EFFECT OF SOWING DEPTH AND SOAKING ON THE GROWTH OF CASTOR OIL PLANT (*Ricinus communis* L.)

Paul Osazee GUOBADIA
AGR1600319

DEPARTMENT OF CROP SCIENCE,
FACULTY OF AGRICULTURE,
UNIVERSITY OF BENIN,
BENIN CITY.

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CERTIFICATION

This is to certify that this research was carried out by Paul Osazee GUOBADIA (AGR1600319) of the Department of Crop Science, Faculty of Agriculture, University of Benin, Benin City.

PROF. A. U. OSIAGBOVO
Project Supervisor

Date

PROF. K. E. LAW-OGBOMO
(Co – Supervisor)

Date

PROF. K. E. LAW-OGBOMO
(Head of Department)

Date

DEDICATION

My research work is heartily dedicated to God Almighty, my family (Guobadia) for their drive, motivation and support throughout my course of study.

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TABLE OF CONTENTS

CHAPTER FIVE

LIST OF TABLES

ABSTRACT

The study was carried out to evaluate the effect of sowing depth and soaking on the growth of castor oil plant (Ricinus communis L.). The experiment was conducted between 10th of March to 17th of may, 2022 at the Department of Crop Science's Experimental Farm Screen House, Faculty of Agriculture, University of Benin, Benin City. The Treatments involved three potting media (Top soil + Poultry manure 1:1, TS + PM 2:1, TS + PM 1:2), three sowing depths (2,4,6 cm) and three soaking time (0, 12 and 24 hr) laid out in a 3 x 3 x 3 factorial arrangement fitted into complete randomized design (CRD) with three replications. The data were collected on plant height, stem girth, numbers of leaves and total area of leaves. Results obtained showed that the physical and chemical properties of the potting media varies. From the results obtained, the depth of sowing, soaking time and media used all had effect on the plant growth parameters as plant highest was recorded at (2.37cm) when TS + PM 2:1 was used with a soaking time of 12 hours and a sowing depth of 2cm

CHAPTER ONE

1.0 INTRODUCTION

Castor (*Ricinus communis* L.) is a member of the Euphorbiaceae family that is found throughout the tropics and sub tropics (Weiss 2000). Castor originated in East Africa probably Ethiopia where it shows tremendous genetic variability. In Nigeria, the size of castor plant varies from small tree perennials mostly in the highlands to small annuals. Castor shows different growth and branching habits such as erect and top branching as well as bushy and lower branching types. Mostly erect and top branching types with large raceme are preferred for cultivation due to their ease in field management. Castor bears oil in its seed that is entirely used for industrial purposes such as in pharmaceutical, paint, ink, cosmetics, polymer industries (Severino *et al.,* 2012). The seeds yield of castor oil plant can be maximized by using appropriate variety combined with optimum plant population, fertilizer, quality seed, weeding practices, optimum plant population and sowing depth, optimum soaking length and type of potting media used. Optimum planting depth can significantly increase seed yield however it can be affected by the growth habit of the variety to be planted.

Farmers usually cultivate castor oil plant intercropped with major food crops like yam, maize and cassava (Ayodele, 2003). While planting castor oil seeds, farmers usually open up the soil and throw in couple of seeds and cover up the soil without using a specific depth. The potential of the resulting seedlings may not be fully realized since a shallow depth of sowing may lead to lodging of the seedlings during a light rainstorm later in its life cycle and an excessively deep sowing may result in non-emergence of the seedling. Depth of sowing has been shown to have a varied effect on the performance of crops (Abrecht, 2009; Fehr, 2003; Gupta, 2009; Tayo, 2003)

Depending on soil type, depth of sowing may determine days to emergence, plant vigour and eventual yield of crops. Tayo (2003) reported that deeply sowed pea delayed emergence, which adversely affected plant vigour and led to reduced yield.

The length of seed soaking affects the growth of castor plant. Seeds emergence is sometimes a problem in castor oil plant even with the seeds of high germinability due to thick seed coat. To overcome this problem, pre-sowing soaking treatments or priming of seeds can be practiced. Pre-soaking seeds proved superior in emergence from the soil and in stand establishment. Pre – soaking treatment enhance lower seed and improved germination and emergent rates. With pre- soaking technique dead seeds are easily detected before sowing and discarded. Recent studies on a series of crop species demonstrate speedy germination, early emergence, and vigorous seedlings accomplished by seed soaking in water for a while, followed by surface drying prior to sowing led to higher crop yield (Harris *et al.,* 2000).

