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Nitrogen Source and the Growth of Date Palm Seedlings

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Abstract

Date palm (*Phoenix dactylifera* L.cv Khedhri) seedlings were grown in perlite and irrigated with full strength nutrient solution and/or containing different concentrations (14, 28, 56, 112 or 224 ppm) of three nitrogen sources (nitrate, ammonium or urea). Treatment lasted for 9 months at constant temperature (30°C), 18 μE S^{-1} m^{-2} of 12 hr light and 60% RH.
Results of length and fresh weight of shoot and root systems as well as leaf area were recorded. In general and compared with minus nitrogen, concentration of 36 ppm of nitrate resulted in a highly significant increase in all growth parameters recorded. The use of ammonium resulted in a highly significant but gradual increase, with increase concentration except root length which was not affected. On the other hand, urea treatment did not result in any significant differences in those growth parameters. No clear effect of the nitrogen source on the nitrogen, calcium and chlorophyll was found.

Introduction

Date palm (*Phoenix dactylifera* L.) is considered one of the major fruit tree in Saudi Arabia. About 11.1 million date palm trees are grown in the Kingdom producing over 500,000 tons of date fruits. There are about 400 cultivars with different properties and characteristics such as color, shape, sweetness and size to mention some. pates are very important food due to their high sugar, minerals and vitamins contents beside their good preservation qualities (Al-Whaibi, 1999).

Nitrogen is a constituent of both structural and nonstructural components of plant cells. It is required as an essential element throughout the development of plants to maintain growth (Salisbury and Ross, 1992). Since most of soils in arid and semi-arid regions are poor in their nitrogen content, hence nitrogen must be added as a fertilizer. This practice is essential to increase crop yield, quality and efficiency. Most fertilizers added to well aerated and worm soils (mainly as ammonia) is rapidly oxidized to NO^{3-}. The increasing addition of fertilizers makes the direct effect of different forms of nitrogen fertilizers of great agricultural interest (Lips *et al*., 1990). Plants respond to nitrogen source quite differently (Mengel and Kirkby, 1982; Chaillou *et al*., 1986).

Nitrate is generally regarded as the more available form for plant uptake compared to ammonium. This is due to the fact that ammonium ions are relatively immobile in most soils because of their attraction cation exchange sites, while nitrate as anion is far more mobile (Salisbury and Ross, 1992). Great physiological differences in uptake and patterns among nitrogen sources exist. However, the magnitude of these differences depends on the plant species, the level of nitrogen form in the soil, growth medium and the environmental conditions to which the plants are exposed (Zornoza *et al*., 1989).

Hussein and Hussein (1983) have mentioned that fertilization of date palm trees in Aswan (Egypt) increased the leaf elongation, size and fresh weight of fruits and has a significant effect on flower production. In their study, they found a relationship between the amount of fertilizer added and the nitrogen content of pinnae, fruit pulp and seed.

This study was conducted to get more information about the effect of three common sources of nitrogen usually used as fertilizers in agricultural practices for plants as well as date palm. This part tried to cover the growth parameters of date palm seedlings.

Materials and Methods

Seeds of local abundant cultivar of date palm (*Phoenix dactylifera* L. cv. Khedhri) were obtained from local market, washed several times with tap water, surface sterilized with 0.005 percent (V/V) sodium hypochlorate and washed. They were soaked in distilled water with aeration until the appearance of the radicle then they were transferred into large pots containing Perlite, and treatment started. Remnants of the seeds were removed after the coleoptile emergence. Hoagland solutions (Hoagland and Arnon, 1950) with the nitrogen source as nitrate, ammonium or urea, at concentrations of 0.0, 14.0, 28.0, 56.0, 112.0 and 224.0 ppm. There were 6 replicates and they were watered by 500 ml of appropriate solution twice a week in the green house at constant temperature (30°C), 18 μE S^{-1} m^{-2} of 12 hr light and 60% RH. Leaf area was determined by Portable Area Meter (Li-cor Co. Model Li-3000). Nitrogen content was determined by Kjeldal Method (Bremner, 1965), while calcium by Flame Photometry and Chlorophyll according to Inskeep and Bloom, 1985. The data was subjected to statistical analysis using Duncan's Test. Protein analysis and the test for urease were evaluated but the results are not reported here.

