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Studies on physical properties of banana fiber

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Abstract

A field experiment was laid out at Banana Research Station Nanded during 2013 and 2014 in randomized block design with six treatments and four replications. For the said experiment cv. Ardhapuri and Grand Naine was selected. For fiber extraction pseudostem, midrib and peduncle were utilized. From the experiment it was observed that length, girth and weight of pseudostem, mid-rib & peduncle were recorded significantly maximum from cv. Grand Naine. Minimum days required (2.36) for drying of fiber was recorded from mid-rib of cv. Ardhapuri. The highest weight of fiber (929.00) was observed in pseudostem of cv. Grand Naine. Significantly maximum length of fiber (44.57) was recorded from pseudostem of cv. Grand Naine and strength of fiber (557.55) from pseudostem of cv. Ardhapuri. The highest elongation (6.32) of fiber was estimated from peduncle of cv. Ardhapuri. The best colour of fiber was observed from peduncle of cv. Ardhapuri.

Keywords: Banana fiber, properties of fiber, analysis of banana fiber

Introduction

Banana (*Musa Spp.*) is the most important staple food in the globe. Banana plant is considered as the symbol of prosperity and fertility. Owing to its greater socio-economic significance and multifaceted uses they are referred as “Kalpatharu” (plant of virtues). Banana is second largest growing fruit crop followed by mango in India. Maharashtra stands second with respect to area and first in production. In addition of fruit production huge quantity of banana pseudostem, leaves and peduncle is generated which is discarded as waste. For every 30-40 kg of banana sold in the market there is 250 kg of waste was observed. In recent years, efforts have been directed towards the utilization of cheap renewable agricultural resources, such as banana pseudostem, leaves and peduncle as alternative substrate for extraction of fiber. Banana is a major cash crop of this country generating vast agricultural waste after harvest. Best fibers like banana have complex structure. They are generally lignocellulosic, consisting of helically wound cellulose microfibrils in amorphous matrix of lignin and hemicellulose. The cellulose content serves as a deciding factor for mechanical properties along with microfibril angle. A high cellulose content and low microfibril angle impart desirable mechanical properties for bast fibers.

Materials and Methods

The present investigation was carried out at banana research station (BRS) Nanded during 2013 and 2014. The different plant parts were used for the extraction of fiber like pseudostem, mid-rib and peduncle of banana cv. Grand Naine and Ardhapuri after harvesting. Length girth and weight of pseudostem, mid-rib and peduncle was recorded. The number of leaves per plant was recorded. The fiber was extracted by using fiber extraction machine.

Results and Discussion**Fiber observations**

The fiber observations include days required for drying of fiber, weight, length, strength elongation and colour of fiber. These parameters are responsible for affecting the quality of fiber as justified by Khan *et al.* (2013)^[5] and Satish Pujari *et al.* (2014)^[12].

Days required for drying of fiber

The data on days required for drying of fiber (Table 1) indicated significant differences among the treatments during investigation. The days required for drying of fiber were noticed minimum (2.36) in treatment T5 where mid-rib of leaves of cv. Ardhapuri was used.

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It was significantly less than all other treatment. The maximum days (2.82) required for drying of fiber was observed in treatment T3 where peduncle of cv. Grand Naine was used. It was statistically at par with treatment T6 Solis (1952).

The treatment T5 gave earliest dried fiber. This might be due to less cell sap adhering it whereas treatment T3 prolonged the drying period due to adhering of cell sap. The similar trend was recorded in both the year of experimentation. The results are in agreement with findings reported by George *et al.* (2001)

Table 1: Days required for drying and Weight of fiber of pseudostem, mid-rib of leaves and peduncle of banana

