



**GROWTH, YIELD AND OIL YIELD OF CASTOR (*Ricinus communis* L.) AS
INFLUENCED BY VARIETY, NUTRIENT SOURCES AND AGRO-ECOLOGY IN
BAUCHI STATE, NIGERIA**

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ABSTRACT

A field experiment was conducted at both Abubakar Tafawa Balewa University teaching and research farm, Bauchi located in the Northern Guinea Savannah and also at Bulkachuwa village of Katagum LGA located in Sudan Savannah both in Bauchi state, during the wet seasons of 2016, 2017 and 2018 to study the growth, yield and oil content of castor (*Ricinus communis* L.) as influenced by variety, nutrient sources and agro-ecology. The treatments consisted of a factorial combination of five nutrient sources (poultry manure, cow dung, chicken feather, municipal waste, mineral fertilizer) and a control and two varieties of castor (Ex-India 1 and 2), these gave 12 treatment combinations and laid out in a randomized complete block design (RCBD) with three replications. Data were collected on plant height, number of leaves, leaf area, seed yield and oil content. All data collected were subjected to analysis of variance and Duncan's Multiple Range Test was adopted in separating the means. Results of the experiment revealed a significant ($P \leq 0.05$) difference among the treatments used throughout the study period. The result further shows that, application of poultry manure, chicken feather and mineral NPK fertilizer produced statistically ($P \leq 0.05$) similar results in most of the characters measured but significantly ($P \leq 0.05$) better than cowdung and municipal waste especially on plant height, number of leaves, leaf area and seed yield. The control consistently had the lower values for the parameters measured. The results further revealed that, variety Ex-India 2 recorded superior performance over Ex-India 1 on growth, yield and seed oil content throughout the study period. The performance of castor was generally better at Bauchi than Bulkachuwa location throughout the study period. The crop grown in 2018 wet season performed statistically ($P \leq 0.05$) better than those of 2016 and 2017 wet seasons on most of the characters studied. Based on the results of this investigation however, application of poultry manure or chicken feather at the rate of 2t/ha or mineral NPK fertilizer (at the rate of 100:50:50 kg/ha) to Ex-India 2 can be recommended for castor seed production and increased oil content in the study areas.

Keywords: Castor, Content, Growth, Oil, and Yield

INTRODUCTION

Castor is a member of the *Euphorbiaceae* family that is found across all the tropical and semi-tropical regions of the world (Silva *et al.*, 2012). Castor was initially believed to have four centers of origin: East Africa (Ethiopia), North and Southwest Asia and the Arabian Peninsula, India and China. However, Ethiopia is considered to be the most probable site of origin because of the presence of high diversity (Anjani, 2012). Earlier, taxonomists also divided the genus *Ricinus* into several species and subspecies (*R. persicus* Popova, *R. chinensis* Thunb, *R. zanzibarinus* Popova, *R. sanguineus* Groenl., *R. africans* Willd. etc.). However, most botanists now believe that all castor groups belong in the same species. The division into several subspecies was probably based on eco-geographical grouping or morphological characters, because most castor accessions readily intercross, producing fertile progeny and having the same chromosome number. After all considerations, castor has now been considered to be a single specie (Anjani,



2012). In the past, castor oil used to be useful almost entirely for pharmaceutical and industrial applications. The oil was reported to be used in the production of oil-based formulations of lubricants, grease, functional fluids and processed oils. Others are oleochemicals, reactive components for paints, coatings, inks, polymers, foams, textile finishing agents, emulsifiers, stabilizers in vinyl compounds and wetting agents (Mutlu and Meier, 2010). Johnson (2007) identified a broad list of castor derivatives considered safe as cosmetic ingredients.

The oil found in castor is unique compared to other vegetable oils because it is only in castor that hydroxylated fatty acid (Ricinoleic acid) in commercial quantity can be obtained. This unique fatty acid comprises about 90% of the castor oil and no any other commercial vegetable oil can exhibit such predominance in a single fatty acid (Xu *et al.*, 2008; Mutlu and Meier, 2010). Moreover, the importance of castor especially as a source of industrial oil cannot be over-emphasized. In Nigeria, commercial cultivation of the crop is rare, eventhough it is mostly cultivated in small-scale almost all over the country. Agronomic practices of castor though, have not been reported in detail by researchers in the country. In many states of Nigeria, castor plants are seeing growing wildly in refuse dumps and abandoned farmlands. Richael, (2004) reported that, small quantities of castor are being grown by farmers especially in northern parts of Bauchi and Kaduna states mostly in backyards using local and unimproved varieties. Due to the desirable qualities of its oil however, interest in castor production among farmers is growing tremendously. Moreover, since little in terms of research has been carried out on the crop, a lot needs to be done to investigate all requirements for optimum production in Nigeria, especially its agronomic practices such as fertilizer, climate, growth habits, morphological characteristics, dry matter accumulation, mineral nutrient uptake and its utilization.

