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RESEARCH ARTICLE

Performance Evaluation of Exotic Coconut Genotypes to Assess their Suitability for Cultivation in the Western Zone of Tamil Nadu

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ABSTRACT

Identification and utilization potential genotypes for development of high yielding cultivars with distinctive traits is the need of the hour to cope up with the shifting demand of international market. The present research examination was carried among seven exotic coconut genotypes viz., San Ramon Tall (SNRT), Federated Malay States Tall (FMST), British Solomon Island Tall (BSIT), Zanzibar Tall (ZNT), St. Vincent Tall (STVT), Gonthembili Tall (GTBT) and Java Tall (JVT) in comparison with three indigenous coconut ecotypes viz., Tiptur Tall (TPT), East Coast Tall (ECT), and Arasampatti Tall (APT) at ICAR-AICRP (Palms) centre, Coconut Research Station, Aliyarnagar. The investigation was intended to identify suitable exotic coconut genotypes with increased copra quantity and quality along with good tender nut parameters for cultivation in the Western Zone of Tamil Nadu. Based on the observations recorded over a period of eight years from 2010 to 2017, Federated Malay States recorded maximum girth (121.2cm) while San Ramon Tall was found to be superior in terms of floral traits and inflorescence production per year. Java tall produced maximum number of buttons per inflorescence (26.0)among the genotypes evaluated. The highest annual nut yield was recorded by Zanzibar Tall (106.6 nuts per palm per year)followed by Federated Malay States (99.9 nuts per palm per year), while San Ramon Tall also recorded considerable nut yield of 75.3 nuts per palm per year. Sanramon Tall recorded the highest average copra content (333.2 gram per nut) with an estimated copra yield of 25.1 Kg per palm per year. Taking into consideration of yield attributes, fruit component traits and tender nut quality parameters, the exotic genotypes San Ramon Tall (SNRT) and Federated Malay States Tall (FMST) were found to be suitable for cultivation in the Western zones of Tamil Nadu.

Keywords: *Coconut; Evaluation of Exotic Genotypes; Western Zone of Tamil Nadu*

INTRODUCTION

Coconut (*Cocos nucifera* L.) is an important plantation crop of the tropics cultivated in more than 80 countries across the globe. Coconut is a monotypic species with two different botanical forms namely tall and dwarf types. India owns a leading position in the world in coconut production and productivity. Coconut is cultivated in an area of 2082.11 thousand ha in more than 16 states of the country producing 23904.10 million nuts with an average productivity of 11481 nuts per ha. The four southern states of India

accounting for more than 92 per cent of the total coconut production in the country include Kerala, Tamil Nadu, Karnataka and Andhra Pradesh together (Coconut Development Board, 2018). The major source of coconut production comes from the tall coconut varieties, while dwarf and hybrid varieties meant especially for tender coconut cultivation contribute for about 10 per cent of the total production. Collection, conservation and utilization of plant genetic resources and their distribution are indispensable components of crop breeding programmes (Upadhyaya *et al.,* 2008). Being a perennial crop with a persistent capacity for sexual reproduction, coconut gene pools serve as a repository for conservation and development of new varieties. Global interests also heavily focus on the identification, collection and conservation of germplasm to safeguard the genetic diversity of the coconut palms grown in India. Field gene banks are the only viable option for ex-situ conservation of coconut largely due to the recalcitrant nature of the coconut seed (Mohd Said Saad and Ramanatha Rao, 2001). The genetic wealth in coconut is commonly exploited through hybridization and selection for desirable yield attributes. To enhance the coconut yield, new genotypes are being introduced to assess their performance under particular locations (Nath *et al.,* 2017).With this back ground, the All India Co-ordinated Research Project on Palms centre, Coconut Research Station, Aliyarnagar, Tamil Nadu Agricultural University started a methodical collection and conservation of coconut germplasm and planted it during 1988 for evaluation purpose with an objective to identify promising genotypes suitable for cultivation in the Western Zone of Tamil Nadu.

