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USING OF SOME WASTES IN IMPROVING WATER HOLDING CAPACITY OF SANDY SOIL AND GROWTH OF *Conocarpus lancifolius* Engl. SEEDLINGS

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ABSTRACT

Improving water holding capacity of Ashraf-Najaf shelterbelt sandy soil was experienced by mixing root zone soil with three types of amending materials; palme particles, sponge pieces, and cardboard slabs. Two quantities of each material were tested. Six months seedlings of *Conocarpus lancifolius* were planted in large pots filled by soil of the study region. At the beginning of growing season, plants were subjected to different water regimes. Agricultural maintaining processes were daily applied for the whole growing period. Growth parameters were frequently recorded during hottest summer months. Results showed that an enhancement in growth was obtained through the addition of waste materials. Sponge pieces affected more in case of daily irrigation, while cardboard slabs revealed improvement for a longer irrigation interval. Palm waste was the weakest affecting material. Doubling the quantity of material had a positive influence on growth parameters. Weight related properties showed a response similar to that of dimensional ones. Based on results, daily irrigation in such sandy soil was of a vital importance in summer months for maintaining healthy, fast growing seedlings.

Keywords: *Conocarpus lancifolius*, wastes, water, holding capacity, soil.

INTRODUCTION

Many of Iraqi governorates started establishing shelterbelts around cities for environmental and recreational objects. Growth conditions in middle and south of country are often unfavorable for healthy plant growth especially in hot summer season. Soil is normally different in texture and structure from one location to another. Now a day, intensive plantation processes are carrying out in shelterbelt projects around holly Najaf and Karbala cities. Long hot season with low relative humidity is dominant in the area. In addition, soil is mostly sandy nature with high drainage capacity. Accordingly, seedlings are suffering thirst and in many cases they cannot survive. The risk is at maximum during first season of planting where plant root is near to soil surface which is subjecting to direct sun light and in sandy soil it is rapidly drained out.

Coarse, sandy soils found in semi-arid and arid regions have large pores that absorb large quantities of water, and retain less than 20 percent of it in the root zone that sits between the surface and depths of 60 to 70 centimeters [1]. Sandy soils have poor structure, with large spaces between sand grains. It has larger particles than clay or loamy soil and allows plenty of oxygen to reach the roots. It doesn't retain moisture and typically has fewer mineral nutrients than finely textured soils. The use of amending materials is a famous technique in improving soil properties. The quality of sandy soil can be improved over time by adding organic matter such as aged manure, sawdust or compost (Weinblatt and Media) [2]. Sawdust and wood chips can be worked into sandy soil to increase water-retention properties, but decomposing wood products tie up nitrogen and other nutrients, making the soil unsuitable for planting for at least one growing season. Nitrogen fertilizer can be used to help offset the effects of decomposing wood products, and lime can be added to decrease the acidifying effect of these amendments [3]. In perennial and shrub beds, wood/bark chips can reduce the need for irrigation by as much as 50 %. Wood/bark chip mulch creates a favorable environment for earthworms and soil microorganisms [4]. In very coarse, sandy soils, addition of organic material can improve water retention, thereby reducing water losses to deep percolation and leaching losses of nutrients [5]. Wastes from paper mills, timber and paper products Paper mill sludge is one of the largest under-utilized organic by-products in Wisconsin. Paper mill residuals are either land filled or land spread, but over 60% are still land filled [6].

One of soil amending methods is using water absorbents material or hydrophilic polymer [7, 8]. Using of super absorbent polymers (SAPs) is the most effective method for water saving in root zone. This method is simple, cheap, and suitable for wide range of crops including trees [9]. These white sugar-like materials [10] are able to absorb up to 400 times their weight in water [11], and have the ability of reducing water quantities for irrigation by 15% to 50% [12]. Significant effects on growth were found by [13] through the use of these materials. They are not available in Iraqi markets and still not experienced in the national agricultural activities. Therefore, suitable alternative materials were experimented in this research aiming to improve water retain in root zone of new planted seedling in areas of shelterbelts where sandy soils are dominants.

