Lechugulla (*Agave lecheguilla* Torr., *Yucca carnerosana* Trel) and Other Leaf Fibres in Northeastern Mexico: Research Needs

Ratikanta Maiti* and Humberto Gonzalez Rodriguez

Universidad Autonoma de Nuevo Leon, Facultad de Ciencias Forestales, Carr. Nac. No. 85 Km. 45, Linares, Nuevo Leon (67 700), Mexico

Corresponding Author

Ratikanta Maiti
e-mail: ratikanta.maiti@gmail.com

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Abstract

The present paper describes in brief the distribution, ecological conditions, morpho-anatomical characteristics and productivity of few leaf fibres specially *Agave lecheguilla*, *Yucca carnerosana* and few aspects of other species grown naturally in Northeast Mexico. The review also suggests sustainable use, conservation and propagation of these species and research needs on these species.

Keywords: *Agave*, anatomy, ecology, extraction, fibres, morphology, productivity, *Yucca*

1. Introduction

Vegetable fibres have great demands in the world to meet the demand in textile industry and domestic uses, although the arrival of synthetic fibres competes with those fibres of vegetable origin. In India and other Asian countries, there are several vegetable fibres like jute (*Corchorus olitotprus*, *C. capsularis*), Kenaf (*Hibiscus cannabinus*, *H. sabdariffa*), flax (*Linum usitatisimum*).

These fibre crops cannot thrive in Northeast Mexico whre only few leaf fibres such as (*Agave lecheguilla*, *Yucca carnerosana*) grow in natural conditions in arid lands to serve the demand of fibre industry and domestic uses. Besides, henequén (*Agave fourcroydes*) is another fibre yielding plants mainly cultivated in some areas like in Tamaulipas and other neighbouring regions. There are few more fibres like *Musa textilis*, *Furcraea cabuya* and others. The authors made a visit to south of Nuevo Leon and collect information the method of exploitation of different species of leaf fibres in different localities. They also conducted few research activities on few of these leaf fibres, mainly *Agave lecheguilla* which is described below. During extensive visits in several arid lands of Northeast Mexico, the distribution, ecological condition and population of *Agave lecheguilla* and *Yucca carnerosana* are observed and mentioned below.

2. Leaf Fibre Plants

2.1. Agave lecheguilla

2.1.1. Distribution and ecological conditions

Agave lecheguilla, popularly called lechuguilla, grow sporadically in arid lands on heaps of pebbles in groups and in isolation on tops of mountains in crevices. Several plants grow in clusters interconnected with each other by rhizomatous undergrounds roots. The plants are rarely found in plain lands. They prefer to grow on heaps of stony pebbles with profuse fine roots which have great capacity to capture little amount sporadic rains, pure water free of solutes. As a result, its roots have high capacity of absorption of water from minimum rainfall occurring in arid lands. .The plants do not grow not grow in alluvial soils with plenty of organic matter. The populations of lechuguilla decrease with decrease of stony pebbles .This is considered as mechanism of adaptation in xeric environments. Villarreal and Maiti (1991d) found large variability in populations of lechuguilla in seven localities of Mina, Nuevo Leon, which influence its productivity.

2.1.2. General morphology

Lechuguilla is very short in height of whorls of stiff curved leaves encircling the plant in several whorls. The whorls of leafs at the base is highly matured while the top representing a cone called “cogollo” is youngest. This indicate that the fibres obtained from the basal whorls are highly lignified which produce strong fibre but those at the top thinner fibre with less lignifications which could be utilized in production of paper pulp (Figure 1).

The leaf surface is covered with thick shining cuticle which reflects solar radiation and reduces transpiration. The leaf margin is best with sharp stiff spines, probably to protect the

plants from grazing animals. The leaf tip contains stiff strong black spines (Figure 1). At maturity the plant produces a long inflorescence with whorls of flowers which in turn produce capsule which burst liberation dark coloured seeds.

