

**INFLUENCE OF POTTING MEDIA, SOWING DEPTH AND WATERING
REGIME ON THE DRY MATTER PRODUCTION OF SOURSOP SEEDLINGS**

BY

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SEPTEMBER 2023

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NIGERIA

**A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF CROP
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THE AWARD OF THE DEGREE OF BACHELOR OF AGRICULTURE (B,
AGRIC.) IN CROP SCIENCE**

SEPTEMBER 2023

CERTIFICATION

This is to certify that the work in this report entitled “Influence of potting mixtures, sowing depth and watering regime on the dry matter production of soursop seedlings” was carried out by Miss Naomi Emike ADUKU with Matriculation Number, AGR1700164 in the Department of Crop Science, Faculty of Agriculture, University of Benin, Edo State, Nigeria.

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DEDICATION

This project work is dedicated to God Almighty for giving me strength to persevere and for guiding me throughout the course of this program. To my parents Mr. Michael U. James and Mrs. Delphine James who gave their unwavering support and encouragement all through. My grandparents and siblings who were always there for me and looked forward to the completion of my program.

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ABSTRACT

This experiment was carried out at the Screen house of the Department of Crop Science, Faculty of Agriculture, University of Benin, Benin City, Nigeria to evaluate the effect of potting mixtures, sowing depth and watering regime on dry matter production of soursop seedlings. This experiment involved three potting media, Top soil(TS) + poultry manure (PM) 1:1 (3kg +3kg), top soil (TS) + poultry Manure (PM) 1:2 (2kg +4kg), and top soil (TS) + poultry manure (PM) 2:1 (4kg + 2kg), three sowing depths (2, 4 and 6cm), and three watering regimes (one every day, once in three days and once in five days) laid out in a 3×3×3 factorial arrangements fitted into complete randomized design (CRD) and replicated three times. At 12 and 14 weeks after sowing (WAS), data were collected on root length, shoot dry weight, root dry weight, dry weight, root : shoot ratio and crop growth rate. Result showed that dry matter variables had significant ($p<0.05$) response to potting mixture, sowing depth and watering regime. The longest root (16.33cm) was produced from top soil + poultry manure 2:1 sowed with seed at 2cm depth and watered every day. The heaviest shoot dry weight (1.25g), root dry weight (0.36g) and dry weight (2.11g) were observed once in three days but with low root:shoot ratio. A potting mixture of top soil + poultry manure 1:1 cropped at 4cm sowing depth and watered once in 5 days produced the highest root:shoot ratio but low crop growth rate (0.01gm^{-2}) and dry weight (0.30g) . The highest crop growth rate ($0.10\text{gm}^{-2}\text{day}^{-1}$) was observed on top soil + poultry manure 2:1 cropped at 2cm depth, watered every day. The matter production of soursop seedlings, TS+PM 1:2 mixture resulted in the highest root length, shoot dry weight, root dry weight, and overall dry weight. It also indicated the highest crop growth rate. The result also showed that the different sowing depths and watering regimes, TS+PM 1:2 mixture consistently outperformed the other mixtures in terms of dry matter production. After cropping with soursop seedlings, this mixture maintained favorable soil properties, including pH, nutrient content, and soil texture. Based on the study's findings, it is recommended to use the TS+PM 1:2 mixture for soursop seedling cultivation, as it consistently demonstrated the highest dry matter production and improved soil properties.

CHAPTER ONE

INTRODUCTION

Soursop (*Annona muricata*) is a member of *Annonaceae* family. The *Annonaceae* family includes about 130 genera and 2300 species (Pineda-Ramírez, 2020). Soursop is a tropical fruit tree native to the Caribbean and Central America. It is a delicious and nutritious fruit, which has a unique flavor profile. Soursop has gained significant attention due to its potential health benefits, particularly its anti-cancer properties and high vitamin C content. In addition to its fruit, various parts of the soursop tree, including the leaves and seeds, have been traditionally used for medicinal purposes (Mutakin *et al.*, 2022). The fresh fruit of soursop is a favorite on the market due to its pleasant and sweet taste, but the sensitive characteristics of the fruit lead to the production of the pulp as the most economically attractive commercial form. Sacramento *et al.* (2012) report pulp yield of 83.12 to 85.85% and Nolasco-González, Hernández-Fuentes, and González (2017) report values between 46.8% and 80.6%. This yield difference described by the authors is attributed to changes according to the location and conditions under which the fruit is produced.

Soursop seedlings are the initial stage of soursop tree growth, and their successful establishment is crucial for the overall cultivation process. Dry matter production, which refers to the total weight of plant tissues excluding water content, is an essential parameter for assessing the growth and productivity of soursop seedlings (Liu, 2016).

