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Effect of *Acacia nilotica* Tree Age and Geographical Location on Seedling Performance (Khartoum Sunt Forest as Case Study)

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Authors' contributions

This work was carried out in collaboration between all authors. Author MMAH designed the study. Authors MMAH and FAH performed the statistical analysis, wrote the protocol, managed the analyses of the study, wrote the first draft of the manuscript and managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Vigorous seedlings had high chance to survive in harsh conditions. Different environmental and physiological factors could affect seedlings performance. So this study aimed to examine the effect of tree location and tree age on *A. nilotica* seedlings performance. Three geographical location were selected (North, west and south) and five dph diameter as age indicator (-40 cm, 41-60 cm, 61-80 cm, 81-100 cm and above 101 cm). The results showed that The young trees in north direction produces seedlings with long roots, which give the seedling the advantage in dry seasons. While the old trees in the same area give highest shoot dry weight. This results suggest that the stress circumstances affect the seeds physiology and produce more vigours seedlings.

Keywords: Seedlings; vigor; tree age; geographical location.

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1. INTRODUCTION

Quality seeds play an important role in the establishment and productivity of forest plantation. The tree age is one among various factors which tells upon the quality of seeds. Studies on the effect of tree age on seed and seedling quality in *A. nilotica* revealed that seeds collected from trees more than eight year old gave better quality seed with high 100 seed weight, germination and germination values. These seed in turn gave healthy seedlings in the nursery with higher values of shoot/root length, root/shoot ratio and dry matter production. Hence, in collecting seeds for nursery rising in this species tree of more than eight years should be chosen [1]. However, some species, such as ash (Fraxinus exelsior) and birch (Betula pendula) produce more quantitative and qualitative seeds during the mid-age period. In addition, beech and oak seed production enhanced and improved at the time of elderly period [2]. In many forest tree species, the main period of seed production is fixed in the middle of age. For example, in Abies nordmandiana [3]. and A. pinsapo [4]. The best age for seed production is between 30-40. Moreover, trunk diameter and plant vigor are the two considerable aspects in seed production which are effective in some species of Garcinia, such as G. lucida [5]. Fertile seeds were produced at early age in UP, India. Germination tests made on the teak seeds from trees 4,8, 10,13,23 year old gave plant per cent 4,6,15,18, respectively. Coppice shoots also fruit very early. Seeds from 9 year old coppice in Sagar (M.P.) produced healthy seedling than old tree. Seeds from healthy, well formed trees provide greater assurance so that resulting stock will have good form, survival and resistance against stress conditions. Hence, the present study was undertaken to know the effect of age and dbh classes on teak germination [6]. There is noticeable degradation in khartoum sunt forest, this degradation may be attributed to many factors such as the forest located in central of Khartoum city and suffered from polluted gases, over exploitation by the visitors. There were decreasing in new regeneration which may be caused by the stress of the environmental and human factors. So the objective of this study is to exploring the effect of location of the trees in the forest and tree age on seedlings performance, the tree age affecting the germination as reported by [7] (seedlings that produced from seeds collected according to the mentioned factors).

2. MATERIALS AND METHODS

The seeds were collected from Khartoum Sunt reserved forest which is located on the eastern bank of the White Nile. The seeds samples were collected from three geographical location of the forest (North, South and West). In each direction the trees were grouped into 5 five groups according to the diameter at the breast height (as indicator of trees age) (20-40 cm, 41-60 cm, 61-80 cm, 81-100 cm and above 101 cm. inside each category in each direction three trees were selected (45 trees). Germination was carried out in a controlled germination room at the National Tree Seed Centre –Soba 30ºC, light for 12 hours from fluorescent lamps and in the field. Another germination test was carried out in the field in order to test the growth performance under harsh conditions. After 6 weeks the seedlings were harvested the root and shoot length were measured using caliper, the fresh weight of the root and shoot were measured with electronic balance and recorded, the fresh samples were dried in an oven for 24 hours at 105ºC and weighted again for the root and shoot dry weight. Data were analyzed using JMP stastical package (package improved from SAS). The analysis of variance ANOVA was performed to examine tree age and location effects on *A. nilotica* seedlings performance. Means were compared using Tucky and Kramer test.

3. RESULTS AND DISCUSSION

The results showed that the locations of the trees in the forest (source of the seeds) have not affected the root length either in the germination room or in the field (Table 1) while the tree age had significantly affected the seedlings root length in the germination room and the field. The seeds collected from the youngest trees gave the tallest root length (Table 1), this could be an indicator of its ability to survive in dry conditions This results agreed somehow with [8] who stated that seedlings from the minimum and maximum age of mother tree had higher leaf mass ratio and lower root mass ratio than from the middle age of mother tree. That result suggests that the seeds collected from stressed areas are still vigorous and produce healthy seedlings as well as the seeds collected from non stressed areas.

