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Response of Sowing Dates, Cultivars and nitrogen application on growth, yield and oil contents of cotton crop (*Gossypium hirsutum* L) growth at Nuba Mountain

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Abstract: The field experiments were carried out under rain fed conditions during two consecutive cropping seasons of 2012/13 and 2013/14 at the Demonstrated Farm of Dadanj University, Nuba Mountain, and South Khordofan State, Sudan. The present studies were conducted to quantify the effect of sowing date, cultivars and nitrogen application on plant growth, seed cotton yield and its components. Two Cultivars, Khalifa (medium) and Burhan (tall) were sown on three sowing dates of July 15, July 25 and August 4 with three nitrogen levels of 0, 60 and 120 kg ha^{-1} during the two consecutive crop seasons. The study was laid out in a split-Split- design with three replications. Observations for growth attributes; such as plant height, number of leaves/plant, 50%flowering. Yield parameters, yield of lint kg/ha^{-1}, yield of seeds kg/ha^{-1}, harveste index of lint kg/h^{-1}, and harvested index of Seed kg/h-1and Oil contents. Were recorded. The results revealed that, cotton growth and yield were reduced with later sowing dates. The data were analyzed statistically by using the GENSTAT software, which showed that both the cultivars with early sowing produced higher growth and yield as compared to the late sowing date. Moreover, The Nitrogen response was consistent across sowing dates and cultivars for all data collected. Nitrogen application (120 kg N ha^{-1}) in early planted cotton gave the highest number of plant growth and yield of (lint and seeds kg/h^{-1}). It could be concluded that the period from the first of July to the mid of it can be considered as the optimum sowing date for yield of the cotton (Khalifa - var) at Sudan and under rain fed condition.
Keywords: *Gossypium hirsutum*, Sowing date, Cultivars, Nitrogen Application

INTRODUCTION

Sowing time is the main factor affecting yield, and considered as key element to investigate the appropriate sowing period of crop cultivars under the particular agro climatic conditions. Sowing time linearly affects the seed cotton yield, because early maturing cultivars start flowering and boll formation well earlier as compared to late ones. Growth and yield contributing parameters including fibre quality traits are closely associated with environments favourable for higher yields. The yield of cotton is mostly associated with sowing dates as boll weight and formation of bolls which are interred linked with the yield [1].

Sowing time has very important role in realizing maximum seed cotton yield in a country like Pakistan where the climatic conditions differ from province [2, 3] Yield of cotton can be sufficiently increased if the optimum time for sowing in particular zone is well known, delayed sowing increase the period between sowing to seedling emergence (square, first flower, first open boll) and plant survival decreases as observed by Ansari and Mahey [4]. Important with increased late-season insect pressures in Arizona. This approach to earliness management has also been important in terms of avoiding inclement weather conditions commonly associated with the summer monsoon season, which creates higher humilities (higher dew point temperatures) and higher night temperatures, resulting in accelerated rates of fruit loss and abortion. Another method used for insect pest management is delayed planting. Delayed plantings have been utilized by many producers in some parts of Arizona to aid in the management of pink bollworm (PBW, Pectinophora gossypiella (Saunders)) populations. Delayed plantings are intended to encourage suicidal emergence of overwintering PBW populations, theoretically lowering early season infestation levels. However, with the increasing use of transgenic cotton varieties that provide resistance to PBW pressures this method of pest management is becoming less common. Crop monitoring revealed early season fruit loss leading to increased vegetative growth tendencies with all three planting dates. General trends also showed decreasing lint yield with the later dates of planting for all varieties. The more determinate variety

(STV 474) was able to set and a fruit load more rapidly than the other varieties in this *study at several dates of planting, which resulted in higher yields* [5] study Evaluation of Planting Date Effects on Crop Growth and Yield for Upland Cotton

In crops like cotton, excesses of N delay maturity, promote vegetative tendencies, and usually result in lower yields [6]. Increased nitrogen rate reduces the lint percentage by 0.16%, increase in boll weight may be due to increase in N rate and increases mineral uptake, photosynthetic assimilation and accumulation in sinks [7]. However, Hussain *et al.;* [8] reported that nitrogen rate had no effect on fiber uniformity. Excess application of N than the required for optimum crop performance can reduce yield or fiber quality [9].

