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EFFECT OF POTTING MEDIA AND WATERING FREQUENCIES ON THE GROWTH OF PEPPER FRUIT (*DENNETIA TRIPETALA*) SEEDLINGS

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ABSTRACT
A nursery trial was conducted in the screen house of the Teaching and Research Farm, Faculty of Agriculture, University of Benin, Benin City, Nigeria in 2011 to investigate the effect of different potting media and watering frequencies on the growth of Dennetia tripetala seedlings. Three different growing media: Rice husks (Rh), pig dung (Pd) and cocoa husk (Ch) were used as sources of growth. They were combined in a 1:1 ratio to make seven media combinations with four watering frequencies at once daily (D_1), twice daily (D_2), once every other day (D_3) and twice every other day (D_4). The trial was laid out in a 7 x 4 factorial design fitted into a Completely Randomized Design (CRD) with three replications. Data were collected on plant height, leaf number, and canopy diameter, stem girth, dry weight of root and shoot. Results obtained revealed that potting medium with sole pig dung significantly produced the best seedling attributes in terms of plant height (11.46cm), stem girth (1.01cm), canopy diameter (9.58cm) while, leaf number (11.16), dry weight of shoots (0.51g) and roots (0.19g) were best with sole rice husk and rice husk plus pig dung (1:1) respectively. Watering twice every other day had a significant ($p<0.05$) influence on plant height, canopy diameter, stem girth and root dry matter. There were significant interaction effects between sole pig dung and watering once, twice daily and twice every other. However, in order to save labour, money and time spent in watering, watering twice every other day plus pig dung sole may be adequate for raising D. tripelata seedlings.
Keywords: Dennetia tripelata, potting media, watering frequency, seedling growth

INTRODUCTION

Dennetia tripetala G. Baker commonly referred to as pepper fruit tree is a well known spicy medicinal plant in Nigeria. The tree belongs to the Annonaceae family. Egharevba and Ikhatua (2004) listed pepper fruit tree among the 25 classes of non-timber forest products (NTFPS) peculiar to the diverse ecological zones in Nigeria. *D. tripetala* is known by different names in different dialects in Nigeria: "Ako" in Bini, "Nmimi" in Igbo, "Ata" in Yoruba and "Umako" in Urhobo (Burkill, 1988). The tree is highly valued for its edible fruit which is consumed in the southern Nigeria (Ejechi and Akpomedaye, 2005). According to Keay (1989) pepper fruit is used as a masticator, when chewed it produces a unique peppery effect. The peppery spicy taste usually serves as a mild stimulant to the consumer. The fruit is usually served along side with kola nut, garden egg and palm wine especially in the southern parts of Nigeria where it plays a key role in the culture of the people for the entertainment of guests during coronation, new yam festivals, burial and marriage ceremonies (Keay, 1989; Enwere, 1998). The fruit contains an essential oil which has been used as an effective protectant for stored grains such as cowpea and maize without negatively affecting their viability (Ejechi *et al.*, 1999). In West Africa, especially in southern parts of Nigeria, the fruit provides income to the rural populace thereby improving the economy.

These uses have increased the demand for this wild indigenous fruit tree. Despite this, its existence is being threatened by over exploitation and deforestation. According to Ladipo (2010) the deforestation rate in Nigeria is about 3.5% per year, translating to a loss of 350,000 – 400,000 ha of forest land per year. Thus, the forests in Nigeria now occupy about 10% of Nigeria's forest land area and well below FAO's recommended national minimum of 25% (Ladipo, 2010). Egharevba and Ikhatua (2004) ascertained that the disappearance of tropical forest trees has resulted in constant erosion and reduction of natural gene pool of important forest tree species including *D. tripelata*.

Thus, there is the need for the domestication of this forest fruit tree through establishment of a protocol for good nursery practice that would ensure the production of vigorous seedlings for plantation establishment.

Successful nursery production of good quality seedlings is largely dependent on the composition of the growing media. According to James and Michael (2009) the selection of the proper media components is critical to the successful production of plants. The addition of organic materials as source of growth in potting media is essential as they are the main sources of organic matter for the supply of essential nutrient elements needed by the plants (Khan *et al.,* 2006). Besides that, organic matter in a growing medium improves its water holding capacity. Hence, James and Michael (2009) recommended that an ideal potting medium should be well drained and yet retain sufficient water to reduce the frequency of watering.

