EVALUATION ON F2 GENERATION SEGREGATION FROM DWARF X TALL CROSS OF COCONUT (*COCOS NUCIFERA L.)* AT FIELD STAGE

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ABSTRACT

Second generation (F2) of coconuts dwarf x tall cross were studied for vegetative and yield characters. Two hundred F2 generation palms arising from the cross used for the experiments. The objective was to determine the segregation patterns of the morphology characters on dwarf and tall crosses of F2 generation planted in MARDI Bagan Datuk, Perak. The F2 population planted, 4 segregation genotypes were selected for the present study on the contrasting morphological and reproductive characters (hybrid, dwarf, tall and non-parental) . Data on year 4 of flowering phases, growth stem height, stem diameter, stem perimeter, and yield were recorded. The segregation to hybrid was the highest number of plants compared to others with 116. Recombination of the autogamous nature along with the Tall characters was observed in the F2 palms in terms of stem height and perimeter. Certain genotypes arising from F2 recorded the high potential number of nuts per hectare/year that comprised to dwarf up to 25,000 compared to other segregated varieties due to their resistance to breeding depression. The possibility of extracting recombined lines with desirable characters to improve the Malayan Dwarf x Tall is also discussed.

Keywords: Coconut, F2 generation, segregation, morphology Characters.

INTRODUCTION

In coconut replanting, dwarf x tall (D x T) cross of coconut hybrids are preferred over the late maturing, and lower-yielding tall varieties because of their precocity, higher and more stable yield, uniformity, and ability to quickly recover from stress. The identification of the existence of hybrid vigor in inter-varietal crosses of Dwarf x Tall coconut caused a breakthrough in coconut breeding (Patel, 1937). The F1 hybrids exhibited precocity in bearing, high nut numbers arid improved nut weights (Bhaskaran & Leela, 1963., Liyanage, 1956., Satyabalan & Kunjan, 1970). Although the hybrids were at an obvious advantage in production potential, their stability mi varying environmental conditions was at a low level. The dwarfness of the coconut is controlled by a heterozygous state and depending upon the heterozygosity of the parents involved in the cross, segregation of dwarfs in the F1 population may vary increasing the variability of the F1 population (Bavappa et al., 1973). The theory of quantitative genetics provides interpretation to the above scenario, that along with the dominant and favorable alleles which bring the maximum heterosis for desirable characters, the recessive and unfavorable genes make their way into the cross thus decreasing its value. Therefore, a long-term strategy to remedy this situation is to eliminate the tin desirable genes by selfing and selection which would also reduce the variability of the resulting progeny. Before initiating this task it is important to study the segregation of characters selfed generations of F1 is derived from Dwarf red x Tall crosses and investigate the nature of genetic control. Proper selection and planting of good quality seed nuts must be done to ensure a productive plantation (Magat, 1999). Therefore the main objectives of this study were to determine the segregation patterns of the morphology characters on Dwarf x Tall crosses of F2 generation planted in MARDI Bagan Datuk, Perak.

MATERIALS AND METHOD

Experiment sites

The experiment was conducted in a plot at MARDI Bagan Datuk. The site was located at 3°53'36.0" N latitude and 100°51'24.0" E longitude. The experiment site was a rain forest agroecology characterized with more than 1900 mm annual rainfall, 24 – 36ºC annual temperature, and 79% – 83% relative humidity. The soil of MARDI Bagan Datuk was generally classified as riverine with medium pH and low availability of N and K.

Planting materials

Two hundred F2 progeny of coconuts at the age of twelve-month old were planted mid-2016 in a fully randomized design horizontally on raised plots at a spacing of 7.0 m between seedlings and 7.0 m between rows triangularly.

Treatments

Of the F2 population planted, 4 segregation genotype varieties were selected (hybrid, dwarf , tall and non-parental) for the present study on the basis at least 40-50 individuals of each family with contrasting morphological and reproductive characters were present.

Data collections

The breeding behavior of each palm was determined by studying the duration of flowering phases. The stem height was measured from the base to the tip of the lowest frond by using a steel ruler. The parameter of stem diameter and perimeter of the stem was collected at the height of 1 meter from the bottom of the stem using a caliper and measuring tape. The yield of nuts per palm was recorded periodically at each harvest and pooled to get nut yield per palm per year. Yield components data was gathered from the number of nuts and weight of 10 husked nuts from each palm. The data were gathered for the 4th year of mid-2020 on each palm.

Experimental design and data analysis

The experimental design was a Complete Randomized Design. Analysis of variance tests was carried out to detect significant differences between the parameters collected with 4 replications. Means of the measured variables were compared by using the appropriate ANOVA procedure (SAS Institute 1989) and the Duncan test ($P<0.05$).

RESULTS AND DISCUSSIONS

Genotypes characters from *F2* and plants segregated.

