EFFECT OF INTERCROPPING SYSTEM AND NITROGEN FERTILIZER ON INTERCROPPED KENAF AND MAIZE

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ABSTRAC

The present investigation was carried out at the Experimental Farm of El-Gemmiza Agriculture Research Station, Agriculture Research Center, Egypt, during the two successive growing summer seasons 2013 and 2014 to study the effect of three intercropping patterns(2 ridge kenaf (k):1 ridge maize (M),(2k:2M) and (2K:4M) and three nitrogen levels (75,105 and 165 kg N/fed)on the productivity of maize (Three way Cross.310) and kenaf (Gize 3) The experiments were laid out in a split- plot design with three replications, three of intercropping patterns were distributed in the main plots, where, nitrogen levels were randomly allocated in the sub-plots. The main obtained results could be summarized as follows:

1- Obtained results showed that all traits of kenaf were significantly affected by intercropping system of maize with kenaf and nitrogen fertilizer, except plant height, fruting zone length, technical length and green yield/plant as compared with pure stand in both seasons. Intercropping system of 4 M:2K (S3) recorded the highest values for all character, while, the lowest values were obtained from intercropping 1M:2K (S1).

2- All characters for yield and yield components of maize were significantly affected by intercropping system and nitrogen fertilizer in the two seasons, except plant height in the first season .The highest values (14.11and13.66) were obtained from intercropping kenaf with maize on S3(4M:2K) in both seasons with hight rate of nitrogen fertilizer N3(165kgN/fed.).Whereas lower values (11.14 and12.02 ard./fed) were obtained from intercropping system S1(2kenaf:1maize)with lower rate on nitrogen fertilizer N1(45kgN/fed).

3-The interactions between intercropping system and nitrogen rates of kenaf and maizet had no significant effect on all maize and kenaf characters under study in the both seasons.

4- The highest values of land equivalent ratio (LER) was1.5 in both seasons from intercropping kenaf with maize on S3(4maize:2 kenaf) under the hightest nitrogen rate(165kgN/fed.)

5- The highest gross return was obtained with intercropping system 4M:2K (S3) in both seasons(9250.633 and 9370.92 in the first and second seasons,resp.).

From this study it could be concluded that, the best results were kenaf was obtained by intercropping system of four ridges maize with two ridges kenaf under the highest nitrogen rate of N3(165 kgN/fed.).

INTRODUCTION

Intercropping agriculture, as defined by many researchers is growing of two or more crops simultaneously in the same land. This system helps farmers to manage more than one crop in the same field. The main reason for greater stability of yield in intercropping is that; if one crop fails, or grows poorly another companion can compensate , and such compensation cannot occur if crops are grown separately .A similar effect can occur if intercropping reduced the incidence of pests and diseases because this again could help to avoid low yield situation .Intercropping involves growing two or more crops in alternating rows on adjacent strips of variable width or in different layers (under-sown crops) on the same piece of land, during the same growing season. It thus promotes a favourable interaction between different plant species or varieties. Intercropping system, particularly involving legume crops, is considered as sound means of yield improvement for the fact that it involves integrating crops through efficient use of resources and reductions in costly inputs (**Keatings and Carberry, 1993; Morris and Garrity, 1993**). The most important reasons to employ intercropping is the increase in productivity per unit of land per unit time via efficient use of radiant energy and space with crops in mixture (**Baldy and Stigter, 1997; Sullivan, 2003**). Growing mixtures could make an important contribution, especially in risk-prone and variable environments by minimizing crop failure due to biotic and abiotic stresses and secure harvest and nutritional balance in small-scale production systems (**Tilahun *et al*., 2005).** In this regard, intercropping may be helpful for stabilization of household food supply and solve future food problems in developing countries **(Beets, 1982; Tsubo *et al*., 2001**). Kenaf (*Hibiscus cannabinus* L.) is an annual plant that can be useful as a source of low cost natural fibre. Itis a fast-growing plant, and can be used in the industry for a wide range of products (building materials,adsorbents, textiles, livestock feed, etc), especially for his fibre content useful for the paper production industry**[Webber and Bledsoe, 2002**]. The knowledge of kenaf agronomy is important at present due to the increased number of new uses for kenaf plant. Kenaf (*Hibiscuss cannabinus* L.) is one of the world'smost potential sources of fiber in the cottage industry.Recently, the interest in growing kenaf has been increased throughout the world for its elevated fibercontent (**Alexopoulou *et al.,* 2000**). Kenaf is a fast growing crop and has high potential to be used as anindustrial crop globally since it contains higher fibermaterials or lignocellulosic material (**Manzanares *et al.,* 1996**).The seeds are goodsource of low cholesterol vegetable oil and also for biodiesel production (**Webber and Bledsoe, 1993**).