2.1.3. Anatomy

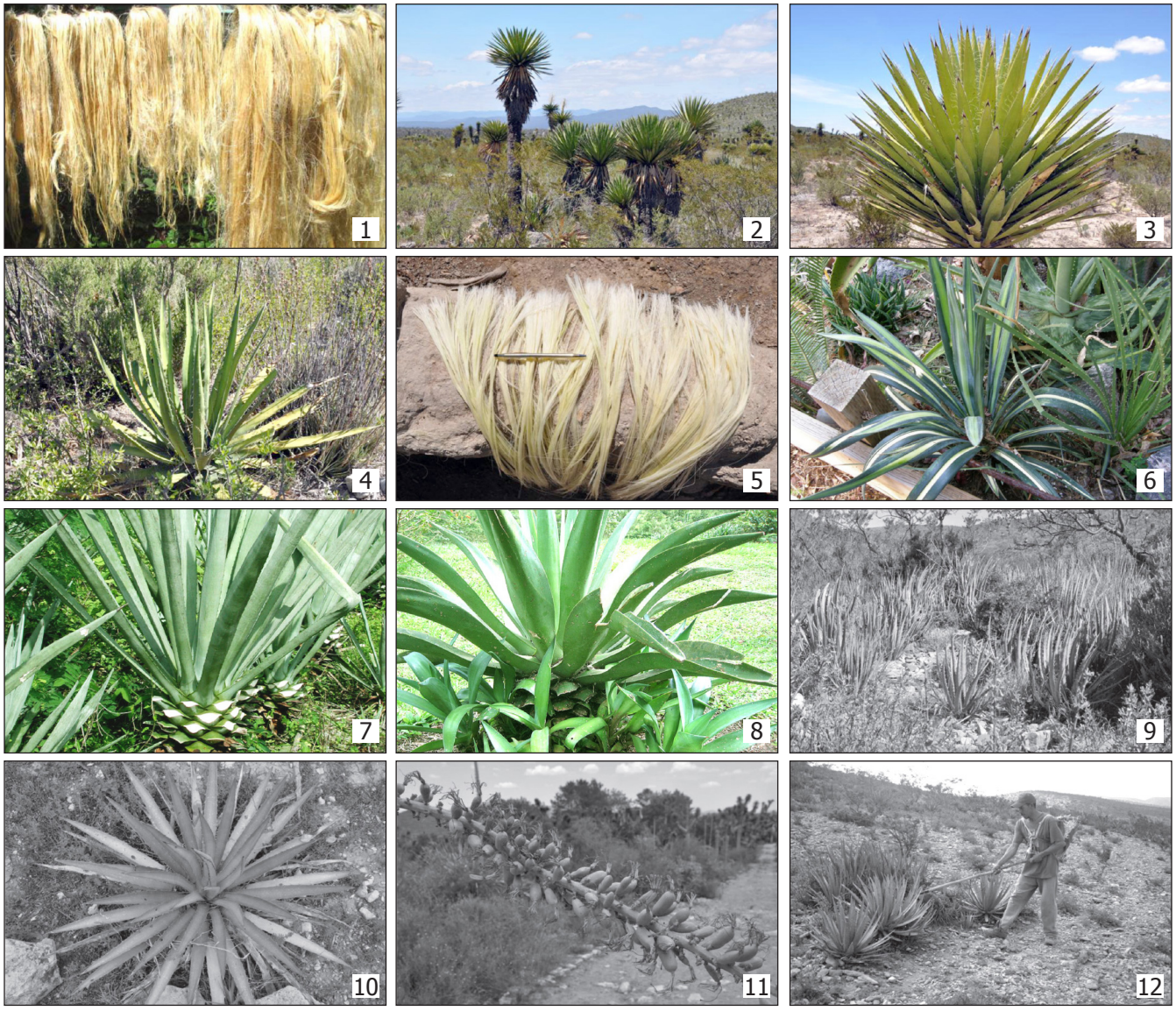
A transverse section of leaf shows the presence of layers of isolated half-moon shaped fibre bundle consisting many thick walled fibre cells, the number and layers of which depend on the maturity and thickness of leaves. .

The quantitative description of morpho-anatomical and productivity (Maiti et al., 1990; Villarreal et al., 1991) revealed that fibre cells are derived from fibre initials at the base of the leaf, needle like in shape, which grow in length and thickness of cell walls by gradual deposition of lignin along the length of the leaf in the mesophyll tissue and join with neigbouring cells to form a single fibre filaments. Finally aeries of fibre filaments join near the leaf tip to form the strong apical spine.

The technique used is to macerate the basal leaf tissue in 10% chromic acid: 10% nitric acid (1:1 and then kept in incubator at 40°C for 12 hours or more. Then the tissues were macerated and washed thoroughly to wash out acids and stained with safranin

