GROWTH AND YIELD OF THREE KENAF VARIETIES IN TWO SPAIN LOCATIONS

E.F. de Andrés[1], J. González Cortés[2], A. Ayuso Mateos[2], M.A. Pérez Rodríguez[2], A. González Moreno[1], J.L. Tenorio[1]
[1]INIA, Dpto. Medio Ambiente. Apdo. 8111. 28080-Madrid, Spain. (Phone: 34918892943; Fax: 34918828124; Email: parlorio@inia.es). [2]Servicio de Investigación y Desarrollo Tecnológico. Consejería de Agricultura y Medio Ambiente. Junta de Extremadura. Finca La Orden. Guadajira. 06187 Badajoz, Spain (Phone: 34924014040; Fax: 34924014001; Email jgonzalezcor@aym.juntaex.es)

ABSTRACT: The objective of this work was to compare the biomass production of three varieties of kenaf in two Spain locations. Also, other objective was to study the effect of sowing date and population density on plant kenaf yield. The experiments were carried out in 2003 in Madrid (experimental farm "La Canaleja" from INIA, Alcalá de Henares) and in Badajoz (experimental farm "La Orden", Guadajira). Three kenaf varieties (Everglades 41; Salvador; Tainung 2) were sowed in two dates (S1, end of May; S2, beginning of June) and cultivated at two densities (D1, 200000 plants/ha; D2, 400000 plants/ha). The results show that the biomass production of kenaf was significantly greater in Badajoz than Madrid. No marked effect on biomass production was observed when different plant populations were used in the two localities. S1 and S2 sowings produced similar harvests in Badajoz, while the S1 yield was significantly better than S2 in Madrid. The response of each variety was different in the two locations. In Madrid, the maximum yield was obtained by Everglades 41, but the differences were not significant in Badajoz.

Keywords: kenaf, biomass production, cultivars

1 INTRODUCTION

Kenaf (*Hibiscus cannabinus* L.) is an annual and fast-growing plant that is mainly used in the industry for paper pulp production, although the kenaf fibers can be used in the industry for a wide range of products: building materials, adsorbents, textiles, livestock feed, etc… [1]. The knowledge of kenaf agronomy is important at present due to the increased number of new uses for kenaf plant.

The establishment of the kenaf crop in Spain will depend if kenaf production can be competitive with other crops grown in the area. The kenaf crop can be also seen as an useful alternative to the maize crop as well as other vegetable irrigated summer crops in our zone. However, there are few data about kenaf agronomy during the last decade for our continental climate [2]. The objective of this work was to compare the biomass production of three varieties of kenaf in two Spain locations. Also, other objective was to study the effect of sowing date and population density on plant kenaf yield.

2 MATERIALS AND METHODS

The experiments were carried out during 2003 in the two localities: A, Alcalá de Henares (Madrid, Spain); and B, Guadajira (Badajoz, Spain). Fig. 1 shows the mean temperature and rainfall during the experimental period in both sites.

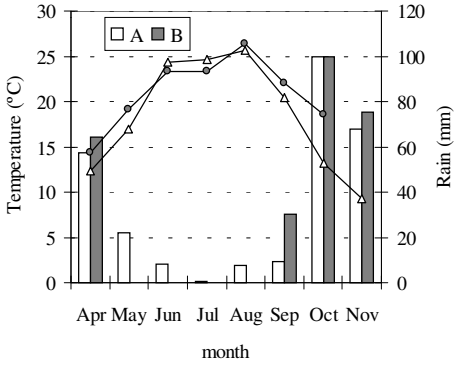

Figure 1. Meteorological data in the two localities (A: Alcalá de Henares, Madrid, Spain; B: Guadajira, Badajoz, Spain) during the experimental period.

2.1 Field experiments in Madrid

Three independent experiments were carried out in the experimental farm "La Canaleja" from INIA, Alcalá de Henares (Madrid, Spain).

In the first trial, we studied the effect of sowing date. The Tainung 2 kenaf variety was sown in two dates (S1, at end of May; S2, at beginning of June). The plant density was 200000 plants/ha.

