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EFFECT OF SALINITY ON GROWTH OF DACTYLOCTENIUM AEGYPTIUM (L) AND TALINUM TRIANGULARE (JACQUILLD)

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ABSTRACT

The salinity tolerance of the grass *Dactyloctenium aegyptium*, a cumulative halophyte was compared with that of *Talinum triangulare*, a glycophyte. Experiments were carried out to test the potentiality of *D.aegyptium* as to its use as a biological soil desalinizer and reclamation species in Nigeria. Based on the response of *T.triangulare* to salinity it was found that it had significant stimulation of growth (dry weight) as sea water concentration increased (0 – 20% sea water). From 30 – 50% seawater growth was suppressed. This is the same pattern that *D.aegyptium* had, showing that there was a relationship between them, that enhances the growth of *T.triangulare* a glycophyte in a saline environment. In terms of ion relations *D.aegyptium* was found to be a cumulative halophyte as there was accumulation of K^+, and reduced uptake of Na^+ and Cl^- at low sea water concentration. Also there was decrease in water content as salinity increased.

T.triangulare had low rate of accumulation of Na^+ and Cl^- at 0 – 20% sea water and the rate of accumulation was significantly higher at 30 – 50% sea water. The results are discussed in relation to the habitat and ecology of the species as well as the use to which *D.aegyptium* can be put to use as a biological desalinizer to increase the yield of *T.triangulare* in a saline waste land.

INTRODUCTION

Talinum triangulare (Jacqwilld) commonly known as water leaf is a glycophyte that grows in the same environment with *Dactyloctenium aegyptium* (L). They are found in waste land as weeds and they are one of the early colonizers of farmland *D.aegyptium* was found to be a biological desalinizer, as it is a cumulative halophyte. It can accumulate excess salts, which they absorb from the saline soil in their shoots. This will help to reduce the salt content of the soil (Adu, 1991).

T.triangulare is an erect herb with fleshy leaves. The stems are succulent, sometimes with purple coloured flowers (Hutchinson and Dalziel, 1954). It posses certain characteristics such as self-compatibility, high seed production and ability to flower that enable it survive as weed. Although, it is a weed, their leaves serve as vegetables in preparing soups and stew in some Nigerian homes (Egbarevba, 1975). *D.aegyptium* is a more or less postrate spreading annual herb, and it is the only Nigerian species in the genus. It is wide spread and abundant in farmland and waste spaces throughout most of Nigeria. It is often one of the first colonizers of bare ground and harsh conditions.

D.aegyptium has significant stimulation of growth (dry weight) at low salinity (Adu,1991). In terms of ion relations, it was found to be a cumulative halophyte as there was daily accumulation of ions in the shoot and root. (Adu, Yeo and Okusanya, 1994).

In Nigeria, large-scale irrigation is practiced in the northern part of the country where most of the food comes from. The water used is often of poor quality leading to concentration in the soil of salts after evapotranspiration. This further compounds the problems of these arid and semi – arid parts of the country. The increasing population in Nigeria and the need for increasing crop production mean that the non-productive lands, many of them salt affected, may have to be used to produce salt tolerant crops of economic value.

In this study, growing *T.triangulare* and *D.aegyptium* in the same saline soil was done to investigate if the presence of *D.aegyptium* (cumulative halophyte) will enhance the growth of *T.triangulare* (glycophyte). The basis of comparison being measurement of fresh and dry weight, ion and water contents.

MATERIALS AND METHODS

The seeds of *T.triangulare* were collected from the National Horticultural Research Institute, Ibadan on the 6th of March 2003. Seeds of *D.aegyptium* were collected from the population growing in the premises of National Salt Company, Ijoko, Ota, Ogun State on the 7th of March 2003.

Seeds of each plant were germinated in seed trays containing humus soil in the Botany Laboratory of Lagos State University, Ojo moistened with distilled water daily. The seedlings were allowed to grow in humus soil for two weeks before transplanting. Four replicates of each plant were transplanted into black cocoa bags filled with humus soil. The experiments took place between March – May 2003. They were salinized with seawater and the treatments were 0, 10, 20, 30, 40, 50% seawater (SW). All the seedlings were brought to these salinity levels by stepwise increments at the rate of $25molm^{-3}$ per day. The seawater is composed primarily of sodium, chloride, molar ratios of Na^+ / Mg^{2+} / Ca^{2+} in the seawater is 1 / 0.022 / 0.024. The balancing anions, chloride, sulphate were present in a ratio of 1/0.081. Harvesting was done after eight weeks and yield was determined. The shoots were weighed fresh, later the fresh materials were dried at 80°C in a forced draught oven (Townsend and Mercer Ltd, Croydon, England) for 24 hours. Dried material were weighed and then used for the determination of the ion contents.

Oven dried material were finely ground in a rotary grinder. Weighted material ranging from 50 – 100mg then placed in a crucible and ashed for 4hrs at 550°C in a muffle furnace. When cooled, the ash was dissolved in 0.1ml, 1m HNO_3 and then made up to 10ml volume with 100ml, 1M HNO_3.

