

Effect of Jatropha Seed Cake (JSC) and Different Inorganic Fertilizers on Growth and Yield of Two Groundnut Cultivars Under Three Harvesting Time.

ABSTRACT

Aim:to investigate the effect of jatropha seed cake and different fertilizers on growth and yield of two groundnut cultivars under three harvesting time

Study Design: The experimental design was a randomized complete block in a split-plot replicated three times. Groundnut cultivars arranged as whole plots and five fertilizers treatment as sub plot.

Locations:field experiments were conducted for two seasons 2011/12-2012/13 under semi-arid condition of Khartoum state-in demonstration farm of Sudan University of Science and Technology, Khartoum North, Shambat.

Methodology: The treatments were Jatropha Jatropha seed cake (2.5 ton/ha), sulphur (119 kg/ha), super phosphate (119 kg/ha), ammonium sulphate(119 kg/ha) and control on two groundnut cultivars (Sodri) and (Gebish) under three harvesting time(every 10 days).

Results:The results showed that yield increased with advanced in harvest time for two seasons. The two tested cultivars revealed similar behavior during vegetative and reproductive growth. Except for plant height of third harvest of first season, primary branch of second harvest and yield of first and third harvest of two seasons. Results showed significant difference among fertilizers treatments and interaction between cultivars and fertilizers concerning the majority of growth and yield components. Super phosphate gave significant difference on leaf area index, plant height, number of primary branches, number of primary branches, number of pods/plant, germination %. On the other hand, sulphur and ammonium sulphate gave significant difference on number of pods/plant, germination % and yield. Ammonium sulphate and jatropha seed cake revealed significant effect on yield kg/ha in first and second season respectively

Conclusion: In conclusion addition of jatropha seed cake and inorganic fertilizers appear promising. Delaying harvesting time gave positive results. There was no variation between two cultivars.

Keywords: jatropha seed cake, inorganic fertilizers, groundnut

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1.INTRODUCTION

Groundnut *Arachis hypogaea* L. is a major cash crop grown mainly under rain-fed conditions in the semi-arid tropics. Groundnut is the 13th most important food crop of the world. It is the world's 4th most important source of edible oil and 3rd most important source of vegetable protein {1}. Groundnut is primarily used for oil extraction in Sudan (Ref). It is consumed directly because of its high food value. Sudan is one of the major groundnut producing countries. The total area under groundnut production is approximately one million ha with an average yield of 855 kg ha⁻¹ (Ref).

The optimum fertilizers are the main concern for maximum yield of any crops. Proper fertilizers doses of inorganic fertilizers have vital effect on the yield of groundnut {2}. Substantial evidence showed that groundnut responds well to additional inorganic and organic fertilizers application {3, 4, 5, 6, 7, 8, 9}. Phosphorus is very important nutrient element for crop growth and yield. It plays an important role in physiological processes of plants. As P source, single superphosphate is the most suitable fertilizer for groundnut in Nigeria Savannah {10}. Sulphur is the best known for its role in the formation of amino acids methionine and cysteine, synthesis of protein and chlorophyll, oil content of the seed and nutritive quality of forage {11}. Sulphur element receives little attention for many years, because fertilizers and atmospheric inputs supplied the soil with adequate amount of sulphur {11}.

Biodiesel is an environmental-friendly substitute for fossil fuel. Research on the production of biodiesel from vegetable oils has concentrated on Jatropha, soybean, palm kernel, sunflower and rapeseed oils with scarce information on groundnut oils {12}. The biodiesel from *Jatropha curcas* has been received much attention in these past decades. The by-product of oil extraction from *Jatropha curcas* seeds and kernel is called seedcake. It contains highly toxic protein unsuitable for animal foods and is good organic manure, has been used as an organic fertilizer {13}. The cake is rich in nitrogen (3.2%) and phosphorus (1.4%) & potassium (1.3%) and can be used as manures {14 and 15}. Limited studies have been reported on potential of Jatropha seed cake to be used as organic fertilizers. Organic manures are very important, it contains both major and minor elements necessary for plant growth, and improve the physical, chemical and biological properties of soil (Ref). The productivity of groundnut depends on proper selection of variety, fertilizer management. This study was carried out to determine/ascertain/assess/know the effect of Jatropha seed cake (JSC) and different fertilizers on growth and yield of two groundnut cultivars under three harvesting times.

