American Journal of Plant Physiology

ISSN 1557-4539

Academic Journals Inc.

www.academicjournals.com

American Journal of Plant Physiology 3 (4): 131-136, 2008
ISSN 1557-4539

Use of Date Palm Leaves Compost as A Substitution to Peatmoss

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Abstract: The main objective of this study was to prepare compost using local farm resources such as Date Palm Leaves (DPL) and compare it with the imported peatmoss on seed germination, rate of germination and growth of ornamental plants. The results showed that total number of seeds germinated, rate of seed germination, plant height, number of leaves per plant and the dry-biomass per plant was better in the Date Palm Leaves Compost (DPLC) relative to the peat moss. Based on the preliminary results, it is concluded that farming community and the various research organizations should be encouraged to develop technology for the preparation of composts using local farm wastes resources such as date palm leaves and *Phragmites australis* rather than importing more expansive peat moss.

Key words: Palm leaves, compost, seed germination, rate of germination, growth, dry-biomass

INTRODUCTION

Saudi Arabia is one of the leading date producing countries in the Middle East where the number of date palm trees is estimated around 18.20 millions (Annon, 1999). Each date palm tree produces 10-20 leaves per year (Pahsa, 1998). The discarded date palm leaves are a source of many hazards such as fire, host for many insect-pests and diseases. The compost showed significant impact on tree growth and production. The main objective of this study is to make use of this hazardous agricultural waste to useful thing by utilizing Date Palm Leaves (DPL) for the preparation of compost and determine its effect on seed germination and growth of many ornamental plants for landscape development. The compost showed significant impact on plant growth and production (Wang *et al*., 1984; Hartz and Giannini, 1998; Klock, 1998).

MATERIALS AND METHODS

The study was carried out Agricultural Research Station, Dirab, King Saud University, Riyadh, Saudi Arabia during 2007.

Preparation of Date Palm Leaves Compost (DPLC)

Date palm leaves compost was prepared by following the method described by Abu-Alfadhal (1970) with some modification. The Dried Date Palm Leaves (DPL) were cut to 10 cm in length and buried in 2×1 m size concrete pit with a 1.1 m depth. The compost layers were built in such a way that each layer was about 25 cm deep. First a layer of 96 kg of dried date palm leaves was placed in the bottom and then, the desired quantity of a mixture of ammonium sulfate, trisuper phosphate, fine (100 μ) calcium carbonate and clay in a ratio of 35:7:35: 100 kg, respectively per ton of dried date

palm leaves was distributed homogeneously. Each layer was sprayed with 77 L of water having a total salinity of 640 mg L^{-1} Total Dissolved Solids (TDS). In all, there were 4 identical layers of DPL, making the total depth of DPL up to 1 m in height. The compaction of date palm leaves was done manually at the time of making each compost layer for proper decomposition. Initially, the compost layers were stirred after six weeks followed by remixing the compost layers with an interval of 3-weeks. After 6-months, the compost pit was opened. The completely decomposed date palm leaves (compost) were separated from the un-decomposed part of date palm leaves which was mainly the hard mid-rib of the palm leaves. The decomposed portion of the date palm leaves (compost) was used in the experiments.

Chemical Composition of DPL Compost and Peatmoss

The two composts (date palm leaves compost and the imported peat moss) were analyzed for carbon, nitrogen, carbon to nitrogen ratio, acidity, total salt concentration, available nitrate, available ammonium, phosphorous, potassium, iron, manganese, copper, zinc and ash. Also, the Water Holding Capacity (WHC) of the composts was also measured. The mean chemical composition of the DPL compost and peatmoss for the two seasons is given in Table 1.

Germination Experiment

Seeds of four ornamental plants namely *Dahlia variabilis*, *Tagetes erecta*, *Zinnia elegans* and *Cosmos bipinnatus* were placed in trays filled with DPL compost and the imported peatmoss and then left in the laboratory at room temperature i.e., around 23°C. The number of seeds germinated and the rate of seed germination were recorded daily. The experimental treatments were replicated three times. A total of 50 seeds of each plant were tested in each replication. The experiments were laid out by following a Completely randomized statistical design.

Growth Experiment

Healthy seeds of four ornamental plants namely, *Dahlia*, *Tagetes*, *Zinnia and Cosmos* were planted in trays filled with a mixture of sand, clay and perlite in a ratio of 1:1:1 by volume during the month of May and June, 2007. The trays were kept in a greenhouse with inside temperature of 18°C plus or minus 2°C. The seed germination was complete in a week. Later on, 8 healthy seedlings were transplanted to 20 cm diameter pots filled with Date Palm Leaves Compost (DPLC) and peatmoss. The pots were kept in the greenhouse. Later on, the seedlings were thinned to 5 seedlings per pot after one week and replicated 3 times. The pots were fertilized at the rate of 150 mg L^{-1} of compound water soluble fertilizer with a composition of 20:20:20 with irrigation water.

