

Mineral Composition of the Foliage of Four Saudi Arabian Date Palm Cultivars

Atalla A. Abo Hassan and Mohamed A. Bacha

*Plant Production Dept., College of Agriculture,
King Saud University, Riyadh, Saudi Arabia.*

The concentrations of nitrogen, potassium, phosphorous, calcium, magnesium and iron in the foliage of Seleg, Sakhi, Nebut Seif and Khudari date palm cultivars were studied during 1978 and 1979 seasons. The average concentrations of these nutrient elements in the four date palm cultivars ranged from 0.97 to 1.36%N, 0.110 to 0.178%P, 1.36 to 1.59%K, 1.00 to 1.29%Ca, 0.39 to 0.47%Mg and 208 to 267 ppm Fe.

The nitrogen and magnesium contents in the foliage were nearly constant during the period from May till August (the period of fruit growth and ripening) in the four date palm cultivars. The phosphorous content, generally, increased in 1978 season, while in 1979 season this trend was not consistent. The potassium content tended to decrease, while the calcium and iron contents tended to increase in the foliage of the four date palm cultivars in both seasons.

In Saudi Arabia, the date palm (*Phoenix dactylifera*, L.) is an important fruit tree. The total production of the date fruits is about 265,000 tons in 1978.

Little is known regarding the mineral composition of the different nutrient elements in the foliage of date palm in Saudi Arabia. Hence, the aim of this investigation is to study the mineral composition and seasonal changes of some nutrient elements in the foliage of four important Saudi Arabian date palm cultivars grown at Riyadh area, with the objective of planning a suitable fertilization programme for the date palm trees in this area.

Materials and Methods

This investigation was carried out during 1978 and 1979 growing seasons on four date palm cultivars grown at the orchard of the College of Agriculture, King Saud University. The cultivars used were, Seleg, Sakhi, Nebut Seif and Khudari. The palms of the four cultivars were about 25 years old and grown in a loamy soil. The planting distance was 7 × 7 meters. Four similar-vigor palms were selected from each cultivar. The trees were fertilized with organic manure at the rate of 15m³ per acre per year.

The foliage samples were obtained by taking 4 median pinnae from 5 consecutive leaves around the palm axis, making a total of 20 pinnae per sample, beginning with the first expanded leaf (Minessy *et al.*, 1974). The pinnae samples were taken from the same leaves at monthly intervals from May till August (the period of fruit growth and ripening) in both years.

The samples were washed, dried and ground for chemical analysis. Nitrogen was determined by the Micro-Kjeldahl Gunning method (AOAC, 1970). Phosphorous was determined colourimetrically by the stannous chloride method (Toth *et al.*, 1948). Calcium and magnesium were determined by the versenate method (Cheng and Bray, 1951). Potassium and iron were determined by atomic absorption spectrophotometer.

Results and Discussion

Nitrogen

The average of the percentage of nitrogen ranged from 1.10 to 1.36 in the first season and from 0.97 to 1.23 in the second season in the foliage of the four date palm cultivars (Tables 1 and 2).

In both seasons, the percentage of nitrogen in the foliage of Nebut Seif was significantly higher than that in the other three cultivars. Furthermore, the percentage of nitrogen in the foliage of Sakhi cultivar was significantly higher than in Seleg cultivar in 1978 season (Table 1).

Regarding the seasonal changes, it was found that the percentage of nitrogen in the foliage of the four date palm cultivars was nearly constant with a few exceptions during the period from May till August in both seasons (Tables 1 and 2). Reuther (1948), found that the nitrogen concentration in date pinnae increased sharply until the leaf became fully expanded, then declined slowly, but fairly continuously with age. Minesy *et al.* (1974), stated that the percentage of nitrogen generally decreased in the pinnae of Zaghloul and Samany date palm cultivars, while in Hayany and Bent Aisha cultivars it remained nearly constant during the growing season.

Phosphorous

The average percentage of phosphorous ranged from 0.109 to 0.172 in the first season and from 0.137 to 0.177 in the second season in the foliage of the four date palm cultivars (Tables 1 and 2).

Statistical analysis showed that the percentage of phosphorous in the foliage of Seleg cultivar was significantly lower than that in both Nebut Seif and Khudari cultivars in

1978. Whereas, it was significantly lower in Seleg cultivar as compared with that in the other three cultivars in 1979.

Concerning the seasonal changes, it was observed that the percentage of phosphorous in the foliage of the four date palm cultivars, generally increased during the period from May till August in 1978, while in 1979 this trend was not consistent (Tables 1 and 2). The results of the first season were disagreed with those found by Reuther (1948). Whereas, the results of the second season agreed with those obtained by Minessy *et al.* (1974).