Nitrogen (N) is one of the most important management practices. N nutrient is an essential element for canopy area development. It required most consistently and in larger amounts that other nutrients for cotton production. One aspect of N nutrition in cotton is its effect on fiber quality. However, the results are varied [10]. Boquet [11] believe that fiber properties such as fiber length, strength, and micron ire will not be appreciably compromised or improved by N application rate unless the crop is under severe N- deficient condition, Keeping in view the above mentioned facts, the present study was carried out to compare the yield and fiber characteristics of cotton cultivars under different nitrogen levels. The amongst the tested cultivars, NIAB-111 showed maximum fiber strength, fiber fineness and fiber elongation followed by CIM-496, whereas FH-901 found to have low fiber strength, fiber fineness and fiber elongation.

MATERIALS AND METHODS

The Field experiment was carried out to investigate the Effect of Sowing Dates, Cultivars and Nitrogen Application on Growth and list yield on Cotton Crop (*Gossipium. hirsutum L.*), grown at Nuba Mountain. At experiment conducted under rain fed conditions for two seasons at the Demonstrated Farm of Eldelang University at Nuba Mountain (NMs). Nuba Mountain (NMs) region situated between the latitudes 10-13 degree North and the longitudes 29-31 degree East, within the boundary of the Republic of Sudan. It covers approximately an area of 138000 km^2. The treatments were three sowing date and three doses of Urea fertilizer as a source of nitrogen with two cotton cultivars that were replicated three date (3 sowings x 2 cultivars x 3 nitrogen doses) replicate three times laid out in a split –split randomized complete block design. The sowing date will be:

Sowing (1 – 15th July, 2 – 26th July and 3 – 5th August)

The two cultivars used in the experiment were: Burhan and Khalifa [12] will bring from ARC, Elobied Station. Three doses of Nitrogen in form of Urea, control 0Nkg/ha, 1N will apply during sowing 60 kg/ha and 2N split for two doses one during sowing date and the other after one month 120kg/ha. The results of this study will analysis using ANOVA by Gene stat.

The study parameters include:

Observation for growth attributes such as

Plant height (cm)/ plant, Number of leaves and 50% flowerind

Yield parameter.

Yield of lint kg/ha^{-1}, yield of seeds kg/h^{-1}, harvested index of lint kg/ha^{-1}, and harvested index of Seeds kg/ha^{-1} and Oil contents

RESULTS AND DISCUSSION

The Summary of the ANOVA

The results, showed that, were highly significant difference among all treatments, were sowing date, nitrogen application, cultivars and interaction in two seasonal.

Cultivars Response

The cultivars showed non- significant for growth and yield indicates that these cultivars were more or less equal in plant growth in two seasonal, (Table I). In this study, cotton cultivars had significant response to sowing dates. Among the tested varieties, khalifa had better performance than burhan. The cultivars response could be genetic potentiality of the variety. Bolonhezi *et al.;* [13] studied cotton cultivars and reported that there were significant differences between productivity for cotton sown at different times. On an average cotton cultivar khalifa endowed with better plant height (53.5A cm), number of leaves/ plant (43.1A) and 50% flowering (68.4 days) exhibited significantly maximum yield of lint (1209.2 kg ha^{-1}) due to maximum yield of Seeds (170.8kg/ha), lint index (68.2g) and seed index (170 g) Although, cotton cultivar burhan were remarkably taller with higher number of leaves /plant produced less yield of lint 1124.8 and 1005.4 kg ha^{-1} due to less yield of seeds (2120.5 and1562.9 kg/ha), respectively. Furthermore the cotton cultivar khalifa Sohni exhibited oil content (26.7 %) than burhan cultivars (Table I and 2). Results are in agreement with findings of Soomro *et al.;* [14], Arain *et al.;* [15], Hassan *et al.;* [16], and Arshad *et al.;* [17] as they reported the performance of cultivars with increased values of yield components and other attributes.

Nitrogen application response

The All characters were greatly influenced by nitrogen application except plant height, number of leaves and 50% flowering in season one (Table 1). Almost all characters were adversely affected by 120kg/ha^{-1} and control 0N were found with decrease in

yield of lint and yield of seed kg/ha (1365.0 and 700.1 kg ha^{-1}) and (6234.6 and 1218.1kg/ha^{-1}) respectively. The characters as influenced by 120kg/ha^{-1} showed significantly maximum effects for plant height (76.6 cm), number of leaves /plant (48.6), 50% flowering (67.8), yield of lint (1365 kg ha^{-1}), yield of seed (2603.7kg/ha), harvested index of lint (65.8), harvest index of seed (224.4) and oil content (25.9%). Thus the seed yield of 2603.7 kg ha^{-1} and lint yield of 1365kg/ha, was greatly influenced by 120kg/ha followed by control 0Nkg/ha with 1218kg ha^{-1} seed and 700.1 kg/ha lint (Table 1 and 2).