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2. MATERIALS AND METHODS.

The experiment was aimed to study the effect of different organic and inorganic fertilizers on growth of two groundnut cultivars under different time of harvest.

2.1 Experimental site

Field experiments were conducted in Demonstration farm, College of Agricultural Studies, Sudan University of Science and Technology, Shambat, Khartoum North, Sudan for two seasons 2011/12- 2012/13. Shambat is located at longitude 32.35"E and latitude 15.31"N, within the semi-desert region. Climate of the locality is semi-desert and tropical with low relative humidity. The mean annual rainfall is about 160 mm, and the mean maximum temperature is more than 40°C in summer and around 20°C in cool season. Solar radiation is about 400–500 cal cm⁻² day⁻¹. The soil of the site is loam clay it is characterized by a deep cracking, moderately alkaline clays, and low nitrogen content and pH (7.5- 8) and high exchangeable sodium percentage (ESP), in subsoil.

2.2 Layout of the Experiment and Land Preparation

~~The experiment was aimed to study the effect of different organic and inorganic fertilizers on growth of two groundnut cultivars under different time of harvest.~~ The experiment was designed in split plots ~~design~~ replicated three times. Two cultivars of groundnut (Sodri =V1) and (Gebish=V2) and four types of fertilizers were applied; (F1) control without fertilizer, (F2) inorganic Jatropa Seed Cake (JSC) of 2.5 tons/ha, and three organic fertilizers: (F3) pure sulfate of 119 kg/ha, (F4) super phosphate of 119 kg/ha and (F5) Ammonia sulfate of 119 kg/ha. After maturing different harvesting times were taken (every 10 days), early, medium and later. The field was prepared according to adopted method by Engineering Department of Agricultural College. Ploughed by disc plough then left for one month to dry out then harrowed using disc harrow after that it was leveled divided into main plots and subplots each of four lines which measured four meter in length and 50 cm apart. The seeds were sown in July 12th, and July 21st respectively for two seasons, 3-4 seeds per hole then thinned to two seed per hole. During July until August (about two months) it was ~~rain fed~~irrigated by rain fall then irrigation was applied every 15 days. For first season the three harvesting time were, October, 11- 21 and first November, and for second season October, 24, and November 4-14.

2.3 The Source of Seeds:

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Two cultivars of groundnut (Sodri =V1) and (Gebish=V2) was obtained from Al –Obied Research Center (North Kordfan) , and Arabian Company for Seeds-Khartoum ([What classes of seeds were these: Foundation or certified seeds. Again what botanical classifications were these seeds Spanish, Valencia or Virginia. What are their research determined maturity dates?. I would appreciate this presented in a tabular form](#)).

2. 3 Data Collection

Observation was taken from 3 plants selected randomly each subplot. Data was recorded on pre and post harvesting stage. The data recorded were during pre-harvest; percentage of germination after 3 weeks and 5weeks, seeds failed to germinate were counted in each hole (implanting seeds), Leaf area index after 90 days. The harvest stage data were: - height of plant, number of primary and secondary branches, number of pods per plant. Yield kg/ha also was taken([How? Yield per plot then extrapolated to per hectare? Fresh weight or dry pod weight?](#)).

2-4 Statistical Analysis:

The collected data were subjected to standard Statistical analysis. The procedure of analysis of variance and mean separation were followed according to the description of {16}. The data was analyzed by MSTAT-C Statistical Package.