By contrast, in some plant species, such as Pinus pongence, all trees at different age were able to produce normal and vigorous seeds [7]. [9] reported that Sorbus trees mature at the age of 15. However, insufficient data exist on seedling, seed germination and plant age of

Sorbus tormin [7]. Fruiting of Dipterocarpus was observed in all diameter classes from 10 cm dbh but proportion of fertile trees was maximum and stable only above 50 cm dbh which could be considered as a limit of maturity for dipteocarpus [10]. Neither tree age nor geographical location affected the shoot length of *A. nilotica* trees (Table 2); this results look logic hence the shoot length is neutral factor of adaptation of seedling in dry areas. Although of considering that the shoot length is one the parameters that measure the seed vigorous.

Table 1. Effect of tree age and geographical location on root length in the germination room and field

Tree age (trunk diameter)	**North root length/ cm**		**West root length/ cm**		**South root length/ cm**	
	Germination room	**Field**	**Germination room**	**Field**	**Germination room**	**Field**
20-40	3.9 a	13.5 a	2.3 a	9.8 a	2.4 b	14.7 a
41-60	4.5 a	8.1 b	4.1 a	9.7 a	4.1 a	10.5 b
61-80	3.9 a	10.3 b	2.2 a	10.9 a	2 bc	7.5 b
81-100	3.5 a	7.8 b	3.8 a	6.5 a	3.7ab	10.8 b
101 ≤			3.4 a	9.5 a	2.5b	9.4 b
Mean	**3.95**	**9.9**	**3.16**	**9.3**	**2.9**	**10.6**
P =	0.9	0.01	0.2	0.6	0.04	0.01
SE ±	1	0.9	0.7	0. 1	0.4	1
CV =	52	27	41	37	15	28

Table 2. Effect of tree age and geographical location on shoot length in the germination room and field

Tree age (trunk diameter)	**North shoot length/ cm**		**West shoot length/ cm**		**South shoot length/ cm**	
	Germination room	**Field**	**Germination room**	**Field**	**Germination room**	**Field**
20-40	9.1 a	12.9a	9.4 a	11.8 a	8.8a	13.6a
41-60	9.5 a	12.5a	8.9 a	18.3 a	9.3a	13.9a
61-80	10.4 a	17a	9.4 a	12.9 a	8a	12.1a
81-100	8.7 a	12.9a	9.7 a	11.9 a	8.6a	12a
101 ≤			8.5 a	16.7 a	8.3a	11.7a
Mean	**9.4**	**11**	**9.2**	**14.3**	**8.6**	**12.6**
P =	0.1	0.5	0.4	0.4	0.2	0.1
SE ±	0.5	2	0.5	2	3	0.6
CV =	10	29	9	27	9	10

Table 3. Effect of tree age and geographical location on root fresh weight in the germination room and field

Tree age (trunk diameter)	**North root fresh weigh/ gm**		**West root fresh weigh/ gm**		**South root fresh weigh/ gm**	
	Germination room	**Field**	**Germination room**	**Field**	**Germination room**	**Field**
20-40	0.21 a	0.03a	0.03 a	0.2a	0.05 a	0.2a
41-60	0.15 a	0.01 a	0.02 a	0.4a	0.02 a	0.04a
61-80	0.14 a	0.02 a	0.01 a	0.2a	0.01 a	0.03a
81-100	0.21 a	0.01 a	0.07 a	0.2a	0.03 a	0.12a
101 ≤			0.05 a	0.3a	0.03 a	0.16a
Mean	**0.17**	**0.017**	**0.032**	**0.26**	**0.028**	**0.11**
P =	0.3	0.03	0. 1	0.4	0.7	0.5
SE ±	0.003	0.03	0.08	0.001	0.01	0.05
CV =	31	34	51	48	86	137

Table 4. Effect of tree age on root dry weight in the germination room and field

Tree age (trunk diameter)	North root dry weigh/ gm		West root dry weigh/ gm		South root dry weigh/ gm	
	Germination room	Field	Germination room	Field	Germination room	Field
20-40	0.03 a	0.01 a	0.03 a	0.02 a	0.02a	0.02 a
41-60	0.02 a	0.03 bc	0.09 a	0.03 a	0.08 a	0.08 a
61-80	0.06 a	0.02 ab	0.07 a	0.03 a	0.03 a	0.01 a
81-100	0.04 a	0.03 c	0.03 a	0.01 a	0.04 a	0.02 a
101 ≤			0.02 a	0.02a	0.03a	0.04a
Mean	**0.037**	**0.022**	**0.048**	**0.022**	**0.04**	**0.034**
P =	0.7	0.06	0.09	0.6	0.2	0.3
SE ±	0.02	0.01	0.02	00.06	0.01	0.009
CV =	87	84	84	40	83	99

Table 5. Effect of tree age on shoot fresh weight in the germination room and field