Sodium, Potassium, Magnesium and Calcium ions were determined by atomic absorption spectrophotometry (Pye Unicam Sp9). Chloride ion was determined by extracting oven dried material in 100ml, 0.1m acetic acid at 90°C for 2 hours. The amount of chloride was estimated using a specific ion electrode EIL. Used in conjunction with a high impedance voltmeter (Vibron). Sulphate was estimated spectrophotometrically by the chloranilic acid reaction (Yeo and Flowers, 1985). Nitrate was determined spectrophotometrically by the phenoldisulphonic acid reaction in aqueous solution extracts of dried material.

RESULTS

The fresh and dry weights for *T.triangulare* and *D.aegyptium* at the six different sea water concentration used are shown in figures 1 and 2 respectively. The pattern observed in relation to fresh and dry weights of the two species is the same. There was significant enhancement ($P<0.05$) of fresh weight as salinity increased from 0 – 20% sea water and these weights gradually reduced at 30 – 50% sea water.

Table 1 gives the water content values of the test species. Generally the water content at each level decreased as salinity increases in each species.

At the last harvest in *T.triangulare*, the ratio of Potassium ion at 30% and 0% Sea water was 0.7:1 showing a slight reduction in accumulation (Table 2). In *D.aegyptium* a ratio of 0.8:1 was found, showing a slight reduction in potassium ion accumulation (Table 3). There was continuous rise in Na^+ concentration in both species as the seawater concentration increased (Table 2 and 3). The increase in Na^+ to K^+ ratio, a function of tolerance to salinity for all species (Adu 1991).

The divalent ions Mg^{2+} was present (Table 2 and 3) at much lower concentration than the Ca^{2+}, $SO4^{2-}$ and were not as affected by changes in the external salinity as the K^+ and Na+.

The chloride content of both species increases from 30 to 50% seawater (Table 2 and 3) and reduced gradually from 0 to 20% Seawater. Both nitrate and sulphate concentration increased as the salinity increased except from 40 and 50% sea water which decreased slightly in *T.triangulare* were significantly lower than those of *D.aegyptium*

Table 1: Water content of *T. triangulare* and *D. aegyptium*

Treatment (sea water concentration)	*T.triangulare* (%)	*D. aegyptium*(%)
0%	60.4 ± 1.43	5.6 ± 1.90
10%	59.9 ± 1.40	4.2 ± 1.83
20%	59.5 ± 1.38	3.0 ± 1.70
30%	59.4 ± 1.35	1.6 ± 1.40
40%	58.9 ± 1.30	1.5 ± 1.37
50%	58.6 ± 1.27	1.2 ± 1.32

Table II: Mean Samples of ion tested in *T. triangulare*

Treatment (sea water)	Na^+	K^+	Ca2t mmol	Mg^{2t} gdwt	No_3^-	Cl^-	So_4^{2-}
0%	24.60 ± 1.17	12.23 ±0.98	36.95 ± 1.39	0.215 ± 0.01	0.021 ± 0.01	11.20 ± 0.26	7.32 ± 0.08
10%	22.01 ± 1.10	12.60 ± 0.30	40.74 ± 2.16	0. ± 0.02	0.035 ± 0.01	11.81 ± 0.45	8.14 ± 0.61
20%	20.43 ± 1.90	13.09 ± 0.50	44.28 ± 2.18	0.341 ± 0.03	0.051 ± 0.02	11.01 ± 0.30	8.66 ± 0.54
30%	25.34 ± 1.37	12.50 ± 0.87	30.65 ± 2.20	0.344 ± 0.01	0.058 ± 0.03	13.30 ± 0.12	8.69 ± 0.37
40%	26.45 ± 1.43	11.77 ± 1.02	31. 28 ± 1.42	0.351± 0.01	0.060 ± 0.02	13.95 ± 0.27	5.77 ± 0.26
50%	28.12 ± 1.45	10.10 ± 0.99	31.18 ± 1.50	0.358 ± 0.01	0.061 ± 0.01	14.10 ± 0.11	5.75 ± 0.07

Table III : Mean samples of ions tested in *D. aegyptium*

Treatment (sea water)	Na^+	K^+	Ca^{2+} mmol	Mg^{2t} gdwt	No_3^-	Cl^-	So_4^{2-}
0%	34.91 ± 1.20	18.60 ± 0.36	50.97 ± 2.48	0.35 ± 0.01	0.029 ± 0.01	12.91 ± 0.37	8.69 ± 0.23
10%	28.77 ± 1.15	19.69 ± 0.51	54.68 ± 1.90	0.36 ± 0.01	0.057 ± 0.01	12.50 ± 0.68	9.25 ± 0.23
20%	23.50 ± 1.99	20.44 ± 0.25	58.59 ± 2.31	0.37 ± 0.02	0.0087± 0.01	10.43 ± 0.17	9.39 ± 0.28
30%	47.31 ± 1.50	16.37 ± 0.34	55.97 ± 2.89	0.39 ± 0.01	0.098 ± 0.02	15.29 ± 0.17	6.75 ± 0.07
40%	64.38 ± 2.11	12. 96 ± 0.28	53.61 ± 2.06	0.41 ± 0.01	0.0669 ± 0.02	16.82 ± 0.40	6.57 ± 0.15
50%	67. 13 ± 2.64	12.54 ± 0.46	56.44 ± 3.39	0.42 ± 0.01	0.052± 0.02	17.43 ± 0.45	4.65 ± 0.16

