Arab Gulf Journal of Scientific Research, 21 (3), pp 153 - 157 (2003)

ORIGIONAL PAPER

Kamal F Elkhalifa

Nursery Establishment of Abanus (*Dalbergia melanoxylon* Guill. and Perr.)

Abstract: The present study is devoted to the establishment of abanus (*Dalbergia melanoxylon*) by seed propagation in the nursery as the tree is of high economic importance, of weak natural regeneration, and listed as an endangered species. The study attempts to determine optimal conditions for raising the seedlings artificially in order to supplement natural regeneration. Seedlings of abanus were raised under partial shade. They were grown in sand, clay or a mixture of sand and clay (1:1 by volume). They were irrigated daily for two weeks for initial establishment and irrigated either daily, every two days or every four days thereafter. The results showed that seedlings should be grown in a mixture of sand and clay so as to obtain the greatest shoot length, shoot fresh weight, root fresh weight and shoot and root dry weights. They may be raised in sand to the greatest root length and number of leaves. Seedlings should be irrigated daily for two weeks for initial establishment, and then every two days thereafter so as to obtain the greatest shoot length, root length and shoot fresh weight.

Keywords: Abanus tree, seed propagation, shaded area, sand, clay, mixture, periodical irrigation, density

إنتاج شتول أشجار الأبنوس فى المشتل

كمال فضل السيد الخليفة

المستخلص: تركز الدراسة على إكثار أشجار الأبنوس عن طريق إنبات البذور فى المشتل، نظراً للأهمية الإقتصادية لهذه الشجرة، وصعوبة تكاثرها طبيعياً، حيث أصبحت مهددة بالإنقراض. زرعت البذور فى منطقة مظللة جزئياً، فى الرمل أو الطين أو خليط من الرمل والطين بنسبة 1:1 تم ري الشتول يومياً لمدة أسبوعين، ثم رويت يومياً ، كل يومين أو كل أربعة أيام بعد ذلك.

أوضحت النتائج أن زراعة الأبنوس فى خليط من الرمل والطين بنسبة 1:1 قد أعطت شتلات أطول، وذات وزن أكبر، للحصول على المجموع الخضري والجذري الرطبين والجافي، كما أن زراعتها فى الرمل النهري، أعطي اعلي طول للجذر، ووزن جاف أكبر و عدد أكبر للأوراق. أما بالنسبة للري فى المواعيد، فقد تبين أن الري مرة كل يومين للحصول على أعلي طول للجزء الخضري وطول الجذر ووزن المجموع الخضري الرطب (وذلك بعد الري اليومي لمدة أسبوعين).

كلمات مدخلية: أشجار الأبنوس، إنبات بذور، تظليل، تربه رملية، تربه طينيه، خليط رمل طين، ري دوري، إكثار.

Introduction

Abanus (*Dalbergia melanoxlon*) belongs the subfamily *fabiaceae* family *Leugminosae*. The tree is much branched, of dense crown, armed with spines, and of imparipinnate alternate leaves, sweet-scented flowers and flat papery indehiscent pods. The tree grows at an altitude of 500-1500 meters in areas of more than 400 mm rainfall, and endures high temperature. It grows well in clay soils near valleys and water sources. In Sudan, abanus grows in the foothills of Jebel Marra, where it is extensive, in Blue Nile, Kassala, Upper Nile and Equatoria States, and the Nuba mountains of Kordofan State.

Abanus has a high economic value. It is sold in the international market under the commercial name "grendille" (Foget, 1995). It is excellent timber for carving, ornamental turnery, walking sticks etc. (Thirakul, 1984). The tree has also medicinal value; e.g. a bark decoction is used in Zimbabwe for cleaning wounds, whereas a root decoction is drunk to alleviate abdominal pains. The bark extract exhibits strong antimicrobial activity. The antibacterial and antifungal properties of these extracts led to the conclusion that bark extracts of abanus were potential antibiotics (Gundidza and Gaza, 1993).

As far as propagation is concerned, abanus faces many problems. Its seed rapidly loses viability, and it is difficult to establish in new areas. When this is

Kamal F. Elkhalifa,
Dept. of Plant Production, Faculty of Agriculture,
King Saud University
24600 Riyadh 11451
Kingdom of Saudi Arabia
Tel. No :00966-1-4670000
Fax:00966-1-4677580
Email:ksuds@ksu.edu.sa

coupled with constant cutting of the tree, it has become one of the endangered tree species. Except for Harris (2000), who reported that planting in autumn, under partial shading, gave the best results compared to other seasons, no literature is found concerning the juvenile development of abanus (*Dalbergia melanoxlon*). However, research has been carried out on other species of the genus *dalbergia*. For instance, Sassaki and Felippe (1997) reported that *Dalbergia miscolobium* was of very poor growth in forest soil.

