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AN OVERVIEW OF HEMP FIBRE

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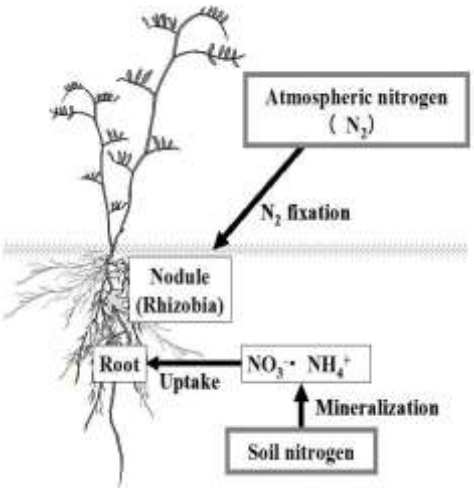
ABSTRACT
Sunhemp (Crotalaria juncea, L), a plant of sub-order Paplionaceae of order Leguminoseae is an annual shrub cultivated as multipurpose legume especially for its fine fibre in many countries including India. The crop is also grown for legume or as a fodder. The sunhemp crop is native to India. The crop is known in India by various names like 'Sonai' or 'San' (Hindi), 'Sanpat' (Bengali), 'Tag' (Marathi), 'Vakku' (Malayalam), 'Janumu' (Telegu), 'Saab' (Kannada). Hemp originated in Central Asia where it was cultivated as a fibre and food crop. Hemp, growing in temperate zones, is an annual cultivated from seed, reaching a height of up to 16 feet (5 metres).

INTRODUCTION
Sunhemp has been used extensively as a soil improvement or green manure crop in the tropics because of its ability to produce large amounts of biomass in as little as 60 to 90 days. Because of this, it has the potential to build organic matter levels and sequester carbon. Also, as a legume it can fix large amounts of nitrogen. Used as a cover crop, sunhemp can improve soil properties, reduce soil erosion, conserve soil, water and recycle plant nutrients. 'Tropic Sun' is also resistant to root-knot nematodes. Other potential uses for sunhemp are forage, paper, fiber and as alternative fuel crop.

Hemp fiber, which comes from the stalks of the plant, is known as bast, which refers to the fibers that grow on the outside of the woody interior of the plant's stalk and under the outer most part (the bark). Bast fibers give the plants strength. Hemp fibers can be between approximately 0.91 m (3 ft) and 4.6 m (15 ft) long, running the length of the plant. Depending on the processing used to remove the fiber from the stem, the hemp may naturally be creamy white, brown, gray, black or green. Hemp bast fibres have several desirable properties; they are non-irritant, water-permeable, anti-static, anti-bacterial and provide shielding from ultraviolet light; moreover, hemp clothing does not cause allergic reactions. It is extremely durable and is known for its comfort, strength, resistance to mold as well as its absorbent qualities. Hemp can be retted either by dry or water retting. It takes 5-7 days to ret. Hemp produces 250 per cent more fiber than cotton. It is also stronger than cotton and can be used to make clothing, shoes, paper, canvas, carpeting, rope, bags, luggage, home furnishings, construction materials, biodegradable plastics and even auto parts. It can be used to create building materials that are twice as strong as wood or concrete. It is stronger than sisal and ramie, and it is much cheaper to grow and process than flax. Hemp also grows with a much higher yield per acre than flax.



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EXTRACTION OF FIBRE

Retting is the process in which the fibre in the bark is separated from the woody portion by the action of microorganisms present in the water. The process involves steeping and keeping the stems submerged in water for certain periods.

The number of days required for retting depends on water temperature, locality, time of year, weather conditions, depth and source of water, thickness of stalks and quantity of straw in relation to volume of water. Cement tanks are good for retting. But earth pits, drains, streams and back water pools of river are also used. If more than one ret is to be carried out in a pool, sufficient flow of water must be ensured to avoid fouling the water which discolours the fibre. Shallow water of about 1 m to 1.5m deep can serve the purpose.

A quality of fibre is largely determined by the retting condition and duration. There are different methods of retting namely, dew retting, water, enzymatic, mechanical and chemical retting

DEW RETTING

Plant stems are cut or pulled out and left in the field to rot, then the pectin material could easily be removed by bacteria. Reduces strength, low and inconsistent quality; restriction to certain climatic change. It may take 2-3 weeks for retting. Eg., Flax, jute and hemp

WATER RETTING

Plant stems are immersed in water (Rivers, ponds or tanks) and monitored frequently (microbial retting). This method produces fibre of greater uniformity and higher quality. It may cause environmental problem hence require high water treatment maintenance. It may take 7-14 days duration for retting. Eg; Flax, hemp, kenaf and Jute

ENZYMATIC RETTING

Enzymes like pectinase, xylanase etc., are used to attach gum and pectin material in the bast. The process is carriedout under controlled conditions based on type of enzyme. The process is faster and cleaner. This causes partial degradation of the components separating the cellulosic fibre from non-fibre tissues. It may take 12-24 hrs for retting. Eg; Flax, jute, hemp

CHEMICAL RETTING

Boiling and applying chemicals normally sodium hydroxied, sodium benzoate and hydrogen peroxide. This process is more efficient and can produce clean and consistent long and smooth surface bast fibre within a short time. However higher concentration of chemicals may reduce tensile strength and produce unfavourable colour. Tis method may take 75min to 1 hour. Eg; kenaf, jute, hemp and flax

MECHANICAL RETTING

Hammering or fibre may separated by hammer mill or decorticator. It produces massive quantities of short fibre in short time and fetches high cost but lower quality fibre. Eg; Kenaf, Agave

SCUTCHING

Scutching was done by using wooden beaters that brakes the core in to shives and simultaneously rottened sheath or bark was removed. It consists of feeding the dried, retted stems to the pairs of rolls, which partially crush and break the woody core of the stem. Later, the fibre is washed in water and dried in sun. The adequate washing leaves lot of gums which binds the finer component of fibre into coarse strands.