MATERIAL AND METHODS

The present study was conducted at Coconut Research Station, ICAR-AICRP on Palms, Aliyarnagar, Coimbatore district, Tamil Nadu, which is located near Western Ghats at 100 29'N latitude and 760 58'E longitude at an elevation of 260m above mean sea level with an undulating topography. The region receives a total rainfall of 802 mm in a year, with nearly 300 mm of the precipitation witnessed during the South West monsoon, 333 mm during North East monsoon and 169 mm during summer. The maximum and minimum temperatures during summer are 35°C and 22.1°C respectively. The maximum and minimum winter temperatures are 31.9° C and 16.8° C respectively. The soil type is sandy loam and non-calcareous with neutral pH, low nitrogen, medium P205 and high K20 content. The planting materials comprised of ten tall coconut genotypes including seven exotic and three indigenous types (Table 1). The genotypes were planted during 1988 at a spacing of 7.5 x 7.5 m as an observational experimental trial with four palms per genotype. The plantations were maintained under irrigated condition following the recommended package of practices.

Observations were recorded on four palms per genotype for vegetative, floral and fruit component traits as per the standard descriptors (Ratnambal *et al.,* 1995). The mean data was obtained from the observations recorded during stabilized bearing stage for a eight year period from 2010-2017 on quantitative traits namely palm height, palm girth, petiole length, leaf length, leaflet length, leaflet breadth, total leaves, annual leaf production, number of inflorescences per palm per year, number of female flowers per spathe, nut yield per palm per year, fruit length, fruit breadth, tender water content, whole nut weight, de-husked nut weight, kernel thickness and copra outturn. Chemical constituents of tender nut water extracted from 6-7-month-old nuts of the ten accessions were tested at the Post Harvest Technology

Centre, TNAU, Coimbatore. The data collected was used to obtain mean, standard deviation and coefficient of variation.

RESULTS AND DISCUSSION

Palm morphology and floral biology

Coconut palms with a circular crown, strong petioles, producing maximum number of functional leaves and inflorescence containing higher number of buttons are desirable for selection and hybridization programmes. Indigenous genotypes such as East Coast tall, Arasampatti Tall and Tiptur Tall native to South India and well adapted have been released as varieties for farmers cultivation through selection. Assessing the adaptability and performance of introduced exotic collections as suitable varieties for the Western Ghats is a long term process due to the perennial nature of the crop. The key vegetative and floral characters recorded for each genotype are presented in the Fig. 1 & 2. FMST recorded maximum girth (121.2cm) while number of functional leaves (39.6), annual leaf production (13.5) and leaf length (540.3cm) was maximum in SNRT On an average, 10 inflorescences per year were produced by the coconut accessions, with SNRT and GTBT recording the highest and lowest number of inflorescences per palm per year respectively. JVT produced maximum number of buttons per inflorescence among the genotypes evaluated (26.0). Based on the evaluation of these exotic collections for a period of eight years from the stabilized bearing phase onwards, the genotype San Ramon Tall was found to be a suitable genotype combining desirable attributes in terms of palm morphology, moderate nut yield, big size nuts and high copra out turn. This genotype originating from the Philippines is an elite tall type with circular crown introduced in India during 1955. Based on the observations made on the floral biology of this accession at AICRP (Palms) centre, Aliyarnagar, Tamil Nadu, SNRT comes to flowering in the sixth year of planting. It is highly cross pollinated with the male phase period of 16.0 days and female phase period of 3.8 days. The average gap between male and female phase is 2.2 days which curtails self-pollination and augments cross pollination mechanism in this tall coconut genotype (Samsudeen *et al.,* 2019). The fruits are oval in shape with a greenish yellow colour.

Nut yield and copra outturn

Being cross pollinated, the Indian coconut cultivars display a high level of variability for various traits. Continuous cultivation for a prolonged period in a particular environment also contributes to variability since the performance of these genotypes is influenced by genotype x environmental interactions and can vary under different agro-climatic conditions (Ramanandam *et al.,* 2018). In the present study also, the coconut genotypes have exposed significant variation for nut yield, fruit component traits and copra output. The average nut yield per palm of exotic collections ranged from 75-100 nuts per palm per annum. The highest nut yield was recorded by ZNT (106.6 nuts per palm per year) followed by FMST (99.9 nuts per palm per year), while SNRT recorded an average nut yield of 75.3 nuts per palm per year.

High nut yield, high copra content and oil content have been significant parameters in the selection of genotypes either for direct utilization as varieties or as parents in hybridization programmes.