The present study attempts to find solutions to the serious problems of the regeneration of abanus through the study of the suitable circumstances of nursery establishment. The effects of different irrigation regimes and soil types under partial shading were investigated.

Materials and Methods

A study tour was carried out to Azaza forest in Blue Nile State, central Sudan to collect the seeds required for the experiments. Seeds were collected from different parts of the crown of the abanus tree, and de-winged manually prior to gemination. An initial laboratory experiment of pre-germination treatments was carried out and, as a result, seeds of abanus were sown in the nursery without pregermination treatment. Every polythene bag contained two seeds and was filled with sand, clay or a mixture of sand and clay (1:1 by volume). The experiment was carried out in the partially shaded nursery of the Faculty of Agriculture, University of Khartoum. There were four compartments: each contained nine blocks designated randomly. Every block had ten polythene bags filled with the soil media (three blocks for each soil type). Each one of the sandy blocks was irrigated differently, either daily, every two days or every four days after daily irrigation for two weeks for initial establishment. The same irrigation routine was followed for the blocks that contained the other soil types. Five readings were taken with interval of two weeks. The items measured directly were shoot length, root length, number of leaves, shoot fresh weight and root fresh weight. Samples of two seedlings from every block were put into a papery case and kept in a furnace at 70° C to dry, whereupon shoot and root dry weights were measured using a digital balance. Data collected were analyzed statistically; Duncan's multiple range test was adopted for mean separation.

Results

Shoot length:

Analysis of variance showed a significant interaction between the effects of soil media and watering intervals on the shoot length of abanus seedlings. Concerning soil effect, significant differences were found among the media only after four weeks. Mean separation proved that a mixture of sand and clay was the best medium (9.892 cm), followed by sand (Table 1). However, watering intervals were not significant except after two weeks, when watering every two days resulted in the greatest shoot length (9.496 cm) (Table 2).

Table 1: Effect of soil media irrigation intervals on shoot length of seedlings of *Dalbergia melanoxylon* after 2, 4, 6, 8 and 10 weeks.

Readings (weeks)	Mean Shoot Length (cm)	S	Mean Shoot Length (cm)	S
After 2	9.2750 a	S1	9.55080 a	W1
	9.1790 a	S3	9.0380 a	W2
	8.7710 a	S2	8.6790 a	W3
After 4	9.8920 a	S3	9.4960 a	W2
	9.1210 b	S1	8.6460 a	W1
	7.6170 c	S2	8.4880 b	W3
After 6	8.5290 a	S1	8.6790 a	W2
	8.3630 a	S3	8.0210 a	W1
	7.4420 a	S2	7.6330 a	W3
After 8	5.7480 a	S3	5.0210 a	W1
	4.0790 a	S1	4.6420 a	W3
	3.7790 a	S2	3.9290 a	W1
After 10	1.2960 a	S1	1.8250 a	W2
	0.8040 a	S2	0.6120 a	W3
	0.6080 a	S1	0.2710 a	W2

Table 2 Effect of soil media and irrigation intervals on root length of seedlings of *Dalbergia melanoxylon* after fourteen days in the nursery.

S	W	RI LS Mean	Std Err LS Mean	Pr (T) HO: LS Mean = 0	
S1	W1	8.15000000	0.42273935	0.0001	1
S1	W2	7.23750000	0.42273935	0.0001	2
S1	W3	6.08750000	0.42273935	0.0001	3
S2	W1	3.45000000	0.42273935	0.0001	4
S2	W2	4.05000000	0.42273935	0.0001	5
S2	W3	4.15000000	0.42273935	0.0001	6
S3	W1	5.51250000	0.42273935	0.0001	7
S3	W2	6.77500000	0.42273935	0.0001	8
S3	W3	5.52500000	0.42273935	0.0001	9

Root length:

Analysis of variance of root length showed significant interactions between soil media and irrigation intervals after two and four weeks. The best combination after two weeks was sand with daily irrigation (8.15cm) (Table 3), but after four weeks it was sand with irrigation every two days (7.425cm) (Table 4).

Table 3: Effect of soil media and irrigation intervals on l of seedlings of *Dalbergia melanoxylon* after a month in the nursery.

