KENAF RESPONSES TO IRRIGATION AND NITROGEN FERTILIZATION IN CENTRAL REGION OF SPAIN

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ABSTRACT: The objective of this work was to study the effect of irrigation and nitrogen fertilization on plant kenaf yield, in central plateau of the Iberian peninsula. The variety “Tainung 2” of kenaf was cultivated at four irrigation levels (I_0, without irrigation; I_{25}, 25 % PET; I_{50}, 50 % PET; I_{100}, 100% PET) and three nitrogen fertilization levels (N_0, 0 kg N/ha; N_{75}, 75 kg N/ha; N_{100}, 100 kg N/ha). The irrigation was the principal factor in the plant growth and plant yield of the kenaf crop, and it affect significantly to the: plant height, stem diameter and also to the others yielding components (leaf, bark and core). Nitrogen fertilization was not significant effect under any of the three treatments on kenaf plant growth and plant yield.

Keywords: biomass production, irrigation, kenaf

1 INTRODUCTION

Kenaf (*Hibiscus cannabinus* L.) is an annual plant that can be useful as a source of low cost natural fibre. It is 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 [1]. The knowledge of kenaf agronomy is important at present due to the increased number of new uses for kenaf plant.

To the farming point of view this crop can be also seen as an useful alternative to the maize crop as well as other vegetable irrigated summer crops in our zone. The establishment of the kenaf crop in Spain will depend if kenaf production can be competitive with other crops grown in the area. However, there are few data about kenaf agronomy during the last decade for our continental climate [2]. The objective of this work was to study the effect of irrigation and nitrogen fertilization on plant kenaf yield, in central plateau of the Iberian peninsula.

2 MATERIALS AND METHODS

The field study was carried out in 2003 on a sandy clay loam soil (Calcic Haploxeralfs) at the experimental farm “La Canaleja” from INIA (Alcalá de Henares, Madrid) in order to determine the appropriate irrigation and nitrogen fertilization requirements. Fig. 1 shows the mean temperature and rainfall during the experimental period.

The kenaf (“Tainung 2” variety) was cultivated at four irrigation levels (I_0, without irrigation; I_{25}, 25 % PET; I_{50}, 50 % PET; I_{100}, 100% PET) and three nitrogen fertilization levels (N_0, 0 kg N/ha; N_{75}, 75 kg N/ha; N_{100}, 100 kg N/ha). The plants were grown in 7x5 m^2 in a randomised block design with three replicates in each essays.

Growth and productivity data were harvested 7 times during the growing period. In each harvest a one-meter row was harvested, and leaves, bark and core were separated. The dry matter in plant yielding components was evaluated after drying the samples at 80ºC at constant weight. Also, the plant height and basal stem diameter were measured in five plants per plot.

The data were analysed using GLM procedures included in the SAS statistical package [3]. Significant differences between means were estimated using Duncan's Multiple Range Test, p = 5 % [4].

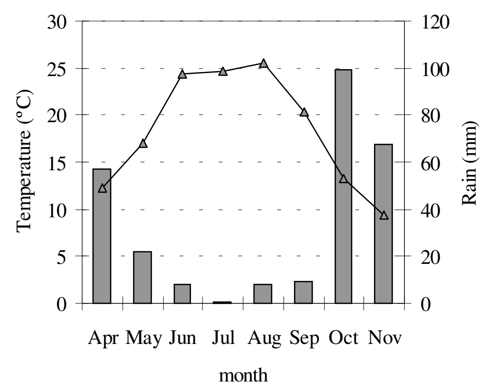

Figure 1. Meteorological data in Alcalá de Henares, (Madrid, Spain) during the experimental period.

3 RESULTS AND DISCUSSION

Irrigation treatments affect clearly to kenaf growth; plant height and basal stem diameter (Figs. 2 and 3). Kenaf plants under I_{100} treatment vigorously increased plant height and stem diameter. The growth increased slowly with the keanf plants under I_0, I_{25}, and I_{50} treatments. I_{50} reduced growth by 30 %, I_{25} by 45 %, and I_0 by 50 % when compared with I_{100} treatment (Figs. 2 and 3).

The nitrogen fertilization have not any effect on the plant growth parameters (plant height and basal stem diameter) during all trial (Figs. 2 and 3).