Copra out turn is an important yield attribute that is essential for sustaining coconut based industries. About eighty percent of the production cost is attributed to the cost of handling, counting, husking, cracking or shelling, irrespective of the size of nuts (Ranasinghe, 1997). A genotype with high nut yield but with small size and low copra content per nut may not be economical (Geethanjali *et al.,* 2014), as the number of nuts required to produce the desired copra or oil content increases thereby escalating the production cost. ZNT an exotic collection from Africa is one such genotype producing a high nut yield but low copra content not exceeding 150g/nut. Among the evaluated collections including both indigenous and exotic collections, San Ramon Tall recorded the highest average copra content (333.2 gram per nut) with an estimated copra yield of 25.1 Kg per palm per year with 4.66 tonnes of estimated copra outturn per hectare. Compared to other genotypes, the high copra out turn of SNRT is attributed to the bigger size of the nuts, maximum fruit weight, de-husked nut weight and moderate nut yield per palm, to the tune of 75.3 nuts per palm per year on an average. Although the other exotic genotypes produced a nut yield greater than SNRT, the copra production per palm was drastically lesser owing to their medium to small size nuts.

Bai and George (2002) reported that the total nut production per se cannot be considered as an important criterion in breeding programmes, and the partitioning of total dry matter (TDM) towards the economic yield in terms of copra content serves as a basic selection parameter in assessing the production potential of the palms. Geethanjali *et al.,* (2014) also reported that a balanced weightage should be given for the traits, viz., number of nuts and copra content in the selection criteria for elite coconut palms, since these traits are important yardsticks in determining the yield performance of coconut genotypes. The genotype San Ramon Tall with its desirable features of moderate nut yield coupled with high copra outturn was found to be a high yielder among the collections evaluated, making it suitable for cultivation and coconut based processing industries.

Tender nut quality

Tall coconut genotypes although mainly used for culinary and coconut oil extraction, also compete with dwarfs to be sold for tender nut purpose. Suitability of a coconut genotype for tender nut purpose depends on quality traits such as TSS, pH, sugars and mineral content. The pleasant and sweet taste of nut water is mainly attributed to the sugar and mineral components present in it (Chikkasubbanna *et al.,* 1990). Rethinam *et al.,* (2001) observed that the quality of total sugar varies from variety to variety and depends upon the cultivar/variety, stage of maturity, duration after harvest and storage condition. In the present study also, genotypes evaluated showed considerable variations for the various tender nut quality parameters analyzed. Except SNRT and FMST, the volume of tender nut water recorded in other genotypes was lesser ranging from 361ml (STVT) to 389ml (BSIT). SNRT recorded an increased volume of tender nut water (723.0 ml), high TSS (5.60Brix), total sugars (5.7%) and, reducing sugars (4.9%), particularly due to its bigger size of nuts. The proportion of sodium and potassium content in tender nut water is important from a human health perspective due to its effect on kidney and urinary tract functions. Generally less to optimal levels of sodium and higher level of potassium content are preferred for varieties suitable as tender nuts (Geethanjali *et al.,* 2021; Apshara *et al.,* 2007). Lesser sodium levels play a regulatory role in reducing coronary diseases and avoids dehydration. In this study, SNRT recorded a low level of sodium

(20.3 ppm) compared to other genotypes and had a potassium content of 2146.0 ppm, making it suitable for tender nut purpose also.

CONCLUSION

Considering a combination of yield attributes, fruit component traits and tender nut quality parameters, the exotic accessions namely San Ramon Tall followed by Federated Malay States Tall were found to be suitable for cultivation in the Western zones of Tamil Nadu. Due to its superior yield performance in terms of copra content, moderate nut yield and tender nut water quality, the accession San Ramon Tall has been released as a dual purpose variety in the name of Kalpa Shatabdi by XXV AICRP (Palms)Annual Group Meeting held during May 2016. It has been recommended for large scale cultivation in the states of Tamil Nadu, Kerala and Karnataka. Based on the superior performance of the variety FMST in terms of nut yield and copra out turn in Tamil Nadu, Federated Malay States recommended for release as Kalpa Ratna by XXVIII AICRP (Palms) Annual Group Meeting held during June 2019 for cultivation in the coconut growing regions of the southern states of India viz., Karnataka, Kerala and Tamil Nadu.

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Ethics statement

No specific permits were required for the described field studies because no human or animal subjects were involved in this research.

Originality and plagiarism

We assure that we have written and submitted only entirely original works.

Consent for publication

All the authors are agreed to publish this research article.