S	W	RI LS Mean	Std Err LS Mean	Pr (T) HO: LS Mean = 0	
S1	W1	4.42500000	0.78777197	0.0001	1
S1	W2	7.42500000	0.78777197	0.0001	2
S1	W3	7.32500000	0.78777197	0.0001	3
S2	W1	3.77500000	0.78777197	0.0001	4
S2	W2	3.73750000	0.78777197	0.0001	5
S2	W3	5.67500000	0.78777197	0.0001	6
S3	W1	6.16250000	0.78777197	0.0001	7
S3	W2	6.66250000	0.78777197	0.0001	8
S3	W3	4.80000000	0.78777197	0.0001	9

Table 4: Effect of soil media and irrigation intervals on root length of seedlings of *Dalbergia melanoxylon* after 2, 4, 6, 8 and 10 weeks.

Readings (weeks)	Mean Shoot Length (cm)	S	Mean Shoot Length (cm)	S
After 2	2.5000 a	S3	0.1404 a	S3
	2.4580 a	S1	0.1331 a	S2
	2.2080 a	S2	0.1327 a	S1
After 4	3.4170 a	S1	0.1242 a	S3
	3.0830 a	S3	0.1150 a	S1
	2.4170 a	S2	0.0933	S2
After 6	2.8330 a	S1	0.0921 a	S1
	2.7920 a	S3	0.0888 a	S3
	2.3750 a	S2	0.0696 b	S2
After 8	1.9170 a	S3	0.0437 a	S3
	1.4580 a	S1	0.0291 a	S1
	1.2920 a	S2	0.0264 a	S2
After 10	0.4170 a	S1	0.0129 a	S1
	0.3750 a	S3	0.0071 a	S2
	0.1670 a	S2	0.0063 a	S3

Number of leaves:

There were no significant differences in number of leaves among the treatments or irrigation levels. Concerning the soil media, there was a significant difference after four weeks, when sand was better than clay but not better than the mixed soil (Table 5).

Shoot fresh weight:

Table 5: Effect of soil media and root fresh weight of seedlings of *Dalbergia melanoxylon* after 2, 4, 6, 8 and 10 weeks.

Readings (weeks)	Mean shoot Length (cm)	S	Mean shoot Length (cm)	W
After 2	0.0063 a	S1	0.1400 a	W1
	0.0063 a	S3	0.1354 a	W2
	0.0059 a	S2	0.1308 a	W3
After 4	0.0063 a	S1	0.1188 a	W2
	0.0057 a	S2	0.1129 a	W3
	0.0050 a	S3	0.1008 a	W1
After 6	0.0053 a	S1	0.0921 a	W2
	0.0053 a	S2	0.0796 a	W1
	0.0043 a	S3	0.0788 a	W3
After 8	0.0077 a	S1	0.0374 a	W2
	0.0025 a	S2	0.0357 a	W1
	0.0024 a	S3	0.0275 a	W3
After 10	0.0027 a	S1	0.0217 a	W2
	0.0013 a	S3	0.0029 b	W1
	0.0010 a	S2	0.0017 b	W3

Shoot fresh weight:

Analysis of variance showed no significant interaction between soil media, the irrigation intervals and shoot fresh weight. Concerning the media effect, it was significant after four and six weeks. The mixed soil type (0.1242 gm) was the best after four weeks and sand (0.0933 gm) was the best after six weeks (Table 6). However, concerning irrigation intervals, significant differences were found only after ten weeks, when irrigation every two days gave the highest result (0.0217 gm).

Root fresh weight:

Analysis of variance showed no significant differences between the treatments or irrigation levels in root fresh weight. Only after eight weeks, was there significant difference among the soil media, when the mixed soil type (0.0077gm) was the best medium.

Shoot dry weight:

Significant interactions between soil media, irrigation intervals and shoot dry weight were found after four weeks from germination, when the mixed soil with daily irrigation (0.03687 gm) was the best combination (Table 6).

Table 6: Effect of soil media and irrigation intervals on shoot dry weight of seedlings of *Dalbergia melanoxylon* after one month in the nursery.

S	W	RI LS Mean	Std Err LS Mean	Pr (T) HO: LS Mean = 0	
S1	W1	0.02675000	0.00276882	0.0001	1
S1	W2	0.03375000	0.00276882	0.0001	2
S1	W3	0.02800000	0.00276882	0.0001	3
S2	W1	0.02075000	0.00276882	0.0001	4
S2	W2	0.01925000	0.00276882	0.0001	5
S2	W3	0.02625000	0.00276882	0.0001	6
S3	W1	0.03687500	0.00276882	0.0001	7
S3	W2	0.03475000	0.00276882	0.0001	8
S3	W3	0.02712500	0.00276882	0.0001	9

Root dry weight:

There were no significant interactions between the treatments, the irrigation levels and root dry weight. Only after eight weeks was there significant difference among soil media, when the mixed soil type soil (0.0045 gm) followed by sand (0.0034 gm) gave the best results (Table 7).