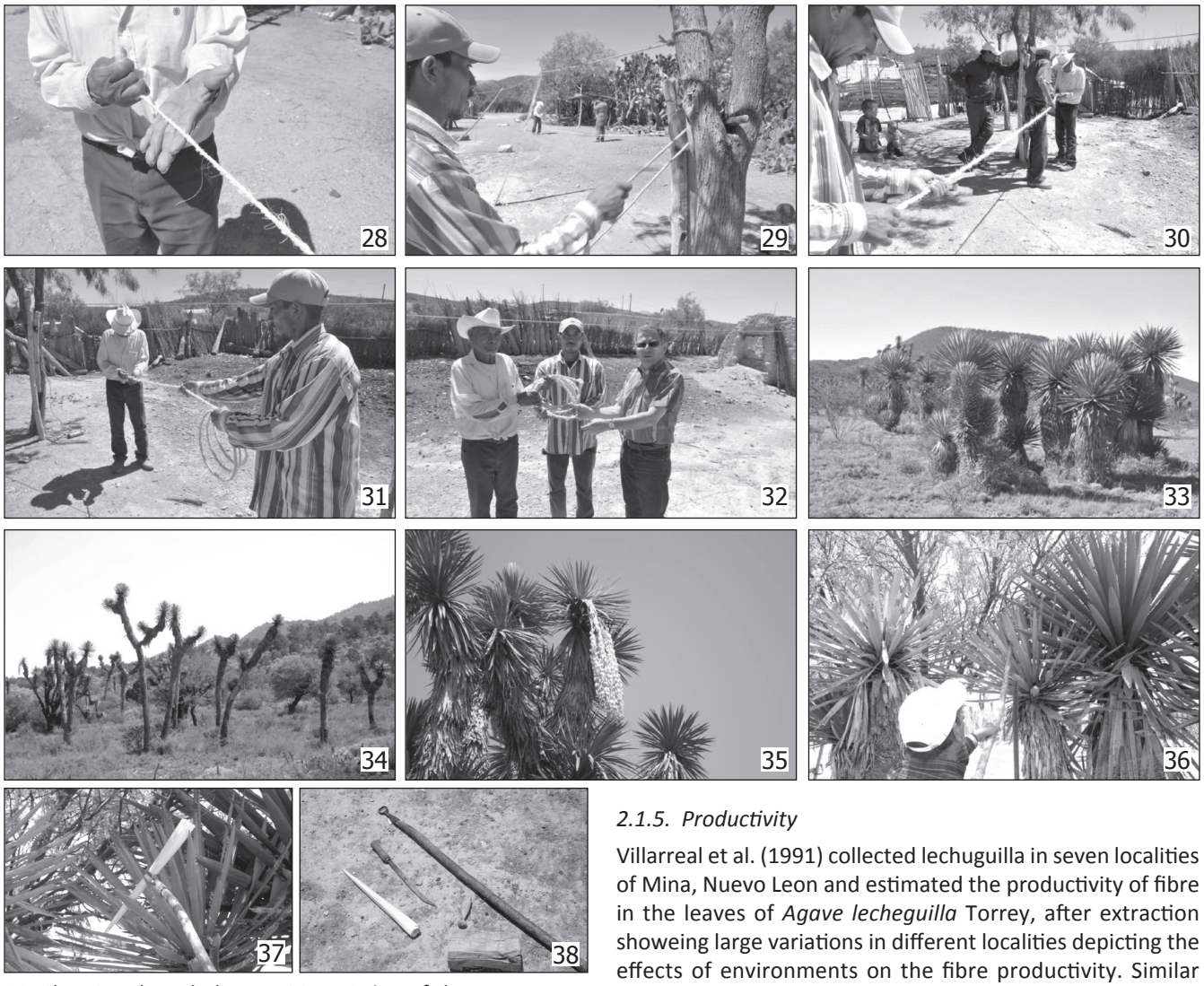
2.1.4. Extraction of fibres

The farmers in the arid lands cut off the central “cogollo” with the help of handmade hook shown in the Figure 1. Thereby they collect huge number of central leaf cones and store them



1: Musa *textilis* fibre; 2: *Yucca carnerosana* plants growing under semi-arid conditions; 3: *Yucca carnerosana* leaves; 4: *Agave lecheguilla* plant; 5: *Agave lecheguilla* fiber known as "Ixtle"; 6: Agave sisalana plant; 7: *Agave fourcroydes* plant; 8: *Furcraea cabuya* plant; 9: *Agave lecheguilla* plants growing under semi-arid conditions; 10: *Agave lecheguilla* plant forms a rosette of leaf canopy spreading external leaves; 11: *Agave lecheguilla* inflorescence; 12: Selecting *Agave lecheguilla* plants for fiber extraction