Water is an essential requirement of a growing plant. Water plays a significant role in the metabolic activities of the plant. The growth of a plant is 'arrested' when water is limiting. Hence, an abundant, dependable and uncontaminated source of water is a necessity in raising seedlings. Determining the watering frequency for a seedling raised in a nursery is essential in order to avoid waste of water and to save cost of watering especially during the dry season. Also, since the organic matter in the potting medium improves water holding capacity, hence watering frequency need to be determined. This study was aimed at determining the most suitable potting medium and appropriate watering frequency required for the growth of *D. tripelata*.

MATERIALS AND METHODS

Potting media: Three media sources (cocoa husk, rice husk and pig droppings) were used as source of growth media. They were used as sole media and combined in ratios of 1:1 to give seven (7) potting media combinations as shown in Table 1.

Watering frequencies: Four watering frequencies; once a day (D_1), twice a day (D_2), once every other day (D_3) and twice every other day (D_4) were used. Determination of volume of water needed to water the growth sources to field capacity was done according to Udo *et al.* (2009). It was found out that 200 ml water was required and this volume of water was used to water each plant at the tested frequencies throughout the experiment.

Potting media analysis: The growing media were analysed for their chemical characteristics. The pH was determined in water (1:1) using a glass electrode Beckman Zero-matics pH meter. The organic matter content, total nitrogen, available phosphorus and the exchangeables bases were determined by the methods of Udo *et al.* (2009) Bulk density was calculated by the formula derived by the American Society of Agronomy (Anon., 1965) as follows:

Bulk density (d) = weight of oven dry core/ volume of the sample (gcm^{-3}). Total porosity was determined according to (Anon, 1965) as % pore space (total porosity) = 100 – (Db x 100)/DP

Plant material: Mature fruits of *D. tripetala* were depulped and the seeds pre-treated in warm water and air dried before sowing in seed tray filled with sterile sand They were then watered every morning until germination occurred. The seedlings were transplanted one seedling per polythene bag measuring 23.5cm x 25cm.5 weeks after sowing. Each polythene bag was filled with 2 kg of the different potting mixtures and thereafter watered to field capacity before being placed in the screen house.

The trial was a 7 x 4 factorial fitted into a completely randomized design (CRD) with three replications. Each replicate had one hundred and fourty (140) polythene bags with five (5) polythene bags per treatment. Data on plant height, number of leaves, stem girth and canopy diameters were collected at 4 weeks intervals. At the end of the trial (24 weeks after transplanting), the plants were harvested, separated into roots and shoots and oven dried at 70^0C for 72 hrs. Data collected were subjected to analysis of variance (ANOVA), using SAS Version 9 Software (2002), while the treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% probability level.

RESULTS AND DISCUSSION

The results of the analysis of the potting media sources used are shown in Table 2. Five of the media sources were slightly acidic with a pH range of 5.68 – 6.50, while media with sole cocoa husk (Ch) and cocoa husk (Ch) plus rice husk (Rh) (Ch +Rh 1:1) were with pH 7.20 and 7.40 respectively. Osaigbovo and Nwaoguala (2011) reported slight acidity with pH range of 5.11 – 6.20 for the potting media sources used to raise *Dialium guineense*. Khan *et al*. (2006) recommended that the media pH value for container grown plant should be slightly acidic (5.5 – 6.5). Highest bulk density ($1.10gcm^3$) and % porosity (68%) were recorded in medium with rice husk (Rh) plus pig dropping (Pd) (Rh + Pd 1:1) while the lowest values ($0.54gcm^3$ and 50%)) were recorded in rice husk (Rh) plus coca husk (Ch) (Rh + Ch 1:1). The higher values of bulk density and total porosity obtained in Rh + Pd (1:1) was due to less compactness and increased aeration of this medium as a result of the addition of a coarse material such as the rice husk. Dolor *et al.* (2009) recommended the amendment of growth sources with coarse materials to increase air filled pores and drainage. Paul and Lee (1976) reported improved aeration in the potting source with high total porosity. Apart from organic carbon, sole pig dung recorded the highest values for nitrogen (3.4%), phosphorus (21.12 mg/kg), potassium (14.10 mg/kg). The differences in the nutrient composition of the media sources may be due to variation in the organic matter content in the different component of the growth media. Similar differences in nutrient composition were reported by Osaigbovo and Nwaoguala (2011) for growth sources used for raising seedlings of *Dialium guineense*.

