



EXAMINATION OF BANANA/JUTE BLENDED FABRIC

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Communicated : 22.08.2025

Revision : 07.09.2025
Accepted : 25.09.2025

Published: 15.10.2025

ABSTRACT:

Natural fibres have a wide scope of application, particularly in the recent tilt towards more sustainable textiles. Amongst conventionally used fibres like cotton, linen, wool, silk there are other fibres produced in India which fall into the category of unconventional fibres like the banana, jute, hemp, ramie, corn, pineapple, sisal, coir etc. The banana or plantain are known for their antiquity and are interwoven with Indian heritage and culture. Globally banana is grown in more than 130 countries across the world, covering 8.25 million hectares, producing 97.38 million tons of banana and plantain. India is largest producer of banana in the world, contributing to the global production of banana, with a total production of 19.19 million tons from 0.565 million hectares. Banana fibre is twice as coarse as mesta and as strong as jute. Unlike jute its structure is non-meshy and the filaments are well separated; they are more extensible as compared to jute. The banana fibre being more porous appeared to be soft. However, owing to its coarser dimensions, its filaments are less pliable. In the present study, the banana fibres were processed on standard jute machinery, further blended with jute and processed in a small-scale jute spinning system. This mini jute spinning unit might be used like "KHADI SYSTEM" to develop economic conditions of farmers to produce value-added items at particular village involved with a banana plant fibre production.

Jute /banana blended yarns and fabrics were studied for their physical and mechanical properties. The fabrics were further subjected to various preparatory/ finishing processes and tested for their physical and mechanical properties.

Keywords: *Banana, Enzymes, Jute, Khadi, Resin, Sustainable, Tensile.*

INTRODUCTION :

Banana cultivation is done in all parts of the country including Uttar Pradesh, but is mainly grown in Gujarat, Kerala, Tamil Nadu, Maharashtra, Andhra Pradesh, Karnataka and Bihar. Banana is cultivated in about 1,86,000 ha of land and the expected fibre yield is around 7.5 lakh tones. The banana plant (*Musa Sapientum*) belongs to monocotyledon family. After the harvesting of the fruit, the pseudostem has no regular use and goes as agricultural waste. But instead of throwing them as waste, if the pseudostem is generally scrapped with a blunt knife or a decorticator we obtain the fibre, which could be utilized for many end-uses. Fresh pseudostem yields about 1-5% of fibre. Development efforts are continuing on fibre extraction and optimization of properties of the fibre as well as its yield; this would bring down the cost of the fibre and improve its quality.

Only a small quantity of fibre is manually extracted and this is used in the Indian cottage industries for making handbags, ropes, twines, fancy articles, cushioning materials, packaging etc. Industrial utilization of the fibre would boost the economy of the banana planters, particularly in places having banana plantations but no utilization of fibre for industrial use. Thus banana is natural/eco-friendly fibre and possesses the characteristics of high strength and luster but, it is stiff and coarse and harsh to touch hence, the fibre needs processing to improve its characteristics so as to make the banana fibres wearable.

MATERIALS :

The banana fibres used in the experiments to be reported was received from Jalgaon, Maharashtra. The Jute fibres used in the experiments to be reported were received from

NIRJAFT, Calcutta. Commercial grade chemicals and finishes supplied by M/s Clariant, Mumbai were used.

EXPERIMENTS AND RESULTS :

The physical properties of the fibres of the Banana and Jute were first examined and its spinnability and weaving performance were then investigated.

Conditioning

All the specimens were conditioned, at 65% RH and 21 deg C for a day to ensure environmental equilibrium, prior to testing.

PHYSICAL PROPERTIES:

The physical properties of the fibres were firstly examined and are measured by means of the standard methods adopted in textile testing procedures. The results given in table; show that banana fibres are as strong as jute. Unlike jute its structure is non-meshy and the filaments are well separated; they are 2 and a half time as extensible as those of jute. The banana fibres being more porous, it appears to be soft, yet owing to its coarser dimensions, its filaments were less pliable than those of jute. Banana fibre is strong, soft and coarse. Individual fibres have linear density ranging from 2 tex to 15 tex which is similar to that observed for jute. However there are differences in the fibre structure between banana and jute.