With the characteristics of easy to grow and regular fruiting, soursop is being grown in many places and has a high yield. However, soursop is very quickly spoiled, so the

situation of crop loss is always a problem that causes great damage to farmers and the overall economic development. This not only puts pressure on the warehouse system but also wastes raw materials, imbalances supply and demand (Mutakin *et al.*, 2022). In the world today, many techniques and technologies have been developed to help increase the preservation time as well as the sensory quality of products in general and of fruits in particular (Ceballos *et al.*, 2012).

The propagation of fruit seedlings in protected environments is widely used as it promotes benefits related to the protection and internal microclimate. However, these environments may have different configurations, directly influencing the quality of seedlings (Costa *et al.*, 2010). When comparing different protected environments for jatoba, Costa *et al.* (2011) observed that the greenhouse with low-density polyethylene (LDPE) has provided more vigorous seedlings than those produced in environments covered with black or thermal-reflective screen, both with 50% shading. For passion fruit, Costa *et al.*, (2009) observed that environments with monofilament or thermal reflective screens, both with 50% shading, promoted better seedlings when compared to those produced in greenhouse with LDPE. For araticum, Cavalcante *et al.* (2008) observed that the full sun environment provided larger seedlings than that produced in greenhouse with LDPE. The substrate is another factor that influences seedlings; physical characteristics, such as porosity, moisture retention and density, as well as chemical characteristics, such as nutrient content, pH and cation exchange capacity, are important parameters for its choice (Silva and Farnezi, 2009). Thus, the choice of the elements that compose the

substrates is a crucial factor for the formation of soursop seedlings. According to Lima *et al.* (2009), soursop seedlings cultivated in substrate composed of soil, humus and carbonized rice husk (2:1:1) present greater vigor when compared with those cultivated in substrates with a mixture of soil, carbonized rice husk, and coconut shell powder.

Products such as dried jam, concentrated soursop juice or spray-dried powder mostly apply drying technologies to reduce moisture content in products. Therefore, creating dry matter from soursop will help preserve and increase the value of this fruit (Chang *et al.*, 2019). On the other hand, researches on applying response surface method (RSM) to optimize the production process are not yet diverse, specifically the processing of dried matter soursop (Chang Lee *et al.*, 2017).

Despite the growing interest in soursop cultivation, there is a notable knowledge gap regarding the dry matter production of soursop seedlings. This gap gives rise to several significant issues the absence of comprehensive data on dry matter production in soursop seedlings hinders our understanding of the growth dynamics of this crucial stage in soursop tree development.

1.1 Justification of the Study

A comprehensive understanding of dry matter production in soursop seedlings will empower farmers to implement more effective cultivation practices and this in turn, lead to higher yields Soursop cultivation has the potential to contribute significantly to sustainable agriculture in tropical regions. By optimizing dry matter production, it can enhance the sustainability and resilience of soursop farming systems, reducing the environmental impact and ensuring long-term agricultural viability. The dry matter production of soursop seedlings is essential for advancing soursop cultivation practices, promoting sustainable agriculture, harnessing the nutritional and medicinal benefits of soursop fruit, and contributing to economic development in tropical regions.

The study was undertaken to evaluate the effect of top soil/poultry manure mixtures, sowing depth and watering regime on dry matter production of soursop seedlings.

CHAPTER TWO

LITERATURE REVIEW

2.1 Effect of top soil/poultry manure mixture on the dry matter production of seedlings

The potential advantages of potting mixture as an organic fertilizer and soil conditioner have attracted a lot of attention in agricultural research. Potting mixture is a blend of manure and bedding materials. Growers looking to maximize crop yields while guaranteeing sustainable agricultural methods are particularly interested in its impact on the dry matter output of seedlings. In comparison to subsoil, which generated the fewest leaves, stems, and roots and consequently the lowest total dry weight (1.37 g), top soil combined with poultry manure produced the most leaf and stem and root dry weight, resulting in the highest total dry weight (1.99 g) (Mintah et al., 2022).

The amount of organic matter in potting mixtures improves the microbial activity and soil structure, both of which have a direct impact on the dry matter production of seedlings. According to Adeyeye et al. (2013), organic matter increases soil aggregation, which enhances root penetration and water infiltration. This improved soil structure then encourages root growth and nutrient uptake, which leads to increased dry matter buildup in seedlings.

2.2 Effect of sowing depth of seedling dry matter production

In certain crops, the depth at which seeds are placed has a significant impact on seedling establishment and subsequent dry matter production. Sowing depth can affect seedling growth in both direct and indirect ways, according to research conducted over the years.

Sowing depth directly affects seedling emergence, which is frequently a crucial factor in the early accumulation of dry matter. The amount of energy and time needed by seedlings to break through the soil surface depends on how deeply seeds are buried in the soil (Adeyeye et al., 2013). When seeds are placed too deeply, they may have delayed emergence, which slows down the generation of dry matter during the crucial early growth stages and causes slower early growth.