Although, studies on the relationship between seed size and early growth have been reported by various authors (Willenborg *et al*., 2005; Gupta, 2009; Alessi, 2003). Umeoka and Ogbonnaya, (2016) noted that the effects of sowing depth and seed size on plant growth and development at various stages; however, the effect of sowing depths and soaking on growth of Castor oil plant in particular, has not been documented. Given the need to optimize sowing depth in castor oil plant and the desirability to have lodging resistant plants vis-à-vis optimum planting depth which will also place the root at a vantage position to tap soil nutrients and absorb water, it is imperative to evaluate the optimum sowing depth and soaking length for growth of castor oil plant.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Sowing depth as it affects germination of seed

Sowing depth is an important factor in both nursery and plantation establishment depending on the type and size of seed sown (Adeogun and Usman, 2012). Depending on the plant species, some seeds need a deep sowing depth for roots to grow deeply for firm anchorage while other plant seeds need to lay on top of the soil without any coverage for germination. Depth of sowing has been shown to have a varied effect on the performance of crops (Tayo, 2003, Fehr, 2003; Abrecht, 2009; Gupta, 2009). Depending on soil type, depth of sowing may determine days to emergence, plant vigour and eventual yield of crops. Tayo (2003) reported that deeply sowed pigeon pea delayed emergence, adversely affected plant vigour and led to reduced yield. Similarly, Alessi and Power (2011) reported that one additional day was required for maize emergence for each 2.5 cm increase in depth of sowing. Fehr *et al.* (2003) found that sowing depth had a major influence on percentage emergence of maize. Average emergence was 73% from 5 cm and 44% from 10 cm. Emergence as low as 13% was observed with the 10 cm depth. Abrecht (2009) reported that deep sowing slowed emergence but increased seedling growth in maize and soybean.

2.2 Seed soaking

Seed emergence is always a problem in seed with hard seed coat even with the seeds of high germinability. To overcome this problem, pre-sowing treatments soaking or priming of seeds can be practiced. Pre-germinated seeds proved superior in emergence from the soil and in stand establishment. Recent studies on a series of crop species demonstrated speedy germination, early emergence, and vigorous seedlings accomplished by seed soaking in water for a while, followed by surface drying prior to sowing, which may lead to higher crop yield (Harris *et al.,* 2000). This practice of soaking is expressed that on-farm seed priming is a simple, inexpensive, and less risk process of improving faster seedling establishment and vigorous early crop growth.

Each crop cultivar requires a critical soaking duration and it should be less than the safe limit (Harris *et al*., 2000). Pre-sowing seed treatments resulted in higher germination and earlier seedling emergence, strong growth, early flowering, maturity and high yields. Speedily germinating seedlings also produce deep root system and improved seedling establishment in many crops. Seed soaking is a useful to bitter gourd growers under sub-optimal temperature condition for definite successful seedling establishment (Wang *et al*., 2002 and Lin and Sung, 2001).

The establishment of a good and uniform stand, which is the base of the success of germination and emergence of seeds, is one of the most important management practices in crop production, especially where once-over harvesting is performed. This can be enhanced by pre-germination seed treatments such as soaking seed. Fast germination and emergence of healthy seedlings is an essential step for the successful establishment of plants, while water deficit during the germination stage leads to a decrease or complete inhibition of seed germination and seedling establishment (Siddique and Kumar, 2018). Under drought conditions, the performance of seed germination, and healthy seedling establishment discouraged due to the decrease of water potential, which leads to a decline in water uptake by plants (Farooq *et al.,* 2009). Issam *et al*. (2012) indicated that seed soaking can increase antioxidant activities as well as decrease lipid peroxidation in the course of seed germination. Soaking effects are associated with a wide range of metabolic events (Shehab *et al*., 2010). Unequal or poor germination and subsequently uneven seedling growth can cause great financial losses by decreasing crop yield, though seed soaking can multiply speed and uniformity of germination (Mamun *et al.,* 2018).