MATERIALS AND METHODS

One ton of sandy soil representing the soil type of shelterbelt project of Ashraf Najaf City was brought to the experimental area of Natural History Research Centre & Museum, University of Baghdad, where the research has

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been conducted. Sufficient quantities of wastes of date palm leave bases, cardboard, and sponge were provided.

Six months old seedlings of *Conocarpus lancifolius* were purchased from local private nursery. They were chosen to have uniform size and shape as much as possible. On beginning of growing season in the country seedlings at March 1st 2014 were transferred to larger polyethylene pots (20 x 35) cm with root surrounding by 10 kg of the brought sandy soil. That was in case of control treatment while weight of other treatments differed according to type and quantity of material added to attain same level of soil in the pot.

Two quantities of amendments were applied; they were measured as bulk volume. Waste particle sizes were 1/2 to 2 cm in length, cardboard particles were occasionally longer. Seedlings were numbered and placed in field in such a way to simplify irrigation processes following the planed irrigation regime. Three intervals of irrigation were conducted; 1, 2, and 4 days. One liter of water was sufficient to reach water holding capacity for the soil used, so this quantity of water was applied following an irrigation schedule prepared according to treatment level.

Three waste materials were mixed thoroughly with soil in two quantities for each and as follows:

a) **Date palm wastes (P):** 2 and 4 liters bulk volume leaf bases particles after being cut into 1/2 to 2 cm size particles by circular saw. They weighed 450 and 900 gm respectively.
b) **Cardboard (F):** 3 and 6 liter of cardboard slashes having a weight of 207 and 414 gm respectively.
c) **Sponge waste (S):** 2 and 4 liters with 52 and 104 gm were the third treatment within this variable.

Three intervals of irrigation were applied; 1, 2, and 4 days. It continued until 31 of August, that means plant stayed under treatment during highest temperature months among the year.

Experiment has designed as factorial CRD and data were analyzed statistically by Statistica 99 Edition [14], and using Duncan Multiple Range Test for difference between treatments.

RESULTS AND DISCUSSIONS

Monthly Measure of shoot parameters showed progressive increment in shoot length, number of branches, and stem diameter (Figure-1). In all the three properties, seedlings with no additive (control - C) were at lower limits. While shoot of plants which

