CHAPTER ONE

INTRODUCTION

Cotton (*Gossypium spp.* L), the white gold or the king of the fiber accounts for 75% of the fiber used in textile industry and contributes 4% of the GDP in India (sankarnaryanan *et al.*, 2010). Cotton is grown in about 76 countries, covering more than 32million hectares, under different environmental conditions worldwide and world cotton commerce is about US$20 billion annually (Saranga *et al*., 2001). Upland cotton is a natural fiber of great economic importance as a raw material for cloth; and is predominantly cultivated in most of the cotton producing countries of the world including Pakistan (Aiken, 2006).The major cotton producing countries are United States, China, India, Pakistan, Uzbekistan, Brazil, Australia, Egypt, Argentina, Turkey, and Greece. Cotton (*Gossypium hirsutum L.*). is a soft fluffy staple fiber plant of the genus *Gossypium* and belongs to family Malvaceae, the plant is a shrub native to tropical and subtropical regions around the world including, it a principal source of raw material for the world textile industry and its dominant position has been seriously eroded by synthetic fibers. The most important product of the cotton plant, other than the cotton itself, is the cotton seed. The lint is used for felting, stuffing, absorbent cotton and other purposes (Anonymous, 2002). Cotton is significant source of foreign exchange earnings. It accounts for 10.5 percent of the value addition to providing raw material to the local textile industry; the surplus lint cotton is exported, (Anonymous, 2005). The cotton grass in Tundra is food for the migrating caribou and snow geese. They also provide food to the large heath butterfly as well as the black grouse. The seed heads are used as wicks in oil lamps by the Inuit of the Inuktitut. They were also used to stuff pillows as an alternative to geese feathers. The introduction of cotton in the central Sudan, (Gezira,1925) was

preceded by the establishment of the cotton based Agricultural Research at (Shambat,1904 and wad Medani,1918) where basic scientific information had been availed on agricultural environment, varieties, cultural practices and crop protection Up to the 1980th cotton had been the predominant research area of Agricultural Research Corporation, (ARC), due to the government priority and full support for commercial cotton production at that time. Cotton is the most important cash crop and plays a vital role in the economy of Sudan, Unfortunately it's per hectare yield is very low as compared to other cotton growing countries of the world. It is partly due to the unawareness of various agronomic practices. One of the most important agronomic considerations for growers to optimize yield and quality is to select an appropriate sowing date for a crop of cotton, *(*Tange*r, et al.,* 2006*).* Choosing the best time of sowing in a particular region can often be difficult, as it is a decision that must strike a balance between sowing too early and enduring problems associated with rain fall, or sowing too late and losing potential yield *(*Akhtar *et al,* 2002*).*Cotton is also produced under rain-fed condition that has never the less been characterized by highly instable areas. Rain-fed cotton has been introduced as early as the last nineteen-twenties in the "Nuba Mountains" in the southern parts of western Sudan with relatively reasonable rainfall amounts. Its cultivation was expanded during the nineteen-forties to the semi-mechanized areas of central Sudan in crop combination including sorghum. The Sudan has a long history of cultivating extra-long staple cotton, but the spectrum of its types has broadened to include long, medium and short staple cotton. Out of 203 thousand ha, has grown with cotton in season 2003/2004, 118 thousand ha (58%) were under the long-staple variety "Barakat", 77 thousand ha (38%) under the medium-staple"Acala" and 8 thousand ha (4%) under the short staple varieties "Nuba and Acarain"(Babiker, 2014).

The target area Nuba Mountains is one of the most important areas of cotton production in Sudan. Despite it is importance, there is scant recommended package for that area based on the results of ARC, (personal communication). Accordingly, farmers are advised to use the recommended packages for the nearby rain-fed areas, which might not give the optimum production. Even though, majority of the farmers are not aware by the best technical packages and don't use any types of fertilizers. On the other hand, the specialty of the study area should be taken in consideration, as the study area are some-how affected with climate changes, the pattern of rain fall fluctuation changes, hence, new technical packages is needed. The history of cotton production goes back to 1923 when the first trials were started by the ministry of Agriculture, (Mohamed, 1998)

1.2 The Objectives of the Research were:

1- To study the effect of different sowing date, Nitrogen fertilizer and cultivars on growth, yield, yield component, oil production and fiber characteristic of two cotton cultivars (*Gossypium hirsutum L.)* at south kordofan state.

2- To study the Effect of nitrogen fertilizer on growth, yield, yield component, oil production and fiber characteristic of two cotton cultivars (*Gossypium hirsutum L.)* at south kordofan state

CHAPTER TWO

LITERATURE REVIEW

2.1General

Cotton is of tropical origin but is most successfully cultivated in temperate climates with well-distributed rainfall. All western U.S. cotton and as much as one-third of Southern cotton, however, is grown under irrigation. In the United States nearly all commercial production comes from varieties of upland cotton (*G. hirsutum*), but small quantities are obtained from sea-island and American-Egyptian cotton (both belonging to the species *G. barbadense. G. arboreum and G. herbaceum* are the chief cultivated species in Asia. Cotton requires a lot of sunshine temperatures between 60 to 95 degrees Fahrenheit (16-35 degrees Celsius), Cotton plant starts from seeds, the seeds germinate in 5 to 10 days and the cotton plant begins its growth with two cotyledons (the seed leaves that form nodes opposite each other at the base of the main stem) until the plant forms true leaves (leaves produced subsequent to the cotyledons). Cotton has a tap root system and roots go deeper into the soil for search of nutrients. Development of a healthy root system for acquiring soil nutrients is vital to feed the growing plant.

2.2 Cultivation:

Successful cultivation of cotton requires a long frost-free period, plenty of sunshine, and a moderate rainfall, usually from 60 to 120 cm (24 to 47 in). Soils usually need to be fairly heavy, although the level of nutrients does not need to be exceptional. In general, these conditions are met within the seasonally dry tropics and subtropics in the Northern and Southern hemispheres, but a large proportion of the cotton grown

today is cultivated in areas with less rainfall that obtain the water from irrigation. Production of the crop for a given year usually starts soon after harvesting the preceding autumn. Cotton is naturally a perennial but is grown as an annual to help control pests. Planting time in spring in the Northern hemisphere varies from the beginning of February to the beginning of June. The area of the United States known as the South Plains is the largest contiguous cotton-growing region in the world. While dry land (non-irrigated) cotton is successfully grown in this region, consistent yields are only produced with heavy reliance on irrigation water drawn from the Ogallala Aquifer. Since cotton is somewhat salt and drought tolerant, this makes it an attractive crop for arid and semiarid regions. As water resources get tighter around the world, economies that rely on its face difficulties and conflict, as well as potential environmental problems (Jane McIntosh, 2008).

2.3 Adaptation:

Cotton seed requires a warm soil conditions and thus, planting can start as soon as soil temperature is warm enough to establish a healthy crop seedlings. It is an established fact that cotton is a perennial plant that is produced as an annual, so very responsive to environmental conditions Planting a crop too early appears with poor crop stand that results lower yield potential and alternately, planting too late commonly becomes very vegetative and difficult to manage resulting in lower seed cotton yield as well. Cotton grass in tundra is able to survive when other trees fail to flourish this is because of certain adaptations. This plant is a perennial that has narrow leaves and flowering heads that have dense bristles. This helps them survive for a long time in form of white hair. The adaptation has helped it sweep across when there are heavy winds. Also, they are able to carry out photosynthesis in low

temperatures, low light intensity as well as survive long daylight times. They spread their seeds with the help of wind pollination. Rain-fall (often less than 50 mm annually) that patterns of seasonal distribution are of minimal ecological significance. More commonly, wild cottons grow in areas of less extreme aridity, but the annual rainfall is still less than 500 mm in most cases. However, where the total amount of rainfall is higher, the seasonality becomes of greater significance. Many parts of the tropics are characterized by wet-season, dry-season cycles, often with an extreme contrast between the two seasons. In such regions, the total amount of rainfall is an imperfect index to the climatic impact of precipitation on vegetation. The wild cottons have adopted different strategies to enable them to survive the aridity and to evolve in the different regions, in which they occur, as will be discussed subsequently (Hakoomat, *et al.*, 2009).

2.4 Temperature:

Significantly effects phrenology leaf expansion internodes elongation biomass production and the partitioning of assimilation to different plant parts (Sankaarnaryanan, *et al.*, 2010). The duration of planting to First Square and first flower to boll opening are two main periods in which genotypic and genotypic environment variability is most frequently accounted (Reddy, *et al.*, 2002). Whereas the first square to first flower period seems to be genotypic in dependent. Higher temperature in addition to reducing the crop duration reduced the retention of bolls and boll weight. It is essential to study the quantitative relationships which account for the effects of plant and environmental factors on reproductive allocation (cadras, *et al.*, 2001). High temperature or drought during the elongation phase of fiber

uniformity and can cause high. Or even under extreme condition low micron ire (Raney, 2001).

2.5 Soil:

General statements about the soil types typical of *Gossypium* habitats are difficult to make because few data are available. Apparently a majority of the species grow on well-drained soils, however, often on relatively steep slopes with excellent drainage. Some desert species show a preference for growing in dry or intermittent stream beds (arroyos), often in nearly pure sand, where water is preferentially available on the relatively rare occasions when rain falls (often flash floods), but where water nevertheless quickly drains away (Sankaarnaryanan, *et al*., 2010).

2.6 Sowing Date:

One of the most important agronomic considerations for growers to optimize yield and quality is to select an appropriate sowing time for cotton crop. Choosing the best time of sowing in a particular region can often be difficult, as it is a decision that must strike a balance between sowing too early and enduring problems associated with cold weather or sowing too late and losing potential yield. Sowing too early, when cold weather can be predominant slows crop growth often leading to poor establishment, poor early growth and exposes the crop to many seedling diseases (Bange and Milroy, 2004). Sowing when conditions are warmer reduces the risk of poorer establishment because the crop grows more vigorously. Sowing late however, will reduce season length and ultimately will reduce yield.

2.7 Nitrogen Fertilizer:

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 (Hou *et al*., 2007: Rosolem and van Melis, 2010) One aspect of N nutrition in cotton is its effect on fiber quality. However, the results are varied (Reddy, *et al.*, 2004). (Boquet, 2005) believe that fiber properties such as fiber length, strength, and micronaire will not be appreciably compromised or improved by N application rate unless the crop is under severe N-deficient condition.

2.8 Cultivars:

The development of transgenic cotton cultivars gives cotton producers more options for controlling pests, but their value to producers depends not only on the cost-savings that they may contribute to the pest management systems employed, but also on the gross revenues from the sale of the crop produced. Thus, the overall value of transgenic cultivars depends on their yield and quality, as expressed in the context of the pest management system whose use is possible because of their genetic modification (May *et al*., 2009). Comprehensive economic evaluation of cotton cultivars with pest-managing traits may require evaluation in systems trials in which the different types of cultivars are evaluated against one another in terms of net returns with each cultivar employing the pest management system consistent with its pesticide tolerances and pest resistances (May *et al*., 2011).cultivar selection is also a key management component in any cropping system even more critical in plant spacing and sowing date for cotton production, although high yield potential is a

predominant consideration, However, maturity, plant size and fiber properties are also major factors to consider There are some other factors such as crop stand, fertilization, day length, salinity, soil fertility status, plant protection measures and environmental condition which as affect Acre yield of cotton. Seed requires a warm soil conditions and thus, planting can start as soon as soil temperature is warm enough to establish a healthy crop seedlings. It is an established fact that cotton is a perennial plant that is produced as an annual, so very responsive to environmental conditions. Testing cotton cultivars has become increasingly difficult with the introduction of cultivars with different maturities and value added traits related to crop management (Hakoomat, *et al*., 2009)

2.9 Effect of Sowing Date on Cotton:

Planting date management not only has a large effect on crop growth, development, and yield but it also impacts insect pest management, reduced season management, of which early planting plays a major role, has become increasingly important in recent years. The ability to plant and establish a crop early, carry it through the primary fruiting cycle in a timely and efficient manner, followed by early termination; has become increasingly Sowing time has very important role in realizing maximum seed cotton yield in a country like Pakistan where the climatic conditions differ from province (Saraz, 2008: Soomro *et al*., 2000) 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 (Hosny and Shahine, 1999), (Ansari and Mahey ,2003).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 (Brown and Zeiher, 2000)

2.10 Effect of Nitrogen on Cotton:

In crops like cotton, excesses of N delay maturity, promote vegetative tendencies, and usually result in lower yields 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 (Sawan, *et al.*, 2006). However (Hussain, *et al.,* 2000) 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. However, the results are varied, (Reddy *et al.*, 2004*).* (Boquet, 2005) believe that fiber properties such as fiber length, strength, and micronaire 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. Fertilizer application of 120 kg N ha^{-1} proved to be best nitrogen level for obtaining high boll weight, seed cotton yield and GOT. The findings of study may be useful in breeding programs as fiber quality traits were more influenced by cultivars than the nitrogen levels. 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 and 120 kg N $ha^{-1}$was proved to be the best nitrogen level for obtaining higher yield and lint percentage. (Saleem, 2010), (Reddy and Reddy, 2012) study the response to nitrogen applied through fresh and composted. Growth characteristics, such as plant height, unbar of main stem nodes, number of nodes above white flower. And lint yield. Composting the litter, however, did not improve its effectiveness as an N source for cotton. The second generation nitrification inhibitor carboxy methylpyrazole had no significant effect on cotton growth or lint yield. Applying poultry litter to row crops like cotton as substitute for commercial fertilizers, such as urea, can help in the safe utilization of poultry litter, which is growing problem in the south eastern United States. Use of poultry litter rather than commercial fertilizer has the advantages of not only benefiting the growth of cotton, but also making use of an inexpensive local nutrient source and at the same time, ameliorating the ever-increasing poultry litter disposal problem, (Mohamed, *et al*., 2016) examined crop response tingle-nutrient fertilizers in long-term trials, over two seasons, in a 3-4 course rotation. These results showed the response to 190 kg ha-1 of urea was consistent and significant in all two season. The fertilization practice adopted in Gezira for cotton production was the application of 86 kg N ha-1 in the form of urea supplied 6 to 8 weeks after sowing followed by green ridging. In all regions and treatments, the higher dose of fertilizers applied brought higher yields. However, evidence for the relatively poor response of cotton to urea fertilization alone, and sometimes resulting in a negative impact in terms of yield, provided the driving force for research testing of multi-nutrient fertilizers. (Ali, *et al.*, 2002) Nitrate (ASN) or Ammonium Sulfate (AS) in comparison with urea. This finding may result from the greater availability of N in ASN and AS forms and the likelihood of the loss of N from urea by volatilization as ammonia (NH3). The beneficial effect of the

additional P and K on cotton yields over that of N alone is clearly evident from the results effect of sowing date and cultivars on cotton

2.11 Effect of Cultivars on Cotton:

Earliness in a cotton cultivar is important to minimize exposure of the primary fruiting cycle to the hot, humid monsoon weather which increases fruit loss and abortion resulted in lower yield potential. The presence of both early and late maturing cultivars in the same test provides an additional challenge because the crop must be managed in a manner that does not favor one cultivar over another to avoid bias in testing. For instance, many current cultivars possess genes for resistance to the herbicide glyphosate. Obviously, the use of this herbicide would damage conventional cultivars that would give the transgenic cultivars a competitive advantage in the test. When testing a range of maturities, the problem is more subtle, but the potential for bias still exists (Bourland, *et al*., 2000)

Cotton fiber quality is mainly influenced by genotype of the cultivars but agronomic practices and environmental conditions are the secondary factors influencing fiber quality (Subhan, *et al*., 2001).