Pearce (2007) noticed that seed soaking in water has enormous effect in the acceleration of germination. It was found that seeds of pea had a great benefit from seed soaking in the acceleration of seedling growth. Furthermore, soaking pea seed with distilled water improved the final germination, and reduced the mean germination time and the frequency of chromosomal aberrations (Sivritepe and Dourado, 2005). The improvements in seed yield, number of leaves per plant and leaf area were also observed in seed soaking study with rainfed upland cotton *Gossypium hirsutum* (Shanmugham, 2002). Although it appears, therefore, that certain pre-germination treatments applied to seeds of certain species may result in beneficial effects, It is equally clear that the response to a treatment may vary not only between species but also between seed lots within a species (Pearce, 2007).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Experimental Site

The experiment was conducted at the Department of Crop Science's Experimental Farm Screen House, Faculty of Agriculture, University of Benin, Benin City. The screen house is located at latitude 5°37' North and longitude 6°24' East and an altitude of 162m above sea level. The site is located at tropical lowland rainforest. It has a bimodal rainfall and annual mean of 2300mm, with a temperature of 25.10°C. It lies within the rainforest region.

3.2 Materials

Castor oil seeds were obtained from a 305 farms of the Faculty of Agriculture, University of Benin, Benin city. The top soil was obtained from Ekosodin while the poultry manures was obtained from University of Benin's Farm Project. Poly pots was obtained from Ring Road Market. Poultry manure was cured for eight weeks under shade before usage.

3.3 Experimental Design

The Study involved three potting media (TS + PM 1:1 (3kg of top soil and 3kg of poultry manure), TS + PM (2:1) (6kg of topsoil and 3kg of poultry manure) TS + PM (1:2) (3kg of top soil, 6kg of poultry manure). Three sowing depths (2, 4, 6cm) and three soaking time (0, 12 and 24hr) laid out in a 3 x 3 x 3 factorial arrangement fitted into complete randomized design (CRD) with three replications.

3.4 General procedure

The Top soil was air dried, the poultry manure was also cured by drying under shade. Using a weighing scale, the appropriate amount of top soil and media was measured and mixed thoroughly, before transferring it to the poly pots. Holes were created round the poly pots for aeration. The castor oil seeds was soaked in lukewarm water for 12 and 24 hours and was mixed with sand for easy sowing. The seeds germinated between 15 - 21 days. The plants were watered daily (with 100ml of water) during the early hours of the day or late evenings, the necessary cultural practices was carried out in the screen house.

3.5 Data collection

Polypots were filled and arranged in blocks and data was collected randomly from each plant using conventional growth indices which include plant height, stem girth, number of leaves, leaf length and leaf width at 2, 4, 6 and 8 weeks respectively after sowing. Heights of sampled plants were measured from the base of the plants to the apical meristem of the randomly selected plants with a meter rule calibrated in cm and average computed. The average measurement of the stem girth was done with a measuring tape calibrated in cm and also with a venier caliper 5cm above the base of each sampled plants were taken. The fully extended leaves were counted and recorded. Leaf length was measured from the petiole to the tip of the leaf using a meter rule calibrated in cm and also the leaf width was also measured from one end of the leaf to the other using a meter rule.

3.6 Data analysis

Data collected were subjected to analysis of variance with Genestat statistical programme version 12 and significant differences among treatment were compared using Least significant differences (LSD) at 5% level of significance.

CHAPTER FOUR

RESULTS

4.1 Physical and chemical properties of the top soil-poultry manure mixture

In table 1 shows the physical and chemical properties of the top soil – poultry manure mixture before cropping, the sand content was highest in TS + PM 2:1 while it was lowest in TS + PM 1:2. The silt content ranged from 77 – 83. TS + PM 1:2 was the most silty while the least silty was recorded in TS + PM 2:1. The clay content ranged from 45 – 70. For TS + PM 2:1 and TS + PM 1:2 respectively. The highest bulk density was recorded in TS + PM 2:1 while the lowest bulk density was recorded in TS + PM 1:1. TS + PM 1:1 was the most porous while TS TS + PM 1:2 was the least porous. The EC ranged from 1.93 and 2.30 for TS + PM (1:1) and TS + PM (2:1), respectively. The soil pH ranges from 6.70 – 6.95. The pH was highest in TS + PM (1:2). However, all pHs felled within slightly acidic. The Organic carbon was most abundant in the range from 18.40 – 30.00g kg^{-1}. The Organic carbon was highest at TS + PM (1:2) and TS + PM (2:1) had the least Organic carbon content. The highest total Nitrogen was recorded in TS + PM 1:2 which ranged from 0.85 gkg^{-1} – 1.29 gkg^{-1}. While the lowest total nitrogen was in TS + PM (2:1). However, the total N content of the potting mixtures were low. This trend was repeated for exchangeable Ca and K all low.