13: Selection and harvest of central young leaves; central conical cylinder known as "Cogollo" for fiber extraction using a local tool known as "lechugero"; 14: Showing the removal of "Cogollo" from the "lechuguero" by hand; 15: Transport of removed "Cogollos" by gatherer using a man made canister or basket hold in his back; 16: Manual shredding of removed *A. lecheguilla* young leaves from "Cogollo" to extract fiber by using traditional tools; 17: Use of an unsharpened knife, a flat piece of wood known as "banco" and a wooden pole which holds the tip of the knife during the shredding process; 18: The parenchymatous leaf residue known as "Guiche" left after fiber extraction; 19: Extracted *A. lecheguilla* fiber from "Cogollo"; 20: The pencil placed between "Cogollo" and extracted fiber in the right picture is shown as a reference; 21: Drying of *A. lecheguilla* fiber; 22: Manual display of dried fiber; 23: Unravel of *Agave lecheguilla* fiber; 24: Disentangle of *Agave lecheguilla* fiber; 25: Showing of unraveled *Agave lecheguilla* fiber; 26: Rolling unraveled *Agave lecheguilla* fiber to begin the thread of a rope; 27: Threading the rope in the initial stage



28: Showing threaded rope; 29: Twisting of the grown rope by using a local man made wooden pulley held between two poles; 30: Tighten up of finished and twisted threaded rope; 31: Stretching and rolling the rope; 32: Rope made from *Agave lecheguilla* fiber; 33: A field view of *Yucca carnerosana* plants; 34: *Yucca* sp. plants growing under semi-arid conditions; 35: *Yucca* sp. inflorescence; 36: Harvest of "Cogollo" leaves by using a local tool named "Cortadora"; 37: Removed "Cogollo" from a Y*ucca carnerosana* plant for fiber extraction; 38: Man made local tools used to harvest and shred "Cogollo" leaves to extract fiber form *Yucca* sp.

Figure 1: Various leaf fibre yielding plants and their extraction methods and tools

under the shade of trees. Then they extract the bunch of fibre filament by beating with stones and scalping out the leaf tissue or the fibres are extracted by a shredding machine if available. The whole family member work whole day under scorching sun and harvest fibres. Then they dry them hanging over rope under sun. Then they sell it in the broker or the middle men.

2.1.5. Productivity

Villarreal et al. (1991) collected lechuguilla in seven localities of Mina, Nuevo Leon and estimated the productivity of fibre in the leaves of *Agave lecheguilla* Torrey, after extraction showeing large variations in different localities depicting the effects of environments on the fibre productivity. Similar study needs to be directed in different agro-climatic regions.

2.2. Yuca carnerosana

2.2.1. Distribution

Yucca grows sporadicaly in isolated condition in arid lands along with other species like mezquites, Prosopis. An increase in number of *Yucca* populations was observed in zones in between hills forming microcliates whose populations decrease gradual away from these microclimatic zones.

2.2.2. General morphology

Yucca carnerosana is branched and arborescent, up to 20 feet tall, with showy white flowers. It has a long palm like stem bearing crown of leaves at the top of the stem (Figure 1).

2.2.3. Anatomy

Similar to that of lechuguilla, morpho-anatomical characteristics of the leaves and fibre in *Yucca carnerosana* (Trel) were studied (Villarreal and Maiti, 1991b) and observed that developmental patterns of fibres in *Yucca carnerosana* showed similar characteristics as that of lechuguilla. *Yucca*

produces long hanging inflorescence producing White flowers which are collected by farmers as palatable edible vegetable.

2.2.4. Extraction

The top crown of leaves is cut down and fibres are extracted more or less in similar ways like that of lechuguilla. The plant dies after cutting stem top for extraction of fibres.

2.3. Henequen (Agave fourcroydes)

Henequen produces good quantity of strong fibres grown in some specific regions. It has a stout stem bearing whorls of leaves which are harvested for extraction of fibre (Figure 1). The anatomy of fibre filaments of Henequen depicted that these were similar in structure like that other *Agave* species (Villarreal and Maiti, 1991a).

2.4. Agave asperima

Some farmers harvested fibres from the leaves of *Agave asperima* and *A. cubuya*. A study has been made on quantitative characterization of morphological and anatomical characteristics in the leaves of *Agave asperima* Jacobi (Villarreal and Maiti, 1991c).

3. Conclusion

Few studies undertaken on few leaf fibres in Mexico specially on Lechuguila and *Yucca carnerosana* show a variability in morphological, anatomical characteristics and productivity These two fibre yielding plants being a source of income for the poor arid land farmers, these are over exploited leading to the extinction of these valuable species.

4. Further Research

Research needs to be directed for sustainable use, conservation and propagation of these species. Only Young leaf cone is harvested, other leaves are not harvested showing los of natural resource. The leaves of different maturity may be collected for the extraction of fibres of different quality which may be utilized for different purposes just carpets, mats, decorative materials. It is also suggested that there are many species of *Agave* which are not exploited for fibres sustainably.

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