In the second essay, the Tainung 2 kenaf variety was cultivated in two plant densities (D1, 200000 plants/ha; D2, 400000 plants/ha). The sowing date was at end of May.

A third experiment was carried out and three kenaf varieties (Everglades 41; Salvador; Tainung 2) were sown at beginning of June. The plant density was 200000 plants/ha.

The plants were grown in 7x5 m^2 with three replicates in each essay.

2.2 Field experiments in Badajoz

Three independent experiments were carried out in the experimental farm "La Orden" from SIDT, Guadajira (Badajoz, Spain).

The effect of sowing date and kenaf variety was studied in the first experiment. Two kenaf varieties (Everglades 41; Tainung 2) were sown in two dates (S1, at end of May; S2, at beginning of June), and the plant population was 400000 plants/ha.

In the second trial, the Salvador kenaf variety was sown in two dates (S1, at beginning of May; S2, at beginning of June). This variety was cultivated in two plant densities (D1, 200000 plants/ha; D2, 400000 plants/ha).

The third essay was conducted in order to examine the effect of plant density and kenaf variety. Three kenaf varieties (Everglades 41; Salvador; Tainung 2) were cultivated in two plant densities (D1, 200000 plants/ha; D2, 400000 plants/ha) and sown at beginning of June.

The plants were grown in 7x5 m^2 in a randomised block design with three replicates in each essay.

2.3 Data recording

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. 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].

3 RESULTS AND DISCUSSION

3.1 Field experiments in Madrid

S1 yield was significantly better than S2 yield (11.6 t/ha vs. 9.2 t/ha). The plant height and stem diameter were similar in both sowing dates. The yield decrease caused by the late sowing time was probably due to the cool temperatures of late summer or early autumn (Fig. 1)

Plant density did not significantly affect to the biomass production, being 11.1 t/ha the mean yield. Neither plant height nor basal stem diameter were influenced by both plant populations.

In Madrid, the maximum yield was obtained by Everglades 41 (11.2 t/ha), followed by Tainung 2 (9.2 t/ha), and the minimum by Salvador (7.1 t/ha), being these differences statistically significant. The three varieties showed similar plant growth parameters (mean plant height: 2.28 m; and mean stem diameter: 18.6 mm).

The ratio of stem components was not influenced by plant density and sowing date (33.5 % bark-66.5 % core). But the ratio of stem components was significantly affected by kenaf variety. The bark proportion of Salvador was significantly higher than Everglades 41 and Tainung 2 (39.7 % vs 32.2 % and 32.7). The bark yield was similar in the three varieties (Fig. 2), but the core yield of Salvador was significantly lower than Tainung 2 and Everglades 41 (Fig. 3).

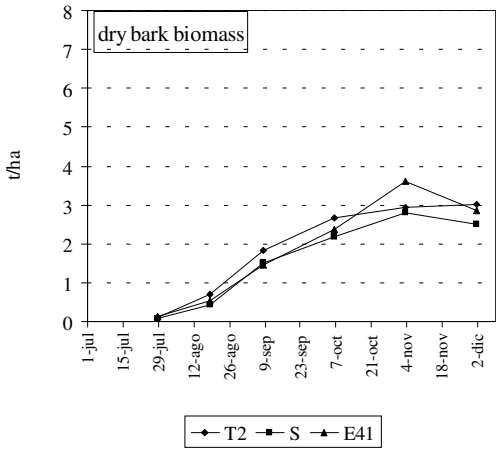

Figure 2. Effect of kenaf variety (T2, Tainung 2; S, Salvador; E41, Everglades 41) on the bark biomass production (t/ha) in Alcalá de Henares (Madrid, Spain) during the estudied period.

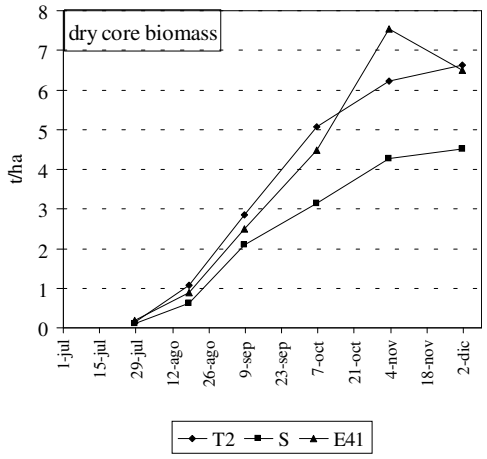

Figure 3. Effect of kenaf variety (T2, Tainung 2; S, Salvador; E41, Everglades 41) on the core biomass production (t/ha) in Alcalá de Henares (Madrid, Spain) during the estudied period.

