ZANCO Journal of Pure and Applied Sciences
The official scientific journal of Salahaddin University-Erbil
https://zancojournals.su.edu.krd/index.php/JPAS

ISSN (print):2218-0230**, ISSN (online):** 2412-3986**, DOI: http://dx.doi.org/10.21271/zjpas**

RESEARCH PAPER

Environmental Effect on Growth and Yield Parameters of Ten Kenaf Varieties (*Hibiscus cannabinus* L.) in Erbil.

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A B S T R A C T:
Differences between growth and yield parameters of ten kenaf varieties were investigated to evaluate and determine the best variety to cultivation at Kurdistan environment. For the first time seeds of ten kenaf varieties were planted in field of Grdarasha in College of Agricultural Engineering Sciences, Salahaddin University – Erbil, Kurdistan. The experiment was arranged using four replicates in Randomized Complete Block Design. Date of flowering, plant height, stem diameter, fresh stem, fresh bast and fresh core yield were measured. Variety FH-952 had the highest value of plant height (340 cm), followed by 4383 variety (310 cm). Despite that, the highest values of other growth and yield parameters such as stem diameter, fresh stem, fresh bast and fresh core yield were recorded on HC 95 variety which was (25.1 mm, 175.0, 41.2 and 134.5) t/ha respectively. Significant results of characteristics from this current study display that, some varieties of kenaf will be selected for replanting since it noted to have high ability to adaptation with Kurdistan environment condition

KEY WORDS: Kenaf variety, Growth, Fiber yield, Environmental.
DOI: http://dx.doi.org/10.21271/ZJPAS.32.4.20
ZJPAS (2020), 32(4); 169-173.

1. INTRODUCTION:

The scientific name of kenaf is *Hibiscus cannabinus* L. native to tropical Africa which also known as one of the fast growing crops, C3 plant (three carbon compounds) (Salih *et al.*, 2014a). High biomass yield and the raised fiber content of kenaf caused to planting this crop in a wide range around the world (Hossain *et al.*, 2010). Stem and biomass yields were among the most important factors for selecting kenaf varieties as a plant material for fiber production and then using in multiple purposes (Webber and Bledsoe 2002).

Ali *et al.* (2017) reviewed that kenaf fiber can be used to make quality fine paper, lower grade papers and cordage, also used to produce rope, canvas, sacking, carpet backing, fishing nets. Also it used in industrial purposes such as interior automobile parts as door panels, headliners. Moreover, the inner part of the plant (core) can be used in animal bedding (Lips *et al.*, 2009).

Given kenaf high adaptability to all kinds of soils, it has the potential to be planted on trouble soils that have a characteristically low efficiency, and also in the soil which is poor in water-holding capacity and nutrient availability (Roslan *et al.*, 2010). These characteristics of the kenaf plant encourage researchers and farmers for choosing and planting and then using their fibers

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Article History:
Received: 20/01/2020
Accepted: 17/05/2020
Published: 08/09 /2020

in wide range of applications. Additionally, climate condition of Kurdistan has a role on plant growing and productions. For example, some varieties of cotton could be grown in the cold condition in some state of Kurdistan (Salih, 2019).

The Iraqi Kurdistan Region (IKR) is located between latitudes 34°00′10″N to 37°20′33.55″N, and longitudes 42°20′25.36″E to 46°18′25″E. It covering an area of about 50,328 km², which constitutes a large portion of the whole of Iraq's territory. The IKR is characterized by a Mediterranean climate, which is cold and rainy in winter and hot and dry in summer. In general, the precipitation season starts in October to end in May with the amount of 350 in the southwestern parts to more than 1,200 mm in northern and northeastern parts. Furthermore, the mean daily temperature varies from 5°C in winter to 30°C in summer; however, this might rise to 50°C in the southern parts of the region (Gaznayee, 2020).

As kenaf was a relatively new crop in Kurdistan. The researchers want to determine the practicality of growing kenaf under local farming conditions, and the economic viability of establishing a kenaf processing enterprise for fiber and animal feed production.

1. MATERIALS AND METHODS

2.1. Location of Experiment

The experiment was conducted at Grdarasha Agriculture Research Station, Department of Field Crops, College of Agricultural Engineering Sciences, Salahaddin University – Erbil, Kurdistan.

2.2 Field Experiment

The field experiment was laid out in Randomized Complete Block Design (RCBD) with four replicates. Seeds of nine varieties with one hybrid of kenaf were planted namely; FH-952, HC 95, HC 2, 4383, 4202, V36, T15, T17, T19 and Hybrid (Table 1). All varieties were reached from Malaysia, at Institute of Tropical Forestry and Forest Production (INTROP), Universiti Putra Malaysia. Seeds were planted on 18 April, 2017 at a soil depth of 1.5 - 3.0 cm in the plot with the size of 1 m^2. The distance between plants was 5 cm and 30 cm was between rows. In this current study, no fertilizers were applied.

