructions in number of leaves. Entire growth types were restricted in 75% one Tech Rubber factory soil whereas 50% soil of One Tech Ply Board factory restrained height and cover of *L. leucocephala*. 25% soil of One Tech Ply Board factory constrained number of leaves of *L. leucocephala* comparatively to Garden soil.

With reference of soil analysis, in the first and second experiments, Each factory soil presented high total soluble salts especially in Khan Towel factory soil (14.0 $\mu g.g^{-1}$) (Table 3) as compared to control soil of Karachi University and Garden soil (Tables 4 &5). Low content of soil organic matter was recorded in every factory soil particularly Tanveer Garment factory soil had lowest organic matter (0.9%). Differences were slight among all factories, Karachi University and garden soils, in contrary of Tanveer Garment factory soil represented somewhat higher soil pH (8.3) than other types of soil including control soil of Karachi University and Garden soil. Diverse ranges was showed in zinc concentration in various soil types mainly Tanveer Garment factory soil revealed in opposition to appreciable point of zinc (0.090 $\mu g.g^{-1}$) in relation to Karachi University and garden soil. The extension of coarse sand was palpable in whole product manifesting sites soil principally One Tech Rubber factory soil had large rate of coarse sand (88.0%). Water capturing ability was less in the majority of the industrial locations soil but water holding capacity was sufficiently shorted (17.0%) in One Tech Rubber factory soil. All factories had adequate magnitude of calcium carbonate whereas One Tech Rubber factory soil exhibited noticeable calcium carbonate (36.5%) absorption. All factories soil demonstrated prominent level of chromium especially One Tech Rubber factory soil (6.899 $\mu g.g^{-1}$) than control soil of Karachi University and garden soil. All factories soil displayed discernible sulfate availability chiefly One Tech Ply Board factory soil had considerable degree of sulfate availability (608 $\mu g.g^{-1}$) in soil. Various limits of Copper was observed in varied kinds of soil but One Tech Ply Board factory soil held greater scale of copper (0.074 $\mu g.g^{-1}$) as correlated to Karachi University and garden soil.

4 Discussion

Successful growth of plants really depends on soil characters and conditions. Good balance of coarse sand, water retaining potential, pH level in soil, organic matter content, concentration of calcium carbonate, total dissolved salts and sulfate availability in soil furthermore concentration of copper and zinc play key role in plant growth. So, height, circumference and number of leaves of *Albizia lebbeck* and *Leucaena leucocephala* were assessed for some weeks under homogenous ecological situations keeping in soil with above mentioned soil properties. In the growth determination of Khan Towel factory soil, after ten weeks, in the second experiments, all of the parameters of *A. lebbeck* and height and cover of *L. leucocephala* were drastically diminished in 75% whereas no. of leaves of *L. leucocephala* by 50% Khan Towel factory soil. It may be caused distinctly increased concentration of total dissolved salts in soil. Rice plant exhibited considerable suppression in salinity [20]. Salinity primarily reduced ability of respiration on a legume pea plant species (*Pisum sativun* cv. Lincoln) and faba-bean bacteroids (*Vicia faba* L. var. minor cv. Alborea), in contrast soybean (*Glycine max* L. var. Williams) was displayed as a salt tolerance species by [21].

In the case of Tanveer Garment factory soil, in the first experiment, all growth expressions of *L. leucocephala* were apparently lessened as a result of 50% soil and in the second experiment, height and cover of same plant was primarily impeded at same percentage. Height of *A. lebbeck,* was obviously hampered by means of 75% and cover and no. of leaves using 25% soil. It might be due to manifest deficiency of organic matter, highest pH, and exceed zinc concentration. Land production ability, soil fertility and level soil deprivation depends upon an important issue of soil organic matter [22]. Maximum numbers of species of two species group (vascular plants and bryophytes) were noted with some extent where greater moister content, soil pH, grazing intensity was observed with lower tree cover [23]. Their study represented that low pH adequately lessened nitrification, whereas net nitrogen mineralization was usually not much affected. The growth of *Phaseolus aureus* cv. R-851 inhibited through zinc application [24]. Oguntade, *et al.* [9] recorded that 20% dye concentration gave the maximum uptake of Manganese (Mn), Iron (Fe) and Zinc (Zn) in the edible shoots of *Amaranthus cruentus* L. in field situation.