Competing interests

There were no conflict of interest in the publication of this content

Data availability

All the data of this manuscript are included in the MS. No separate external data source is required. If anything is required from the MS, certainly, this will be extended by communicating with the corresponding author through corresponding official mail; shivafruitscience@gmail.com.

Author contributions

Research grant	-	VS, SG
Idea conceptualization	-	VS, SG
Experiments	-	VS, SG, MA, ER, SP, PH

Guidance	-	VS, SG, SP, HPM
Writing-original draft	-	VS, SG, MA, ER, SP, PH
Writing- reviewing &editing	-	VS, SG, MA, ER, SP, HPM

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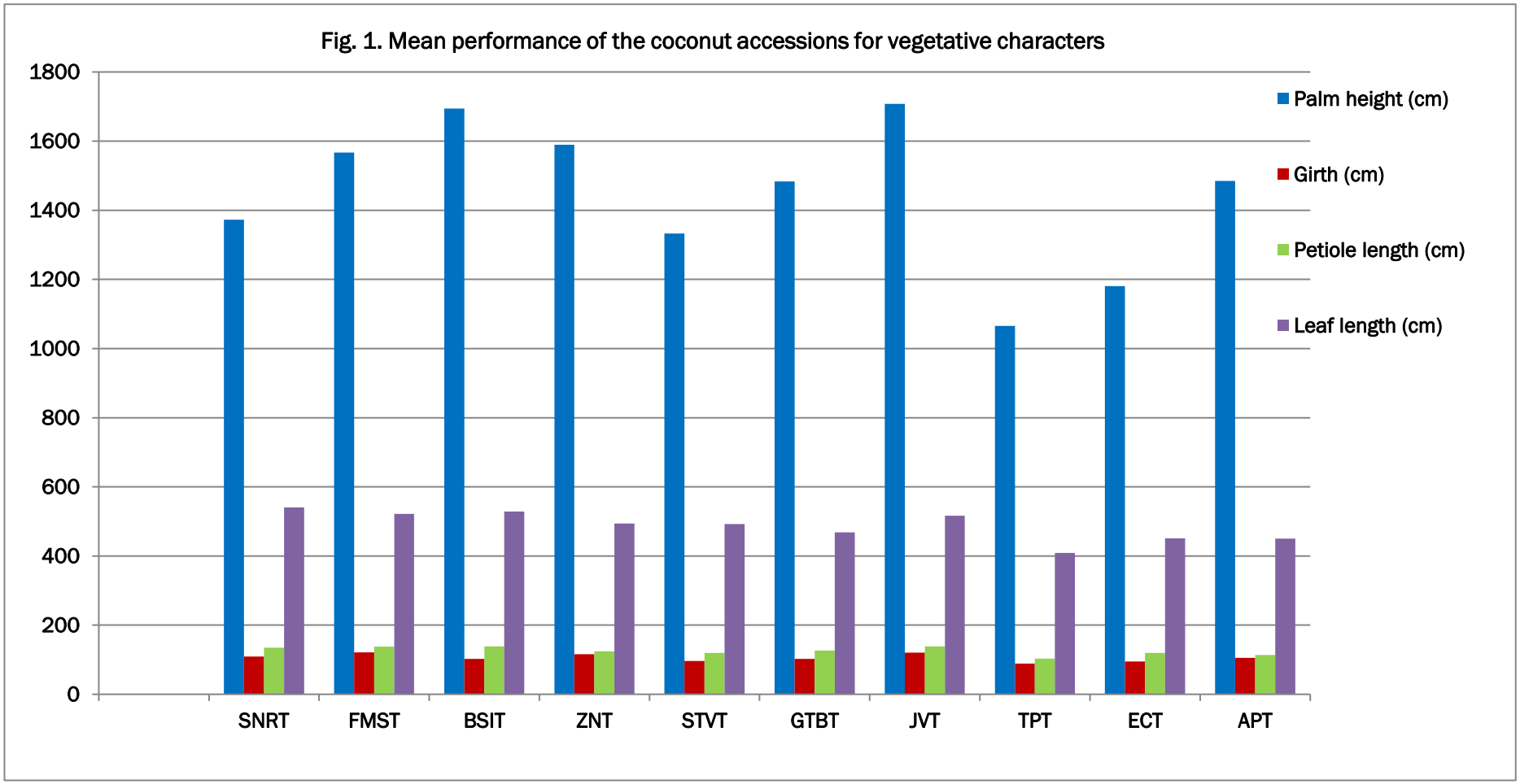
Table 1. Salient palm morphological characters of exotic coconut genotypes