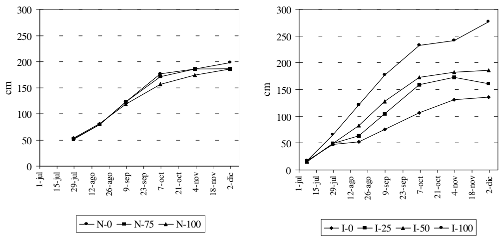

Figure 2. Effect of nitrogen fertilization (N_0, 0 kg N/ha; N_{75}, 75 kg N/ha; N_{100}, 100 kg N/ha) and Irrigation (I_0, without irrigation; I_{25}, 25 % PET; I_{50}, 50 % PET; I_{100}, 100% PET) on the kenaf height (cm) during the experimental period in Alcalá de Henares (Madrid, Spain).

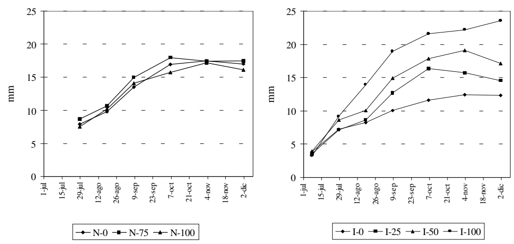

Figure 3. Effect of nitrogen fertilization (N_0, 0 kg N/ha; N_{75}, 75 kg N/ha; N_{100}, 100 kg N/ha) and Irrigation (I_0, without irrigation; I_{25}, 25 % PET; I_{50}, 50 % PET; I_{100}, 100% PET) on the stem diametes of kenaf (mm) during the experimental period in Alcalá de Henares (Madrid, Spain).

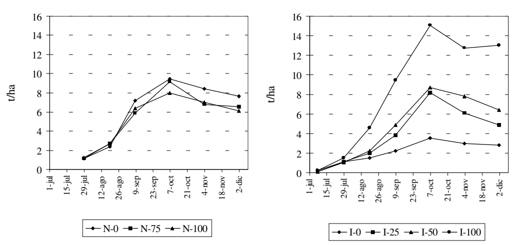

Figure 4. Effect of nitrogen fertilization (N_0, 0 kg N/ha; N_{75}, 75 kg N/ha; N_{100}, 100 kg N/ha) and Irrigation (I_0, without irrigation; I_{25}, 25 % PET; I_{50}, 50 % PET; I_{100}, 100% PET) on the kenaf biomass yield (t/ha) during the experimental period in Alcalá de Henares (Madrid, Spain).

The Fig. 4 shows the effect of nitrogen fertilization and irrigation on the evolution of kenaf biomass production. The fertilization did not affect to the biomass production of kenaf, however the irrigation treatments significantly affected to the kenaf productivity after the 5th week of treatment (Fig. 4).

The irrigation was the principal factor in the plant growth and plant yield of the kenaf crop (Table I). After the 80th day of sowing the irrigation treatment affect significantly to the plant height and basal stem diameter (Table I, and Figs. 2 and 3). Also, the irrigation treatment influenced similarly to the others yielding components: leaf, bark and core (Fig. 5). The I_{100} was the best treatment and the stem yield at the end of growth period was: 11 t/ha (bark: 3.6 t/ha; core: 7.4 t/ha) (Table I, and Figs. 4 and 5). The difference between I_{50} and I_{25} biomass production were not significant (Table I and Fig. 4), and the effect of I_0 on reduction of biomass production was significant with the others irrigation treatments (Table I and Fig. 4). The pattern of biomass production of bark and core were similar (Fig. 5). At the end of the experimental period, I_{50} treatment reduced dry stem production by 37 %, I_{25} by 50 % and I_0 by 75 % when compared with I_{100} treatment (Fig. 4). The highest stem biomass production: 12.4 t/ha (bark: 3.9 t/ha; core: 8.5 t/ha) was obtained in plots treated with N_0 (0 kg N/ha) and I_{100} (100% PET) (Fig. 6)

Table I. Effect of nitrogen fertilization (N_0, 0 kg N/ha; N_{75}, 75 kg N/ha; N_{100}, 100 kg N/ha) and Irrigation (I_0, without irrigation; I_{25}, 25 % PET; I_{50}, 50 % PET; I_{100}, 100% PET) on the dry stem biomass yield of kenaf(t/ha), plant height (cm), and stem diameter (mm) at the end of growth period in Alcalá de Henares, Madrid, Spain, and analyses of variance for the Fertilization and Irrigation variables. N, number of plots; df, degrees of freedom; The letters in the columns indicate means showing a significant difference at the 5 % level (Duncan's multiple range test).

