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Effects of Watering Regimes on Germination and Early Seedling Development of *Dioscoreophyllum cumminsii*

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Abstract

The effects of watering regimes on germination and early seedling development of D. cumminsii were examined in this study. 100 fresh seeds were selected and divided into five groups. Each group was sown separately in weathered sawdust filled into plastic germination trays. These were subjected to five watering regimes, viz: watering with 25ml per week (control), watering once weekly with 50ml, watering twice weekly with 50ml, watering weekly with 100ml, and watering twice weekly with 100ml. Germination was observed and recorded for two months. Also, seedlings raised from previous experiment were pricked into polythene pots filled with nursery topsoil. A total of 25 seedlings were selected and divided into five groups and subjected to five different watering regimes viz: no watering (control), watering weekly with 50ml, watering twice weekly with 50ml, watering once weekly with 100ml and watering twice weekly with 100ml. The experiment was replicated three times. The seedlings were allowed to stabilize for two weeks after which growth assessment commenced and were carried out for three months. Parameters assessed were plant height, leaf production per seedling, stem girth, and leaf area. Results obtained revealed that the highest germination % was observed in seedlings watered with 50ml water twice in a week. Similarly, results from the growth parameters revealed that seedlings watered with 100mls twice per week thus justifying the occurrence of D. cumminsii in the rain forest vegetation.

Keywords: Watering regime, Germination, Seedling development, Dioscoreophyllum cumminsii

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1. Introduction

Water is an important factor in the growth, development and productivity of plants (Gbadamosi 2014). It is a determinant factor for seed germination and can affect the germination percentage and germination rate of plants. It is also essential for enzyme activation, breakdown, translocation, and use of reserve storage material (Shaban 1995). Water is required by plants for the manufacture of carbohydrates and as a means for transportation of foods and mineral elements. Various vital processes in plants such as cell division, cell elongation, stem as well as leaf enlargements and chlorophyll formation depend on plant water availability (Price *et.a.* 1986). Thus insufficient water in plants below a critical level is usually demonstrated by changes in all structures leading to the death of the plants (Levy and Krikum 1983). Similarly, Awodola (1984) observed that reduction in relative water contents affects physiological processes and hence plant growth. Also, water in excess of plant need may retard physiological processes in plants (Isah *et.al.*2013).

Water requirements of a crop are dependent on the botanical characters of the crop, its stage of growth and the prevailing weather conditions. Different criteria based on soil, plant and metrological factors were used for estimation of crop water needs (Sale 2015). The effect of water deficit on yield (total or economic) is the integral of its effects on the growth and other physiological process (Farah 1996). Plant species respond differently to water availability, also, different plant parts adapt differently to varying water stress conditions. Seeds of many crop species are sensitive to flooding stress during germination (Sung 1995, Wuebker *et.al.*2001, Sesay 2009) while prolonged flooding eliminates some species yet favour others (Casanova and Brock 2000). Seabloom *et. al.* (2001) opined that the depth of flooding can also have significant effect on species composition and biomass of establishing plants. Roots play an important role in plant survival during periods of drought (Hoogenboom *et.al.* 1987). Hsiao and Xu (2000) reported that under water deficiency, growth is readily inhibited and growth of roots is favoured over that of leaves. Often, leaves of plants growing in water stressed environment are small both in number and size.

Wilson and Witkowski (2001) studied the response of four African savanna trees', namely *Acacia karro, A. nilotica, A. tortilis* and *Mundulea sericeato,* germination and early seedlings to different water requirements. They reported that frequent, not necessarily high, rainfall appears to be essential for germination and seedlings survival over the first 7 weeks of assessment. Yoshida *et. al.,* (2005) in an experiment on the effect of watering regimes at 3 stages of development (during transplanting, just after transplanting and after establishment of the transplant) of *Chin-guen-tsai* (Brassica cam group) observed a strong influence of watering regimes after establishment of the transplant.

