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Determination of Optimum Plot Size in Sesamum Using Experimental Data

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The technique of converting the experimental data into uniformity trial data was made use of in determining the optimum plot size in sesamum from the experimental results of sesamum conducted during Monsoon 1976 and Summer 1977 seasons at the Tamil Nadu Agricultural University Farm, Coimbatore. The optimum plot size was found to be 8 basic units viz., 19.2 x 3.6 m^2 for both the seasons in sesamum.

In agricultural experiments size of experimental plots play an important role on the results of the experiment. Optimum plot size is usually determined from uniformity trial data. Due to time factor involved in such investigations, important agricultural experiments are conducted in many situations using different plot sizes in the absence of such information. It is also costlier to conduct separate uniformity trial for each and every experimental field to find out the optimum plot size for adoption in the experiments. To obviate this difficulty a technique was suggested by Ray *et al* (1973) to estimate the optimum size and shape of plots by using the yield data collected from the usual fertiliser trials. This technique was attempted to estimate the optimum size of experimental plots for sesamum crop from the experimental data obtained from a research project of the authors, 'Yield loss estimation due to pests and diseses in sesamum' at the Tamil Nadu Agricultural University, Coimbatore.

MATERIAL AND METHODS:-

The data from experiments of the research project, 'Yield loss estimation due to pests and diseases in sesamum, during the Monsoon 1976 and Summer 1977 crops were made use of in the present investigation. The experiments were conducted at two different fields of Tamil Nadu Agricultural University Farm, Coimbatore. The details of the experiment are presented in Table. 1.

The technique of converting the experimental data into uniformity trial data is as follows :

For any Randomized Complete Block Design, the statistical model is

$$Y_{ij} = \mu \times t_i + \beta_j + \varepsilon_{ij} \;\cdots\cdots\cdots (1)$$

where Y_{ij} is the observed yield due to the application of ith treatment in jth block. μ is the true mean effect. λ_i^t is the true treatment effect due to the ith treatment and βj is the true block effect due to jth block.

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ε_{ij} is error associated with the experimental unit in the jth block subjected to the ith treatment. It was assumed that ε_{ij} s are normally and independently distributed with zero mean and common variance. As we do not consider the block effects in Uniformity trials, the same is ignored in model (1) leading to a modified model

$$Y_{ij} = \mu + t_i + \varepsilon_{ij} \quad \ldots\ldots\ldots\ldots (2)$$

where ε^*_{ij} is the new error component.

The least square estimators of μ and t_i are $\bar{Y}$ and $(\bar{Y}_{i.} - \bar{Y}_{..})$ respectively. $\bar{Y}_{..}$ is the grand mean and $\bar{Y}_{i.}$ is the mean of ith treatment. The estimated value of t_i [i.e., $(\bar{Y}_{i.} - \bar{Y}_{..})$] is subtracted from the yield, Y_{ij}, the observed value for the ith treatment in jth block. The resulting residuals formed a kind of data which was analysed in the same way as done with a uniformity trial data. The analysis was conducted on the basis of the total 40 basic units from each season (one basic unit = 3.6 x 2.4m^2). Plot sizes of all posible combinations of basic units were considered (Table. 2). The coefficients of variation among the plots of various sizes were obtained and used to determine the optimum plot size.

RESULTS AND DISCUSSION :

The different plot sizes formed by the various combinations of basic units, the coefficients of variation among the different plot sizes for the Monsoon 1976 and Summer 1977 data are presented in table. 2. It will be seen from the results that the coefficient of variation decreased as the plot size increased. The method of maximum curvature suggested by Federer (1955) to obtain the optimum plot size involves human bias since the point of maximum curvature is obtained from a freehand curve. Therefore the algebraic relationship between the coefficient of variation and plot size reported by Smith (1958) seemed to be quite suitable for the present situation. The curve fitted was of the type

$$y = ax^{-b} \quad \ldots\ldots\ldots\ldots (3)$$

where y is the co-efficient of variation for plot size of x basic units. 'a' and 'b' are unknown constants. The least square estimates 'a' and 'b' obtained for the data are presented in Table. 3.

The significance of coefficents 'b' was tested and it was found significant at 5 per cent level of significance for both the seasons. Optimum plot size was obtained as the abscissa of the point after the maximum curvature. Federer (1955). Smith (1958), and Gupta and Raghavarao (1971)]. The curve is given by

$$C = \frac{(1+y_1^2)^{3/2}}{y_2}$$

where C is the curvature. y_1 and y_2 are the first and second derivatives of y obtained from (3). In the present study

$$C = \frac{(1 + 100.032\, x^{-2.9772})^{3/2}}{14.8884x^{-2.4886}} \text{ and}$$

$$C = \frac{(1 + 1334.2875\ x^{-3.8110})^{3/2}}{69.6039\ x^{-2.9055}}$$

for Monsoon 1976 and Summer 1977 respectively. The maximum curvature point was attained approximately as x = 5 and x = 6 for monsoon 1976 and Summer 1977 respectively. Hence the optimum plot size was chosen as 8 basic units (19.2 x 3.6 m^2) in both the seasons.

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Table. 1. Experimental details on sesamum crop

Season	Design	Number of blocks	Varieties	Treatments	Plot size (in square meteres
Monsoon 1976	RBD	10	TMV_3, 1740	Control, + Treated	3.6x2.4 m^2
Summer 1977	RBD	10	TMV_3, 1855/1	Control, + Treated	3.6x2.4 m^2

RBD = Randomized Complete Block Design

\+ A recommended plant protection schedule for the sesamum crop was given for the 'treated' plots

Table 2. Plot size in basic units and Coefficient of Variation from the reconstructed Uniformity trial date.

Plot size in basic units	Length × Breadth (3.6 m × 2.4 m)	Coefficient of variation (in per cent) Monsoon 1976	Summer 1977
1	1 × 1	20.16	25.19
2	1 × 2	15.69	19.60
4	1 × 4	10.82	16.00
8	1 × 8	7.81	15.40
5	5 × 1	8.34	11.90
10	5 × 2	5.95	4.00
20	5 × 4	5.10	1.30

Table 3. Least square estimates of 'a' and 'b' for Monsoon 1976 and Summer 1977 data.

Season	Estimate 'a'	Estimate 'b'
Monsoon 1976	20.47	0.4886
Summer 1977	40.34	0.9055