Effect of water supply method, variety selection and their interaction on growth and yield of kenaf in the tropical wet-and-dry climate of Nigeria

Article · August 2016

CITATIONS
0

READS
39

4 authors, including:

Abayomi Olayiwola Eruola
University of Agriculture, Abeokuta
59 PUBLICATIONS **288** CITATIONS
SEE PROFILE

Joseph Omoniyi Adejuwon
University of Agriculture, Abeokuta
52 PUBLICATIONS **549** CITATIONS
SEE PROFILE

Akeem Adekunle Makinde
University of Agriculture, Abeokuta
44 PUBLICATIONS **157** CITATIONS
SEE PROFILE

Effect of water supply method, variety selection and their interaction on growth and yield of kenaf in the tropical wet-and-dry climate of Nigeria

*Ayoola, K.O.[1], Eruola, A.O.[*1] , Adejuwon, J.O.[1], Makinde, A.A.[1]*

Abstract: *Determining crop variety that will synchronize with effective water supply is the first step in maintaining profitable production. Field and pot experiment were conducted in the research farm of the University of Agriculture, Abeokuta, to determine the appropriate kenaf variety that will match crop growth and yield with effective water availability. The experiment involves three varieties of Kenaf (Ifeken 100, Cuba 108 and Tainung 2) and two water supply methods (rain-fed and irrigation). Physiological parameters during the different phenological stages of kenaf growth and yield were analyzed with respect to treatments using ANOVA. The result showed that variety selection and water supply methods significantly influenced the stem girth, fibre and seed yield in the study area. However, there was no significant variation in the plant height with selected varieties, although the plant height of crop produced by water supply from rainfall was about twice that of crop irrigated. The highest fibre and seed yield was observed in tainung 2 (0.50 and 0.29 tonnes ha^{-1} respectively)with rainfall cultivated crop producing 35% higher fibre and 30% seed yield than the irrigation cultivated crop. Furthermore, the interaction between variety and water supply method produced the highest fibre and seed yield in tainung 2 x rainfed interaction (0.65 and 0.33 tonnes ha^{-1} respectively). It could be concluded that kenaf can survive when cultivated using rainfed and with irrigation, also when cultivated on the field and in a container. Tainung 2 cultivation should be encouraged in the study area.*
Keywords: *Kenaf, variety, rain-fed, irrigation, girth, fibre.*

Riassunto: *La determinazione delle varietà che più si adattano al metodo d'irrigazione è il primo passo per ottenere una produzione remunerativa. Presso l'azienda sperimentale dell'Università dell'Agricoltura di Abeokuta sono stati condotti esperimenti in campo e in contenitore per determinare la varietà di kenaf più appropriata per garantire una buona crescita e resa in base all'effettiva quantità di acqua disponibile. Sono state considerate tre varietà di kenaf (Ifeken 100, Cuba 108 and Tainung 2) e due gestioni irrigue (non irrigato e irrigato). Durante le differenti fasi fenologiche, i parametri fisiologici e produttivi sono stati analizzati, con il metodo ANOVA, in relazione ai trattamenti irrigui. I risultati hanno mostrato che la varietà e il metodo d'irrigazione influenzano significativamente il diametro dello stelo e la resa in fibra e in seme nell'area di studio. Non è stata osservata nessuna variazione significativa nell'altezza delle piante tra le varietà selezionate, anche se l'altezza delle piante non-irrigate era circa il doppio rispetto a quella delle piante irrigate. La maggiore quantità di fibra e semi è stata osservata in Tainung 2 (rispettivamente 0.50 e 0.29 t ha^{-1}) non-irrigata che ha prodotto il 35% in più di fibra e il 30% in più di seme rispetto alla coltura irrigata. L'interazione Tainung 2 x non-irrigato ha prodotto la maggior quantità di fibra e di seme (rispettivamente 0.65 e 0.33 t ha^{-1}). Possiamo concludere che il kenaf può sopravvivere in coltivazione anche senza irrigazione, sia coltivato in campo che in contenitore. La coltivazione di Tainung 2 può quindi essere incoraggiata nell'area di studio.*
Parole chiave: *Kenaf, varietà, non-irrigato, irrigato, diametro, fibra.*

