# PROGENY EVALUATION OF DURA X DURA CROSSES TO BE UTILIZED FOR FEMALE PARENTS IN OIL PALM (*Elaeis guinensis* Jacq.) SEED PRODUCTION

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## ABSTRACT

Oil palm plantation development in recent year has undergone limitation of suitable land for cultivation, so to increase the production both for seed supply and for oil production in the future are emphasized on land intensification and resource use efficiency. In order to obtain high quality seed of oil palm, identification of suitable female parent which is able to produce greater number of viable seeds and the progeny that able to produce bunch with high oil content were very crucial. In order to obtain this expected material, careful observation and continual evaluation must be established. Therefore in this study, we evaluated ten best $F_1$ crosses of Dura × Dura (D×D) progenies to be used as female parent. The materials has been planted at Pinang Sebatang estate (block D014) and Teluk Siak estate (block E014) in Minamas Plantation, kabupaten Siak, Riau in 2010. The progenies planted consist of one selfing Dura plant and nine crosses D×D plants. The experiment was conducted in a randomized complete block design with five replicates. Parameters observed are fertile fruit ratio, bunch weight, mesocarp to fruit ratio, oil to wet mesocarp ratio, kernel to fruit ratio and oil to bunch ratio. The result showed that there were significantly difference amongst progenies for mesocarp to fruit ratio, kernel to fruit ratio and average bunch weight, but not for three other parameters. Based on several parameters observed, most of material evaluated had the mean values higher than the commercial minimum standard requirement. So the material may be used and very potential as female parent in commercial seed production.

Keywords : crossing, female parent, fertile fruit, progeny Dura x Dura, selfing

## INTRODUCTION

The commercial oil palm plantations grows mainly is Tenera which is actually F1 hybrid between selected Dura as female parent and selected Pisifera as male parent. Generally Dura population used to produce commercial seed is derived from Deli Dura which originally obtained from four palms which planted at Botanical Garden in Bogor (1848). Early selections among open pollinated descendants of Bogor palms, notably in the district of Deli in Sumatra, were not intended for a commercial venture, but were meant for landscaping the avenues leading to the managers bungalow in Tobacco plantation. Although a breeding population may have been introgressed with other population, their still remain a considerable number of populations derived entirely from a few ancestral palms. Oil palm breeding and selection by Harrisons and Crosfield (now Golden Hope) at

Oil Palm research Station (OPRS) in Banting started in 1955. The initial breeding were based on 500 palms from Ulu Remis Genetic blocks of F1 and F2 generation. The first breeding trial, at Dusun Durian estate in Klanang Baru. The elite duras from Dusun Durian estate were progeny tested and subsequently selected as mother for seed production (Basiron *et al.*, 2001).

Based on Malaysia standard, Dura to be used as a female parent must be meet some criteria and it's differentiated based on the pedigree and the performance (SIRIM, 2005). The standard of including minimum fresh bunch yield 150 kg per palm per year, minimum mesocarp to fruit ratio is 55%, maximum shell to fruit of 35%, minimum oil to dry mesocarp of 75% and minimum oil to bunch of 18% (SIRIM, 2005).

Recently, Indonesia is the world's largest producer and exporter of Crude Palm Oil (CPO) harvested from the total area of about 11,300,370 ha and total CPO production of 31,284,306 tons annually (Dirjenbun, 2016). Oil palm plantation development will be targeted to be about 40 million tons in 2020. Therefore, best oil palm seed with high oil productivity and has specific character become high priority for all stakeholders.

Previous study reported that Dura selected for mother plant showed very wide variability in bunch yield per year, fruit to bunch ratio, mesocarp to fruit ratio (Hartley, 1988), fertile fruit bunch ratio, bunch number per year, and mesocarp to fruit ratio (Khusairi, 1998; Khusairi & Rajanaidu, 2005). So that in order to improve seed yield performance of mother plants, a breeding programme have been designed by OPRS by making cross between Dura x Dura of different genotypes.

By the end of 2016, there was 15 oil palm seed producers in Indonesia and annually can produce more than 150,000,000 germinated seeds, but the total seed sold was only 75,715,738 seeds annually and remaining seeds are still un sold. Therefore, oil palm seed producers must produce the best and specific planting material to ensure their seed production survive.