The depth at which seeds are sown can have an impact on root growth, which is closely related to the production of dry matter. According to Proctor et al. (2013), shallow sowing depths typically encourage shallower root systems, which may be favorable in soil with little water availability or in circumstances where quick seedling emergence is essential. On the other hand, deeper seeding may promote deeper root growth, which is favorable in drought-like situations as it enables seedlings to reach moisture from deeper soil layers. The sowing depths that generated the highest root and emergence yields were 26.9 mm and 30.6 mm, respectively. In a greenhouse pot experiment, partitioning of dry matter increased from 23.6 to 26.1% to leaves, from 6.9 to 14.2% to stems, and reduced from 69.5 to 59.7% to roots as seeding depth grew from 10 to 100 mm. According to

Proctor et al. (2013), the ideal sowing depth resulted in a maximum root weight of 119.9 mg.

Because deeper roots may search a broader soil volume for water and nutrients, some crops, such as sorghum, wheat, and barley, frequently benefit from deeper sowing depths (Roy et al., 2003). Conversely, shallow sowing may be advantageous for crops that are shallowly sown, such as soybeans, to ensure quick emergence and robust early development (Roy et al., 2003).

By affecting seed location in relation to soil temperature and moisture gradients, sowing depth can also have an indirect impact on seedling dry matter content. The soil temperature varies depending on the depth of the seed, with deeper seeds experiencing milder temperatures (Dong et al., 2015). This may affect the speed of seed germination and early seedling development, which in turn may affect the generation of dry matter.

2.3 Effect of watering regime on seedling dry matter production

According to Shinkafi and Aduradola (2009), moisture stress reduces overall physiological activities, which in turn affects plant growth and development. According to Isah et al. (2012), a plant cell's physiological functions may be slowed down by receiving more water than it requires.

The time, frequency, and quantity of water delivered to seedlings throughout their watering regime has a significant impact on how much dry matter they produce. It has an

impact on many physiological processes, nutrient uptake, and overall plant growth. It is a crucial component of seedling management in agriculture and forestry.

In order to ascertain the effects of various watering frequencies on the germination and early growth of *Annona muricata* seeds and seedlings, Isah et al. (2012) conducted a study. Three watering schedules were used: once per week, twice per week, and three times per week. Height, collar diameter, and leaf count were used to assess early seedling growth under the three hydration regimes. The irrigation regimens had a big impact on seed germination. Three weekly waterings resulted in the highest germination rate (86.6%), followed by two weekly waterings (58.6%) and one weekly waterings (53.34%). At all growth phases (months 1, 2, 3, and 4), there were also noticeable variations in seedling height, collar diameter, and number of leaves. Three times per week of watering resulted in the highest seedling height at months 2-4, highest collar diameter at months 3-4, and highest number of leaves at months 1-4, while one watering per week resulted in the lowest seedling height, collar diameter, and number of leaves at months 1-4. Through their impact on seed germination and early growth, watering practices have a considerable impact on seedling dry matter output. For seedlings to successfully emerge during the germination phase, there must be enough moisture. During this crucial period, inconsistent or insufficient watering might cause irregular emergence patterns and lower dry matter production overall.

In order to maintain the soil moisture levels required for photosynthesis, which directly contributes to the buildup of dry matter, irrigation frequency and timing are important

considerations. Water stress from insufficient irrigation can lower photosynthetic activity and dry matter production (Chaves et al., 2003). On the other side, excessive watering can result in decreased soil oxygen availability, which can have a detrimental effect on root growth and nutrient uptake, ultimately decreasing the generation of dry matter. The ability of the plant to absorb crucial nutrients is also impacted by the amount of water in the soil. A well-balanced watering program allows the efficient delivery of nutrients to plant tissues, increasing overall development and dry matter accumulation. Conversely, even when nutrients are present in the soil, water stress can affect nutrient uptake and allocation, preventing the synthesis of dry matter.

A study by Ogunrotimi and Kayode (2018) examined the impact of the watering regime on the early growth of *Solanum macrocarpon* seedlings. Seedlings were grown from seeds in germination trays, moved to plastic pots, and watered daily (W1), three times per week (W2), twice per week (W3), and once per week (W4) at 200 ml (full capacity). Leaf area, plant height, stem diameter, leaf count, relative growth rate, and shoot and root weights were among the growth indicators analyzed. The findings of Ogunrotimi and Kayode (2018) revealed that watering schedules had no appreciable impact ($p > 0.05$) on growth indices. The weights of the shoots and roots were highest in seedlings that received daily irrigation. Furthermore, the highest leaf area, stem diameter and number of leaves were obtained in seedlings subjected to watering everyday.