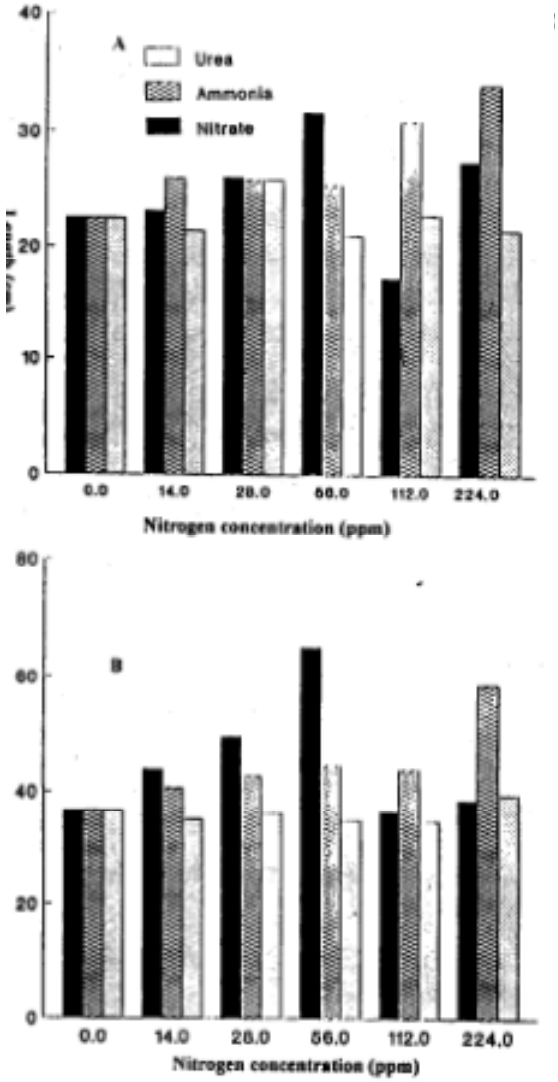

Fig. 1: Effect of different concentrations of three nitrogen source on root (A) and shoot (B) length of date palm seedlings

