

OPTIMUM PLOT SIZE FOR W.C.T. COCONUT PALMS FROM FERTILIZER TRIAL YIELD DATA

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ABSTRACT

The yield data of an NPK fertilizer experiment conducted at CPCRI, Kasaragod were made use of for studying the coefficients of variations of plots of different sizes and shapes, after converting to a uniformity trial data by eliminating treatment effects on the yield of individual palms. Not much variations in C.V. were observed for plots of different shapes of the same size. The C.V. decreased with the increases in plot size. Smith's Law (1938) was found to give a satisfactory fit to the underlying relationship between CV and plot size. The per unit decreases in CV were found minimum, when the plot size exceeded 8 palms/plot. With fixed experimental resources, smaller plots were found more efficient. The efficiency decreased with increase in block size.

INTRODUCTION

In recent years a number of investigations on uniformity trials have been published, particularly on cereals and other short duration crops. In perennial tree crops only few uniformity trials seem to have been conducted. Compared to annual short duration crops such investigations on perennial tree crops require relatively longer period. Since experiments on perennial crops are conducted for a long time, care should be taken in their planning and lay out. As the material is costly, economy in the lay out reduces the total cost of experiment. Hence the size and shape of plots for experiments on perennial crops are important.

Normally size and shape of plots for a particular crop is investigated to obtain a

proper experimental unit for agricultural experiment. For studying the optimum plot size for a particular crop, coefficients of variations from plots of various sizes and shapes are calculated on the yield data from uniformity trial. The optimum size and shape of plot is the one which gives least CV for a given cost and also relatively less variation due to soil fertility. After conducting uniformity trial on coconut, optimum plot size of 18-20 trees per plot was reported from Sri Lanka (Joachim, 1937). In India no such uniformity trial has been conducted so far to work out the optimum plot size for coconut. Unlike annual crops, it is difficult to conduct a uniformity trial on perennial tree crops, mainly due to the large area required, long pre-bearing period and the time taken for the stabilisation of yield. Encouraging results obtained from a study of optimum plot

size for D × T coconut palms from the yield data of an NPK fertilizer experiment (Nambiar, 1986) has prompted for a similar study on WCT palms.

MATERIALS AND METHODS

The yield data of the NPK fertilizer experiment on WCT coconut conducted at CPCRI, Kasaragod were made use of for this study. The experiment was started during 1965 with 27 treatment combinations of N, P and K laid out in a factorial confounded design with 3 blocks in a single replication. The palm wise yield data for 1981-82 and 1982-83 for 197 palms were used for this study. The method is to convert the yield data of the fertilizer experiment to a uniformity trial data by eliminating treatment effects, from the yield of individual palms as suggested by Ray, (1973). This technique will hold good only when the number of palms/plot is constant and the yield figures are available palmwise. In this way the entire yield data was converted to a uniformity trial data and the CVs were worked out by forming plots of different sizes and shapes, taking individual palm as the ultimate unit for ana-

lysis. The analysis was carried out for individual years as well as for the pooled data.

RESULTS AND DISCUSSION

For the pooled data of two years the average CVs of different shapes of the same size were plotted against the plot size 'x' (Fig. 1). The CVs decreased with the increase in plot size for the individual years as well as for the pooled data. Fairfield Smith equation $y = a x^{-g}$ (Smith, F. 1938) gave a good fit for the data, where 'y' is the average CV, 'x' is the plot size of x units and 'g' is the soil heterogeneity coefficient. The fitted equation for the pooled data was $y = 35.72 x^{-0.61}$ with an R^2 value of 0.98. The per unit decreases in CV were minimum when the plot size exceeded 8 palms/plot. The value of 'g' explains the pattern of variability in the field and its value lies between 0 and 1. Lower values of 'g' indicates soil heterogeneity and higher values indicates soil homogeneity.