Exchangeable Mg was mos abundant in TS + PM 2:1 but only higher than in TS + PM 1:1. TS + PM 1:2 and TS + PM 2:1 had similar echangeable Na which was only higher than that in TS + PM 1:1.

Table 1: Physical and Chemical Properties of the Top Soil-Poultry Manure Mixture

Potting medium	Sand (g kg^{-1})	Silt (g kg^{-1})	Clay (g kg^{-1})	Bulk density (g cm^3)	Prosity (%)	EC (ds cm^{-3})	pH	Org. C (g kg^{-1})	Total N (g kg^{-1})	Avail P (mg kg^{-1})	Exchangeable cation (cmo1 kg^{-1})			
											Ca	Mg	K	Na
TS+PM 1:1	860	78	62	1.10	65	1.93	6.70	20.60	0.89	15.10	1.18	0.40	0.36	0.23
TS+PM 1:2	847	83	70	1.20	62	2.10	6.95	30.00	1.29	21.20	1.26	0.43	0.41	0.25
TS+PM 2:1	878	77	45	1.30	63	2.30	6.89	18.40	0.85	12.50	1.31	0.44	0.38	0.25
LSD $_{(0.05)}$	16.4	3.4	13.4	0.10	1.6	0.195	0.137	6.474	0.255	4.692	0.069	0.022	0.0226	0.012

4.2 Growth of castor seedling plant.

4.2.1 Plant height and stem girth

The effect of potting medium source, sowing depth and soaking time on plant height and stem girth is presented in Table 2. At 2 weeks after sowing (WAS), plant height was highest in TS + PM (1:2) while plant height was lowest in TS + PM (2:1). This trend was repeated in at 4 and 8 WAS. However, plants in TS + PM 1:2 recorded the shortest height while plant in TS + PM 2:1 had the tallest height.

Sowing depth had significant effect on the plant height of castor seedlings throughout the sampling periods. At 2 WAS, the highest plant height was observed on seeds sown at 4cm while the lowest plant highest was observed on seeds were sown at 6cm. This distribution trend was repeated at 4-8 WAS. Plant seeds soaked for 12 hours produced plants which had the tallest height throughout the sampling period.

Plants in TS + PM 2:1 produced plants which had the least thickest, while plants in TS + PM 1:2 had the thinnest stems at 2-8 WAS. Seeds sown at 4cm depth produced plants with the thickest stem at 2-8 WAS. The thickest stems was recorded on plants produced from seed soaked for 12 hours. Potting mixtures, sowing depth and soaking time interaction was significant for plant heigh and stem girth. The tallest and thickest plants were recorded on plants produced from seeds soaked for 12 hours and sown in TS + PM 2:1 at a sowing depth of 4cm (Table 3).

TABLE 2: Height and stem girth of castor plant as influenced by sowing depth, soaking and potting media

