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EFFECT OF *TRICHODERMA* SPP. AND WATERING FREQUENCY ON GROWTH OF CASHEW (*ANACARDIUM OCCIDENTALE* L.) SEEDLINGS

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ABSTRACT

Development of environmental friendly seed and soil treatment for high yield is pertinent. Therefore, this study aims to evaluate the effect of *Trichoderma* spp. and watering frequency on growth of cashew (*Anacardium occidentale* L.) seedlings in the nursery. This study was laid out in a 4 x 4 factorial arrangement in a Complete Randomized Design (CRD) replicated three times. There were four (4) seed + soil treatments and four (4) watering frequencies. *Trichoderma* spp. was cultured on Potato Dextrose Agar (PDA) and a *Trichoderma* seed coating medium was prepared and used to inoculate cashew seeds before sowing. There was no significant interaction between the seed + soil treatments and watering frequency on all plant growth parameters analysed. Watering every 7 days recorded 21 days to emergence, UnSeed + TrSoil had the highest stem girth (2.42cm), UnSeed + UnSoil (11.92) and watering daily (14.08) had the highest number of leaves. TrSeed + TrSoil (21.52cm) and watering daily (22.26cm) had the tallest plants. There was significant difference for effect of watering frequency on root length. TrSeed + UnSoil (11.71g) and watering daily (14.23g) had more fresh weight, while TrSeed + UnSoil (5.60g) and watering every 3 days (4.45g) were the lowest in dry weight. It can be inferred from this study that cashew seedlings will thrive better in soil treated with beneficial microorganisms such as *Trichoderma*, and also watering daily will have significant influence in plant growth attributes. However, watering daily may not be advised before emergence.

Keywords: Cashew, Seedlings, *Trichoderma*, Watering

INTRODUCTION

Appropriate water management is an integral agronomic practice because of its apparent influence on the successful growth and development of many crops (Nduka *et al*., 2024). The survival of seedlings is an essential factor hindering the enhanced productivity of cashew agroforestry systems (Traore *et al*., 2023).

Nduka *et al* (2024) reported that many cashew farmers employ the use of various nuts of cashew and watering rates in their nursery production. Carr (2013) stated that notwithstanding that cashew is drought tolerant, water is a limiting factor in its productivity.

Trichoderma spp. are a group of beneficial microorganisms that are soil-borne and popular for their inherent soil quality enhancement, plant growth facilitation, as well as biocontrol agents against numerous plant diseases (Asghar *et al*., 2024). More recently, research has recorded *Trichoderma* spp. as having direct impact on plant growth and development leading to crop productivity (Zin and Badaluddin, 2020). As described by Hyakumachi and Kubota (2003), Plant Growth Promoting Fungi (PGPF) are microorganisms that have the capacity to stimulate plant growth; so therefore, *Trichoderma* spp. could be a superior PGPF.

Cashew (*Anacardium occidentale*) is an important tree crop that is primarily cultivated in East Africa, South East Asia, and West Africa (Nitidae, 2019). In the World, cashew is an essential tree crop with its production playing significant economic development roles in producing countries (Balogoun *et al*., 2024). Balogoun *et al*. (2014) reported that the production of cashew is simple, profitable, and easy to manage. Cashew is a main source of income for numerous smallholder farmers in cashew producing parts of Nigeria (Adeigbe *et al*., 2015). Cashew is fast growing, drought tolerant, hardy and a multipurpose tree crop cultivated in many tropical countries (Malik and Bhadauria, 2020). However, in order to improve survival of seedlings in cashew production, there should be application of proper silviculture practices (Traore *et al*., 2023). In order to foster greater and sustainable production and profitability, mango and cashew cultivation should be accompanied with addition of the lost soil nutrients that are required by the crops (Musa and Adamu, 2019). Commercial cashew plantations are established in Nigeria through seedlings raised in the nursery (Hammed, 2012).