T. No.	Treatment details	Days (N)			Weight (g)		
		2012-2013	2013-2014	Pooled	2012-2013	2013-2014	Pooled
T ₁	Extraction of fiber from pseudostem of Grand Naine (V ₁ P ₁)	2.50	2.47	2.48	920.37	937.33	929.00
T ₂	Extraction of fiber from midrib of leaves of Grand Naine (V ₁ P ₂)	2.33	2.43	2.38	324.00	354.33	339.16
T ₃	Extraction of fiber from peduncle of Grand Naine (V ₁ P ₃)	2.73	2.90	2.82	169.57	186.00	177.79
T ₄	Extraction of fiber from pseudostem of Ardhapuri (V ₂ P ₁)	2.43	2.53	2.48	801.67	823.00	812.33
T ₅	Extraction of fiber from midrib of leaves of Ardhapuri (V ₂ P ₂)	2.32	2.40	2.36	227.33	252.33	239.83
T ₆	Extraction of fiber from peduncle of Ardhapuri (V ₂ P ₃)	2.82	2.78	2.80	164.67	167.33	166.00
	S.E. ±	0.03	0.04	0.01	043.68	045.63	012.89
	C.D. at 5%	0.08	0.14	0.03	137.41	143.55	035.71

Weight of fiber

Results with regard to weight of fiber indicated from (Table 1) that the treatment T1 given significantly highest weight of fiber (929.00) as compared to all other treatments where pseudostem of cv. Grand Naine was used which was followed by treatment T4. The treatment T6 was estimated the lowest weight of fiber (166.00) where peduncle of cv. Ardhapuri was

used. The next better treatments in this regard were T2, T5 and T3 which were at par with each other. The highest weight of fiber in treatment T1 might be due to more length, weight and girth of pseudostem of plant. Similar trend was observed in both the year of experimentation. Results are in accordance with the reported by Sapuan *et al.* (2006)^[11] and Liu *et al.* (2009)^[7].

Table 2: Length and Strength of fiber of pseudostem, mid-rib of leaves and peduncle of banana

T. No.	Treatment details	Length (cm)			Strength (gf)		
		2012-2013	2013-2014	Pooled	2012-2013	2013-2014	Pooled
T ₁	Extraction of fiber from pseudostem of Grand Naine (V ₁ P ₁)	44.33	44.80	44.57	427.43	465.60	446.50
T ₂	Extraction of fiber from midrib of leaves of Grand Naine (V ₁ P ₂)	33.70	32.36	32.03	425.23	426.23	425.70
T ₃	Extraction of fiber from peduncle of Grand Naine (V ₁ P ₃)	27.57	26.87	27.21	245.04	445.57	445.25
T ₄	Extraction of fiber from pseudostem of Ardhapuri (V ₂ P ₁)	37.73	37.40	37.51	558.57	556.67	557.55
T ₅	Extraction of fiber from midrib of leaves of Ardhapuri (V ₂ P ₂)	26.67	25.70	26.18	268.57	269.17	268.80
T ₆	Extraction of fiber from peduncle of Ardhapuri (V ₂ P ₃)	22.97	22.87	22.91	319.43	320.30	319.85
	S.E. ±	02.22	01.84	00.59	029.84	042.20	010.55
	C.D. at 5%	06.98	05.78	01.63	093.88	132.75	029.22

Length of fiber

The data presented in (Table 3) in respect of length of fiber indicates that the treatment T1 was given significantly maximum length of fiber (44.57) as compared to all other treatments where pseudostem of cv. Grand Naine was used which was followed by treatment T4. The next best treatments in this regard were T2, T3, T4 and T5 which were at par with each other. The treatment T6 was given lowest length of fiber

(22.91) where peduncle cv. Ardhapuri was used. The maximum fiber length in treatment T1 might be due to more length, weight and growth of pseudostem of cv. Grand Naine. Similar trend was observed in both the year of experimentation. The present findings are in conformity with results obtained by Luo and Netravali (2012)^[8] and Khan *et al.* (2013)^[5].