Treatment	Plant height (cm) Weeks after sowing				Stem girth (cm) Weeks after sowing			
	2	4	6	8	2	4	6	8
Plotting medium								
TS+PM 1:1	11.43	21.61	40.27	40.27	0.71	1.46	2.55	3.00
TS+PM 2:1	8.91	18.03	50.54	50.54	0.80	2.13	3.32	4.36
TS+PM 1:2	12.56	33.17	35.10	63.20	0.57	1.15	1.54	3.58
LSD (0.05)	2.197	3.498	4.837	6.900	0.135	0.229	0.256	0.334
Sowing depth (cm)								
2	10.16	22.64	40.21	52.80	0.63	1.53	2.23	2.76
4	12.93	28.33	50.54	68.00	0.82	1.84	2.99	3.58
6	9.80	21.84	39.55	55.00	0.63	1.38	2.20	2.91
LSD (0.05)	2.197	3.498	4.837	6.900	0.135	0.229	0.256	0.334
Soaking time (hr)								
0	0.00	15.64	31.57	42.20	0.00	1.03	1.85	2.32
12	18.22	29.56	51.14	71.70	1.56	1.90	2.94	3.71
24	14.68	27.61	47.58	61.90	0.92	1.82	2.62	3.22
LSD (0.05)	2.197	3.498	4.837	6.900	0.135	0.229	0.256	0.334
Interaction								
PMxSD	3.805	6.059	8.377	11.950	0.234	0.397	0.443	0.578
PMXST	3.805	6.059	8.377	11.950	0.234	0.397	0.443	0.578
SDxST	3.805	6.059	8.377	11.950	0.234	0.397	0.443	0.578
PM x SD xST	6.591	10.495	14.510	20.700	0.405	0.688	0.768	1.002

Table 3: Interaction of the potting medium, sowing depth and soaking time on the height and stem girth of castor plant.

Potting medium	Sowing depth (cm)	Soaking time (hr)	Plant height (cm) Weeks after sowing				Stem girth (cm) Weeks after sowing			
			2	4	6	8	2	4	6	8
TS+PM 1:1	2	0	0.00	19.07	32.27	40.50	0.00	1.27	2.20	2.67
		12	21.28	29.40	55.33	69.00	1.30	1.93	3.17	3.70
		24	22.67	30.53	53.93	67.50	1.40	2.17	3.03	3.53
	4	0	0.00	23.17	39.67	58.80	0.00	1.60	2.50	3.30
		12	14.83	20.17	33.47	63.90	0.87	1.27	3.63	3.50
		24	20.33	30.13	51.50	62.20	1.23	2.17	3.00	3.33
	6	0	0.00	7.33	35.67	47.80	0.00	0.53	2.20	2.87
		12	23.77	34.70	60.57	79.70	1.57	2.23	3.20	4.13
		24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TS+PM 2:1	2	0	0.00	26.97	57.33	77.90	0.00	1.87	3.03	3.83
		12	23.17	40.00	68.37	96.60	1.47	2.67	3.50	4.83
		24	24.37	43.50	77.67	100.80	1.47	2.90	4.07	4.87
	4	0	0.00	26.00	59.87	77.20	0.00	1.63	3.07	3.90
		12	23.13	39.50	82.93	107.20	1.37	2.50	4.20	5.37
		24	21.83	37.37	73.80	102.10	1.47	2.30	3.73	5.17
	6	0	0.00	24.33	38.33	50.20	0.00	1.50	2.33	2.77
		12	21.52	33.33	53.83	88.80	1.43	2.10	2.90	4.53
		24	0.00	27.53	56.66	76.60	0.00	1.50	2.33	2.77
TS+PM 1:2	2	0	0.00	0.00	0.00	0.00	0.00	2.10	2.90	4.53
		12	0.00	0.00	0.00	0.00	0.00	1.70	3.07	3.97
		24	0.00	0.00	17.00	23.20	0.00	0.00	0.00	0.00
	4	0	0.00	13.93	21.03	27.20	0.00	0.00	0.00	0.00
		12	15.60	34.40	50.57	63.70	1.07	2.20	2.90	3.33
		24	21.67	30.30	42.00	50.00	1.37	2.00	2.57	2.80
	6	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		12	21.67	34.50	55.17	76.70	1.33	2.17	3.00	3.97
		24	21.27	34.83	55.70	7.80	1.33	2.20	3.07	3.93
$LSD_{(0.05)}$			6.591	10.495	14.510	20.700	0.405	0.688	0.768	1.002

4.4.1 Number of leaves and leaf area.

The effect of potting medium source, sowing depth and soaking time on number of leaves and leaf area presented in table 4. Potting media, sowing depth and soaking time had significant effect on number of leaves. Seeds sown in TS + PM 2:1 had the highest number of leaves at 2-8WAS. Seeds sown at 4cm depth produced plants with the most number of leaves while plants produced from seeds sown at 2cm depth had fewest number of leaves at 2-8 WAS. Seeds soaked at 0-12 hours produced plants with the lowest and highest number of leaves, respectively. Seeds soaked for 24 hours and sown at 2cm depth in TS + PM 2:1 had the most number of leaves at 8 WAS (Table 5). Plants produced from TS + PM 1:2 recorded the least leaf area except at 2-4 WAS. Plants produced sown in TS + PM 2:1 had the highest leaf area except at 6 WAS. Seeds sown at 4cm depth had the highest leaf area while unsoaked seeds produced plants with the small leaf area. Seeds soaked for 12 hours and sown at 4cm depth in TS + PM 2:1 had the highest leaf area at 8 WAS (Table 5).