1. INTRODUCTION

Crop production in the Tropical Wet-and-Dry area of Nigeria as in other part of world is affected by climate change and variability. However of all the climatic parameters involved in crop production, water supply is generally the most critical agro-meteorological factor limiting crop production where irrigation is not available (Dennett *et al.*, 1981), particularly in Africa where agricultural activities is largely rain fed. In the study area, one major persistent problem facing crop production is the water supply which is strongly dependent on rainfall. The rainfall variability in the area is not limited to seasonal fluctuations but also includes year to year variability in the onset, cessation and duration of the rains. These are also characterized by dry spells of unpredictable magnitude which may last for more than three weeks. Incidence of wet season dry spells particularly during the full

* Corresponding Author e-mail: layosky@yahoo.com,08057354226
[1] Department of Water Resources Management and Agrometeorology, University of Agriculture, Abeokuta, Nigeria.

vegetative stage when evaporative demand is high can lead to retardation of yield formation (Fageria, 1980, Nortes *et al*., 2009). Moisture stress during flowering, pollination, and grain-filling stages is especially harmful to agricultural crops (Decker, *et al*., 1986). The major concern of farmers is how to minimize the damage of excess moisture to crops as well as the effect of deficiencies aris-ing from incidence of dry spells. It follows therefore that evaluation of water supply methods assumes a great significance in assessing water supply for agriculture and particularly for schedule of farm operations of a crop particularly kenaf in a rain-fed agricultural region.

Kenaf (Hibiscus *cannabinus*) an important annual herbaceous crop(Liu, 2005), with the leaves rich in protein useful in animal feed and the core used as animal beddings, soil amendments and oil absorbents in chemical industries and in ethanol production (Webber and Bledsoe, 2002; Zhou et. al, 2002; Liu, 2005, Agbaje *et al.*, 2008). Balogun *et al.*, (2007) and Ryma (1999) reported that Kenaf can help to alleviate global warming by absorbing carbon dioxide gases due to its rapid growth rate. The cultivation of kenaf is gradually becoming popular in this agro-ecological zone. Hence the development of suitable irrigation methods for Kenaf cultivation is an important tool towards reliable schedule of its farm operations in this environment. Although soil and thermal factors are not constraints in the study area, the annual rainfall amount though within the range for optimum kenaf cultivation (1000-1300mm), the distribution of this annual amount during the phonological stages of growth remains major hindrance particularly at the vegetative stage. (Orkwor, 1990). Hence, selection of a specific variety will have great impact on the way crop-water relationship is managed. Similarly, the time frame in which a crop can be planted due to weather and/or other circumstances should have a large impact on the selection of a suitable variety. Hence, for successful cropping, it is pertinent to identify the characteristic of variety and then synchronize the crop growth cycle with the period of effective water availability particularly because the rainfall in the area is characterized by an unpredictable distribution, variability and seasonality. The selection of cultivar (variety) has been noted to be among the factor that contributes to the realization of a successful cropping (Bello, 1999; Bello, 2000; Olasantan, 2007). To this end, this study intends to evaluate the effect of water supply methods, variety selection and their interaction on the growth and yield of kenaf.

2. MATERIALS AND METHODS

2.1 Description of the Study area

Field and pot experiment were carried out at the Federal University of Agriculture, Abeokuta (7°15′ N, 3°25′ W; 159m asl), south-western Nigeria during 2014-2015 cropping seasons. The area is characterized by a tropical climate with distinct wet and dry seasons with bimodal rainfall pattern and mean annual air temperature of about 30°C. The actual rainfall totals during the 2014 and 2015 cropping season were 1177.2 and 1201.6mm, respectively. The region is characterized by relatively high temperature with mean annual air temperature being about 30°C. The soil at the experimental site was categorized as a well-drained tropical ferruginous soil. The A horizon of the soil is an Oxic Paleudulf of the Iwo series with 83% sand, 5% silt and 12% clay with a pH of 6 considered tolerable for kenaf cultivation.