Morphological growth of *D. tripelata* as influenced by the growth sources is presented in Table 3. *Dennetia tripelata* seedlings grown in sole pig dung medium was significantly ($P<0.05$) higher in plant height (11.46cm) and canopy diameter (9.58cm) than other combinations except sole Rh (11.28cm and 8.85cm), Rh + Pd 1:1 (11.41cm and 9.54cm) and Ch + Pd 1:1 (10.47cm and 8.21cm) respectively. The highest leaf number was obtained in sole Rh (11.16) compared to other treatments. Although, no significant differences were recorded among the various treatments in stem girth, the highest was obtained in sole Pd (1.01cm). Dry weight of shoot and root (Table 4) were significantly ($p<0.05$) higher in potting mixture of Rh + Pd (1:1) over other media types with exception of sole Pd, sole Rh, while Ch + Pd (1:1) and Rh + Ch (1:1) for only dry root weight respectively.

The superior performance of *D. tripeleta* in sole Pd medium could be attributed to high organic matter content of the growth source which mineralized to produce high amount of nutrients used up by the plant. According to Reddy and Reddi (1995), manures from monogastric such as pig dung are effective organic fertilizers that are important sources of plant nutrients. The better performance of *D. tripelata* seedlings in dry weight of shoot and root in medium with Rh + Pd (1:1) could be due to improvement of the physical status such as less compactness and increased aeration of the medium. Osaigbovo *et al*. (2009) reported a better root development when river sand was used to amend top soil and poultry manure. The poor performance of *D. tripelata* seedlings observed in sole Ch potting medium in this study was contrary to the report of Khayyat *et al*. (2007) on pothos plant (*Epipremnum aureum*). Khayyat *et al*. (2007) reported superior development in freshness, shoot length, shoot fresh and dry weight, root fresh, dry weight and root number in medium containing only cocoa peat in Golden pothos (*Epipremnum aureum*). The poor performance recorded with sole Ch could be due to the degree of composting.

Watering twice every other day (D_4) significantly ($p<0.05$) enhanced the height of *D. tripelata* seedlings over watering once every other day (D_3) but was statistically non- significantly different from watering once a day (D_1) and twice daily (D_2) (Table 4). Canopy diameter was significantly higher in watering once a day (D_1) seedlings than watering once every other day (D_3) but was not different statistically from other watering regimes. Leaf number and stem girth were however, higher in D_4 and D_1 respectively. For dry weight of shoot and root, (Table 6) D_2 had a pronounced effect that had significant effect on the root dry weight over D_3 only. Ouma (2007) reported increased growth of avocardo seedlings at more frequent irrigation interval of every day than less frequent intervals of every two days and three days respectively. Aminah (2002) reported increased height as the only variable significantly affected with watering once a day but was not significantly better than watering twice every other day. The author ascertained that watering twice a day as normally practiced in most nurseries is not necessary when using medium containing high organic matter. The addition of organic matter to the potting medium will greatly improve its water holding capacity as shown in this trial. Hence Aminah (2002) recommended that organic matter should form the major fraction of the potting media. Organic matter helps resist compaction and retain water while still maintaining movement of air and root growth as reported by Khan *et al*. (2006).

There were significant interaction effects between potting media and watering frequency as shown in Table 7. Pig dung and its interactions with watering once daily, twice daily and twice every other day produced superior growth in all the parameters measured. Thus, pig dung can be combined with either of these watering regimes. However, in order to save labour, money and time spent in watering, watering twice every other day may be sufficient. This may produce adequate aeration of the medium connected with the time spent before re-watering. Moreover, there could be the possibility of reduced leaching of nutrient due to the time interval between watering.

Table 1: Potting Media Compositions

Media Composition	Ratio
Rice husk (Rh)	Sole
Pig dropping (Pd)	Sole
Cocoa husk (Ch)	Sole
Rice husk + pig dropping (Rh + Pd)	1:1
Rice husk + Cocoa husk (Rh + Ch)	1:1
Pig dung + Rice husk (Pd + Rh)	1:1
Pig dung + Rice husk + cocoa husk (Pd + Rh + Ch)	1:1:1