CHAPTER THREE

MATERIALS AND METHOD

3.1. Study area

This experiment was carried out at the screen house of the Department of Crop Science, Faculty of Agriculture, University of Benin, Benin City Nigeria. The site is located at latitude of 5° 37'N and longitude 6° 24'E and altitude of 162 m above sea level. The site is located in the tropical rain forest. It has a bimodal rainfall and annual mean of about 2300 mm.

3.2. Seed collection and preparation

The fruits of *A. muricata* were obtained from Oba market in Benin City. Fruits were de-pulped using hands and seeds collected were sorted and air dried under shades before sowing. Seed viability test was done using the floatation method by soaking seeds in water for three hours. Seeds that sinks was regarded as viable and used for the study while the seeds that floated were discarded.

3.3. Experimental design

This experiment involved three potting media, top soil (TS) + poultry manure (PM) 1:1 (3kg +3kg) TS : PM 1:2 (2kg +4kg) and TS : PM 2:1 (4kg +2kg), three sowing depths (2,4 and 6cm) and three watering regimes (every day, once in three days and once in five

days) laid out in a 3×3×3 factorial arrangements fitted into completing randomized design (CRD) and replicated three times. The top soil and poultry were weighed, mixed and homogenized as a composite and placed in polythene bags for each of the experiment with unit weight of 6kg. The soils were analyzed for physical and chemical properties using standard laboratory procedures describe by Mylavarapu and Kennelly (2002).

3.4. Cultural practice

After filling the polythene bags with the different potting media and randomized , the bags were irrigated with 200 ml of water for a week after when sour sop seeds were sowed Germination began at three weeks after sowing, hand weeding was carried out regularly within and around the polythene bags. The seedlings were watered as per treatment throughout the duration of the experiment.

3.5. Data collection

3.5.1. Dry matter analysis

At 12 and 14 weeks after sowing (WAS) was the dry weight of seedlings where taken. The seedlings were carefully uprooted to avoid damage to the root. The fresh weight was taken using a weighing balance. The root length was taken using a meter rule calibrated in centimeters. The shoots were cut from the root and dried separately in an oven at 70•C to a constant weight to obtain dry weight. Data collected on shoot and root dry weights were used to estimate dry weight, root; shoot dry ratio and crop growth rate.

Dry weight = Dry shoot weight + Dry root weight

$$\text{Root;shoot dry ration} = \frac{\text{Dry root weight}}{\text{Dry shoot weight}}$$

$$\text{Crop growth rate } C^- = I/P \times \frac{(W_2 - W_1)}{t_2 - t_1}$$

3.6. Data analysis

Data obtained for different variables were subjected to analysis of variance (ANOVA) Significant different among treatment means were compared using the least significant difference (LSD) at 0.05 profitability level.

CHAPTER FOUR

RESULTS

4.1: Soil physical and chemical properties prior to cropping with soursop

The soil physical and chemical properties of different mixtures of topsoil (TS) and poultry manure (PM), are presented in table 4.1. The pH of the different points moderately acidic. It was highest in TS+PM 1:2 and lowest in TS+PM 2:1. The TS+PM 1:2 mixture exhibited the highest organic carbon content (31 g/kg), total nitrogen content (1.32 g/kg), and available phosphorus (11.3 mg/kg). Conversely, the TS+PM 2:1 mixture had the lowest values for these parameters. Cation exchange capacity (CEC) varied among the mixtures, with the TS+PM 1:2 mixture having the highest CEC values, particularly for calcium (Ca), magnesium (Mg), and potassium (K) content. The TS+PM 2:1 mixture generally had lower CEC values, while the TS+PM 1:1 mixture fell in between. The soil texture analysis reveals differences in sand, silt, and clay percentages. The TS+PM 1:2 mixture had the highest percentage of sand (70%), while the TS+PM 1:1 mixture had the highest clay content (56%). Bulk density was the lowest in the TS+PM 1:2 mixture (1.16 g/cm³) and highest in the TS+PM 1:1 mixture (1.3 g/cm³). Porosity was highest in the TS+PM 1:1 mixture and lowest in the TS+PM 1:2 mixture.

Table 4.1: Soil physical and chemical properties

Medium	PH	Org. C (g/kg)	Total N (g/kg)	Avail P (mg/kg)	Ca (cmol/kg)	Mg (cmol/kg)	K (cmol/kg)	Na (cmol/kg)	H (cmol/kg)	Al (cmol/kg)	Sand (g/kg)	Silt (g/kg)	Clay (g/kg)	EC (ds/m)	Porosity (%)	Bulk density (g/cm)
Top soil + PM 1:1	5.72	25.6	1.09	9.67	1.14	0.32	0.28	0.18	0.15	0.1	882	62	56	1.5	50	1.3
Top soil + PM 1:2	5.83	31	1.32	11.3	1.26	0.38	0.34	0.21	0.1	0.04	880	70	50	2	48	1.16
Top soil + PM 2:1	5.67	23.8	1.02	9.1	0.96	0.3	0.25	0.16	0.23	0.11	884	60	56	1.5	50	1.2
Mean	5.74	26.8	1.14	10.02	1.12	0.33	0.29	0.18	0.16	0.08	882	64	54	1.67	49.3	1.22
Standard error	0.047	2.163	0.091	0.66	0.087	0.024	0.027	0.014	0.038	0.038	1.16	3.1	2	0.17	0.7	0.042
LSD (0.05)	0.087	4.002	0.168	1.221	0.161	0.044	0.05	0.026	0.07	0.07	2.146	5.7	3.7	0.31	1.2	0.078