Maize is one of the most important food and feed crops in Egypt for human consumption and animal feeding. Intercropping system is especially beneficial for small farmers is the low-input high risky environment of the developing areas of the world. It is perhaps the best example of how interactions between crops can be exploited to produce considerable yield benefits. Intercropping can achieve much larger yield than sole crops by using environmental resources more fully over time or more efficiently in space (**Willy *and Osiru* 1972**). Nitrogen, are considered as the major limiting factors in crop growth, development and finally economic yield (**Glass, 2003**). To grow kenaf the responses of plants to N fertilization are of considerable importance in agriculture. The objective of this investigation was to study the effect of intercropping patterns and three nitrogen levels on the productivity of kenaf (Giza 3) and maize (Three way Cross 310).

MATERIALS AND METHODS

The experiments were conducted for 2 years at the Experimental Farm of EL-Gemmiza Agriculture Research Station, Agriculture Research Center, Egypt, during the two successive growing summer seasons of 2013 and 2014.Kenaf variety Giza 3 and maize variety T WC 310.were used. The kenaf seed was sown spaced at 70 cm between ridges and 10 cm within hill while the maize were spaced at 70 cm between ridgs and 20 cm within hill. The seeds each maize and kenaf were sown per hill on plots. Both the maize and the kenaf seedling were thinned to one per stand, 3 weeks, after emergence. A split plot design with three replications was used. The experimental plot area was 12.6 m^2, consisted of 6 ridges, 3 m long and 0.7 m wide. The main plots were devoted for intercropping system for kenaf and maize. Three intercropping system were as follows:

1-1M: 2K- l ridge of maize: 2 ridges of kenaf
2-2M: 2K - 2 ridges of maize: 2 ridges of kenaf
3-4M: 2K- 4 ridges of maize: 2ridges of kenaf
4-Sole maize
5-Sole kenaf

All these arrangements gave different kenaf plant populations while the maize population remained constant. The subplots were devoted for nitrogen fertilizer. Three levels of nitrogen were used as follows:

1- N_1(75 kgN/fed.) whereas:45 kg N/fed.(100%) is the recommended dose for kenaf/fed. + 30 kg N/fed.,(25%) from recommended for maize.

2-N_2(105 kgN/fed.) whereas: 45 kg N/fed.(100%) the recommended for kenaf/fed+ 60 kg N/fed.(50%) from recommended for maize.

3-N_3(165kgN/fed.) whereas: 45 kg N/fed.(100%) the recommended for kenaf /fed+ 120 kg N/fed.(100%) for recommended of maize.
Phosphorus (15.5% P2O5) at a rate of 31.0 kg P2O5 /fed and potassium as potassium sulphate (48% K2O) at a rate of 48 kg K2O/fed were applied during seedbed preparation. Nitrogen as urea (46.6% N) was applied at the above mentioned levels. It was added into three equal portions, the first third was applied prior planting, during land preparation. The second third was applied after 15 days of emergence and the rest was added at the bloom stage (40 days after emergence).Plots were weeded as needed through hand hoeing. Other normal agronomic practices for kenaf and maize production were followed.

The soil was clay in texture with pH of 7.3, 1.2% organic matter and having 21.8, 9.5 and 520 ppm available N, P and K, respectively and EC 0.8 millemoh/cm^3.