2.2 Pot experiment study

The pot experiment involved 9 pots of 10 kg each of sterilized soil samples collected from the field experimental site location. The soil was sterilized using soil sterilizer at 65^{0}C for 1.5h. The treatments consisted of 3 varieties of kenaf (Ifeken 100, Cuba 108 and Tainung 2), planted during the wet and dry seasons using two water supply methods (rainfed and irrigation). Irrigation was carried on daily basis by adding 0.5 litre of water to each plot per day. The equivalent depth of water held in soil was determined by multiplying moisture content (%) by dry density of soil (g/cc) multiplied by depth of root zone of soil (cm) divide by 100 (estimated to be 12.3 mm). The kenaf varieties were planted at 2.5 cm depth with two seedlings per stand in a Randomised Complete Block Design (RCBD) in three replicates. Irrigation water was supplied using watering can to soil saturation per day. The plants growth was monitored and growth parameters measured at the different phonological stages. At maturity stage (three months), the seed and fibre of the plants in each pot were harvested. The kenaf yield was estimated by summing up the total weight of kenaf harvested per pot multiplied by the area

of the circular pot ($\Pi d^2/4$) and converting the same to t ha^{-1}. The fibre weight was measured using manual weighing scale.

2.3 Field experiment

The experimental site, comprised of an area of (20 x 20m^2) was previously cultivated with cassava but had been fallowed for over 3 years. The site was cleared in June 2014, in preparation for cropping following the popular practice by the farmers in the study area. This period marks the preparatory period for the cultivation of wet season planting in the study area for kanaf. The soil was ploughed twice to a 20 cm depth using a tractor and subsequently, clearing was done manually using cutlass and hoe. The clearing was repeated for the dry season planting in November 2015. The experiment involved two treatments (3 Varieties and 2 water supply methods) laid out arrangement in randomized complete block design (RCBD) and the resulting 6 treatments were replicated three times. The total of 9 of 5 x 5 m^2 plots with a walk way of 1m between adjacent plots covering the total land area of 20 x 20m. Two kenaf seedlings each per cultivar were planted into each plot at 2.5cm depth with 5 x 5 cm spacing and watered immediately after planting. Water supply is basically rainfed on the field during the wet season with rainfall peak at 205.9 mm in October, and irrigation is by spraying during the dry season to a water root depth of 14.5 mm. The irrigation water was sourced from the university reservoir adjacent to the experimental site. Irrigation scheduling followed the pattern in pot experiment. The plants growth was monitored and growth parameters (stem girth and plant height) measured at the different phenological stages. At maturity stage (three months), the seed and fiber of the plants in each plot were harvested. The kenaf yield was estimated by summing up the total weight of kenaf harvested per plot and converting the same to t ha^{-1}. The fibre weight was measured using manual weighing scale.

2.4 Data analysis

Data collected were subjected to analysis of variance (ANOVA) using statistical software to evaluate the effects of varieties, water supply methods and their interactions on the response variables. The significance of the main and

Treatments	Stem Girth (cm)										
	3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS	10 WAS	11 WAS	12 WAS	13 WAS
Variety											
Tainung 2 (Vt)	0.94^{a}	1.58^{a}	2.24^{a}	3.27^{a}	4.12^{a}	4.60^{a}	5.10^{a}	5.35^{a}	5.61^{a}	5.80^{a}	6.07^{a}
Ifeken 100 (Vi)	0.86^{a}	1.33^{b}	1.89^{a}	2.87^{ba}	3.82^{ba}	4.37^{ba}	4.81^{b}	5.21^{ba}	5.35^{ba}	5.50^{a}	5.64^{ba}
Cuba 108 (Vc)	0.83^{a}	1.35^{b}	1.86^{a}	2.61^{b}	3.36^{b}	4.96^{b}	4.49^{c}	4.86^{ba}	5.20^{b}	5.42^{a}	5.58^{b}
Water Supply Method											
Rain-fed (R)	0.91^{a}	1.80^{a}	2.58^{a}	3.42^{a}	4.24^{a}	4.82^{a}	5.32^{a}	5.71^{a}	6.01^{a}	6.29^{a}	6.52^{a}
Irrigation (I)	0.84^{a}	1.04^{b}	1.41^{b}	2.41^{b}	3.29^{b}	3.79^{b}	4.23^{b}	4.57^{b}	4.75^{b}	4.85^{b}	5.00^{b}
Interaction (V * W)											
Vt * R	0.97^{a}	2.05^{a}	2.91^{a}	3.66^{a}	4.47^{a}	4.93^{a}	5.55^{a}	5.88^{a}	6.18^{a}	6.48^{a}	6.81^{a}
Vt * I	0.91^{a}	1.11^{c}	1.57^{b}	2.87^{bc}	3.77^{bc}	4.27^{bc}	4.65^{b}	4.82^{b}	5.03^{b}	5.13^{b}	5.33^{b}
Vi * R	0.89^{a}	1.62^{b}	2.35^{a}	3.45^{ba}	4.31^{ba}	4.87^{ba}	5.22^{a}	5.79^{a}	5.87^{a}	6.09^{a}	6.33^{a}
Vi * I	0.82^{a}	1.04^{c}	1.42^{b}	2.29^{dc}	3.33^{dc}	3.86^{c}	4.39^{b}	4.63^{cb}	4.82^{cb}	4.90^{cb}	4.95^{b}
Vc * R	0.87^{a}	1.72^{b}	2.48^{a}	3.15^{ba}	3.95^{bac}	4.66^{ba}	5.18^{a}	5.45^{a}	5.98^{a}	6.30^{a}	6.43^{a}
Vc * I	0.79^{a}	0.97^{c}	1.25^{b}	2.08^{d}	2.78^{d}	3.25^{d}	3.80^{c}	4.27^{c}	4.41^{c}	4.54^{c}	4.73^{b}