2.12 Effect of Cultivars and Sowing Date on Cotton:

Agronomists have also developed new cultivation practices adapted to late planting with the aiming of accelerating the crop cycle, while reducing the vegetative vigor, thus, agronomic management does not promote excessive crop growth that delays maturity. Therefore, optimum sowing date for a cultivar in a region is considered to be the most important manageable factor in cotton crop similarly, other scientists investigated the sowing dates from May 1 to June 16 with six cotton cultivars and reported that regardless of the cultivars, best results were obtained with the crop planted on May 16 Most cotton cultivars grown commercially, posses the normal leaf type while leaf shapes of okra leaf cultivars can perform better in late planting

by altering canopy structure and light interception characters as these leaves are characterized by moderately cleft leaves and relatively small leaf area and typically, they have less vegetative growth and early maturity with greater flower production capacity Therefore, cultivar selection is also a key management component in any cropping system even more critical in plant spacing and sowing date for cotton production, although high yield potential is a predominant consideration, however, maturity, plant size and fiber properties are also major factors to consider There are some other factors such as crop stand, fertilization, day length, salinity, soil fertility status, plant protection measures and environmental condition which also affect acre, Yield of cotton A group of scientists in the country has opinions with their findings that early sown cotton produces taller plants with higher number of sympodial and monopodial branches, boll number, seed index and seed cotton yield These findings are also supported in other countries by researchers who reported that higher seed cotton yield due to early sowing was mainly attributed to higher boll number and seed index, similarly, cotton yield declines with delay in sowing due to the shorter time available to initiate and mature an adequate number of bolls. In USA, a scientist reported that early planting increased the cotton yield by shifting the flowering period earlier (Hakoomat, *et al*., 2009)

2.13 Cotton Picking:

Picking time in cotton is very important phase and affects the quality of lint. Usually cotton picking is practiced by the grower thrice during whole cotton growing period. Due to inclement weather condition of Hyderabad, lower Singh and fluctuations in minimum and maximum temperature and relatively higher humidity levels (more than 65%) there is deterioration in the quality and viability of seed. The effects of different picking treatments intervals in minimizing the effect of low temperature, excess air moisture and effects of delayed picking in deteriorating the fiber quality

traits i.e., fiber length and strength delayed pickings was reported in earlier findings of (Soomro, *et al*., 2004) reported higher values of staple length, fiber maturity and strength as result of frequent pickings intervals with 15 days obtained in early picking treatments. Picking of cotton crop is a very important phase for the grower as it is directly related to quality and consequently to its price in the market. In Pakistan, cotton is picked thrice or more times taking just the open bolls. In this way, immature bolls are also taken away with the fully matured bolls irrespective of the plant position, which lowers the uniformity and evenness of the fiber. Thus picking intervals must be maintained to obtained quality cotton fiber. The fiber quality of the open boll is affected by an array of factors, which can be grouped into two categories pre-harvesting and the post-harvesting. It is necessary to consider all post harvesting factors and subsequent operations involved in handling, storage, seed removal and fiber processing likely to affect fiber quality after picking. Nevertheless some factors affecting earlier stages must be taken into consideration in terms of their possible influence on the succeeding ones. Improved practices and better harvesters may preserve fiber quality and lower the cost (Bradow and Davidonis, 2000).

2.14 Cotton Fiber:

Cotton fiber is composed of concentric layers. The cuticle layer on the fiber itself is separable from the fiber and consists of wax and pectin materials. The primary wall, the most peripheral layer of the fiber, is composed of cellulosic crystalline fibrils. The secondary wall of the fiber consists of three distinct layers. All three layers of the secondary wall include closely packed parallel fibrils with spiral winding of 25-35^{o} and represent the majority of cellulose within the fiber. The innermost part of cotton fiber- the lumen- is composed of the remains of the cell contents. Before boll opening, the lumen is filled with liquid containing the cell nucleus and protoplasm.

The twists and convolutions of the dried fiber are due to the removal of this liquid. The cross section of the fiber is bean-shaped, swelling almost round when moisture absorption takes place, (Duckett, 2003). During scouring (treatment of the fiber with caustic soda), natural waxes and fats in the fiber are saponified and pectin's and other non-cellulose materials are released, so that the impurities can be removed by just rinsing away. After scouring, a bleaching solution (consisting of a stabilized oxidizing agent) interacts with the fiber and the natural color is removed. Bleaching takes place at elevated temperature for a fixed period of time. Mercerization is another process of improving sorption properties of cotton. Cotton fiber is immersed into 18- 25% solution of sodium hydroxide often under tension. The fiber obtains better luster and sorption during mercerization. After scouring and bleaching, the fiber is 99% cellulose. Cellulose is a polymer consisting of anhydroglucose units connected with 1, 4 oxygen bridges in the beta position. (Duckett, 2003)

2.15 Ginning Out Turn (GOT %):

Ginning out-turn is a useful indicator of the performance of a genotype. Ginning out-turn can be described as the percentage of lint obtained from a sample of seed cotton. Genotypes with high ginning out-turn values are thus preferable, because they yield more lint, the percentage weight of lint in seed is known as ginning out-turn (GOT %), and is its value usually around one third of the total cotton seed weight. It fair to use this percent for a quick conversion of seed cotton figures into lint, **(**Emeetai-Areke, 2000)

2.16 Fiber Quality

The following are the main factors that contribute to fiber quality:

2.16.1 Fiber length:

This is the length of the fiber or staple length in mm and is one of the fiber quality characters that are important to the textile industry **(**Emeetai-Areke, 2000)

2.16.2 Fiber Strength:

This quality characteristic is useful to spinners. High tensile strength of the fiber is needed for good spinning, especially with fast modern spinning machines. The strength of the fibre is determined by securing a bundle of fiber between clamps set 32 mm apart and measuring the force required to break the fiber **(**Emeetai-Areke, 2000)

2.16.3 Micronaire (Fiber Fineness):

Micronire measurements reflect fiber fineness and maturity. A constant mass (2.34 grams) of cotton fibers is compressed into a space of known volume and air permeability measurements of this compressed sample are taken. These, when converted to appropriate number, denote Micronaire values (Gordon Cook, *et al*., 2010). The texture of cotton fiber is determined. Cotton fiber may be classified as Soft and silky or coarse and harsh. Fineness is expressed in micronaire units. Micronaire is a measure of the rate at which air, at standard pressure, flows through a standard volume of cotton lint. The finer the fiber, the slower the rate of airflow and hence the lower the micronaire value. This quality characteristic is also important in the selection of fiber that is suitable for manufacturing a particular product **(**Emeetai-Areke, 2000)

2.16.4 Uniformity of Fiber Length:

This is also an important lint quality characteristic which is indicative of the Maturity of the fiber. The value is taken as a ratio of 50% span length to 2.5% span

length of a sample of combed fiber. This value is important in Determining the spinning performance and utility of the lint. Higher values are an indication that the yarn spun from such fiber will be uniform in size and Strength and that less fiber will be wasted **(**Emeetai-Areke, 2000)

2.17 Oil Content:

Cottonseed Oil is the oil extracted from the seeds of various species of cotton plants. Generally, there is 18% oil content in cottonseeds. It is pale yellow in color and is widely used for cooking. Cottonseed comes after Soybean, Corn and Canola (rapeseed) in the list of genetically modified crops. Various species of cotton is grown all around the world. The (Gossypium herbaceum L.) species are more generally used to extract oil. But it should be mentioned that most of the cotton production of the US is used in the textile industry. Seed oil content was unchanged with increased as N- rate oil yield ha^{-1}significantly (32.9kg ha-1) which is attributed to the increase in seed yield applied N at rate of 25 or 50 kg ha -1 to cotton plants and found that the percentage of seed oil content decreased but oil yield in creased with increased N rate .application of all growth retardants resulted in an in significant increase in seed oil content above the control and also significantly increased the oil yield ha-1 over the control (29.3-45.2 kg oil ha-1) with the clearest effect from pix (45.2 kg ha-) followed by cycocel (Sawan, *et al.,* 2001).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Location:

A Field experiments were carried out under rain-fed area during two consecutive cropping seasons, 2012/2013 and 2013/2014 at the Demonstration Farm of the Faculty of Agricultural Sciences, University of Dalanj, South Khordofan State - Sudan. To Study the Effect of sowing dates, cultivars and nitrogen on growth, yield, yield components, fiber characteristic and oil content of cotton Crop (*Gossypium hirsutum* L.) at Nuba Mountains (NMs), region, which 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 layout of the experiment was Normal Factorial Experiments, with Randomized Complete Block Design with three replications. The treatments were three sowing dates and three doses of Nitrogen fertilizer as a source of nitrogen with two cotton cultivars that were (3 sowings x 3 nitrogen doses x 2 cultivars)

3.2 Treatments:

3.2.1 Sowing Dates:

Three Sowing dates via, (1) 15th July, (2) 26th July and (3) 4th August

3.2.2 Cultivars:

Two cultivars Burhan and Khalifa were used in this experiment (these two cultivars were newly recommended for rain-fed areas (Mustafa, *et al*., 2006).

3.2.3 Nitrogen:

The Two doses of Nitrogen in form of Urea was applied 60 and 120kg/ha, during sowing date, 2N split for two doses one during sowing date and the other after one month 120kg/ha and control 0N.

3.3 Design of Experiment:

Experiment was Normal Factorial Experiments, with Randomized Complete Block Design use three replications, the results of this study were analysis using ANOVA by Statistic (8). Replication contained 18plots to which different treatment were randomly a signed. The size of the plot was $3*3m^2$ and included 4 rows.

3.4 Land Preparation (L P):

The land preparation included disking harrowing, leveling and ridging at spacing of 70 cm, were applied seeds was planted at 50cm a spacing between seeds holes. The seed was planted on the top of the ridges 10 seeds/ hole.

3.5 Cultural Practices:

Weeds control was done by hand after two weeks of sowing and then as needed throughout the growing season. After 30 days from sowing, the plants were Thinning to three plants / hole in all sowing, in both two seasons.

Various measures and observations, as shown blow, were taken in both seasons, from a permanent sampling area of four rows. The four middle rows of each plot were saved for yield data.

3.6 Data Collection:

3.6.1 Stand Growth and Flowering:

3.6.1.1 Plant Height (cm): Five plants were tagged. Measuring started after 45 days of sowing as (reading one), after 60 days from sowing as (reading two), measured from a point immediately above the soil surface to the top of the plant.

3.6.1.2 Number of Leaves/ plant. Five randomly selected plants, were measured at 45 days and 60 days of sowing.

3.6.1.3 Stem Diameter (cm): measured on the stalk at the second internodes above the ground level using vernia instrument at maturity.

3.6.1.4 Number of Branches: measured at picking time from five randomly selected plants

3.6.1.5 Days to 50% Flowering: 50% of flowers was measured after sowing, when each of 50% of the plants within a plot at least one flower.

3.6.1.6 Days to 100% Flowering: The number of days after sowing, when each of 50% of the plants within a plot bear at least one flower.

3.6.1.7 Number of Non-Productive Branches:

Measured at picking time from five randomly selected plants

3.6.1.8 Number of Productive Branches:

Measured at picking time from five randomly selected plants.

3.6.1.9 Leaf Area Index (LAI):

Leaf area index (LAI)**:** were measured on each of 5 randomly selected plants per Plot then the leaf area index was measured, the leaf was painted in securities graph Order to calculate leaf area index.

3.6.2 Yield and Yield Components Attributes:

Taken from each plots (treatments) length meter for according (lint yield kg/ha, seeds yield kg/ha, seeds cotton kg/ha, final yield lint kg/ha and seeds kg/ha lint index, and seed index and GOT ginning out turn

3.6.2.1 Number of Bolls/plant: the average of the five selected plants for three picking.

3.6.2.2 Seeds Cotton kg/ha:

Taken meter of length the middle ridges of each plot and then harvesting it from cotton seeds then weight of lint /length of meter kg/ha was determined for three picking

3.6.2.3 Lint Yield (kg/ha): taken meter of length the middle ridges of each plot and then harvesting it from cotton seeds then weight of lint /length of meter kg/ha was determined for three picking

3.6.2.4 Seeds Yield kg/ha: taken meter of length the middle ridges of each polt and then harvesting it from cotton seeds then weight of seeds /length of meter kg/ha were determined

3.6.2.5 Final Yield of Lint kg/ha:

Final yield of lint kg/ha =Total of three picking from Lint yield (kg/ha)

3.6.2.6 Final Yield of Seeds kg/ha:

Final yield of seeds kg/ha= Total of three picking from seeds yield (kg/ha)

3.6.2.7 Lint Index:

Taken from each plots (treatments) meter length for according weight lint kg/ha of lint of the samples of meter length for three picking. , the harvest index was calculated according to the following formula

Harvest index of lint = (weight of lint yield ×100)/(biological yield)

3.6.2.8 Seeds Index: Taken from each plots (treatments) meter length for according seeds kg/ha weight before threshing as biological yield kg/ha length meter estimating seeds yield kg/ha. Harvest index was calculated according to the following formula:-

Harvest index= (seed yield/kg/ha ×100)/(biological yieldkg/ha)

3.6.2.9 Ginning Out-Turns (G.O.T) %:

The proportion of lint to seed cotton expressed as percentage:

$$\text{Ginning out-turns (G.O.T)} = \frac{\text{weight of lint (Kg)}}{\text{Weight of seed cotton (Kg)}} \times 100$$

3.6.3 Fiber Characteristics:

3.6.3.1 Testing Laboratory:

Main cotton lint characteristics will carry out at the Fiber Cotton Testing Laboratory of Cotton Research Program, Wad Madani, Sudan, using High Volume Instrument (HVI) under standard testing conditions (temperature 20° C±2 and relative humidity 65% ±1). Stickiness level was measured (Eric, *et al.*, 2006)

3.6.4 Oil Percentage for Cotton Seeds:

Seed kernels were obtained by removal of the seed coat. The kernels were then ground into fine powder using a Moline grinder .The total oil content of the kernel was determined according to the Association of official Analytical Chemists (AOAC, 2016) procedure. Oil was extracted by petroleum ether (60-80^{o}c) in continues sox let extracting an apparatus using a sample of 2g of the kernel powder. The extraction was continued for eight hours for the separation of the oil. The

apparatus was carefully dismounted and the solvent in the flask was distilled to dryness in an air oven. The oil content was then calculated according to the following formula

$$\text{Oil \%} = \frac{\text{the weight of extract (Oil)}}{\text{Weight of sample (g)}} \times 100$$

3.6.5 Statistical Analysis:

The data were subjected to statistical analysis of variance (ANOVA) appropriate for Normal Factorial Experiments, with Randomized Complete Block Design arrangement in method as described by Gomez and Gomez (1984) mean separation were carried using the LSD. All statistical analysis was performed using Statistix (8) computer program. Associations between the different characters were measured by the correlation coefficient that gives an indication the degree of this relation.

CHAPTER FOUR

RESULTS

The results of the experiment conducted in two growing seasons (2012/2013 and 2013/2014) are ware presented in the form of tables for each of the parameters studied Furthermore, the combined analyses of variance for the collected dates from seasons were conducted for some of the parameter. In view of the fact that the dates for all parameters were analyses in accordance with the statistic (8), analysis of variance for the Normal factorial Experiments, with Randomized Complete Block Design RCBD, and three representative ANOVA ware presented in the Appendices.

4.1 Growth Attributes:

4.1.1 Plant Height (cm):

At the first reading the results showed that mid sowing date 26th July (S_2) sustained the highest mean of plant height at both seasons irrespective to the nitrogen level(Tables 1 and 5). However at the second reading, early sowing date 15th July (S_1) displayed the highest mean of plant height at both seasons, irrespective to sowing dates. Result showed that two cotton cultivars treated with 120kg N/ha ($_2$N) displayed the highest mean of plant height at all readings for the two seasons.

4.1.2 Number of Leaves /plant:

Analysis of variance on number of leaves per plant due to late sowing dates (S_3) and early sowing date (S_1) sustained the highest mean of leaves number at the first and second reading respectively for the first season. While at the second season, early sowing date 15th July (S_1) displayed the highest mean of number of leaves at the second reading, irrespective to the nitrogen level (Tables 2 and 5) with respect to

cotton khalifa treated with nitrogen, result showed that, 60kg N/ha ($_1$N) displayed the highest leaves number in the first reading at cultivar khalifa (C_2) irrespective to sowing date. However, at the second season, 120kgN/ha ($_2$N) sustained the highest leaves number at in both cultivars, at the second reading (Tables 2 and 5).

4.1.3 Stem Diameter:

Result showed that cotton Burhan (C_1) cultivar treated with, mid sowing date 26th July treated with 60kg N/ha (S_2*$_1$N) increased mean of stem diameter to 7.8 cm, at the first reading, in the first season. While, at the second season, cotton cultivar Burhan (C_1) treated with 120kg N/ha (C_1* $_2$N) displayed increasing stem diameter at the reading first, (Tables 3 and 5).

4.1.4 Number of Branches/ plant:

In the first season Result showed that cotton cultivars treated with late sowing date 4th August (S_3) displayed the highest mean of Number of branches at reading first reading, irrespective to the nitrogen level (Table 4). However, at the second early sowing date 15th July (S_1) sustained the highest mean of branches number in the first season. While at the second season, cotton cultivars treated with mid sowing date 26th July and early sowing date 15th July (S_2 and S_1) sustained the highest mean of branches number at the first and second reading, respectively,(Tables 4 and 5).