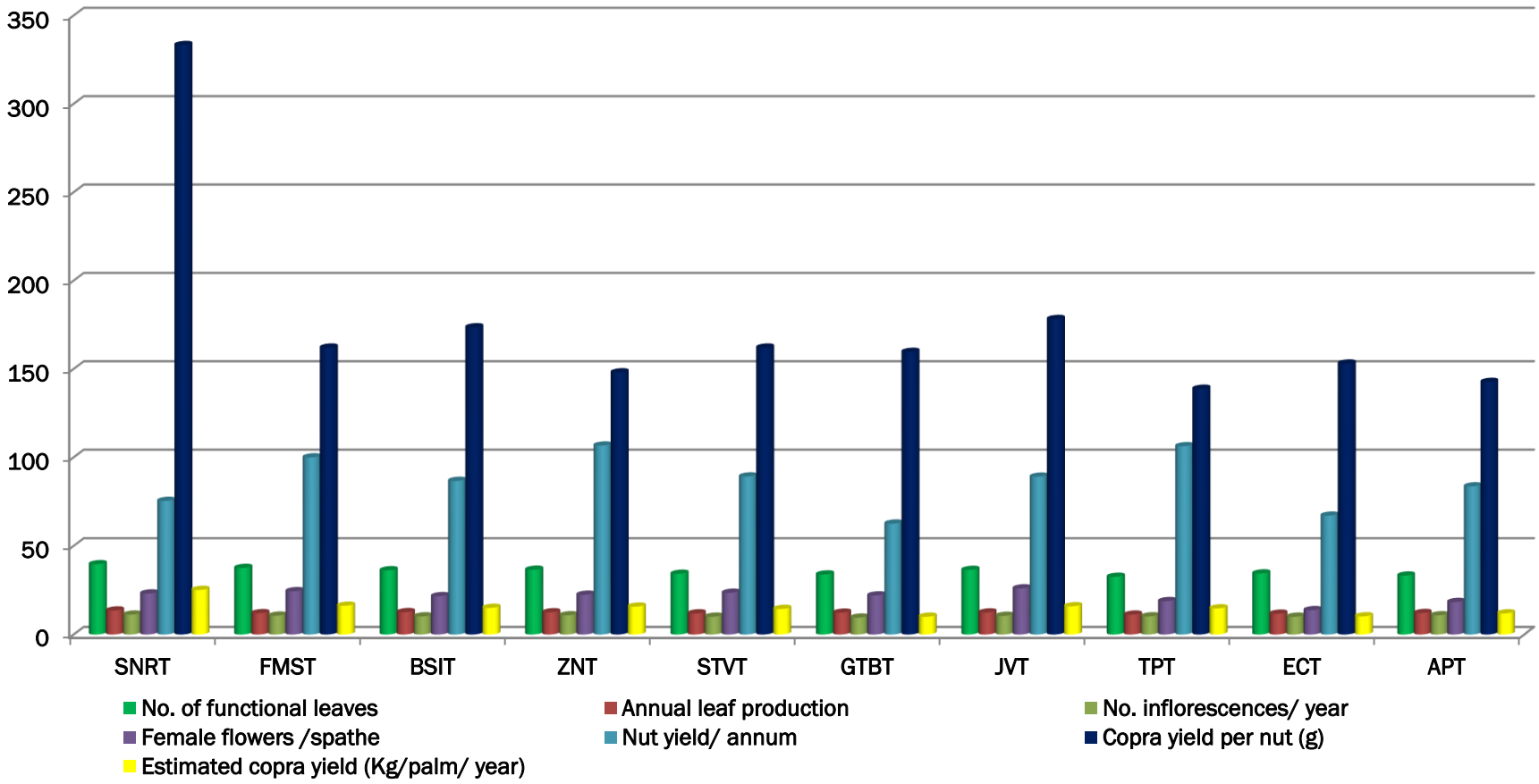
S. No	Accessions	Code	Accession Number	Source/Origin
1	San Ramon Tall	SNRT	IND 034	The Philippines
2	Federated Malay States Tall	FMST	IND 010	Micronesia
3	British Solomon Islands Tall	BSIT	IND 036	Solomon Islands
4	Zanzibar Tall	ZNT	IND 037	East Africa
5	St. Vincent Tall	STVT	IND 053	Trinidad and Tobago
6	Gonthembili Tall	GTBT	IND 051	Sri Lanka
7	Java Tall	JVT	IND 022	Indonesia
8	Tiptur Tall	TPT	--	Karnataka (India)
9	East Coast Tall	ECT	--	Tamil Nadu (India)
10	Arasampatti Tall	APT	--	Dharmapuri, Tamil Nadu (India)