Mean with the same letter are not significantly different ($p \leq 0.05$) using Duncan multiple range test

Tab. 1 - Effect of variety selection, water supply methods and their interaction on stem girth in field trial in different weeks after sowing (WAS).
Tab. 1 - Effetto della varietà, del metodo d'irrigazione e della loro interazione sul diametro dello stelo in prove in campo in differenti settimane dopo la semina (WAS).

Treatments	Stem Girth (cm)										
	3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS	10 WAS	11 WAS	12 WAS	13 WAS
Variety											
Tainung 2 (Vt)	0.83^{a}	1.39^{a}	1.82^{a}	2.60^{a}	3.00^{a}	3.32^{a}	3.76^{a}	4.42^{a}	4.85^{a}	5.42^{a}	5.59^{a}
Ifeken 100 (Vi)	0.67^{b}	1.25^{a}	1.47^{b}	1.96^{b}	2.44^{b}	2.90^{a}	3.29^{a}	3.85^{b}	4.26^{b}	4.74^{b}	5.14^{b}
Cuba 108 (Vc)	0.68^{b}	1.24^{a}	1.46^{b}	2.08^{b}	2.58^{b}	3.03^{a}	3.44^{a}	3.99^{b}	4.47^{b}	4.90^{b}	5.12^{b}
Water Supply Method											
Rain-fed (R)	0.73^{a}	1.38^{a}	1.87^{a}	2.57^{a}	3.06^{a}	3.54^{a}	3.84^{a}	4.69^{a}	5.05^{a}	5.61^{a}	5.86^{a}
Irrigation (I)	0.72^{a}	1.20^{a}	1.29^{b}	1.84^{b}	2.28^{b}	2.63^{b}	3.15^{b}	3.48^{b}	4.01^{b}	4.43^{b}	4.71^{b}
Interaction (V * W)											
Vt * R	0.76^{b}	1.33^{a}	1.40^{cb}	2.26^{b}	2.71^{b}	2.90^{bc}	3.46^{ba}	3.73^{c}	4.37^{dc}	4.86^{c}	4.99^{c}
Vt * I	0.68^{b}	1.40^{a}	1.73^{b}	2.29^{b}	2.70^{b}	3.25^{ba}	3.62^{ba}	4.41^{b}	4.80^{bc}	5.35^{bc}	5.63^{b}
Vi * R	0.65^{b}	1.10^{a}	1.22^{c}	1.62^{c}	2.18^{c}	2.54^{c}	2.96^{b}	3.29^{c}	3.73^{e}	4.12^{d}	4.66^{c}
Vi * I	0.72^{b}	1.30^{a}	1.66^{cb}	2.49^{ba}	3.27^{ba}	3.61^{a}	3.85^{a}	4.57^{b}	5.02^{ba}	5.49^{ba}	5.76^{ba}
Vc * R	0.65^{b}	1.18^{a}	1.26^{cb}	1.66^{c}	1.95^{c}	2.45^{c}	3.03^{b}	3.41^{c}	3.93^{de}	4.31^{d}	4.47^{c}
Vc * I	0.79^{a}	0.97^{c}	1.25^{b}	2.08^{d}	2.78^{d}	3.25^{d}	3.80^{c}	4.27^{c}	4.41^{c}	4.54^{c}	4.73^{b}

Weeks after sowing = WAS

Mean with the same letter are not significantly different ($p \leq 0.05$) using Duncan multiple range test

Tab. 2 - Effect of variety selection, water supply methods and their interaction on stem girth in pot trial in different weeks after sowing.