Block size and minimum number of replications

When there are large number of treatments under factorial type of experiments, use of smaller blocks will become necessary adopting confounding system or incomplete blocks. The efficiency of blocks of 'm' plots relative to block of 'n' plots is defined by the ratio $RE (m/n) = \frac{n(m-1)(1-n^{-g})}{m(n-1)(1-m^{-g})}$. Smaller blocks are found to be more efficient than bigger blocks, which indicates that the adoption of confounded or incomplete block design will increase the efficiency. In the planning of field experiments one of the main points

Fig. 1 COEFFICIENT OF VARIATION IN RELATION TO SIZE OF PLOT

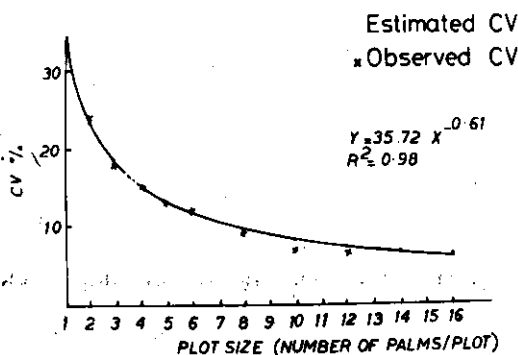


Table I. Plot size and CV under different block sizes and the minimum number of replication (*r*) required for 5% standard error of treatment mean.

Plot size (<i>x</i>)	4 plot block		6 plot block		8 plot block	
	CV %	<i>r</i>	CV %	<i>r</i>	CV %	<i>r</i>
1	29.95	36	26.55	28	31.06	38
2	20.53	17	17.36	12	16.06	10
3	16.47	11	13.54	7	10.92	5
4	14.08	8	11.35	5	8.31	3
5	12.47	6	9.90	4	6.72	2
6	11.29	5	8.85	3	5.65	-
8	9.65	4	7.42	-	4.30	-
10	8.55	3	6.47	-	3.47	-
12	7.74	-	5.79	-	2.92	-

Blank space indicates that replication has not been worked out due to less d.f.

to be considered is the number of replications to be provided, which depends upon the total variability and the amount of precision desired. The CVs under different block size and the minimum number of replications required for 5% SE of mean are given in Table I and the efficiencies of different block size are given in Table II. The number of replications required for a given level of accuracy for a fixed block size decreased with the increase in plot size.

Optimum plot size under cost consideration

To relate the cost of experimentation with the plot size Fairfield Smith (1938) recommended a general cost function given by $Cx = C_0 + C_1 x$, when C_0 is that portion of the cost which is independent of the size of plot and C_1 is the contribu-

tion of the cost by a unit increase in the plot size. The optimum value of x is that which minimises the cost per unit information viz., $(C_0 + C_1 x) / \sqrt{x}$ where $\sqrt{x} = VI/x^2$.

Assuming Smith's Law, for a fixed variance, the optimum plot size x_{opt} is given by $\frac{g}{1-g} \frac{C_0}{C_1}$ (Sardana, *et al*, 1967).

Optimum plot size obtained on cost consideration from the above formula (2) is given in Table III for value of 'g' ranging from 0.1 to 0.8 and $\frac{C_0}{C_1}$ from 4 to

8. For 'g' ranging from 0.5 to 0.6 and $\frac{C_0}{C_1}$ from 4 to 8, the optimum plot size ranges from 4 to 12 palms/plot.

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Table II. Efficiency of different block sizes.

Block size (Plots/Block)	4	6	8	20
Relative efficiency	1.16	1.11	1.07	1

Table III. *Optimum plot size under cost consideration.*

S	Co/Ci				
	4	5	6	7	8
0.1	0.44	0.56	0.67	0.78	0.89
0.2	1.00	1.25	1.50	1.75	2.00
0.3	1.71	2.14	2.57	3.00	3.43
0.4	2.67	3.33	4.00	4.67	5.33
0.5	4.00	5.00	6.00	7.00	8.00
0.6	6.00	7.50	9.00	10.50	12.00
0.7	9.33	11.67	14.00	16.33	18.67
0.8	16.00	20.00	24.00	25.00	32.00

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