Fig. 1. Mean performance of the coconut accessions for vegetative characters



1

Fig. 2. Mean performance of the coconut accessions for vegetative, floral and yield characters



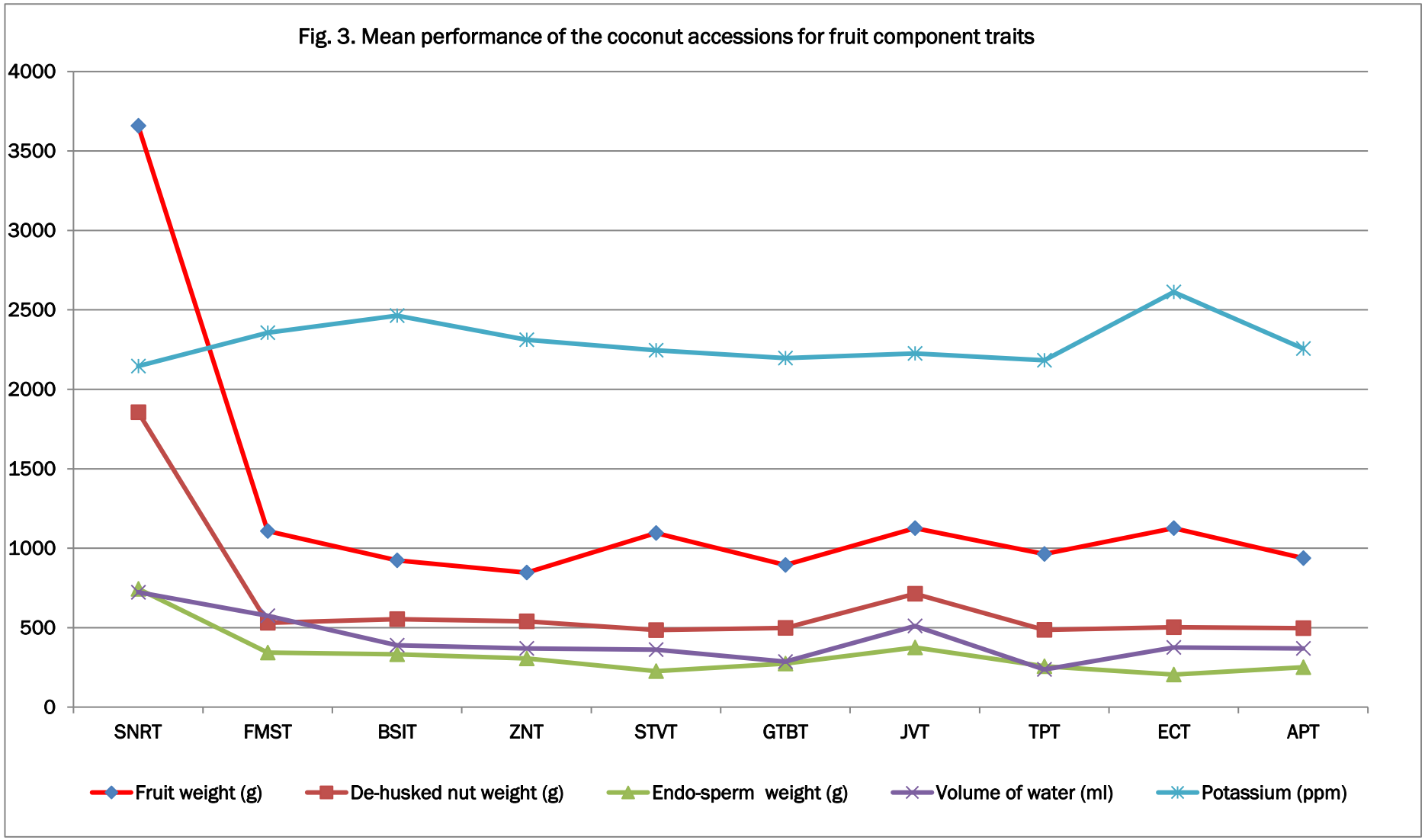


Fig. 3. Mean performance of the coconut accessions for fruit component traits
4000
3500
3000
2500
2000
1500
1000
500
0
SNRT
FMST
BSIT
ZNT
STVT
GTBT
JVT
TPT
ECT
APT
Fruit weight (g)
De-husked nut weight (g)
Endo-sperm weight (g)
Volume of water (ml)
Potassium (ppm)

