

RESEARCH ARTICLE

EVALUATION OF WILD SUGARCANE *ERIANTHUS ARUNDINACEUS* (RETZ) JESW. GERMPLASM

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Abstract

The wild sugarcane species, *Erianthus arundinaceus*, was evaluated for its stalk characters, biomass production, fiber content and juice quality. This species has the potential to provide fiber as raw material for paper manufacture, bio-fermentation of juice into alcohol and energy through cogeneration. So far no systematic evaluation of this semi-wild species has been done for biomass yield, fiber content and quality, and no program to cultivate it for its co-products ever attempted. Initially, 107 accessions available in the world germplasm collection of *Erianthus* maintained at the Sugarcane Breeding Institute, Coimbatore, were screened for nine quantitative traits and the data were subjected to analysis of variance and correlation analysis. Single stalk weight and number of tillers showed high variance (CV%). Hierarchical cluster analysis produced nine clusters. Out of these 107 clones, six clones were further evaluated for 13 yield characters. Analysis of the data indicated that the clone SES 159 was the most promising in terms of biomass and stalk yield.

Key words: Wild sugarcane, *Erianthus arundinaceus*, bagasse, biomass, evaluation, fiber, paper

Introduction

Wild sugarcane species, particularly the closely related genus *Erianthus* (old world species), are native to India and occur naturally in many parts of the country. They belong to the tribe Andropogoneae

under the grass family Poaceae (Bor, 1960). These species have high fiber and low sucrose content in their stalks. Among the Indian species, *Erianthus arundinaceus* (Retz) Jesw. alone is stem forming, like sugarcane, and capable of vegetative propagation. It is often found grown as a hedge (wind break) around betel gardens and along banks of canals or streams for erosion control in South India. It has been reported (Anonymous 1972) that *E. arundinaceus* yields pulp which is suitable for making writing and printing papers, and that the juice can be fermented to produce alcohol. *Erianthus arundinaceus* is characterized by tall perennial growth, high biomass, thick vegetative stem, good tillering, drought tolerance, disease and pest resistance, ratoonability, low input requirement and sparse flowering. The objective of the present study was to screen the germplasm collection of *E. arundinaceus* and select the best clones for further evaluation, with an intent to utilising this wild sugarcane species as a renewable source of fiber and fuel.

Materials and methods

Sugarcane Breeding Institute maintains a vast germplasm collection of variable forms of *E. arundinaceus* collected from different parts of the country and from South East Asia (Anonymous 2001). For each accession, two clumps were maintained in a 3 m row with 1 m inter-row space. Majority of these collections were characterized for 66 vegetative and floral descriptors and documented (Sreenivasan et al. 2001). In order to select superior clones which combine high yield of stalks and quality fiber, 107 clones of one year old crop of *E. arundinaceus* were screened for nine quantitative characters, namely stalk length, stalk diameter, single stalk weight, internode length, number of internodes, number of tillers, fiber content, hand refractometer brix and juice-extraction percent during 2002-2003.

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Observations were recorded on fully grown stalks collected from two clumps for each accession in the germplasm garden. The six clones selected in the first trial were further evaluated in 2003-2004 for plant height, biomass yield, stalk yield and single stalk bagasse weight in addition to the nine quantitative traits mentioned earlier. Data were recorded on stalks from three plants per clone (accession) after one year of growth (un-replicated trial). For fiber estimation, fresh stalks were cut, weighed and fiber extracted in a fiber extraction machine. The juice extracted was used to estimate extraction percent. The fiber was oven dried at 80°C and fiber content calculated on oven dry weight basis. The data were subjected to analysis of variance, product-moment correlations and hierarchical cluster analysis (with squared distance method) using SPSS version 11.0 software.

Results and discussion

The range, mean and coefficient of variation computed from 107 clones screened for the nine quantitative characters are presented in Table 1. Number of tillers and single stalk weight were the most highly variable characters while fiber content and stalk diameter were the least variable.

The clone SES 3 had the highest stalk length of 368 cm. Seven clones namely SES 3, IJ 76-342, IJ 76-364, IK 78-48, IS 76-156, IS 76-191 and EA Cuttack had high stalk weight of 1000g or above and hence have the potential to give high yield. SES 27 and IJ 76-374 possessed high HR Brix of 10. Fiber content was the highest (31.1%) in IJ 76-407. There were

45 non-flowering clones which offer the advantage of indeterminate and uninterrupted vegetative growth. Non-flowering nature will also prevent natural spread through seed dispersal under large scale cultivation. Correlation analysis of nine characters (Table 2) revealed very significant correlation between stalk length and stalk diameter, single stalk weight, internode length, while stalk diameter was highly correlated with internode length. Single stalk weight was strongly correlated with stalk length and a significant negative correlation with number of tillers.