4. RESULTS AND DISCUSSION

The effect of [JatrophaJatreopha](#) Seed Cake (JSC), sulfur, super phosphate and ammonium sulfate fertilizer on germination % of two groundnut cultivars (Sodri and Gebish) were presented in table (1a) for season 2011/12 and table (1b) season 2012/13. There were no significant difference between two cultivars for 3 and 5 weeks of sowing, and among the fertilizers for 5 weeks of sowing, but there were significant differences among fertilizers X cultivars for two seasons for 3 and 5 days of sowing. Sulfur fertilizer with V1(Sodri) and super phosphate with V2 (Gebish) gave the highest values for first and second seasons respectively. Among fertilizers for two seasons in 3 weeks of sowing application of sulfur and (JSC) obtained the highest values. This evaluated that groundnut responded well to application of organic and inorganic fertilizes. This was in line with [Rumbidzai. andMabwe](#){9}.

Table 1a.Effect of Jatropha seed cake and different fertilizers on germination % of two groundnut cultivars season 2011/12.

	3 WS			5WS		
	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X
F1(Control)	70.0 b	69.0 b	69.5 ab	77.5 bc	81.3 b	79.4 a
F2(Jateropha)	65.0 bc	64.6 bc	64.8 ab	71.3 c	76.8 bc	74.1 a

F3(Sulfur)	82.9 a	58.7 c	70.8 a	89.2 a	69.5 c	79.4 a
F4(Super ph.)	66.7 bc	63.8 bc	65.2 ab	75.2 bc	71.7 c	73.4 a
F5(Amoniumsulfate)	69.6 b	49.6 d	59.6 b	70.6 c	72.8 bc	71.7 a
X	70.8 a	61.1 a		76.8 a	74.4 a	75.6
CV%			21.5			18.9
LSD V			7.8			7.8
LSD F			10.2			10.2
LSD V*F			62.7			54.1

Table 1b.Effect of Jatropha seed cake and different fertilizers on germination % of two groundnut cultivars season 2012/13.

	3 WS			5WS		
	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X
F1(Control)	45.8 c	60.3 b	53.1 b	36.3 c	50.4 ab	43.4 a
F2(Jateropha)	54.6 b	60.4 b	59.5 a	46.9 b	50.7 ab	48.8 a
F3(Sulfur)	41.9 c	65.4 b	53.7 b	31.7 c	50.5 ab	41.1 a
F4(Super ph.)	46.1 c	68.9 a	57.5 ab	37.2 c	56.8 a	47.0 a
F5(Amoniumsulfate)	57.5 b	57.5 b	57.5 ab	46.4 b	46.4 b	46.4 a
X	49.9 a	62.5 a		39.7 a	51.0 a	
CV%			31%			34.6%
LSD V			4.86			11.30
LSD F			9.63			8.57
LSD V*F			26.7			15.00

The results of leaf area index ~~are were~~ presented in table 2, there were significant difference in first season between cultivars, fertilizers and interaction among cultivars and fertilizers.V2, F4 (super phosphate) and the interaction of V2XF4 gave the highest values. While the second season the significant differences were noticed only among the interaction of cultivars and fertilizers and V1XF4 showed the highest values. This result was as mentioned above appear the rolls of the effect of addition of fertilizers.

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Table 2. Effect of Jatropha seed cake (JSC) and different fertilizers on leaf area index of two groundnut cultivars seasons 2011/12-2012/13.

	2011/12			2012/13		
	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X
F1(Control)	29.2 efg	30.6 def	29.9 b	34.7 b	29.3 de	31.9 a
F2(Jateropha)	32.3 cd	32.6 cd	32.5 ab	38.1 a	28.7 e	33.4 a
F3(Sulfur)	35.2 ab	30.6 def	33.4 a	36.2 ab	31.7 cd	33.9 a
F4(Super ph.)	27.8 9	36.4 a	32.1 ab	34.0 bc	28.8 e	31.4 a
F5(Amoniumsulfate)	28.4 fg	33.8 bc	31.1 ab	34.4 b	30.3 de	32.3 a
X	30.6 b	32.9 a		35.5 a	29.7 a	
CV%	13.2			14.1		
LSD V			1.5			2.5
LSD F			2.3			3.3
LSD V*F			3.0			13.7