4.1.5 50% and 100% Flowering:

Result showed respectively that late sowing date 4th August (S_3) and mid sowing date 26th July (S_2), sustained the highest mean of flowering at 50% and 100% at the first season. While at the second season, early sowing date 15th July and late sowing date 4th August, (S_1 and S_3) gave the highest mean of flowering 50% and100% respectively, (Tables 6 and 9).

4.1.6 Number of Non-productive and Productive Branches:

Cotton cultivars treated with, mid sowing date 26th July and early sowing date 15th July ($S_2$and S_1) sustained the highest mean of productive at the first and second season, respective irrespective to the nitrogen level (Table 7 and 9). While, early sowing date 15th July (S_1) sustained the highest mean of non productive at both season. However, cotton Burhan and Khalifa ($C_1$and C_2) treated with 60kgN/ha ($_1$N) displayed the highest productively, at the first season. Cotton cultivars displayed the highest nonproductive at the first and second season. However, Burhan (C_1) treated with 120kg N/ha ($_2$N) gave the highest non productive at the second season.

4.1.7 Leaves Area Index:

Result showed that, late sowing date 4th August (S_3) sustained the highest mean of leaves area index at both seasons respectively, irrespective to nitrogen level (Table 8). However, Kalifa (C_2) treated with 0kg N/ha ($_0$N) displayed the highest leaves area index at the both seasons, (Table 8 and 9).

Table1. Effect of sowing dates and fertilizers on plant height of two cotton cultivars for two seasons, (Interaction).

Treatments		Plant height 2012/2013								Plant height 2013/2014							
		45 days (1)				60 days (2)				45 days (1)				60 days (2)			
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn
C1	0N	56.2^{abcd}	43.6^{bcd}	56.8^{abcd}	52.2	71.4^{abcd}	64.1^{cde}	53.9^{de}	63.1	47.9^{abc}	61.3^{ab}	5.3e	38.2	30.6^{de}	55.3^{bcd}	20.7^{e}	35.5
	1N	57.3^{abcd}	60.1^{abc}	52.1^{abcd}	56.5	69.2^{abcd}	71.7a^{bcde}	70.9^{abdc}	70.6	54.8^{ab}	62.5a	22.6^{de}	46.6	74.8^{abc}	62.5^{abc}	16.0^{e}	51.1
	2N	42.5^{bcd}	57.3^{abcd}	44.5^{bcd}	62.3	89.9^{a}	81.8^{abc}	49.4^{e}	73.7	60.3^{ab}	56.5ab	20.1^{de}	45.6	86.1a	62.0^{abc}	7.8^{e}	52
Xs		52	53.7	51.1		76.8	72.5	58.1		54.3	60.1	16		63.8	59.9	14.8	
C2	0N	68.7^{a}	60.7^{abc}	52.1^{ab}	60.5	71.4^{abcd}	63.1^{cde}	53.9de	63.1	53.1^{ab}	49.1^{abc}	15.1^{e}	39.1	77.9ab	49.2^{cd}	20.2^{e}	49.1
	1N	65.6^{cde}	43.6^{bcd}	45.8^{abcd}	51.7	69.2^{abcd}	69.7^{abcde}	72.9^{abdc}	70.6	38.4	49.9^{ab}	22.2^{de}	36.8	64.8^{abc}	59.9^{abc}	20.7^{e}	48.5
	2N	93.2^{a}	76.5^{abc}	49.3abcd	73.0	89.9^{a}	81.8^{abc}	49.4^{e}	73.7	38.2^{cde}	47.7^{abc}	49.2^{abc}	45.0	57.6^{bc}	54.1^{bcd}	53.3^{dce}	55
Xs		75.8	60.3	49.1		76.8	71.5	58.7		43.2	48.9	28.8		66.8	54.4	19.1	
CV%				26.8%				20.6%				32.5%				31.3%	
SE+-				11.6				7.0				11.4				13.1	

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 2. Effect of sowing dates and fertilizers on Number of leaves of two cotton cultivars for two seasons, (In

Treatment		Number of leaves 2012/2013								Number of leaves 20				
		45 days (1)				60 days (2)				45 days (1)				
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn	S1
C1	0N	23.9^{BCDE}	18.9^{CDE}	26.1^{ABCD}	23.0	44.2^{BCD}	$43.^{BCD}$	27.1^{CD}	38.1	33^{ABC}	29.6^{BCD}	9.7^{EFG}	24.1	20.7^{DEF}
	1N	22.7^{BCDE}	16.4^{E}	34.3^{AB}	24.5	43.6^{BCD}	40.7^{BCD}	36.0^{BCD}	40.1	51.7^{A}	30.8^{BC}	14.3^{CDEF}	32.3	^{57AB}
	2N	27.2^{ABCD}	32.7^{ABC}	28.9^{ABCD}	29.6	73.6A	51.0^{ABC}	26^{CD}	50.2	45.6^{AB}	31.2^{BC}	2.8^{G}	26.5	68.2^{A}
Xs		24.6	22.7	29.8		53.8	44.9	29.7		43.4	30.5	8.9		48.6
C2	0N	22.9^{BCDE}	17.0^{DE}	33.0^{ABC}	24.3	47.2^{BCD}	44.5^{BCD}	49.4^{ABC}	47	27.2^{BCD}	27.9^{BCD}	7.2^{EG}	20.8	53.8^{AB}
	1N	28.1^{ABCD}	27.5^{ABCD}	38.2^{A}	31.3	44.2^{BCD}	36.5^{BCD}	25^{D}	35.2	26.7^{BCD}	32.8^{ABC}	10.7^{DEFG}		39.7^{BCD}
	2N	22.2^{BCDE}	30.7^{ABCD}	33.3^{AB}	28.7	59.3^{AB}	48.4^{ABC}	33.1^{CD}	46.9	25.8^{CDEF}	22.7^{CDE}	15.7^{CDEF}	21.4	46.7^{ABC}
Xs		24.4	25.1	34.7		50.2	43.1	35.8		27.8	27.8	11.2		46.7
CV%				31.7				35.4				38.5		
SE+-				7.0				12.4				9.5		

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 3. Effect of sowing dates and fertilizers on Stem diameter of two cotton cultivars for two seasons, (Inte

Treatments		Stem diameter season 2012/2013								Stem diameter season					
		45 days (1)				60 days (2)				45 days (1)				6	
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S
C1	0N	2.4ab	1.4b	2.3ab	2.0	2.8^{ABCD}	2.5^{ABCD}	2.0^{CD}	2.4	2.8abcd	2.5abcd	2.0cd	2.4	0.4^{DEF}	0.4
	1N	2.4ab	7.8a	2.4ab	4.2	2.6^{ABCD}	2.6^{ABCD}	2.7^{ABCD}	2.6	2.6abcd	2.6abcd	2.7abcd	2.6	0.9^{AB}	0.5
	2N	2.7a	2.7a	2.8a	2.7	3.2^{AB}	2.9^{ABC}	1.9^{D}	2.7	3.2ab	2.9abc	1.9d	2.7	1.1^{A}	0.5
Xs		2.5	4.0	2.5		2.9	2.7	2.2		2.9	2.7	2.2		2.4	0.5
C2	0N	2.0ab	2.3ab	2.6a	2.3	2.8^{ABCD}	3.1^{AB}	2.4^{BCD}	2.8	2.8abcd	3.1ab	2.4bcd	2.8	0.8^{ABC}	0.4
	1N	2.4ab	2.5a	2.5a	2.5	2.6^{ABCD}	2.9^{ABC}	2.1^{CD}	2.5	2.7abcd	2.9abc	2.1cd	2.6	0.7^{BCD}	0.5
	2N	2.5a	2.7a	2.6a	2.6	3.2^{A}	3.1^{AB}	2.4^{ABCD}	2.9	3.2a	3.1ab	2.4abcd	2.9	0.6^{BCD}	0.5
Xs		2.3	2.5	2.6		2.9	3.0	2.3		2.9	3.0	2.3		1.1	0.5
CV%				26.3				19.3							
SE+-				13.2				9.3							

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 4. Effect of sowing dates and fertilizers on Number branch of two cotton cultivars for two seasons, (In

Treatments		Number of branches				seasons 2012/2013				Number of branches				seaso	
		45 days (1)				60 days (2)				45 days (1)				60	
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S
C1	0N	4.9A^{BC}	3.9^{BC}	7.1^{ABC}	5.3	9.0b	8.8b	9.5b	9.1	6.7^{CD}	14.7^{A}	6.2^{DE}	9.2	4.7^{EFG}	6.1
	1N	3.8^{C}	6.9^{ABC}	7.7^{ABC}	6.1	12.3b	9.6b	10.8b	10.9	8.9^{B}	5.7^{DE}	2.7^{F}	5.8	11.6^{B}	8.4
	2N	5.6^{ABC}	8.7^{A}	5.9^{ABC}	6.7	13.7ab	9.7b	7.2b	10.2	9.1^{B}	5.8^{DE}	2.0^{F}	5.6	17.7^{A}	5.6
Xs		4.8	6.5	6.9		11.7	9.4	9.2		8.2	8.7	3.6		11.3	6.7
C2	0N	3.9^{C}	6.2^{ABC}	7.9^{ABC}	6	11.2b	11.4b	10.9b	11.2	5.5^{DE}	6.2^{DE}	2.3^{F}	4.7	12.1^{B}	6.7
	1N	4.7^{ABC}	7.8^{ABC}	6.8^{ABC}	6.4	13.3ab	8.4b	9.0b	10.2	4.7^{E}	8.9^{B}	5.0^{E}	6.2	11.0^{B}	8.6
	2N	3.7^{C}	8.3^{AB}	8.4^{A}	6.8	19.5a	9.6b	8.9b	12.7	8.1^{BC}	6.1^{DE}	5.4^{DE}	6.5	11.1^{B}	8.0
Xs		4.1	7.4	7.7		14.7	9.8	9.6		6.1	7.1	4.2		11.4	7.8
CV%				38.3								15.0			
SE+-				2.2								0.8			

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 5 Means, Plant height (cm), Number of leaves, Stem diameter (cm) and Number of branch under different sowing dates and Fertilizer on two Cultivars cotton for two seasons.

	Season 2012-13							
	Plant height(cm)		Number of leaves		Stem diameter		Number of branches	
	45 days	60 days	45 days	60 days	45 days	60days	45 days	60 days
Cultivar 1	50.3 A	70.6 A	25.7 A	42.8 A	2.4 A	2.6A	6.1 A	10.1 A
Cultivar 2	55.7 A	71.7 A	28.1 A	43.1 A	2.5 A	2.7 A	6.4 A	11.3 A
SE	2.7	4.0	2.3	4.1	0.1	0.1	0.7	1.1
	Season 2013-14							
	Plant height(cm)		Number of leaves		Stem diameter		Number of branches	
	45 days	60 days	45 days	60 days	45days	60days	45days	60 days
Cultivar 1	43.8A	48.8A	27.6 A	29.3 A	0.5 A	0.9 A	6.9 A	7.5 A
Cultivar 2	42.5A	53.5A	21.8 A	29.1 A	0.5 A	0.6 A	5.8 B	7.4 A
SE	3.8	4.4	3.1	3.9	0.04	0.03	0.3	0.4

	Season 2012-13							
	Plant height(cm)		Number of leaves		Stem diameter		Number of branches	
Fertilizers	45 day	60 days	45 days	60 days	45 days	60 days	45 days	60 days
Fertilizers1	47.4 D	68.6 A	23.6 A	42.6 AB	2.2 B	2.6 A	5.6 A	5.6 A
Fertilizers2	58.4 A	68.3 A	27.9 A	37.7 B	2.5 AB	2.6 A	6.3 A	8.6 A
Fertilizers3	53.1 AB	76.6 A	29.2 A	48.6 A	2.7 A	2.8 A	6.8 A	8.2 A
SE	3.3	4.9	2.8	5.0	0.2	0.2	0.2	0.3
	Season 2013-14							
	Plant height(cm)		Number of leaves		Stem diameter		Number of branches	
	45 days	60days	45 days	60 days	45 days	60 days	45 days	60days
Fertilizers1	41.6A	46.5A	22.4A	22.9B	0.4 A	0.7 A	6.9 A	5.6B
Fertilizers2	44.7A	52.6A	27.8 A	25.8B	0.5 A	0.7 A	6.0 B	8.6 A
Fertilizers3	43.2A	54.3A	24.0 A	28.9 A	0.6 A	0.8 A	6.1 B	8.1A
SE	4.7	5.3	3.9	4.8	0.04	0.03	0.3	0.4

	Season 2012-13							
	Plant height(cm)		Number of leaves		Stem diameter		Number of branches	
sowing dates	45 days	60days	45 days	60 days	45day	60 days	45 days	60days
sowing 1	57.8 A	76.1 A	36.0 B	52.0 A	2.4 A	2.9 A	4.4 B	13.2 A
sowing 2	53.2 AB	76.8 A	23.9 B	44.0 A	2.4 A	2.8 A	7.0A	9.6 B
sowing 3	47.9 B	60.4 B	32.3 A	32.8 B	2.5 A	2.3 B	7.3 A	9.4 B
SE	3.3	4.9	2.8	5.0	0.2	0.2	0.9	1.4
	Season 2013-14							
	Plant height(cm)		Number of leaves		Stem diameter		Number of branches	
sowing dates	45 days	60days	45 days	60days	45days	60days	45days	60days
sowing 1	51.1A	69.3A	35.0 A	47.7A	0.7 A	0.8 A	7.2 B	11.3 A
sowing 2	55.2A	59.3A	29.2 A	30.4B	0. 5 B	0.8 A	7.9 A	7.2 B
sowing 3	23.2B	24.9 B	10.1B	9.5C	0.3 C	0.7 B	3.9 C	3.8 C
SE	3.3	5.3	3.9	4.8	0.04	0.03	0.3	0.4

Table 6. Effect of sowing dates and fertilizers on 50% flowering and 100%flowering, of two cotton cultivars for two seasons, (Interaction)

Treatment		Season One 2012/2013								Season two 2013/2014							
		50% flowering				100% flowering				50% flowering				100% flowering			
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn
C1	0N	67.7^{ABC}	73.3^{AB}	70.7^{ABC}	70.6	70.7^{ABC}	76.3^{A}	71.7^{ABC}	72.9	79.3^{AB}	70.7^{BCDEF}	70.3^{BCDEF}	73.4	85.7^{A}	71^{BCD}	65.7^{D}	74.1
	1N	70^{ABC}	67.3^{ABC}	66^{ABC}	67.8	73^{ABC}	72^{ABC}	67^{C}	70.7	75.3^{ABCD}	69.3^{CDEF}	65.7^{EF}	70.1	86.3^{A}	72^{BC}	67.3^{CD}	75.2
	2N	64.7^{ABC}	67.3^{ABC}	66.3^{ABC}	66.1	71.7A^{BC}	71.7^{ABC}	68^{BC}	70.5	74.7^{ABCDE}	72.7^{ABCDEF}	71.3^{BCDEF}	72.9	85.7^{A}	72^{BC}	67.3^{CD}	75
Xs		67.5	69.3	67.7		71.8	73.3	68.9		76.4	70.9	69.1		85.9	71.7	66.8	
C2	0N	64.7^{BC}	70.7^{ABC}	71.7^{ABC}	69	69.7^{ABC}	72.3^{ABC}	70.3^{ABC}	70.8	77.7^{ABC}	71.0^{BCDEF}	68.7^{CDEF}	72.5	83.7^{A}	69^{BCD}	67.7^{CD}	83.5
	1N	62^{C}	69.3^{ABC}	71^{ABC}	67.4	67^{C}	75.3^{AB}	75A^{BC}	72.4	81.3^{A}	67.0^{DEF}	65.0^{F}	71.1	84.3^{A}	70.3^{BCD}	73.7^{B}	76.1
	2N	64^{BC}	67^{ABC}	75^{A}	68.7	66^{C}	77.3^{A}	71A^{BC}		81.7^{A}	81.7^{A}	69.7^{CDEF}	77.7	84.3^{A}	73.7^{B}	70.7^{BCD}	76.2
XSs		63.6	69	72.6		67.6	75	72.1		80.2	73.2	67.8		84.1	71	97.3	
CV%				9.3				6.9				4.7				4.3	
SE+-				6.2				4.6				7.8				5.7	

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table.7 effect of sowing dates and fertilizers on productively and nonproductively branches of two cotto two seasons, (Interaction).