Tab. 2 - Effetto della varietà, del metodo d'irrigazione e della loro interazione sul diametro dello stelo in prove in contenitore in differenti settimane dopo la semina (WAS).

Treatments	Plant Height (cm)										
	3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS	10 WAS	11 WAS	12 WAS	13 WAS
Variety											
Tainung 2 (Vt)	15.00^{a}	24.28^{a}	46.67^{a}	71.11^{a}	100.26^{a}	120.77^{a}	140.40^{a}	154.68^{a}	183.81^{a}	209.43^{a}	228.31^{a}
Ifeken 100 (Vi)	13.83^{a}	23.13^{b}	43.69^{a}	69.00^{a}	95.24^{a}	119.43^{a}	135.77^{a}	152.30^{a}	178.24^{a}	200.91^{a}	219.82^{a}
Cuba 108 (Vc)	13.75^{a}	22.97^{b}	43.39^{a}	68.03^{b}	94.00^{a}	119.15^{a}	135.90^{a}	150.68^{a}	177.79^{a}	200.30^{a}	219.69^{a}
Water Supply Method											
Rain-fed (R)	16.55^{a}	29.56^{a}	54.75^{a}	87.69^{a}	116.62^{a}	155.49^{a}	181.44^{a}	203.40^{a}	221.59^{a}	244.44^{a}	266.42^{a}
Irrigation (I)	11.83^{b}	17.35^{b}	34.41^{b}	51.07^{b}	76.37^{b}	84.07^{b}	93.27^{b}	101.70^{b}	138.30^{b}	162.65^{b}	5.00^{b}
Interaction (V * W)											
Vt * R	17.64^{a}	30.90^{a}	58.27^{a}	89.64^{a}	123.86^{a}	155.88^{a}	186.30^{a}	205.76^{a}	227.57^{a}	253.74^{a}	274.17^{a}
Vt * I	12.35^{bc}	17.65^{c}	35.06^{b}	52.58^{b}	76.66^{b}	85.65^{b}	94.49^{b}	103.60^{b}	140.07^{b}	165.11^{b}	182.45^{b}
Vi * R	16.07^{a}	29.03^{a}	53.10^{a}	87.00^{ba}	113.75^{a}	155.24^{a}	179.27^{a}	202.50^{a}	219.03^{a}	239.83^{a}	262.60^{a}
Vi * I	11.60^{c}	17.23^{b}	34.28^{b}	51.00^{b}	76.73^{b}	83.62^{b}	92.27^{b}	102.09^{b}	137.44^{b}	161.99^{b}	177.04^{b}
Vc * R	15.95^{ba}	28.76^{a}	52.89^{a}	86.43^{a}	112.27^{a}	155.36^{a}	178.74^{a}	201.95^{a}	218.17^{a}	239.74^{a}	262.52^{a}
Vc * I	11.54^{c}	17.83^{b}	33.89^{b}	49.63^{b}	75.72^{b}	82.94^{b}	93.06^{b}	99.41^{b}	137.41^{b}	160.86^{b}	176.86^{b}

Mean with the same letter are not significantly different ($p \leq 0.05$) using Duncan multiple range test

Tab. 3 - Effect of variety selection, water supply methods and their interaction on plant height in field trial in different weeks after sowing.

Tab. 3 - Effetto della varietà, del metodo d'irrigazione e della loro interazione sull'altezza delle piante in prove in campo in differenti settimane dopo la semina (WAS).