Several growth and yield characteristics were studied such as; day of plant flowering, and also at harvesting the following characteristics were recorded on a random sample of tree plants from each plot: Plant height (cm), Stem diameter (mm), Fresh stem yield (t/ha), Fresh bast yield (t/ha), and Fresh core yield (t/ha).

After planting seeds of three varieties which include: T15, T17 and T19 were not germinated. It might be referring to its viability.

Table 1. Number, name and country of origin of kenaf varieties were used in the present study.

Number of varieties	Name of varieties	Country of origin
1	FH-952	China
2	HC 95	Bangladesh
3	HC 2	Bangladesh
4	4383	BJRI (Bangladesh Jute Research Institute) code for origin from Sudan
5	4202	BJRI (Bangladesh Jute Research Institute) code for origin from Tanzania
6	T15	China
7	T17	China
8	T19	China
9	V36	China (Commercial production line of Malaysia)
10	Hybrid	China

2.3 Botanical Characteristics

The kenaf plants have different leaf types and flower colors. Also, the kenaf seeds are slate-black, wedge-shaped are approximately 6 mm long and 4 mm wide. Generally, kenaf has the same type of stem only may be different in color, some of them have dark red or brown stem which is affected by time of harvesting. Additionally, stem diameter also affected by cultivation practices such as fertilization, irrigation, plant density and others (Figure 1).

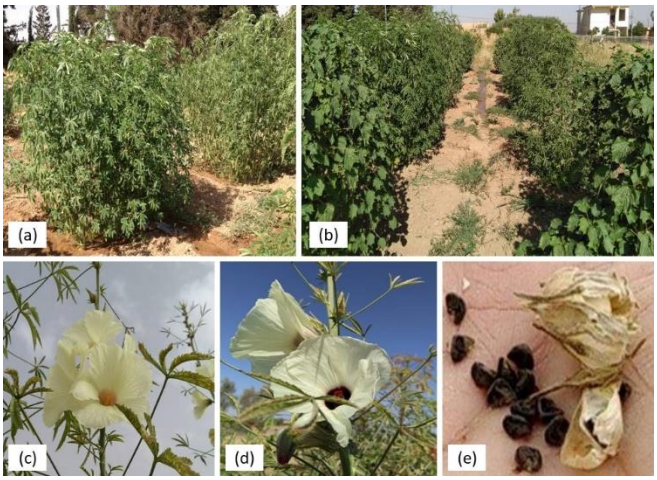


Figure 1: (a,b) different kenaf varieties; (c,d) different flowers; (e) kenaf seeds.

2.4 Data Analysis

Data of flowering, growth and yield characteristics were subjected to Analysis of Variance (ANOVA), using SPSS Statistics and mean comparison was performed by Duncan at P ≤ 0.05

2. RESULTS AND DISCUSSION

Significant results were recorded among varieties in all parameters were studied (Table 2). As mentioned earlier kenaf plant was cultivated for the first time in Kurdistan so results from this current study will be assisted the researchers to do further research which is to establish kenaf plant as a main crop in Kurdistan since it can be used in wide range of industrial applications.

Table 2. The analysis of variance (ANOVA) for the comparison of growth and yield parameters between seven kenaf varieties.

Source of variation	Parameters	DF	Sum of Squares	Mean Square	F value	P value
Variety	DOF (d/plant)	6	2043.0	340.5	19.3	0.000
	PH (cm)	6	24185.7	4031.0	3.7	0.012
	SD (mm)	6	100.0	16.7	2.8	0.040
	FSY (t/ha)	6	24593.6	4098.9	90.4	0.000
	FBY (t/ha)	6	1077.7	179.6	17.9	0.000
	FCY (t/ha)	6	15768.0	2628.0	173.0	0.000

Significant occurs when P ≤ 0.05, DF=Degree of freedom, DOF=Day of flowering, PH=Plant height, SD=Stem diameter, FSY=Fresh stem yield, FBY=Fresh bast yield, and FCY=Fresh core yield.

Date of flowering is one of the growth parameters was determined between varieties which is most important since it affected plant height, fiber yield and also fiber quality. The average of chemical compounds was changing during flowering, so it may be caused to improve the fiber quality and quantity. Mediavilla *et al.* (2001) reviewed that different varieties of hemp plant were recorded a similar growth pattern with a maximum of stem yield at flowering. Figure 2 shows the different results of flowering. Hybrid was flowering after 165 days, while could see the flower on V36 after 195 days of planting. It was in agreement with previous research which concluded that growth parameters were different with kenaf varieties (Salih *et al.*, 2014b).