Treatments		Season one (2012/2013)								Season two (2013/201					
		productive				nonproductive				productive				non	
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S
C1	0N	4.8^{C}	6.2^{ABC}	5.9^{ABC}	5.6	4.4^{ABC}	4.9^{ABC}	4^{BCD}	4.4	5^{BCDEF}	4.3^{CDEF}	3.7^{DEF}	4.3	3.5^{DE}	4.8^{E}
	1N	9.0^{AB}	9.9A	9.3^{AB}	9.4	4.3^{ABC}	3.0^{CDE}	3.5^{CD}	3.6	6.4^{ABC}	6.9^{AB}	3.2^{EF}	5.5	5.8^{AB}	6.6^{A}
	2N	6.6^{ABC}	9.4^{AB}	8.5^{ABC}	8.2	3.2^{CDE}	3.5^{CD}	3.4^{BCD}	3.4	6.7^{AB}	5.9^{ABCD}	3.5^{EF}	5.4	6.6^{A}	6.1^{A}
Xs		6.8	8.5	7.9		4.0	3.8	3.6		6.0	5.7	3.5		5.3	5.8
C2	0N	5.7^{BC}	7.1^{ABC}	4.8^{C}	5.9	5.8^{AB}	5.9^{A}	6.1^{A}	5.9	5.4^{ABCDE}	6.4^{ABC}	3.9^{DEF}	5.2	5.8^{AB}	5.4^{A}
	1N	6.1^{ABC}	8.5^{ABC}	9.3^{AB}	8.0	5.7^{AB}	4.5^{ABC}	1.5^{E}	3.9	7.3^{A}	7.6^{A}	2.9^{F}	5.9	4.9^{BCD}	3.7^{D}
	2N	7.2^{ABC}	6.9^{ABC}	7.1^{ABC}	7.0	2.3^{DE}	2.1^{DE}	3.4^{CDE}	2.6	7.4^{A}	4.7^{BCDEF}	3.2^{EF}	5.1	3.9^{CDE}	5.7^{A}
Xs		6.3	7.5	7.1		4.6	4.2	3.7		6.7	6.2	3.3		4.9	4.9
CV%				33.2				28.8				25.4			
SE+-				1.2				1.9				1.1			

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C_1= Burhan, C_2 = khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 8. Effect of sowing dates and fertilizers on Leaves area index of two cotton cultivars for two seaso

Treatments		Season One 2012/2013				Season two 2013/2014			
		Leave area index				Leave area index			
		S1	S2	S3	Xn	S1	S2	S3	Xn
C1	0N	48.1^{A}	51.5^{A}	54.6^{A}	51.4	45.8^{BCD}	49.6^{ABCD}	52.2^{ABCD}	49.2
	1N	55.1^{A}	47.5^{A}	58.8^{A}	53.8	50.6^{ABCD}	42.9^{D}	53.4^{ABCD}	49
	2N	44^{A}	57^{A}	58^{A}	53	45.1^{CD}	48.1^{ABCD}	59.3^{A}	50.8
Xs		39.3	52	57.1		47.2	46.9	55	
C2	0N	54.8^{A}	61.8^{A}	56.9^{A}	57.8	50.9^{ABCD}	56.9^{ABC}	57.5^{AB}	55.1
	1N	52.2^{A}	52.9^{A}	54^{A}	53	55.6^{ABC}	46.8^{BCD}	48.3^{ABCD}	50.2
	2N	43.9^{A}	51.5^{A}	58^{A}	51.1	44.8^{CD}	45.1^{CD}	46.8^{BCD}	45.6
Xs		50.3	55.4	56.3		50.4	49.6	50.9	
CV%				23.3				14.9	
SE+-				5.3				6.1	

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 9.Mean 50%flowering, 100% flowering, Number of non productive branches, Number of productive branches and leaves area index under different sowing dates and Fertilizer on two Cultivars cotton for two seasons

	Season 2012-2013				
Cultivar s	**50% flowing**	**100% flowing**	**N. of nonproductive branches**	**N. of productive branches**	**Leaves area index**
Cultivar1	**68.5^{A}**	**71.3^{A}**	**3.9^{A}**	**7.7^{A}**	**53.1^{A}**
Cultivar2	**68.4^{A}**	**71.6^{A}**	**4.1^{A}**	**7.0^{A}**	**54.0^{A}**
SE	**1.7**	**1.4**	**0.3**	**0.7**	**3.4**
	Season 2013-2014				
Cultivars	**50% flowing**	**100% flowing**	**N. of nonproductive branches**	**N. of productive branches**	**Leaves area index**
Cultivar1	**72.1^{A}**	**74.8^{A}**	**4.8^{A}**	**5.1^{A}**	**49.7^{A}**
Cultivar2	**73.7^{A}**	**75.3^{A}**	**4.5^{A}**	**5.4^{A}**	**50.3^{A}**
SE	**1.6**	**0.9**	**0.3**	**0.4**	**2.0**
	Season 2012-2013				
Fertilizer	**50% flowing**	**100% flowing**	**N. of nonproductive branches**	**N. of productive branches**	**Leaves area index**
Urea 1	**69.8^{A}**	**71.8^{A}**	**5.2^{A}**	**5.8^{B}**	**54.6^{A}**
Urea 2	**67.7^{A}**	**71.7^{A}**	**3.8^{B}**	**8.7^{A}**	**53.4^{A}**
Urea 3	**67.8^{A}**	**70.8^{A}**	**3.1^{B}**	**7.6^{A}**	**52.6^{A}**
SE	**2.1**	**1.7**	**0.4**	**0.8**	**4.2**
	Season 2013-2014				
Fertilizer	**50% flowing**	**100% flowing**	**N. of nonproductive branches**	**N. of productive branches**	**Leaves area index**
Urea 1	**72.9^{AB}**	**73.8^{A}**	**4.4^{B}**	**4.8^{B}**	**52.2^{A}**
Urea 2	**70.6^{B}**	**75.7^{A}**	**4.6^{AB}**	**5.7^{A}**	**49.6^{A}**
Urea 3	**75.3^{A}**	**75.6^{A}**	**5.0^{A}**	**5.3^{AB}**	**48.2^{A}**
SE	**1.9**	**1.1**	**0.3**	**0.4**	**2.5**

	Season 2012-13				
sowing dates	**50% flowing**	**100% flowing**	**N. of nonproductive branches**	**N. of productive branches**	**Leaves area index**
sowing 1	**66.1^{A}**	**69.6^{B}**	**4.3^{A}**	**6.6^{A}**	**49.7^{A}**
sowing 2	**69.2^{A}**	**74.2^{A}**	**4.0^{A}**	**8.0^{A}**	**53.7^{A}**
sowing 3	**70.1^{A}**	**70.6^{B}**	**3.7^{A}**	**7.5^{A}**	**57.2^{A}**
SE	**2.1**	**1.7**	**0.4**	**0.8**	**4.2**
	Season 2013-14				
sowing dates	**50% flowing**	**100% flowing**	**N. of nonproductive branches**	**N. of productive branches**	**Leaves area index**
sowing1	**78.3^{A}**	**85.0^{A}**	**5.1^{A}**	**6.4^{A}**	**48.8^{A}**
sowing 2	**72.4^{B}**	**71.3^{B}**	**5.4^{A}**	**6.0^{A}**	**48.2^{A}**
sowing 3	**68.4^{B}**	**68.7^{C}**	**3.5^{B}**	**3.4^{B}**	**52.9^{A}**
SE	**1.9**	**1.1**	**0.3**	**0.4**	**2.5**

4.2 Yield and Yield Components:

4.2.1 Number of Bolls/plant:

The statistical analysis revealed that highly significant differences (P=0.01) in yield of lint, kg/ha occur at the sowing dates in the first season moreover, result of bolls number /plants, showed that cotton cultivars treated with early sowing date 15th July (S_1) sustained the highest mean of number of bolls/plant at the first, second and third reading irrespective to the nitrogen level (Table 10). Cotton Burhan (C_1) showed the highest mean of number of bolls/plants at the first and second reading. While at the third reading result, showed that Khalifa (C_2) displayed the highest number of bolls/plant compared to other treatments. At the second season, result showed that, mid sowing date 26th July (S_2) sustained the highest mean of number of bolls/plant as compared to other treatment, at the first, second and third reading, irrespective to the nitrogen level (Table 13). However, at the second picking Burhan treated with 60kg N /ha (C_1 *$_1$N) recorded the highest mean of number of bolls/plant, as compared to other treatments, (Table 13).

4.2.2 Yield of Lint kg/ha:

The statistical analysis revealed highly significant differences (P=0.01) in yield of lint, kg/ha (Table 12). Result of yield lint (kg/ha), showed that cotton cultivars treated with early sowing date 15th July (S_1), sustained the highest mean of yield at the first, second and third picking, irrespective to the nitrogen level (Table 12). Cotton Khalifa (C_2), showed the highest mean of yield at the first and second picking compared to other cotton cultivars. However, Khalifa (C_2) treated with 120kg N/ha ($_2$N), sustained the highest mean of yield at the third a picking. While at the second picking result showed that Khalifa treated with 60kg N/ha (C2*1N), displayed the highest mean of yield compared to other treatments. At the Second season result showed that early sowing date 15th July (S_1), sustained the highest mean of yield as compared to other treatment, at the first picking, irrespective to the

nitrogen level (Table 13). However, at the second picking, Khalifa treated with 60kg N/ha (C_2 *$_1$N), accorded the highest mean of yield of lint kg/ha, (Table13).

Table 10. Effect of sowing dates and fertilizers on Number of bolls growth of two cotton cultivars for one season, 2012-2013 (Interaction)

Treatments		Number of bolls/ plant season 2012/2013											
		Reading (1)				Reading (2)				Reading (3)			
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn
C1	0N	1.1^{EF}	1.7^{CDEF}	1.4^{CDEF}	1.4	7.3^{A}	7.0^{A}	3.3^{CDE}	5.9	5.8^{BCDE}	7.1^{BC}	5.2^{CDEF}	6.0
	1N	1.9^{CDEF}	1.0^{F}	2.5^{BCD}	1.8	2.7^{DEF}	2.6^{DEF}	2.7^{DEF}	2.7	3.9^{EFG}	4.2^{DEFG}	4.7^{DEFG}	4.3
	2N	4.0^{A}	3.7^{AB}	2.6^{BCD}	3.4	2.1^{ED}	7.3^{A}	4.8^{BC}	4.7	4.5^{DEFG}	10.1^{A}	7.3^{B}	7.3
Xs		2.3	2.1	2.17		4.0	5.6	3.6		4.7	7.1	5.7	
C2	0N	2.7B	1.3^{DEF}	1.4^{CEF}	1.8	8.5^{A}	3.4^{BCDE}	5.1^{B}	5.7	10.9^{A}	7.2^{B}	7.4^{B}	8.2
	1N	1.5^{CDEF}	1.5^{CDEF}	1.0^{F}	1.3	4.0^{BCDE}	3.0^{DEF}	1.3^{F}	2.8	6.1^{BCD}	6.7^{BC}	2.8^{G}	5.2
	2N	2.3^{CDE}	1.1^{FE}	1.7^{CDEF}	1.7	$3.^{3CDE}$	2.1EF	3.3^{CDE}	2.8	4.1^{DEFG}	3.6^{FG}	7.0^{BC}	5.0
Xs		2.2	1.3	1.4		5.2	3.2	3.2		6.7	5.8	5.7	
CV%				39.2				25.1				19.7	
SE+-				0.6				0.6				0.7	

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = Khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table11. Effect of sowing dates and fertilizers on Number of bolls of two cotton cultivars for season two, (Interaction)

Treatments		Number of bolls/plant season 2013/2014										
		Reading (1)				Reading (2)				Rea		
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	
C1	0N	2.4^{F}	7.7^{CD}	1.7^{F}	3.9	5.6^{DEFG}	15.5^{AB}	0.0^{H}	7.0	6.6^{EFGHI}	16.3^{ABC}	
	1N	10.0^{BC}	7.7^{CD}	2.1^{F}	6.6	17.6^{A}	17.2^{A}	1.3^{GH}	12.0	19.4^{A}	18.2^{AB}	
	2N	13.5A	6.9^{DE}	2.3^{F}	7.6	13.2^{ABC}	10.3^{BCD}	0.0^{H}	7.8	14.1^{BCD}	11.4^{CDE}	
Xs		8.6	7.4	2.0		12.1	14.3	0.4		13.4	15.3	
C2	0N	11.3^{AB}	4.5^{EF}	2.1F	6.0	13.8^{ABC}	8.8^{CDE}	1.0^{GH}	7.9	15.0^{ABC}	9.7^{DEF}	
	1N	7.6^{CD}	11.1^{AB}	8.7^{BCD}	9.1	7.7^{DEF}	15.6^{AB}	1.3^{GH}	8.2	8.8^{EFGH}	16.5^{ABC}	
	2N	3.8F	7.1^{CDE}	1.7^{F}	4.2	4.5^{EFGH}	7.6^{DEF}	3.1^{FGH}	5.1	5.8^{FGHI}	8.9^{DEFG}	
Xs		7.6	7.6	4.2		8.6	10.7	1.8		9.9	11.7	
CV%				29.4				35.8				
SE+-				1.5				2.7				

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = Khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 12. Effect of sowing dates and fertilizers on Yield of lint kg/ha of two cotton cultivars for season o (Interaction).

treatments		Season one 2012/2013									
		Pick one				Pick two				Pick	
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2
C1	0N	1892.8^{abc}	1148.1^{cdef}	725.4^{efg}	**1255.4**	1861^{b}	1959.7^{b}	2591.1^{ab}	**2137.2**	993.5b	1220.8
	1N	1153.8^{cdef}	1267.2^{cdef}	309^{g}	**910**	2610.3^{ab}	1794.2^{b}	1875^{b}	**2093.2**	691.2b	948.0^{b}
	2N	1338.6^{bcde}	1712.6^{abcd}	575.8^{fg}	**1275.5**	2901.6^{ab}	2156.9^{ab}	1898.4^{b}	**2319**	1370.4b	1029.1
Xs		**1461.7**	**1376**	**536.7**		**2457.6**	**1970.3**	**2121.5**	**2183.1**	**1018.4**	**1066.0**
C2	0N	1645.8^{abcd}	776.4^{efg}	259.6^{g}	**893.9**	1887.5b	1841.7b	2083.2^{ab}	**1937.5**	1352.6^{b}	1901.6
	1N	2091.1^{ab}	1000.8^{defg}	546.3^{fg}	**1212.7**	3776.6^{a}	3233.7^{ab}	2262.3^{ab}	**3091**	1486.4^{b}	1736.6
	2N	2226^{a}	1703.5^{abcd}	633.6e^{fg}	**1521**	2817.7^{ab}	2212.4^{ab}	2622.8^{ab}	**2551**	5942.1a	1697.7
Xs		**1987.6**	**1160.2**	**479.8**		**2827.3**	**2429.3**	**2322.8**		**2927.0**	***1787.6***
CV%				**35.3**				**32.4**			
SE				**373.7**				**834**			

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = Khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 13.Effect of sowing dates and fertilizers on Yield of lint kg/ha of two cotton cultivars for season tw (Interaction).