Table 4: Number of leaves and leaf area of castor plant as influenced by potting medium, sowing depth and soaking time

Treatment	Number of leaves per plant Weeks after sowing				Leaf area Weeks after sowing			
	2	4	6	8	2	4	6	8
Plotting medium								
TS+PM 1:1	2.20	4.28	6.20	7.22	25.30	260.00	1294	2406
TS+PM 2:1	2.26	5.28	6.83	8.33	47.80	459.00	196	4146
TS+PM 1:2	1.65	3.02	3.98	4.70	29.40	219.00	850	1573
LSD (0.05)	0.348	0.625	0.539	0.615	15.30	67.300	374.7	618.9
Sowing depth (cm)								
2	1.80	4.04	4.98	6.07	31.80	330.00	1341	2510
4	2.39	4.89	6.76	7.89	33.40	320.00	1664	3241
6	1.93	3.61	5.28	6.30	43.20	287.00	1621	2375
LSD (0.05)	0.348	0.625	0.539	0.615	ns	ns	374.7	618.9
Soaking time (hr)								
0	0.00	2.93	4.26	5.30	0.00	114.00	630	1337
12	3.41	4.89	6.50	7.56	59.40	416.00	1889	3685
24	2.70	4.72	6.26	7.41	43.20	407.00	1621	3105
LSD (0.05)	0.348	0.625	0.539	0.615	15.300	67.30	374.7	618.9
Interaction								
PMxSD	0.603	1.082	0.933	1.066	26.50	116.60	ns	1071.9
PMXST	0.603	1.082	0.933	1.066	26.50	116.60	ns	1071.9
SD+ST	0.603	1.082	0.933	1.066	26.50	116.60	648.9	1071.9
PM+SD+ST	1.045	1.875	1.617	1.846	45.91	202.00	1124.0	1850.6

Table 5: interaction of potting medium, sowing depth and soaking time on numbers of the leaves and leaf area of the castor plant.

Potting medium	Sowing depth (cm)	Soaking time (hr)	Number of leaves/plant Weeks after sowing				Leaf area (cm2) Weeks after sowing			
			2	4	6	8	2	4	6	8
TS+PM 1:1	2	0	0.00	4.17	5.50	6.67	0.00	96.00	588	993
		12	4.00	6.17	7.33	8.67	44.40	413.00	2547	4561
		24	4.00	6.33	7.83	9.33	28.80	451.00	1793	3090
	4	0	0.00	5.00	5.50	7.00	0.00	227.00	1161	2304
		12	2.67	4.17	8.17	8.00	15.10	311.00	1250	2828
		24	4.00	5.50	8.33	9.33	15.30	357.00	1534	3097
	6	0	0.00	1.33	5.67	7.00	0.00	60.00	532	1447
		12	5.17	5.83	7.50	9.00	123.70	421.00	2239	3336
		24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TS+PM 1:2	2	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		24	0.00	2.67	3.33	4.00	0.00	0.00	423	672
	4	0	0.00	2.67	3.67	4.33	0.00	19.00	501	848
		12	2.67	5.33	6.83	8.00	52.40	432.00	2247	3364
		24	4.00		0.00	0.00	65.40	336.00	1261	2077
	6	0	0.00	0.00	0.00	0.00	0.00	0.00	0	0
		12	4.00	5.17	7.50	8.67	66.90	468.00	154	3315
		24	4.17	6.00	7.83	9.00	80.30	663.00	1696	3882
TS+PM 2:1	2	0	0.00	4.67	6.00	8.00	0.00	246.00	1257	2809
		12	4.00	5.83	6.83	8.33	91.00	593.00	1898	4399
		24	4.17	6.50	8.00	9.67	121.70	1120.00	3559	6063
	4	0	0.00	4.17	6.17	7.67	0.00	175.00	974	2142
		12	4.17	6.00	7.67	9.00	74.90	565.00	3467	6460
		24	4.00	5.83	7.83	9.33	77.00	456.00	2583	6052
	6	0	0.00	4.33	5.83	7.00	0.00	207.00	659	1487
		12	4.60	5.50	6.67	8.33	65.80	539.00	1830	4898
		24	0.00	4.33	6.50	7.67	0.00	225	1737	3008
$LSD_{(0.05)}$			1.045	1.875	1.617	1.846	45.910	202.00	1124.0	1856.8