Sowing dates response

All the characters were greatly influenced by sowing dates except 50% flowering in season one (Table 1 and 2). Almost all characters were adversely affected by early and late sowing were found with decrease in yield of lint and yield of seed kg/ha (508.3 and 814.5 kg ha^{-1}) and (927.1 and 896.9kg/ha^{-1}) respectively. The characters as influenced by July 15 sowing date showed significantly maximum effects for plant height (76.1 cm), number of leaves /plant (52.0), 50%flowering (78.3), yield of lint (1724.7 kg ha^{-1}), yield of seed (3638.6g), harvested index of lint (89.7), harvest index of seed (99.3) and oil content (27.9%). Thus the seed yield of 3638 kg $ha^{-1}$and lint yield of 1724.7 was greatly influenced by July 15 sowing date followed by august 5 sowing date with 896.9 kg ha^{-1} seed and 508kg/ha (Table 1 and 2).

Results of sowing dates effects are quite in harmony with the findings of many researchers [18-26] who have worked on sowing date management trials and suggested that the proper sowing time affects the growth and yield parameters in cotton. They also reported that early and late sowings were attributed with decreased seed cotton yield. In the light of these facts, further advantages of right time of planting may increase productivity of cotton. Performance under late sown conditions needs to be assessed with regards to the production potential. As stated by several workers that though earliness in cotton is an inherent varietal trait, it is also influenced by the prevailing weather conditions and cultural practices [27, 28].

Table 1: Summary of the ANOVA table for Sowing Dates, Cultivars and Nitrogen Application on Growth and Productivity on Cotton Crop for two seasons

Characters	SEASON	V	N	S	V×N	V×S	N ×S	V×N× S
		d.f =1	d.f =2	d.f =2	d.f =2	d.f =2	d.f =4	d.f=4
Plant height (cm)	2012/13	391.0^{NS}	548.7*	439.4^{NS}	113.4^{NS}	90.9^{NS}	247.6^{NS}	138.2^{NS}
	2013/14	23.0^{NS}	43.7^{NS}	5482.9**	110.8^{NS}	868.8*	83.5^{NS}	608.8*
No. of leaves	2012/13	79.2^{NS}	150.8^{NS}	400.2**	70.5^{NS}	30.9^{NS}	114.0^{NS}	30.5^{NS}
	2013/14	451.2*	139.7^{NS}	3060.2**	36.1^{NS}	441.1*	25.3^{NS}	141.0^{NS}
50%flowering	2012/13	0.1^{NS}	26.2^{NS}	81.1^{NS}	14.7^{NS}	110.0^{NS}	11.2^{NS}	14.0^{NS}
	2013/14	34.2^{NS}	98.0*	450.7*	38.7^{NS}	31.2^{NS}	37.7^{NS}	24.1^{NS}
Yield of lint kg/ha	2012/13	96190^{NS}	529994*	6796434**	671316*	686202*	240338^{NS}	127080^{NS}
	2013/14	269975**	2891140**	1204181**	158100*	1073452**	779469**	151194**
Yield of seeds kg/ha	2012/13	1867770^{NS}	1246776^{NS}	3.3**	4117267**	500292^{NS}	853207^{NS}	60513.0^{NS}
	2013/14	64129^{NS}	1942690*	6654312**	567843^{NS}	1239279*	622141^{NS}	1096473*
Lint index	2012/13	0.6NS	16.6*	21.6*	2.0^{NS}	15.0^{NS}	20.1*	21.7*
	2013/14	13341.9**	4703.2**	19134.9**	253.0*	24137.7**	4221.4**	632.5**
Seeds index	2012/13	2.6^{NS}	1921.3**	4421.0**	1790.2**	25.9^{NS}	1443.9**	1820.0**
	2013/14	499^{NS}	45484**	114732**	57504**	987**	2862**	18098**
Oil content	2012/13	17.4**	17.2**	7.4**	15.6**	17.3**	21.9**	13.5**
	2013/14	7.2**	18.1**	29.7**	11.9**	5.9**	4.8**	7.4**