Table (1): Planting and harvesting dates of kenaf and maize in the two seasons 2013 and 2014

Crop	First season 2013		Second season 2014	
	Planting date	Harvesting date	Planting date	Harvesting date
Kenaf	1/6/2013	11/10/2013	3/6/2014	13/10/2014
Maize	1/6/2013	1/10/2013	3/6/2014	2/10/2014

The other recommended agronomic practices of growing kenaf with maize were applied as recommended in maize filds.
At harvest, the maize cobs were shelled and weighed. The harvested kenaf stalks were bundled and retted in water. After retting, they were washed,sun -dried and the resultant fibre was weighed. The yields per plot were recorded and the current cash values of the two crops at the time of harvest were used in evaluating and analysing the monetary returns per fedden.
At harvest time a random sample of ten plants from each sub-plot were taken in both seasons to determine the following characters:

A- kenaf yield and its components
1- Plant height (cm).2-fruting zone length(cm).
3- technical length(cm). 4-No of capsula/plant.
5-No of seeds/capsula. 6- Seed yield/capsulas (g)
7- Seed yield/fed (kg).8-green yield/plant(g)
9-green yield/fed(ton/fed). 10-fiber yield/plant(g). 11-fiber yield/fed(ton). 12-fiber percentage.

B-Maize yield and its components
1- Plant height (cm)
2- Ear length (cm).
3- 100- kernels weight (g)
4- Grain yield/plant (g)
5- Grain yield/fed. (ardab).

The land equivalent ratio (LER)

The land equivalent ratio (LER) was calculated for all the crop mixtures, using the following formula

$$LER = \frac{yab}{yaa} + \frac{yba}{ybb}$$

Where:
yab = yield of intercropped component a
yaa = yield of solid crop a
yba = yield of intercropped component b
ybb = yield of solid crop b

Statistical analysis

Data statistically analyzed as the technique analysis of variance (ANOVA) of split- plot design as mentioned by Gomez and Gomez (1984). Treatment means were compared using the Least Significant Difference (LSD at 5%) test as outlined by Waller (1969).

RESULTS AND DISCUSSION

Effect of N fertilization levels on yield and its components of maize

Data in Table (2) show that, increasing N levels had significant effect on all the studied characters in both seasons. Increasing nitrogen levels up to 165 kg/fed. produced the highest values of all studied traits for maize in both seasons. Maximum values of plant height, ear length, 100-kernels weight, grain yield /ear and grain yields/fed were observed with adding N3 (165 kg N /fed.).The increase in these characters with the increase of nitrogen level might be due to the role of nitrogen in activating the growth and yield components**.** These changes may positively affect LAI photosynthesis and photoassimilates effect into grain and hence increasing grain yield **(Khalil *et al.,* 2004 and Fageria, 2007**). Such effects resulted in N more efficient use which, in turn, was associated with early and moderate vegetative growth along with grain yield and its attributes **(Fageria and Gheyi, 1999)**.

Plant height: The main effects of nitrogen fertilizer on the plant height of maize were found significant (Table 2). The average plant heights ranged between 179.7 and 203.32 cm in first season and 204.66 and 211.22 cm in second seasons for nitrogen fertilizer levels. The increasing in plant height with the rise in N dose indicated that plants used N during active cell division to form building blocks (protein) for cell elongation. The performance of maize plant might be the result of residual soil fertility improved. These results are in line with those of **Balasbramaniyan and Palaniappan (2001).**

Ear length: Ear lengths of maize plants significantly varied depending on nitrogen fertilizer. The effect of nitrogen fertilizer levels on ear length of maize plants was positive direction and as nitrogen rates

were increased, ear length was increase. The highest ear lengths were determined at N3 (19.93.0 cm and19.34cm) in the first and second seasons, respectively, and the lowest values of ear lengths of maize plants was recorded with N1 treatment (18.93cmand18.23cm) in the first and second seasons, respectively. The N1 treatment (75kg/fed.) was recorded the lowest values of all studied traits. The obtained results may be in line with those detected by **El-Gizawy and Salem (2010) and Iqbal *et al.* (2015).**

Effect of intercropping patterns on maize Yield

The sole crop stand of maize gave significantly higher grain yield than all the crop mixture in both seasons. It was realized that the pure culture of maize afforded efficient utilization of resources since it was free of competition from other crops. It was, therefore, evident to obtain higher yield from the pure stands than in the mixed cropping.