It has been proven that growing media is effective for increasing crop output. In cultivating fruit crops, growing media plays an essential role in influencing the qualitative and quantitative aspects for economic significance (Sharma *et al*., 2023). In nursery production of seedlings, organic materials that are inexpensive and likely accessible are often used as growth enhancers, with the soil as the primary medium. Organic materials also supplement the soil with adequate nutrients and organic matter required for proper seedlings production (Sharma *et al*., 2023). Khan *et al* (2006) stated that to produce quality fruit tree seedlings, an appropriate potting media is necessary because vigorous growth is required to face the seasonal hazards encountered on the field.

Utmost reliance on 100% topsoil as a growing medium for production of cashew seedlings is not the most efficacious method (Olufemi *et al*., 2023); hence, the introduction of *Trichoderma* spp. as growing media in this study.

MATERIALS AND METHODS

This study was carried out in the screen house of the Department of Crop Science, University of Benin, Benin City, Edo State, Nigeria between March to June, 2023. Cashew fruits were collected, de-pulped, and the extracted seeds were sorted and selected, afterwards a viability test was carried out and the viable seeds were air dried before sowing. Top soil samples were collected from the experimental farm of the Department of Crop Science, University of Benin. *Trichoderma* spp. was prepared in the Department of Crop Science Media Laboratory, University of Benin using cobs from corn (*Zea mays*) as a carrier. The *Trichoderma* used in

this study was isolated from soil samples obtained from Sapele road, Benin City using serial dilution techniques (Rao, 2003). Pure cultures of the *Trichoderma* isolate was maintained on PDA at 25ºC ± and the isolate was identified using morphological and reproductive characters as well as microscopic analysis (Watanabe, 2002). Twenty (20mls) of water was used to mix 50g of starch, *Trichoderma* seed coating medium was prepared by heating 1000 mls of H_2O to boiling, after boiling, 400ml of hot water was used to prepare the starch mixture. 10ml of cooled water was poured on the 7 day-old *Trichoderma* culture and scooped. 10 ml of prepared starch was added to the mixed solution and was stirred properly for homogeneous mixture. Cashew seeds each were then coated in the *Trichoderma* solution and air-dried for 12 hours under ambient conditions before sowing.

This study was laid out in a 4 x 4 factorial arrangement in a Complete Randomized Design (CRD) replicated three times. There were four (4) seed + soil treatments which included: Untreated Seed + Untreated Soil (UnSeed + UnSoil), Untreated Seed + Treated Soil (UnSeed + TrSoil), Treated Seed + Untreated Soil (TrSeed + UnSoil), and Treated Seed + Treated Soil (TrSeed+TrSoil); and four (4) watering frequencies (Daily, 3days, 5 days and 7days respectively).

Plant growth parameters measured were stem girth, number of leaves, plant height, root length, fresh weight, and dry weight. Data was analyzed using Genstat statistical software (version 12), and means were compared using Duncan Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

The physical and chemical properties of the experimental soil are presented in Table 1. The textural class was loamy sand with nitrogen, phosphorus, organic carbon and organic matter contents of 0.62 g/kg, 18.33g/kg, 10.31 g/kg, and 17.79g/kg respectively, while other parameters were sufficient for growth of cashew. The soil had a pH of 5.67 was recorded in this study which was moderately acidic. Egbe *et al* (1989) recorded a pH of 5.5 to 7.5 as optimal for tree crops, which is in line with the results of this study. Nduka *et al* (2024) also had a pH of 6.3 which is slightly acidic for soil used in a study of cashew seedlings in the nursery, which is not divergent from this study.

Table 1: Soil Physical and Chemical Properties

Properties	Value
pH	5.67
Total Nitrogen (g/kg)	0.62
Total Organic Carbon (g/kg)	10.31
Organic Matter (g/kg)	17.79
Availbale Phosphorus (mg/kg)	18.33
K (cmol/kg)	0.24
Ca (cmol/kg)	0.87
Mg (cmol/kg)	0.21
Na (cmol/kg)	0.13
H^+(cmol/kg)	0.10
Al^{3+} (cmol/kg)	0.03
CEC	4.32
Sand (g/kg)	872
Silt (g/kg)	80
Clay (g/kg)	48
Textural class	Loamy sand

CEC: Cation Exchange Capacity

For seed + soil treatments, there was no significant difference in most of the plant parameters measured such as days to emergence, stem girth, number of leaves, plant height, fresh weight, and dry weight, however root length recorded significant difference (Table 2). Nevertheless, for watering frequency, there was significant difference in root length, fresh weight,and dry weight.