V= Cultivars, N= Nitrogen fertilizer, S= Sowing date
NS = not significant, *= significant at 0.05%, **=highly significant at 0.01

Table 2: Sowing date and nitrogen application, response on agronomic, yield and yield compute of two cultivars of cotton at growth under rain fell season one 2012/13

	Cultivars		Sowing date			Dose of nitrogen application		
	Burhan	**khalifa**	**15th July**	**26th July**	**5th August**	**0kg/ha**	**60kg/ha**	**120kg/ha**
Plant height	70.6^{A}	71.7^{A}	76.1^{A}	76.8^{A}	60.4^{B}	68.6^{B}	68.3^{B}	76.6^{A}
Nu. of leaves	42.8^{A}	43.1^{A}	52.0^{A}	44.0^{B}	32.8^{C}	42.6^{B}	37.7^{C}	48.6^{A}
50% flowering	68.5^{A}	68.4^{A}	66.1^{A}	69.2^{A}	70.1^{A}	69.8^{A}	67.7^{A}	67.8^{A}
Lint kg/ha	1124.8^{A}	1209.2^{A}	1724.7^{A}	1268.1^{B}	508.3^{C}	1074.7^{A}	1061.4^{A}	1365.0^{A}
Seed kg/ha	2492.5^{A}	2120.5^{A}	3638.6^{A}	2353.8^{B}	927.1^{C}	2102.9^{A}	2212.9^{A}	2603.7^{A}
lint Index	6.2^{A}	6.0^{A}	4.9^{B}	6.6^{A}	6.9^{A}	89.2^{B}	96.8^{A}	65.8^{C}
Seed Index	170.8^{A}	162.7^{A}	99.3^{C}	148.5^{B}	255.5^{A}	128.4^{C}	150.6^{B}	224.4^{A}
Oil content (%)	25.9^{B}	26.7^{A}	27.4^{A}	25.9^{B}	25.6^{C}	25.7^{B}	27.4^{A}	25.7^{B}

Table 3: Sowing date and nitrogen application, response on agronomic, yield and yield compute of two cultivars of cotton at growth under rain fell season one 2013/14

	Cultivars		Sowing date			Dose of nitrogen application		
	Burhan	**khalifa**	**15th July**	**26th July**	**5th August**	**0kg/ha**	**60kg/ha**	**120kg/ha**
Plant height	48.8^{A}	53.5^{A}	69.3^{A}	59.3^{A}	24.9^{B}	46.5^{A}	52.6^{A}	54.3^{A}
Nu. of leaves	29.3^{A}	29.1^{A}	47.7^{A}	30.4^{B}	9.5^{C}	22.9^{A}	25.8^{B}	38.9^{A}
50% flowering	72.1^{A}	73.7^{A}	78.3^{A}	72.1^{B}	68.4^{B}	72.9A^{B}	70.6^{B}	75.3^{A}
Lint kg/ha	1146.8^{A}	1005.4^{B}	1331.7^{A}	1082.2^{B}	814.5^{C}	700.1^{C}	1497.8^{A}	1030.5^{B}
Seed kg/ha	1631.8^{A}	1562.9^{A}	1905.9^{A}	1989.2^{A}	896.9^{B}	1218.1^{B}	1795.4^{A}	1778.5^{A}
lint Index	99.6^{A}	68.2^{B}	78.0^{B}	54.7^{C}	119.1^{A}	89.2^{B}	96.8^{A}	65.8^{C}
Seed Index	170.8^{A}	162.7^{A}	99.3^{C}	148.5^{B}	255.5^{A}	128.4^{C}	150.6^{B}	224.4^{A}
Oil content (%)	27.3^{A}	26.6^{B}	27.9^{A}	27.5^{B}	25.5^{C}	27.1^{B}	27.9^{A}	25.9^{C}

Interactions

Interactions (sowing dates, cultivars and nitrogen) were also significant for harvesting index of lint and seed and oil Constance (Table 3). The cotton cultivar khalifa, 120kg/ha^{-1}N` and sown on July 15 (Table 3) manifested significantly higher plant height (89.9cm), number of leaves (73.6), 50% Flwoering (75d ays), yield of lint (2226.0kg/ha) and yield of seeds (4190.1kg/ha), hovering index of lint and seeds(195.8kg/ha,(425.7kg/ha) and oil content (30.7), The interaction results showed that the lint and seed yield kg/ ha was significantly higher (2226 kg ha^{-1} and 4190.1kg/ha^{-1}) in cotton cultivar khalifa with July 15 and 120kg/ha N followed by Burhan with same date with average lint and seeds of yield of 1827.1 and 3093.1 kg ha^{-1}, respectively.

