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Estimate of Optimum Plot Size From Uniformity Data of Bidi Tobacco

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ABSTRACT

The optimum plot size for field experimentation on bidi tobacco was worked out using uniformity trial data. Two methods, viz., (i) the maximum curvature and (ii) Fairfield Smith's variance law were used for the purpose. The optimum plot size of 8 unit (1.8 m x 3.0 m) worked out by using maximum curvature method has more reliability. The Smith's law served as a guide line only.

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INTRODUCTION

Efficient planning of agricultural field experiments depends on the adoption of optimum size and shape of plots which in turn depends on the nature of experiments, variability present in the experimental material and the cost of various operations as well as the materials involved in conducting the experiment. Soil variation patterns have been measured by uniformity trials, the results of which are used in determining optimum size and shape of plot (Day, 1920; Smith, 1938; Koch and Rigney, 1951; Hatheway and Williams, 1958 and Patel and Patel, 1967). Few experiments have been conducted on Virginia flue cured, burley, hookah and chewing tobaccos (Koch & Rigney, 1951; Crews *et al.*, 1963; Pavate and Patel, 1963; Gupton, 1972 and Ramchander *et al.*, 1976) to determine optimum size as well as shape of plots. Such information however, is not available with regard to bidi tobacco, an indigenous type grown in India only. The information presented in this article was generated from uniformity trial conducted at the Bidi Tobacco Research Station, Gujarat Agricultural University, Anand Campus, Anand during the year 1980-81.

Experimental:

The most popular bidi tobacco variety Anand 119 was transplanted at a spacing of 90 cm x 75 cm in plot No. 1 of the farm, covering an area of about 0.5 hectare. The crop was topped at eighteen leaves after removing bottom 2-3 sand leaves. The other crop cultivation practices in vogue were followed.

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Four blocks each of 18 m x 15 m were marked for collecting observations on leaf length, leaf width and yield. Each block consisted of 20 rows with 20 plants per row. Since bidi tobacco is a spaced planted crop, the individual plant was taken as basic unit (Federer, 1955 and Frey, 1967) for collecting required information. There were such 400 basic units per block and in all 1600 units under study. The dimensions of the smallest unit were 90 cm length and 75 cm width (0.6750 sq.m.).

The different sized plots of size 1, 2, 4, 5, 8, 10, 16, 20, 25 and 40 units were formed by combining the adjacent units both length-wise as well as width-wise.

Statistical :

The maximum curvature method was used to determine optimum plot size. Since this method involved plotting a curve of the C.V. % per unit area against plot size, the C.V. % per unit area was estimated for various size plots using the following relation.

$$\text{C.V. \%} = \frac{\text{Standard deviation per unit}}{\text{General mean}} \times 100$$

These C.V. % are termed as C.V. % (unadjusted).

Soil heterogeneity index, b', was also estimated (Smith, 1938) for determining optimum plot size. The estimated b' indicates the degree of correlation among the adjacent units. It was, therefore, thought worthwhile to work out C.V. % after adjusting variance per unit area for degree of correlation (b') among adjacent units to help work out optimum plot size based on uncorrelated estimates. These C.V. % are termed as C.V. % (adjusted).

RESULTS AND DISCUSSION

The comparisons were made among different sizes and shapes of plots using C.V. % (unadjusted) and C.V. % (adjusted). Since maximum variation was observed in yield of bidi tobacco, the results only of yield attribute are reported in this article.

The C.V.% (unadjusted) varied from 19.94% for one unit to 4.44% for forty units plot (Table 1) while C.V.% (adjusted) varied from 19.94% to 6.29% for the same range of plot size. The C.V.% per unit area decreased with increase in the size of plot. These results are in agreement with the results reported by Gupton (1972) in burley tobacco and Ramchander *et al.* (1976) in Virginia flue cured and hookah tobaccos.

The differences between C.V.% of the consecutive points (plot size) may help to estimate per unit decrease in C.V.% and thereby the point of maximum curvature. The per unit decrease in C.V.% (unadjusted) decreased with the increase in plot size upto 25 units plot (Table 1). Beyond 5 unit plot size, the per unit decrease in C.V. % (unadjusted) was not proportional to the amount of land used in forming large sized plots. Therefore 5 unit plot size could be taken as point of maximum curvature. The optimum plot size is one just beyond the point of maximum curvature. Therefore, 8 unit plot size was considered as an optimum plot size for bidi tobacco. Beyond 8 unit plot size the decrease in C.V. % (unadjusted) was not proportional to the amount of land used.

The correlation among adjacent units (b'= 0.8251) when used in adjustment, increased the variance per unit (V_x). The relation derived by Smith (1938) to estimate V_x is $V_x = V_x/b'$ (with usual notations) where b' has the value between 0 to 1. The C.V.% (adjusted) were high (Table 1) as compared to C.V.% (unadjusted). The optimum plot

TABLE 1

Average C.V. % per unit size for yield of bidi tobacco.

Size of plot	*C.V. % (unadjusted)*	*Difference in C.V. % (unadjusted)*	*Per unit decrease in C..V % (unadjusted)*	*C.V. % (adjusted)*
1	19.94	—	—	19.94
2	14.07	5.87	5.87	15.01
4	10.60	3.47	1.74	11.55
5	9.50	1.10	1.10	10.86
8	8.14	1.36	0.45	10.25
10	7.40	0.74	0.37	8.92
16	6.11	1.29	0.22	7.72
20	5.59	0.52	0.14	7.08
25	0.05	5.65	0.01	6.80
40	4.44	1.10	0.07	6.29

size worked out on the basis of Smith's formula, depends on K_2 (the cost proportional to total area per trea tme nt), which varies with the nature of experiment. It is rather difficult to arrive at exact value of K_2 for each and every experiments. Therefore, K_2 imposes limitations in defining the exact value of the optimum plot size. However, for varying proportions of K_2, the limits for optimum plot size could be established The Smith's law, thus, provides only guide line in determining the optimum plot size. Pearce (1976) also showed that the Smith's law lacks theoretical basis.

Among all combinations of 8 unit plot, a plot of 2 rows each of 4 plants, had minimum C.V.% (unadjusted). Taking into consideration the requirement of agronomical operations, handling of experimental material and the average variability, 8 unit plot (2 rows each of 4 plants i.e. 1.8 mx 3.0 m) is optimum net plot size for bidi tobacco.

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