1:1 = Top soil (TS) +Poultry manure (PM) (3kg +3kg), 2:1 = TS : PM (2kg +4kg) and 3:1 = TS : PM (4kg +2kg)

4.2: Dry matter production of sour sop seedlings as influenced by potting mixtures, soaking time and watering regime

The dry matter production of sour sop seedlings as influenced by potting mixtures, sowing depth and watering regime is presented in Table 4.2. Root length was highest in TS+PM 1:2 mixture (11.15cm) and lowest in TS+PM 2:1 mixture (10.15cm). Sowing depth has no significant effect on root length. Watering once in 3 days had the highest dry root. Seeds sown in TS+PM 1:2 at 4 cm depth and watered once in five days had the longest dry root 12 WAS while seeds sown in TS+PM 2:1 at 2cm depth and watered every day had the longest dry root (16.33cm).

The TS+PM 1:1 and 1:2 mixture, had higher shoot dry weight than the 2:1 mixture. Seed sown in TS+PM 1:2 had the highest dry shoot weight at 12 and 14 WAS while TS+PM 1:1 had the lowest dry shoot weight at 14 WAS. Plants in TS+PM 1:1 and 2:1 were identical (taller) than those in TS+PM 1:2. Seed sown at 4cm depth had the highest shoot dry weight at 12 WAS, while seeds sown at 2cm depth had the lowest shoot dry weight at 12 WAS. Seeds sown at 2 and 4cm depth had the highest shoot dry weight at 14 WAS respectively. Seedling watered every day and once in three days had the highest shoot dry weight at 12 – 14 WAS, respectively. Seed sown in TS+PM 1:1 at sowing depth of 4cm and water once in 3 days had the highest shoot dry weight at 12 WAS. At 14 WAS, seeds sown in TS+PM 1:2 at 4cm depth and watered once in everyday had the highest shoot dry weight (1.49g). Root dry weight was similar among potting mixture at 12 WAS. At 14 WAS, seedlings in TS+PM 1:1 and 1:2 had identical root dry weight values but lower

than that of seedlings in TS+PM 2:1. Seedlings watered every day and once in 5 days were identical and lower than those in TS+PM 1:2 medium. At 14 WAS, seedling watered every day and once in 3 days had comparable root dry weight values but higher than those watered every 5 days. Seedlings in TS+PM 1:1 medium, sown at 4cm depth and watered once in 3 days had the heaviest root dry weight at 12 WAS. At 14 WAS, seedlings in TS+PM 2:1 medium had the heaviest dry weight.

Table 4.2: Dry matter production of sour sop seedlings as influenced by potting mixtures, soaking time and watering regime

Treatment	Root length (cm)		Shoot dry weight (g)		Root dry weight (g)		Dry weight (g)		Root shoot ratio		Crop growth rate (gm ⁻² day ⁻¹)
	Weeks after sowing		weeks after sowing		weeks after sowing		weeks after weeding				
	12	14	12	14	12	14	12	14	12	14	
Top soil/poultry manure potting mixture											
1:1	11.03a	0.75b	0.30b	0.55c	0.06a	0.09b	0.37b	0.64c	0.27a	0.24a	0.02b
1:2	11.15a	12.38a	0.40a	0.85a	0.06a	0.09b	0.46a	0.94a	0.18b	0.14b	0.04a
2:1	10.15b	12.94a	0.30b	0.24b	0.05a	0.13a	0.39b	0.87b	0.18b	0.23a	0.03ab
LSD (0.05)	0.893	0.918	0.024	0.067	ns	0.02	0.029	0.07	0.054	0.006	0.013
Sowing depth (cm)											
2	10.66	12.59a	0.30c	0.84a	0.06a	0.13a	0.36c	0.97a	0.24a	0.21ab	0.04a
4	10.86	11.57a	0.40a	0.68b	0.06a	0.09b	0.46a	0.77b	0.22ab	0.25a	0.02b
6	10.81	11.92a	0.34b	0.63b	0.05a	0.09b	0.40b	0.73b	0.17b	0.16b	0.03ab
LSD (0.05)	Ns	Ns	0.024	0.067	ns	0.02	0.029	0.07	0.054	0.066	0.013
Watering regime											
Every day	10.37	12.54a	0.42a	0.77b	0.05b	0.11a	0.48a	0.87b	0.15c	0.20ab	0.04a
Once in 3 days	11.31	12.15a	0.33b	0.90a	0.07a	0.13a	0.40b	1.03	0.25a	0.17b	0.03ab
Once in 5 days	10.65	11.37b	0.29c	0.63c	0.05b	0.08b	0.34c	0.56	0.23b	0.25a	0.02b
LSD (0.05)			0.024	0.067	0.015	0.02	0.029	0.07	0.054	0.066	0.013
Interaction											
P x S	Ns	*	*	*	ns	*	*	*	ns	Ns	ns
P x W	*	*	*	*	*	*	*	*	*	Ns	ns
S x W	Ns	*	*	*	ns	*	*	*	ns	Ns	ns
P x S x W	*	*	*	*	*	*	*	*	*	Ns	*