By the year of 2020, the number of oil palm seed producer are to reach 20 companies with total seed production around 200,000,000. This big number of seed are expected to fill the demand of new oil palm estate area and the requirement for replanting old oil palm.

Increasing oil palm seed caused of 3 main factors, first is good CPO price therefore will deliver good profit as well to stakeholder and small holder. Second, there is government policy to facilitate to get license and evaluation of land for plantation, facilitate loan with low interest and finally will increase domestic income. Third, the stakeholder interest to extend their plantation or open new oil palm plantation.

The aim of this trial is identify and selected the best dura progeny and individual palms to be utilized as female parent to produce commercial oil palm seed. Best progeny and selected palms will used for next breeding program as well such as to produce semi clone planting material.

## MATERIALS AND METHODS

Planting materials used in this study were nine F1 crosses between Dura x Dura and one Selfed Dura created by the Oil Palm Research Station, Banting in 2009. The detail plant of crosses was outlined in Table 1. The F1 seed then was planted in 2010 at Pinang Sebatang estate (block D014) and Teluk Siak estate (block E014) in Minamas Plantation, Kabupaten Siak, Riau, with planting density 136 palms $ha^{-1}$. The soil type is Typict Paleudults and Typic Endoaquepts with the altitude around 12 m above sea level. This trial was laid out in radomize complete block design (RCBD).

Table 1. Detail crosses plan of material used in the study created by Oil Palm Research in Malaysia in 2009

| Progeny number | Crossings | Parents | |
|---|---|---|---|
| | | Female | Male |
| 1 | D×D | BM 2534/27 | BM 2515/151 |
| 2 | D×D | BM 2534/27 | BM 2534/27 |
| 3 | D×D | BM 2195/29 | BM 2189/6 |
| 4 | D×D | BM 2197/8 | BM 1363/17 |
| 5 | D×D | BM 2515/151 | BM 2525/56 |
| 6 | D×D | BM 2523/69 | BM 2525/56 |
| 7 | D×D | BM 2525/56 | BM 2532/17 |
| 8 | D×D | BM 2519/166 | BM 2522/83 |
| 9 | D×D | BM 2523/69 | BM 2519/166 |
| 10 | D×D | BM 2525/56 | BM 2515/151 |

Fertilizer applied followed estate commercial rate and cultural practices followed the estate standard. Some vegetative measurement has been started before palms harvested such as crown disease incidence and sex ratio counting. Traits observed in this study were concentrated to the oil palm yield component beginning plant age of 5 years until 7 years after planting to obtain three years data. The traits including bunch number per year, fresh fruit bunch, fertile fruit ratio (FFR), average bunch weight (ABW), mesocarp to fruit ratio (M/F), oil to wet mesocarp (OWM), kernel to fruit ratio (K/F), and oil per bunch ratio (O/B). The procedure to obtain those yield components traits followed.

The data collected were then subjected to analysis of variance by SPSS package (Windows version 17.0) software. Means of progeny were compared by using Duncan new multiple range test.

## RESULT AND DISCUSSION

It widely known that many factors affect the yield components in oil palm plantation including uncontrollable such as weather and planting materials. Data analysed showed that progeny were significantly difference for average bunch weight, mesocarp to fruit ratio and kernel to fruit ratio, but not for fertile fruit ratio, oil to wet mesocarp ratio and oil to bunch ratio. There was also found that year significantly affected fertile fruit ratio, average bunch weight and oil to bunch ratio, but did not differ for mesocarp to fruit ratio, oil to wet mesocarp ratio and kernel to fruit ratio. Data analysed were summarized in Table 2 and Table 3. Progeny did not affect female flower development, however, fertile fruit affected mainly by external factors such as weevil activities and type of population, and pollen availability. Beside of weevil population and pollen availability factors, other factors such as rainfall also affect fertile fruit ratio. High rainfall affected pollination efficiency and weevil activities. Rainfall and number of rainy days has significant correlation with fruit set, while poor fruit set has significant correlation with bunch weight (Lubis *et al*., 2014). During the rainy season, the weevil not active and the pollen load of the pollinating weevil could be washed off due to the persistent rain. Some companies reported during haze incidence in 2015 also reduce the weevil population and yield dropped. Progeny and year effect on fertile fruit ratio were shown in Figure 1.a and Figure 1.b.