MATERIALS AND METHOD

The Study Area

A field experiment was conducted during the wet seasons of 2016, 2017 and 2018 at the teaching and research farm of the Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University Bauchi, (10° 22'N and 9° 47'E) in the Northern Guinea Savanna ecological zone and also at Bulkachuwa Village (11°38'N and 10°31'E) of Katagum LGA in the Sudan Savanna ecological zone of Nigeria. The experiment was carried out to study the growth, yield and oil content of castor as influenced by variety, nutrient sources and agro-ecology. The treatments consisted of five nutrient sources (poultry manure, cow dung, chicken feather, municipal waste, NPK fertilizer and a control), two varieties of castor (Ex-India 1 and 2) and conducted in two different agro-ecologies (Bauchi and Bulkachuwa). The five nutrient sources and two varieties were factorially combined to give 12 treatment combinations. The 12 treatment combinations were laid out in a randomized complete block design (RCBD) with three replications. The field was ploughed once and harrowed twice to a fine tilth during the first year while manual tillage using hand hoe was carried out in the subsequent years so as to maintain the residual effects of the treatments in each plot. Each of the organic fertilizer source was applied at the rate of 2 tons/ha in each year of the study. Inorganic fertilizer however, was applied in the form of NPK 15:15:15 and urea at the rate of 100 kg N, 50 kg P₂O₅ and 50 kg K₂O. Data were collected on plant height, number of leaves, leaf area, seed yield and oil content. All the data collected were subjected to combined analysis of variance (ANOVA) using the statistical analysis system procedure (SAS, 2003) while all the significant treatment means were separated using Duncan's Multiple Range Test (DMRT).



RESULTS AND DISCUSSION

Effect of Nutrient Sources, Variety, Location and Year on Plant Height of Two Castor Cultivars

Plant Height (cm)

Table 1 shows the effect of nutrient source, variety, location and year on plant height. At the different nutrient sources, application of poultry manure, chicken feather and mineral fertilizer produced significantly ($P \leq 0.05$) taller plants than the other treatments used, throughout the sampling period. The significant ($P \leq 0.05$) difference observed throughout the study period on plant height of castor in which application of poultry manure, chicken feather and mineral fertilizer produced statistically ($P \leq 0.05$) similar and taller plants indicated the importance of fertilizer application in the production of castor. Taller plants as observed under the application of poultry manure and chicken feather indicated a better mineralization of the poultry products than municipal waste and cowdung. The increase in plant height as a result of the poultry products could be due to lower carbon to nitrogen ratio of poultry manure and chicken feather than municipal waste and cowdung. The result of this findings is in line with the report of Amanullah *et al.* (2007) who reported that, increase in plant height as a result of poultry manure application could be due to higher availability of soil nutrients and its uptake by the plant. The better performance observed in this study as a result of addition of the different nutrient sources could also be due to increase in organic matter content of the soil. The results also conforms with the report of Montemurro *et al.* (2006) that, the quantity of organic matter in the soil depends directly on the amounts of organic material introduced to the soil either by natural return through roots, stubbles and root exudates or by artificial application in the form of organic manure. The taller plants observed when inorganic fertilizer was used also proved the response of castor to fertilizer application. This is in agreement with the results of Severino *et al.* (2006) who reported an increase in castor performance as a result of NPK application.

The superiority of Ex-India 2 in terms of height over Ex-India 1 throughout the study period could be due to the differences in genetic makeup of the two varieites. Variation in the terms of varietal response to fertilizer application could also be taken. The results observed lend support to an earlier one (Singh *et al.* (2007) that, castor varieties differ genetically in their response to management practices especially fertilizer use, water management and field situation.