Note: means with different alphabet are significant. 1:1 = Top soil (TS) + Poultry manure (PM) (3kg +3kg), 2:1 = TS : PM (2kg +4kg) and 3:1 = TS : PM (4kg +2kg)

4.3: Interactive effect of potting mixture, soaking time and watering regime on the dry matter production of soursop seedlings

The interactive effect of potting mixture, soaking time and watering regime on the dry matter production of soursop seedlings is presented in table 4.3. Dry weight observed in TS+PM 1:1 and 2:1 were identical which were lighter than the dry weight of seedlings in TS+PM 1:2 medium at 12 WAS. At 14 WAS, seedlings in TS+PM 1:1 had the lowest dry weight while those in TS+PM 1:2 medium had the highest dry weight.

Seed sown at 2cm sowing depth, produced seedlings with the lowest dry weight while those sown at 4cm sowing depth had the highest dry weight at 12 WAS. At 14 WAS, seed sown at 4 and 6cm sowing depth produced seedlings that had identical dry weight but lighter than those produced by seeds sown at 2cm sowing depth. Seedlings watered once in 5 days had the lowest dry weight at 12 and 14 WAS. Seedlings watered every day and once in 3 days, had the highest dry weight at 12 and 14 WAS respectively. The highest dry weight (0.91g) at 12 WAS was observed in TS+PM 1:1 medium sown at 4cm and watered once in 3 days. At 14 WAS, seedlings in TS+PM 2:1, sown at 6cm depth and watered every day had the heaviest dry weight (1.38g).

Seedlings in TS+PM 1:2 and 2:1 produced identical root shoot ratio which were smaller than those produced by seedlings in TS+PM 1:1 at 12 WAS. At 14 WAS seedlings in TS+PM 1:1 and 2:1 had identical root:shoot ratio which were higher than those produced by seedlings in TS+PM 1:2 medium. Seedlings risen from 2 and 4cm sowing depth

produced the highest root shoot ratio at 12 and 14cm WAS, respectively. Seedlings watered once in five day and every day had the highest root:shoot ratio at 12 and 14 WAS. The highest root:shoot ratio was observed in TS+PM 1:1 medium sown at 2cm sowing depth and watered once in 3 days at 12 WAS.

Seedlings in TS+PM 1:2 medium produced crop growth rate which is significantly only higher than those in TS+PM 1:1 medium. Seedlings risen from seeds sown at 2cm sowing depth was only significantly ($p < 0.05$) higher than those sown at 4cm sowing depth. Seedlings watered everyday is only higher than those watered every 5 days. The highest crop growth rate ($0.07 \text{ gm}^{-2}\text{day}^{-1}$) was observed in TS+PM 1:2 sown at 2cm sowing depth and water once in 5 days and those sown at 4cm sowing depth and watered every day.

Table 4.3: Interactive effect of potting mixture, soaking time and watering regime on the dry matter production of soursop seedlings