Tables 3a-3b showed the results of effect of JSC and different fertilizers on plant height of two groundnut cultivars for three harvesting time. The results indicated non significant differences between cultivars except in third harvest of second season and V1 (Sodri) gave the highest value. Among fertilizers treatments all of them revealed highly significant difference except the first harvest of second season. In general, F4 (super phosphate fertilizers) showed the highest records in first harvest of first season and second harvest of second season also with control in second and third harvest of first season, but in second season third harvest F2(JSC) showed the highest value. The interaction of cultivars with fertilizers showed significant difference for all parameters and F4 and F1 obtained the highest values except in the third harvest of second season F2 gave the higher value.

The results showed the effect of JSC and different fertilizers on number of primary branches of two groundnut cultivars seasons 2011/12-2012/13. It was presented in table 4a-4b for two seasons respectively. The results obtained that there were no significant differences between cultivars for three different harvesting time except in season two second harvest and V1(Sodri) gave higher record than V2(Gebish). Among fertilizers in the first season the results showed that F2 (JSC) in first and third harvest and F4 (Super phosphate) gave the highest values with significant differences. Meanwhile second season showed slight difference in first and second harvest and no significant difference in third harvest for fertilizers treatment. The results of interaction of cultivars with fertilizers showed that F2 for two cultivar in first harvest and V1F4

second harvest and V2 F2 for thirds harvest had the highest values with significant difference. The interaction in season two showed results similar to results of fertilizers with difference in V1 which gave the biggest values in first and second harvest, but thirds harvest gave significant difference in V1F4.

Numbers of pods/plants were obtained in table 5a-5b. The results showed non significant differences between cultivars for two seasons in all harvest time. Fertilizer treatment showed no significant differences in first harvest of first season and second and third harvest of second season. In first season super phosphate gave the significant difference among treatments. In second season F5 gave the highest values. {17} study the relationships between nutrient uptake parameters, biomass and pod dry weight and found that they were positive and significant in both seasons. The interaction treatment revealed highly significant difference for three harvests for two seasons. In general third harvest of two seasons had the highest number of pods/plant and V2F4 of third harvest of second season obtained the heaviest numbers of pods/plant which was 18.3 pods/plant. {18} gave the same result and showed that the genotypes obtained an increasing trend in the number of mature pods as harvesting date delayed.

The yield kg/ha of two groundnut cultivars for three harvests were presented in table 6a-6b for two seasons. The result showed that yield increased with advanced in harvest time for two seasons, and the yield of third harvest is the best of the first and second harvest this result was in line with {18} but {19} found that peanut harvest at physiological maturing period gave better result than that at 10 days earlier or later. V2 (Gebish) gave slight big yield compared with V1 (Sodri) with significant difference in first and third harvest of first season and first harvest of second seasons. Among fertilizers treatment in second seasons Tables 6b the results showed that F2 for three harvests gave the highest yield and also for interaction had the same results with variation in cultivars V2F2 gave the highest values. In first season Table 6a, F5 (Amonium sulphate) gave the highest values for three harvest. The interaction of cultivars and fertilizers in this season gave significant difference. The same results among fertilizers treatments were detected {20}.

Table 3a. Effect of Jatropa seed cake and different fertilizers on plant height of two groundnut cultivars season 2011/12.