It is pertinent therefore to delineate the required physiological and silvicultural characteristics of species to encourage their cultivation. Hence, effort to adequately domesticate *Dioscoreophyllum cumminsii* for the production of its very valuable and high-quality fruits (as reported by Bamigboye and Kayode {2016}), must define these characteristics. Thus the study being reported here examined the effects of watering regimes on germination and early seedling development of *Dioscoreophyllum cumminsii.*

2. MATERIALS AND METHODS

2.1 *Seed Germination*

Seeds extracted from freshly collected fruits of *D. cumminsii* were tied inside black polythene nylon for two days for the gelatinous membrane to decompose and expose the seeds. One hundred (100) fresh seeds were selected and divided into five groups. Each group was sown separately in weathered sawdust filled into plastic germination trays ($32x24x12cm^3$). These were subjected to five watering regimes, viz: watering with 25ml per week (control) (T_1); watering once weekly with 50ml (T_2); watering twice weekly with 50ml (T_3); watering weekly with 100ml (T_4); and watering twice weekly with 100ml (T_5). Germination was observed and recorded for two months. The data obtained were expressed in percentages.

2.2 *Early Seedling Development*

Seedlings raised from previous experiment, at two–leaf stage, were pricked into polythene pots filled with nursery topsoil. A total of twenty five (25) seedlings were selected and arranged in completely randomized design (CRD). Five watering regimes and frequencies were used namely: no watering (control) (T_1); watering weekly with 50ml (T_2); watering twice weekly with 50ml (T_3); watering once weekly with 100ml (T_4) and watering twice weekly with 100ml (T_5). The experiment was replicated three times. Seedlings were allowed to stabilize for two weeks after which growth assessment commenced and were carried out for three months. Parameters assessed were plant height, leaf production per seedling, stem girth, and leaf area. The data collected were subjected to analysis of variance (ANOVA) and DMRT at $p \leq 0.05$ was used to separate the means.

3. Results and Discussion

3.1 *Percentage Germination (%)*

The effect of varying watering regimes on percentage germination of seeds of *D. cumminsii* is shown in Table 1. The results revealed that the highest mean germination (50%) was obtained from the seeds that received 50mls of water twice in a week (T_3), followed by those that received 100ml of water twice in a week (T_5, 45%) while the control (T_1, 25ml of water weekly) had the least (5%). (Table1).

Table 1. *Effect of varying watering regimes on percentage germination of seeds of D. cumminsii*

Watering regimes	Germination (%)
T_1 (25mls)	05
T_2 (50mls once/wk)	35
T_3 (50mls twice/wk)	50

T_4 (100mls once/wk)	35
T_5 (100mls once/wk)	45

3.2 *Plant Height*

The mean seedling heights for the watering regimes at the end of the third month were shown in Table 2. The was observed in $T_{5,}$ that is, seedlings subjected to watering twice per week with 100mls of water (6.00cm) and followed by $T_{4,}$ that is, seedlings watered once per week with 100mls (5.67cm). Seedlings that were not water ($T_{1,}$ the control) did not survive beyond the second month. Statistical analysis revealed that there were significant differences ($p \leq 0.05$) in the heights of the seedlings due to differences in the watering regimes.

Table 2. *Effect of varying watering regimes on seedlings height of D.cumminsii*

Treatments	**Seedling Height (cm) / Month**		
	One	**Two**	**Three**
T_1 (25mls)	1.07d	1.27d	0
T_2 (50mls once/wk)	1.57c	2.60c	4.67c
T_3 (50mls twice/wk)	1.80b	3.27b	5.00bc
T_4 (100mls once/wk)	1.87b	3.43ab	5.67ab
T_5 (100mls twice/wk)	2.10a	3.83a	6.00a

3.3 *Leaf Production*

Table 3 shows the effect of varying watering regimes on leaf production in *D. cumminsii.* The highest mean leaf production (7.00) was recorded in T_5, that is, seedlings treated with 100ml of water twice in a week. T_3 and T_4, that is, seedlings treated with 50ml twice weekly and 100ml once weekly, recorded the same mean value of 5.67 while the least was recorded in T_2, that is, seedlings that were watered with 50ml once weekly (4.00).