The significant ($P \leq 0.05$) difference observed throughout the study period on plant height of castor indicates that, 2018 rainy season irrespective of the location was superior to 2016 and 2017 rainy seasons. The higher plant height as observed in 2018 is due to continues application of nutrient sources which lead to their accumulation in 2018 than the subsequent years under investigation. The results of the present findings cormforms with the report of Mullens (2002) that, continues application of manure will lead to their accumulation, leading to soil fertility build up and increase in crop growth in the subsequent years.

Table 1: Effect of nutrient sources, variety, location and year on plant height of two castor cultivars

Treatments	Plant Height (cm)		
	4 WAS	8 WAS	12 WAS
Nutrient source			
Control	22.46 ^d	52.73 ^e	112.61 ^d
Poultry manure	37.06 ^a	116.61 ^b	219.33 ^a
Municipal waste	34.31 ^b	91.40 ^c	146.95 ^c
Chicken feather	35.46 ^{ab}	122.02 ^a	193.46 ^b
Cowdung	31.28 ^c	78.10 ^d	142.64 ^c
Mineral fertilizer	37.52 ^a	114.62 ^b	196.59 ^b
LS	**	**	**
SE±	0.925	1.816	3.820
Variety			
Ex-India 1	31.39 ^b	92.24 ^b	166.37
Ex-India 2	34.64 ^a	99.60 ^a	170.83
LS	**	**	NS
SE±	0.527	1.051	2.210
Location			
Bauchi	33.21	112.09 ^a	169.10
Bulkachuwa	32.82	79.74 ^b	168.11
LS	NS	**	NS
SE±	0.532	1.050	2.213
Year			
2016	26.57 ^b	82.59 ^c	148.78 ^c
2017	26.82 ^b	90.51 ^b	165.10 ^b
2018	45.65 ^a	114.63 ^a	191.72 ^a
LS	**	**	**
SE±	0.645	1.281	2.704
Interaction			
VxN	**	*	**
VxL	NS	NS	NS
NxL	NS	NS	NS
NxY	**	**	**
LxY	NS	NS	NS
VxY	NS	NS	NS
NxVxLxY	NS	NS	NS

LS = Level of significance, SE± = Standard error, NS = Not significant, * and ** = significant at 0.05 and 0.01 respectively. Means followed by different letters are statistically different following DMRT

Effect of Nutrient Source, Variety, Location and Year on Number of Leaves of Two Castor Cultivars

Number of Leaves

Table 2 shows the effect of nutrient sources, location and year on number of leaves of two castor cultivars taken at 4, 8 and 12WAS. The results indicated a significant ($P \leq 0.05$) difference in the number of leaves among the different sources of nutrient used. The impact of fertilizer application in castor production may not be over emphasized when statistically higher number of leaves were observed with the application of different nutrient sources over the control. The increase in number of leaves observed in this study is due to the increase in plant height as a result of nutrient source application. The result of the present findings is in line with the report of Silva *et al.* (2007) who reported a response of castor to fertilizer application. The application of poultry manure and

chicken feathers was observed to produce statistically similar number of leaves with mineral fertilizer. This revealed the potentials of the two poultry products in supplementing or replacing inorganic fertilizer in castor production. Agbede *et al.* (2008) reported a similar result in sorghum that, application of poultry litter supplies nutrients necessary for crop growth and the most prevalent being nitrogen and also has the potential for competing with inorganic fertilizers. Significantly ($P \leq 0.05$) higher number of leaves observed in Bauchi over that of Bulkachuwa location could be as a result of differences in terms of weather conditions in which Bauchi experienced higher rainfall and relative humidity during the period under investigation than Bulkachuwa location. The present observation lend support from the results of Mullens *et al.* (2002) who reported that, weather condition in an environment play a significant role in the performance of castor. Significantly ($P \leq 0.05$) higher number of leaves observed in 2018 rainy season over that of 2016 and 2017 could be attributed to the increase in soil fertility as a result of continues addition of organic matter in the soil.

