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Estimate of Optimum Plot Size From Uniformity Data of Mustard for North Gujarat

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ABSTRACT

Uniformity trial was conducted at the Regional Research Station, Gujarat Agricultural University, Sardar Krushinagar during *rabi* season of 1986-87 to find out optimum plot size and number of replications for field experiment on mustard crop Cv Varuna T. 59. The crop was raised at a spacing of 30 cm. x 10 cm. The grain yield data were obtained for 1600 basic units, the dimension of each baisc unit was single row of 1 meter length. The coefficient of variation and soil heterogeneity index were used for determining optimum plot size, which was worked out to be of 16 units, i.e. 8 rows each of 2 meter length (2.4 m x 2.0 m). For normal field experiment 5 replications was adequate.

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INTRODUCTION

In agricultural research efficient planning of field experiments apart from other consideration like randomization, replication and local control, also depends upon suitable size and shape of plot. Each experimental site has an inherent variation i.e. soil variability which could be assessed through uniformity trial. The study and such variation helps in proper choice in size of shape of plots and blocks, experimental design, number of replications etc. Such studies based on uniformity trials under Indian conditions were undertaken with various annual crops like Safflower (Widemann and Leininger ; 1963), Paddy (Agrawal and Deshpande; 1967), Bajri (Patel and Patel; 1967), Tobacco (Prajapati and Patel; 1984), Mustard (Kumar *et al.*,; 1986), Sorghum (Ramnath and Narayana; 1987) and Mangbean (Singh and Singh; 1989).

However, there is no information on optimum plot size for mustard, for North Gujarat, being predominantly irrigated mustard growing area. Mustard, being an important annual cash crop where grain is economical product. The field experiment (uniformity trial), therefore, was conducted on mustard crop at the Regional Research Station (RRS), Gujarat Agricultural University, Sardar Krushinagar during rabi season of 1986-87.

MATERIALS AND METHODS

The most popular mustard variety "Varuna T. 59" was raised at a spacing of 30 cm. x 10 cm., covering an area of 0.5 hectare. All the recommended practice in vogue were followed. A block of 40 rows of 40 meter length was harvested and grain yield data were obtained seperately for 1600 basic units, the dimension of each basic unit was single row of

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one meter length. The dimensions of the smallest unit were 1 meter length and 30 cm. width (0.30 sq. m.). Contiguous plots were then combined in 36 different combinations and the different sized plots of size 1, 2, 4, 5, 8, 10, 16, 20, 25, 40, 50, 80 and 100 units were formed by combining neighbouring units both lengthwise and widthwise. The coefficient of variation (C.V. %) for each such arrangement was calculated independently and optium plot size was determined using maximum curvature method (Federer, 1955) and soil heterogeneity index 'b' (Smith; 1938). The minimum number of replications (r) and area required for 5 per cent standarad error of mean for different plot size was calculated by the following formula (Nigam and Gupta, 1979).

$$r = (C.V.\ \%)^2 / (5\%\ SE)^2$$

RESULTS AND DISCUSSION

The comparisons were made among different sizes and shapes of plots using C.V.%. The C.V.% decreased steadily either with increase in length of the row or an increase in the number of rows are presented in Table-1 and graphically depicted in Figure-1. The decrease in the C.V.% with an increase in the plot size is in agreement with the finding of Patel and Patel in Bajra (1967), Agrawal and Deshpande in paddy (1967), Prajapati and Patel in tobacco (1984) and Singh and Singh in mungbean (1989). The decrease however was more rapid when number of rows were increased, but beyond 8 rows the decrease in C.V.% was very low. Among varying length of 8 rows, a plot length of 2 meter is ideal, because thenafter reduction in C.V.% was marginal.