Concerning intercropping patterns, data revealed that plant height recorded tha highest value with S_3,follwed by S_2,whereas the lost value was recorded with S_1.These results due to wide distance between maize plants and higher competition between two plants .Ear length, recorded the height value with S_3,followed by S_2,while the lowest value was recorded with S_1.On the other hand, 100-kernels weight, grain yield/ear and grain yield/fad., the highest value was recorded with S_3,followed by S_2 whereasS_1 recorded lowest value. The lower grain yield in the crop intercropped might be attributed to the effect of intercropping and plant population pressure on maize plants, because the intercrops competed well with the maize for both light and soil nutrients. These effects might have caused reduction in the real grain yield. four ridges of maize and two ridges of kenaf gave the best grain yield among the mixtures . This might have been possible because kenaf plants have tap roots that draw nutrients from higher depth than maize and thus the crops did not compete for the soil nutrients. Similar results were found by **Metwally, *et al* (2009)** and **Tamiru, 2014)**, who found significant differences between the two intercropping patterns

The interaction of N fertilization level x intercropping pattern on all studied traits had significant effects in both seasons and in the combined data. The maximum values of plant height and ear length were recorded by the interaction of N_1 xS_2 as shown as in Table 2. On the other hand, the interaction of N_1 x S_1 recorded the highest 100-kernels weight; grain yield/ear and grain yield/fed. in both seasons and in the combined data. However, the lowest values of grain yield/fed. were recorded from the interaction between N_2 and S_3.

Effect of N fertilizer level on yield and its components of kenaf :

Nitrogen fertilizer significantly affected all traits of kenaf crop yield and its components under any of the three intercropping treatments in both seasons (Table3). Hovere, plant height, technical length and fruting zone length was not significant in both seasons. Plants in the N3 (165 kg N) was taller than the other treatments on all measured dates. Shorter plants under N deficiency might have been due to their effects on cell elongation as well as cell division (**Roggatz *et al*., 1999**).

Effect of intercropping patterns on kenaf Yield:

The mixture of four ridges of maize and two ridges of kenaf produced highest seed yield/fed. and seed yield/plant in both seasons(table 3) . One ridge of maize and two ridges of kenaf produced the lowest yield of all traits in both years. The low yields in this crop arrangement suggests some sort of competition among thecrops for either light or soil nutrient since the two crops have different growth patterns. The competitive effect of maize on kenaf was drastic enough in this crop arrangement to cause low yield **(Asante,1993**).

Fibre yield

Differences in grean stalk yield /fed. and fibre yields of kenaf on the intercropping pattern were significant in both seasons ,however,green stalk yield /plant and fiber percentage not significant in both seasons(Table 4).Of the mixtures , four ridges of maize and two ridges of kenaf produced highest fibre yield in both seasons with high rate of nitrogen(N3=165kg N/fed). One ridge of maize and two ridges of kenaf produced the lowest yield of fibre yield in both seasons under low rate of nitrogen (N1=75kgN/fed). The low yields in this crop arrangement suggests some sort of competition among the crops for either light or soil nutrient since the two crops have different growth patterns. The competitive effect of maize on kenaf was drastic enough in this crop arrangement to cause low fibre yield **(Asante 1993).**

Land equivalent ration (LER):

Data in Table (5) reveald that interaction kenaf with maize increased land equivalent ratio(LER)in all intercropping tretments in the two seasons .Intercropping system 4 ridges maize:2 ridges kenaf gave the highest values for(LER)were 1.5 and 1.5 in the first and second seasons, respectively. While, Intercropping system 2 ridges maize: 2 ridges kenaf produced the lowest values of(LER)were 1.2and1.3 in both seasons, respectively. In all intercropping treatments kenaf were more contributing than maize in both seasons The highest