Table 2: Effect of nutrient source, variety, location and year on number of leaves of two castor cultivars

Treatments	Number of Leaves		
	4 WAS	8 WAS	12 WAS
Nutrient source			
Control	5.06 ^c	7.67 ^d	11.61 ^d
Poultry manure	6.82 ^a	12.50 ^a	25.01 ^a
Municipal waste	6.07 ^b	11.09 ^b	16.18 ^c
Chicken feather	6.80 ^a	12.78 ^a	22.53 ^b
Cowdung	6.10 ^b	9.99 ^c	15.57 ^c
Mineral fertilizer	7.06 ^a	12.76 ^a	22.24 ^b
LS	**	**	**
SE \pm	0.144	0.242	0.531
Variety			
Ex-India 1	6.39	10.99	17.63 ^b
Ex-India 2	6.45	11.28	20.08 ^a
LS	NS	NS	**
SE \pm	0.081	0.142	0.311
Location			
Bauchi	6.79 ^a	13.11 ^a	18.96
Bulkachuwa	6.05 ^b	9.15 ^b	18.74
LS	**	**	NS
SE \pm	0.080	0.141	0.310
Year			
2016	6.35 ^b	9.95 ^b	15.27 ^c
2017	5.64 ^c	9.47 ^c	20.01 ^b
2018	7.27 ^a	13.99 ^a	21.28 ^a
LS	**	**	**
SE \pm	0.101	0.170	0.382
Interaction			
NxV	NS	NS	NS
VxL	NS	NS	NS
NxL	NS	NS	NS
NxY	NS	**	**
LxY	NS	NS	NS
VxY	NS	NS	NS
NxVxLxY	NS	NS	NS

LS = Level of significance, SE \pm = Standard error, NS = Not significant, * and ** = significant at 0.05 and 0.01 respectively. Means followed by different letters are statistically different following DMRT



The increase in organic matter content of soil of the experimental sites either come from continues application of nutrient sources or from the fallen foliage of the castor. This is in line with report of Kaskavalci *et al.* (2006) that continues addition of castor leaves and fruits to the soil increased the fertility status and yield of tomato.

Effect of Nutrient Source, Variety, Location and Year on Leaf Area of Two Castor Cultivars **Leaf Area (cm)**

The results of the effect of nutrient source, variety, location and year on leaf area as presented in Table 3 revealed a significant ($P \leq 0.05$) difference among the various treatments on all the factors studied. The superior performance of poultry manure, chicken feather and mineral fertilizer on leaf area among the different nutrient sources applied was an indication of the potentials of the two poultry products in competing with mineral fertilizer in the promotion of leaf area in castor. The higher leaf area observed under poultry manure and chicken feather could be as a result of its improvement of the soils physical characteristics such as decrease in bulk density, increase in total porosity, infiltration and water holding capacity. The results of this finding is in conformity with the report of Lateef *et al.* (2010) who reported that, chicken feather as a plant nutrient, has a slow releasing fertilizer, providing plants with nitrogen over an extended period of time. The significant increase in leaf area observed under cowdung and municipal waste over the control indicated their influence on the growth of castor. The increase in leaf area could be as a result of increase in organic matter content due to their application in the soil. The results of this findings conforms with the report of Montemurro *et al.* (2006) that, the quantity of organic matter in the soil depends directly on the amounts of organic material introduced to the soil either by natural return through roots, stubbles and root exudates or by artificial application in the form of organic manure.

A better growing condition which might have prevailed in Bauchi than Bulkachuwa location during the conduct of the experiment possibly have led to the higher leaf area in the two locations. The result of this findings lend support to that of Tropilab (2006) who reported that, optimum and minimum temperatures of 30 and 22°C respectively are favourable for growth performance of castor. Similarly, the result is in line with the report of Horton *et al.* (2006) who observed that, Aruna castor variety grows best where rainfall and temperatures are favourable throughout the year. The superior performance of castor irrespective of the variety and location in 2018 over 2016 and 2017 rainy seasons could be due to better growing conditions which prevailed in 2018 as higher rain were observed toward the end of the season in 2018 than 2016 and 2017. It could also be as a result of continues application of nutrient sources which resulted to increase in the fertility status of the soil leading to increase in crop growth. This is in line with the report of Mullens (2002) that, continues application of manure will lead to their accumulation, leading to soil fertility build up and increase in crop growth in the subsequent years.