Table 3. *Effect of varying watering regimes on leaf production in D. cumminsii*

Treatments	Leaf Production / Month		
	One	**Two**	**Three**
T_1 (25mls)	2.00c	2.33c	0
T_2 (50mls once/wk)	2.67bc	3.33b	4.00b
T_3 (50mls twice/wk)	3.00ab	4.33a	5.67a
T_4 (100mls once/wk)	3.33ab	4.33a	5.67a
T_5 (100mls twice/wk)	3.67a	5.00a	7.00a

3.4 *Stem Girth*

The results obtained revealed that the highest mean girth (0.97cm) was recorded in T_5, seedlings treated with 100mls twice per week. This was followed by T_3, seedlings watered with 50mls twice/week (0.87cm) while T_2, seedlings watered with 50mls once/week, recorded the least mean value of 0.77cm stem girth. Statistical analysis ($P \leq 0.05$) showed that the values obtained were significantly different in the varying treatments.

Table 4. *Effect of varying watering regimes on stem girth of D. cumminsii*

Treatments	Stem Girth (cm) / Month

	One	Two	Three
T_1 (25mls)	0.40b	0.4	0
T_2 (50mls once/wk)	0.47b	0.53c	0.77b
T_3 (50mls twice/wk)	0.57a	0.73b	0.87ab
T_4 (100mls once/wk)	0.57a	0.73b	0.83b
T_5 (100mls twice/wk)	0.63a	0.87a	0.97a

3.5 *Leaf Area*

Effect of watering regimes significantly ($P \leq 0.05$) influenced leaf area of the species (Table 5). The largest mean leaf area was recorded in T_5, the seedlings subjected to 100ml of water twice per week (6.00cm^2). This was followed by T_3 and T_4, the seedlings treated with 50ml of water twice per week and 100mls once weekly (5.00cm^2) while the least value (4.33cm^2) was recorded in T_2, that is, the 50ml/week seedlings. Significant differences abound in the values recorded in the treatments (Table 5).

Table 5. *Effect of varying watering regimes on leaf area of D. cumminsii*

Treatments	Leaf Area (cm^2) / Month		
	One	Two	Three
T_1 (25mls)	2.00c	2.90b	0
T_2 (50mls once/wk)	2.73b	3.24b	4.33c
T_3 (50mls twice/wk)	3.12ab	4.07a	5.00b
T_4 (100mls once/wk)	3.05ab	4.19a	5.00b
T_5 (100mls twice/wk)	3.22a	4.34a	6.00a

Water is a major constituent of all living organisms. Its availability in adequate quantity and at biologically tolerable interval affects physiological activities of plant. This study revealed that *Dioscoreophyllum cumminsii* is a slow growing species. Previous studies have also revealed that other indigenous plant species in West Africa such as *Dialum guineensis* (Oni 2002)*, Vitellaria paradoxa* (Odebiyi *et.al.* 2004) and *Parkia biglobosa* (Sale 2015) were slow growing species. The highest germination values were observed in seedlings watered twice in a week with 50ml. However, seeds that were watered with negligible amount of water (25mls per week) recorded poor germination percentage, this tends to suggest that little moisture supply may not enhance germination in this species, this tends to lend credence to the previous assertion of Mantovani and Iglesias (2008), that germination percentage, time, rate and synchronicity varied with increasingly negative water potentials from 0.0 to -0.14 MPa.

The results obtained from the growth parameters considered in this study revealed that seedlings watered with 100mls twice per week (Treatment T_5) performed best thus justifying the occurrence of *D. cumminsii* in the rain forest vegetation. The results obtained from the control suggest that water is an important factor in the growth of this plant. Previous study by Seiler and Cazella (1990) reported that extreme soil drying ultimately reduces root growth. Also study by Hartmann and Kester (1983) asserted that water limits plant growth in virtually all environments. The results obtained in this study also support the assertion of Abdelbasit *et. al.* (2012) that water stress causes significant variation on seedlings relative growth rate (stem length, leaf, root and total plant biomass).

Seedlings that received 50mls once/week recorded the least mean in all parameters assessed. Previous studies by McMaster and Smike (1988) and Abo El-Kheir (2000) reported that during vegetative growth, phyllochron decreases under water stress and leaves become smaller, which results in low leaf area index, low shoot dry weight and poor growth. Study by Lawlor and Leach (1985) also submitted that decrease in leaf area is a common effect of poor supply of water. In conclusion, the results obtained from this study revealed that adequate supply of water is a prerequisite to a successful management of the juveniles of this species. Therefore, successful domestication of this species could be achieved in nurseries with adequate water supply.

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