Treatments	Plant Height (cm)										
	3 WAS	4 WAS	5 WAS	6 WAS	7 WAS	8 WAS	9 WAS	10 WAS	11 WAS	12 WAS	13 WAS
Variety											
Tainung 2 (Vt)	13.35^{a}	16.51^{a}	28.09^{a}	48.76^{a}	73.43^{a}	103.10^{a}	126.530^{a}	142.20^{a}	158.19^{a}	178.52^{a}	188.79^{a}
Ifeken 100 (Vi)	12.04^{c}	14.43^{b}	21.89^{b}	42.49^{b}	60.29^{b}	83.74^{b}	101.05^{b}	124.41^{b}	137.69^{b}	154.93^{ba}	171.43^{a}
Cuba 108 (Vc)	12.74^{b}	15.48^{ba}	23.15^{b}	41.30^{b}	56.87^{b}	76.60^{b}	93.32^{b}	112.36^{b}	124.39^{b}	147.90^{b}	173.43^{a}
Water Supply Method											
Rain-fed (R)	14.94^{a}	17.50^{a}	29.97^{a}	63.63^{a}	89.73^{a}	126.17^{a}	155.89^{a}	177.87^{a}	189.80^{a}	203.42^{a}	216.70^{a}
Irrigation (I)	10.47^{b}	13.44^{b}	18.79^{b}	24.74^{b}	37.32^{b}	49.47^{b}	58.05^{b}	74.77^{b}	90.38^{b}	117.47^{b}	139.07^{b}
Interaction (V * W)											
Vt * R	15.71^{a}	17.95^{a}	32.07^{a}	67.00^{a}	93.04^{a}	137.19^{a}	176.62^{a}	197.91^{a}	206.24^{a}	217.61^{a}	228.70^{a}
Vt * I	11.00^{c}	15.06^{b}	24.11^{c}	30.53^{b}	53.83^{c}	69.02^{c}	76.45^{c}	86.49^{c}	110.14^{c}	139.43^{b}	148.87^{b}
Vi * R	14.02^{b}	17.05^{a}	27.65^{bc}	62.01^{a}	90.41^{ba}	127.25^{ba}	151.15^{b}	172.50^{b}	186.14^{ba}	195.65^{a}	205.39^{a}
Vi * I	10.06^{d}	11.82^{c}	16.10^{d}	22.97^{c}	30.17^{d}	40.24^{d}	50.95^{d}	76.33^{dc}	89.24^{dc}	114.21^{b}	137.47^{b}
Vc * R	15.10^{a}	17.51^{a}	30.18^{ba}	61.89^{a}	85.74^{b}	114.06^{b}	139.89^{b}	163.21^{b}	177.02^{b}	197.01^{a}	216.01^{a}
Vc * I	10.37^{dc}	13.45^{cb}	16.13^{d}	20.71^{c}	28.00^{d}	39.14^{b}	46.75^{d}	61.51^{d}	71.76^{d}	98.78^{c}	130.86^{b}

Mean with the same letter are not significantly different ($p \leq 0.05$) using Duncan multiple range test

Tab. 4 - Effect of variety selection, water supply methods and their interaction on plant height in pot trial in different weeks after sowing.
Tab. 4 - Effetto della varietà, del metodo d'irrigazione e della loro interazione sull'altezza delle piante in prove in contenitore in differenti settimane dopo la semina (WAS).

interaction effects was determined and significant means were separated using DUNCAN multiple range test at 5 % level of probability.

3.0 RESULTS AND DISCUSSION

The study confirmed the agro-climatic potential of the study area for three kenaf varieties and also the suitable water supply method. Variety selection was found to significantly influenced the stem girth during the late period of crop growth stages from the 6 weeks after sowing (WAS) which marked the mid- season and the late period irrespective of planting condition (field and pot trials) as observed in Tab. 1 and 2. The highest stem girth was observed in Tainung 2 followed by Ifeken100 then Cuba108. Significantly higher stem girth was noticed recorded for crop cultivated using rain- fed water source than crop cultivated using irrigation at all the physiological phases. Rainfed cultivation increased the stem girth by 65% more than using irrigation regime, this may be attributed to high temperature during dry season that aggravated moisture stress and enhance respiration rate under irrigated condition. Tab. 3 and 4 shows the effect of variety selection, water supply methods and their interaction on plant height on the field and in pot trial. There is no significant variation in the plant height with selected varieties irrespective of condition of planting. There is progressive increase in plant height with stages of growth from about 15 cm at 3 weeks after sowing (WAS) to 228 cm 13 WAS. However, the highest plant height was observed in Tainung2 whereas similar height was noticed for Ifeken100 and Cuba 108. Furthermore, significantly higher plant height was noticed recorded for crop cultivated using rain- fed water supply source than crop cultivated using irrigation bat all the physiological phases. The plant height of crop produced by water supply from rainfall was about twice the plant height for crop irrigated. In general, there was prolonged vegetative growth of kenaf cultivars during the moist period which resulted in taller plant height and wider stems girth. This agrees with the work of Balogun *et al.*, 2007 and Webber *et al.*, 2002. Variety selection was found to significantly influence the fibre and seed yield of kenaf both on the field and in the pot trial as shown in Tab. 5 and 6. The highest fibre and seed yield was observed in tainung 2 (0.50 and 0.29 t ha^{-1}