The results of the evaluation of six clones short listed out of the 107 accessions for various parameters are given in Table 3. Analysis of variance carried out for the first nine characters showed that the differences observed for plant height, stalk length, stalk diameter and single cane weight among clones were significant. Maximum plant height was noted in IMP1536 while the stalk length was the highest in SES 3. EA Cuttack had a high fiber content of 31%. Since SES 159 had the highest values for biomass, total stalk yield, NMC, internode length and HR Brix, it has been taken up for large-scale trial cultivation in 2004.

The dendrogram from a cluster analysis of 107 clones of *E. arundinaceus* is shown in Fig 1. Cluster analysis is a useful tool for grouping numerous clones and detecting deficiencies in germplasm collection, evaluate genetic drift through long-term conservation and also identify clones for a core collection (Tai et al, 1995). Nine clusters were obtained with the highest number of 31 clones in

Table 1. Quantitative characteristics of 107 *Erianthus arundinaceus* clones during 2002-03

S. No.	Trait	Range	Mean	CV%
1	Stalk length (cm)	140 – 368	261.13	14.68
2	Stalk diameter (mm)	14.1 – 26.1	20.09	11.63
3	Single stalk weight (g)	130 – 1100	582.25	31.92
4	Internode length (cm)	6.2 – 19.7	12.12	23.48
5	No. of internodes	15 – 39	26.66	18.90
6	No. of tillers	8 – 48	27.07	32.22
7	Fiber content (%)	15.7 – 31.1	26.78	10.82
8	HR Brix	3.2 – 10.1	6.22	26.20
9	Juice extraction (%)	27.8 – 63.1	47.21	13.39

Table 2. Correlation matrix for nine quality traits in *Erianthus arundinaceus*

	Stalk length	Stalk diameter	Single stalk weight	Inter-node length	No. of internodes	No. of tillers	Fiber content	HR Brix	Juice extraction
Stalk length	1	.341**	.474**	.655**	-.004	-.184	-.052	.234*	-.089
Stalk diameter		1	.059	.674**	.166	-.042	.042	.226*	-.140
Single stalk weight			1	.269**	-.017	-.378**	.059	.026	-.121
Internode length				1	.196*	-.234*	.095	.279*	.200*
No. of internodes					1	-.120	.399**	-.039	-.128
No. of tillers						1	.067	-.203*	.369**
Fiber content							1	.022	-.016
HRBrix								1	-.264**
Juice extraction									1

Level of significance: 'r' = 0.190 at 5%* & 0.250 at 1%**

Table 3. Yield and quality parameters of six selected clones of *Erianthus arundinaceus*

Parameter	EA Cuttack	SES 3	SES 159	IJ 7 6-342	Mythan A	IMP 1536	S.E.	C.D.
Plant height (cm)	436.7	528.3	546.7	461.7	530.0	575.0	18.16	59.20
Biomass yield (kg)	37.17	55.50	74.17	25.83	58.17	62.00	15.17	NS
Stalk yield (kg)	25.83	29.17	51.83	15.00	34.33	40.50	10.83	NS
Number of tillers	35	39	71	27	47	52	13.20	NS
Stalk length (cm)	250	353	333	303	346	329	5.73	18.68
Stalk diameter (mm)	20.6	23.5	20.8	18.3	20.2	20.0	0.81	2.63
Number of Internodes	28	35	27	28	30	29	3.06	NS
Internode length (cm)	10.9	14.3	16.8	13.0	13.7	16.2	1.80	NS
Single cane weight (g)	600	650	500	450	600	400	0.41	1.33
Bagasse weight (g)	350	450	400	300	350	250	-	-
Juice extraction (%)	41.67	30.77	20.2	33.33	41.67	37.50	-	-
HRBrix	7.1	8.8	9.8	7.3	6.7	4.8	-	-
Fiber content (%)	31.0	21.2	24.0	25.3	25.4	21.4	-	-

Cluster I and 30 clones in Cluster II. Other Clusters had lesser number of clones ranging from 2 to 19 clones, while Clusters VI and VII had only one clone each. The dendrogram showed that the clusters VIII and IX were close to each other and clusters I – VII were close. Cluster VIII had clones from India and Cluster IX from Indonesia only while other

clusters had clones collected from India as well as Indonesia.

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Table 4. Character means of nine clusters from 107 clones of *Erianthus arundinaceus*

Cluster	No. of clones	Cane height (cm)	Cane diameter (mm)	No. of inter-nodes	Inter node length (cm)	Single cane weight (g)	No. of tillers	Fiber (%)	HR Brix	Juice extraction (%)
I	31	261	20.81	25	12	634	29	26.5	6.22	45.60
II	30	254	19.62	26	12	509	25	27.4	5.67	49.21
III	12	288	21.04	30	12	770	26	26.4	6.84	46.53
IV	19	255	18.58	27	12	418	24	27.1	6.17	47.47
V	4	206	17.33	26	11	306	34	26.9	8.07	48.22
VI	1	150	19.20	20	9	430	36	26.3	9.60	51.10
VII	1	140	14.40	15	10	130	27	25.4	3.90	50.59
VIII	2	361	24.10	27	16	1068	34	25.8	7.95	51.00
IX	7	301	22.86	31	13	897	32	25.4	5.97	43.49