Potassium

The average percentage of potassium ranged from 1.36 to 1.58 in the first season and from 1.36 to 1.56 in the second season in the pinnae of the four date palm cultivars (Tables 1 and 2).

In 1978, the percentage of potassium in the Khudari cultivar was significantly higher than that in the other three cultivars. The data also showed that the percentage of potassium in Sakhi cultivar was significantly higher than that in Nebut Seif cultivar (Table 1). In 1979, the percentage of potassium in Seleg cultivar was significantly higher than that in the other cultivars. Furthermore, the percentage of potassium in Nebut Seif was significantly lower than in both Sakhi and Khudari cultivars (Table 2).

Regarding the seasonal changes, it was found that the percentage of potassium in the foliage decreased during the period of fruit growth and ripening in the four date palm cultivars (Tables 1 and 2). These results were in agreement with those obtained by Reuther (1948) and Minessy *et al.* (1974), on date palm trees.

Calcium

The data in Tables 1 and 2 showed that the mean percentage of calcium ranged from 1.00 to 1.10 in 1978 and from 1.14 to 1.29 in 1979 in the foliage of the date palm cultivars.

The statistical analysis revealed that, in 1978, the only significant difference was found between Seleg and Sakhi cultivars. In 1979, the percentage of calcium in the foliage of Nebut Seif was significantly higher than that in all other cultivars (Table 2).

Considering the seasonal changes, it was found that the percentage of calcium, generally increased during the period of fruit growth and ripening in both seasons, except that in Khudari cultivar in 1978 (Tables 1 and 2). These findings were similar in trend with those obtained by Reuther (1948) on date palm. On the other hand, Minessy *et al.* (1974) found that calcium content remained more or less constant all over the growing season in the foliage of some Egyptian date palm cultivars.

Magnesium

In both seasons, no significant differences were found between the content of magnesium in the foliage of the four date palm cultivars (Tables 1 and 2). Furthermore, no significant differences were observed between the different sampling

dates (from May till August) in both seasons. Similar results were found by Minessy *et al.* (1974). On the other hand, Reuther (1948) found that there was a rapid increase in the concentration of magnesium until the leaf was fully expanded, then a rapid decline reaching a minimum, somewhere between the first and second year.

Iron

The iron content ranged from 214 to 242 ppm in 1978 and from 208 to 267 in 1979 in the foliage of the four date palm cultivars (Tables 1 and 2). The data also showed that, in 1978, there was no significant difference in the iron content between the different cultivars (Table 1). In 1979, the only significant difference was found between Khudari (267 ppm) and Nebut Seif (208 ppm) cultivars.

Regarding the seasonal changes, it was found that the iron content, generally increased during the period from May till August, in the foliage of the four date palm cultivars in both seasons (Tables 1 and 2). Similar results were also found by Minessy *et al.* (1976) working on Zagloul and Hayany date palm cultivars. Similar data were also reported on other fruit trees regarding the seasonal changes of iron in the leaves such as Smith and Taylor (1952) on peaches, and Taha *et al.* (1972) on figs.

Data of the present study showed that the average nitrogen content in the foliage of the four studied date palm cultivars was lower than that reported by Reuther (1948), De Geus (1967) and Minessy *et al.* (1974) on date palm trees. On the other hand, potassium, calcium and magnesium contents were higher in the foliage of the four cultivars under consideration than those reported by the same authors. Furthermore, both phosphorous and iron contents were within the ranges reported by De Geus (1967) and Minessy *et al.* (1976).

Table 1: The mineral composition of the foliage of Seleg, Sakhi, Nebut Seif and Khudari date palm cultivars in 1978.