	First harvest			Second harvest			Third harvest		
	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X
F1(Control)	18.1 cd	19.8 bc	18.9 b	21.3 c	23.3 b	22.3 a	21.3 cde	26.1 a	23.7 a
F2(Jateropha)	20.4 b	17.3 d	18.8 b	19.6 def	20.4 cde	19.9 b	21.9 cd	20.3 ef	21.1 b
F3(Sulfur)	18.7 bcd	20.2 b	19.4 b	19.2 ef	22.8 b	21.0 ab	20.1 ef	19.6 f	19.9 b
F4(Super ph.)	22.3 a	23.3 a	22.8 a	19.5 ef	24.7 a	22.1 a	22.7 bc	23.6 b	23.2 a

F5(Amoniumsulfate)	19.5 bc	19.8 bc	19.7 b	18.9 f	21.0 cd	19.9 b	20.7 def	19.8 ef	20.2 b
X	19.8 a	20.1 a		19.7 a	22.4 a		21.3 a	21.9 a	
CV%			16.4			11.7			12.2
LSD V			1.79			1.35			1.45
LSD F			2.3			1.77			1.89
LSD V*F			3.6			9.4			2.7

Table 3b.Effect of Jatropha seed cake and different fertilizers on plant height of two groundnut cultivars season 2011/12.

	First harvest			Second harvest			Third harvest		
	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X
F1(Control)	19.0 d	22.5 bc	20.8 a	18.1 d	21.6 c	19.9 cd	18.8 e	24.7 bc	21.8 ab
F2(Jateropha)	20.5 cd	25.9 a	23.2 a	21.5 c	26.1 b	23.8 ab	21.6 d	27.4 a	24.5 a
F3(Sulfur)	23.1 b	22.5 bc	22.8 a	18.6 d	25.9 b	22.3 bc	18.6 e	25.6 ab	22.1 ab
F4(Super ph.)	20.4 cd	24.1 ab	22.2 a	23.0 c	29.6 a	26.3 a	23.2 cd	24.1 bc	23.7 ab
F5(Amoniumsulfate)	21.8 bc	21.7 bc	21.7 a	17.9 d	18.8 d	18.4 d	21.7 d	21.7 d	21.7 b
X	20.9 a	23.3 a		19.9 a	24.4 a		20.8 b	24.7 a	
CV%			19.2			21.3			16.3
LSD V			0.78			2.52			2.66
LSD F			2.33			3.31			2.03
LSD V*F			3.05			7.60			13.7

Different concentration of JSC gave the various results on the yield of each vegetable crop. Treatment with the half rate of chemical fertilizer mixed with high rate (10 t/ha) of JSC had proven to provide the best marketable yield of Chinese kale, in which such yield was comparable to that of full rate of chemical fertilizer (Ref). In addition, the half rate of chemical fertilizer combined with any rates of JSC (low, medium, and high) gave the most tomato fruit yield. When applied with low rate (2.5 t/ha) of JSC to the sweet potato plot, the outcome showed the highest tuber yield {21}. As mentioned above, fertilizers in form of jatropha seed cake, super phosphate, sulphur and ammonium sulphate on different yield and yield gave positive results with significant difference. {6} concluded that phosphorus rate increased the number of filled pods and

seed yield. Also {22} found that application of FYM and S fertilization increased the yield and yield attributed of groundnut. {23} confirmed that sulphur application increased pod yield of groundnut. On the other hand, {24} found that sulphur application significantly influenced the growth and yield attributed characters, yield and oil content over control regardless of the source and levels of sulphur. In contrast {3} found that sulphur supply only increase the sulphur concentration of the plants without enhancing the yield.

Table 4a. Effect of Jatropha seed cake and different fertilizers on number of primary branches of two groundnut cultivars season 2011/12.

	First harvest			Second harvest			Third harvest		
	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X
F1(Control)	4.5 bc	4.1 c	4.5 bc	4.1 d	4.5 cd	4.3 c	5.0 bc	4.8 bcd	4.9 ab
F2(Jateropha)	5.6 a	5.3 a	5.6 a	4.7 c	5.2 b	4.9 ab	5.1 b	5.7 a	5.4 a
F3(Sulfur)	5.1 ab	3.9 c	5.1 ab	4.7 d	5.2 b	4.9 ab	4.3 de	4.9 bc	4.6 b
F4(Super ph.)	4.5 bc	4.2 c	4.5 bc	5.8 a	4.6 cd	5.1 a	4.9 bc	4.5 cde	4.7 b
F5(Amoniumsulfate)	4.5 bc	4.5	4.5 bc	4.4 cd	4.6 cd	4.5 bc	4.8 bcd	4.2 c	4.5 b
X	4.8 a	4.4 a		4.7 a	4.8 a		4.8 a	4.8 a	
CV%			24			17			16.5
LSD V			0.61			0.44			0.43
LSD F			0.79			0.58			0.57
LSD V*F			2.5			2.6			1.5

Table 4b. Effect of Jatropha seed cake and different fertilizers on number of primary branches of two groundnut cultivars season 2012/13.