Sowing of cotton cultivar khalifa on July 15 with 120kg/ha N applied found the good growth and yield also desirable for micron ire and showed improvement as sowing delays, Results obtained from cultivars grown on July 15 and 120kg/ha N dose are in line with the findings obtained by Mascagni and Boquet [29], Soomro *et al.;* (2000), Hassan *et al.;* [15], Mushtaq *et al.;* [30], Niazi [22], and Ali *et al.;* [25].

CONCLUSION AND RECOMMENDATIONS

The nitrogen response was consistent across sowing dates and varieties for all data collected. Nitrogen application (120 kg N ha-1) in early planted cotton gave the highest plant growth, yield of lint and seed kg/ha-1 and oil content. The period from the first of July to the mid of it can be considered as the optimum sowing date for yield of the cotton seeds (khalifa - var) at Sudan and under rain fed condition.

Table 4: Interaction amongst of sowing dates x cultivars x nitrogen application for agronomic, yield and oil contented in cotton crop.

	Burhan									khalifa								
	Sowing One			Sowing Tow			Sowing Three			Sowing One			Sowing Two			Sowing Three		
	0N	1N	2N	0N	1N	2N	0N	1N	2N	0N	1N	2N	0N	1N	2N	0N	1N	2N
Plant height	71.4	69.2	89.9	64.1	71.7	81.8	53.9	70.9	49.4	71.4	69.2	89.9	64.1	71.7	81.8	53.9	70.9	49.4
Nu. of leaves	44.2b	43.6b	73.6a	43.0bc	40.7b	51.0a	27.1c	36.0b	26.0c	47.2b	44.2b	59.3a	44.5b	36.5bc	48.4a	49.5a	25.1d	33.1c
50% flowering	67.7^{A}	67.7^{A}	67.7^{A}	73.3^{A}	73.3^{AB}	73.3^{AB}	70.7^{A}	70.7^{A}	70.7^{A}	64.7b	62c	64b	70.7a	69.5ab	67ab	71.7ab	71ab	75a
Lint kg/ha	1892.8c	1153.8c	1338.6b	1148.1c	1267.2c	1712.6ab	725.4e	309g	575.8f	1645.8a	2091.1a	2226a	776.4ef	1000.8^{de}	1703.5ab	259.6g	546.3fg	
Seed kg/ha	3889.8^{a}	3889.8^{a}	3889.8^{a}	3225.8^{abc}	3225.8^{abc}	3225.8^{abc}	1407.7^{defg}	1407.7^{defg}	1407.7^{defg}	2294.1^{bcde}	2294.1^{bcd}	2294.1^{bcd}	1391.8^{def}	1391.8^{def}	1391.8^{def}	408.0^{g}	408.0^{g}	408.0^{g}
lint Index	4.8^{CDE}	4.8^{CDE}	4.8^{CDE}	7.3^{ABCD}	7.3^{ABCD}	7.3^{ABCD}	7.8^{ABC}	7.8^{ABC}	7.8^{ABC}	4.1^{CDE}	4.1^{CDE}	4.1^{CDE}	4.4^{CDE}	4.4^{CDE}	4.4^{CDE}	10^{AB}	10^{AB}	10^{AB}
Seed Index	49.6c	49.6c	49.6c	23.0^{hi}	23.0^{hi}	23.0^{hi}	32.8^{e}	32.8^{e}	32.8^{e}	115.8a	115.8a	115.8a	18.7^{ij}	18.7^{ij}	18.7^{ij}	30.9^{efg}	30.9^{efg}	30.9^{efg}
Oil content (%)	28.8^{C}	28.8^{C}	28.8^{C}	25.7^{HI}	25.7^{HI}	25.7^{HI}	24.1^{K}	24.1^{K}	24.1^{K}	24.6^{J}	24.6^{J}	24.6^{J}	23.9^{K}	23.9^{K}	23.9^{K}	27.4^{E}	27.4^{E}	27.4^{E}

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