Tree age (trunk diameter)	North shoot fresh weigh / gm		West shoot fresh weigh / gm		South shoot fresh weigh / gm	
	Germination room	Field	Germination room	Field	Germination room	Field
20-40	0.22 a	0.02 a	0.16 a	0.04 a	0.01 a	0.19 b
41-60	0.22 a	0.02 a	0.23 a	0.01 a	0.02 a	0.23 b
61-80	0.23 a	0.03 a	0.22 a	0.03 a	0.03 a	0.29 b
81-100	0.20 a	0.02 a	0.19 a	0.01 a	0.03 a	0.54 a
101 ≤			0.22 a	0.05 a	0.02 a	0.20 b
Mean	**0.22**	**0.022**	**0.20**	**0.028**	**0.022**	**0.29**
P =	0.5	0.6	0.3	0.5	0.3	0.006
SE ±	0.01	0.004	0.03	0.01	0.02	0.04
CV =	11	30	24	89	23	53

Table 6. Effect of tree age on shoot dry weight in the germination room and field

Tree age (trunk diameter)	North shoot dry weigh / gm		West shoot dry weigh / gm		South shoot dry weigh / gm	
	Germination room	Field	Germination room	Field	Germination room	Field
20-40	0.03 a	0.02b	0.03 b	0.04 a	0.02 a	0.07 a
41-60	0.03 a	0.02 b	0.04 a	0.03 a	0.03 a	0.02 a
61-80	0.03 a	0.04 a	0.03 b	0.03 a	0.02 a	0.03 a
81-100	0.03 a	0.04 a	0.03 b	0.03 a	0.02 a	0.03 a
101 ≤			0.03 b	0.02 a	0.02 a	0.04 a
Mean	**0.03**	**0.03**	**0.032**	**0.03**	**0.022**	**0.024**
P =	0.1	0.02	0.03	0.2	0.2	0.5
SE ±	0.002	0.003	0.02	0.005	0.002	0.08
CV =	16	49	16	15	16	159

The results showed that the seeds collected from different direction and different tree age produced seedlings that its root fresh weight with no differences (Table 3). This result contrasting with results obtain in Table 1 where the seedlings from the north had longest roots, these may suggesting that the root were thinner in its diameter.

It seems that the age of the trees do not affected the root dry weight, expect in the seedling from north and planted in the field the younger trees were superior to older ones (Table 4).

The trees age was not affected the shoot fresh weight expect in the south direction the oldest tree gave the heaviest seedlings (Table 5).

The seedlings dry weight from the north direction from old trees were superior comparing with other direction and ages (Table 6) this agreed with [7]. who stated that Seedling attributes after 12 months showed that seedling obtained from young and middle aged plantations (between 18 to 45 years) performed better than those beyond 50 years.

4. CONCLUSION

The location of the trees and its age affected the *A. nilotica* seedlings performance. The young trees in stressed areas produces seedlings with long roots, which give the seedling the advantage in dry seasons. While the old trees in the same area give highest shoot dry weight. This results suggest that the stress circumstances affect the seeds physiology and produce more vigours seedlings.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Suresh KK, Jambulingam R, Seka I. Effect of tree age on seed and seedling quality in *Acacia nilotica*. The Indian Forester. 2001;127:6.
2. Fennessy J. The collection, Storage, Treatment and handling of broadleaves tree seed. COFORD Reproduction Material no: 2002;4.
3. Vidakovich M. Conifers, morphology and variation; 1991. Graficki Zavod Yngdoh N, Kumar M, Kumar N, Pandey AK. Effects of age of plantation on seed characters and growth performance of Tokopatta (*Livistona jinkensiana* Griff.) seedling. J. Appl. & Nat. Sci. 2014;6:672–676.
4. Gatalan G, Parados JA. Genetics of the pinsapo. Ann. Forest Science. 1983;9:185-208.
5. Guedje NM, Lejoly J, Nkongmeneck BA, Jonkers WBJ. Population dynamics of Garcinia lucida (Clusiaceae) in Cameroonian Atlantic forests. Forest Ecol. Manag. 2003;177/1-3:231-241.
6. Mutanal M, Patil SJ. Effect of tree age and diameter on germination of teak. J. Agric. Sci. 2003;16(3):481-484.
7. Espahbodi1 K, Hosseini SM, Mirzaie–Nodoushan H, Tabari M, Akbarinia M, Dehghan-Shooraki Y. Tree age effects on seed germination in SORBUS TORMINALIS Appl. Plant Physiology. 2007;33(1-2):107-119.
8. Mao P, Han G, Wang G, Yu J, Shao H. Effects of age and stand density of mother trees on early pinus thunbergii seedling establishment in the coastal zone, China. The Scientific World Journal. 2014; 468036:9.
9. Harris AS, Stein WI. *Sorbus aucuparia* L., mountain- ash. In: Schopmeyer CS, Tech. Cord. Seed of woody plants in the United States. Agric. Handbk. 450. Washingtong .DC: USDA Forest Service, 780-784. Hrvatske, Coroatia, Zagreb, p. 745. International Forestry Research. 1974;32.
10. Nguyen N, Sist P. The phenology of some dipterocarps. Research Abstracts. Centre for 1998.

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