HACKLING

Is nothing but combing which aligns the fibre strands in parallel. Short fibres and fragments of fibres are separated during the scutching and hackling process. Long fibres are called ‘line’ and short fibres are called ‘tow’.

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CHEMICAL COMPOSITION OF SUNHEMP FIBRE

Like all the other vegetable fibres, quality of sun hemp differs on variety and different agro-climatic region where it is being grown

Table-1 Chemical composition of some bast fibres

Fibre	Cellulose (%)	Hemicellulose (%)	Lignin (%)	Pectin (%)
Hemp (%)	70-92	18-22	3-5	0.9
Jute	51-84	12-20	5-13	0.2
Flax	60-81	2-3	14-19	16.4

Source: Tahir et al.(2011)

Table-1 denotes chemical composition of different bast fibres. Quality of hemp fibres depend s on the chemical composition. Cellulose content in hemp was greater (70-92%) than other bast fibres whereas, lignin content was lower which indicates good spinnabity character of hemp. However, there are problems in processing of hemp fibres for textile applications; the high content of pectin and lignin affect the "spinnability" of the fibers, resulting in a low-quality product. Conventional hemp yarn is produced by wet spinning, because the individual fibers are small and short, but the production of pure hemp yarn is very costly and the poor quality of yarn produced in this way limits the design and use of hemp fabric. Processing can produce cotton- like hemp fibers, which can be blended with other fibers in the cotton spinning system to produce high-specification hemp blended yarn and fabric.

PHYSICAL PROPERTIES OF HEMP

Study of physical properties reveals application areas where fibre can be utilized. Bast fibres generally composed of elongated thick walled ultimate cells that are joined together both end to end and side-by-side, farming aggregates of fibre bundles along the height of the plant stem. Sun hemp fibre is multicellular like jute, whereas cotton is unicellular.

Table-2 Physical properties of sunhemp, jute and cotton fibres

Properties	Sunhemp	Jute	Cotton
Ultimate cells length (cm)	5.1-8.9 (3.9-17.6)	1.9-3.2	15-45
Filaments gravimetric fineness (tex)	3.05 (2.5-3.5)	1.2-3.5	0.10-0.30
Tenacity (cN/tex)	44.42 (25-65)	35-50	20-45
Extension at break (%)	1.14	1.0-2.5	6.5-7.5
Modulus of torsional rigidity ((x 10^{10} dyne/ cm^2)	1.29 (0.9-2.8)	0.25-1.30	0.8-1.20
Bundle Tenacity (g/tex)	32.35	13-35	-
Flexural rigidity (cN-mm^2)	90.51 (60-105)	61.19	-
Moisture regain (%)	10.75 (10-11)	12.5-13.5	7-8.5
Whiteness index (Hunter)	54.36 (53-55)	52-54	-
Yellowness index (ASTM D-1925)	41.87 (41-42)	45-46	-
Brightness index (ISO- 2740)	24.36 (23-24)	22-24	-

Source: *Basu et al.*(2006)

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It is observed from the table-2 that ultimate cells of sunhemp fibres was longer than jute but much more shorter than cotton. Cell wall is much thicker than that of jute. Strength is an important physico-mechanical property which largely determine its yarn quality. Single fibre tenacity and bundle strength is much comparable to jute and extensibility of this fibre is as same as or marginally higher than jute but three times lower than cotton. Both flexural and torsional rigidity of sunhemp fibres was notably high. High torsional rigidity causes great resistance for twist flowing to the fibre strands during spinning bending offered by the fibres. Thicker cell wall may be the reason for higher rigidity. Moisture regain of sun hemp was found to be lower than jute but much higher than cotton. Sunhemp is more lustrous than jute which is indicated by lower yellowness index and marginally higher whiteness and brightness index values may be attributed to lower lignin content as compared to jute.

The important characteristic of sunhemp fibre is its high tensile strength and extensibility. Because of environmental problems created by synthetic fibres though possessing many plus points, more attention is diverted to many natural fibres – jute, hemp, ramie etc. However these fibres have limited applications in textiles. To improve their properties blends and composites can be produced.

Blending is the combining of different fibres together intimately to achieve a desired product characteristic. Blends can influence colouring, strength, softness, absorbency, ease of washing, resistance to wrinkling, ease of spinning, cost, etc.

The blending of different types of fibres is widely practiced means of not only enhancing the performance but also the aesthetic qualities of textile fabric. Blended yarns made from natural and manmade fibres havr the particular advantage of successfully combining the good properties of both fibre components, such as comfort of wear with easy care properties. These advantages also permit an increased variety of products to be made, yielding a stronger marketing advantage.

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