
**Growth and mineral content of a woody legume trees *Leucaena leucocephala* (Lam.) de Wit. and two citrus species in mixed culture**

Abd-allah, M. A.1; L.I. El-Juhany2 (*) and F. A. Hassan2

1 Department of Citrus, Sabhia Horticulture Research Station, Alexandria, Egypt.
2 Department of Timber Trees, Sabhia Horticulture Research Station, Alexandria, Egypt.

**ABSTRACT**

A pot experiment was conducted in the greenhouse at Alexandria Horticulture Research Station (Sabhiea) for two successive seasons in order to evaluate the growth and mineral content of *Leucaena leucocephala* trees and two citrus species namely *Citrus aurantium* (cleopatra mandarin) and *C. reticulata* (sour orange) in mono and mixed culture. The presence of leucaena in the mixed culture increased shoot growth of both citrus species seedlings with a marked increase for mandarin in both growing seasons. This was associated with an increase in shoot phosphorus content and a slight increase in shoot nitrogen content for mandarin in the mixed culture. However, there no significant differences were found in soil nitrogen sole and mixed.

(*) Present address: Plant Production Department, College of Agriculture, King Saud University, B. O. Box 2460 Riyadh 11451, Saudi Arabia.

**INTRODUCTION**

The available biological nitrogen is becoming an important and widely adopted with the nitrogen fixing trees as it plays major roles by providing green manure to intercropped food plants (Kang, et al. 1986). The green manure that is provided by the pruning of leucaena is beneficial for soil mineral content and it could be absorbed by the roots of plants from deep soil layers. Thus planting woody legumes with non-legumes in a mixed culture improve soil fertility (Walker et al., 1954 and Turvey and Smethurst, 1983). Growth of citrus trees, as many other plants, is ceased at non-N and infertile soils. It was also noticed that root growth of citrus trees always followed shoot growth (Inoue and Shi, 1990). The increase in soil nitrogen through organic material occurs by litter fall from above-ground plant parts, mainly dominated by leaves. These decompose later on and then nitrogen releases or blends with soil chemical compounds. Leucaena is a multipurpose legume tree and its nitrogen-fixing ability is already recognized. Also, it forms mutual beneficial partnership with soil bacteria of genus *Rhizobium* (Sanginga et al., 1988).

The present study aims at evaluating the significance of planting *Leucaena leucocephala* (Lam.) de Wit. as a legume tree with *Citrus aurantium* L. (sour orange) and *Citrus reticulata* L. (cleopatra mandarin)in mixed cultures through quantifying their vegetative growth and mineral content.
MATERIALS AND METHODS

Plant material and management
Six months-old seedlings of *Leucaena leucocephala, Citrus aurantium* (sour orange) and *Citrus reticulata* (mandarin) were planted in 30-cm diameter pots filled with four kilograms of soil each in a greenhouse at Alexandria Horticulture Research Station (Sabhiea) for two successive growing seasons during 1997 and 1998. The analysis of the soil (Black, 1965) showed that it has the following characteristics: Texture: sandy clay loam; pH: 7.8; Electrical conductivity: 6.8 ds/m; Organic matter: 0.258 % and Organic Carbon: 0.15%. Both leucaena and citrus seedlings were planted either solely (one species in each pot) or in a mixed culture; leucaena associated once with sour orange and once with cleopatra mandrin. All pots were watered daily in summer and twice weekly in winter.

Statistical design and analysis
The pots were arranged in the greenhouse in a complete randomized block design, and the data were analyzed through analysis of variance procedure according to Snedecor and Cochran (1972). The differences between the means of treatments were compared using LSD.

Plant harvesting and chemical analysis
At the end of each growing season, the plants were severed at soil surface. The shoots were dried at 70 °C for 24 h, weighed and stored until quantifying nitrogen, phosphorus and potassium. The dried shoots were ground using a laboratory-type Wiley mill. 0.3 g of this ground shoots was taken to determine N, P and K contents through digesting with hydrogen peroxide according to Evenhuis and Deward (1980). Nitrogen and phosphorus were determined using colorimeter apparatus at 662.5 μm and 650 μm, respectively according to AOAC (1970) and (Rangaanna, 1977). Potassium was determined by flame photometer. Samples of soils from each treatment were taken at the end of each growing season to determine nitrogen percentage in the soil.

RESULTS AND DISCUSSION
The analysis of variance showed that the stem diameter and height of leucaena seedlings decreased significantly when associated either with sour orange or mandarin in the first growing season, or only with mandarin in the second growing season compared with those of leucaena seedlings in the sole culture (table 1). On the other hand, shoot dry weight of leucaena seedlings decreased compared with that of leucaena seedlings in the sole culture only when planted with sour orange and only in the first growing season (table 1). Similar results were obtained by Sudhir *et al.* (1983) where the performance of *Leucaena leucocephala* was better in sole culture than in mixed culture; but it gave a slightly higher total biomass later. In the present study also, leucaena caught up by the second growing season. This may be the result of the difference between leucaena and citrus species in their rate of growth. Leucaena is known as a fast growing tree species whereas citrus species are not. The statistical analysis of the data revealed that the shoots of leucaena seedlings in both sole and mixed cultures had similar concentrations of N, P and K. This result suggests that phosphorus seems to be critical for leucaena. On soils with low phosphorus, leucaena may be impossible to grow without the application of fertilizer (Narayan Hegde 1983).
Stem diameter and height of both sour orange and mandarin seedlings decreased significantly in the presence of leucaena seedlings compared with those in the sole culture (fig. 1 and 2). In the second growing season only stem height of sour orange seedlings that decreased significantly in the presence of leucaena. This may be attributed to the allelopathic effect of leucaena. The allelopathic potential of leucaena has been reported by Kuo et al. (1982).