In the condition of One Tech Rubber factory soil, in the first experiment, 50% soil extent reasoned clear retardation in cover and no. of leaves of *A. lebbeck* moreover all of the growth kinds of the same plants and *L. leucocephala* in second experiment. It may be due to adequate magnitude of coarse sand, $CaCO_3$ and chromium and lower water holding capacity in soil. Gohar *et al.* [25] revealed that soil textured had marked effect on root morphology of cotton plant. On varied tillage applications, [26] noted diverse impact on the water retaining ability on orchid in China.

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In the position of One Tech Ply Board factory soil, in the first experiment, height of *A. lebbeck* was substantially miserable applying 50% whereas in the second experiment, whole of the growth aspects of similar plant were notably obstructed employing 75% soil. In the other hand, height and cover of *L. leucocephala* were literally hampered at 50% and no. of leaves treating 25% soil which might be sourced due to high concentration of available sulfate and copper in soil. A number of growth expressions were curbed via Cu and Fe solution [27]. In the second experiment, 50% soil of Karachi University created virtual growth barriers in height and cover of *A. lebbeck* although no. of leaves of the same plant and all of the growth assortments of *L. leucocephala* in the utilization of 75% Karachi university soil. Predominant obstacles in growth may be caused due to low capacity of water holding and organic matter and high magnitude of coarse sand, total soluble salts, chromium concentration and soil pH level in Karachi University soil in against of Garden soil. Singh [28] ascertained due to enhanced content of organic matter, water holding capacity of soil increased due to the colloidal nature of organic matter where plant communities were growing. Noxious effects of salinity are universal farming and eco-environmental issues. Zarea, *et al.* [29] had evaluated affects of salinity on the tolerance of wheat to soil salinity and found *Piriformospora indica* fungus and *Azospirillum* strains may be different in their tolerance of salinity and influence the photosynthetic pigment contents, water uptake and accumulation of proline in wheat seedlings. Initial soil pH has been determined to have a considerable impact on the putrefaction of supplementary organic materials and therefore to assess the route and degree of following soil pH changes [30].

It could be concluded that soils of industrial areas were more injurious subsequently soil of University of Karachi for growth of *Albizia lebbeck* and *Lucaena leucocephala,* particularly at higher amount. Garden soil caused better growth for growth of both plants.

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Table 1. Growth of plants in different soils