The time taken to flowering of each F2 palm was recorded and the mean flowering time with the range appears in Table 1. The mean flowering time varies from 20 months to 36 months in the cross of dwarf and tall. There are no significant differences were present between the segregation crossed varieties. The table also shows the number of plants and percent that segregated from F2 plant. I obviously show that segregation to hybrid was the highest number of plants compared to others with 116 or 58.00 % out of total samples. The lowest segregation is significantly at non-parental varieties with 9 plants and 4.50% out of total samples. The work on describing and using within population diversity and generating further diversity is longer term and requires the specialties in the Geneticist (Foale, 1992).

The results on the flowering time were significantly revealed that the highest variation for flowering time was generated. It is important to note that the progeny of *F2* had potential of generating the whole range of variation for flowering time among the 200 individual's studies. The male phase of Tall and Dwarf varieties lasts for about 18 days but the female phase lasts for 5-7 days in Tall palms and 10-16 days in Dwarf (Liyanage, 1949).

Table 1: Genotypes arising from *F2* and Segregation of characters.

Variety segregation	Pollination behavior	Time to flower (month)	No of plants	% of plants
Hybrid	Inbreeding	32 a	116 a	58.00 a
Dwarf	Outbreeding	20 b	36 b	18.00 b
Tall	Outbreeding	36 a	39 b	19.50 b
Non-parental	Inbreeding	24 b	9 c	4.50 c

Mean value with the same letter for each treatment are not significantly different at $P < 0.05$

Growth characters of segregation palm

Data on the stem perimeter, height and diameter of autogenous palms are given in figure 1, 2 and 3. The segregation of growth characters of the palms were of great importance. The stem perimeter was estimated highest at segregation of tall with 88.54 ± 41.31 cm while non-parental segregation was the lowest stem perimeters records with 86.82 ± 41.91 as shown in figure 1. Significant differences ($P< 0.05$) for mean of stem height tremendously shows at tall segregation genotype with 101.32 ± 28.05 cm compared to other segregation verities while dwarf shows the lowest stem height characters with 100.87 ± 28.05 cm as mentioned in figure 2.

Figure 3 revealed the mean stem diameter of palms; of the individual varied from 32.55 cm to 32.97 cm at the age of 4 years from planting which non-parental segregation variety was the highest and dwarf cold be the lowest respectively. The seedling vigor was highly correlated with adult palm characters such as early flowering, nut yield and copra production (Liyanage & Abeywardena, 1957). The fertilizer application is mainly based on chemical fertilizers which are costly and exerts negative impacts on soil health (Jithya, 2010).

Figure1: Vegetative data of the F2 segregation on stem perimeter. Bar with the same letter for each treatment are not significantly different at P < 0.05.

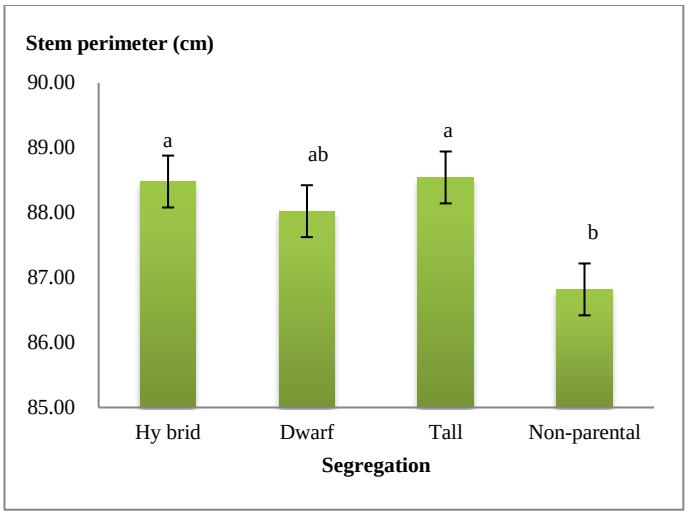


Figure 2: Vegetative data of the F2 segregation on stem height. Bar with the same letter for each treatment are not significantly different at P < 0.05.

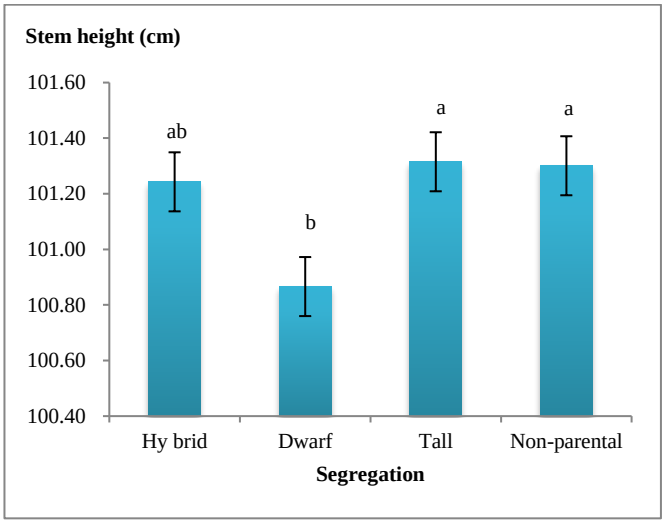
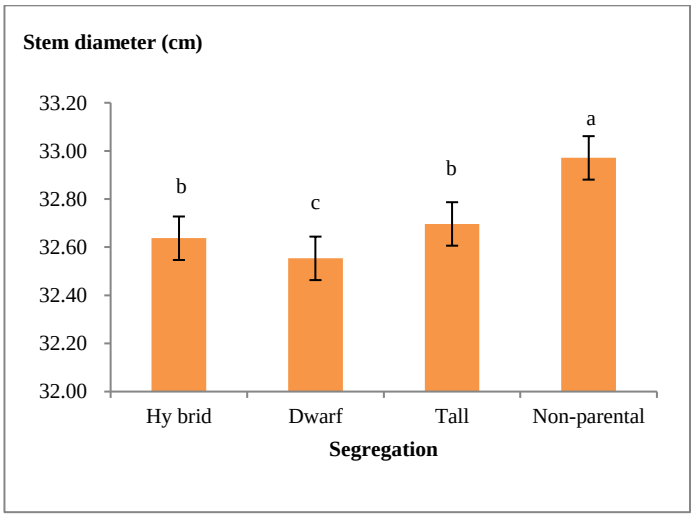