Among various combinations, the C.V.% decreased progressively with an increase in plot size up to 16 units (Table 2). The difference between C.V.% of the consecutive points (plot size) may help to estimate per unit decrease in C.V.% and thereby point of maximum curvature (Federer, 1955). The per unit decrease in C.V.% decrease with increase in plot size up to 20 units plot (Table 2). But beyond 16 units plot size the per unit decrease in C.V.% was not proportional to the amount of land used in forming large sized plot. Therefore, 16 units plot size could be considered as an optimum plot size for mustard.

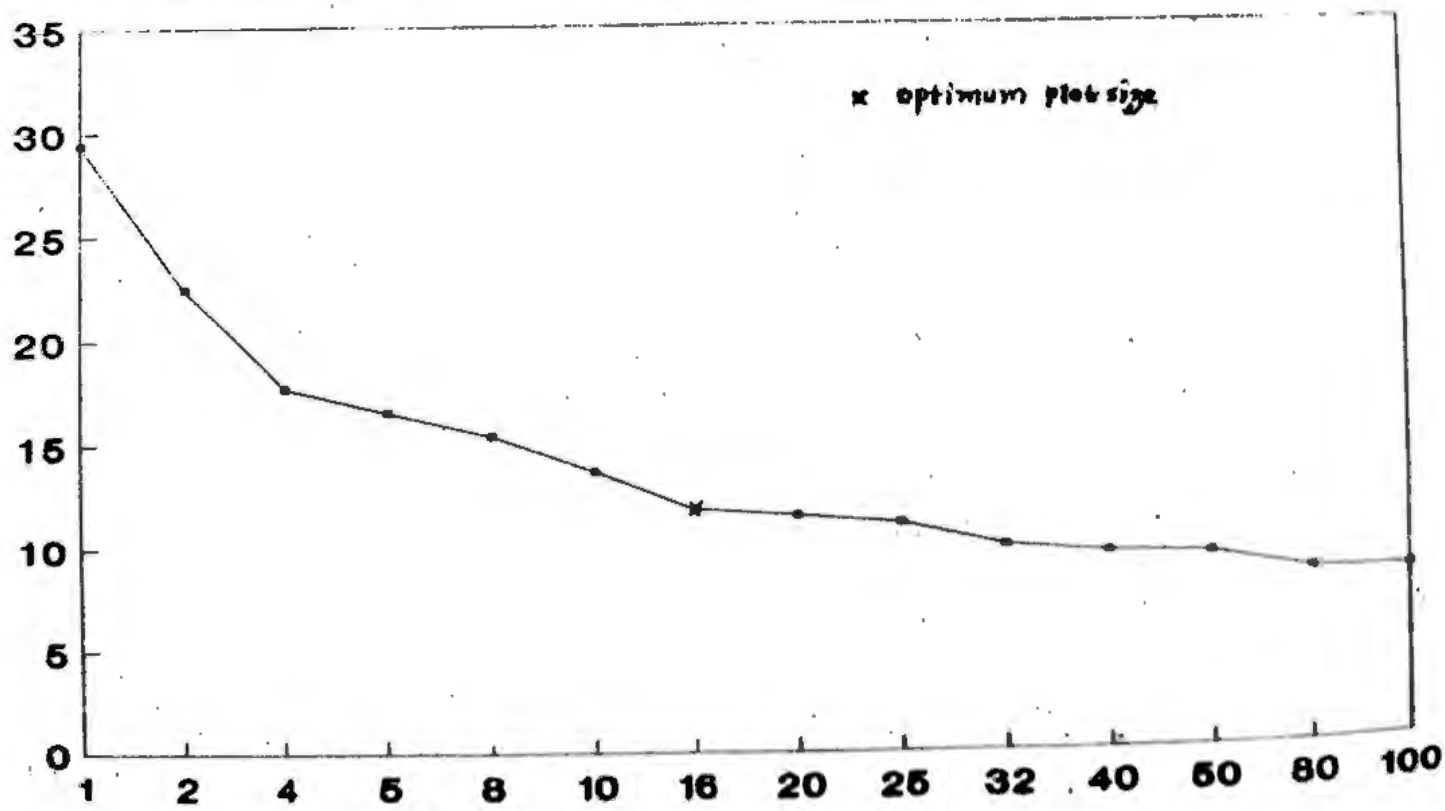

Fig. 1 : Coefficient of variability for different sized plots.