Treatments		Season two 2013/2014									
		Pick one				Pick two				Pi	
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2
C1	0N	445.1^{ef}	650.6^{de}	1088.2^{b}	728	1610.5^{bcd}	411^{hi}	304.3^{i}	775.3	535^{ef}	1313.6^{bc}
	1N	1781.2^{a}	1647.8^{a}	1599.0^{a}	1.676	1267.6^{e}	580.4^{gh}	1478.8^{bcde}	1108.9	1121^{cd}	1996.3a
	2N	1572.9^{a}	722.7^{cde}	814.3b^{cd}	1.0366	1697.9^{bc}	1586.3^{bcd}	311i	1198.4	1065.5^{cd}	1416.8^{bc}
Xs		1266.4	1007.0	1167.2		1525.3	859.2	698.0		907.2	1575.6
C2	0N	810.7^{bcd}	641de	565.3^{def}	672.3	2061.1^{a}	938.1^{fg}	695.8^{fg}	1231.7	1557.3^{b}	568.7^{ef}
	1N	1796.9^{a}	1827.1^{a}	334.7f	1319.6	1396.5^{de}	1726.3^{b}	287.3i	1136.7	492.9^{f}	1425.9^{bc}
	2N	1583.4^{a}	1004.2^{bc}	485.5^{ef}	1024.4	1498.6^{bcde}	1444.6^{cde}	410.7^{hi}	1118	380.8^{f}	952.1^{de}
XSs		1397.0	857.4	464.8		1652.1	1369.7	464.6		810.3	982.2
CV%				38.3				29.4			
SE+-				146.3				132.4			

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key Cultivars C_1= Burhan, C_2 = Khalifa

S_1 = sowing date at 15th July, S_2 = 26th July and S_3 = 4th August

Fertilizer $_0$N= Control, $_1$N = 60 kgN /ha and $_3$N = 120 Kg N/ha (Urea) respectively,

4.2.3 Yield of Seeds kg/ha:

The statistical analysis revealed that no significant differences in yield of seeds kg/ha among all treatments in the first season, cotton cultivars treated with, early sowing date 15th July (S_1), sustained the highest mean of yield at the first picking, irrespective to the nitrogen level (Table 14). With respect to the second and third picking, mid sowing date 26th July (S_2), displayed the highest mean of yield. Cotton Burhan (C_1), showed the highest mean of yield at the first and second picking. However, Khalifa (C_2) treated with 120kgN/ ha ($_2$N), sustained the highest mean of yield at the first and second picking. While at the third picking result showed that Burhan treated with 120 kg N/ha (C_1*$_2$N), displayed the highest mean of yield compared to other treatments. At the second season result showed that, early sowing date 15th July (S_1), sustained the highest mean of yield as compared to other treatments, at the second picking, irrespective to the nitrogen level (Table 15), however recorded.

Table 14. Effect of sowing dates and fertilizers on Yield of seeds kg/ha of two cotton cultivars for season one, (Interaction)

treatments		Season One 2012/2013											
		Pick one				Pick two				Pick three			
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn
C1	0N	3889.8^{a}	3225.8^{abc}	1407.7^{defg}	2841.1	3305^{b}	16877^{a}	3666^{b}	7949.3	785.4^{k}	2341.5^{efg}	1743.3^{hij}	1623.4
	1N	3850.0^{a}	2104.8^{cdef}	421.7^{g}	2125.5	5029^{b}	3177^{b}	3647^{b}	3951	1457.2^{j}	2979.8^{cd}	2588.6^{de}	2341.9
	2N	3637.0^{ab}	2830.1^{abcd}	1065.4^{fg}	2510.8	4420^{b}	9608^{ab}	3412^{b}	5813	2213.6^{efgh}	5213.4^{a}	929.2^{k}	2785.4
Xs		3792	2720.2	964.9		42513	9887.3	3575		1485.3	3511.6	1753.7	
C2	0N	2294.1^{bcdef}	1391.8^{defg}	408.0^{g}	1364.6	5029^{b}	2766^{b}	3867^{b}	3887	1517.1^{ij}	3430.4^{c}	3130.5^{c}	2692.7
	1N	4190.1^{a}	2781.5^{abcde}	922.6^{fg}	2631.4	4871^{b}	5497^{b}	4466^{b}	4944.7	2351^{ef}	3017^{cd}	720.3^{k}	2029.4
	2N	3970.5^{a}	2781.5^{abcde}	1337.5^{efg}	2696.5	4826^{b}	9398^{ab}	5742^{b}	6655.3	1815.1^{ghij}	4155.5^{b}	1988.9^{fghi}	2653.1
Xs		3484.9	2318.3	889.4		4908.7	5887	4691.7		1894.4	3534.3	1946.6	
CV%				32				36				31	
SE+-				712.3				4059.3				259.3	

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = Khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 15. Effect of sowing dates and fertilizers on Yield of seeds kg/ha of two cotton cultivars for season

treatments		Season two 2013/2014									
		Pick one				Pick two				P	
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2
C1	0N	884.5^{efg}	1713.7^{bcdef}	1373.6^{cdefg}	1323.7	1591.4^{b}	1468.9^{b}	1249.5^{b}	584.3	5524^{a}	252
	1N	2114.0^{abcd}	1669.6^{bcdef}	1099.3^{defg}	1627.6	2554.7b	1554.9^{b}	893.1^{b}	1667.6	1320.9^{bcd}	133
	2N	1915.5^{bcde}	3093.1^{a}	822.8^{fg}	1943.8	2953.6^{b}	1874.7^{b}	588.6^{b}	1805.6	2710^{b}	219
Xs		1638	2158.8	1098.6		2366.6	1632.8	9104		3184.7	201
C2	0N	1793.1^{bcdef}	1070.0^{defg}	473.8^{g}	1112.3	3336.4^{b}	1865.9^{b}	621.9^{b}	1941.4	1685.8^{bcd}	860
	1N	2346.2^{abc}	2690.8^{ab}	852.4^{efg}	1963.1	2048^{b}	2545.6^{b}	842.4^{b}	1812.1	1669.3^{bcd}	302
	2N	2382.4^{abc}	1697.8^{bcdef}	759.4^{fg}	1613.2	7652.2^{a}	1724.1^{b}	997.4^{b}	3457.9	1341.5^{bcd}	749
Xs		2173.9	1819.5	695.2		4345.5	2045.2	820.6		1565.5	154
CV%				32.4				35.7			
SE+-				562.1				1902.6			

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key< Cultivars C_1= Burhan, C_2 = Khalifa

Sowing dates at 15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer $_0$N= Control, $_1$N = 60 kgN /ha and $_3$N = 120 Kg N/ha (Urea) respectively,

Table 16.Mean Number of bolls, Yield of lint kg/ha and Yield of Seeds kg/ha , Effect under of different sowing dates and Fertilizer on two Cultivars cotton for two seasons

	Season 2012-13								
	Number of Bolls			Yield of lint kg/ha			Yield of Seeds kg/ha		
Cultivar s	Pick(1)	pick (2)	Pick(3)	Pick (1)	pick (2)	Pick(3)	Pick((1)	pick(2)	Pick(3)
Cultivar1	2.2A	4.4A	6.1A	1124.8^{A}	2183.1^{A}	932.4^{A}	2492.5^{A}	5915.7^{A}	2250.2^{B}
Cultivar2	1.6B	3.8B	5.9A	1209.2^{A}	2526.4^{A}	1843.6^{A}	2120.5^{A}	5162.6^{A}	2458.4^{A}
SE	0.2	0.3	0.3	124.6	278.01	507.3	237.4	1353.1	86.4
	Season 2013-14								
	Number of Bolls			Yield of lint kg/ha			Yield of Seeds kg/ha		
Cultivars	Pick(1)	pick(2)	Pick(3)	Pick (1)	pick (2)	Pick(3)	Pick(1)	pick (2)	Pick(3)
Cultivar1	6.0a	9.0A	10.7A	1146.8^{A}	1027.5B	913.8^{A}	1631.8^{A}	1636.6^{A}	$2429.^{A}$
Cultivar2	6.4a	7.0B	8.5B	1005.4^{B}	1162.1^{A}	685.8^{B}	1562.9^{A}	2403.8^{A}	$1260.^{B}$
SE	0.5	0.9	0.9	48.8	44.1	70.6	187.4	634.2	289

	Season 2011-12								
	Number of Bolls			Yield of lint kg/ha			Yield of seeds kg/ha		
Fertilizer	Pick(1)	pick (2)	Pick(3)	Pick (1)	pick (2)	Pick(3)	Pick(1)	pick(2)	Pick(3)
Urea 1	1.6^{B}	5.8^{A}	7.1^{A}	1074.7^{A}	2037.4^{A}	1184.9^{A}	2102.9^{A}	5918.2^{A}	2158.0^{B}
Urea 2	1.6^{B}	2.7^{C}	4.7^{C}	1061.4^{A}	2592.0^{A}	1075.7^{A}	2353.8^{B}	4464.6^{A}	2185.7^{B}
Urea 3	2.6^{A}	3.8^{B}	6.1^{B}	1365^{A}	2435.0^{A}	1903.5^{A}	927.1^{C}	6234.6^{A}	2719.3^{A}
SE	0.3	0.3	0.4	152.6	340.5	621.3	290.8	1657.2	105.9
	Season 2013-14								
	Number of Bolls			Yield of lint kg/ha			Yield of seeds kg/ha		
Fertilizer	Pick(1)	pick (2)	Pick(3)	Pick(1)	picking)	Pick(3)	Pick(1)	pick (2)	Pick(3)
Urea 1	5.0^{B}	7.4^{B}	9.1^{B}	700.1^{C}	1003.5^{B}	736.7^{B}	1218.1^{B}	1689.0^{A}	2706.1^{A}
Urea 2	7.9^{A}	10.1^{A}	11.8^{A}	1497.8^{A}	1122.8^{A}	939.3^{A}	1795.4^{A}	1739.8A	1428.0^{B}
Urea 3	5.9^{B}	6.5^{B}	8.0^{B}	1030.5^{B}	1158.2^{A}	723.5^{B}	1778.5^{A}	2631.8A	1400.5^{B}
SE	0.6	1.1	1.4	59.7	54.0	86.4	229.5	776.7	353.9

	Season 2012-13								
	Number of Bolls			Yield of lint kg/ha			Yield of seeds kg/ha		
sowing dates	Pick(1)	pick (2)	Pick(3)	Pick (1)	pick (2)	Pick(3)	Pick(1)	pick (2)	Pick(3)
sowing 1	2.2^{A}	4.7^{A}	5.7^{A}	1724.7^{A}	2642.4^{A}	1972.7^{A}	3638.6^{A}	$4596.8A^{B}$	$1689.^{B}$
sowing 2	1.7^{A}	4.2^{A}	6.5^{A}	1268.1^{B}	2199.8^{A}	1422.3^{A}	2353.8	7887.1A	$3522.^{A}$
sowing 3	1.8A	3.4B	5.7A	508.3^{C}	2222.1	769.0	927.1^{C}	4133.4^{B}	$1850.^{B}$
SE	0.3	0.3	0.4	152.6	340.5	621.3	290.8	1657.2	105.9
	Season 2013-14								
	Number of Bolls			Yield of lint kg/ha			Yield of seeds kg/ha		
sowing dates	Pick(1)	pick (2)	Pick(3)	Pick (1)	pick (2)	Pick(3)	Pick(1)	pick (2)	Pick(3)
sowing1	8.1A	10.4A	11.6A	1331.7^{A}	1588.7^{A}	858.7^{B}	1905.9^{A}	3356.0^{A}	2375.3^{A}
sowing 2	7.5A	12.5A	13.5A	1082.2^{B}	1114.5^{B}	1278.9^{A}	1989.2^{A}	1839.0^{AB}	1780.6^{AB}
sowing 3	3.1B	1.1B	3.7B	814.5^{C}	581.3^{C}	261.8^{C}	896.9^{B}	865.5^{B}	1378.8^{B}
SE	0.6	1.1	1.1	59.7	54.0	86.4	229.5	776.7	353.9

4.2.4 Lint Index (%):

The result displayed, highly significant differences (P=0.01) in lint index between all treatments, late sowing date 4th august (S_3), sustained the highest mean of lint index at the first and second picking irrespective (Table 17). However cotton Khalifa (C_2) treated with 60kg /ha ($_1$N) displayed the highest mean of lint index of at both picking. At the season two results showed that, late sowing date 4th august (S_3), showed the highest mean of lint index of, at the first pinking. However, at the second and third picking, mid sowing date 26th July (S_2) showed the best sowing date (Table 18)

4.2.5 Seed Index (%):

Results showed that, early sowing date 15th July (S_1), sustained the highest mean of harvest index of seed at the first picking. However at the second picking late sowing date 4th august (S_3), and mid sowing date 26th July the highest mean of harvest index of seed (Table 18). AT the second season results showed that early sowing date 4th august (S_3) displayed the highest mean of harvest index of seed at all picking .While cotton Khalifa treated with 120kgN/ha (C_1* $_2$N) at the first, second and third picking recorded the highest mean of harvest index of seed irrespective (Table 20)

Table 17. Effect of sowing dates and fertilizers on Harvest index lint of two cotton cultivars for season one, (Interaction)

Treatment		Season One 2012/2013											
		Pick one				Pick two				Pick three			
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn
C1	0N	4.8^{CDE}	7.3^{ABCD}	7.8^{ABC}	6.6	$7.9F^{GH}$	9.6^{EFGH}	19.9^{B}	12.5	21.1^{BC}	6.1^{H}	14.9^{DE}	14.0
	1N	3.2^{DE}	10.9^{A}	5.8^{CDE}	6.6	13.6^{CDEF}	7.6^{GH}	12.6^{CDEFG}	11.3	8.6^{GH}	15.2^{DE}	18.2^{CD}	14
	2N	7.7^{ABC}	4.2^{CDE}	4.3^{CDE}	5.4	17.8^{BC}	10.4^{DEFGH}	20.1^{B}	16.1	13.7^{EF}	9.6^{GH}	21.1^{BC}	14.8
Xs		5.2	7.5	6.0		13.1	9.2	17.5		14.5	10.3	18.1	
C2	0N	4.1^{CDE}	4.4^{CDE}	10^{AB}	6.2	17.4^{BC}	6.7^{H}	14.0_{CDE}	12.7	23.4^{B}	10.6^{FG}	21.2^{BC}	18.4
	1N	7.3^{ABCD}	7.9^{ABD}	6.3^{BCD}	7.2	17.7^{BC}	16.2^{BCD}	32.4^{A}	22.1	31.3^{A}	10.4^{FG}	8.7^{GH}	16.8
	2N	2^{E}	5^{CDE}	7^{ABCD}	4.7	6.2^{H}	6.9^{GH}	15.9^{BCD}	9.7	21.2^{BC}	9.5^{GH}	21.7^{BC}	17.5
Xs		4.5	5.8	7.8		13.8	9.9	20.8		25.2	10.2	17.3	
CV%				28.4				28.5				32.3	
SE+-				2.0				2.9				2.0	

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = Khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 18 .Effect of sowing dates and fertilizers on Harvest index lint of two cotton cultivars for season tw

Treatment		Season Two 2013/2014										
		Pick one				Pick two				Pick thr		
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S
C1	0N	68.6^{E}	37.7^{G}	195.8^{A}	100.7	189.5^{B}	196.9^{B}	113.1^{DE}	166.5	134.8^{B}	70.9^{DEFG}	19
	1N	97.4^{D}	62.7^{EF}	181.4^{A}	113.0	81.4^{G}	29.2^{J}	78.6^{GH}	63.1	53.8^{GHI}	68.1^{EFGH}	73
	2N	38.6^{G}	61.5^{EF}	153.0^{B}	84.4	62.5^{HI}	94F^{G}	161.5^{C}	106	113.8^{C}	46.9^{IJ}	88
Xs		68.2	54.0	176.7		111.1	106.7	117.7		100.7	62.0	11
C2	0N	73.8^{E}	51.5^{FG}	107.9^{D}	77.7	55.2^{I}	77G^{H}	126.9^{D}	86.4	25.0^{KL}	56.7F^{GHI}	75
	1N	124.5^{C}	51.1^{FG}	63.6^{EF}	79.7	46.6^{IJ}	55^{I}	107.5^{EF}	69.7	28.4^{JK}	53.2^{GHI}	53
	2N	65.0^{EF}	63.7^{EF}	12.7^{H}	47.1	103^{EF}	437.9^{A}	111^{DEF}	217.3	76.7^{DE}	49.7^{HI}	8.0
Xs		87.8	55.4	61.4		68.3	190	115.1		43.4	53.2	45
CV%				26.3				29.4				33
SE+-				8.0				9.0				9.1

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = Khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 19.Effect of sowing dates and fertilizers on Harvest index seeds of two cotton cultivars for seas