Top soil/poultry manure potting mixture	Sowing depth (cm)	Watering regime	Root length (cm)		Shoot dry weight (g)		Root dry weight (g)		Dry weight (g)		Root shoot ratio	Crop growth rate ($\text{gm}^{-2} \text{day}^{-1}$)
			Weeks after sowing	Weeks after sowing	Weeks after sowing	Weeks after sowing	Weeks after weeding	Weeks after weeding				
TS+PM 1:1	2	1	12	14	12	14	12	14	12	14	12	0.06
		2	10.13	8.67	0.5	0.74	0.06	0.08	0.56	0.82	0.12	0.06
		3	12.33	11.33	0.18	1.06	0.11	0.14	0.29	1.2	0.6	0.03
	4	1	10.6	10.23	0.14	0.32	0.03	0.08	0.17	0.41	0.21	0.01
		2	8.4	9.77	0.15	0.24	0.03	0.09	0.18	0.33	0.18	0.02
		3	12.97	10.17	0.79	0.84	0.12	0.07	0.91	0.93	0.15	0.01
	6	1	12.17	12	0.12	0.19	0.07	0.1	0.2	0.3	0.59	0.01
		2	8.67	15.07	0.35	0.4	0.03	0.14	0.38	0.48	0.09	0.01
		3	12.57	9.1	0.20	0.6	0.07	0.05	0.27	0.64	0.31	0.02
TS+PM 1:2	2	1	11.47	10.43	0.29	0.57	0.05	0.06	0.34	0.63	0.16	0.04
		2	9.63	12.3	0.22	0.94	0.05	0.1	0.28	1.03	0.25	0.02
		3	11.67	14.2	0.34	0.27	0.07	0.11	0.4	0.38	0.2	0.03
	4	1	11.70	13.8	0.28	0.9	0.07	0.1	0.35	1.01	0.25	0.07
		2	12.87	12.23	0.62	1.49	0.08	0.12	0.7	1.61	0.13	0.07
		3	8.73	10.27	0.14	1.08	0.03	0.08	0.17	1.15	0.22	0.03
	6	1	13.63	10.93	0.94	1.18	0.11	0.08	1.05	1.26	0.12	0.01
		2	12.87	12.57	0.57	0.34	0.10	0.06	0.67	0.41	0.18	0.05
		3	10.17	12.97	0.2	1.08	0.04	0.11	0.25	1.18	0.21	0.03
TS+PM 2:1	2	1	9.10	12.17	0.25	0.46	0.02	0.06	0.27	0.46	0.08	0.06
		2	9.40	16.33	0.36	1.4	0.05	0.15	0.41	1.55	0.14	0.1
		3	10.13	16.07	0.49	1.75	0.04	0.36	0.53	2.11	0.09	0.04
			10.37	10.33	0.17	0.16	0.05	0.07	0.21	0.24	0.3	0.01

4	1	9.10	12.5	0.29	0.22	0.05	0.06	0.34	0.28	0.16	0.02
	2	11.47	14.1	0.30	0.68	0.07	0.14	0.37	0.81	0.24	0.02
	3	8.43	12.13	0.23	0.19	0.04	0.07	0.27	0.26	0.16	0.01
6	1	12.23	13.47	0.71	1.16	0.07	0.17	0.78	1.33	0.1	0.03
	2	11.80	11.2	0.30	0.71	0.07	0.1	0.37	0.81	0.25	0.02
	3	8.40	10.33	0.20	0.39	0.04	0.06	0.23	0.45	0.16	0.01
LSD (0.05)		1.547	2.755	0.071	0.16	0.044	0.06	0.087	0.21	0.161	0.038

Note: means with different alphabet are significant. 1:1 = Top soil (TS) +Poultry manure (PM) (3kg +3kg), 1:2 = TS : PM (2kg +4kg) and 2:1 = TS : PM (4kg +2kg)

4.4: Properties of top soil/ poultry manure mixtures after cropping with soursop seedlings

The soil physical and chemical properties of different mixtures of topsoil (TS) and poultry manure (PM) after cropping with soursop seedlings is presented in Table 4.4. The pH across the potting media were in the moderately acidic in TS+PM 1:1 and 1:2 but strongly acidic in TS+PM 2:1 with the highest pH observed in the TS+PM 1:2 mixture (pH 5.64) and the lowest in the TS+PM 2:1 mixture (pH 5.33). In terms of nutrient content, TS+PM 1:2 had the highest total nitrogen (1.12 g/kg) and organic carbon (27.5 g/kg) content, as well as the highest available phosphorus (8.91 mg/kg). This mixture also exhibited a higher cation exchange capacity (CEC), with values of 0.3 K cmol/kg and 1 Ca cmol/kg. Exchangeable magnesium content was similar among the potting mixtures, averaging around 0.25-0.32 cmol/kg. However, exchangeable calcium content in TS+PM 1:2 was comparable to that of TS+PM 1:1, both around 0.95 cmol/kg, while TS+PM 2:1 had slightly lower exchangeable calcium (0.84 cmol/kg).

Regarding soil texture, TS+PM 1:1 had the highest percentage of clay (62%) and silt (60%), whereas TS+PM 1:2 had the highest percentage of sand (65%). The lowest bulk density was observed in TS+PM 1:2 (1.4 g/cm³), while the highest bulk density was found in TS+PM 1:1 (1.35 g/cm³). Porosity was highest in TS+PM 1:1 and TS+PM 1:2 but lowest in TS+PM 2:1. Electrical conductivity (EC) of both TS+PM 1:1 and TS+PM 1:2 was comparable but lower than that of TS+PM 2:1.