3.2 Field experiments in Badajoz

Both sowing dates did not produce significant differences on biomass production. However, plant growth parameters were significantly higher in the sowed plants at beginning June.

Plant density did not significantly affect to the biomass production and plant growth parameters, how in the other locality.

The biomass production at the end of growth period was not significant between varieties. The biomass productions were 26.5 t/ha (Tainung 2), 22.4 t/ha (Everglades 41), and 21.6 t/ha (Salvador). The final height of Tainung 2 was significant higher than

Everglades 41 and Salvador (3.70 m vs. 3.36 and 3.42 m). The basal stem diameter was similar in the three varieties (mean of 14.1 mm).

Sowing date and plant density were not affect to the ratio of stem components (32.9 % bark-67.1 % core). Nevertheless, the bark ratios of Salvador and Everglades 41 were significantly higher than Tainung2 (35 % and 36.4 % vs 30.4 %).

3.3 Effect of locality

The results show that the biomass production of kenaf was significantly greater in Badajoz than Madrid (Table I and Fig. 4). The stem yields at the end of growth period were: 21.0 t/ha in Badajoz and 9.1 t/ha in Madrid. Also, the plant height was significantly higher in Badajoz than Madrid (3.59 m vs. 2,28 m) but the stem diameter was significantly larger in Madrid than Badajoz (18.6 mm vs. 14.4 mm).

Kenaf has been shown to need relatively high temperatures during its growth cycle [5], and kenaf ceases to grow at a temperature below 20°C [6]. In this way, the differences between the two localities can be mainly due to Madrid low temperatures compared with Badajoz temperatures. Mainly temperatures registered at the beginning and at the end of studied period (Fig. 1).

Table I. Effect of kenaf variety (Taninung 2, Salvador, Everglades 41) and experimental locality (A: Alcalá de Henares, Madrid, Spain; B: Guadajira, Badajoz, Spain) on the dry stem biomass yield of kenaf (t/ha), plant height (cm), and stem diameter (mm) at the end of growth period, and analyses of variance. 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)
Locality				
A	9	9.1 b	227.8 b	18.6 a
B	9	21.0 a	359.1 a	14.4 b
Kenaf variety				
Tainung 2	6	15.9 a	315.0 a	17.2 a
Salvador	6	14.1 a	285.7 ab	15.2 a
Everglades 41	6	15.3 a	279.7 b	17.2 a
OVERALL SCORES	18	15.1	293.5	16.5
Source of variation	**df**	**Stem biomass**	**Plant height**	**Stem diameter**
		---------- *P* ----------		
Locality (L)	1	0.0001	0.0001	0.0001
Variety (V)	2	ns	ns	ns
L x V	2	ns	ns	ns

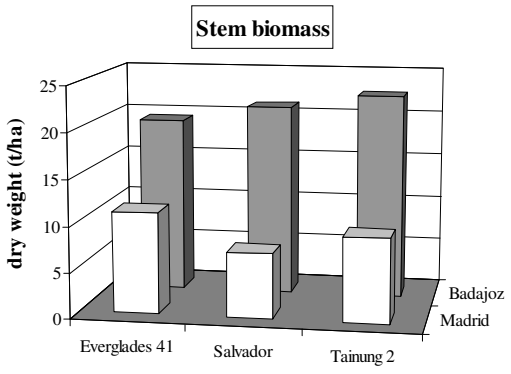

Figure 4. Effect of kenaf variety (Tainung 2, Salvador, Everglades 41) and experimental locality (A: Alcalá de Henares, Madrid, Spain; B: Guadajira, Badajoz, Spain) on the dry stem biomass yield of kenaf (t/ha) at the end of studied period.

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5 ACKNOWEDLEGEMENTS

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