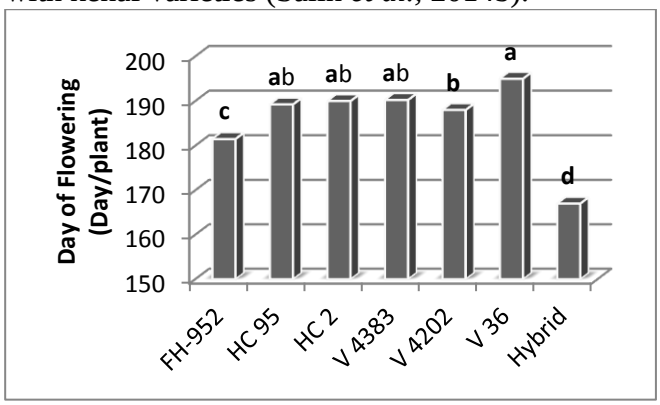


Figure 2: Day of flowering of seven kenaf varieties. Means with the same letter are not significantly different (Duncan, P ≤ 0.05).

FH-952 variety had the highest stem compared to other varieties were studied. Its plant height was about (340 cm), while V36 had the lowest plant height (240 cm) (Figure 3). It might be caused by the varieties and its ability to adaptation with the Erbil environment. Salih *et al.* (2014b) planted seeds of two kenaf varieties (FH-952 and 4383), it was done at Universiti Putra Malaysia, 2013, so they found that kenaf plants have different growth performance. FH-952 was recorded the highest plant high.

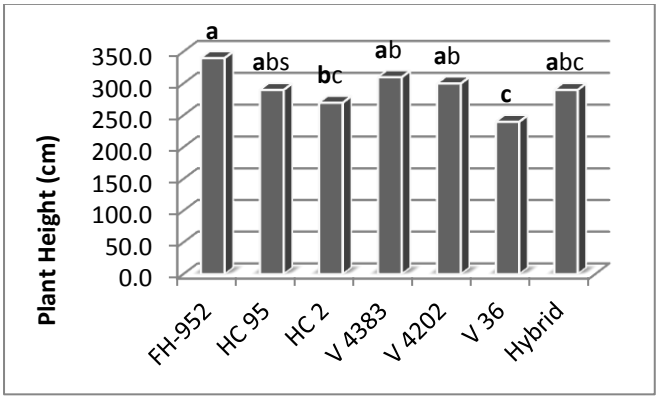
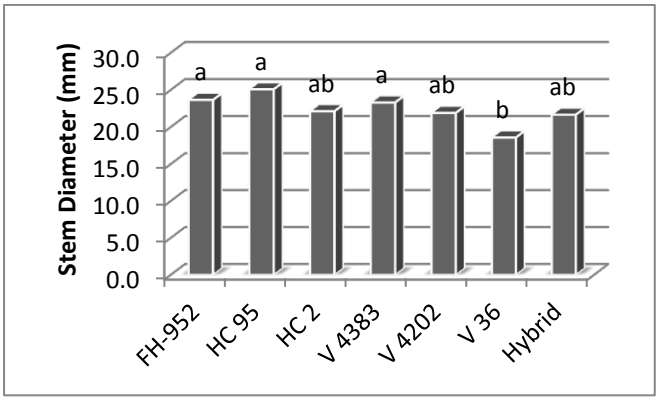


Figure 3: Comparison of plant height between seven kenaf varieties. Means with the same letter are not significantly different (Duncan, $P \leq 0.05$).

The biggest stem diameter was recorded of HC95 which was by (25.1 mm), followed by FH-952 and 4383 varieties the values were about (23.7 and 23.3 mm), respectively (Figure 4). Despite that, kenaf V36 had to the smallest stem diameter which was only (18.6 mm). These results strongly supported by (Salih *et al.*, 2014b; Hossain *et al.*, 2011; and Wong *et al.*, 2008). Many factors effected stem diameter such as field management and varieties.



Figur 4: Comparison of stem diameter between seven kenaf varieties. Means with the same letter are not significantly different (Duncan, $P \leq 0.05$).

Figures 5, 6 and 7 were showed the yields of fresh stem, fresh bast and fresh core was different according to the varieties. The maximum fresh stem yield, fresh bast and fresh core yield were recorded by (175.0, 41.2 and 134.5) t/ha respectively for HC95 variety. Conversely, V36 was recorded the minimum fresh yields (78.8, 24.9 and 53.7) t/ha respectively for all yield parameters. It was agreement with (Jie *et al.*, 2017; Salih *et al.*, 2014c; and Hossain *et al.*, 2012).