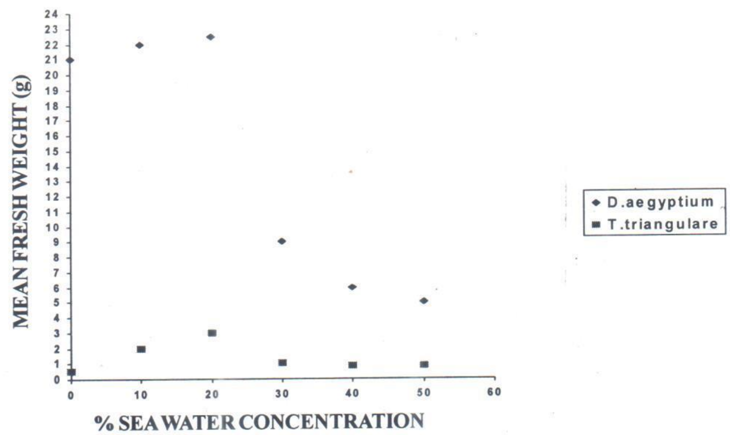

Figure 1: Effect of Salinity on mean fresh weight in D.aegyptium and T.triangulare

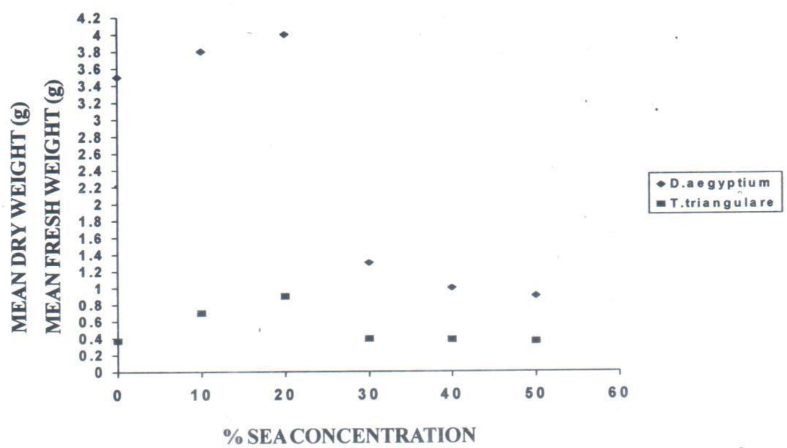

Figure 2: Effect of Salinity on mean dry weight in D.aegyptium and T.triangulare

DISCUSSION

The performance of *T.triangulare* in response to salinity follows closely the growth pattern of *D.aegyptium*, which is a cumulative halophyte. It appears that *D.aegyptium*, which has been confirmed to grow best at 0 – 20% seawater (Adu et.al., 1994) has an ameliorating effect on the saline soil in which *T.triangulare* was growing on. The stimulation of growth at low salinity could be as a result of salt uptake (Greenway, 1968) induction of enzymatic activity by the uptake of certain ions (Baxter and Gibbons 1957) or the provision of favourable osmotic potentials within the cell (Okusanya, 1979; Adu, Makinde and Aiyegbiroju, 2000). In *D.aegyptium* there was an increase in Na^+, Ca^{2+} Cl^- uptake and accumulation and also water loss (Tables 1 and 3). This leads to high concentration of solute in the cell sap. This accords with the result of Glenn (1987) that the accumulation of high Na^+ and Cl^- in the shoot is a salt tolerant mechanism. This implies that *D.aegyptium* growing on saline soil accumulated sodium chloride in the shoot, which is absorbed from the soil. This helps to reduce considerably a sodium chloride level that affects the growth of *T.triangulare*, a glycophyte.

D.aegyptium appears to be affected in their growth at high salinity (30 – 50% seawater) by high sodium uptake and water loss. This leads to concentration of solutes in their cell sap, a condition inimical to their growth.

This may lead to osmotic dehydration, which may have an immediate cause on salt injury such as the depression of growth and dry weight in the species tested especially at higher seawater concentration

T. triangulare in response to this also show poor growth at 30-50% SW (Fig 1 and 2). This implies that *T. Triangulare* on its own cannot survive in a saline environment and there is high osmolarity caused by high $N^{a}+$, CL^{-}, Ca^{2+} and as well as decrease in water content. Also toxicity of ion may play some parts.

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