	First harvest			Second harvest			Third harvest		
	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X
F1(Control)	6.1 a	4.7 cd	5.4 a	6.2 a	4.3 de	5.3 a	5.0 bc	4.6 cd	4.8 a
F2(Jateropha)	5.3 b	3.8 e	4.6 b	4.2 e	3.9 e	4.0 b	5.4 abc	5.2 bc	5.3 a
F3(Sulfur)	4.1 de	5.4 b	4.8 ab	5.3 bc	3.8 e	4.6 ab	5.8 ab	5.0 bc	5.4 a
F4(Super ph.)	4.5 cd	5.0 bc	4.7 ab	4.9 cd	5.2 bc	5.1 a	6.3 a	4.0 d	5.2 a

F5(Amoniumsulfate)	6.2 a	4.1 de	5.2 ab	5.7 ab	5.0 bcd	3.3 a	5.8 ab	5.1 bc	5.5 a
X	5.2 a	4.6a		5.3 a	4.4 b		5.7 a	5.7 a	
CV%			20.2			24.0			32.5
LSD V			0.71			0.83			0.93
LSD F			0.54			0.63			1.21
LSD V*F			2.20			0.66			2.31

Taable5a. Effect of Jatropha seed cake and different fertilizers on number of pods/plant of two groundnut cultivars season 2011/12.

	First harvest			Second harvest			Third harvest		
	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X
F1(Control)	5.4 cd	8.1 a	6.7 a	8.0 b	5.0 d	6.5 b	13.1 bc	10.9 cd	12.0 ab
F2(Jateropha)	7.0 abcd	7.5 ab	7.3 a	5.5 cd	8.1 b	6.8 b	10.6 cde	12.0 cd	11.3 b
F3(Sulfur)	5.5 cd	5.3 cd	5.4 a	7.6 bc	8.0 b	7.8 ab	9.6 de	15.8 b	12.7 ab
F4(Super ph.)	5.6 bcd	5.0 d	5.3 a	9.0 ab	11.0 a	10.0	22.8 a	7.7 e	15.2 a
F5(Amoniumsulfate)	7.1 abc	5.3 cd	6.2 a	8.7 ab	7.2 bcd	7.9 ab	13.4 bc	9.3 de	11.5 ab
X	6.1 a	6.2 a		7.8 a	7.8 a		13.9 a	11.2 a	
CV%			53.3			51.5			40.7
LSD V			1.80			2.10			2.80
LSD F			1.55			2.20			3.66
LSD V*F			2.37			4.10			7.80

Table 5b.Effect of Jatropha seed cake and different fertilizers on number of pods/plant of two groundnut cultivars season 2012/13.

	First harvest			Second harvest			Third harvest		
	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X
F1(Control)	5.9 d	9.1 b	7.5 bc	12.5 bc	15.8 a	14.2 a	12.4 cd	17.9 a	15.1 a
F2(Jateropha)	7.4 bcd	6.8 cd	7.1 c	11.5 c	14.6 ab	13.1 a	14.4 bc	14.4 bc	14.4 a

F3(Sulfur)	8.4 bc	10.9 b	9.7 ab	11.2 c	15.0 a	13.1 a	11.9 cd	14.9 b	13.4 a
F4(Super ph.)	10.9 a	7.8 bc	9.3 ab	11.9 c	15.7 a	1.3.8 a	11.9 d	18.3 a	15.1
F5(Amoniumsulfate)	10.9 a	10.9 a	10.9 a	11.7 c	14.3 ab	12.9	15.4 b	10.3 d	12.9 a
X	8.7 a	9.1 a		11.8 a	15.1 a		13.2 a	15.2 a	
CV%			33.5			26			29.3
LSD V			6.60			2.00			2.27
LSD F			8.89			2.63			2.97
LSD V*F			14.53			7.10			23.9

LSD V*F		14.53			7.10				23.9
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Table 6a.Effect of Jatropha seed cake and different fertilizers on yield (kg/ha) of two groundnut cultivars season 2011/12.