Treatments		Season one 2012/2013									
		Pick one				Pick two				P	
	0N	S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2
C1	1N	49.6c	23.0^{hi}	32.8^{e}	35.1	18.1^{fg}	16.7^{g}	27.8^{cde}	20.9	4.7^{hi}	11.9^{c}
	2N	41.4^{d}	28.7^{efgh}	13.2^{jk}	27.8	24.8^{e}	23.0ef	25.4^{e}	24.4	7g^{hi}	19.5^{b}
		59.5^{b}	25^{fghi}	27.9^{efgh}	37.5	31.9^{cd}	14.8^{gh}	26.8^{de}	24.5	16.7^{bc}	26.1^{a}
Xs		50.2	25.6	24.6		24.9	18.2	26.7		9.5	19.2
C2	0N	115.8a	18.7^{ij}	30.9^{efg}	54.3	33.6^{c}	10.3^{hi}	23.3^{ef}	22.4	9^{fgh}	9.4f^{g}
	1N	31.5d	23.5^{hi}	23.5^{hi}	26.2	22.8^{ef}	32.5^{cd}	51.1^{b}	35.5	11.1^{defg}	14.8^{b}
	2N	10.2b	28.6^{efgh}	14.0^{jk}	17.6	6.6i	7.3^{i}	64.3^{a}	26.1	3.3i	19.6^{b}
Xs		52.5	23.6	22.8		21.0	11.9	46.2		7.8	14.6
CV%				32.5				33.2			
SE+-				3.4				2.9			

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = Khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 20. Effect of sowing dates and fertilizers on Harvest index seeds of two cotton cultivars for season

Treatments		Season two 2013/2014										
		Pick one				Pick two				Pick th		
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S
C1	0N	54.3^{M}	77.8^{KL}	128.5^{GH}	86.9	167.9^{E}	125.8^{EG}	367.8^{B}	220.5	176.2^{ABC}	125.1^{BC}	3
	1N	104.3^{IJ}	88.4^{JK}	211^{D}	134.6	118.8^{GH}	78.2^{IJ}	363.9^{B}	187.0	119.0^{BC}	77.4^{C}	3
	2N	174.1^{E}	273.3^{C}	425.7^{A}	291.0	72.4^{IJK}	93^{HIJ}	431.1^{A}	198.8	72.2^{C}	93.5^{G}	4
Xs		110.9	146.5	255.1		119.7	99.0	38.8		122.5	98.7	3
C2	0N	63.2^{LM}	150.7^{FG}	295.7^{B}	169.7	90.1^{HIJ}	99.8^{GHI}	237.8^{D}	142.6	122.3^{BC}	99.5^{C}	2
	1N	65.1^{LM}	124.2^{HI}	310.3^{B}	166.5	66.6^{JK}	152.9^{EF}	282.3^{C}	167.3	66.3^{C}	153.1^{BC}	2
	2N	135^{GH}	176.5^{E}	161.7^{EF}	157.7	93.0^{HIJ}	118.7^{GH}	45.4^{K}	85.7	94.4^{C}	118.6^{BC}	4
Xs		87.8	150.5	741.0		83.2	123.8	188.5		94.3	123.7	1
CV%				32.3				29.5				3
SE+-				11.0				14.8				1

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key Cultivars C_1= Burhan, C_2 = Khalifa

Sowing date at 15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer $_0$N= Control, $_1$N = 60 kgN /ha and $_2$N = 120 Kg N/ha (Urea) respectively,

4.2.6 Seed Cotton Yield (kg/ha)

Effects of sowing dates cotton cultivars and fertilizer in the yield seed cotton were presented in table (21). Result showed that cotton cultivar recited early sowing date 15th July (S_1), sustained the highest mean of yield at the first and third picking irrespective to the nitrogen level (Table 21). With respect to the second picking late sowing date 4th august (S_3), displayed the highest mean of yield. However, at the second picking result showed that Burhan treated with 60kg N/ha (C_1* $_1$N), displayed the highest mean of yield compared to other treatments. Second season result showed that early sowing date 15th July (S_1), sustained the highest mean of yield at first and second picking irrespective to the nitrogen level compared to other treatment, (Table 22). However Khalifa (C_2) treated with 60 kg N/ha ($_1$N), sustained the highest mean of yield at the first, second and third picking. While at the third picking result showed that Khalifa treated with 60kgN/ha (C_2*$_1$N) displayed highest mean of yield compared to other treatments.

Table 21.Effect of sowing dates and fertilizers on Cotton seeds kg/ha of two cotton cultivars for season one, Interaction

Treatments		Season One 2012/2013											
		Pick one				Pick two				Pick three			
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn
C1	0N	5782.6ab	4373.9abcde	2133.1ef	4096.5	2101.0 b	9071.0b	3057.0 b	4743.0	1157.2 bc	1472.5 bc	5402.4 a	2677.4
	1N	4895.0abc	3372.0cdef	730.7g	2999.2	3585.7a	2147.0 b	2566.0 b	13523.3	1473.5 bc	404.7 c	2275.9 abc	1384.7
	2N	4975.7abc	4542.7abcd	1641.2fg	3719.9	3159 b	2135.0 b	1764.0 b	2352.7	1457.6 bc	2682.8 abc	442.1 c	1527.5
Xs		5217.8	4096.2	1501.7		13705.7	4451.0	2462.3		1362.8	1520.0	2706.8	
C2	0N	3939.9bcde	2168.2efg	667.6g	2258.6	1510.0 b	2060.0 b	2500.0 b	2023.3	795.6 c	1294.5 bc	735.6 c	941.9
	1N	6281.4a	2796.4def	1468.9fg	3515.6	2885.0 b	2042.0 b	2819.0 b	2582	1234.3 bc	1015.5 bc	881.8 c	1043.9
	2N	6196.5a	4485.0abcd	1970.5ef	4217.3	3225.0 b	2537.0 b	4472.0 b	3411.3	4490.7 ab	2057.1 abc	1679.7 bc	2742.5
Xs		5472.6	3149.9	1369.0		2540.0	2213.0	3263.7		2173.5	1455.7	1099.0	
CV%		36.1				37.5				35.4			
SE+-		987.0				10772				1771			

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = Khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 22.Effect of sowing dates and fertilizers on Cotton seeds kg/ha of two cotton cultivars for season t

treatments		Season two 2013/2014									
		Pick one				Pick two				Pic	
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2
C1	0N	1335.2 d	2358.7bcd	2475.3abcd	2056.4	3067.1abcd	1898.5cdef	2137.9cdef	2367.8	1300.3hi	3858.6
	1N	3895.8ba	3263.1abc	2745.0abcd	3301.3	3761.9abc	2201.1cdef	1172.0ef	2378.3	2771.1f	3326.0
	2N	3500.0ab	3872.9ab	1635.5cd	3002.8	4256.0ab	3240.4abcd	700.5 f	2732.3	3743.0de	3670.0
Xs		2910.3	3164.9	2285.3		3695.0	2446.7	1336.8		2604.8	8407.9
C2	0N	2604.6abcd	1742.1cd	1055.3 d	932.9	4923.6 a	2540.0bcdef	904.5 f	2789.4	3228.9ef	1224.0
	1N	4139.3 a	3930.7ab	1172.0 d	3080.7	3255.2abcd	4679.5 a	1166.3ef	3033.7	2116.1g	4458.9
	2N	3943.1ab	2369.2bcd	1193.5 d	2501.9	3676.6abc	3057.5abcde	1408.8 def	2714.3	1717.6gh	1643.6
Xs		3562.3	2680.7	1140.3		3951.8	3425.7	1159.9		2354.2	1942.2
CV%		36.7				39.5				36.4	
SE+_		859.71				955.69				258.83	

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = Khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Tables 23.Mean harvesting index of lint, harvesting index of seeds and Cottonseeds kg/ha effect of different Sowing Date and fertilizer on cotton for two seasons:

	Season 2012-2013								
	Harves index of Lint			Har index of seed			Cotton Seeds kg/ha		
Cultivar s	Pick(1)	pick (2)	Pick(3)	Pick (1)	pick (2)	Pick(3)	Pick((1)	pick(2)	Pick(3)
Cultivar1	6.2^{A}	13.3^{A}	14.3^{B}	33.5^{A}	23.3^{B}	14.3^{A}	3605.2^{A}	6873^{A}	1863.2^{A}
Cultivar2	6.0^{A}	14.8^{A}	16.2^{A}	33.0^{A}	28.0^{A}	11.7^{B}	3330.5^{A}	2672.1^{A}	1576.1^{A}
SE	0.7	1.0	0.7	1.1	1.0	0.8	329	3590.6	590.4
	Season 2013-14								
	Harvesting index of Lint			Harvesting index of seed			Cotton Seeds kg/ha		
Cultivars									
Cultivar1	99.6^{A}	111.9^{B}	93.9^{A}	170.8^{A}	202.1^{A}	201.2^{A}	2786.8^{A}	2492.8^{A}	2939.4^{A}
Cultivar2	68.2^{B}	124.5^{A}	47.4^{B}	164.7^{A}	131.9^{B}	136.2^{A}	2461.1^{A}	2845.8^{A}	2777.9^{A}
SE	2.7	3.0	3.0	3.7	4.9	41.8	286.6	318.6	86.3

	Season 2012-2013								
	Harve index of Lint			Harv index of seed			Cotton Seeds kg/ha		
Fertilizer	Pick(1)	pick (2)	Pick(3)	Pick (1)	pick (2)	Pick(3)	Pick(1)	pick(2)	Pick(3)
Urea 1	6.4^{AB}	12.6^{B}	16.3^{A}	45.2^{A}	23.0^{B}	8.6^{C}	3177.5^{A}	3383.2^{A}	1809.6^{A}
Urea 2	6.9^{A}	16.7^{A}	15.4A^{B}	27.0^{B}	17.4^{C}	16.9^{A}	3257.4^{A}	8052.5^{A}	1214.3^{A}
Urea 3	5.0^{B}	12.9^{B}	14.1^{B}	27.5^{B}	36.5^{A}	13.4^{B}	3968.6^{A}	2881.0^{A}	2135.0^{A}
SE	0.8	1.2	0.8	1.4	1.2	1.0	403.0	4397.6	723.1
	Season 2013-2014								
	Number of Bolls			Yield of lint kg/ha			Yield of seeds kg/ha		
Fertilizer	Pick(1)	pick (2)	Pick(3)	Pick(1)	picking)	Pick(3)	Pick(1)	pick (2)	Pick(3)
Urea 1	89.2^{B}	126.5^{B}	93.0^{A}	128.4^{C}	181.5^{A}	188.8^{A}	1928.5^{B}	2578.6^{A}	4060.1^{A}
Urea 2	96.8^{A}	66.4^{C}	55.1^{C}	150.6B	177.1A	177.0^{A}	3191.0^{A}	2706.0^{A}	2393.7^{B}
Urea 3	65.8^{C}	161.7^{A}	63.9^{B}	224.4^{A}	142.3B	140.2A	2752.4^{A}	2578.6^{A}	2122.2^{C}
SE	3.3	3.7	3.7	4.5	6.0	51.2	351	390.2	105.7

	Season 2012-2013								
	Harves index of Lint			Harvesting index of seed			Cotton Seeds kg/ha		
sowing dates	Pick(1)	pick (2)	Pick(3)	Pick (1)	pick (2)	Pick(3)	Pick(1)	pick (2)	Pick(3)
sowing 1	4.9^{B}	13.4^{B}	19.9^{A}	51.3^{A}	23.0^{B}	8.6^{C}	5345.2^{A}	8122.6^{A}	1768.1^{A}
sowing 2	6.6^{A}	9.6^{C}	10.2^{C}	24.7^{B}	17.4^{C}	16.9^{A}	3623.0^{B}	3331.9^{A}	1487.8^{A}
sowing 3	6.9^{A}	19.1^{A}	15.7^{B}	23.7^{B}	36.5^{A}	13.4^{B}	1435.3^{C}	2863.1^{A}	1902.9^{A}
SE									
	Season 2013-2014								
sowing dates	Pick(1)	pick (2)	Pick(3)	Pick (1)	pick (2)	Pick(3)	Pick(1)	pick (2)	Pick(3)
sowing1	78.0^{B}	89.7^{C}	72.0^{B}	99.3^{C}	101.5B	108.4^{B}	3236.3^{A}	3823.4^{A}	2479.5^{B}
sowing 2	54.7^{C}	148.3^{A}	57.6^{C}	148.5^{B}	111.4^{B}	111.2^{B}	2922.8^{A}	2936.2^{B}	3030.2^{A}
sowing 3	119.1^{A}	116.4^{B}	82.3^{A}	255.5^{A}	288.0^{A}	286.4^{A}	1712.8^{B}	1248.3^{C}	3066.3^{A}
SE	3.3	3.7	3.7	4.5	6.0	51.2	351.0	390.2	105.7

4.2.7 Ginning Out Turn (G.O.T %):

Result of yield ginning out turn (kg/ha), showed that cotton cultivars early sowing date 15th July (S_1), displayed the highest ,mean of yield at the second and third picking, irrespective to the nitrogen level (Tables 24 and 25). At the first picking, late sowing date 4th august (S_3) displayed the highest mean of yield comported to untreated control. Cotton Khalifa (C_2) showed the highest mean of yield at the first, second and third picking. However, at the first picking result showed that Khalifa (C_2) displayed the highest mean of yield compared to cotton Burhan (C_1), (Table 24). At the Second season, result showed that mid sowing date 26th July (S_2), sustained the highest mean of yield at irrespective to the nitrogen level compared to other treatment (Table 24 and 25). However Khalifa (C_2), treated with 60kgN/ha ($_1$N), sustained the highest mean of yield at the first, picking. While at the third picking result showed that Khalifa treated with 120kgN/ha (C_2*$_2$N), displayed the highest mean of yield of ginning out turn compared to other treatments.

Table 24. Effect of sowing dates and fertilizers on G.O.T, growth of two cotton cultivars for two seasons, Interaction

Treatments		Season One 2012/2013								Season two 2013/2014							
		Pick one				Pick one				Pick one				Pick two			
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn
C1	0N	77.9^{ab}	74.5^{ab}	80.8^{ab}	77.7	91.8^{abc}	55.7^{d}	74.3^{bcd}	73.9	74.5^{cdef}	68.0^{ef}	98.4^{abc}	80.3	86.^{6ab}	51.1c	79.0^{abc}	72.0
	1N	79.3^{ab}	89.7^{ab}	91.3^{ab}	86.8	65.3^{cd}	83.1^{abc}	65.3^{cd}	79.2	103^{ab}	83.1^{bcdef}	71.5^{def}	85.9	79.2abc	69.1^{abc}	57.4^{bc}	68.7
	2N	64.3^{b}	90.1^{ab}	83.5^{ab}	79.3	80.2^{bcd}	109.3a	86.9^{abc}	92.1	86.2^{abcdef}	64.8^{f}	85.0b^{cdef}	78.7	89.3a	84.4^{ab}	70.6^{abc}	81.4
Xs		73.8	84.8	85.2		79.1	82.7	75.5		87.9	72.0	85.0		84.8	68.2	69.0	
C2	0N	101.4^{a}	86.5^{ab}	91.9^{ab}	93.3	99.9^{ab}	94.1^{ab}	82.5^{bc}	92.2	78.9^{bcdef}	84.1^{bcdef}	111.5^{a}	91.5	84.0^{ab}	85.4^{ab}	91.5^{a}	87.0
	1N	78.5^{ab}	85.0^{ab}	90.7^{ab}	84.7	93.1^{ab}	89.2^{abc}	74.7^{bcd}	86.0	94.1^{abcd}	113.6a	72.6^{def}	93.4	90^{a}	92.3^{a}	72.7^{abc}	84.9
	2N	85.4^{ab}	90.2^{ab}	83.9^{ab}	86.5	89.7^{abc}	87.7^{abc}	75.0^{bcd}	84.1	97.6^{abc}	90.1^{abcde}	81.2^{bcdef}	88.4	76.9^{abc}	95.8^{a}	70.5^{abc}	81.1
Xs																	
CV%				32.4				32.3				29.4				26.4	
SE+-				13.9				13.2				12.0				15.6	

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = Khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 25.Effect of sowing dates and fertilizers on G.O.T, of two cotton cultivars for two seasons, I

Treatments		Season ONE 2012/13				Season TWO 2013/2		
		Pick three				Pick three		
		S1	S2	S3	Xn	S1	S2	S3
C1	0N	93.9^{ab}	87.7^{abcd}	61.6^{d}	81.1	80.4^{abcd}	81^{abcd}	66.8^{cd}
	1N	93.0^{abc}	78.0^{abcd}	102.8a	91.3	96.3a	89.8^{abc}	83.7^{abc}
	2N	95.7^{ab}	63.0.^{cd}	90.2^{abcd}	83.0	69.8^{abcd}	95.3^{ab}	70.4^{abcd}
Xs		94.2	76.2	84.9		82.2	88.7	73.6
C2	0N	67.8^{bcd}	68.7^{bcd}	90.9^{abcd}	75.8	96.0^{a}	90.8^{abc}	53.6^{d}
	1N	89.7^{abcd}	75^{abcd}	100.8^{a}	88.5	74.4^{abcd}	76.9^{abcd}	72.5^{abcd}
	2N	72.8^{abcd}	85.8^{abcd}	94.9a^{b}	84.5	73.7^{abcd}	89.5^{abc}	67.9^{cd}
Xs		76.8	76.5	76.5		81.4	85.7	64.7
CV%				32.6				29.6
SE+-				14.9				13.6

Means followed by different letters are significant at (P < 0.05 and P<0.01) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = Khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

4.2.8 Final Yield of Seeds kg/ha:

Results showed that early sowing date 15th July (S_1), sustained the highest mean of final yield of seeds irrespective to cotton cultivars (Table 26). However, Khalifa (C_2) treated with120kgN/ha ($_2$N), sustained gave best mean of yield of seeds while in the second season result showed that early sowing date 15th July (S_1), sustained the highest mean of Final yield of Seeds (kg/ha) however Burhan (C_1) treated with 120kgN /ha ($_2$N), sustained the highest mean of yield compared to other treatments.