Treatments	Fibre Yield (t ha^{-1})	Seed Yield (t ha^{-1})
Variety		
Tainung 2 (Vt)	0.59^{a}	0.29^{a}
Ifeke n 100 (Vi)	0.45^{b}	0.22^{b}
Cuba 108 (Vc)	0.43^{b}	0.20^{b}
Water Supply Method		
Rain-fed (R)	0.58^{a}	0.28^{a}
Irrigation (I)	0.40^{b}	0.20^{b}
Inter action (V * W)		
Vt * R	0.65^{a}	0.33^{a}
Vt * I	0.52^{a}	0.25^{b}
Vi * R	0.56^{a}	0.26^{ba}
Vi * I	0.34^{b}	0.17^{c}
Vc * R	0.52^{a}	0.24^{bc}
Vc * I	0.33^{b}	0.17^{c}

Mean with the same letter are not significantly different ($p \leq 0.05$) using Duncan multiple range test

Tab. 5 - Effect of variety selection, water supply methods and their interaction on fibre and seed yield in field trial.
Tab. 5 - Effetto della varietà, del metodo d'irrigazione e della loro interazione sulla resa in fibra e seme in prove in campo.

respectively) whereas similar fibre and seed yield was noticed for ifeken 100 (0.45 and 0.22 t ha^{-1} respectively) and cuba 108 (0.43 and 0.20 t ha^{-1} respectively). Furthermore, significantly higher fibre and seed yield was recorded for crop under rainfed cultivation (0.58 and 0.28 t ha^{-1} respectively) than irrigated regime (0.40 and 0.20 t ha^{-1} respectively). The higher fibre and seed yield of crop produced by water supply from rainfall was (35% and 30% respectively) more than the fibre and seed yield of crop produced by irrigation. The onset of rainy season

Treatments	Fibre Yield (t ha^{-1})	Seed Yield (t ha^{-1})
Variety		
Tainung 2 (Vt)	0.28^{a}	0.09^{a}
Ifeke n 100 (Vi)	0.10^{b}	0.03^{b}
Cuba 108 (Vc)	0.09^{b}	0.02^{b}
Water Supply Method		
Rain-fed (R)	0.09^{a}	0.08^{a}
Irrigation (I)	0.03^{b}	0.03^{b}
Inter action (V * W)		
Vt * R	0.25^{a}	0.23^{a}
Vt * I	0.19^{a}	0.11^{b}
Vi * R	0.22^{a}	0.17^{ba}
Vi * I	0.13^{b}	0.11^{c}
Vc * R	0.21^{a}	0.17^{bc}
Vc * I	0.08^{b}	0.05^{c}

Mean with the same letter are not significantly different ($p \leq 0.05$) using Duncan multiple range test

Tab. 6 - Effect of variety selection, water supply methods and their interaction on fibre and seed yield in pot trial.
Tab. 6 - Effetto della varietà, del metodo d'irrigazione e della loro interazione sulla resa in fibra e seme in prove in contenitore.

in addition to length and number of rain days and cessation date of rainfall influence soil water reserve and productivity of rainfed crops in the tropics (Omotosho *et al.*, 2000).

In the late season cropping opportunities, soil moisture deficit constitutes an important limitation to productivity of rainfed crops (Agele *et al.*, 2002). In this study the use of irrigation buffers the edaphic stress variables and improved the growth, development and yield performance of dry season kenaf.

It was observed from the Tab. 1-4 that there exists a significant interaction (P> 0.05) between variety selection and water supply method in stem girth and plant height of kenaf in both trials. It was obvious that varieties cultivated under rainfall regime were generally higher in stem girth and plant height than irrigated crop. Furthermore, it was observed that irrespective of water supply method the highest stem girth and plant height was noticed recorded for Tainung 2 than the remaining two varieties.

The interactive effect of variety and water supply methods on the fibre and seed yield of kenaf was observed to have significant interaction in both trial (Tab. 5 and 6). It was obvious that the highest fibre and seed yield was noticed in tainung 2 x rainfed interaction (0.65 and 0.33 tonnes ha^{-1} respectively) whereas similar fibre and seed yield was noticed for ifeken 100 x rainfed interaction (0.56 and 0.26 t ha^{-1} respectively) and cuba 108 x rainfed interaction (0.52 and 0.24 t ha^{-1} respectively). Furthermore, significantly higher fibre and seed yield was noticed recorded for cultivated crop varieties with their interaction with rain- fed water supply source. The higher fibre and seed yield of crop produced by water supply from rainfall and interaction with varieties was (about 40% and 35% respectively) more than the fibre and seed yield of crop produced by irrigation and varieties interaction.

