Industrial Crops and Products 68 (2015) 131–140

Contents lists available at ScienceDirect

Industrial Crops and Products

journal homepage: www.elsevier.com/locate/indcrop

How kenaf (*Hibiscus cannabinus* L.) can achieve high yields in Europe and China

E. Alexopoulou [a,*], D. Li [b], Y. Papatheohari [c], H. Siqi [b], D. Scordia [d], G. Testa [d]

[a] *CRES – Center for Renewable Energy Sources and Saving, 19th Km Marathonos Avenue, 19009 Pikermi Attikis, Greece*
[b] *IBFC – Instituite of Bast Fiber Crops, 348 Western Xianjiahuxi Road, Changsha, 410205 Hunan, China*
[c] *AUA – Agricultural University of Athens, Iera Odos 75, Votakinos, Athens, Greece*
[d] *UNICT – University of Catania, Productioni Agrarie e Alimentari, Via Valdisavoia 5, 95123 Catania, Italy*

ARTICLE INFO

Article history:
Received 12 July 2014
Received in revised form 15 October 2014
Accepted 17 October 2014
Available online 29 January 2015

Keywords:
Kenaf
Hibiscus cannabinus L.
Crop management
Varieties
Sowing time
Plant populations
Weed control
Nematodes
Harvesting time

ABSTRACT

Kenaf is an annual spring fibre crop and it is considered as a valuable multipurpose crop due to numerous end uses. Currently, in the framework of an EU project entitled FIBRA (www.fibrafp7.net), kenaf is being investigated in Europe and China as source for sustainable bio-based products. Like all the other cultivated crops, the determination of the appropriate crop management (varieties, sowing dates, plant populations, irrigation, fertilization, weed control and harvesting time) is a key factor for the successful insertion of the crop in the existing agricultural cropping systems with economic benefits. Recently, new kenaf varieties have been released in both USA and China with increased biomass productivity and for some of them with an increased resistance to nematodes and anthracnose. Kenaf sowing should take place in spring as soon as the soil temperature is higher than 15 °C. When the crop it is cultivated for its fibre stem the plant population should vary from 200,000 to 500,000 plants/ha and the row spacing from 35 to 50 cm. In areas that the precipitation is limited, during the hot summer months, irrigation is needed in order the crop to reach high biomass yields. It is a crop with sensitivity to nematodes, especially when it is cultivated in areas with sandy soil and this sensitivity should be taken under consideration in the rotation systems that will be applied. Harvesting time and methods should be adjusted according to the use of the crop (fibre, seeds, fibre and seeds, forage). The development of varieties or hybrids with higher yields (either for stem production or dual purpose varieties for stems and seeds production) and improved resistance to drought as well as to nematodes and anthracnose is considered one of the main challenges for the future of the crop.

1. Introduction

Kenaf (*Hibiscus cannabinus* L.) is an annual spring crop with origin from Africa, where still semi-wild kenaf can be found (Cheng et al., 2004). It belongs to the Malvaceae family and in section Furcaria and is closely related to cotton and roselle. It is a short day crop that can be cultivated from 30° S to 45° N. Since 1940s research has been carried on kenaf from production to the end use.

In the past, the importance of the crop was mainly focused on paper pulp production, while the last two decades kenaf has being characterized as a multi-purpose crop due to its high number of industrial applications (Falasca et al., 2014). Kenaf stem fibres (either derived from the bark or the core) are an excellent source for fabrics, building materials (particleboards, low-density panels, wall paper backing, furniture underlays etc.), bedding material, poultry and/or cat litter, oil absorbent, etc. (Kugler, 1988; Kulger, 1996; Kaldor et al., 1990). Additionally, the whole plant has high protein and good digestibility and may be pelletized (Webber and Bledsoe, 1991).

Recently, it is considered as a valuable dual purpose crop (stem fibres and seeds) and a number of bioactive components have been identified including tannins, saponins, polyphenols, alkaloids, fatty acids, phospholipids, tocopherols and phytosterols (Mohamed et al., 1995). It has been reported to be anodyne, aperitif, aphrodisiac, fattening, purgative, and stomachic and has long been used in traditional medicine to treat bilious conditions, bruises and fever (Coetzee et al., 2007; Mohamed et al., 1995; Nyam et al., 2009).

A quite new application is to use it as food additive. The powder from dry kenaf leaves have been added in several kinds of food and it was found that the content of calcium and fibre was improved,

* Corresponding author. Tel.: +30 210 6603382; fax: +30 210 6603301.
E-mail address: ealex@cres.gr (E. Alexopoulou).

http://dx.doi.org/10.1016/j.indcrop.2014.10.027
0926-6690/

while the taste remained the same. Its leaves can be also used as tea.

Recently, in the framework of an EU project entitled FIBRA (www.fibrafp7.net), kenaf among other fibre crops (ramie, hemp, flax, nettle, jute, etc.) it is being investigated in Europe and China as an important source for sustainable bio-based products. In the current review it is presented how kenaf can give high yields through the appropriate cultural practices (varieties, sowing dates, plant populations, irrigation and fertilization needs, nematodes and rotation, weed control and harvesting time) when it is cultivated in Europe and China.