CHAPTER FIVE

DISCUSSION

From the result of the study it was observed that castor oil plant growth performance was affected by sowing depth and soaking time throughout the assessment period. The difference in plant height, stem girth, number of leaf and leaf area could be attributed to the variation in the properties of the media, sowing depth and soaking duration. Each species has specific sowing depth requirement based on the type of seed and environmental condition (McWilliams, *et al*., 1998; Aldrete and Mexal 2005). The plant height and stem girth, number of leaves, leaf area were affected by increasing sowing depths with the 4 cm depth having higher mean values for the different growth attributes evaluated. This result agrees with Nabi, *et al.* (2011) and Siddig, *et al.* (2015) who in their studies on cotton (*Gossypium* spp) and faba beans (*Vicia faba* L.) respectively, reported that plant height reduced significantly with increased sowing depth. Apart from the observed effect of increasing depths on plant height of *A. muricata* as observed in this study, Kumar and Srivastava (2010) had also reported that seed depth affected germination percentage in *Ricinus communis. muricata*.

In castor oil plant, the soaking of seeds did not show regular effects on plant growth but the effect of soaking shows that the height of the plant in the fourth week in the treatment of soaking for 12 and 24 hours was almost twice the height of the plant in the same week in the treatment of the control. The number of leaves increased in soaking treatments compared with the control. The results of soaking the seeds in castor oil plant are consistent with the Mwanyongo and Chitonya, (1997) in which it was found that soaking for 24 hours had a positive effect on plant height and number of leaves in both peanuts and Bambara. Kaur *et al.* (2015) indicated that unsoaked seeds produce plants that took more days to 50% flowering than plants grown from soaked seeds. This is in consistency with the results of this study

The interaction effects shows that the soaking duration and sowing depth may have affect directly and indirectly to the process of imbibition and absorbing of the seed to the water and filling its tissues. The increase of soaking duration and sowing depth 4cm may lead to increase infiltration of electrolytes, especially the weak seeds which have no vitality or enough vigour to arrange membrane to the fact that it prevents or decrease the infiltration of electrolytes, in addition to start seed coat tears, emergence of radicle or plumule or both when it regains its active growth. Highest crop growth observed in 4cm and soaking time of 12 and 24 hours implied that sowing at not too shallow depth generally stimulates more growth than when seeds are sown on the soil surface or deeper depths. This is because the former (shallow depth) provides a moist environment around them and prevents seeds and seedlings from drying out, as well as prevent damages by insects (Rusdy and Sjahril, 2015). This result concurs with that of Opande *et al.* (2017) and Chima *et al.* (2017) who noted that germination decreased with increase in sowing depths *in C. brevidens* and *A. muricata,* respectively. Ali and Idris (2015) observed that the deeper the seed is Mexal (2005) on *Pinus brutia, P. greeggi* and *P. cembroides,* and Koffi *et al.* (2015) on *Lagenaria siceraria*. In their reports they observed that plumule emergence was delayed by increasing sowing depth. The possible reason for the delayed emergence at lower sowing depths could probably be as a result of the long distance the plumule has to contend with before reaching the soil surface (Raju *et al,* 2017).

Conclusion and Recommendation

Generally, there was a positive effect of soaking duration and plant depth on the plant growth parameter of castor oil plant. Seed soaking for 12 and 24 hours and sowing depth of 4cm improved the growth of plants in terms of plant height, stem girth, leaf number and leaf area. These results could be used in improving the crop growth. It should be taken into consideration that seed soaking and sowing not too deep is a good practice in improving crop growth and subsequent crop development.

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