Table 2. Progeny mean average over three years of several traits observed based on sample plants

| Progeny | Variables | | | | | |
|---|---|---|---|---|---|---|
| | FFR | ABW | MF | O/WM | K/F | O/B |
| 1 | 63.17 a | 10.80 d | 63.87 e | 52.06 a | 6.42 a | 22.69 a |
| 2 | 64.04 a | 10.89 d | 62.36 bcde | 51.09 a | 6.38 a | 22.03 a |
| 3 | 64.36 a | 9.31 bc | 60.98 abc | 52.26 a | 7.19 a | 21.27 a |
| 4 | 60.99 a | 9.18 bc | 67.84 f | 50.76 a | 8.34 b | 22.11 a |
| 5 | 64.90 a | 9.42 bc | 61.16 abcd | 54.73 a | 9.17 b | 22.13 a |
| 6 | 64.37 a | 9.01 ab | 59.24 a | 56.50 a | 8.66 b | 22.12 a |
| 7 | 63.49 a | 7.85 a | 60.71 ab | 53.44 a | 6.98 a | 22.25 a |
| 8 | 63.41 a | 9.69 bcd | 63.56 cde | 52.86 a | 7.19 a | 22.33 a |
| 9 | 62.32 a | 9.45 bc | 63.69 de | 52.89 a | 7.02 a | 22.78 a |
| 10 | 60.95 a | 10.45 cd | 63.92 e | 53.34 a | 7.11 a | 22.22 a |
| Mean | 63.20 | 9.61 | 62.73 | 52.99 | 7.45 | 22.19 |

Table 3. Year mean averaged over ten progenies of several traits observed based on sample plants

| Year | Variables | | | | | |
|---|---|---|---|---|---|---|
| | FFR | ABW | M/F | O/WM | K/F | O/B |
| 1 | 64.90 b | 7.90 a | 63.37 a | 52.69 a | 7.46 a | 23.15 b |
| 2 | 65.84 b | 10.03 b | 62.86 a | 53.07 a | 7.22 a | 23.12 b |
| 3 | 58.86 a | 10.89 c | 61.97 a | 53.23 a | 7.66 a | 20.31 a |
| Mean | 63.20 | 9.61 | 62.73 | 52.99 | 7.45 | 22.19 |

As shown in Figure 1, progeny did not influence significantly on fertile fruit ratio, however, average bunch weight was significantly affected by both progeny and year. It mean that each progeny has different flower formation. Length of spikelet and number of female flower in one spikelet affecting the development of female flower become fruit. Progeny which has good female flower formation will produce good bunch if others factor which influence the fruit development supporting. Year was significantly difference on average bunch weigh will increase by increasing palm age.

