

## Identification and Characterization of Pisifera Palms from Different Oil Palm Genetic Resources

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### ABSTRACT

Thirty one accessions of four different sources planted during 1998 in the field gene bank at Directorate of Oil Palm Research (DOPR), Research Centre, Palode, Kerala were evaluated. Three pisiferas, one tenera and 83 dura palms were identified out of 87 palms as per fruit form analysis. The section of results pertaining to pisiferas is presented in this paper. Characterization of pisifera palms from genetic resources was carried out for possible utilization of individual palms. The characterization revealed that one pisifera (DOPRG-53-E66) showed fertile character which recorded normal bunch and fruit development with 25 % fruit to bunch whereas, other pisiferas (DOPRG-53-E-75 and DOPRG-54-E65) showed aborted bunches throughout the evaluation period. However, DOPRG-54-E65 found to set few fruits twice with *virescence* fruit pigmentation and shell-less kernel. DOPRG-53-E66, DOPRG-54-E65, and DOPRG-53-E-75 palms had average height increment of 65.1, 69.2, and 55.1 cm per year, respectively. Suitable sterile pisifera palms could be selected as promising palm after progeny testing for commercial hybrid seed production.

**Key words:** Oil palm germplasm, characterisation, pisifera, virescens

### INTRODUCTION

Three distinct types of fruits are recognized in oil palm (*Elaeis guineensis* Jacq.) viz., dura where the fruits have thick endocarp (2- 8 mm), tenera with a thin endocarp (0.5 to 4 mm) characterized by fibrous ring surrounding the endocarp and pisifera where the fruits have no endocarp. Presence of shell is controlled by a single gene and the genotype of dura, pisifera and tenera represented by  $Sh^+ Sh^+$ ,  $Sh^- Sh^-$  and  $Sh^+ Sh^-$ , respectively. Significant yield improvement in oil palm has been obtained by exploring this monogenetic character to produce hybrid tenera with more mesocarp and large quantity of oil in commercial plantations (Wonkey- Appiah, 1987). Diversity in genetic makeup of oil palm parents induces wide variation in yield and growth among families (Ataga, 1994). Thodupuzha dura  $\times$  pisifera material was the base breeding material for Indian oil palm industry which has narrow genetic base. Inadequacy of genetic variability in these materials necessitated the introduction of exotic material of specific characteristics for incorporation into the existing breeding programme aiming at the production

of location specific hybrid seeds especially in the context of providing seed materials for the identified areas of diverse agro climatic conditions. To broaden the oil palm genetic base, genetic resources collected from different locations (Pillai *et al.*, 2000). Preliminary investigations on pisifera palms characterization and allied components were studied by Pillai and Nampoothiri (1981). Characterization of pisifera palms was undertaken in a tenera inter se mated progeny population as a part of breeding for hybrid seed production by Murugesan *et al.* (2008). Above investigations were confined to Thodupuzha material which were extensively used in the Indian breeding programme. There is a necessity to introgress new and distant pisifera sources into the ongoing programme as existing pisifera source has very narrow genetic base. Non availability of sufficient parental palms is one of the major constraints encountered in the hybrid seed production and establishment of large scale oil palm plantations in the country. Identification of potential pisifera is important as the pisifera as pollen parent can be used for the pollination of many dura bunches over a long period. The benefit to be obtained

from *pisifera* progeny testing will depend on the amount of genetic variation within *pisifera* population.

## MATERIALS AND METHODS

Pillai *et al.* (2000) collected different exotic genetic resources during 1995. Thirty one accessions of such resources were planted during 1998 in the field gene bank at Directorate of Oil Palm Research, Research centre Palode and all the individual palms were evaluated for fruit types, vegetative and bunch characteristics for three *pisifera* palms as per IBPGR (1989) descriptor (whichever characters possible for *pisifera* fruit form). The *pisifera* palms were classified either as fertile producing ripe bunches with high fruit set or semi fertile with partially fruit set or sterile palms. Bunch analysis was done for three bunches during peak season as per the procedure described by Blaak *et al.* (1963). Methodology described by Corley *et al.* (1971) was adapted to measure vegetative growth of the palms. Seventeenth frond was taken for estimating leaf character and other vegetative characters were recorded during June month every year and average of four years was reported. Similarly, bunch production and number of bunches were recorded and average of four years were reported.