Table 2: Chemical Analysis of Different Potting Sources

Potting Sources	pH	Bulk density (g/cm^3)	Porosity (%)	Org C (%)	N (%)	P Mg/kg	K Mg/kg
Rh	6.50	0.70	55	28.98	0.06	13.37	0.08
Pd	5.80	0.67	57	20.50	3.40	21.12	14.10
Ch	7.20	0.55	55	25.35	0.06	10.61	0.09
Rh + Pd	5.68	1.10	68	18.22	2.30	16.32	10.13
Rh + Ch	7.40	0.54	50	20.75	0.07	19.50	0.56
Ch + Pd	6.10	1.00	55	10.17	0.90	18.91	5.29
Rh + Ch + Pd	5.30	0.60	55	26.16	0.92	18.41	8.02

Ch = Cocoa husk, Pd = Pig dung and Rh = Rice husk

Table 3: Effects of Potting Media on Morphogical Growth of *D. tripetala*

Media	Canopy diameter (cm)	Leaf no.	Plant Height (cm)	Stem girth (cm)
Ch	7.92^{b}	8.91^{c}	9.39^{d}	0.70^{abc}
Pd	9.58^{a}	9.83^{abc}	11.46^{a}	1.01^{a}
Rh	8.85^{ab}	11.16^{a}	11.28^{abc}	0.90^{ab}
Rh + Pd	9.54^{a}	10.75^{ab}	11.41^{ab}	0.90^{ab}
Pd + Ch	8.21^{ab}	9.33^{bc}	10.47^{abcd}	0.80^{ab}
Rh + Ch	8.08^{b}	9.33^{bc}	9.87^{cd}	0.80^{ab}
Rh+ Ch + Pd	8.28^{b}	9.58^{bc}	9.96^{bcd}	0.70^{abc}

*Mean values followed by the same letter within a column are not significantly different (P>0.05).

Table 4: **Effects of potting media on the root and shoot dry weight *D. tripetala*.**

Media	Root Dry weight (g)	Shoot Dry weight (g)
Ch	0.09^{c}	0.25^{c}
Pd	0.17^{ab}	0.46^{ab}
Rh	0.15^{abc}	0.46^{ab}
Pd + Ch	0.13^{abc}	0.31^{bc}
Rh + Pd	0.19^{a}	0.51^{a}
Rh + Ch	0.14^{abc}	0.29^{c}
Rh + Ch + Pd	0.12^{bc}	0.26^{c}

*Mean values followed by the same letter within a column are not significantly different (P>0.05).

Table 5: Effect of watering frequencies on the morphological growth of *D. tripetala*.

Watering Frequency	Canopy diameter (cm)	Leaf no.	Plant height (cm)	Stem Girth (cm)
D_1	9.16^{a}	9.38	10.46^{ab}	0.61
D_2	8.61^{ab}	9.81	10.68^{ab}	0.08
D_3	7.96^{b}	9.61	9.80^{b}	0.04
D_4	8.80^{ab}	10.57	11.24^{a}	0.08

*Mean values followed by the same letter within a column are not significantly different (p>0.05)
,D_1= Watering once daily, D_2= Watering twice daily, D_3= Watering once every other day and D_4= Watering twice every other day.

Table 6: Effect of Watering Frequencies on the dry weight of root and shoot of *D. tripetala*

Watering –Frequency	Root Dry weight (g)	Shoot Dry weight (g).
D_1	0.15	0.35^{ab}
D_2	0.16	0.43^{a}
D_3	0.12	0.30^{b}
D_4	0.14	0.37^{ab}

*Mean values followed by the same letter within a column are not significantly different (P>0.05).
D_1= Watering once daily, D_2= Watering twice daily, D_3= Watering once every other day and D_4= Watering twice every other day.

Table 7: Effects of Potting Media and Watering Frequencies on the Growth of *D. tripetala* Seedlings.