LER were determined at N3 (1.46 and1.51) in the first and second seasons, respectively , as shown as in Table 5 **(Asante,1993**
Economic Evalution)

Gross Return:

Data in Table(6) show that the highest total income were(L.E 9250.63 and 9370.92)in the first and second seasons ,respectively, when maize was intercropped with kenaf ,was obtained with S3(4M:2K) and highest level of nitrogen(N3165 kg N/fed.) in both season

RE FERENCES

Alexopoulou ,E, M.Christou, M, Mardikis ,A Chatziathanassiou (2000). Growth and yield of kenaf varieties in central Greece. Ind.Crops Prod. 11: 163-172.

ASANTE, A.K. (1993).Spatial arrangement on maize and kenaf intercropping. *Crops Research Institute, P.D. Box* 3785, *Kumasi, Ghana*

Balasbramaniyan P and S.P. Palaniappan (2001). Principles and Practices of Agronomy: Integrated Farming System. Agrobios publishers. 486-489..

Baldy C, and C.J. Stigter (1997). Agrometeorology of multiple cropping in warm climates. INRA, Paris.

Beets WC (1982). Multiple Cropping and Tropical Farming Systems. Westview Press, Boulder

El-Gizawy, N.Kh.B. and H .M. Salem (2010). Influence of nitrogen sources on yield and its components of some maize varieties. *World J. Agric. Sci.,* 6 (2): 218-223.

Fageria, N.K. (2007). Green measuring in crop production. J. Plant Nut.,(30):691-719.

Fageria, N.K. and H. R. Gheyi (1999). Efficient crop production Cambia Grande, P Paraiba, Brazil. Univ. of Paraiba.

Glass, A.D.M. (2003). Nitrogen use efficiency of crop plants: physiological constraints upon nitrogen absorption. *Crit. Rev. Plant Sci.*, 22, 453-470.

Gomez, K.A. and A. Gomez (1984). Statistical Procedures of Agricultural Research. John Wiley & Sons, New York, 2nd ed., 680p.

Iqbal, M.A., Z. Ahmad, Q. Maqsood, I.I. SHfza, and M. M. Ahmad (2015). Optimizing nitrogen level to improve growth and grain yield of spring planted irrigated maize (*Zea mays* L.). *J. Advanced Botany & Zoology* 2: 1- 4.

Keating BA,and P.S. Carberry (1993). Resource capture and use in intercropping: solar radiation. Field Crops Res. 34:273-301.

Khalil, H.E., A.I.Nawar and A.S Kanel (2004). Response of sunflower to multi seasonal crop sequences under different regimes of NPK. Fertilization. Alex. J. Agric. Res., (49):12-23.

Manzanares M, J.L. Tenorio and L. Ayerbe (1996). Sowing time, cultivar, plant population and application of N fertilizer on kenaf in Spain's central plateau. Biomass Bioenerg., 12: 263- 271.

MC.Gillchrist, C. A. (1965). Analysis of competition experiments .Biometrics ,21:975-985.

Metwally, A.A., G.O. Mohamed, M. N. Shereif and D.R.E. Abo Hegazy (2009). Yield and land equivalent ratio of intercropped corn and soybean under three intercropping patterns. 4th Conference on Recent Technologies in Agriculture.

Morris R. A. and D. P. Garrity (1993). Resource capture and utilization in intercropping: non-nitrogen nutrients. Field Crops Res. 34:319-334.

Roggatz, U.,A.J. S. cdonald , I Stadenberg and U. Schurr (1999). Effects of nitrogen deprivation on cell division and expansion in leaves of *Ricinus communis* L. *Plant Cell Environ.,* 22, 81-89.

Sculze, E.D. (1986). Carbon dioxide and water vapor exchange in response to drought in the atmosphere and

Sullivan P. (2003). Intercropping principles and production practices. National Center for Appropriate Technology (NCAT). ATTRA Publication. p. 135.