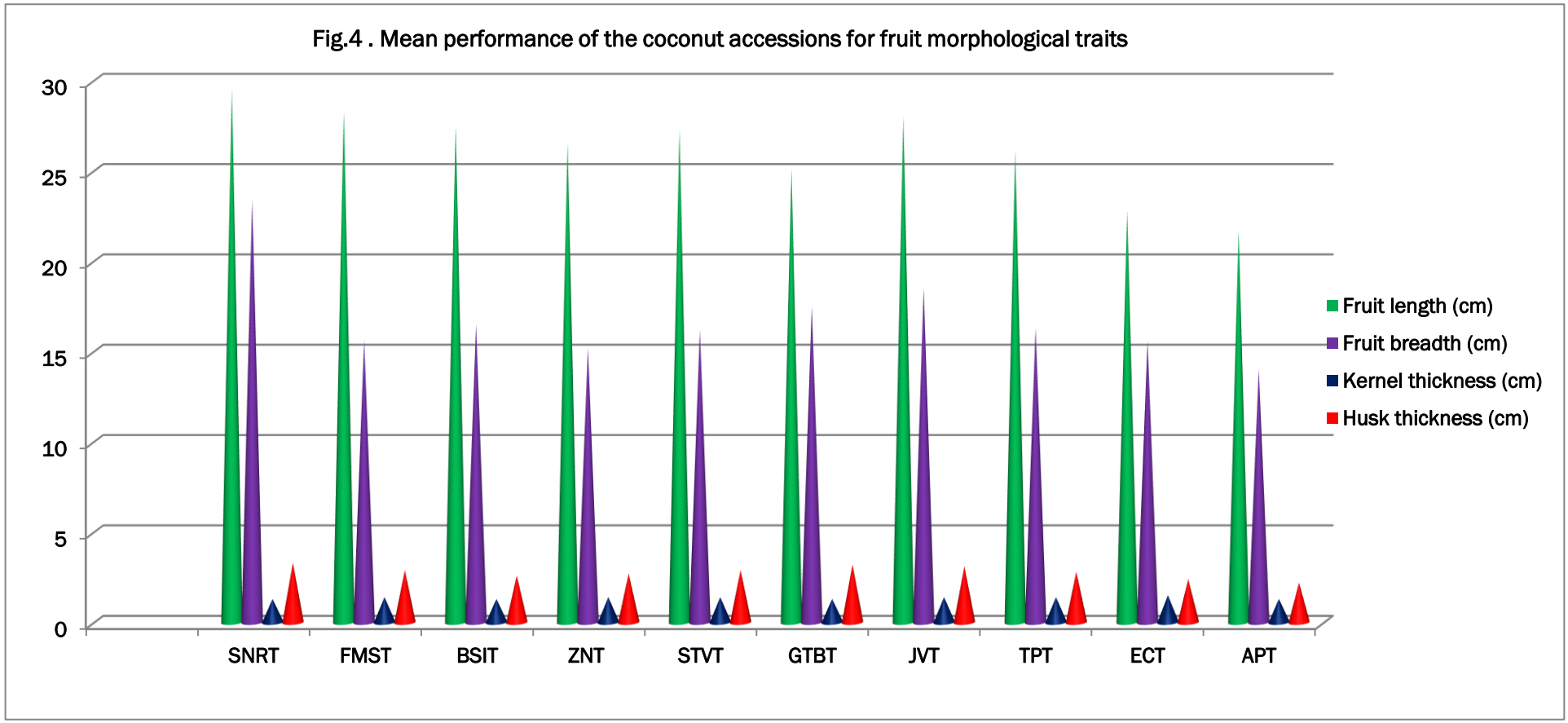


Fig.4 . Mean performance of the coconut accessions for fruit morphological traits
30
25
20
15
10
5
0
SNRT
FMST
BSIT
ZNT
STVT
GTBT
JVT
TPT
ECT
APT
Fruit length (cm)
Fruit breadth (cm)
Kernel thickness (cm)
Husk thickness (cm)