Medium	Watering frequency	Plant height (cm)	Leaf number	Canopy diameter (cm)	Stem girth (cm)	Shoot dry weight (g)	Root Dry weight (g)
	D_1	8.53^{e}	8.00^{b}	7.33^{cd}	0.07^{b}	0.21^{cd}	0.08^{c}
Ch	D_2	10.23^{abcd}	8.67^{ab}	8.17^{abcd}	0.08^{b}	0.24^{bcd}	0.11^{bc}
	D_3	8.50^{e}	9.00^{ab}	8.17^{abcd}	0.07^{b}	0.27^{bcd}	0.09^{bc}
	D_4	10.30^{e}	10.00^{ab}	8.00^{bcd}	0.8^{b}	0.23^{bcd}	0.10^{bc}
	D_1	9.40^{abc}	9.97^{bd}	9.47^{abcd}	0.09^{b}	0.34^{bcd}	0.16^{abc}
	D_2	12.53^{abc}	11.00^{ab}	8.83^{abcd}	0.10^{b}	0.34^{bcd}	0.24^{ab}
Rh	D_3	12.43^{abc}	11.30^{ab}	8.47^{abcd}	0.10^{b}	0.38^{bcd}	0.23^{abc}
	D_4	10.93^{abcde}	11.67^{ab}	8.63^{abcd}	0.09^{b}	0.42^{bcd}	0.16^{abc}
	D_1	13.37^{a}	12.00^{a}	11.00^{a}	1.78^{a}	0.78^{a}	0.27^{ab}
	D_2	10.73^{abcde}	8.67^{ab}	10.33^{ab}	0.08^{b}	0.47^{abcd}	0.18^{abc}
Pd	D_3	9.67^{cde}	9.67^{ab}	7.00^{d}	0.09^{b}	0.23^{bcd}	0.09^{bc}
	D_4	12.07^{abcd}	10.00^{ab}	10.00^{abc}	0.08^{b}	0.55^{abc}	0.16^{abc}
	D_1	11.33^{abcde}	9.33^{ab}	8.67^{abcd}	0.08^{b}	0.35^{bcd}	0.17^{abc}
	D_2	9.47^{cde}	9.33^{ab}	8.00^{bcd}	0.08^{b}	0.33^{bcd}	0.12^{bc}
Pd+Ch (1:1)	D_3	9.57^{cde}	8.67^{ab}	8.17^{abcd}	0.08^{ab}	0.29^{bcd}	0.10^{bc}
	D_4	11.50^{abcde}	10.00^{ab}	8.00^{bcd}	0.09^{b}	0.29^{bcd}	0.13^{abc}
	D_1	10.10^{bcde}	9.33^{ab}	8.00^{abcd}	0.08^{b}	0.38^{bcd}	0.11^{bc}
	D_2	11.87^{abcd}	10.67^{ab}	8.83^{abcd}	0.09^{b}	0.53^{abcd}	0.21^{abc}
Rh + Pd (1:1)	D_3	10.67^{abcde}	11.33^{ab}	9.00^{abcd}	0.09^{b}	0.41^{bcd}	0.15^{abc}
	D_4	13.00^{ab}	11.67^{ab}	9.33^{abcd}	0.09^{b}	0.52^{abcd}	0.15^{abc}
	D_1	10.73^{abcde}	9.33^{ab}	8.67^{abcd}	0.08^{b}	0.33^{bcd}	0.16^{abc}
	D_2	10.07^{bcde}	9.33^{ab}	8.17^{abcd}	0.08^{b}	0.36^{bcd}	0.15^{abc}
Ch +Rh (1:1)	D_3	8.83^{de}	8.67^{ab}	7.17^{cd}	0.06^{b}	0.18^{cd}	0.09^{bc}
	D_4	9.83^{dcde}	9.67^{ab}	8.33^{abcd}	0.08^{b}	0.27^{bcd}	0.15^{abc}
	D_1	9.77^{dcde}	9.00^{ab}	8.00^{bcd}	0.08^{b}	0.26^{bcd}	0.12^{abc}
	D_2	10.03^{dcde}	9.67^{ab}	8.00^{bcd}	0.08^{b}	0.32^{bcd}	0.13^{abc}
Rh + Ch +Pd (1:1)	D_3	8.97^{de}	8.67^{ab}	7.80^{bcd}	0.08^{b}	0.18^{d}	0.08^{c}
	D_4	11.07^{abcde}	11.00^{ab}	9.33^{abcd}	0.09^{b}	0.28^{bcd}	0.15^{abc}

*Mean values followed by the same letter within a column are not significantly different (P>0.05).

CONCLUSION

This study has demonstrated that sole pig dung is a better potting medium for the growth of *Dennetia tripetela* seedlings. Pig dung is abundant and can easily be sourced from piggery farms. The utilizations of pig dung for potting source will also help to solve the problem of waste disposal in piggery farms. Watering twice every other day is sufficient for the growth of *D. tripetala* and it saves cost and labour involved in watering. The combination of pig dung watered twice every other day is adequate and thus recommended for the growth of *D tripetala* in the nursery.

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