Table 4.4: Properties of top soil/ poultry manure mixtures after cropping with soursop seedlings

Potting media	PH	T.N (g/kg)	T.O.C (g/kg)	AV.P (mg/kg)	K cmol/kg	Ca cmol/kg	Mg cmol/kg	Na cmol.kg	H+ cmol/kg	Al+ cmol/kg	Sand (g/kg)	Silt (g/kg)	Clay (g/kg)	Bulk density (g/cm)	Porosity (%)	EC (dsm-1)
TS+PM 1:1	5.56	0.88	22	7.83	0.25	0.95	0.28	0.16	0.21	0.12	878	60	62	1.35	50	0.42
TS+PM 1:2	5.64	1.12	27.5	8.91	0.3	1	0.32	0.18	0.15	0.08	880	65	55	1.4	45	0.45
TS+PM 2:1	5.33	0.85	20.3	8	0.2	0.84	0.25	0.15	0.26	0.12	886	56	58	1.3	48	0.4
SEM	0.185	0.085	2.173	0.335	0.029	0.047	0.02	0.009	0.032	0.013	2.4	2.6	2	0.029	1.4	0.015
LSD (0.05)	0.342	0.157	4.02	0.62	0.054	0.087	0.037	0.017	0.059	0.024	4.4	4.9	3.8	0.054	2.7	0.028

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Discussion

The current study shows that the TS+PM 1:2 mixture exhibited the highest organic carbon, nitrogen, and phosphorus content, making it the most enriched with nutrients. The higher CEC values in this mixture also indicate enhanced nutrient retention. However, the TS+PM 2:1 mixture consistently has lower values, suggesting that it may not be as effective for soil enrichment. The variations in soil texture and bulk density between mixtures remain consistent with Agrawal, (1991). The TS+PM 1:2 mixture promote better growth in terms of root length, shoot and root dry weight, and overall dry weight. The watering regime "Every day" still appears to be the most favorable for growth, although "Once in 3 days" also shows promise. These findings reinforce the importance of potting mixture composition and watering frequency for soursop seedling growth, consistent with (Pal 1991). Modupeola *et al.*, (2011) results of the study showed that poultry manure at 30t ha⁻¹ enhanced better growth and dry matter yield characteristics. Application of the poultry manure on top soil produced taller plants, more profuse leaves ad branches and higher shoot dry matter yield compared to either the inorganic N source (Urea) or the control treatment (Adeyeye *et al.*, 2013). The interactive effects of potting mixtures, sowing depth, and watering regime on soursop seedling growth remain consistent with past results, with the TS+PM 1:2 mixture consistently

performing the best. Variations in sowing depth and watering regime still influence growth, but the superiority of the TS+PM 1:2 mixture remains unchanged. The TS+PM 1:2 mixture retains its advantage in terms of pH, nutrient content, and CEC. Bulk density and porosity continue to reflect the properties of each mixture. Overall, the TS+PM 1:2 mixture and watering influence soil properties after cropping is consistent with Shinkafi and Aduradola, (2009) findings. Moisture stress causes reduction in general physiological activities and thus growth and development of plants (Shinkafi and Aduradola, 2009). Isah *et al.* (2012) also stated that too much water in excess of plants need may retard physiological processes in plant cell. The watering regime, which includes the timing, frequency, and amount of water applied to seedlings, plays a crucial role in influencing their dry matter production. It is a fundamental aspect of seedling management in agriculture and forestry, impacting various physiological processes, nutrient uptake, and overall plant growth. Isah *et al.* (2012) also showed the impact of different watering frequencies on germination and early growth of *Annona muricata* seeds and seedlings respectively

5.2 Conclusion

The result showed that, the treatment with the highest means across various factors was the TS+PM 1:2 mixture. This mixture indicated favorable soil physical and chemical properties, including moderately acidic pH, high organic carbon content (31 g/kg), total

nitrogen content (1.32 g/kg), and available phosphorus (11.3 mg/kg). It also had the highest cation exchange capacity (CEC) for calcium (Ca), magnesium (Mg), and potassium (K). Additionally, the TS+PM 1:2 mixture had the highest percentage of sand (70%) and the lowest bulk density (1.16 g/cm³). The matter production of soursop seedlings, TS+PM 1:2 mixture resulted in the highest root length, shoot dry weight, root dry weight, and overall dry weight. It also indicated the highest crop growth rate. The result also showed that the different sowing depths and watering regimes, TS+PM 1:2 mixture consistently outperformed the other mixtures in terms of dry matter production. After cropping with soursop seedlings, this mixture maintained favorable soil properties, including pH, nutrient content, and soil texture.

5.3 Recommendation

Based on the study's findings, it is recommended to use the TS+PM 1:2 mixture for soursop seedling cultivation, as it consistently demonstrated the highest dry matter production and improved soil properties. Additionally, implementing an "Every day" watering regime can further enhance seedling growth. Continuous monitoring of soil pH and nutrient levels is advised to maintain optimal conditions for soursop cultivation.

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