TABLE 1

Average coefficient of variation in per cent with plots of different sizes and shapes.

Breadth (m.)	*No. of rows*	*Length (cm.)*					
		1	*2*	*4*	*5*	*8*	*10*
0.30	1	29.39	23.05	19.00	17.52	16.96	15.03
0.60	2	21.78	17.23	15.35	13.75	12.18	11.67
1.20	4	16.75	14.65	11.59	11.31	10.07	9.96
1.50	5	15.30	12.90	10.96	10.92	9.75	9.49
2.40	8	12.97	11.12	9.51	9.51	8.67	8.43
3.00	10	12.28	10.53	8.91	9.11	8.41	8.29

TABLE 2

Per unit decrease in coefficient of variation for different plot size.

Unit	*Plot size (m^2)*	*Average C.V.%*	*Difference in C.V.%*	*Per unit decrease in C.V.%*
1	0.30	29.39	---	---
2	0.60	22.42	6.97	6.97
4	1.20	17.66	4.76	2.38
5	1.50	16.41	1.25	1.25
8	2.40	15.23	1.18	0.39
10	3.00	13.49	1.74	0.87
16	4.80	11.63	1.86	0.31
20	6.00	11.32	0.31	0.08
25	7.50	10 92	0.40	0.08
32	9.60	9.79	1.13	0.16
40	12.00	9.42	0.37	0.05
50	15.00	9.30	0.12	0.01
80	24.00	8.42	0.88	0.01
100	30.00	8.27	0.15	0.002

The well known Smith (1938) equation $Y-a. X^{-b}$ was fitted between plot variance and plot size for various length of plot and the equations are given in Table 3. The values of 'b' varied from -0.601 to -0.621 indicating existence of correlation between neighbouring plots. It also showed that the C.V.% decreased as the length of the plot and number of rows increased.

TABLE 3

Smith's equation for different lengths.

Length of plot (m.)	*Smith's equation*
1	$Y=2.658 * x^{-0.621}$
2	$Y=2.656 * x^{-0.613}$
4	$Y=2.653 * x^{-0.610}$
5	$Y=2.650 * x^{-0.608}$
8	$Y=2.647 * x^{-0.603}$
10	$Y=2.645 * x^{-0.601}$

From the estimates of C.V.% (Table 2), the minimum number of replications and area required for 5% standard error of mean for different plot size was calculated and are given in Table 4. The number of replications required for a given level of accuracy decreased with an increase in the plot size, which indicates greater efficiency of smaller plots. But small plots were not economical and convenient for various agronomical operations. Similarly, very large plots, which requires less number of replications, were unwieldy for field operations.

Among all combinations of 16 units plot, a plot of 8 rows each of 2 meter length had lowest C.V.%. Taking into considerations the requirement of agronomical operations and handling of experimental materials 8 rows each of 2 m. length (2.4 m. x 2.0 m.) is an optimum net plot size with 5 replications being adequate for conducting mustard trial.

TABLE 4

Number of replications and the area required for 5% SEm. ±.

Unit	*Plot size (m^2)*	*No. of Replications*	*Area required (m^2)*
1	0.30	35	10.50
2	0.60	20	12.00
4	1.20	12	14.00
5	1.50	11	16.50
8	2.40	9	21.60
10	3.00	7	21.00
16	4.80	5	24.00
20	6.00	5	30.00
25	7.50	5	37.50
32	9.60	4	38.40
40	12.00	4	48.00
50	15.00	3	45.00
80	24.00	3	72.00
100	30.00	3	90.00

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