Table 2: Effect of seed + soil with *Trichoderma* spp. on growth attributes of cashew seedlings

Seed + Soil	D2E	SG(cm)	No. L	PH(cm)	RL(cm)	FW(g)	DW(g)
UnSeed + UnSoil	24.58^a	2.24^a	11.92^a	17.80^a	8.44^b	10.39^a	5.66^a
UnSeed + TrSoil	21.92^a	2.42^a	11.50^a	19.67^a	12.17^a	10.93^a	6.70^a
TrSeed + UnSoil	25.33^a	2.27^a	11.83^a	18.49^a	7.56^b	11.71^a	5.60^a
TrSeed + TrSoil	20.42^a	2.40^a	11.58^a	21.52^a	9.50^{ab}	10.91^a	6.16^a
SED	2.17	0.23	1.72	2.76	1.40	1.91	1.22

D2E: Days to Emergence; SG: Stem Girth; No. L: Number of Leaves; PH: Plant Height; RL: Root Length; FW: Fresh Weight; DW: Dry Weight; SED: Standard Error Difference

For effect of seed + soil treatments on days to emergence, TrSeed + UnSoil took an average of 25 days to emergence, whereas TrSeed + TrSoil emerged in 20 days (Table 2 and Figure 1). Watering every 7 days recorded 21 days to emergence, whereas daily watering emerged in about 25 days (Table 3). Amoah (2005) reported 14 and 21 days to emergence for cashew seeds sown at 4cm and 8/12cm depth, and Singh *et al* (2015) recorded between 14-18 days to emergence in a pre-sowing treatment study on germination of cashew seedlings. These results were slightly different from this study possibly due to lack of pre-sowing treatment and sowing depth analysis.