Tamiru, H.(2014).Effect of intercrop row arrangement on maize and haricot bean productivity and the residual soil. Global J. of Sci. Frontier Res. Agri. and Veter.14 (4)27-34

Tsubo M. S. Walker and E. Mukhala (2001). Comparisons of radiation use efficiency of mono- and inter cropping systems with different row orientations. Field crops Res. 71(1):17-29.

Waller, R.A. and D.B. Duncan. (1969). A bays rule for the symmetric multiple comparison problem. Amer. Stat. Assoc. J., 1485-1504

Webber C.L. and R.E. Bledsoe (1993). Kenaf: production, harvesting, processing and products, In: Janick J, Simon JE (Ed.): New Crops,

Webber CL and V.K. Bledsoe (2002). Kenaf yield components and plant composition. In: J.Janick and A. Whipkey (eds.), Trends in new cropsand new uses. ASHS Press, Alexandria, VA., pp. 348-357.

Webber, C. L. and V.K. Bledsoe (2002). Kenaf yield the components and plant composition. Trends in new crops and new uses. J. Janick and A. Whipkey (eds.). ASHS Press, Alexandria, VA.

Willy,R. W. and S.O. Osiru (1972). Studies on mixture of maize and beans (Phaseolus vulgaris) with particular reference to plant population. J.Sci. Cambridge 79:519-529.

الملخص العربى

تاثير نظم التحميل و التسميد الازوتى على محصول التيل و الذرة

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اقيمت تجربتان حقليتان بالمزرعة البحثية لمحطة البحوث الزراعية بالجميزة بمحافظة الغربية خلال الموسمين الزراعيي2013و2014لدراسة اثر نظم التحميل (2خط تيل:1 خط ذرة ونظام 2خط تيل: 2 خط ذرة و نظا م 2خط تيل: 4خط ذرة) و التسميد الازوتى(75-105-165كجم ازوت/فدان)على محصول التيل و الذرة المحملين وكان عرض الخط 70 سم وقد نفذت التجربة فى تصميم القطع المنشقة مرة واحدة فى ثلاث مكررات. واظهرت النتائج:

1--تاثرت جميع صفات التيل تحت الدراسة معنويا بنظم التحميل والتسميد الازوتى فيما عدا عدد البذور للكبسولة و ارتفاع النبات للتيل وطول المنطقة الثمرية والتى لم تتاثر معنويا بنظم التحميل وكانت اعلى قيمة لمحصول بذور التيل 369.86 و375.11 كجم/ف لنظام التحميل 4ذرة:2 تيل مع اعلى معدل تسميد ازوتى 165كجم ازوت/فدان(ن3).

2- تاثرت جميع صفات الذرة تحت الدراسة معنويا بنظم التحميل والتسميد الازوتى فيما عدا صفة ارتفاع النبات والذى لم تتاثر معنويا مع نظم التحميل وكانت اعلى قيمة لمحصول حبوب الذرة 14.11 و 13.66 اردب/ف تحت نظام التحميل الثالث (4ذرة:2 تيل)مع اعلى معدل تسميد ازوتى(ن3) 165كجم ازوت للفدان بينما اقل قيمة لمصول حبوب الذرة كانت 11.14 و 12.02 اردب/ف نظام التحميل الاول(1ذرة:2تيل)مع اقل معدل للتسميد الازوت(ن1) 75كجم ازوت للفدان.

3- لم يتاثر التفاعل بين نظم التحميل والتسميد الازوتى معنويا لكل صفات التيل و الذرة تحت الدراس-

4-اشارت النتائج الى ان اعلى قيمة لمعدل استغلال الارض 5 .1 وتحققت بزراعة التيل و الذرة مع نظام تحميل 4خط ذرة : 2 خط تيل و معل التسميد الثالث165 كجم ازوت/فدان (ن3).

5- بحساب عائد الفدان اتضح تفوق المحصول المحمل للتيل مع الذرة لنظام التحميل (4ذرة :2تيل) بالجنية المصرى(9250.63 – 9370.92) عن المحصول النقى للذرةكما انة اعطى اعلى عائد نقدى للفدان للموسم الأول والثانى على الترتيب.

