

Screening of Banana Cultivars for Rope Production

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Abstract: Banana is one of the most important fruit crops grown in India. In India, the area under banana has increased from 1.49 lakh ha during 1956-57 to 8,03,000 ha during 2013-14 with the production of 2,97,25,000 MT with the production share of 33.4% in fruit crops. The Tamil Nadu contribute highest in area (1,18,000) and production (56,50,000 MT). After the harvest of fruits, huge quantity of waste biomass from Pseudo stem, burnt or left in situ causing detrimental impact on environment. Though, the technologies for extraction of fibers and paper making from Pseudo stem are available, not being adopted by the industries mainly due to lack of awareness. However, a vast potential of extracting rope from pseudo stem which is need to exploited besides other uses. The observation recorded existing crop genome group of banana ABB Group- Monthan, (chakai), Peyan (muppatai), Karpooravalli and AAB Group- Poovan and Rasthalli in the farmers field and samples were collected for analysis Among the cultivars Monthan had higher content of cellulose (63.7 %) and lignin (13.4%), Poovan recorded high hemicellulose content (31.6%) and Karpuravalli with high pectin content of 15.3%. Pesticides residue analysis of Organochlorine and Synthetic pyrethroids level detected (<0.01 ppb) BDL, and Organo phosphates level (<0.05 ppb) BDL. The details of methods used and results obtained will be presented in this paper.

INTRODUCTION

Banana is one of the most important fruit crops grown in India and Tamil Nadu occupy area of 1,18,000 and production 56,50,000 MT (5). The area under banana has increased from 1.49 lakh ha during 1956-57 to 4.63 lakh ha during 2006-07, i.e., increase by 210 per cent. After harvest of fruit, huge quantity (60 to 80 t/ha) of waste biomass (pseudostem, leaves, suckers etc.) is generated. Presently, this biomass is discarded as waste. Present project envisages development of effective value chain for efficient utilization of each and every component of banana pseudostem. Considerable work has been done in the field of direct use and product development from banana fruits. However, not much attention has been focused on effective utilization of the huge biomass generated in the form of pseudostem, leaves, suckers etc. The various uses of banana fibre have been collated by Uma et

al. (3). In India, presently this biomass is dumped on roadside or burnt or left *in situ* causing detrimental impact on environment (6). Though, the technologies for extraction of fibres and paper making from pseudostem are available, yet it has not been adopted by the industries mainly due to high transport cost. However, there exist a vast potential of extracting fibres from pseudostem. The quantity and quality of fibres show wide variability with cultivars. The fibre extracted from banana pseudostem could not command proper market owing to its restricted use in cottage industries. There appears to be good scope of profitable use of this fibre in textile and paper industries on commercial scale. In recent time, banana rope had a very limited application and primarily used for making mats and other value added products. With the increasing environmental awareness and growing importance of eco-friendly fabrics, banana

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rope also been recognized for all its good qualities. There is need to explore possibilities of utilization of pseudostem for fibre, paper, edible products, mordant, microcrystalline cellulose and enriched organic manures.

Genomic status and fiber yield

Though rope can be produced from all banana and plantain cultivars, the rope yield shows great variability according to genome status (AA, AAA, AB, ABB, AAABB, AAAB, ABBB, BB), ploidy level (2x, 3x, 4x) and the variety. The relative combination of the A and B genomes tends to produce strong, bulky plants with greater yield. Therefore, plants with a greater proportion of the B (i.e. ABB) genome produce more yield than their other triploid (AAA or AAB). (2). It has been stated that rope is extracted from the pseudostem, only top 8-10 layers of sheath from the pseudo stem yield better quality rope. The present study therefore used five major commercial cultivars of banana, which is conventionally grown to study the characteristics of these varieties with respect plant morphology and biochemical parameters.

MATERIALS AND METHODS

Test clones

Five commercially cultivars of banana which is grown in the farmers field were tested. The details of the clones in terms of their taxonomic status and other traits in the Indian banana industry are shown in the table 1.

Biochemical parameters

Preparation of sample

Sample were randomly collected from each layer of the fibre extractable pseudo stem of each banana cultivar, cut into small pieces, and ground in an electric mixer to achieve maximum uniformity. This paste was used for the biochemical analysis. The paste was used for the biochemical analysis.