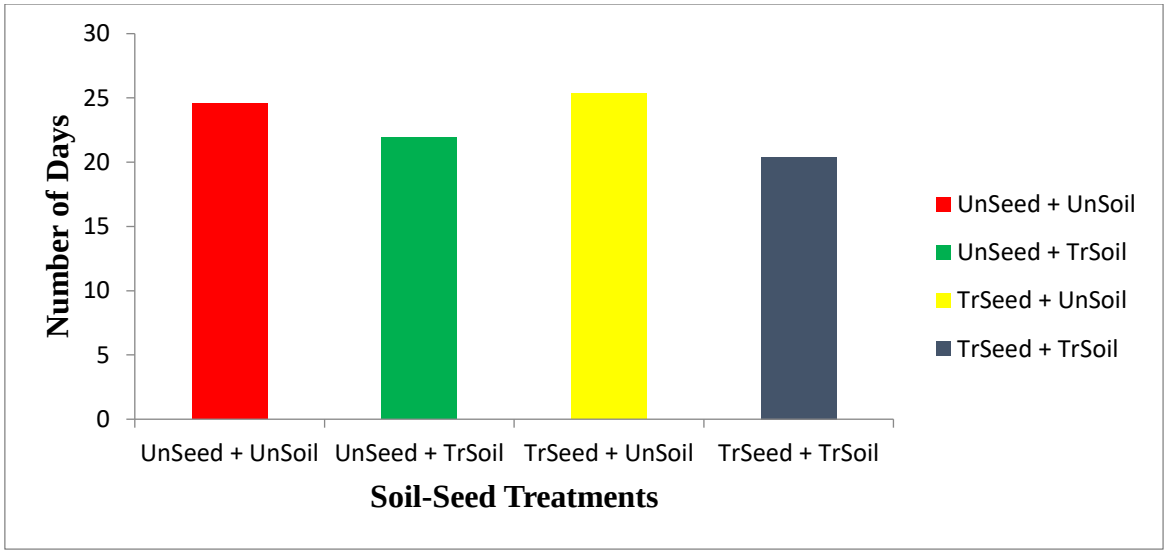

Figure 1: Histogram showing days to emergence of cashew seedlings

Table 3: Effect of watering frequency on growth attributes of cashew seedlings

Watering Frequency	D2E	SG	No. L	PH	RL	FW	DW
Daily	24.92[a]	2.31[a]	14.08[a]	22.26[a]	11.57[a]	14.23[a]	8.39[a]
3 days	22.3[a]	2.14[a]	10.33[a]	16.74[a]	7.58[b]	8.41[b]	4.45[b]
5 days	23.75[a]	2.31[a]	12.08[a]	17.76[a]	8.06[b]	11.08[ab]	5.52[ab]
7 days	21.25[a]	2.58[a]	10.33[a]	20.72[a]	10.47[ab]	10.21[ab]	5.75[ab]
SED	2.11	0.23	1.72	2.76	1.40	1.91	1.22

D2E: Days to Emergence; SG: Stem Girth; No. L: Number of Leaves; PH: Plant Height; RL: Root Length; FW: Fresh Weight; DW: Dry Weight; SED: Standard Error Difference

UnSeed + TrSoil had the highest stem girth (2.42cm), while UnSeed + UnSoil was the lowest in stem girth (2.24cm) (Table 2). In the effect of watering frequency on stem girth, watering every 7 days had the thickest stem (2.58cm), while watering every 3 days has the slimmest girth of 2.14cm (Table 3). Olufemi *et al* (2023) conducted a study on the suitability of some growing media for production of cashew seedlings and Yisau *et al* (2023) examined the effect of seed source and size on growth of cashew seedlings, they both recorded slimmer stems at week 12 in comparison with results from this study which attest to the soil enhancement capacity of the growing media used in this research.

UnSeed + UnSoil had the most number of leaves (11.92), meanwhile, UnSeed + TrSoil recorded the least number of leaves (11.50) (Table 2). Watering daily had the highest number of leaves (14.08), while watering every 3 days and 7 days had the least leaf numbers (10.33) (Table 3). Santos *et al* (2021) used strains of *Trichoderma* to promote growth of dwarf cashew rootstock and reported similar number of leaves with this study; this indicates that *Trichoderma* may be a good nutrient base for plant growth.

UnSeed + UnSoil had the lowest plant height (17.80cm), while TrSeed + TrSoil were highest in plant height (21.52cm) (Table 2). Watering daily had the tallest plants (22.26cm) compared to watering every 3 days which recorded the shortest plants (16.74cm) (Table 3). Mng'omba *et al* (2011) reported that watering daily influenced number of leaves and plant height for *Vangueria infausta* and *Persea Americana* seedlings which is consistent with results from this study. However, Oyekale and Okunlola (2009) produced tall cashew seedlings compared to the output from this study which perhaps may be due to difference in nut size used.

Root length was statistically similar between UnSeed + TrSoil (12.17cm) and TrSeed + TrSoil (9.50cm) but was different from UnSeed + UnSoil (8.44cm) and TrSeed + UnSoil (7.56cm) (Table 2). For effect of watering frequency on root length, watering daily (11.57cm) was significantly different from watering every 5 days (8.06cm) and every 3 days (7.58cm), but was similar to watering every 7 days (10.47cm) (Table 3). For proper field establishment of seedlings, root development is a critical attribute (Grossnickle and Ivetic, 2022). Singh *et al* (2015) recorded longer roots for a pre-treatment study of cashew. This implies that pre-treatment of cashew seeds before sowing in the nursery is paramount for proper root development. Notwithstanding, this was different from the results of this study which could be as a result of the size of pots used and the pre-sowing treatment applied.

For effect of seed + soil treatments on fresh weight, TrSeed + UnSoil had more fresh weight (11.71g), whereas, UnSeed + UnSoil had the lowest fresh weight (10.39g) (Table 2). Fresh weight for watering daily (14.23g) was statistically different from watering every 3 days (8.41g), but significantly similar to watering every 5 days (11.08g) and every 7 days (10.21g) statistically different (Table 3). Plant weight is an essential and commonly used attribute to evaluate plant growth (Chen *et al*., 2016). Iqbal *et al* (2022) conducted a study of nursery potting media on germination and development of mango seedlings and reported comparative fresh biomass to this study.