				Albizia lebbeck			*Leucaena leucocephala*		
Experiment no.	**Soils %**	**Soil types**	**Soils**	**Height (cm)**	**Cover (cm)**	**No. of leaves**	**Height (cm)**	**Cover (cm)**	**No. of leaves**
1	50	Control	Karachi University	7.75a±0.72	30.15a±1.71	11.75a±0.48	20.97b±2.39	64.08b±4.33	31.17b±12.42
		Factories	Khan Towel	4.80b±0.39	18.08bc±1.71	10.50a±0.29	20.08b±1.72	66.50b±5.42	32.83b±3.58
			Tanveer Garment	6.73a±0.52	21.25b±1.94	9.50a±0.87	16.83b±1.82	61.92b±5.27	31.67b±3.56
			One Tech Rubber	4.45b±0.73	9.53d±1.27	21.25b±1.94	20.58b±1.00	67.17b±1.70	33.33b±1.74
			One Tech Ply Board	3.75b±0.14	14.70cd±2.80	6.00b±2.12	26.33a±1.14	85.50a±2.79	44.33a±3.08
2	100	Control	Garden soil	5.92ab±0.70	15.83a±1.59	6.17a±0.79	6.72a±0.47	24.92a±1.75	16.83a±2.43
	25	Less polluted	Karachi University	7.17a±1.07	17.67a±2.02	6.50a±1.06	4.88a±0.72	15.08b±3.96	9.33ab±3.37
	50			4.53b±0.47	14.80a±0.92	6.00a±0.45	6.70a±0.75	15.80ab±3.89	13.17ab±4.52
	75			6.80ab±0.67	16.78a±1.89	4.33a±0.61	4.83a±0.78	12.73b±2.25	6.67b±1.61
	100	Control	Garden soil	5.92a±0.70	15.83a±1.59	6.17a±0.79	6.72a±0.47	24.92a±1.75	16.83a±2.43
	25	Factory	Khan Towel	5.72a±0.53	16.70a±1.12	5.33a±0.56	5.45ab±0.60	17.42b±1.40	9.00b±0.68
	50			5.38a±0.55	15.58a±1.58	5.83a±0.54	6.32ab±0.29	15.70b±0.92	8.33b±0.33
	75			5.20a±0.54	12.82a±3.33	3.83a±1.17	5.03b±0.44	14.92b±1.89	8.67b±1.26
	100	Control	Garden soil	5.92a±0.70	15.83a±1.59	6.17a±0.79	6.72a±0.47	24.92a±1.75	16.83a±2.43
	25	Factory	Tanveer Garment	6.97a±0.44	16.45a±3.37	5.50a±1.28	7.03a±0.93	19.82ab±1.86	13.33a±2.22
	50			6.95a±0.65	20.33a±1.11	7.50a±0.99	6.57a±0.63	16.80b±1.64	14.00a±2.31
	75			5.78a±0.94	21.73a±2.01	8.50a±1.23	6.82a±0.50	19.15b±1.74	11.17a±1.19
	100	Control	Garden soil	5.92a±0.70	15.83ab±1.59	6.17ab±0.79	6.72a±0.47	24.92a±1.75	16.83a±2.43
	25	Factory	One Tech Rubber	5.58a±0.47	17.07ab±1.39	7.00ab±0.73	6.78a±0.75	19.18b±1.21	12.50ab±1.31
	50			4.92a±0.62	12.73b±3.51	4.33b±1.09	6.13a±0.71	16.82b±1.60	9.67b±2.16
	75			5.78a±0.52	20.92a±2.09	7.83a±1.11	7.02a±0.69	18.72b±1.45	12.00ab±2.19
	100	Control	Garden soil	5.92a±0.70	15.83a±1.59	6.17a±0.79	6.72a±0.47	24.92a±1.75	16.83a±2.43
	25	Factory	One Tech Ply Board	6.40a±0.83	19.73a±1.85	5.67a±0.49	6.25a±0.27	17.53b±1.00	9.50a±1.48
	50			5.88a±0.76	17.02a±1.45	6.83a±0,48	4.53b±0.47	13.60b±1.63	11.00a±1.24
	75			5.45a±0.44	14.48a±2.45	4.83a±1.11	4.67b±0.54	14.80b±1.51	12.83a±3.87

Soil %= 25% soil + 75% garden soil; 50% soil + 50% garden soil; 75% soil + 25% garden soil.
Statistical significance determined by analysis of variance. Numbers followed by the same letters in the same column are not significantly different ($p < 0.05$) according to Duncan's Multiple Range Test.
± Standard error.

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Table 2. Percentage reduction in growth of plants grown in different soils in comparison with control soil.

				Albizia lebbeck			*Leucaena leucocephala*		
Experiment no.	**Soils %**	**Soil types**	**Soils**	**Height (cm)**	**Cover (cm)**	**No. of leaves**	**Height (cm)**	**Cover (cm)**	**No. of leaves**
1	50	Factories	Khan Towel	38.1	40.0	10.6	4.2	3.8+	2.1+
			Tanveer Garment	13.2	29.5	19.1	19.7	3.4	1.6
			One Tech Rubber	42.6	68.4	70.2	1.9	4.8+	3.6+
			One Tech Ply Board	51.6	51.2	48.9	25.6+	33.4+	37.8+
2	25	Less polluted	Karachi University	21.1+	11.6+	5.3+	27.4	39.5	44.6
	50			23.5	6.5	2.8	0.3	36.6	21.7
	75			14.9+	6.0+	29.8	28.1	48.9	60.4
	25	Factories	Khan Towel	3.4	5.5+	13.6	18.9	30.1	46.5
	50			9.1	1.6	5.5	6.0	37.0	50.5
	75			12.2	19.0	37.9	25.1	40.1	48.5
	25		Tanveer Garment	17.7+	3.9+	10.9	4.6+	20.5	20.8
	50			17.4+	28.4+	21.6+	2.2	32.6	16.8
	75			2.4	37.3+	37.8+	1.5+	23.2	33.6
	25		One Tech Rubber	1.2	7.8+	19.9+	0.9+	23.0	25.7
	50			16.9	19.6	29.8	8.8	32.5	42.5
	75			2.4	32.2+	26.9+	4.5+	24.9	28.7
	25		One Tech Ply Board	8.1+	24.6+	8.1	7.0	29.7	43.6
	50			0.7	7.5+	10.7+	32.6	45.4	34.6
	75			7.9	8.5	134.7+	30.5	40.6	23.8

Soil %= 25% soil + 75% garden soil; 50% soil + 50% garden soil; 75% soil + 25% garden soil, + Percentage increase

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Table 3. Soil properties of different soils.