<table>
<thead>
<tr>
<th>Culture type</th>
<th>Stem height (cm)</th>
<th>Stem diameter (cm)</th>
<th>Shoot dry weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leucaena</td>
<td>178.5</td>
<td>186.9</td>
<td>1.10</td>
</tr>
<tr>
<td>Leucaena/ sour orange</td>
<td>123.5</td>
<td>169.1</td>
<td>0.56</td>
</tr>
<tr>
<td>Leucaena/ cleopatra mandarin</td>
<td>109.5</td>
<td>110.5</td>
<td>0.51</td>
</tr>
<tr>
<td>L.S.D. at (0.05)</td>
<td>21.3</td>
<td>72.5</td>
<td>0.51</td>
</tr>
</tbody>
</table>

On the other hand, it seems that the time since planting the seedlings in the present study was not enough to maximize the benefits from the leaf litter of leucaena. The presence of leucaena in the mixed culture however, increased shoot dry weight of both citrus species seedlings significantly with a marked increase for mandarin in both growing seasons (fig. 3). This was associated with a significant increase in shoot phosphorus concentration and a slight increase in shoot nitrogen concentration for mandarin in the mixed culture compared with the other treatments. N concentration increased significantly in sour orange shoots when planted with leucaena; the increase accounted for by ca. 80% (table 2).

Table (2): Concentrations of N (nitrogen), P (phosphorus) and K (potassium) in shoot dry matter of *Leucaena leucocephala* (leucaena), *Citrus aurantium* (sour orange) and *Citrus reticulata* (cleopatra mandarin) when planted either in sole or mixed cultures during two sequential growing seasons (1997 and 1998). Values are means of three replicates.

<table>
<thead>
<tr>
<th>Culture type</th>
<th>N%</th>
<th>P%</th>
<th>K%</th>
<th>Soil N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leucaena</td>
<td>3.847</td>
<td>3.783</td>
<td>0.368</td>
<td>0.385</td>
</tr>
<tr>
<td>Leucaena/sour orange</td>
<td>3.999</td>
<td>3.818</td>
<td>0.367</td>
<td>0.389</td>
</tr>
<tr>
<td>Leucaena/cleopatra mandarin</td>
<td>3.964</td>
<td>3.783</td>
<td>0.372</td>
<td>0.376</td>
</tr>
<tr>
<td>Sour orange</td>
<td>1.171</td>
<td>2.104</td>
<td>0.153</td>
<td>0.147</td>
</tr>
<tr>
<td>Sour orange/leucaena</td>
<td>2.104</td>
<td>2.119</td>
<td>0.189</td>
<td>0.183</td>
</tr>
<tr>
<td>Cleopatra mandrin</td>
<td>1.684</td>
<td>1.789</td>
<td>0.168</td>
<td>0.192</td>
</tr>
<tr>
<td>Cleopatra mandrin/leucaena</td>
<td>2.999</td>
<td>1.999</td>
<td>0.251</td>
<td>0.251</td>
</tr>
<tr>
<td>L.S.D. at 0.05</td>
<td>0.663</td>
<td>0.597</td>
<td>0.048</td>
<td>0.083</td>
</tr>
</tbody>
</table>

CONCLUSION

The results obtained from the present study suggest that mixed culture is a suitable way of management for enabling different agricultural crops of acquiring various resources efficiently in favour of their growth. Planting leucaena as a nitrogen-fixing legume tree with citrus species in mixed culture in seedling stage increased their growth and mineral content to some extent. However, more research work in this area is still needed with suggestion of lengthen the duration of such experiments. Continuos check of the nutrient levels is also essential to maintain a desirable yield.
REFERENCES


ملخص بالعربية

النمو والمحتوى المعدني لشجرة ليوسينا البقولية الخشبية و نوعين من الحمضيات في بيئة مختلطة

محمد عبد الله1 و طفي الجهني2 (*) و فاطمة عبد العزيز حسن2

قسم الموالح، محطة بحوث النباتات بالصحبة، الإسكندرية، مصر
قسم الأشجار الخشبية، محطة بحوث النباتات بالصحبة، الإسكندرية، مصر

أجرت تجربة أقصى في البيت المحمي في محطة بحوث النباتات الإسكندرية لمدة موسمين متوازنين من أجل تقييم النمو والمحتوى المعدني لأشجار ليوسينا (Sabhiea) و أشجار نوعين من الحمضيات، وهي اليوسفي (Leucaena leucocephala) واليوسفي الحامض (C. reticulata) واليوسفي الحامض كليوباترا (Citrus aurantium) في بيئة مفردة و أخرى مختلطة. ووجد اليوسينا مع اليوسفي معاً في البيئة المختلطة سبب زيادة في نمو المجموع الخضري لتشتات نوعي اليوسفي، مع زيادة ملحوظة في موسمي النمو. وترافق هذا مع زيادة في محتوى المجموع الخضري من الفوسفور، و زيادة طفيفة في محتوى من النيتروجين في نوعي اليوسفي في البيئة المختلطة. ومع ذلك، لم توجد اختلافات كبيرة في نتائج النترة بين البيئة المفردة والمختلطة.