Table 3: Effect of Nutrient Source, Variety, Location and Year on Leaf Area of Two Castor Cultivars

Treatments	Leaf Area (cm)		
	4 WAS	8 WAS	12 WAS
Nutrient sources			
Control	337.50 ^c	675.12 ^d	956.17 ^d
Poultry manure	731.25 ^a	2025.36 ^a	2137.88 ^a
Municipal waste	675.02 ^{ab}	1406.25 ^b	1687.53 ^b
Chicken feather	787.54 ^a	1967.75 ^a	2250.40 ^a
Cowdung	562.50 ^b	1237.52 ^c	1406.25 ^c
Mineral fertilizer	787.14 ^a	1968.85 ^a	2193.79 ^a
LS	**	**	**
SE±	56.251	50.610	53.411
Variety			
Ex-India 1	563.61 ^b	1518.72 ^b	1687.53 ^b
Ex-India 2	789.44 ^a	1687.50 ^a	1912.54 ^a
LS	**	**	**
SE±	52.251	48.010	49.113
Location			
Bauchi	843.75 ^a	1743.75 ^a	1800.32
Bulkachuwa	618.75 ^b	1518.27 ^b	1743.75
LS	**	**	NS
SE±	52.251	48.010	49.113
Year			
2016	618.71 ^b	1350.24 ^c	1462.26 ^b
2017	450.08 ^c	1631.29 ^b	1518.75 ^b
2018	843.75 ^a	1800.32 ^a	2362.45 ^a
LS	**	**	**
SE±	52.251	48.010	49.113
Interaction			
NxV	NS	NS	NS
VxL	NS	NS	NS
NxL	NS	NS	NS
NxY	**	**	**
LxY	NS	NS	NS
VxY	NS	NS	NS
NxVxLxY	NS	NS	NS

LS = Level of significance, SE± = Standard error, NS = Not significant, * and ** = significant at 0.05 and 0.01 respectively. Means followed by different letters are statistically different following DMRT

Effect of Nutrient Source, Variety, Location and Year on Grain Yield and Oil Content of Two Castor Cultivars

Seed Yield

Table 4 presents the result on the effect of nutrient sources, location and year on seed yield of two castor varieties. The significantly ($P \leq 0.01$) higher seed yield observed with the application of nutrient sources revealed the impact of fertilization in castor production. This corroborate the report of Silva *et al.* (2007) who observed an increase in castor seed yield due to application of nitrogen rich fertilizers. The higher yield as observed in this study as a result of the application of poultry manure, chicken feather and mineral fertilizer than the other nutrient sources (1516.60, 1559.12 and 1600.10 kg/ha respectively) indicated the impact of these fertilizers to soil fertility. The increase in seed yield with the application of poultry products could be due its higher nitrogen content compared to other nutrient sources. It could also be attributed to the increase in soil organic



carbon and improvement in soil physical properties as a result of poultry products application. This is in line with the report of Agbede *et al.* (2008) that, poultry products have an impact on soil pH and liming due to varying amounts of calcium carbonate and improves soil physical properties by reducing bulk density, temperature and increasing total porosity and moisture content. The result of this findings also lend support from the report of Kuncoro *et al.* (2014) who reaffirmed that, organic additives reduce the compactness of soil by improving soil aeration and water penetration.

The increase in yield as observed with the application of municipal waste (1055.32 kg/ha) and cowdung (1088.94) over control (584.23 kg/ha) could be due to their impact on soil fertility through reduction of bulk density, increasing total porosity and aggregate stability. This is in agreement with the report of Meena *et al.* (2016) who observed that, combine application of municipal waste and mineral fertilizer increases soil organic carbon leading to an increase in crop yield. It is also in conformity with the findings of Lopez *et al.* (2008) who reported that, cowdung gave taller plants, higher number of leaves and increase in dry matter yield of crops.

Table 4: Effect of Nutrient Source, Variety, Location and Year on Grain Yield and Oil Content of Two Castor Cultivars

Treatments	Yield (kg)	Characters	Oil Content
Nutrient source			
Control	584.23 ^c		41.42 ^c
Poultry manure	1516.60 ^a		43.93 ^a
Municipal waste	1055.32 ^b		42.54 ^b
Chicken feather	1559.12 ^a		44.49 ^a
Cowdung	1088.94 ^b		41.23 ^c
Mineral fertilizer	1600.10 ^a		43.63 ^{ab}
LS	**		*
SE±	54.971		0.372
Variety			
Ex-India 1	1158.38 ^b		42.20 ^b
Ex-India 2	1309.72 ^a		43.98 ^a
LS	**		*
SE±	31.741		0.070
Location			
Bauchi	1366.26 ^a		43.74
Bulkachuwa	1201.84 ^b		42.44
LS	*		NS
SE±	31.741		2.071
Year			
2016	952.07 ^c		41.87
2017	1309.15 ^b		42.01
2018	1440.94 ^a		42.39
LS	**		NS
SE±	38.867		1.923
Interaction			
NxV	**		NS
VxL	NS		NS
NxL	NS		NS
NxY	**		NS
NxL	**		NS
VxY	NS		NS
NxVxLxY	NS		NS