UnSeed + TrSoil recorded the highest dry matter (6.70g), while TrSeed + UnSoil was the lowest in dry weight (5.60g) (Table 2). For effect of watering frequency on dry weight, watering daily (8.39g) had more dry weight and was significantly different from watering every 3 days (4.45g), but not statistically different from watering every 7 days (5.75g) and 5 days (5.52) (Table 3). The beneficial effect of the physical and chemical characteristics of appropriate growing media composition might result in increased dry biomass

(Medany *et al*., 2009). Ogbeide and Aremu-Dele (2023) reported higher fresh and dry weight compared to results from this study, which could be mainly due to the jumbo nut size and longer nursery duration used in their study.

CONCLUSION

Management of resources such as water, and proper combination/treatment of organic materials and seeds is imperative in nursery production of tree crops. Seedlings watered every 7 days emerged faster and had thicker stems, whereas watering daily had high number of leaves, tallest plants, longer roots, more fresh weight and dry weight. The seedlings planted in UnSeed + UnSoil had more number of leaves, while UnSeed + TrSoil emerged faster, had thicker stems and high dry weight. TrSeed + UnSoil had more fresh weight, whereas TrSeed + TrSoil had the tallest plants and longest roots. It can be inferred from this study that cashew seedlings will thrive better in soil treated with beneficial microorganisms such as *Trichoderma*, and also watering daily will have significant influence in plant growth attributes. However, watering daily may not be advised before emergence. The effectiveness of other beneficial microorganisms alongside organic manure/nutrient may be considered for cashew seedling production.

REFERENCES

Adeigbe, O.O., Olasupo, F.O.,Adewale, B.D. andMuyiwa, A.A.(2015). A review on cashew research and production in nigeria in the last four decades. *Scientific Research Essays* 10(5): 196-209. https://doi.org/10.5897/SRE2014.5953

Amoah, F.M. (2005). The germination and early growth of cashew (*Anacardiumoccidentale*).Tropical Science 45(4): 149-152. https://doi.org/10.1002/ts.15

Asghar, W., Craven,K.D.,Kataoka, R.,Mahmood, A.,Asghar, N.,Raza, T. and Iftikhar, F. (2024). The application of *Trichoderma* spp., an old but new useful fungus, in sustainable soil health intensification: a comprehensive strategy for addressing challenges. *Plant Stress*12: 100455. https://doi.org/10.1016/j.stress.2024.100455

Balogoun, I., Ogoudjobi, S. L., Zoundji, C.C.,Bero, E. O., Affagle, S. andMoussa, D. (2024). Evaluation of the germination and development potential of cashew seeds in nursery in Benin.*International Journal of Biosciences*24(3): 50-58. http://dx.doi.org/10.12692/ijb/24.3.50 -58

Balogoun, I., Saidou, A., Ahoton, E.L., Amadji, L. G., Ahohuendo, C.B., Adebo, I.B., Babatounde, S., Chougourou, D., Adoukonou-Sagbadja, H. and Ahanchede, A. (2014). Caractérisation des systèmesde production à base de l'anacardierdans lesprincipales zones de culture du Bénin. *AgronomieAfricaine* 26(1): 9-22.

Carr, M.K.V. (2013). A review: the water relations and irrigation requirements of cashew (*Anacardiumoccidentale*L.). *ExperimentalAgriculture* 50(1): 24–39. https://doi.org/10.1017/s0014479713000392

Chen, W-T., Yeh, Y-H.F., Liu, T-Y.and Lin, T-T. (2016). An automated and continuous plant weight measurement system for plant factory. *Frontiers in Plant Science* 7:392. https://doi.org/10.3389/fpls.2016.00392

Egbe, N.E., Ayodele, E.A. and Obatolu, C.R. (1989). Soil and nutrition of cocoa, coffee, kola.cashew and tea. In: Progress in Tree Crop Research in Nigeria, 2nd Edition, CRIN, Ibadan, 27-38.

Grossnickle, S.C. and Ivetić, V. (2022). Root system development and field establishment: effect of seedling quality. *New Forests* 53(6): 1021-1067. https://doi.org/10.1007/s11056-022-09916-y

Hammed, L.A. (2012). Growth analysis of cashew seedlings as affected by nut-size. *Annals of Biological Research* 3(2): 755-772.