:اوضحت الدراسة طبقا لظروف التجربة انه تم الحصول على افضل النتائج باستخدام نظام التحميل الثالث (4ذرة: 2تيل) مع معدل التسميد العالى165كجم ازوت/فدان(ن3).

Table (2): Effects of nitrogen levels, intercropping systems and their interactions on maize yield and its components in both seasons

Treatments	Plant height (cm)		Ear length (cm)		100-kernels weight		Grain yield/ear (g)		Grain yield/fed (ardab)	
Intercropping patterns	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
S_1	181.0	206.556	19259	18.244	30.81	31.58	150.929	145.59	11.149	10.878
S_2	200.744	207.667	19.689	18.533	31.547	32.376	153.757	149.41	13.268	13.889
S_3	202.244	210.667	19.744	19.633	32.713	33.533	157.53	151.82	14.111	14.640
LSD 0.05	**44.57**	**4.52**	**0.37**	**0.35**	**1.19**	**2.03**	**23.13**	**14.35**	**1.00**	**0.772**
	NS	NS	*	*	*	*	*	*	*	*
N_1	179.7	204.667	18.933	18.233	30.937	31.589	145.873	146.74	12.021	11.964
N_2	200.967	209.000	19.826	**18.833**	31.663	32.541	155.446	148.8	12.84	13.137
N_3	203.322	211.222	19.933	19.344	32.47	33.359	160.897	151.28	13.667	14.25
LSD 0.05	**35.28**	**2.604**	**1.318**	0.262	**0.508**	**1.241**	**12.727**	**7.183**	**0.789**	**1.100**
	NS	*	*	*	*	*	*	*	*	*
Interactions	NS	NS	NS	**NS**	NS	NS	NS	NS	NS	NS
LSD 0.05										
solid									21.33	20.85

Whereas(S)intercropping system(S1 2ridges kenaf:1 maize ridge),(S2 2ridges maize:2 ridges kenaf) and S3(4 ridges: 2 ridges kenaf (N)nitrogen rates (N1 75kgN/fed.,N2105kg N/fed. and N3 165 kg N/fed. NS indicate not significant

Table3: Yield and yield components of kenaf as affected by intercropping system, nitrogen level and interaction during 2013and2014 seasons

Treatment	Plant height(cm)		Fruting zone length(cm)		Technical length(cm)		No of capsuges/plant		No of Seeds/capsule		Seed yield/plant(g)		Seed yield/ fed(kg)	
Intercropping patterns	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
S1	329.89	331.11	56.34	51.27	233.5	238.2	41.89	39.44	15.11	14.89	21.78	23	331.44	349.33
S2	368.67	363.67	57.55	53.34	236.7	257.4	43.33	42.33	15.56	14.88	23.11	24.33	369.33	355
S3	378.44	385.44	59.61	55.23	259.9	268.2	45.11	46.89	16	15.77	25.56	25.44	375.11	369.78
LSDat.05	65.22	53.93	3.01	2.520	42.56	27.89	1.805	2.30	1.11	1.22	1.26	0.625	15.52	6.88
	NS	NS	NS	NS	NS	NS	*	*	NS	NS	*	*	*	*
N1	352.22	353.33	53.49	50.25	237.8	242.05	40.78	40.44	14.78	14.56	21.78	22.89	348.56	348.55
N2	351.67	363.22	59.09	53.01	252.1	250.05	44.22	43.33	15.67	15	23.56	24.22	359.56	385.55
N3	373.11	363.67	60.93	56.57	266.8	268.7	45.33	44.98	16.22	16	25.11	25.67	367.78	367
LSD at0.05	27.73	37.67	5.91	0.333	40.01	47.90	1.061	1.415	0.88	0.483	0.593	0.625	5.13	4.27
	NS	NS	NS	NS	NS	NS	*	*	*	*	*		*	*
Interactions	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Whereas(S)intercropping system(S1 2ridges kenaf:1 maize ridge),(S2 2ridges maize:2 ridges kenaf) and S3(4 ridges: 2 ridges kenaf (N)nitrogen rates (N1 75kgN/fed.,N2105kg N/fed. and N3 165 kg N/fed. NS indicate not significant