	First harvest			Second harvest			Third harvest		
	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X
F1(Control)	250.2 f	445.7 de	347.9 c	309.3 f	695.5 cd	502.4 d	760.5 e	1224.0 cde	992.3 e
F2(Jateropha)	791.2 b	360.3 ef	575.8 ab	942.3 cd	450.8 ef	69.60 e	2675.3 ab	936.5 de	1805.9 c
F3(Sulfur)	967.3 a	455.7 cde	711.5 a	1331.5 a	705.0 de	1018.3 b	2710.5 ab	1621.8 c	2166.2 b
F4(Super ph.)	390.7 ef	595.0 cd	492.8 bc	430.0 f	895.2 cd	662.6 c	1331.0 cd	1569.3 c	1450.2 d
F5(Amoniumsulfate)	831.0 ab	609.5 c	720.3 a	1119.5bc	1424.7 a	1272.1 a	2761.1 a	2254.5 b	2507.8 a
X	646.1 a	493.2 b		826.5 a	834.2 a		2047.7 a	1521.2 b	
CV%			50.7%			57.3%			49.5%
LSD V			132.0			2216			584.7
LSD F			340.9			572.2			150.0
LSD V*F			157.9			260.3			483.1

Table 6b.Effect of Jatropha seed cake and different fertilizers on yield (kg/ha) of two groundnut cultivars season 2011/12.

	First harvest			Second harvest			Third harvest		
	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X	V1(Sodri)	V2(Gebish)	X
F1(Control)	124.7 e	126.5 e	193.1 d	327.3 d	242.8 de	285.1 c	792.3 c	444.3 d	618.3 cd
F2(Jateropha)	62.7 f	677.5 a	370.1 a	89.5 f	1607.7 a	848.6 a	191.2 e	1721.2 a	956.2 a
F3(Sulfur)	90.0 g	377.2 b	193.1 d	85.7 f	713.7 b	399.7 b	142.7 e	1340.5 b	741.6 bc
F4(Super ph.)	242.7 a	119.5 e	186.8 c	162.7 ef	274.0 d	218.3 c	556.5 d	558.5 d	557.5 d
F5(Amoniumsulfate)	325.0 c	196.7 d	260.8 b	512.7 c	432.5 c	472.6 b	719.7 c	794.8 c	757.3 b
X	152,7 a	299.5 b		235.6 a	654.19 a		480.5 a	971.9 a	
CV%			38.9%			35.5%			32.6%
LSD V			71.8			666.4			884.2
LSD F			18.5			172.1			228.3
LSD V*F			48.4			86.4			129.4

4. SUMMARY AND CONCLUSION

Groundnut is very important oil seed in the Sudan. The productivity of groundnut depends on proper selection of variety, fertilizer management and other management practices. Currently application of jatropha seed by-product as oil diesel remain seed cake waste. This jatropha seed cake can use as a good green manure fertilizers. In this study using jatropha seed cake compared with different inorganic fertilizers; sulphur, superphosphate and ammonium sulphate gave significant difference in growth, yield and yield components of groundnut. On the other hand, delayed harvesting time gave good results. The two genotypes of groundnut obtained similar results without clear variation in their growth. Thus additional studies under more conducive condition are needed to better understand the role of jatropha seed cake plays as fertilizer to increase growth and yield of crops.

Comment [WU2]: Why bold this section and leave the rest?

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Comment [WU3]: Use same fonts and publishers' design