Physical Properties of banana and Jute fibres:

No	Physical characteristics	Banana fibre	Jute fibre
1	Single fibre tenacity (gf/tex)	46-64	35-47
2	Single fibre extension at break (%)	2.9-4.3	1.0-2.5
3	Fibre bundle tenacity (gf/tex)	24-30	14-30
4	Length of raw fibre(cm)	34-85	-
5	Moisture regain 65%.r.h. (%)	14.0-15.2	12.0

SPINNABILITY

Banana fibres being too thick cannot be spun on cotton spinning machinery. It is similar to jute fibres in many respects such as thickness, flexibility, rigidity etc. Therefore, an attempt was made to spin it on the Jute spinning machine. After some spinning trials it was found that spinnability of banana fibres is best with 20cm to 30cm staples, sprayed with batching oil-water emulsion of 6% i.e.: jute batching oil on the weight of fibre being used, difficulties were faced at the carding and spinning stages. To ensure spinning different factors were therefore varied, and their effects on the performance of the card, drawings and yarn stages were observed throughout the experiments.

Banana fibres were processed on the following standard jute machinery: - a softener (Fraser, 63 pairs of rollers), a Barker Card (JF2, half circular), A Finisher Card (low, type N, half circular), first, second and third Drawing Frames (Mackie, screw gill), and a sliver Spinning Frame (Mackie, 4¹/₄" pitch).

BLENDING OF BANANA WITH JUTE FIBRES:

Banana fibres and jute fibres were further taken for blending. The fibres were mixed at the finisher-card-feed stage, as is the normal practice in jute mills. Banana fibres were blended with jute at different ratios were also processed in small scale jute spinning machine designed and developed by NIRJAFT. The yarns developed by same unit were compared. It has been observed that both the developed yarns could be used to develop various products. This Mini jute unit might be used like "KHADI SYSTEM" to develop economic conditions of farmers to produce value added items at particular village involved with banana plant fibre production. Jute/ banana Fabrics blend of 70:30 blend ratios were prepared at NIRJAFT, Calcutta. The yarns were further studied for basic properties. Blends with higher percentage of banana could not be spun because the quality

deteriorates with an increase in the percentage of banana fibres. So a banana/ jute blended yarn of 70:30 blend ratio was prepared following the above mentioned procedure.

CHARACTERISATION OF BANANA/JUTE BLENDED YARNS:

The banana/jute blended yarn of 70:30 blend ratio were further studied for their physical and mechanical properties like the Twist direction, Yarn count, Twists per inch, average breaking load, Breaking extension, Tex and tenacity. These parameters were studied at CIRCOT using the Universal Testing machine with 10 kg load cell capacity. Gauge length used was 50cm. Cross head speed was adjusted to 50mm/min to get breaking in 12 to 30 seconds. 20 strands were broken for each sample. After the break each strand was cut at the jaw faces and weighed to get its linear density in tex and tenacity in g/tex, Results are given in the table below.

Banana /Jute yarn test results.

S	Sample	Twist direction	Twist per inch	Yarn count (Ne)	Tex	Tenacity (g/Tex)
1.	Banana/Jute blended yarn.	Z-twist.	4.418	1.86	317	6.94

Preparation of Jute/Banana fabrics

The jute/banana yarn prepared in the above manner is further taken on the handloom to make jute/banana blended fabrics having warp and weft of the jute/banana blended yarns. As the banana jute/banana yarn is very coarse and with lot of protruding fibres, there were technical difficulties in the weaving of the fabric.

METHODS :

PREPARATORY PROCESS

Scouring

The raw banana/jute blended fabrics were scoured in a lab jigger using 1g/L of non-ionic wetting agent, 2g/L of proton based sequestering agent, 4g/L of soda ash, 1g/L of

detergent, 1:10 MLR, 5.5 pH, 60 deg C (temp), 30 min. After scouring the fabric samples were washed thoroughly in hot water and normal water and neutralized with acetic acid (2ml/L) followed by usual cold washing and finally air-dried.