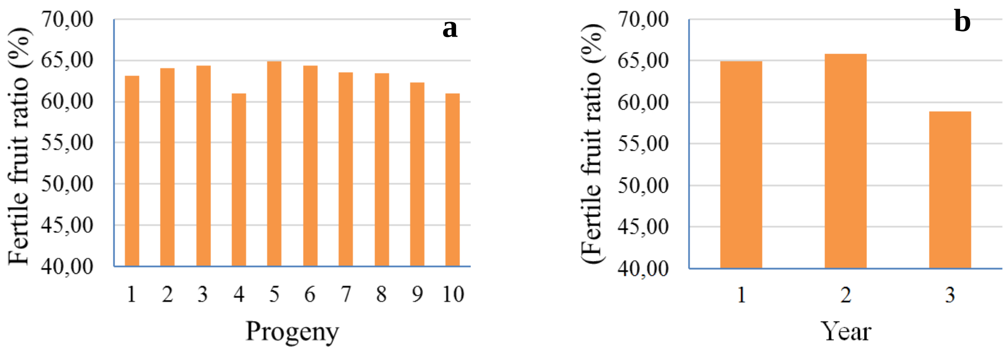


Figure 1. Progeny (a) and year (b) effect on fertile fruit ratio

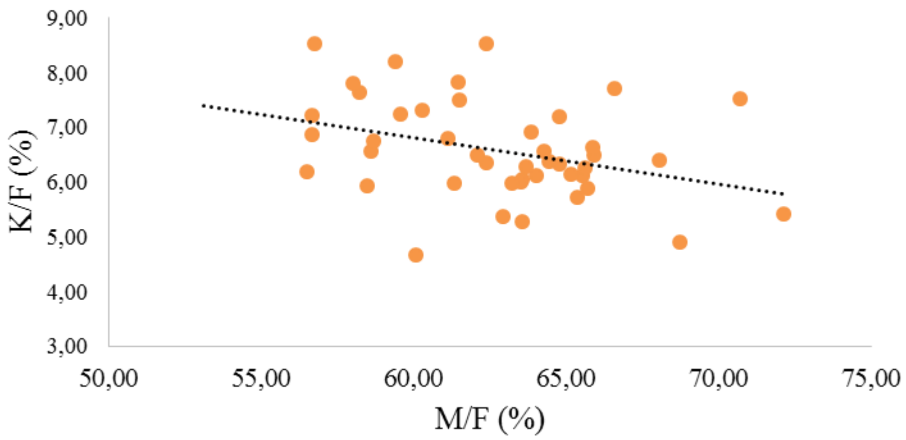


Figure 2. Correlation between O/B ratio and K/F ratio

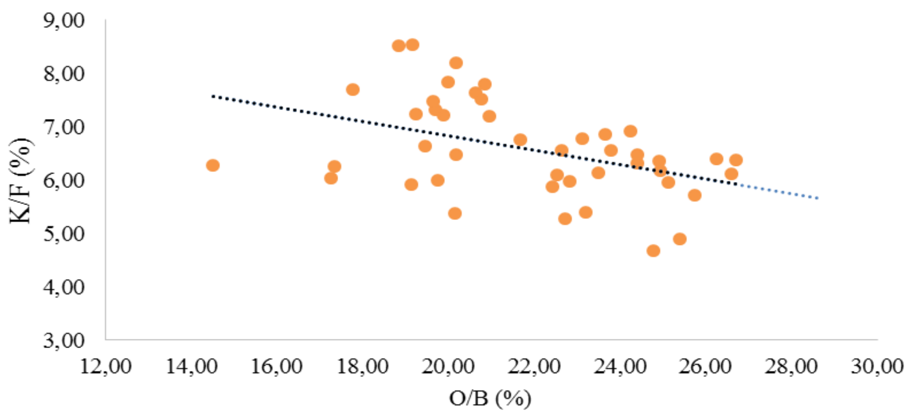


Figure 3. Correlation between O/B ratio and K/F ratio

Progeny has high contribution on mesocarp to fruit and kernel to fruit are genetically and others bunch component. Meaning the heritability estimate based on progeny was intermediate to high.

But heritability estimate based on progeny for other component such as average bunch weight, fertile fruit ratio, oil to wet mesocarp and oil to bunch ratio was low to intermediate. Amirudin *et al.* (2015), reported that heritability some parameters such as Fresh fruit bunch, average bunch weight and bunch number were various depend on location. Meaning that environment contributed on certain parameters observed.

Analysis data showed that oil to bunch ratio was negatively correlated to kernel to fruit ratio. Increasing kernel to ratio would reduce the mesocarp to fruit ratio which will potentially affect the oil to bunch ratio. Kernel and shell thickness at least will influence the oil content in mesocarp that finally will affecting the oil to bunch ratio as well. Correlation between kernel to fruit ratio and oil to bunch ratio also correlation between kernel to fruit ratio and mesocarp to fruit ratio shown in figure 2 and figure 3. Beside of kernel and shell thickness, environment also contributed on oil to bunch such as bunch ripening, harvesting standard, nutrient and etc. Bunch with optimum ripening will produce more oil compared to other ripening level. Unripe and under ripe bunch will produce less oil compared to optimum ripening. The harvesting standard and harvesting round also has high contribution on oil to bunch. Age of palm also affecting the oil extraction rate. Corley and Law (2001) reported that there is some evidence for declining of oil extraction rate with palm age, but an important factor in the decline in OER in Malaysia appears to us to be the deliberate change in ripeness standard from 5 loose fruit per kg to as little as 1 loose fruit per bunch.

## CONCLUSION

Based on data collected and analysed, some progenies were very promising to be utilized as female parent to produce commercial seed. Since all stakeholder and planter need the seed with highest productivity and specific characteristic, palm selected from the best progeny first then selected continued to best individual palm within the best progeny. To enhance the seed palm productivity, the selected palm could be crossed with other palm within the progeny, crossed with palm with different progeny or with the palm self / selfing.

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