4.2.9 Final Yield of Lint kg/ha:

Result showed that at the early sowing date 15th July (S_1) showed the highest mean of final yield of lint (kg/ha) compared to other sowing dates, irrespective to cotton cultivars (Table 27).However cotton Khalifa (C_2) alone or in combination with 120kgN/ha ($_2$N) increased the mean of final yield of lint significantly as compared to other treatments. While Burhan (C_1) in combine with ($_1$N) displayed the highest mean of yield (Table 27).

Table 27.Effect of sowing dates and fertilizers on Final Yield of Lint kg/ha of two cotton cultivars for two Seasons, (Interaction).

Treatments		Season one 2012/2013				Season two 2013/2014			
		Final Yield of Lint				Final Yield of Lint			
		S1	S2	S3	Xn	S1	S2	S3	Xn
C1	0N	2935.6^{BCD}	2464.0^{CDEF}	1819.3^{DEF}	2406.3	2461.8^{CDE}	2388.2^{CDE}	2551.9^{ABCD}	2467.3
	1N	2757.5^{BCDE}	2402.8^{CDEF}	1797.1^{DEF}	2319.1	4155.2^{AB}	4234.7^{A}	2160.3^{DE}	3516.7
	2N	3138.4^{BCD}	3395.7^{BC}	1408.9^{F}	2647.7	4596.0^{A}	3618.5^{ABCD}	1345.3^{E}	3186.6
Xs		2943.8	2754.2	1675.1					
C2	0N	2536.7^{CDEF}	2189.8^{CDEF}	1533.5^{EF}	2086.7	4286.5^{A}	2148.7^{DE}	1107.2^{E}	2514.1
	1N	3923.9^{AB}	2018.6^{DEF}	1850.8^{DEF}	2264.2	3969.1^{ABC}	4574.5^{A}	1354.6^{E}	3299.4
	2N	4844.2^{A}	3418.3^{BC}	2373.5^{CDEF}	3545.3	3202.9^{ABCD}	3288.7^{ABCD}	1083.5^{E}	2525.0
Xs		4101.6	2542.2	1919.3		3819.5	3337.3	1181.8	
CV%				32.4				34.4	
SE+-				662.3				817.0	

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key >Cultivars C_1= Burhan, C_2 = Khalifa

Sowing dates at 15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer $_0$N= Control, $_1$N = 60 kgN /ha and $_2$N = 120 Kg N/ha (Urea) respectively,

Table 26. Effect of sowing dates and fertilizers on Final Yield of Seeds kg/ha of two cotton cultivars f (Interaction).

treatment		Season one 2012/2013				Season two 2		
		Final Yield of Seeds				Final Yield of see		
		S1	S2	S3	Xn	S1	S2	S
C1	0N	5286^{B}	23666^{A}	15240^{AB}	14730.7	2925.2^{EFGH}	5723.7^{ABCDEF}	7
	1N	7299^{AB}	3863^{B}	3775^{B}	4979.0	6579.7^{ABCD}	4556.4^{BCDEFGH}	2
	2N	6454^{B}	5965^{B}	2370^{B}	4929.7	7553.2^{ABC}	7098.7^{ABC}	1
Xs		6346.3	11164.7	7128.3		5686.0	5792.9	4
C2	0N	3709^{B}	3333^{B}	2370^{B}	3137.3	6485.5^{ABCD}	3572.5^{DEFGH}	1
	1N	5380^{B}	3733^{B}	3319^{B}	4144	6032.0^{ABCDE}	8303.1^{A}	2
	2N	9067^{AB}	5660^{B}	5750^{B}	6825.7	5658.1^{ABCDEFG}	4175.4^{CDEFGH}	2
Xs		6052.0	4242.0	3813		6058.5	5350.3	2
CV%				38.3				3
SE+-				7376.3				1

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key > Cultivars> C1= Burhan, C_2 = Khalifa

Sowing dates> S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer> $_0$N= Control, $_1$N = 60 kg /ha and $_2$N = 120 Kg /ha (Urea) respectively,

Table 28.Mean Yield of G.o.T, Final yield (Lint kg/ha and Seeds kg/ha) Effect of different sowing dates and Fertilizer on two Cultivars cotton for two seasons

	Season 2012-13				
	G.O.T			FINAL YIELD	
Cultivar s	Pick(1)	pick (2)	Pick(3)	Final Yield of Seeds	Final Yield of lint
Cultivar1	81.3^{A}	79.1^{A}	85.1^{A}	8220.6^{A}	2457.7^{A}
Cultivar2	88.2^{A}	87.3^{A}	82.9^{A}	4702.3^{A}	2743.3^{A}
SE	4.6	4.4	5.0	2458.8	220.8
	Season 2013-14				
	G.O.T				
Cultivars	Pick(1)	pick(2)	Pick(3)	Final Yield of Seeds	Final Yield of lint
Cultivar1	81.6^{B}	74.1^{A}	81.4^{A}	5203.8^{A}	3056.8^{A}
Cultivar2	91.5^{A}	84.3^{A}	77.3^{A}	4529.4^{A}	2779.5^{A}
SE	4.0	5.2	4.5	554.5	272.3

	Season 2012-2013				
	G.O.T			FINAL YIELD	
Fertilizer	Pick(1)	pick (2)	Pick(3)	Final Yield of Seeds	Final Yield of lint
Urea 1	85.5^{A}	83.0^{A}	78.4^{A}	1809.6^{A}	2246.5^{B}
Urea 2	85.7^{A}	78.4^{A}	89.9^{A}	1214.3^{A}	2458.5^{B}
Urea 3	82.9^{A}	88.1^{A}	83.7^{A}	2135.0^{A}	3096.5^{A}
SE	5.7	5.4	6.1	723.1	270.4
	Season 2013-14				
	G.O.T		FINAL YIELD		
Fertilizer	Pick(1)	pick (2)	Pick(3)	Final yield of Seed	Final yield of Lint
Urea 1	85.9^{A}	79.6^{A}	78.1^{A}	4713.8^{A}	2490.6^{B}
Urea 2	89.6^{A}	76.8^{A}	82.2^{A}	5060.1^{A}	3408.1^{A}
Urea 3	84.2^{A}	81.3^{A}	77.8^{A}	4826.0^{A}	2855.8^{AB}
SE	4.9	6.4	5.6	679.1	333.5

	Season 2012-2013				
	G.O.T			FANIL YIELD	
sowing dates	Pick(1)	pick (2)	Pick(3)	Final Yield of seeds	Final Yield of lint
sowing 1	81.1^{A}	86.6^{A}	85.5^{AB}	6199.2^{A}	3356.1^{A}
sowing 2	86.0^{A}	86.5^{A}	76.4^{B}	7703.3^{A}	2648.2^{B}
sowing 3	87.0^{A}	76.4^{A}	90.2^{A}	5482.0^{A}	1797.2^{C}
SE	5.7	5.4	6.1	3011.4	270.4
	Season 2013-2014				
	G.O.T		FINAL YIELD		
sowing dates	Pick(1)	pick (2)	Pick(3)	Final Yield of seed	Final Yield of lint
sowing1	89.0^{A}	84.3^{A}	81.8^{A}	5872.3^{A}	3778.6^{A}
sowing 2	84.0^{A}	79.7^{A}	87.2^{A}	5571.7^{A}	3375.6^{A}
sowing 3	86.7^{A}	73.6^{A}	69.0^{B}	3155.9^{B}	1600.4^{B}
SE	4.9	6.4	5.6	679.1	333.5

4.3FiberQuality:

4.3.1 Fiber Fineness (MIC):

Result showed, early sowing date 15th July (S_1) gave the highest mean of fiber fineness (MIC) and (HVI) at the first season, (Table 29). Result showed that fiber at the second season, late sowing date 4th august (S_3) showed the mean of highest fineness (MIC) however at the early sowing date 15th July (S1), sustained the best mean of fineness (HVI) (Table 29) moreover Khalifa (C_2) treated with 60kgN/ha ($_1$N) occur the highest mean of fineness (MIC) and while Burhan (C_1) treaded with 120kgN/ha ($_2$N) gave the highest mean of fineness (HVI), (Table 29).

4.3.2 Fiber Length (UHM):

At the first season, early sowing date 15th July (S_1) showed the highest mean of length compared with other treatments (Table 30). However at the Khalifa (C_2) treated with 60kg N/ha ($_1$N) gave the highest mean of length fiber. Result showed that fiber length at the second season, early sowing date 15th July (S_1), showed the highest mean of fiber length comported other treatments (Table 30) moreover Burhan (C_1) treated with 0kg N/ha ($_0$N) gave the highest mean of length fiber, (table 30).

4.3.3 Fiber Length (UI):

Result showed that fiber length at the first season, early sowing date 15th July (S_1), showed the highest mean of length competed other treatments (Table 30), however at the Burhan (C_1) treated with 60kgN/ha ($_1$N) gave the highest mean of length fiber. Result showed that fiber length at the second season, mid sowing date 26th July (S_2) showed the highest mean of fiber length comported other treatments (Table 30) moreover Khalifa (C_2) treated with 60kgN/ha ($_1$N) gave the highest mean of length fiber, (table 30).

4.3.4 Fiber Elongation:

Result showed that early sowing date 15th July (S_1) sustained the highest mean of fiber elongation at the first season to nitrogen level (31).cultivar Burhan (C_1) showed the highest mean of fiber elongation at the first season. However Khalifa (C_2) treated with 60kgN/ha ($_1$N), sustained the highest mean of fiber elongation (Table 31) the result showed that mid sowing date 26th July (S_2) sustained the highest mean of fiber elongation at the second season irrespective to nitrogen level (Table 31). Compared with other sowing date, and the cotton Khalifa (C_2) the highest mean of fiber elongation at the second season, however Khalifa (C_2) treated with 120kgN/ha ($_2$N) sustained the highest mean of fiber elongation compared with other treatments, (Table 31).

4.4. Oil Content (%):

Result showed that late sowing date 4th august (S_3) sustained the highest mean of oil content at the first season compared other sowing dates (Table 32). Cotton Khalifa (C_2) showed the highest mean of oil content at the first season. And result showed that mid sowing date 26th July (S_2), sustained the highest mean of oil content at the second season compared with other sowing dates (Table 32). Cotton Khalifa (C_2) treated with 60kgN/ha ($_1$N) recorded the highest mean of oil content, (Table 32).

Table 29. Effect of sowing dates and fertilizers on Fiber fineness of two cotton cultivars for two seasons, (Interaction)

Treatments		Season One 2012/13								Season two 2013/14							
		fineness (MIC)				fineness (HVI)				fineness (MIC)				fineness (HVI)			
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn
C1	0N	2.8^{FG}	3.8A^{BCDE}	3.3^{CDEF}	3.3	25.8^{EF}	31.4^{AB}	25.7^{EF}	27.6	2.9^{GH}	3.0^{FGH}	3.5^{DEFG}	3.1	27.7^{BCD}	26.4^{BCDE}	26.1^{BCDE}	26.7
	1N	3.8^{ABCDE}	3.9^{ABCD}	3.3^{CDEFG}	3.7	31.5^{A}	30.5^{ABC}	26.6^{DEF}	29.5	3.0^{8CDE}	2.7^{H}	3.3^{EFGH}	3.0	27.6^{BCD}	25.8^{CDE}	25.9^{BCDE}	26.4
	2N	3.5^{BCDE}	4.0^{ABC}	3.3^{CDEF}	3.6	31.6^{A}	26.6^{DEF}	27.1^{CDEF}	28.4	3.8^{CDE}	3.9^{CDE}	4.0^{BCD}	3.9	28.3^{B}	28.2^{BC}	27.3^{BCD}	27.9
Xs		3.4	3.9	3.3		29.6	29.5	26.5		3.2	3.2	3.6		27.9	26.8	26.4	
C2	0N	3.4^{CDE}	2.7^{G}	4.4^{A}	3.5	30.0^{ABCD}	25.5^{EF}	27.4^{CDEF}	27.6	3.7^{CDEF}	3.8^{CDE}	4.7^{AB}	4.1	24.3EF	26.8^{CDE}	25.8^{CDE}	25.6
	1N	3.8^{ABCDE}	3.6^{BCDE}	3.3^{CDEFG}	3.6	27.5^{CDEF}	27.7^{BCDE}	29.8^{ABCD}	28.3	5.0^{A}	3.7^{CDE}	3.8^{CDE}	4.2	27.3^{BCD}	27.1^{BCD}	27.3^{BCD}	27.2
	2N	4.0^{ABC}	3.2^{DEFG}	3.2^{DEFG}	3.5	29.7^{ABCD}	23.9F	27.1^{CDEF}	26.9	3.6^{CDEF}	4.2^{BCD}	4.3^{BCD}	4.0	31.0^{A}	24.2^{EF}	23.2F	26.1
Xs		3.7	3.2	3.6		29.5	25.7	28.1		4.1	3.9	4.3		27.5	26.0	25.4	
CV%				3.4				9.5				5.4				4.0	
SE+-				0.4				1.8				0.4				1.2	

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key> Cultivars C_1= Burhan, C_2 = Khalifa

Sowing dates at S_1= 15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer $_0$N= Control, $_1$N = 60 kgN /ha and $_2$N = 120 Kg N/ha (Urea) respectively,

Table 30. Effect of sowing dates and fertilizers on Fiber length, of two cotton cultivars for two seasons, (I

Treatments		Season One 2012/2013								Season two 2013/201					
		Length (Uhm)				Length (ui)				Length (Uhm)					
		S1	S2	S3	Xn	S1	S2	S3	Xn	S1	S2	S3	Xn	S1	
C1	0N	26.9^{BC}	28.6^{AB}	26.6^{BC}	27.4	82.5^{ABCD}	84.2^{A}	80.8^{BCDE}	82.95	28.0^{ABC}	27.0^{ABCD}	26.2^{D}	27.1	82.0^{BC}	8
	1N	30.1^{A}	28.2^{AB}	26.5^{BC}	28.3	83.4^{AB}	84.0^{AB}	82.3^{ABCD}	83.2	28.2^{AB}	27.0^{ABCD}	24.2E	26.5	83.2^{B}	8
	2N	28.7^{AB}	27.3^{BC}	27.0^{BC}	27.8	83.4^{AB}	82.0^{BCD}	82.4^{ABCD}	82.6	28.0^{ABC}	27.7^{ABCD}	26.4^{CD}	27.4	83.0^{BC}	8
XS		28.6	28.0	26.7		83.1	83.7	81.8		28.1	27.2	25.6		82.7	8
C2	0N	28.5^{AB}	26.5^{BC}	26.6^{BC}	27.2	83.5^{AB}	80.8^{CDE}	83.0^{AB}	82.4	28.5^{A}	27.5^{ABCD}	27.1^{ABCD}	24.3	82^{BC}	8
	1N	26.6^{BC}	26.4^{BC}	27.2^{BC}	26.7	82.8^{ABC}	79.9^{E}	82.3^{ABCD}	81.7	27.5^{ABCD}	27.3^{ABCD}	17.2^{ABCD}	24.0	82.3^{BC}	8
	2N	28.1^{AB}	25.4^{C}	27.1^{BC}	26.9	82.0^{BCD}	82.5^{ABCD}	80.7^{DE}	81.7	26.8^{BCD}	27.5^{ABCD}	24.0^{D}	26.1	81.4^{BC}	7
XS		27.7	26.1	27.0		82.8	81.1	82.0		27.5	27.4	22.8		81.9	8
CV%				9.0				4.3				4.0			
SE+-				1.2				1.04				0.8			

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key> Cultivars C_1= Burhan, C_2 = Khalifa

Sowing dates at S_1= 15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer $_0$N= Control, $_1$N = 60 kgN /ha and $_2$N = 120 Kg N/ha (Urea) respectively,

Table 31. Effect of sowing dates and fertilizers on Fiber Elongation growth for two cotton Cultivars fo seasons,(interaction).