Bleaching

The scoured banana/jute blended fabrics were further taken for conventional hot H₂O₂ bleaching in a lab jigger using 3g/L of caustic soda, H₂O₂ 6ml/L, stabilizer 1.5ml/L, 95 deg C (temp), 60 min (time) followed by hot rinse at 80 deg C for 10 min, followed by cold rinse, neutralized with acetic acid (2ml/L) followed by usual cold washing and finally air dried. The bleached fabric was also treated with an optical brightening agent (OBA-0.7%) in the same bath for 60 min, MLR 1:10 and the temp 95 deg C.

Physical and Mechanical properties of the Banana/Jute blended fabrics:

The fabric was further studied for their physical and mechanical properties both in their grey state and after each of the preparatory and finishing processes. All the tests were carried out under standard atmospheric conditions. The results are given in the table below.

- The twist direction in the yarns.
- The cover factor in the fabric.
- The yarn count of the fabric.
- Ends and picks were measured using a pick counter. Averages of ten readings are reported.
- Fabric weight per unit area was determined using 10cmx10cm pieces on Electronic weighing balance; five pieces were weighed to get the average values.
- Fabric Thickness was determined using thickness tester T 20 g/cm² pressure.
- Tearing strength was measured using Elmendorf tearing tester.
- Abrasion resistance was measured using Martindale abrasion tester. Weight loss in fabric

for 100 cycles was measured and is expressed in percentage with reference to the original weight.

- Bending length of fabrics in both warp and weft directions are expressed in cm gives the stiffness of fabric in that particular direction, and was measured using Cantilever type Sasmira fabric stiffness tester with a specimen size of 200mm x25mm.

- Measurement of the breaking tenacity and the breaking extension both warp and weft way was determined. These were carried out on the Instron. Gauge length used was 10cm and the crosshead speed was 10mm/min.

- Bursting strength if the fabric was determined using the m/s Unique enterprises Diaphragm bursting strength tester.

BANANA/JUTE FABRIC PARAMETERS:

PARAMETERS	BANANA/JUTE FABRIC Grey	BANANA/JUTE FABRIC Scoured & Biopolished	BANANA/JUTE FABRIC Bleached.	BANANA/JUTE FABRIC OBA-Treated.
1. Twist Direction in the yarn.	Warp & Weft = Z-twist.	Warp & Weft = Z-twist.	Warp & Weft = Z-twist.	Warp & Weft = Z-twist.
2. Ends & Picks per inch.	9 ends/sq.inch & 12 picks /sq. inch.	10 ends/sq.inch & 12 picks /sq. inch.	10 ends/sq.inch & 12 picks /sq. inch.	9 ends/sq.inch & 13 picks /sq. inch.
3.Weight per unit area (gms/m ²)	248	212	198	215
4.Fabric thickness (mm)	1.53	1.63	1.49	1.56
1. Tearing strength (g)	Warp=2720 Weft=2816	Warp=1856 Weft=2240	Warp=1099 Weft=1421	Warp=1760 Weft=2048
6.Yarn Count of the fabric	1.86 Ne	2.07 Ne	1.92 Ne	2.06 Ne
7.Bending length (cm)	Warp =3.65 Weft =3.77	Warp =3.1 Weft =3.9	Warp =3.27 Weft =4.06	Warp =3.4 Weft =3.5
8. Abrasion Resistance (%)	2.36	2.26	2.7	1.9
9.Bursting strength (Kg/sq.cm)	9.45	9.40	9.37	9.10

TENSILE STRENGTH OF JUTE/BANANA BLENDED FABRICS:

No	SAMPLE	DIRECTION	BREAKING LOAD (Kg)	BREAKING EXTENSION (%)
1.	GREYFABRIC (CONTROL)	Warp	15.0	2.8
		Weft	34.6	3.0
2.	BLEACHED FABRIC	Warp	16.06	2.4
		Weft	20.9	2.3
3.	SCOURED	Warp	19.4	2.5
		Weft	32.9	3.2

CONCLUSIONS:

It is clear from these results that banana/jute blended fabric becomes compact after preparatory processes. Fabric being thick is stiff

but strong and appropriate finishing treatments would improve their feel and performance.

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