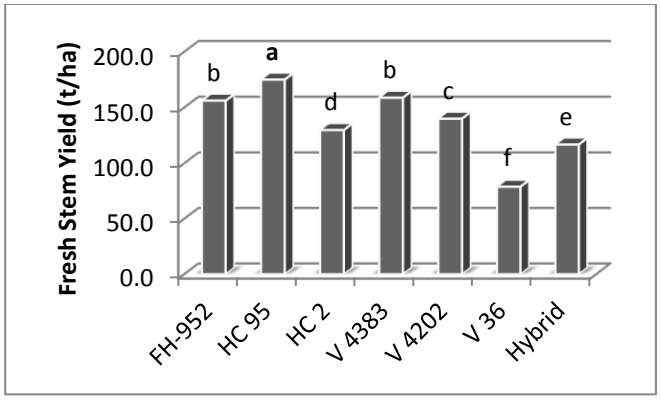


Figure 5: Comparison of fresh stem yield between seven kenaf varieties. Means with the same letter are not significantly different (Duncan, $P \leq 0.05$).

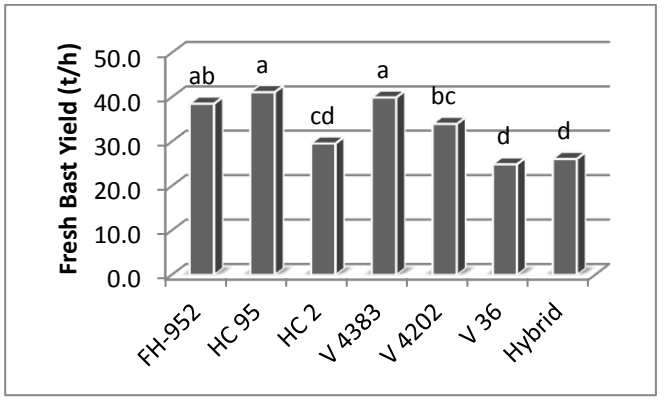


Figure 6: Comparison of fresh bast yield between seven kenaf varieties. Means with the same letter are not significantly different (Duncan, $P \leq 0.05$).

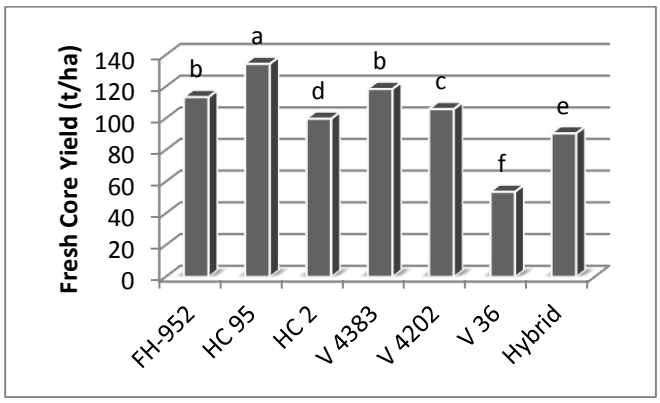


Figure 7: Comparison of fresh core yield between seven kenaf varieties. Means with the same letter are not significantly different (Duncan, $P \leq 0.05$).

Highly significant results of fresh yields suggested that kenaf varieties HC95, FH-952 and 4383 can be replanted to reach on the great information about them in Kurdistan environment. On the other hand, 4202 and HC2 varieties also showed the significant results of fresh yields which was verified to its ability for adaptation in Kurdistan environment. Actually, results of these varieties less than results of HC95, FH-952 and 4383 varieties, but it may be providing the high

value of fiber yield at different environmental situations. For that purpose, can say that it may be suitable with other states in Kurdistan region.

3. CONCLUSIONS

During this present study received great information about several kenaf varieties in Erbil, Kurdistan environment. The results showed that kenaf can be planted as a major crop since their fibers have potential impact to be used in industrial and as forage. Variety HC 95 had the maximum fresh stem, fresh bast and core fiber yield followed by FH-952 and 4383 varieties. As mentioned earlier, any fertilizers were not applied in this current study so believed that for the future using fertilizers may have significant effect of improving quality and quantity of fibers. On the other hand, researchers should be recommended farmers for planting this crop through Ministry of Agriculture and Water Resources.

Acknowledgements

Authors would like to thanks the all staffs at the researching filed, the Field of Grdarasha, College of Agricultural Engineering Sciences, Salahaddin University – Erbil for preparing the field and tools during the research. Also, authors want to many thanks to Institute of Tropical Forestry and Forest Production (INTROP) at Universiti Putra Malaysia and also special thanks to Mr. Baharum Zainal for providing all kenaf seeds.

Conflict of Interest (1)

The authors declare no conflict of interest.

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