Treatments		Season one 2013/2014				Season two 2012/		
		Elongation				Elongation		
		S1	S2	S3	Xn	S1	S2	S3
C1	0N	6.1^{CD}	6.4^{BC}	6.0^{CD}	6.2	5.5^{AB}	5.6^{AB}	5.5^{AB}
	1N	6.9^{A}	6.7^{AB}	6.2^{CD}	6.6	5.8^{A}	5.5^{AB}	0.0^{C}
	2N	6.4^{ABC}	6.3^{BC}	6.1^{CD}	6.3	5.5^{AB}	5.6^{AB}	0.0^{C}
Xs		6.5	6.5	6.1		5.6	5.7	1.8
C2	0N	5.8^{DE}	5.1^{G}	5.4^{EFG}	5.4	5.5^{AB}	5.7^{AB}	5.9^{A}
	1N	5.5^{EFG}	5.3^{EFG}	5.7^{DEF}	5.5	5.8^{A}	5.8^{A}	5.5^{AB}
	2N	6.0^{CD}	5.1^{G}	5.3^{FG}	5.5	5.9^{A}	5.8^{A}	5.2^{B}
Xs		5.8	5.2	5.5		5.7	5.8	5.5
CV%				0.2				0.4
SE+-				02				0.3

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key < Cultivars C_1= Burhan, C_2 = Khalifa

Sowing date at S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer $_0$N= Control, $_1$N = 60 kgN /ha and $_2$N = 120 Kg N/ha (Urea) respectively,

Table 32. Effect of sowing dates and fertilizers on Oils Content of two cotton Cultivars for two seas

Treatments		Season One 2012/2013				season 201		
		Oils CONTENT				Oils CONTI		
		S1	S2	S3	Xn	S1	S2	S3
C1	0N	28.8^{C}	25.7^{HI}	24.1^{K}	26.0	28.1^{CD}	30.4^{A}	26.7^{G}
	1N	30.7^{A}	25.8^{HI}	26.5^{G}	27.7	28.1^{CD}	29.2^{B}	25.7^{H}
	2N	24.5^{J}	26.0^{GH}	26.5^{F}	25.7	27.9^{DEF}	26.7^{G}	23.9J
Xs		28.0	25.8	25.7		28.0	28.8	25.4
C2	0N	24.6^{J}	23.9^{K}	27.4^{E}	25.3	17.1^{FG}	25.3^{H}	25.0^{HI}
	1N	29.8^{B}	28.3^{D}	28.6^{C}	28.9	28.1^{CD}	28.8^{BC}	27.2^{EFG}
	2N	26.2^{G}	25.7^{HI}	25.6^{I}	25.8	28.0^{DE}	25.3^{H}	24.4^{IJ}
Xs		26.9	26.0	27.2		24.4	26.5	25.5
CV%				0.6				0.5
SE+-				0.1				0.4

Means followed by different letters are significant at ($P < 0.05$ and $P<0.01$) (Duncant test).

Key> Cultivars C_1= Burhan, C_2 = Khalifa

Sowing dates at S_1=15th July, S_2 = 26th July and S_3 = 4th August

Nitrogen Fertilizer $_0$N= Control, $_1$N = 60 kgN /ha and $_2$N = 120 Kg N/ha (Urea) respectively,

Table33 .Mean Fiber Characters (UHM, UI, and HVI, MIC and Elong) and Oil contended, under different sowing date and Fertilizer on two Cultivar cotton for two seasons

	Season 2012-13					
	Fiber Characters					Oil contended
Cultivar s	UHM	UI	HVI	MIC	Elong	Oils
Cultivar1	27.7^{A}	82.8^{A}	28.5^{A}	3.6^{A}	6.3^{A}	26.7^{A}
Cultivar2	26.9^{A}	81.9^{A}	27.6^{A}	3.4^{A}	5.4^{B}	25.9^{B}
SE	0.4	0.3	0.5	0.1	0.1	0.1
	Season 2013-14					
	Fiber Characters					Oil contended
Cultivars	UHM	UI	HVI	MIC	Elongation	Oils
Cultivar1	27.0^{A}	82.2^{A}	27.0^{A}	3.4^{B}	5.7^{A}	227.3^{A}
Cultivar2	27.1^{A}	82.2^{A}	26.2^{A}	4.1^{A}	5.3^{B}	26.6^{B}
SE	0.3	0.7	1.4	0.1	0.1	0.1

	Season 2012-13					
	Fiber Characters					Oil contended
Fertilizer	UHM	UI	HVI	MIC	Elongation	Oils
Urea 1	27.3^{A}	82.4^{A}	27.6^{A}	3.4^{A}	5.8^{B}	25.7^{B}
Urea 2	27.5^{A}	82.4^{A}	28.9^{A}	3.7^{A}	6.0^{A}	27.4^{A}
Urea 3	27.3^{A}	82.2^{A}	27.7^{A}	3.4^{A}	5.8^{AB}	25.7^{B}
SE	0.5	0.4	0.7	0.1	0.1	0.1
						Season 2013-14
	Fiber Characters					Oil contended
Fertilizer	UHM	UI	HVI	MIC	Elongation	
Urea 1	27.4^{A}	82.1^{AB}	26.0^{A}	3.6^{B}	5.6^{A}	27.1^{B}
Urea 2	26.9^{A}	83.1^{A}	26.8^{A}	3.7^{AB}	4.7^{B}	27.9^{A}
Urea 3	26.7^{B}	81.1^{B}	27.0^{B}	3.9^{A}	3.7^{B}	25.9^{C}
SE	0.3	0.8	0.5	0.1	0.1	0.2

	Season 2012-13					
	Fiber Characters					Oils contended
sowing dates	UHM	UI	HVI	MIC	Elongation	Oils
sowing 1	28.1^{A}	83.0^{A}	29.3^{A}	3.5^{A}	6.0^{A}	27.4^{A}
sowing 2	27.1^{A}	82.2^{AB}	27.6^{A}	3.5^{A}	5.8^{B}	25.9^{B}
sowing 3	26.8^{B}	81.9^{B}	27.3^{B}	3.5^{A}	5.7^{B}	25.6^{C}
SE	0.5	0.4	0.7	0.1	0.1	
	Season 2013-14					
	Fiber Characters					Oils contended
sowing dates	UHM	UI	HVI	MIC	Elongation	Oils
sowing1	27.8^{A}	82.3^{A}	27.7^{A}	3.8^{AB}	5.7^{A}	27.9^{A}
sowing 2	27.4^{A}	82.5^{A}	26.3^{B}	3.5^{B}	5.7^{A}	27.5^{B}
sowing 3	25.9^{B}	81.4^{A}	25.9^{B}	3.9^{A}	3.7^{B}	25.5^{C}
SE	0.3	0.8	0.5	0.1	0.1	0.2

CHAPTER FIVE

5.1 DISCUSSION

Sowing date at mid July increased all vegetative growth compared to other sowing dates in both seasons, Decrease of all assessed morphologic traits, all vegetative growth at delayed sowing date can be attribute to unfavorable climatic conditions during vegetative growth ,(Appendix 1and 2)

Cultivars Burhan increased all vegetative growth compared to Khalifa in both seasons, the fact that Cultivar selection, a key management component in any cropping system, is even more critical in ultra-narrow row cotton production growing season application the120kg/ha Urea increased all vegetative growth compared with other dose nitrogen in both seasons. The highest dose was the best as the plant utilized all urea fertilizer.

Interaction between sowing dates, nitrogen dose fertilizer and cultivars results showed significant effect on number of branches and number of bolls in both seasons, number of branches, number of vegetative branches and number of bolls in first season, plant height, number of leaves, number of branches, stem diameter, number of bolls, number of fruit branches, number of vegetative branches in second season. Their differences were due to the differences in the environmental condition (Appendix 1 and 2) and might be due to genetic effect best genotypes.

In this study there were significant ($P<0.05$) differences among sowing dates in both seasonal, the sowing date (S_1) recorded the highest vegetative growth. This might be attributed to the fact the sowing date are the most important factors managing the cotton, and the sowing date best the optimum These results agrees with Hakoomat *et.al.,* (2011) and Aslam and Ibrahim (2007) stated that the early sowing date significantly increased all vegetative growth,

also agrees with (Mohamed *et al.*, 2016) reported that early planted cotton significant increased all vegetative growth.

Results showed that nitrogen had significant differences ($P<0.05$) among nitrogen doses in both seasons. The nitrogen at 120kg/ha, recorded the highest vegetative growth. This might be attributed to the fact that nitrogen fertilizer will give healthy vigorous plant and promoter these results were in line with wenqing, *et al.*,(2012), Mohamed *et al.*, (2016) and Baraich *et al.*,(2012) reported that application of nitrogen up to 200Kg N/ha increased vegetative growth, and numbers of bolls grass, form Study showed similar results and each applied the 120kg/ha Nitrogen fertilizer had significantly ($P<0.05$) affected number of bolls /plant in 2nd season. Wenging *et al.*, (2012) found a response of nitrogen rate and flowering date on fiber quality of cotton which increased the rates nitrogen working on increased the number of bolls

From the analysis of variance, it was clear that the sowing date had significantly ($P<0.05$) affect on seed cotton yield kg/ha in both 1st and 2nd seasons. Sowing at (S_1) gave highest grain yield (2639kg/ ha) in 1st season. Similar results were reported by (Zaheer *et al.*, (2012) who obtained significant effects of sowing date on cotton seed also Soomro, *et al.*, (2000) reported the effect of different sowing date on the yield of newly developed strain under climatic conditions also agrees with (Mohamed *et al.*, (2016) the early planted cotton significantly that increased of cotton seeds yield kg/ha, compared delayed sowing increase the period between sowing to seedling emergence. The influence of fertilizer on seed cotton yield kg/ha was significant different at both seasons. Fertilizer dose at 120 Kg N/ha gave the highest seed cotton yield kg/ha, in both seasons, This results was in line with Mohamed *et al.*, (2016) reported that Nitrogen application (120 kg Nha^{-1}) gave the highest seeds cotton and Wenging, *el at.*, (2012*)* found that the nitrogen rate and flowering date on fiber quality, Highest seed cotton was obtained by increasing nitrogen.

The results showed that interaction between sowing dates, nitrogen dose fertilizer and cultivars had significant ($P<0.05$) effect on seed cotton kg/ha in both seasons. Sowing at (S_1), applied 120kgN/ha and Khalifa cultivars gave the highest seed cotton. This result was in agreement with *Hakoomat, et al*., (2011) who found that the application of nitrogen up to 150Kg N/ha and sown on15th July increased seed cotton kg/ha and (Arshad *et al.*,2007) who found response of growth, and quality of different cotton cultivars to early sowing date,

Sowing dates had highly significant ($P<0.01$) effect on yield of lint kg/ha as differences among sowing dates in 2st season. Sowing date at (S_1) recorded highest yield of lint kg/ha. Similar results were obtained by Zaheer *et al.*, (2012) who found that early sown date gave highly yield of lint kg/ha. The influence of fertilizer on lint Kg/ha was significant difference in both seasons. Fertilizer dose 120 Kg N/ha gave the highest Yield of lint kg/ha both seasons. This results was in agreement with Saleem, *et al.,* (2004) who reported that 120 kg/ha was proved to be the best nitrogen levels for obtaining higher yield and yield of lint kg/ha. The present study showed that interaction between sowing dates, nitrogen dose fertilizer and cultivars had significant effect on seed cotton kg/ha, in 2st season. Sowing date (S_1), applied 120kg/ha and cultivars Khalifa gave the highest seed cotton. This result agreems with Hakoomat, *et al*.,(2011) who found that the application of nitrogen up to 150Kg N/ha and sow on15th July increased seed cotton kg/ha with Arshad *et., at.*,(2007) found response of growth, and quality of different cotton cultivars to early sowing dates and Hakoomat, *et al*.,(2011) who reported that 200 Kg N/ha gave the highest seeds cotton and with Wenging ,*el at.,(*2012) reported that increasing nitrogen dose in increasing cotton yield.

The results showed that interaction between sowing dates, nitrogen fertilizer and cultivars had highly significant ($P<0.01$) effect on yield lint Kg/ha in second season. Cotton Khalifa Sowing at 15th July and treated with 120 kg N/ha gave the highest, yield of lint Kg/ha. This result was in agreement with Mohamed *et al.*, (2016) who found that the Nitrogen application (120 kg Nha^{-}

[1]), early planted cotton and cotton Khalifa gave the highest yield of lint kg/ha and Hakoomat, *et al.*, (2011) who found that the application of nitrogen up to 150Kg N/ha and sown on15th July increased seed cotton kg/ha The fiber quality charactistics determined in this study included staple length, fiber fineness, fiber strength and elongation. The length and strength affected significantly by different sowing dates, in both seasonal, Maximum fiber length (UHM and UI) (30.1mm and 88.1mm) was recorded in sowing date 15thJuly, respectively, while maximum fiber strength (HVI) 31.6tex^{-1} was recorded at 15July sowing date. This result was in agreement with (Mohamed *et al.*, 2016) who found period from the first of July to the mid of it can considered as the optimum sowing date for yield of the cotton seed and fiber characteristic, the elongation affect gave highly significant ($P<0.01$) at sowing dates and cultivars in the first season, cultivars Khalifa showed, the maximum elongation 6.9 mm at sowing date 15 July. The fines maturity (MIC) was observed in the interaction between sowing date, nitrogen and cultivars in the second season. (MIC) 5.0 the difference in the results between the seasons was attributed to the difference in environmental conditions.

Oil Content (%), showed that during the two year of this study the crop sown early, nitrogen rate 120kg/ha and cultivars Khalifa and interaction between this treatments were significantly ($P>0.01$).With result to oil content, result showed that cotton crop sown early July in combination with nitrogen gave the maximum value for oil content (27.9%) and (27.9%) respectively. These results were in agreement with Sawana, *et al.*,(2007) who reported that nitrogen, Potassium effect on oil content and quality of cotton seed, after applying the higher N- rate, as foliar a application increased oilseed. All this results agreement with (Mohamed, *et al.*, 2016) reported Nitrogen application (120 kg N ha-1) in early planted cotton gave the highest Oil Content.

5.2 SUMMARY AND CONCLUSIONS

Field experiment was conducted under rain fed conditions for two Seasons (2012/2013 and 2013/2014) at the Demonstration Farm of the Faculty of Agricultural Sciences, University of Dallanj at Nuba Mountain (NMs). to study the Effect of Sowing Dates, Cultivars and Nitrogen Application on Growth, Yield, oil and fiber of Cotton Crop (*Gossypium. hirsutum L.*) grown at Nuba Mountain.

Based on the finding of this study, we may conclude the following:

1. 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.

2. Both the cultivars with early sowing dates produced higher growth and yield as compared to the late sowing date

3. Cultivar Khalifa gave the maximum yield of seed cotton kg/ha , can be recommended as optimum cultivar.

4. Delayed sowing increase the period between sowing to seedling emergence (square, first flower, first open bolls) and plant survival decreases and the revealed that, cotton growth and yield, were reduced with later sowing dates

5. The Nitrogen response was consistent across sowing dates and cultivars for all data collected.

6.Nitrogen application (120 kg Nha^{-1}) in early planted cotton gave the highest number of branches/plants , number of non productive branches/plants, plant height/plants , number of leaves/plants, stem diameter/plants, in both seasons and highest mean of yield kg/ha and yield component.

7. Nitrogen application (120 kg N ha-1) in early planted cotton gave the highest number of bolls /plant, seed cotton yield kg/ha, oil content (%) and fiber characteristic.

8. 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 and nitrogen application (120 kg N ha-1) gave the highest number of bolls/pants, seed cotton yield kg/ha, oil content (%) and fiber characteristic, for Khalifa - cultivar under rain- fed condition, growth at south kordofan State – Sudan

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