## RESULTS AND DISCUSSION

The fruit form analysis revealed that out of 87 individual palms of 37 accessions, three *pisifera*, one *tenera* and 83 *dura* palms were identified in field gene bank of Directorate of Oil Palm Research (DOPR). The *pisifera* palms were further evaluated for vegetative and bunch characteristics. *Pisiferas* are often unproductive and many of them were partially female sterile, generally shows abortion in the inflorescence after anthesis (Murugesan *et al.*, 2008). Corley and Tinker (2003) classified *pisifera* in to three groups based on fertility. They were 1. Fertile palms producing large number of normal fruits and shellless kenels 2, partially sterile with only few fertile fruits per bunch and 3, sterile giving few fruits occasionally. The present study revealed that one *pisifera* (DOPRG-53-E66) showed fertile character which recorded normal bunch and fruit development with 25% fruit to bunch where as other two *pisiferas* (DOPRG-53-E-75 and DOPRG-54-E65) showed aborted bunches throughout the evaluation period. The illustration consisting palm view, bunch, spikelet, fruit cross section of *pisiferas* DOPRG-53-E66, DOPRG-54-E65 and DOPRG-53-E-75 are given in Fig 1a, 1b and 1c, respectively. Wonky- Appiah (1987) reported some *pisifera* palms with mature ripe bunches regularly under natural condition. The reported fertile *pisiferas* had four years average fresh fruit bunch

yield of 83.5 kg/year, 14.5 bunch numbers. *Virescens pisifera* recorded 18 bunch numbers whereas DOPRG-53-E-75 produced 15.4 (Table 1). The vegetative parameters in terms of rachis length, petiole width, number of leaflets, leaflet length, leaflet width, frond production, height increment, trunk diameter, leaf area and other characters showed no significant results for comparing *pisiferas*. The fertile *pisifera* (DOPRG-53-E66) fruits had 98.81% mesocarp to fruit with 14.86% of oil per bunch. The results of characterization of *pisiferas* of genetic resources are given in Table 2. The fertile *pisiferas* with high fruit set and other fruit characteristics were reported by Murugesan *et al.* (2008) and Chin (1993). Fresh Fruit Bunch characteristics of *pisifera* palms recorded during 2006-07 to 2009-10 are given in Table 2. An explanation for the occurrence of high yielding fertile *pisifera* was that there might be unusual high frequency of crossing over during the formation of gametes in the *tenera* parent thus increasing the proportion of fertile *pisifera* palms in the offspring. The fertile *pisiferas* are undesirable for use as parental palms as they pose problem in regeneration and difficult to handle shell-less fruit while processing for factory extraction. The palms with continuous production of aborted bunches were sprayed with 2, 4, 5,-T P (2, 4-5- Trichlorophenoxy Propionic Acid) as recommended by Thomas *et al.* (1973). As a result, few fruit set was observed in DOPRG-54-E65 for two times which revealed presence of *virescence* fruit colour and presence of shell less kernels (Fig. 1b). The *virescence* fruits are quite conspicuously green when unripe and change to a bright intense orange colour upon ripening. It would be advantageous to place planting materials with *virescence* fruit for easy identification of ripe bunches. A change in color is associated with fruit ripeness in oil palm. For this reason, this trait is one of the indicators usually used by field workers to help identify ripe bunches during harvest. However, sometimes this indicator is not adequate for bunches of *nigrescens* fruits (black color when unripe), because the color change when ripe is often subdued and the workers frequently cut bunches with sub-optimal degrees of ripeness and lower oil contents. It is reported that *virescence* fruit forms are extensively used for developing varieties with homozygous *virescence tenera* by ASD Costa Rica ([Http://www.asd-cr.com/paginas/english/molecular\\_biology.html](http://www.asd-cr.com/paginas/english/molecular_biology.html)). In this respect, *pisifera* palm DOPRG-54-E65 with *virescence* fruit with sterile fruit characteristics has practical utility which could be used as male parent along with *virescence dura* parent available with DOPR for producing *virescence tenera*. Visual observation during evaluation revealed that all the leaf axils of *pisiferas* bears female bunch with high sex ratio. It was reported that total numbers of