	N	**Stem biomass (t/ha)**	**Plant height (cm)**	**Stem diameter (mm)**
Nitrogen Fertilization (F)				
N_0	12	7.4 a	176.5 a	16.9 a
N_{75}	12	5.9 a	170.8 a	18.0 a
N_{100}	12	6.2 a	156.9 a	15.7 a
Irrigation (I)				
I_0	9	2.8 c	107.1 c	11.6 c
I_{25}	9	5.4 b	158.8 b	16.4 b
I_{50}	9	6.9 b	173.3 b	17.8 b
I_{100}	9	10.9 a	233.0 a	21.6 a
OVERALL SCORES	36	6.5	168.1	16.9
		Stem biomass	**Plant height**	**Stem diameter**
Source of variation	**df**	-------------------	***P***	----------------
F	2	ns	ns	ns
I	3	0.0001	0.0001	0.0001
F x I	6	ns	ns	ns

Nitrogen fertilization was not significant effect under any of the three treatments on kenaf plant growth and plant yield (Table I, and Figs. 2, 3, 4 and 5). That could be because soil was full feed enough in nitrogen before the kenaf was sowed to surplus the crops needs at the plant growing period during the experiment. This lack of response by kenaf to different nitrogen applications in in agreement with the results of other studies [2, 5]

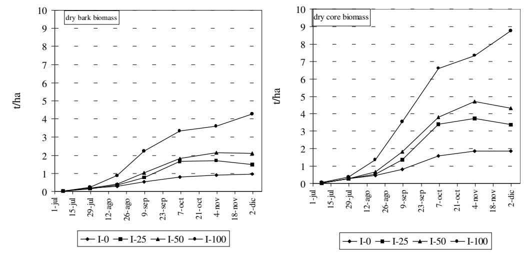

Figure 5. Effect of Irrigation (I_0, without irrigation; I_{25}, 25 % PET; I_{50}, 50 % PET; I_{100}, 100% PET) on bark and core biomass yield (t/ha) during the experimental period in Alcalá de Henares (Madrid, Spain).

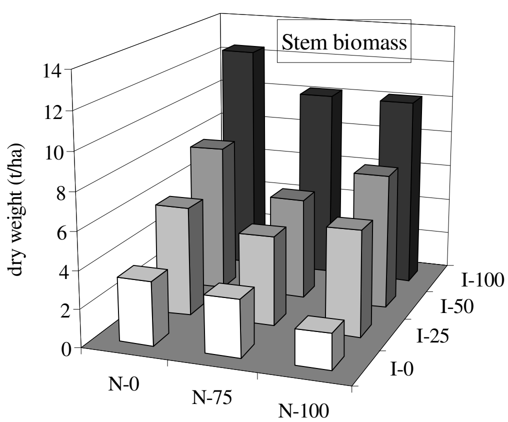

Figure 6. Effect of nitrogen fertilization (N_0, 0 kg N/ha; N_{75}, 75 kg N/ha; N_{100}, 100 kg N/ha) and Irrigation (I_0, without irrigation; I_{25}, 25 % PET; I_{50}, 50 % PET; I_{100}, 100% PET) on the stem biomass yield (t/ha) at the end of growth period in Alcalá de Henares (Madrid, Spain).

In the central region of Spain, were the kenaf trials were located irrigation practices should be performed at 100 % PET. We have found that the reduction of water amount decrease the production of plant kenaf biomass in our climatic conditions, and this is according with others studies [6]. We have found also that in our climatic and crop rotation conditions it is not necessary the application of nitrogen fertilization, but in the case we want a quick increase to maintain the soil quality to the former nitrogen level, we should applied the nitrogen extracted by the kenaf crop.

4 REFERENCES

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5 ACKNOWEDLEGEMENTS

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