Soil	**Coarse sand (%)**	**Water Holding Capacity (%)**	**Organic matter (%)**	**$CaCO_3$ (%)**	**Total soluble salts (%)**	**pH**	**Available sulfate (μg^{-g})**	**Cu**	**Zn**	**Cr**
A	21d ±1	37a ±0	4.3a ±0.3	12.8e ±0.2	3.8d ±0.2	8.1bc ±0.0	24d ±1	0.016bc ±0.004	0.062b ±0.004	1.194c ±0.083
B	58b ±0	27b ±0	2.0cd ±0.3	17.8d ±0.3	5.9cd ±0.7	8.4a ±0.0	8d ±0	0.002c ±0.002	0.029c ±0.017	6.066a ±0.046
C	24d ±2	29b ±3	2.1c ±0.2	29.5b ±1.5	14.0a ±2.0	8.0bc ±0.1	575a ±13	0.023b ±0.012	0.033c ±0.001	4.139b ±0.093
D	47c ±0	31b ±2	0.9e ±0.0	24.5c ±0.5	8.0bc ±0.0	8.3ab ±0.1	108c ±23	0.008bc ±0.002	0.090a ±0.002	4.229b ±0.111
E	88a ±1	17c ±3	1.1de ±0.1	36.5a ±2.5	12.0a ±0.0	8.2ab ±0.1	401b ±11	0.002c ±0.002	0.019cd ±0.002	6.899a ±0.978
F	26d ±2	40a ±0	3.3b ±0.4	17.5d ±1.5	9.0b ±1.0	7.8c ±0.2	608a ±45	0.074a ±0.002	0.003d ±0.002	1.404c ±0.406

A = Garden soil; B = Karachi University soil; C = Khan Towel factory soil; D = Tanveer Garment factory soil; E = One Tech Rubber factory soil; F = One Tech Ply Board factory soil.
Statistical significance determined by analysis of variance. Number followed by the same letters in the same column are not significantly different ($p < 0.05$) according to Duncan's Multiple Range Test, ± Standard error.

Table 4. Percentage reduction in soil characters of factories soils in comparison with control soil (Karachi University).

Soil	Coarse sand	Water Holding Capacity	Organic matter	$CaCO_3$	Total soluble salts	pH	Available sulfate	Cu	Zn	Cr
A	58.6	7.4+	5.0+	65.7+	137.3+	4.8	7087.5+	1050.0+	13.8+	31.8
B	19.0	14.8+	55.0	37.6+	35.6+	1.2	1250+	300.0+	210.3+	30.3
C	51.7+	37.0	45.0	105.1+	103.4+	2.4	4912.5+	0.0	34.5	13.7+
D	55.2	48.1+	65.0+	1.7	52.5+	7.1	7500.0+	3600.0+	89.7	76.9

A = Khan Towel factory soil; B = Tanveer Garment factory soil; C = One Tech Rubber factory soil; D = One Tech Ply Board factory soil, + Percentage increase.

Table 5. Percentage reduction in soil characters of different soils in comparison with control soil (Garden soil).

Soil	Coarse sand	Water Holding Capacity	Organic matter	$CaCO_3$	Total soluble salts	pH	Available sulfate	Cu	Zn	Cr
A	176.2+	27.0	53.5	39.1+	55.3+	3.7+	66.7	87.5	53.2	408.0+
B	14.3+	21.6	51.2	130.5+	268.4+	1.2	2295.8+	43.8+	46.8	246.6+
C	123.8+	16.2	79.1	91.4+	110.5+	2.5+	350.0+	50.0	45.2+	254.2+
D	319.0+	54.1	74.4	185.2+	215.8+	1.2+	1570.8+	87.5	6.4	477.8+
E	23.8+	8.1+	23.3	36.7+	136.8+	3.7	2433.3+	362.5+	95.2	17.6+

A = Garden soil; B = Khan Towel factory soil; C = Tanveer Garment factory soil; D = One Tech Rubber factory soil; E = One Tech Ply Board factory soil, + Percentage increase.

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