Total cellulose

Percentage total cellulose was estimated the procedure Updegraff (1969). Cellulose undergoes

acetolysis with acetic / nitric reagent (4:1 ratio) forming acetylated cellodextrins, which are dissolved and hydrolyzed to form glucose molecules after treatments with 67% sulphuric acid. This glucose molecules was dehydrated to form hydroxymethyl furfural, which forms a green-coloured product with anthrone and the colour intensity was measured at 630nm.

STATISTICAL ANALYSIS




The experiments were conducted using a completely randomized design with three replications. The results were analyzed using SAS package

RESULTS AND DISCUSSION

The result of the investigation reveal that, monthan recorded maximum pseudostem weight (53Kg), pseudostem girth (63cm) and length of the rope mode (93cm) where as pseudostem height was recorded in poovan cultivar which is on bar with karpuravalli (3m) (Table 2). Plants with a greater proportion of the B (i.e. ABB) genome produce more yield than their other triploid (AAA or AAB) (Uma *et al.*, 2005).

The single dry sheath weight (101g) and total dry sheath weight (1216g) followed by Peyan (44g, 461g) and Rasthali (44g, 468g) respectively. The percentage of cellulose in banana pseudostem varied significantly among cultivars. Among the five cultivars Monthan had higher content of cellulose (63.7 %,) and lignin (13.4%), Poovan recorded high hemicellulose content (31.6%) and Karpuravalli with high pectin content of 15.3%. All of them significantly differed from each other with respect to cellulose content (Table 2). The cellulose content of fibre samples of each variety increased after scouring, while hemicelluloses and lignin content are decreased due to their removal from the fibre (1). Residue analysis of the cultivars showed no significant variation among the cultivars tested (Table 3). The cost of production of rope and its value added products from banana pseudostem were presented in Table 4.

Table 1
Details of commercial test clones used in this study

Cultivar	Genomic status and sub group	Characters
	ABB Group	<p>It is a popular variety grown for table purpose in medium rich soils. Its commercial cultivation is spread over in Central and Southern districts of Tamil Nadu and Kerala. In Bihar, cultivation is in patches under the name 'Kanthali'. Karpuravalli is a tall, robust plant well suited to marginal lands and soils, produced under low input conditions. It is also the sweetest among Indian bananas. Karpuravalli is occasionally seeded depending on the seasonal variability. Its ash coated golden yellow and sweet fruits have good keeping quality. Karpuravalli is highly susceptible to wilt disease, tolerant to leaf spot disease and well suited for drought, salt affected areas and for low input conditions</p>
	ABB Group	<p>Suitable for backyards and mixed cropping systems, it is a choice variety, suitable for the fresh leaf market and is highly prized for its medicinal values. It is slightly longer in duration compared with other backyard varieties. It exhibits field tolerance to Fusarium wilt and a high degree of tolerance to leaf spot diseases</p>
Monthan,	ABB Group	<p>It is a widely cultivated variety for processing. Monthan is a fairly tall and robust plant bearing bunches of 18-20 kg after 12 months. Fruits are bold, stocky, knobbed and pale green in colour. The skin is usually green. The new prolific 'Monthan' type clones of economic value namely 'Kanchi Vazhai' and 'Chakkia' are recently becoming popular in Tamil Nadu. Apart from its culinary use of fruits, pseudostem core is a highly relished vegetable with many medicinal properties. Monthan is also cultivated for production of leaves in Trichy and Tanjore districts of Tamil Nadu. It has many desirable qualities like immunity to Banana Bunchy Top Virus (BBTV) diseases, salt tolerance and normal bunch mass even under marginal condition, but it is highly susceptible to <i>Fusarium</i> wilt disease</p>
		

Rasthali

AAB Group

It is a medium tall variety commercially grown in Tamil Nadu, Andhra Pradesh, Kerala, Karnataka and Bihar. Its unique fruit quality has made Rasthali popular and a highly prized cultivar for table purpose. Fruits are yellowish green throughout their development, but turn pale yellow to golden yellow after ripening. Fruit is very tasty with a good aroma. Longer crop duration, severe susceptibility to *Fusarium* wilt, requirement of bunch cover to protect fruits from sun cracking and formation of hard lumps in fruits make crop production more expensive