Figure 3: Vegetative data of the F2 segregation on stem girth. Bar with the same letter for each treatment are not significantly different at P < 0.05.



Yield characters of segregation palm

A brief description of the segregation and recombination pattern of the identified vegetative, reproductive and yield characters of 4 segregated palms was given in Table 2 and 3 . Table 2 shows the mean data of vegetative the *F2* segregation variety for yielded plants. Out of 116 plants evaluated as shown in table 1, 63 or 54% plants were yielded in hybrid segregation. It was followed by dwarf with 23 out of 36 plants or 64% and tall segregation with 9 out of 39 plants or 23%, whereas non-parental varieties were 6 out of 9 plants or 67%.

Table 2 also revealed the mean number of bunch per plant each year and potential nuts each bunch. Significant differences (P.<0.05) were shown for the amount of bunch each plants was estimated as highest at 14 in non-parental variety, followed by dwarf with 11 bunches and hybrid segregation with 10 bunches, but unfortunately tall variety as the lowest recorded. There potential number of nuts between the segregated families of palms was highest in the non-parental family with 12 nuts while dwarf shows the lowest potential each bunch with 10 nuts.

Table 2: Vegetative data of the *F2* segregation families for yielded plants

Variety segregated	No of yielded plants	% of yielded plants	No of Bunch/ plant/year	No of nut/ bunch
Hybrid	63 a	54 a	10 b	11 a
Dwarf	23 b	64 b	11 b	10 b
Tall	9 c	23 c	7 c	11 a
Non-parental	6 c	67 c	14 a	12 a

Mean value with the same letter for each treatment are not significantly different at $P < 0.05$

Yield data of the *F2* segregation families for yielded plants at parameter number of nuts and potential yield per hectare/year was mentioned at table 3. A significant difference in the yield of nuts/plants and nuts/hectare/year was observed between the segregated families. The palm of dwarf progeny shows the outbreeding behavior has a stature equivalent to a hybrid palm of 110 nut/plant/year but the potential nuts/hectare/year was highest with 25,816 compared to hybrid segregated progeny with 19,766. The bear's nuts numbers of 77/plant/year was examined on the Tall palm which potentially rise only 10,932 of nuts/hectare/year.

Table 3: Yield data of the *F2* segregation families for yielded plants

Variety segregated	No of nuts/ plant/year	Number of nuts	Potential No of nuts/ Ha/ Year
Hybrid	110 b	1,764 a	19,766 b
Dwarf	110 b	667 b	25,816 a
Tall	77 c	180 c	10,932 c
Non-parental	168 a	240 c	23,852 a

Mean value with the same letter for each treatment are not significantly different at $P < 0.05$

The inbreeding nature of the present material is assured by following a shorter female phase as of the Tall variety but with an overlap with the male phase. When considering the vegetative and yield characters of the families indicated in Table 3, the highest nut number was recorded respectively elucidating the fact that these genotypes are resistant to inbreeding depression.

CONCLUSION

The segregation and combination of the morphology characters at the F2 generation revealed significant and tremendous results on the growth behavior and yield segregates independently in the individuals of the families examined. There are no significant differences were present between the segregation crossed varieties. The lowest segregation is significantly at non-parental varieties with 9 plants and 4.50% out of total samples. The work on describing and using within population diversity and generating further diversity is longer term and requires the specialties in the geneticist. The seedling vigor was highly correlated with adult palm characters such as early flowering, nut yield and copra production. It was revealed the mean number of bunch per plant each year and potential nuts each bunch. Significantly shown for the amount of bunch each plants was estimated as highest at 14 in non-parental variety, followed by dwarf with 11 bunches and hybrid segregation with 10 bunches. There potential number of nuts between the segregated families of palms was highest in the non-parental family with 12 nuts. The segregated palm of dwarf and hybrid significantly showed a very potential nut number of more than 19,000 and 25,000 nuts/ha/year. The lines developed are expected to be early flowering with high yield and. resistance to environmental fluctuations as the genetic stability of the lines is assured by an additive nature of genes rather than the dominant heterozygous which would segregate, in the next generation as of the present F1 hybrids.

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