4. CONCLUSION

From this study, it is clear that kenaf can be cultivated using both rain-fed and irrigation water supply methods. There was every indication that kenaf can survive when cultivated on the field and in a container. Also judging from the duration of the period of effective water availability irrespective of water supply method, the potential of Tainung 2 can be encouraged in the study area though all selected kenaf varieties are suitable for planting.

5. REFERENCES

Agbaje G.O, Saka J.O, Adegbite A.A, and Adeyeye O.O., (2008). Influence of agronomic practices on yield and profitability in Kenaf (*Hibiscus canabinus* L.) fibre cultivation. *African Journal of Biotechnology*, Vol. 7(5), pp. 565-574.

Agelle S.O., Olufayo A. and Iremiren G.O., (2002). Effect of season of sowing on water use and yield of tomato in the humid south of Nigeria. *Afican Crop Science Journal*. 10: 231-237.

Allen R. G., Pereira L. S., Raes D., and Smith M., (1998). "Crop evapotranspiration: Guidelines for computing crop requirements." *Irrigation and Drainage Paper No. 56*, FAO, Rome, Italy.

Balogun M.O, Raji J.A, Akande S.R, and Ogunbodede B.A., (2007). Variations in photo-and thermal-sensitivities among local improved and exotic kenaf accessions in Nigeria. *J. of Food, Agric. And Environ.* 5 (1): 385-388.

Bello N.J., (1999). Investigating the optimum planting date for sorghum in the forest savanna transition zone of Nigeria.

Bello N.J., (2000). Application of rainfall-potential evapotranspiration model for the determination of optimum planting date of maize (Zea mays) in a tropical wet and dry climate.

Decker W.L., Jones V.K., and Achutuni R., (1986). The impact of CO_2 induced climate change on US agriculture. In M.R. White (ed.), Characterization of information requirements for studies of CO_2 effects: Water resources Agriculture Fisheries Forests and Human Health. *United State Department of Energy*, DOE/ER-0236, Washington, D.C.

Dennett M.D., Elliston, J., and Speed C.B., (1981). Climate and cropping systems in west Africa. *Geoforum* 12(2): 198-202.

Fageria, N.K., (1980). Deficiencia hidrica em arroz de cerrado e resposta ao fosforo. *Pesqui. Agropec. Bras.* 15: 259-265.

Liu Y., (2005). Diallel and stability analysis of kenaf (*Hibiscus cannabinus L.*) in South Africa. University of Free State, Bloemfontein South Africa (unpublished thesis).

Nortes P.A., Gonzalez-Real,M.M., Egea G., and Baille A., (2009). Seasonal effects of deficit irrigation on leaf photosynthetic traits of fruiting and non-fruiting shoots in almond trees. *Tree Physiology*, 29: 375-388.

Olasantan F.O., (2007). Effect of population density and sowing date of pumpkin on soil hydrothermal regime, weed control and crop growth in a yam pumpkin intercrop. *Experimental Agriculture* 43: 365-380.

Omotosho J., Bayo A., Balogun A. and Ogunjobi K.O., (2000). Predicting monthly and seasonal rainfall, onset and cessation of the raining season in west Africa using only surface data. *International Journal of Climatology*, 20: 865-880.

Orkwor G.C., (1990). IITA/NRCRI Root crops research and Technology transfer course manual. *National root crops research institute (NRCRI)*, Umudike, Umuahia, Nigeria, 8-12 July, 1992. 1-9 pp.

Rymza A., (1999). Utilization of kenafraw materials. Paper presented to the forest product society, Boise, Idaho.

Webber C.L, Bhardwaj H.L, and Bledsoe V.K., (2002). Kenaf production: fiber, feed and seed. In Janick, J and A. whipkey (Eds). *Trends in new crops and new uses.* ASHS press, Alexandria, V.A, pp. 348-355.

Zhou C., Bao-rong Lu, Brian B., kazuhiko Sameshima and Jia-knan Chen, (2002). Comparative studies in kenaf varieties based on analysis of agronomic and RAPD data. *Hereditas* 136(3): 231-239.