Hyakumachi, M. and Kubota, M. (2003). Fungi as plant growth promoter and disease suppressor. In: D.K. Arora (Ed.), Fungal Biotechnology in Agricultural, Food and Environmental Application, Marcel Dekker, New York. pp. 101-110.

Iqbal, J., Kiran, S., Mustafa, G., Khan, A.H., Raza, S., Bibi, F., Hussain, R., Bulchari, S.I.U.S., Iqbal, N. and Khan, A. (2022). Effect of different nursery potting media on the germination and development of mango (*Mangiferaindica*L.) seedlings.*Biological* and *ClinicalSciences Research Journal* 2022: 136. https://doi.org/10.54112/bcsrj.v2022i1.136

Malik, J.A. and Bhadauria, M. (2020). Cashew nut (*Anacardiumoccidentale*). In: Antioxidants in Vegetables and Nuts-Properties and Health Benefits. Springer, Singapore. pp. 539-557.

Medany, M., Abdrabbo, M.A.,Farag, A., Hassanien, M. and Abou-Hadid, A. (2009). Growth and productivity of mango grown under greenhouse conditions.*Egyptian Journal of Horticulture* 36:373-382.

Mng'omba, S.A., Akinnifesi, F.K., Sileshi, G., Ajayi, O.C., Nyoka, B.I. and Jamnadass, R. (2011). Water application rate and frequency affect seedling survival and growth of *Vangueriainfausta* and *Perseaamericana*. *African Journal of Biotechnology*10(9): 1593-1599. https://doi.org/10.5897/AJB10.710

Musa, A. and Adamu, S. (2019). Variability in soil physic-chemical properties of hypoluvic arenosols under mango and cashew in Shira, North-Eastern Nigeria. *FUDMA Journal of Sciences* 3(2): 321-335.

Nduka, B.A., Aremu-Dele, O., Ibe, O., Ugioro, O., Adegbala, A.A. and Umar, S. (2024). Response of water management on above and below ground growth pattern distribution of cashew seedling (*AnacardiumOccidentale* L.) in the nursery.*Asian Journal of Agricultural and Horticultural Research* 11 (4):70-81. https://doi.org/10.9734/ajahr/2024/v11i4341

Nitidae. (2019). The West African cashew sector in 2018: general trends and country profiles. *Nitidae Report* pp. 1-15.

Ogbeide, C.E. and Aremu-Dele, O. (2023). Effect of some growing media on fresh and dry matter accumulation of cashew (*Anacardiumoccidentale* L.) seedlings raised in the nursery.*Nigerian Agricultural Journal* 54(1): 93-98.

Olufemi, A. D., Abanum, N. B., Olalekan, S. I., Ademola, A. K., Olaoluwa, O.B. (2023). Suitability of some growing media for cashew seedling growth and development in the

nursery.*Agricultural Science and Technology* 15(3): 23-30. https://doi.org/10.15547/ast.2023.03.024

Oyekale, J.I. and Okunlola, A.I. (2019.Effects of seed weights on germination rate and seedling vigor of cashew (*Anacardiumoccidentale* L.).*Pacific Journal of Science and Technology* 20(1):325-330.

Singh, L.S., Pariari, A., andShukla, G. (2015). Effect of Panchagavya and GA3 on germination and seedling growth in cashew (*Anacardiumoccidentale* L.). *Journal of Horticultural Sciences* 10(2): 245-249. https://doi.org/10.24154/jhs.v10i2.140

YisauJ.A., Emilimor P. N., Odeyale O. C., andMajolagbe M. (2023). Effect of seed source and seed size on the early growth of *Anacardiumoccidentale* seedlings. *FUDMA Journal of Sciences* 7(2): 125-130. https://doi.org/10.33003/fjs-2023-0702-1399

Zin, N.A. and Badaluddin, N.A. (2020) Biological functions of *Trichoderma* spp. for agriculture applications.*Annals of Agricultural Sciences* 65: 168-178. https://doi.org/10.1016/j.aoas.2020.09.003

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