Table 3: Elongation and colour of fiber of pseudostem, mid-rib of leaves and peduncle of banana

T. No.	Treatment details	Elongation (per cent)			Fiber colour		
		2012-2013	2013-2014	Pooled	Musell colour notation	Value	Colour
T ₁	Extraction of fiber from pseudostem of Grand Naine (V ₁ P ₁)	3.73	3.80	3.77	10YR/2	8	Very pale brown
T ₂	Extraction of fiber from midrib of leaves of Grand Naine (V ₁ P ₂)	2.47	2.50	2.48	2.5Y/2	9	Very pale yellow
T ₃	Extraction of fiber from peduncle of Grand Naine (V ₁ P ₃)	4.70	4.73	4.72	4YR/1	8	Pink
T ₄	Extraction of fiber from pseudostem of Ardhapuri (V ₂ P ₁)	4.10	4.17	4.13	10YR/2	8	Very pale brown
T ₅	Extraction of fiber from midrib of leaves of Ardhapuri (V ₂ P ₂)	2.40	2.50	2.45	2.5Y/2	9	Pale orange yellow
T ₆	Extraction of fiber from peduncle of Ardhapuri (V ₂ P ₃)	6.23	6.40	6.32	5YR/2	8	Pinkish white
	S.E. ±	0.39	0.36	0.11	-	-	-
	C.D. at 5%	0.22	1.13	0.30	-	-	-

Strength of fiber

The results in (Table 2) revealed that the strength of fiber was influenced significantly due to different treatments. The data indicated that the maximum strength of fiber (557.55) was recorded in the treatment T4 which had pseudostem of cv.

Ardhapuri. This treatment was statistically at par with treatment T1 and T3 which had pseudostem and peduncle of cv. Grand Naine respectively. The lowest strength of fiber (268.80) was recorded in treatment T5 which had mid-rib of leaves of cv. Ardhapuri. It was statistically at par with the

treatment T6 which had peduncle of cv. Aradhapuri. The maximum strength of fiber in treatment T4 was due to maturity of cell wall. The similar trend was observed in both the year of experimentation. The findings is in agreement with the results reported by Lina *et al.* (2012)

Elongation of fiber

The results obtained from experiment (Table 3) revealed that the elongation of fiber was influenced significantly due to different treatments. The maximum elongation of fiber (6.32) was obtained in treatment T6 where peduncle of cv. Ardhapuri was used. It was followed by treatment T3 where peduncle of cv. Grand Naine was used. The next best treatments in this regard were T4 and T1 which were at par with each other. The treatment T5 was given significantly minimum elongation of fiber (2.45) which had mid-rib of leaves of cv. Ardhapuri. The maximum fiber elongation in treatment T6 might be due to maturity of the cell wall. The similar trend was observed in both the year of experimentation. The above results corroborates with Mylsamy and Rajendran (2011)^[9], Joseph *et al.* (2012)^[3]

Colour of fiber

The results with regards to colour of fiber (Table 3) indicated that the differences in fiber colour are significant due to different treatments. The best colour of fiber (5YR/2) pinkish white peduncle of cv. Ardhapuri in treatment T6. Treatment T6 was followed by treatment T3 (5YR/1) pink where peduncle of cv. Grand Naine was used. The next better treatments in this regards were T1 and T4 which were at par with each other. The treatment T2 given dull colour of fiber (2.5Y/2) very pale yellow which was followed by treatment T5 (2.5Y/2) pale orange yellow where mid-rib of leaves of cv. Grand Naine and Ardhapuri were used respectively. The similar trend was observed in both the year of experimentation. The fibers of various parts of banana plant showed the dominant spectral wave length of munsell colour i.e. Hue 10YR, 5YR, 4YR and 2.5Y. the fibers showed variation in value and chroma also the values varied between 8-9 and chroma i.e. purity of colour varied between 0-2 according to munsell colour chart fiber of above samples are vary pale brown to vary pale yellow. These little used for fiber extraction. The present findings are in conformity with results obtained by Yadav (2005)^[13], Patil *et al.* (2008)^[10], Alane (2010)^[1] and Kalbher S. G. (2007)^[4].

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