LS = Level of significance, SE± = Standard error, NS = Not significant, * and ** = significant at 0.05 and 0.01 respectively. Means followed by different letters are statistically different following DMRT

Interaction of Variety and Nutrient Sources on Seed Yield of Castor

Seed Oil Content

The significantly ($P \leq 0.05$) higher oil content observed throughout the study period with the application of various nutrient sources indicated the contribution of fertilizer in the production of castor. This is in line with the report of Leles *et al.* (2010) who indicated a significant response of castor to fertilizer application. The increase in oil content as observed with the application of poultry manure and chicken feathers could be due to increase in phosphorous and nitrogen availability. The result of this findings is also in agreement with the findings of Silva *et al.* (2013) who stated that, chicken feather is a good source of nitrogen in compost heap, supplying the heap with nitrogen for a long period of time.

Table 5: Interaction of Variety and Nutrient Sources on Seed Yield of Castor

Treatments	2016		Variety 2017		2018	
	Ex-India 1	Ex-India 2	Ex-India 1	Ex-India 2	Ex-India 1	Ex-India 2
Nutrient sources						
Control	265.90 ^g	406.52 ^{fg}	460.34 ^g	641.71 ^{fg}	379.65 ^g	551.27 ^g
Poultry manure	763.61 ^d	1416.54 ^{ab}	1648.96 ^{abc}	1819.25 ^{ab}	1378.88 ^{bc}	1772.38 ^a
Municipal waste	463.70 ^{efg}	1159.44 ^c	954.96 ^{ef}	1209.05 ^{de}	1056.93 ^{ef}	1157.86 ^{de}
Chicken feather	643.91 ^{de}	1515.74 ^a	1594.54 ^{bcd}	1915.71 ^{ab}	1437.92 ^b	1846.85 ^a
Cowdung	535.02 ^{ef}	1274.50 ^{bc}	945.48 ^{ef}	1385.41 ^{cd}	930.96 ^f	1262.27 ^{cd}
Mineral fertilizer	583.38 ^{def}	1566.64 ^a	1590.89 ^{bcd}	2024.82 ^a	1420.09 ^b	1814.68 ^a
LS		**		*		*
SE±		66.241		139.620		58.311

LS = Level of significance, SE± = Standard error, NS = Not significant, * and ** = significant at 0.05 and 0.01 respectively. Means followed by different letters are statistically different following DMRT

Table 6: Interaction of Year, Location and Nutrient Sources on Seed Yield of Castor

Treatments	Parameters				
	Year			Location	
	Seed Yield (kg)			Bauchi	Bulkachuwa
Nutrient sources	2016	2017	2018		
Control	465.46 ^h	551.03 ^h	736.20 ^{gh}	684.71 ^e	483.75 ^e
Poultry manure	1090.08 ^{ef}	1375.63 ^{cd}	1784.10 ^{ab}	1667.07 ^a	1366.14 ^{bc}
Municipal waste	876.57 ^f	1082.04 ^{ef}	1107.34 ^{def}	1145.94 ^{cd}	964.71 ^d
Chicken feather	1079.82 ^{ef}	1442.39 ^c	1855.15 ^a	1721.74 ^a	1396.50 ^b
Cowdung	904.76 ^{fg}	1096.62 ^{de}	1265.45 ^{cde}	1206.50 ^{bc}	971.38 ^d
Mineral fertilizer	1025.01 ^{ef}	1567.39 ^b	2007.97 ^a	1788.92 ^a	1411.27 ^b
LS		**		**	
SE±		95.212		77.745	

LS = Level of significance, SE± = Standard error, NS = Not significant, * and ** = significant at 0.05 and 0.01 respectively. Means followed by different letters are statistically different following DMRT

CONCLUSSION AND RECOMMENDATIONS

From the results, it became clear that the application of organic nutrient sources especially poultry manure and chicken feather and mineral fertilizer had an influence on the growth and yield of castor. Even though, these organic sources had similar influence on the crop, the potentials of the poultry products as an organic source may not be overemphasized. Based on the results of this study, application of poultry manure or chicken feather at the rate of 2 tons/ha or mineral fertilizer at the rate of 100 kg N, 50 kg P and K/ha should be adopted by farmers in the study area for profitable castor production.



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