Table 7: Effect of soil media on root dry weight of seedlings of *Dalbergia melanoxylon* after 2, 4, 6, 8 and 10 weeks.

Readings (weeks)	Mean Shoot Length (cm)	S
After 2	0.0036 a	S1
	0.0032 a	S3
	0.0031 a	S2
After 4	0.0031 a	S1
	0.0029 a	S2
	0.0023 a	S3
After 6	0.0028 a	S1
	0.0025 a	S2
	0.0023 a	S3
After 8	0.0045 a	S1
	0.0012 a	S2
	0.0012 a	S3
After 10	0.0015 a	S1
	0.0012 a	S3
	0.0005 a	S2

Discussion

The superiority of the sand/clay mixture could be due to the better nutritional supply from clay loam compared to sand alone. It could also be attributed to better soil humidity provided by clay loam and better aeration provided by sand compared to clay alone (Hassain, 1994). When interaction analysis was carried out on root length after four weeks, the best combination was sand with irrigation every two days, but there was no significant difference among soil media thereafter. The superiority of the sand medium might be attributed to the fact that soil texture and structure had an important influence on root form as well as root length (cm) (Kozlowski, 1971).

The mixture was the best medium for shoot fresh weight after four weeks, whereas sand was the best after six weeks; however, there was no significant difference among soil media thereafter. This might be due to the fact that sand and the mixture of sand/clay had better water relation compared to clay alone, which might enhance mineral nutrition.

The best medium for root fresh weight after eight weeks was the mixture but there was no significant difference among soil media before that. This might be due to the fact that the effect of different textural grades of soil on root growth have often been, to a large extent, attributed to water holding capacity (Kozlowski, 1971). When dedication analysis was used on stem fresh weight after four weeks, the best combination was sand with irrigation every two days, but there was no significant difference among soil media thereafter. The best medium for shoot dry weight after six weeks was the mixture and when using interaction analysis after four weeks the best combination was the mixture of sand and clay with irrigation every two days. However, there was no significant difference among soil media after two weeks, eight weeks or ten weeks. This might be due to the physical fact that the coarser the soil particles, the lesser would be the total surface area of the soil particles. Consequently, the amount of nutrients and water adhering to soil decreases as the particles get larger (Tahir, 1985).

The best medium for root dry weight after eight weeks was the mixture, but there was no significant difference among soil media before that. There was no significant difference in number of leaves, root fresh weight, stem fresh weight, root dry weight, leaf dry weight and diameter at root collar related to watering intervals. Watering every two days gave the greatest shoot length after four weeks, but there

was no significant difference among watering intervals thereafter. This might be due to the fact that shoot dry weight production and elongation were directly related to watering frequency (Wenger, 1952).

Watering every two days gave the greatest shoot fresh weight after ten weeks, but there was no significant difference among watering intervals before that. This might be due to the fact that lengthening of watering intervals might have many effects on the measured parameters because the water content in the plant cells was lowered. One of these effects was an influence on cell turgidity, which affects the closure of stomata.

Based on the present study, it is recommended that abanus trees should be raised in a mixture of sand and clay (1:1 by volume), preferably with irrigation at two-day intervals.

References

Foget, K. (1995) *Field advisor for trees and shrubs in arid zones of the Sudan.* S. O. S. Sahel International, London.

Gundidza, M. and **Gaza, N.** (1993) Antimicrobial activity of *Dalbergia melanoxylon* extracts. *J. of Ethnopharmacology* **40** (2): 127-130.

Harris, J. E. (2000) *Some information about the Mpingo tree.* African Blackwood Conservation Project.

Hossain, N. M. (1994) *Natural and artificial regeneration of Ziziphus spina-christi* (Linn.). M.Sc. thesis, University of Khartoum.

Kozlowski, T.T. (1971) *Growth and development of trees,* Vol. 2, New York and London. Ip. 499

Kramer, P.J. (1969) *Plant and soil water relationship.* McGraw Hill Book Company, New York. Ip. 449

Sassaki, R. M. and **Felippe, G. M.** (1997) *Soil type and early growth pattern in Dalbergia miscolobium* Benth. Secao de Fisiologia e Bioquimica de Plantas, Instituto de Botanica, Brazil.

Tahir, H. M. (19985) *The impact of watering interval, soil texture and seed treatment on* Acacia Senegal *seedlings at the nursery stage.* M. Sc. Thesis, University of Khartoum.

Thirakul, S. (1984) *Manual of Dendrology.* Forest Inventory and Market Demand Survey Project, Quebec, Canada.

Wenger, K. F. (1952) Effect of moisture supply on the growth of sweet gum and pine seedlings. *J. of Forestry* **50:** 862.

Ref 2196
Received 03/09/2002
In revised form 24/08/2003