

OPTIMUM PLOT SIZE FOR FIELD TRIALS ON OIL PALM

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ABSTRACT

The palm-wise yield data of NPK fertilizer experiment, conducted at Oil palm Estate, Bharatipuram, Kerala were made use of for this study. The treatment effects were eliminated from the yields of individual palms and coefficients of variation were worked out by forming plots of different sizes and shapes. Fairfield Smith's equation (1938) $y = ax^{-b}$ gave a good fit to the data. The values of 'r²' ranged from 0.98 to 0.99. Using the maximum curvature method, the optimum plot size was found to be around 8 palms/plot. The coefficient of variation was less for plots of shape 4 rows × 2 columns, the rows being across the slope. Smaller blocks were found to be more efficient.

INTRODUCTION

The information on plot variability derived from uniformity trials is very useful in the planning experiments, although each field experiment must be planned on its own merit. No uniformity trial can give general rules to dictate the choice of plot and block dimensions and the number of replications required for an experiment. For each individual experiment, it is necessary to consider a number of factors *viz.*, available experimental area, residual degrees of freedom, loss of planting material, plot shape, block size, etc. Despite these considerations, uniformity trials do give some indication of the variability to be expected from a given crop. For perennial crops, the variability was found to be higher in a large number of experiments, which can be mainly attributed to the high variability in the experimental material. This calls for suitable corrective measures for improving the efficiency of field experimentation and selection of optimum plot size is one of the important step towards this goal.

Studies on the size and shape of plots for yield trials on oil palm are limited. Webster (1939) recommended a plot size of 12-32 palms based on the study of a single year yield data. Ollagnier (1951) reported that the coefficients of variation were found to vary from 27% for plots of 3 palms to 11.5% for plots of 24 palms and recommended a plot size of 6-12 palms. The above results were obtained from the studies on uniformity trials conducted on oil palm. In the present case, the optimum plot size was worked out from the yield data of NPK fertilizer trial on oil palm, after estimating and eliminating treatment effects from individual palms. Similar studies were made earlier on D × T and WCT coconut palms (Nambiar, 1986).

MATERIALS AND METHODS

The palm-wise yield data of 350 oil palms under the NPK fertilizer experiment were collected from Bharatipuram Estate, for 3 years from 1981 to 1983. This experiment was laid out during 1972. The oil palm

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seedlings of tenera variety were planted on contour terraces with a spacing of 9m x 9m. Regular manurial doses were imposed from 1975 onwards. The layout plan with palm numbers was collected to identify the row and column position of the palms. The treatment effects for each treatment combination were estimated by the method suggested by Ray (1973). These treatment effects were subtracted from the respective palm yields and the entire yield data was converted to a uniformity trial data. Coefficients of variation were worked out by forming plots of different sizes and shapes by taking individual palm yield as the ultimate unit of analysis, for individual years as well as for the pooled yield of 1981-'82 and 1982-'83. This was done for blocks of 4, 6, 8 and 12 plots and without blocking.

The maximum curvature method of determining optimum plot size by drawing graph lacks objectivity and accuracy (Federer, 1955). The curvature 'C' on any point

on a curve is defined as $C = \frac{Y_2}{(1+Y_1^2)^{3/2}}$

where Y_1 and Y_2 are the first and second derivatives of the functional form of the curve $y=ax^{-g}$, where Y is the average coefficient of variation for a plot size of 'x' units and 'g' soil heterogeneity coefficient. The point at which the average curvature attains the maximum value is obtained by differentiating the expression and setting $\frac{dc}{dx} = 0$. The resulting equation is $x^{2(g+1)} =$

$$\frac{(ag)^2 (2g+1)}{(g+2)}$$

RESULTS AND DISCUSSION

Coefficients of variation decreased with the increase in plot size (Table I). From the table, it is clear that the pattern of decrease in CV with increase in plot size is the same for individual years, as well as for pooled yield. Fairfield Smith's equation, $y = ax^{-g}$

Table I. Coefficients of variation for yield of ffb in different plot sizes

Plot size (x)	1981 CV(y)	1982 CV(y)	1983 CV(y)	Av.81-82 CV (y)	Av. 82-83 CV (y)
1	52.81	50.19	57.01	40.99	45.07
2	37.20	35.04	40.45	29.67	32.18
3	32.12	29.77	33.59	25.01	26.52
4	26.77	24.49	29.70	21.04	23.19
6	20.91	20.91	23.43	17.87	18.98
8	20.72	17.85	22.76	16.35	17.90
12	17.71	16.78	19.85	13.09	15.00
14	15.77	15.90	14.83	13.48	14.04
y =	51.30x ^{-0.44}	47.79x ^{-0.44}	56.48x ^{-0.46}	40.09x ^{-0.44}	43.63x ^{-0.43}
r ²	0.99	0.98	0.98	0.99	0.99

Table II. *Coefficients of variation for different shapes of the plot*

Rows x Columns	1981 CV(y)	1982 CV(y)	1983 CV(y)	Av.81-82 CV (y)	Av. 82-83 CV (y)
4 x 2	19.21	13.00	22.45	12.85	16.08
2 x 4	17.82	19.03	23.35	15.21	17.91
1 x 8	27.59	25.51	27.46	23.03	24.08

Table III. *Coefficients of variation under different block sizes*

Plot size (x)	4 plot block	6 plot block	8 plot block	12 plot block	No. of replications required for 10% S.E. of treatment mean
1	49.05	49.07	48.70	48.93	24
2	34.21	33.70	34.19	34.59	12
3	27.50	27.69	27.83	28.26	8
4	25.57	25.07	25.99	25.56	7
6	20.17	20.65	20.68	21.15	5
8	19.77	19.66	19.07	19.50	4
12	16.28	16.45	16.29	16.54	3

gave a good fit for the data giving r^2 values ranging from 0.98 to 0.99 and soil heterogeneity coefficients from 0.44 to 0.46. The optimum plot size obtained by maximising the equation of curvature was found to be 8 palms/plot. The coefficient of variation was less for a plot shape of 4 rows and 2 columns (Table II). The rows being across the slope.

The coefficients of variation under different block sizes and the number of replications required for 10% standard error of treatment mean are given in Table III. The relative efficiencies of different block sizes compared to a block sizes of 20 are given in Table IV. Smaller blocks were found to be more efficient.

Table IV. *Relative efficiency of different block sizes*

Block sizes	Efficiency
4	1.27
6	1.18
8	1.13
12	1.06
20	1.00

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