Table 1: Mean chemical composition of DPLC and peatmoss for two seasons

Element	DPLC	Peat moss
Carbon ratio (%)	7.92	33.06
Nitrogen total (%)	0.80	0.79
Carbon to nitrogen ratio	9.93	42.39
Acidity (pH)	6.85	4.28
ECe of compost extract	6.18	1.43
Available nitrate (mg L^{-1})	574.00	84.00
Available ammonium (mg L^{-1})	217.00	420.00
Phosphorus (%)	0.29	0.05
Potassium (%)	0.29	0.02
Iron (ppm)	2750.00	1090.00
Manganese (mg L^{-1})	88.50	50.00
Copper mg L^{-1})	12.50	13.00
Zinc (mg L^{-1})	23.50	7.00
Ash (%)	56.92	4.19
WHC (%)	178.34	492.42

Plant growth measurements such as plant height, true leaves number and dry weight of the vegetative growth were taken after 45 days of transplanting during the month of May and June. The plant height was taken from the soil surface to the top of the plant. The plants were dried in open paper bags for three weeks in the laboratory.

Statistical Analysis

The experiments were laid out as a complete randomize design, with three replications and fifty seeds per replication for the germination experiment and five plants per replication for the growth experiment. All the data were analyzed using ANOVA (SAS, 2000) and means were compared by the Least Significant Different ($LSD_{0.05}$) according to Steal and Torrie (1996).

RESULTS AND DISCUSSION

Germination Experiment

First Growing Season

There was no significant difference in the number of seeds germinated in the DPLC and peatmoss except *Dahlia* where the germination was significantly more in DPLC than imported peatmoss with an $LSD_{0.05}$ value of 4.97 (Table 2). Although, there was an increasing trend in the number of seeds germinated in the DPLC than peatmoss, but the difference was not significant at 5% level of significance. This suggests that DPLC proved better growing medium for seed germination of ornamental plants than the peatmoss.

The rate of germination was identical in both the DPLC and the peatmoss for all the plants except *Zinnia* where the rate of seed germination was significantly more in DPLC than peatmoss ($LSD_{0.05}$ = 0.05). However, for other plants, the trend in the rate of seed germination was higher in DPLC than peatmoss for Dahlia and Tagetes except Cosmos (Table 2).

Second Growing Season

The total number of seeds germinated were significantly higher in DPLC than peatmoss for all the plants except Tagetes where the difference was not significant ($LSD_{0.05}$ = 1.43) (Table 3).

Table 2: Effect of DPLC and peatmoss on seed germination and the rate of seed germination during the first growing season

Treatment	*Dahlia*	*Tagetes*	*Zinnia*	*Cosmos*
No. of seed germinated				
Compost	42.00a	50.00a	45.00a	28.3a
Peat moss	32.00b	46.30a	46.30a	26.3a
$LSD_{0.05}$	4.97	7.99	18.97	13.83
Rate of germination (Day)				
Compost	5.26a	5.39a	5.02a	5.24a
Peat moss	4.77a	4.46a	4.33b	5.28a
$LSD_{0.05}$	1.75	1.01	0.05	0.95

Means in a column followed by the same letter are not significantly different by $LSD_{0.05}$

Table 3: Effect of DPLC and peatmoss on seed germination and the rate of seed germination during the second growing season

Treatment	*Dahlia*	*Tagetes*	*Zinnia*	*Cosmos*
No. of seeds germinated				
Compost	42.30a	50.00a	45.00a	29.00a
Peat moss	33.30b	45.70b	45.67a	26.67b
$LSD_{0.05}$	2.48	1.43	7.17	1.43
Rate of Germination (Day)				
Compost	4.58a	5.41a	5.39a	5.32a
Peat moss	4.78a	4.47b	4.29a	5.39a
$LSD_{0.05}$	2.62	0.20	1.35	0.16

Means in a column followed by the same letter are not significantly different by $LSD_{0.05}$

The rate of seed germination was not affected both by the DPLC and peatmoss except the Tagetes plant where the rate of seed germination was higher in DPLC relative to peatmoss ($LSD_{0.05} = 0.20$) (Table 3).

Growth Experiment

First Growing Season

Different types of composts (growing medium) did not affect significantly the plant height of all the ornamental plants (Table 4). There was a slight increasing trend in plant height in the DPLC than peatmoss, but the difference was not significant at 5% level of significance.

Similarly, the number of leaves for all the plants did not respond positively to different types of composts (Table 4). This suggests that different types of composts did not affect the number of leaves of the ornamental plants.

Mean dry-weight per plant was not affected significantly by the different types of composts except *Tagetes* plant where the dry-weight was significantly higher in DPLC than Patmos's at 5% level of significance during the first growing season (Table 4).