Table 4: Green stalk yield (plant and fedden), friber yield (plant and fedden) and fiber percentage of kenaf as affected by intercropping system, nitrogen level and interaction during 2013and2014 seasons

Treatment	Green stslk yield/plant(g)		Green stslk yield/fed(ton/fed)		Fiber yield(g/plant)		Fiber yield(ton/fed)		percentage	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
S1	644.48	684.52	9.890	9.930	47.25	44.80	0.717	0.743	7.155	7.079
S2	655.01	690.01	10.470	12.660	47.94	45.81	0.964	0.944	6.710	7.014
S3	690.07	705.70	12.740	13.82	49.26	46.95	0.995	0.982	6.948	6.785
	NS	NS	*	*	*	*	*	*	NS	NS
LSD at0.05	16.85	125.40	0.412	0.412	1.07	1.84	2.92	5.85	0.938	1.339
N1	629.53	679.91	10.480	11.510	46.89	43.27	0.861	0.851	6.823	6.885
N2	658.12	692.32	10.780	12.120	48.19	46.52	0.894	0.893	6.977	7.085
N3	690.81	704.00	11.650	12.730	49.35	47.77	0.922	0.927	7.013	6.909
	NS	NS	*	*	*	*	*	*	NS	NS
LSD at0.05	24.61	78.20	0.457	0.457	1.41	1.68	2.29	2.29	0.031	1.315
Solid							1.121	1.115		
Interactions	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Whereas(S)intercropping system(S1 2ridges kenaf:1 maize ridge),(S2 2ridges maize:2 ridges kenaf) and S3(4 ridges: 2 ridges kenaf (N)nitrogen rates (N1 75kgN/fed.,N2105kg N/fed. and N3 165 kg N/fed. NS indicate not significant

Table (5): Land equivalent ration from yields as affected by intercropping kenaf and maize 2013 and2014 seasons

Treatments	2013 season			2014 season		
	Maize(LER)	Kenaf(LER)	Total(LER)	Maize(LER)	kenaf(LER)	Total(LER)
S1	0.522	0.859	1.381	0.522	0.946	1.4
S2	0.622	0.639	1.261	0.666	0.666	1.3
S3	0.661	0.887	1.54	0.702	0.885	1.5
N1	0.563	0.768	1.33	0.573	0.693	1.33
N2	0.601	0.797	1.39	0.630	0.799	1.42
N3	0.641	0.822	1.46	0.683	0.832	1.51

Whereas(S)intercropping system(S1 2ridges kenaf:1 maize ridge),(S2 2ridges maize:2 ridges kenaf) and S3(4 ridges: 2 ridges kenaf (N)nitrogen rates (N1 75kgN/fed.,N2105kg N/fed. and N3 165 kg N/fed. NS indicate not significant

Table 6: Total income of kenaf and maize advantages of intercropping treatments in 2013 and 2014 seasons

Treatments	Solid		S_1		S_2		S_3	
	Kenaf	Maize	kenaf	maize	kenaf	maize	kenaf	maizer
	Fiber yield Ton/fed	Grain yield/fed (ardab)	Fiber yield	grain yield/fed (ardab)	Fiber yield	Grain yield/ fed (ardab)	Fiber yield	grain yield/fed(ardab)
2013								
yield	1.121	21.33	0.717	11.149	0.964	13.268	0.995	14.111
Actual yield L.E.	5605	6462.99	3585	3378.14	4820	4020.204	4975	4275.633
Total income L.E.	5605	6462	6963.14		8840.20		9250.633	
2014								
yield	1.115	20.85	0.743	10.878	0.944	13.889	0.987	14.64
Actual yield L.E.	5575	6317.55	3715	3296.034	4720	4208.367	4935	4435.92
Total income L.E.	5575	6317.55	7011.03		8928.37		9370.92	

LE 303/ ardab for maize and LE 5000 for kenaf.