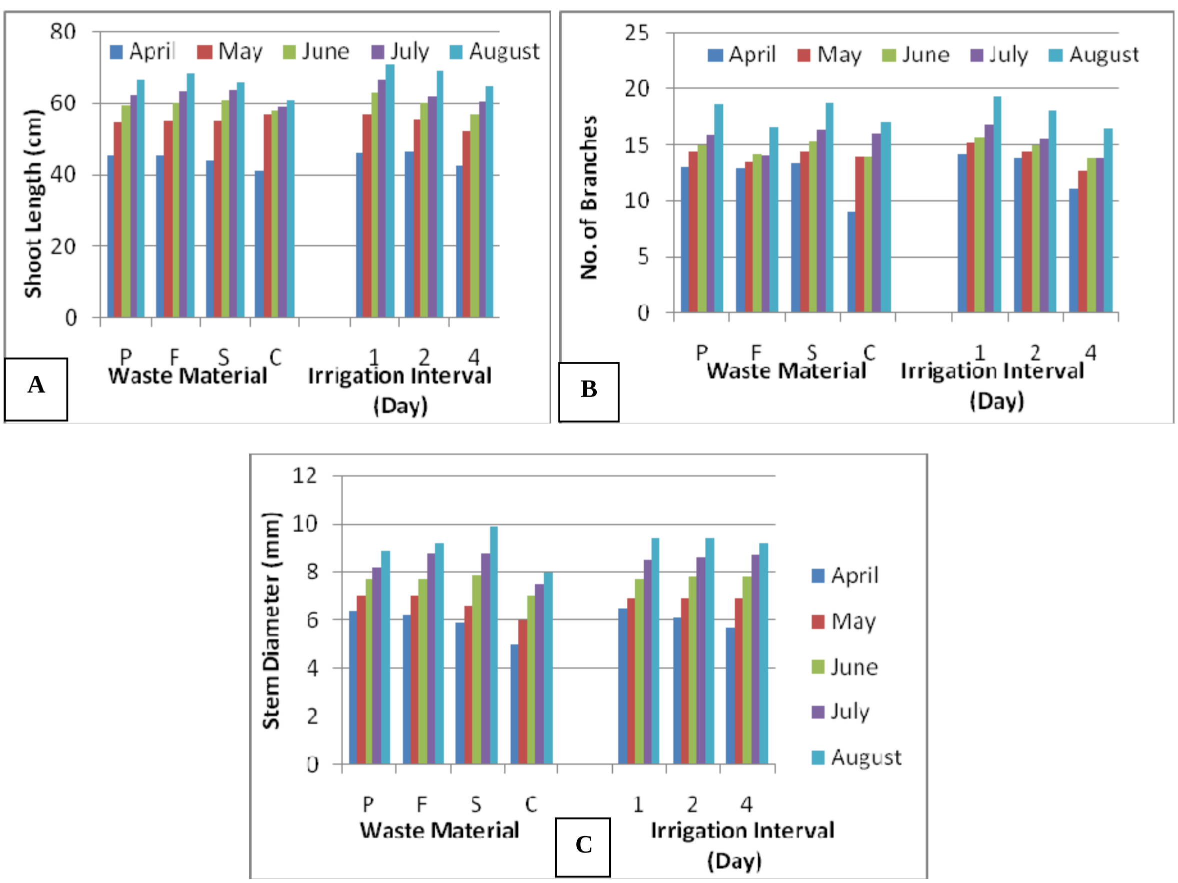

Figure-1. Monthly development of shoot length (A), number of branches (B), and stem diameter (C) of *C. lancifolius* seedlings as affected by type of waste material and irrigation interval.

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contain waste material in root zone continued in growth between May and August, plants of control treatment had very little addition in length during the same period. Temperature at these four months is at its maximum levels therefore, water requirements of plant is increased hence, waste materials in root zone played an important role in reserving water and maintaining growth during the period of hot months. The response was not in same clearness in case of branches and stem diameter. Type of waste material had no clear interaction with time of measurement. Only one notification could be recorded that is the high stem diameter obtained at august for plants having sponge (S) in their root zone.

The effect of irrigation started from the beginning of planting but it differed according to property. Noticeable increment in August has observed in shoot length and number of branches comparing with preceding months. Long interval (4 days) affected more on number of branches than on shoot length or stem diameter.

Growth parameters at harvest showed different levels of dependence on the three investigated factors. Shoot length has primarily affected by irrigation interval (Table-1). Daily irrigated plants possessed about 16% more length than others.

Table-1. Growth parameters of *C. lancifolius* seedlings as affected by type of waste and irrigation interval.