2. The importance of the crop in Europe and China

Kenaf production (and other allied crops), at world level, reached its maximum values in 1985 and thereafter starting to decline. Nowadays, the world production for kenaf and other allied crops it is estimated to 284 thousand tones (2010/2011) and China contributes with 32% to the total kenaf production. It should be mentioned that in its area of origin (Africa) the production contributes only 4% to the total (FAO, 2012).

Kenaf has a history of 100 years in China, while jute has been cultivated in China for more than eight centuries. Kenaf was introduced into Mainland China as a new crop from Taiwan (originally brought from India) in the beginning of last century. From 1974 to 1984, China enjoyed a rapid productivity increase of 137% that led to a 112.9% increase in the kenaf and jute production. In the beginning of 1990s the kenaf market was declined as result of the competition with much cheaper synthetic fibres. The kenaf cultivation area was gradually declined from 300,000–400,000 to 120,000–150,000 ha/yr during the last 20 years. In Fig. 1 the main areas of kenaf cultivation in China are being presented.

In Europe its cultivation area (Po Valley, Italy) maximized for the period 2000–10 (500–700 ha), while currently has been limited to few demonstration and pilot fields in several sites of South Europe. In Italy the harvested material used to be consumed by the company KEFI ITALIA (located close to Bologna) to produce insulation mats from the bark material (www.kenaf-fiber.com), while the core material was used as animal bedding. Additionally, when KEFI ITALIA was active additional applications from kenaf fibres were exploited. From the period 2003–2007 the EU project entitled BIOKENAF (www.cres.gr/biokenaf) offered an integrated approach to kenaf covering the whole production chain (production, harvesting and storage) and testing its suitability for industrial products (high added value) and energy production.

3. Key parameters in kenaf cultivation

3.1. Varieties

The selection of the best-adapted variety for each site is a key parameter for achieving high yields that will ensure the highest economic returns (Bhangoo and Cook, 1998). Significant improvements in kenaf germplasm have been made in the last century both in USA and China. Many varieties have been developed that vary morphologically, in their response to the climatic conditions, to the resistance in diseases and enemies, in their fibre quality as well as in their fibre yields (Catling, 1982; Cook et al., 1998).

Many kenaf hybrids with high productivity were developed when the problem with the manual pollination was solved (Li, 2002). Kenaf hybrids are very popular in some countries, like China, Russia, and Thailand. It has been estimated that in China around 1000 tonnes of hybrid seed is being sold every year. In China quite important hybrids (Fig. 2) currently are: H316, H318, H328 (photoinsensitive) and H368 with yields between 2.1 and 2.3 t/ha of retted fibre after 120 growing days (10.5–11.5 t/ha stem yields) and 3.0 t/ha of retting fibre after 150 growing days (15 t/ha stem yields). These Chinese hybrids are being characterized with high resistance to anthracnose and to lodging.

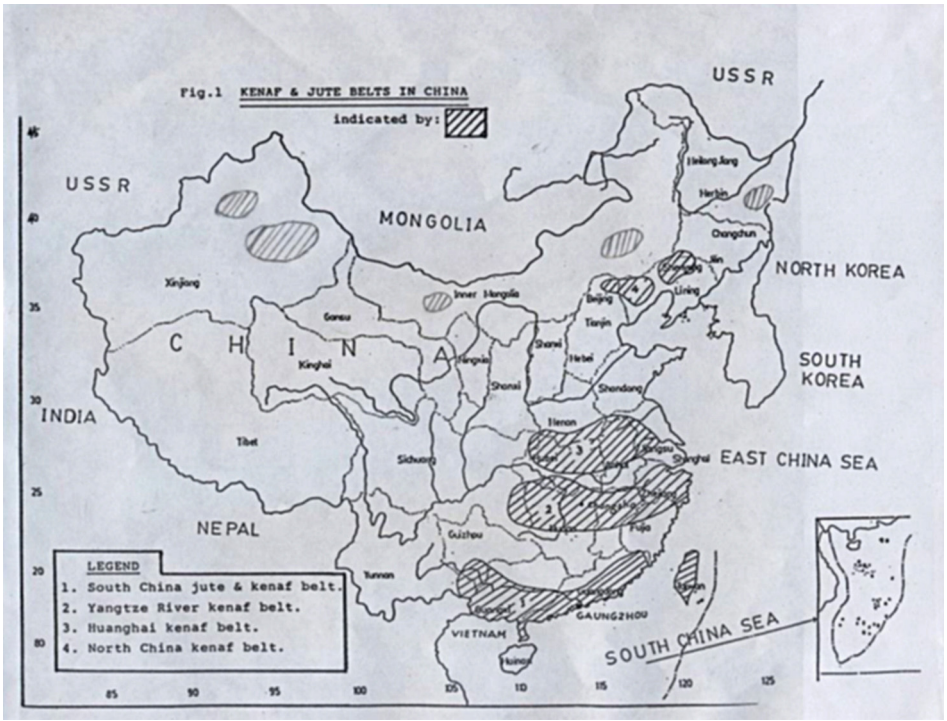

Fig. 1. Main areas of kenaf cultivation in China.

Source: IBFC.