The main characteristics of these nine clusters, as shown by the means of nine characters listed in Table 4, are as follows:

- I - Medium tall plants with medium thick stalks
- II - Medium tall plants with high fiber content and good juice extraction percent
- III - Medium tall plants with high number of internodes
- IV - Medium tall plants with good fiber content and moderate HR brix percent
- V - Medium height with high HR Brix percent in juice
- VI - Short plants with high tillering and high juice extraction percent
- VII - Short plants with low stalk weight, low HR Brix and high extraction percent
- VIII - Very tall plants with thick heavy stalks, long internodes and high extraction percent
- IX - Tall plants with thick stalks and many internodes

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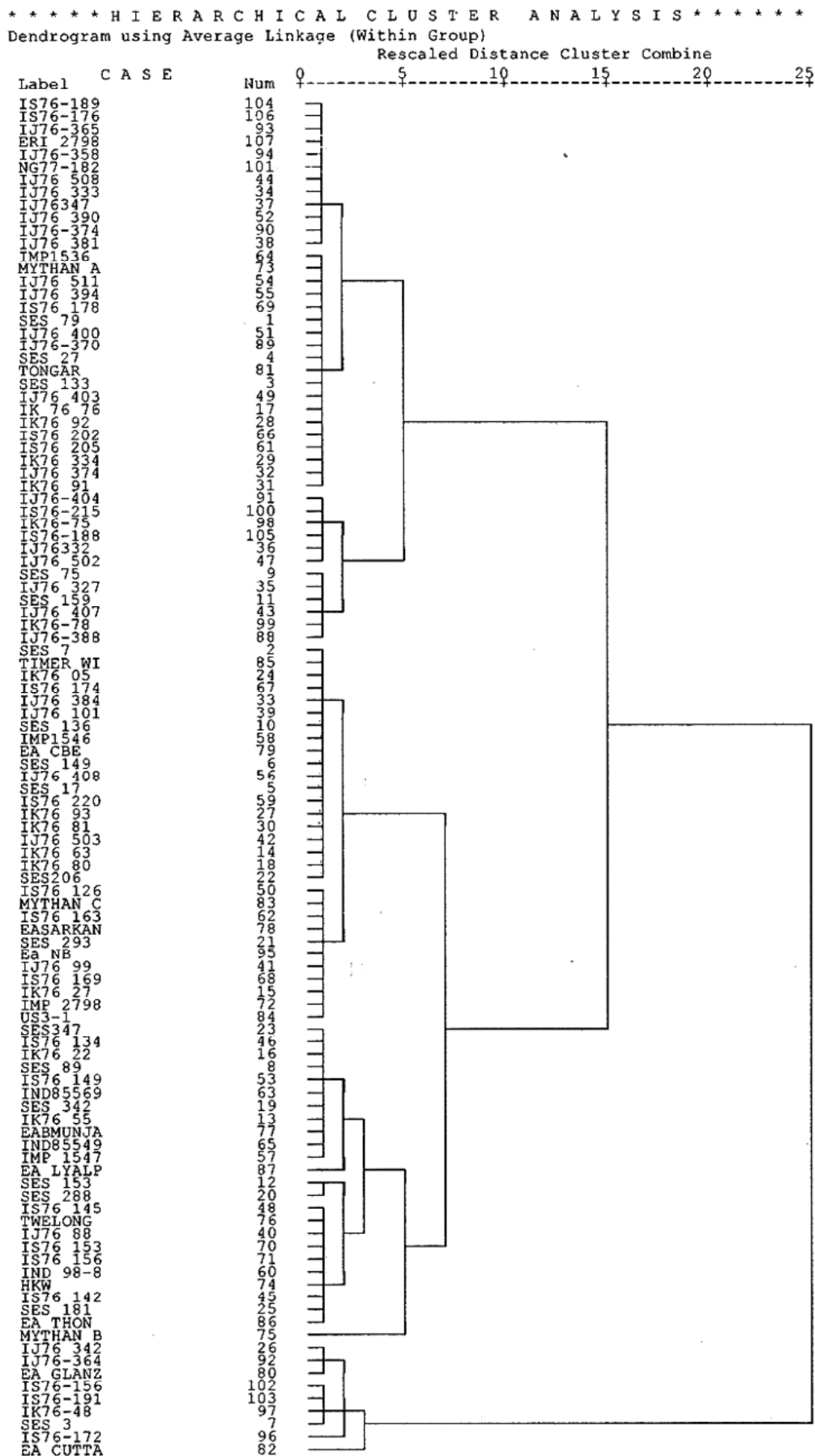


Fig 1. Dendrogram depicting the clustering pattern of 107 *Erianthus arundinacis* clones