Property	**Irrigation interval** (day)	**Waste type**				
		Palme	**Cardboard**	**Sponge**	**Control**	**Mean**
Shoot Length (cm)	1	69.44 (abc)	72.22 (b)	78.67 (a)	66.78 (bc)	71.78
	2	65.56 (bc)	69.67 (abc)	59.67 (c)	63.33 (bc)	64.50
	4	65.11 (bc)	64.22 (bc)	59.22 (c)	60.78 (c)	62.33
	Mean	66.70	68.70	65.85	63.63	67.04
Number of Branches	1	22.22 (ab)	19.67 (abc)	23.78 (a)	21.78 (ab)	21.86
	2	17.89 (abc)	15.67 (bc)	18.33 (abc)	15.11 (bc)	16.75
	4	18.56 (abc)	13.89 (c)	14.33 (c)	15.21 (bc)	15.49
	Mean	19.56	16.41	18.81	17.36	18.03
Stem Diameter (mm)	1	9.13 (ab)	9.58 (ab)	10.33 (a)	9.98 (a)	9.76
	2	9.22 (ab)	8.61 (b)	10.50 (a)	9.06 (a)	9.35
	4	8.55 (b)	9.91 (ab)	9.08 (ab)	9.61 (a)	9.99
	Mean	8.97	9.37	9.97	9.55	9.70
Root Length (cm)	1	42.56 (b)	51.00 (ab)	49.67 (ab)	50.3 (ab)	48.30
	2	57.00 (a)	56.33 (a)	55.00 (a)	53.67 (ab)	55.50
	4	49.22 (ab)	51.33 (ab)	49.89 (ab)	49.22 (ab)	49.92
	Mean	49.59	52.86	51.52	51.06	51.54

Difference between 2 and 4 days intervals was not significant. Type of waste material has affected in combination with irrigation interval. Addition of sponge pieces improved shoot length significantly with daily irrigation, this effect disappeared when irrigation interval elongated to 2 or 4 days. The result refers that sponge reserved quantity of water in sandy soil for hours not for 2 days that was clear from obtaining low results in case of middle and long interval. Unlikely, cardboard and palm waste provided lower length with daily irrigation but maintained longer seedling than with sponge in case of the two longer intervals. That is because these two materials are of hygroscopic nature and have the ability to absorb and retain a lot of water through their content of cellulose, hemicellulose and lignin.

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Table-2. Growth parameters of *C. lancifolius* seedlings as affected by the interaction between quantity and type of waste material.

Property	Waste bulk volume (liter)	Waste type			
		Palme	Cardboard	Sponge	Mean
Shoot Length (cm)	1	65.88 (ab)	67.71 (a)	61.93 (b)	65.17
	2	67.52 (a)	69.68 (a)	69.78 (a)	68.99
	Mean	66.70	68.70	65.85	67.08
Number of Branches	1	17.95 (b)	15.91 (b)	19.14 (a)	17.67
	2	21.17(a)	16.91 (ab)	18.48 (a)	18.85
	Mean	19.56	16.41	18.81	18.26
Stem Diameter (mm)	1	9.06 (a)	9.04 (a)	10.12 (a)	9.41
	2	8.87 (a)	9.70 (a)	9.82 (a)	9.46
	Mean	8.97	9.37	9.97	9.44
Root Length (cm)	1	47.59 (a)	52.81 (a)	51.30 (a)	50.56
	2	51.58 (a)	52.92 (a)	51.74 (a)	52.08
	Mean	49.59	52.86	51.52	51.32

Table-3. Weight properties of seedlings as affected by waste type and irrigation interval.

Property	Irrigation interval (day)	Waste type				
		Palme	Cardboard	Sponge	Control	Mean
Shoot Green Wight (gm)	1	35.66 (ab)	46.59 (a)	39.43 (ab)	31.99 (b)	38.42
	2	31.97 (b)	32.54 (b)	32.42 (b)	32.98 (ab)	32.48
	4	26.00 (b)	33.44 (ab)	28.67 (b)	24.99 (b)	28.27
	Mean	31.21	37.52	33, 51	29.98	33.06
Shoot Dry Weight (gm)	1	24.21 (ab)	33.93 (a)	28.59 (a)	23.41 (ab)	27.54
	2	24.37 (ab)	21.56 (b)	23.46 (ab)	23.47 (ab)	23.22
	4	19.78 (b)	21.84 (ab)	20.90 (b)	19.84 (b)	20.59
	Mean	22.79	25.78	24.32	22.24	23.78
Root Dry Weight (gm)	1	44.32 (ab)	44.71 (ab)	51.62 (a)	45.40 (ab)	46.51
	2	25.13 (cd)	25.83 (cd)	30.41 (bcd)	26.64 (cd)	27.00
	4	22.96 (cd)	16.32 (d)	30.52 (bcd)	23.01 (cd)	23.20
	Mean	30.80	28.95	37.52	31.68	32.24

Number of branches and stem diameters revealed similar trend in relation to irrigation interval. 35% from the average number of branches and 5% of stem diameter were reduced by applying 4 days interval of irrigation. Also, sponge pieces appeared positive effect on these two properties in short irrigation interval and extinct in long one.