AAB Group

It is a leading commercial cultivar grown throughout the country with location specific ecotypes like palayankodan in Kerala, Poovan in Tamil Nadu, Karpura Chakkarakeli in Andhra Pradesh and Alpan in North Eastern Region. It is generally cultivated as a perennial crop. Tamil Nadu is the leading producer of Poovan cultivar owing to its climatic and marginal soil condition. Poovan is also commercially cultivated for leaf industry throughout Tamil Nadu and in certain parts of Kerala. Fruit is slightly acidic, firm and has typical sour-sweet aroma. Fruits turn to attractive golden yellow on ripening. Medium sized bunch, closely packed fruits, good keeping quality and resistant to fruit cracking is its plus points. But it is highly susceptible to Banana Bract Mosaic Viral (BBMV) disease and Banana Streak Virus, (BSV), which cause considerable reduction in yield.

Table 2
Plant morphology and chemical parameters of selected cultivars

Cultivars	Pseudostem Weight (kg)	Pseudostem Height (m)	Pseudostem girth (cm)	Single Fresh Sheath Weight (g)	Single dry sheath Weight (g)	Total Weight of dry Sheath (g)	Length of rope made	Leaf Length	Leaf breadth	No of Leaves	Cellulose	Hemicellulose	Lignin	Pectin	
Karpuravalli	48	3	56	1	37	451	2	89	2	53	19	60.7	26.5	11.9	15.3
Peyan	28	2	45	1	44	561	2	57	1	57	16	52.3	24.3	12.1	13.2
Monthan	53	2	63	1	66	860	2	92	2	59	17	63.7	27.9	13.4	15.7
Rasthali	34	2	47	0.5	44	548	2	68	1	49	17	54.9	28.3	12.7	14.8
Poovan	28	3	47	1	101	1216	2	72	2	59	18	56.3	31.6	10.9	12.8
SE (diff)	2.63	0.17	0.25	0.14	3.72	53.46	0.15	1.95	0.19	1.27	1.22	0.67	0.33	0.15	0.18
CD (0.05)	5.73	0.37	0.54	0.29	8.12	116.48	0.33	4.26	0.43	2.77	2.66	1.42	0.70	0.34	0.39
CD (0.01)	8.03	0.53	0.76	0.41	11.38	163.32	0.46	5.97	0.60	3.88	3.73	1.97	0.96	0.47	0.53

Table 3
Pesticides residue analysis

Organochlorine compounds	Amount detected (ppb)	Synthetic pyrethroids	Amount detected (ppb)	Organo phosphates	Amount detected (ppb)
<i>BDL: Below Detectable Level</i>					
α -HCH	BDL (<0.01)	Bifenthrin	BDL (<0.01)	Dichlorovas	BDL (<0.05)
β -HCH	BDL (<0.01)	Fenpropathrin	BDL (<0.01)	Phorate	BDL (<0.05)
γ HCH	BDL (<0.01)	γ - Cyhalothrin	BDL (<0.01)	Dimethoate	BDL (<0.05)
δ -HCH (<0.05)	BDL (<0.01)	β -Cyfluthrin	BDL (<0.01)	Parathion-methyl	BDL
Dicofol	BDL (<0.01)	α - Cypermethrin	BDL (<0.01)	Malathion	BDL (<0.05)
Endosulfan- α	BDL (<0.01)	Fenvalerate	BDL (<0.01)	Chlopyriphos	BDL (<0.05)
Endosulfan - β	BDL (<0.01)	Fluvalinate	BDL (<0.01)	Quinalphos	BDL (<0.05)
Endosulfan sulfate	BDL (<0.01)	Deltamethrin	BDL (<0.01)	Profenophos	BDL (<0.05)
<i>p.p'</i> -DDD	BDL (<0.01)			Ethion	BDL (<0.05)
<i>p.p'</i> -DDT	BDL (<0.01)			Triazophos	BDL (<0.05)
<i>p.p'</i> -DDE	BDL (<0.01)				

Table 4
Cost of production of rope from banana pseudo stem

S.No.	Particulars	Cost (INR)
1.	The expenditure for cost of production of banana / Acre	54000
2.	Cost of Hand Operated Banana Rope Spinning Machine.	100000
3.	Net income from Banana leaf and fruit / Acre (1000plants)	2,60,000
4.	Net income from fiber by using this technology (100m rope/plant) INR	65,000
5.	Net income from value added products (2mat from 100m rope)	105000
6.	Net income from banana farmer having one acre (1000plts)	4,30,000

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