Cultivar	Month	N %	P %	K %	Ca %	Mg %	Fe ppm
Seleg	May	1.22	0.069	1.53	0.93	0.45	188
	June	1.15	0.099	1.35	1.08	0.32	173
	July	1.14	0.143	1.28	1.18	0.38	270
	August	1.19	0.126	1.32	1.21	0.42	280
Mean		1.18	0.110	1.37	1.10	0.39	228
Sakhi	May	1.16	0.098	1.61	0.78	0.38	93
	June	1.20	0.118	1.39	1.00	0.48	258
	July	1.15	0.179	1.130	1.15	0.30	195
	August	1.23	0.223	1.51	1.06	0.57	410
Mean		1.19	0.155	1.45	1.00	0.43	239
Nebut Seif	May	1.28	0.146	1.49	0.84	0.39	163
	June	1.41	0.156	1.35	1.09	0.39	155
	July	1.43	0.176	1.21	1.18	0.45	250
	August	1.32	0.210	1.39	1.12	0.50	288
Mean		1.36	0.172	1.36	1.06	0.43	214
Khudari	May	1.05	0.119	1.72	0.84	0.34	140
	June	1.14	0.113	1.55	1.21	0.44	253
	July	1.18	0.176	1.36	1.15	0.49	383
	August	1.10	0.271	1.71	1.00	0.46	193
Mean		1.12	0.170	1.59	1.05	0.43	242
LSD for:							
Cultivars and dates	5%	0.08	0.024	0.09	0.07	NS	65
	1%	0.10	0.032	0.12	0.10		87
Interaction	5%	0.16	0.047	0.18	0.14	NS	130
	1%	0.21	0.063	0.24	0.19		174

Table 2: The mineral composition of the foliage of Seleg, Sakhi, Nebut Seif and Khudari date palm cultivars in 1979.

Cultivar	Month	N %	P %	K %	Ca %	Mg %	Fe ppm
Seleg	May	0.99	0.153	1.74	1.09	0.37	148
	June	0.79	0.119	1.51	1.15	0.52	315
	July	1.05	0.136	1.47	1.12	0.42	270
	August	1.06	0.141	1.54	1.18	0.56	235
Mean		0.97	0.137	1.57	1.14	0.47	242
Sakhi	May	1.11	0.159	1.54	1.00	0.41	185
	June	0.95	0.122	1.43	1.00	0.43	228
	July	1.20	0.183	1.58	1.30	0.46	245
	August	1.02	0.163	1.39	1.27	0.48	260
Mean		1.07	0.157	1.49	1.14	0.45	230
Nebut Seif	May	1.27	0.201	1.54	1.15	0.48	145
	June	1.35	0.102	1.31	1.33	0.41	193
	July	1.21	0.197	1.43	1.27	0.55	277
	August	1.10	0.206	1.15	1.42	0.43	215
Mean		1.23	0.177	1.36	1.29	0.47	208
Khudari	May	1.00	0.231	1.66	1.00	0.49	195
	June	0.95	0.150	1.44	1.21	0.39	195
	July	1.23	0.199	1.36	1.21	0.51	268
	August	0.95	0.130	1.25	1.36	0.45	410
Mean		1.03	0.178	1.43	1.20	0.46	267
LSD for:							
Cultivars and dates	5%	0.07	0.027	0.07	0.09	NS	48
	1%	0.09	0.037	0.09	0.12		64
Interaction	5%	0.14	0.055	0.14	0.18	NS	96
	1%	0.18	0.074	0.19	0.24		129

References

- AOAC (1970). *Association of Official Agricultural Chemists. Official Methods of Analysis* (11 th ed.) Washington, D.C.
- Cheng, K.L. and Bray, R.H. (1951). "Determination of Ca and Mg in soil and plant material". *Soil Sci.* 72: 449-458.
- De Geus, J.G. (1967). *Fertilizer Guide for Tropical and Subtropical Farming*. Centre d'Etude de l'Azote. Zurich.
- Minessy, F.A., Bacha, M.A. and El-Azab, E.M. (1974). "Seasonal changes in some macro-nutrient element the foliage of four soft date palm varieties grown in Egypt". *Alex. J. Agric. Res.* 22(2): 293-299.
- Minessy, F.A., Bacha, M.A. and El-Azab, E.M. (1976). "A comparative study on Fe, Mn and Cu content in the foliage of Zagloul and Hayany date palms grown in sandy soil". *Egypt. J. Hort.* 3, (1): 21-27.
- Reuther, W. (1948). "The mineral composition of date palm foliage". *Proc. Amer. Soc. Hort. Sci.* 51: 137-144.
- Smith, C. B. and Taylor, G. A. (1952): "Tentative optimum leaf concentration of several elements for Elberta peach and Stayman apple in Pennsylvania orchards". *Proc. Amer. Soc. Hort. Sci.* 60: 33.
- Taha, M. W., El-Gazzar, A. and Abou Nagi, S.E. (1972). "A study on the iron content in leaves and roots of Sultani and Pygros fig varieties grown in two different soil types". *Alex. J. Agric. Res. Res.* 20: 115.
- Toth, S. J., Prince, A.L. Wallace, A. and Mikkelsen, D.S. (1948). "Rapid quantitative determination of eight mineral elements in plant tissue by systematic procedure involving use of a flame-photometer". *Soil Sci.* 66: 459-466.