Situation was different with root length. Two days interval plant had longest root while one and four days seemed not significantly different. Daily irrigation offered sufficient water in root zone, but after first day water deficit might encourage root for elongation in a known physiological phenomenon. In case of four days where relative harmful effect was expected, root growth was showed slight reverse effect.t General review to the level of effect of waste quantity refers that some improvement was insured by doubling the quantity of waste material (Table-2). In most cases effect was not significant, with shoot length and numbers of branches were the most effective properties. Response depended on type of waste, and sponge appeared more enhancements in shoot length.

Weight related properties showed more dependence on irrigation interval than on type of waste material (Table-3). Interaction between these two factors was obvious, too. Cardboard material with one day interval resulted in highest shoot green and dry weights. Sharp drop happened when interval elongated to 2 days.

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Palm lesser effected than rest materials but still better than control. Palm particles are rather a type of wood, water penetration through voids and inside cell cavities takes more time than needed to penetrate through cardboard slabs or sponge pieces. Accordingly, addition of palm did not offer additional moisture in root zone as the two other materials did. Comparing with control, palm, cardboard, and sponge offered more shoot weight than control by 4%, 25%, and 12% respectively.

Figure-2. Root of *C. lancifolius* seedlings with three types of amendments; (S) sponge, (F) cardboard, and (P) palm waste.

Table-4. Weight properties of seedlings as affected by interaction between quantity and type of waste materials.

Property	**Waste bulk volume** (liter)	**Waste type**			
		Palme	**Cardboard**	**Sponge**	**Mean**
Shoot Green Wight (gm)	1	29.56 (b)	33.79 (b)	35.66 (ab)	33.00
	2	32.86 (b)	41.24 (a)	31.39 (b)	35.16
	Mean	31.21	37.52	33.51	34.08
Shoot Dry Weight (gm)	1	21.84 (a)	25.87 (a)	24.98 (a)	24.23
	2	23.74 (a)	25.69 (a)	23.66 (a)	24.36
	Mean	22.79	25.78	24.32	24.29
Root Dry Weight (gm)	1	30.37 (ab)	25.29 (b)	36.27 (a)	30.64
	2	30.42 (ab)	32.62 (ab)	38.77 (a)	33.94
	Mean	30.80	28.95	37.52	32.28

Influence of water deficit was clearer in case of root length. As a mean, root dry weight of daily irrigated plants exceeded that of 2 days interval by about 60%. Sponge pieces produced highest root dry weight while cardboard was the lowermost. Figure-2 shows how roots aggregated above the layer of sponge pieces which maintained moisture for certain time. Unlikely, palme wastes and cardboard slabs permited root to penetrate deeper in soil. Table-4 appears that quantity of waste material had no significant effects on weight properties although the noticed improvement which occurred in case of using 2 liters from material.

CONCLUSIONS

From results of research the following conclusions could be pointed out:

- Addition of certain types of waste materials to root zone of plant improves water reserving property in sandy soil.
- Sponge pieces assist in reserving water for a short period while cardboard slabs maintain moisture for longer time.
- Palme waste has a weak positive effect on growth.
- Irrigation interval is the most effective variable on both shoot and root properties.
- Seedlings of *C. lancifolius* can survive thirst and doing well with four days irrigation interval.
- Daily irrigation is an important criteria in retaining good, healthy, and fast growing seedlings in Holy Najaf shelterbelt

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