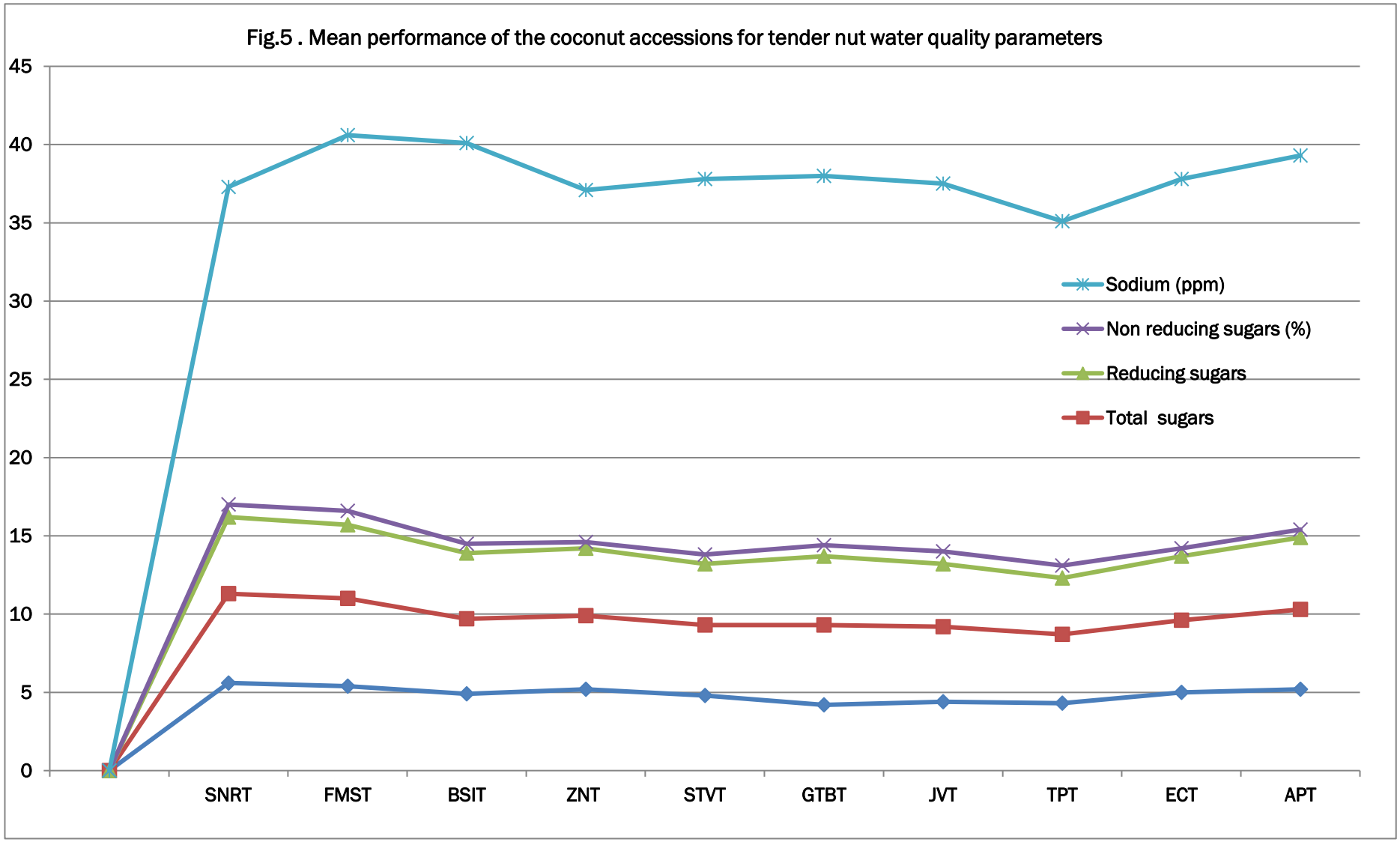


Fig.5 . Mean performance of the coconut accessions for tender nut water quality parameters
45
40
35
30
25
20
15
10
5
0
SNRT
FMST
BSIT
ZNT
STVT
GTBT
JVT
TPT
ECT
APT
Sodium (ppm)
Non reducing sugars (%)
Reducing sugars
Total sugars