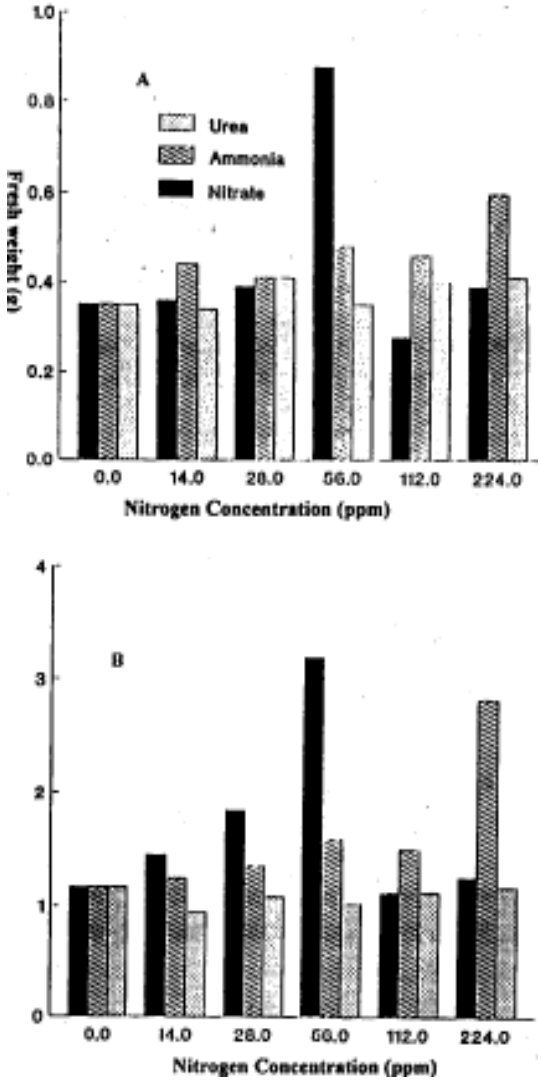

Fig. 2: Effect of different concentrations of three nitrogen source on root (A) and shoot (B) fresg weight of date palm seedlings

Results and Discussion

The results of the effect of nitrogen concentrations from different sources are shown in Fig. 1-6. Root length increased significantly as the nitrate concentrations increased up to 56.0 ppm then started decreasing. Ammonium and urea had no significant effect on root length. These results suggest that nitrate source is better for root elongation than the other two sources. In spite of the fact that nitrate uptake and utilization demand more energy than ammonium, many plants prefer nitrate as a source of nitrogen (Salisbury and Ross,1992; Alfoldi *et al*., 1992). On the other hand, shoot length was affected in the same pattern for nitrate but for ammonium shoot length increased significantly, while urea source had no apparent effect as shown in Fig. 1. However nitrate concentration of 56.0 was extremely better for shoot growth than ammonium, but at higher concentrations ammonium appeared to be better for shoot growth. Fig. 2 shows that of the roots and the shoot increased significantly as nitrate concentration increased up to 56.0 ppm and above that concentration there was no significant effect. When ammonium was the source, root and shoot fresh weight increased gradually and significantly. Urea had no effect on root and shoot fresh weight. These results coincide with the effect of nitrogen source on the first parameter, the elongation.

The source and concentration of nitrogen as shown in Fig. 3, significantly influenced the leaf area of the seedlings. Leaf area increased significantly and gradually as nitrate concentration increased up to 56.0 ppm but decreased above that. On the other hand, leaf area increased significantly and no inhibition was noticed. Urea, as a

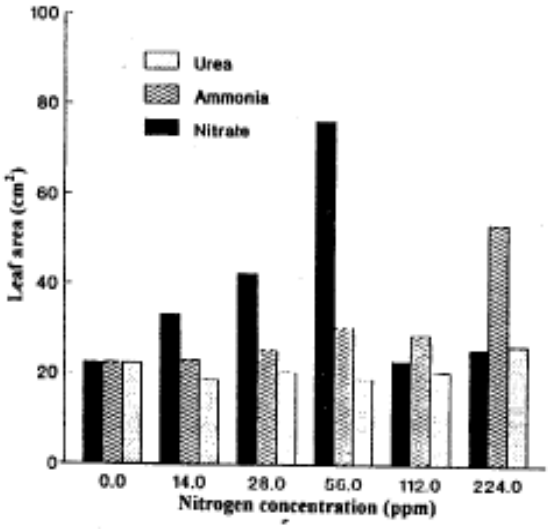

Fig. 3: Effect of different concentrations of three nitrogen sources on leaf area of date palm seedlings.

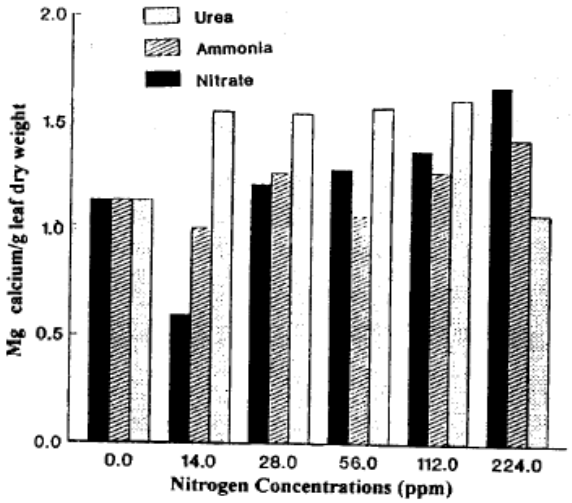

Fig. 5: Effect of different concentrations of three nitrogen sources on leaf calcium content of date palm seedlings