Second Growing Season

The trend for the effect of DPLC and peatmoss on plant height, number of leaves and dry weight of vegetative growth was almost identical to the first growing season except the dry weight of biomass of *Tagetes* which was significantly more in DPLC than peatmoss during the second growing season ($LSD_{0.05} = 0.63$) (Table 5).

Table 4: Effect of different DPLC and peatmoss on plant height, number of leaves and dry weight of vegetative growth during the first growing season

Treatment	*Dahlia variabilis*	*Tagetes erecta*	*Zinnia elegans*	*Cosmos bipinnatus*
Plant height (cm)				
Compost	19.93a	27.47a	27.00a	31.00a
Peat moss	13.27a	28.00a	26.60a	30.73a
$LSD_{0.05}$	11.18	2.01	16.91	4.59
No. of Leaves (Nos)				
Compost	11.93a	13.47a	11.20a	12.40a
Peat moss	11.93a	13.00a	12.33a	12.53a
$LSD_{0.05}$	5.04	2.74	5.76	3.04
Dry weight of vegetative growth/plant (g)				
Compost	2.43a	4.03a	2.57a	1.51a
Peat moss	2.45a	2.43b	2.42a	1.51a
$LSD_{0.05}$	0.03	0.15	0.49	0.06

Means in a column followed by the same letter are not significantly different by $LSD_{0.05}$

Table 5: Effect of DPLC and peatmoss on plant height, number of leaves and dry weight of vegetative growth during the second growing season

Treatment	*Dahlia variabilis*	*Tagetes erecta*	*Zinnia elegans*	*Cosmos bipinnatus*
Plant height (cm)				
Compost	26.33a	35.57a	33.70a	37.00a
Peat moss	17.63a	35.30a	33.80a	37.13a
$LSD_{0.05}$	11.93	3.23	7.72	1.76
No. of leaves/plant				
Compost	17.27a	17.13a	15.53a	15.87a
Peat moss	16.27a	17.20a	16.27a	16.13a
$LSD_{0.05}$	7.32	2.01	1.60	2.74
Dry weight of vegetative growth/plant (g)				
Compost	3.33a	5.11a	3.79a	5.42a
Peat moss	3.32a	3.46b	3.53a	5.36a
$LSD_{0.05}$	0.29	0.63	1.32	0.56

Means in a column followed by the same letter are not significantly different by $LSD_{0.05}$

DISCUSSION

Generally composts are used to enhance seed germination and normal plant establishment especially for the ornamental plants which are sensitive to the growing media. The results indicated that preparation of DPLC using the local resources is economical and also a gate way to minimize environmental hazards due to the land disposal of dried DPL. In the present study, number of total seeds germinated and the rate of seed germination were equal or better in DPLC than the peatmoss (Table 2, 3). This could be attributed to moderate pH, available ammonium and Water Holding Capacity (WHC) and the higher nutrient value of the DPLC than the peatmoss (Table 1). The results agree with those of Burger *et al*. (1997), who stated that seed germination was better in green plants compost. Similarly, Roe *et al*. (1997), found that 89.2% germination of seeds was obtained when 16.1% of the sewage compost was mixed with solid waste gardens compost. The low germination in peat moss might due to high available ammonium (Ells *et al*., 1991). The higher seed germination rate (faster germination) in peat moss in some cases could be due to low ph (might caused scarification), high WHC and low salt concentration (Table 1). Roe *et al*. (1997) obtained faster germination with peatmoss as compared to compost.

The growth parameters of all four species were identical in both the composts (growing mediums) except for the dry-weight of biomass of *Tagetes* which was better in the DPLC than peatmoss. This may be due to the fact that both the composts (growing mediums) have some advantages and disadvantages which were stated earlier in results. The results agree with those of Chong *et al*. (1991), who grew eight species of ornamental plants in mushroom compost and bark mediums. They observed better growth in the mushroom compost than bark. Also, Hartz *et al*. (1996) obtained better growth for Tagetes in the garden waste compost than peatmoss. But, Aiello and Graves (1997) obtained different result when they used bark compost and peat moss 1:1 by volume.

The lower carbon, carbon to nitrogen ratio, high WHC and the higher ash contents of DPLC is due to high clay content of DPLC. Because clay was added on the basis of total weight of the DPL, but the un-decomposed part of DPL i.e., mainly the hard mid-rib of date palm leaves was excluded. Only the decomposed portion of DPL was used in the experiments.

In conclusion, DPLC is an excellent substitute for peatmoss. but, further studies are required to develop improved methods for the preparation of compost from farm waste materials such as Date Palm Leaves (DPL), *Phragmites australis* (commonly known as Reed Plant growing on the bank of drainage canals), wheat straw and rice straw on economical grounds.

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