inflorescence in general is the same for dura and tenera but it is higher for pisifera and their bunches abort before fruit mature (Sparnaaij, 1969). In spite of repeated spray of growth regulator, DOPRG-53-E-75 showed no fruit set during the evaluation and seen with aborted female bunches (Fig. 1c). Based on the present study,

present materials could be grouped into two and DOPRG-53-E6) comes under fertile pisifera category and DOPRG-54-E65 and DOPRG-53-E-75 are sterile pisiferas. However, DOPRG-53-E-75 requires further confirmation as it is not set fruit so far. Fertile pisiferas are undesirable as they showed fairly good fruit set. In

**Table 1: Reproductive characters in pisifera palms from different genetic resources**

Year	DOPRG-53-E66*		DOPRG-54-E65 **		DOPRG-53-E-75**	
	FFB yield (kg/palm/year)	No. of bunches	FFB yield (kg/palm/year)	No. of bunches	FFB yield (kg/palm/year)	No. of bunches
2006-07	72.0	15.1	-	18.1	-	16.2
2007-08	68.5	10.5	-	21.2	-	17.1
2008-09	72.3	16.1	-	17.3	-	13.1
2009-10	121.2	16.3	-	16.1	-	15.3
Mean	83.5	14.5	-	18.18	-	15.4

\* Fertile \*\* Sterile pisiferas

**Table 2 : Characterization of pisifera palms from different genetic resources**

Characteristics of pisiferas	DOPRG-53-E66	DOPRG-54-E65	DOPRG-53-E-75
Flower colour	White	White	White
Fruit form	Pisifera (Fertile)	Pisifera (Sterile)	Pisifera (Sterile)
Tree form	Normal	Normal	Normal
Fruit colour	Nigrescence	Virescens and albescence	Nigrescence
Mesocarp pigmentation	Normal	Normal	Normal
Trunk diameter	92.36	89.81	78.03
Height increment (cm)	65.1	69.2	55.1
Rachis length (m)	6.58	7.5	5.6
Petiole width (cm)	12.0	12.3	9.5
No. of leaflets	280	308	292
Leaflet length(cm)	60.5	92.5	69.84
Leaflet width(cm)	4.75	5.42	5.69
Fron production/year	24.0.	24.1	24.7
Leaf area (m <sup>2</sup> )	5.43	8.49	6.38
Fron fresh weight (kg)	12.0	11.0	7.0
Fron dry weight (kg)	4.38	3.78	2.30
Petiole depth	2.12	2.14	2.08
Stalk length (cm)	8.33	-	-
Peduncle length (cm)	26.66	-	-
Wt. of 10 fruits (g)	57.7	-	-
Wt. of 10 nuts (g)	4.0	-	-
Single fruit wt. (g)	5.77	-	-
Single nut wt. (g)	0.4	-	-
Oil to dry mesocarp (%)	75.1	-	-
Oil to wet mesocarp (%)	63.58	-	-
Mesocarp to fruit (%)	92.81	-	-
Fruit to bunch (%)	25.19	-	-
Oil to bunch (%)	14.86	-	-

spite out of good quality characteristics, work at Nigerian Institute for Oil Palm Research (NIFOR) has already confirmed that fertile pisiferas when used to produce Dura x Pisifera gave tenera with thicker shells than sterile pisifera (Sparnaaij, 1963). Sparnaaij (1969) has advocated lowest or zero fruit set for ideal pisifera and hence DOPRG-54-E65 could be considered as ideal one provided their combining ability should be tested with dura mother palms before proceed to hybrid seed production and supply to farmers.

## CONCLUSION

Three pisiferas consisting one fertile and two sterile were identified from base population of genetic resources available at field gene bank of Directorate of Oil Palm Research (DOPR) Palode Research Centre and potentiality of sterile pisifera DOPRG-54-E65 possessing virescens trait could be utilised by confirmation through progeny test results.

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Fig. 1: Palm view, bunch, spikelet, fruit cross sections of fertile and sterile pisifera



a. DOPRG-53-E66



b. DOPRG-54-E65



c. DOPRG-53-E-75