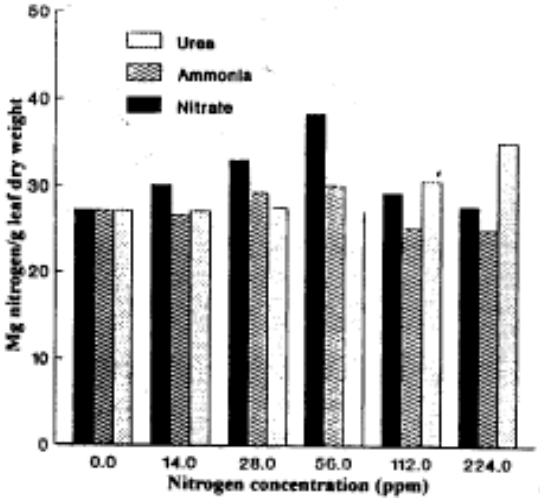

Fig. 4: Effect of different concentrations of three nitrogen sources on leaf nitrogen content of dtepalm seedlings

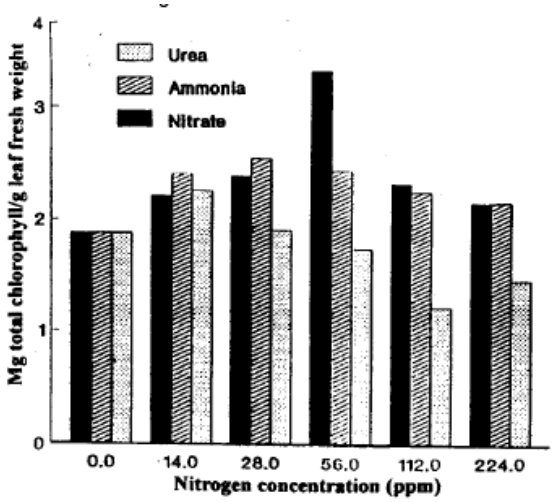

Fig. 6: Effect of different concentrations of three nitrogen sources on total chlorophyll of date palm seedling leaf

source of nitrogen, had no apparent effect on leaf area. Response of date palm seedlings to nitrate and ammonium appears to be dependent on nitrogen level in the growth media. Nitrate was better for growth at low concentration while ammonium was better for growth at high concentrations in the media. A similar result has been reported for ryegrass (Nielsen and Cunningham, 1964). The growth reduction in plants supplied with urea as compared with those supplied with either nitrate or ammonium has been attributed to differences in nutrient uptake (Heuer, 1991). It could be that for nitrogen, to be available for the plant, microorganisms should degrade that urea. This speculation supported, indirectly, by the absence of urease in the shoot.

Analytically nitrogen, calcium and total chlorophyll contents of the shoot as affected by the source and concentration of nitrogen are shown in Fig. 4-6 respectively. Nitrogen content of the shoot increased significantly up to 56.0 ppm for both nitrate and ammonium, but decreased above that. As for urea, as a source of nitrogen, the significant increase in nitrogen content of the shoot started above 56.0 ppm. Calcium content of the shoot was, insignificantly, affected by both the source of nitrogen (Fig. 5). However, these results do not agree with those reported for wheat (Cox and Reisenauer, 1973). The same results were found (Fig. 6) for total chlorophyll when nitrate or ammonium were used as

a source of nitrogen. The results indicate a reduction in the total chlorophyll when urea was the source of nitrogen. Urease activity was not detectable in the leaves (results are not shown here) i.e. urea did not induce urease synthesis which is in contrast with reports for other plant such as barley (Chen and Chiny, 1988).

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