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# Estimation of Optimum Plot Size and Shape for Field Experiments in Tomato *(Lycopersicon esculentum Mill.)*

By

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ABSTRACT

Uniformity trial with tomato crop was conducted at the Vegetable Section, Tamil Nadu Agricultural University, Coimbatore and the data indicated that the coefficient of variation (CV) decreased with increase in plot size and this reduction in CV with increased plot size was practically negligible beyond 9.00 $m^2$. For a given area, the smallest plot was found to give 100 per cent relative information. Relative information for different sizes and shapes of plots also exhibited similar trend to that of CV. Plots elongated along east-west direction gave more relative information suggesting that the plots should have more length along east-west direction than increasing rows along north-south direction.

## INTRODUCTION

Maximum accuracy for imposed treatements with a given experimental area is necessary to have information on coefficient of variation (CV) for different sizes and shapes of the plots. Hutchinson and Panse (1935), Kulkarni *et al.* (1936), and Abraham and Vachhani (1964) have provided data for cotton, jowar and rice respectively. Similar work on jute and tobacco have been reported by Ghose and Sanyal (1945) and Pavate and Patel (1963). Information on the field plot technique for vegetable crops like tomato is lacking in India and hence a study was undertaken to estimate the optimum size and shape of plots that could be recommended for conducting trials with tomato crop.

## MATERIALS AND METHODS

A uniformity trial was conducted with Co 1 tomato variety during 1967 *Kharif* season at Vegetable Section Tamil Nadu Agricultural University, Coimbatore. A representative sandy loam field with an area of 0.06 ha and measuring 36.00 m from north to south and 16.80 m from east to west was selected for the study. Nitrogen, phosphorus and potassium were applied at 100, 80 and 50 kg/ha respectively. The entire quantity of $P_2O_5$ and $K_2O$ were applied as basal dose. Half the quantity of N was applied basally and the other half top dressed 30 days after planting. The seedlings were planted 75 cm between rows and 60 cm between plants within rows. Cropping, cultural and manurial practices were

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kept uniform throughout the crop period in the entire area of the field. Leaving four border rows on all sides of the field to avoid border effect, the remaining area of 30x12 m was considered for the experiment. Thus there were 40x20 plants. Each plant was considered as a basic unit. The total weight of fruits for each basic unit was recorded separately. The number of pickings ranged from six to ten. Different plot sizes and shapes as shown in Table 1 were formed by combining the yields of adjacent units. Variability among different plot sizes and shapes were estimated. The effect of plot shape on the coefficient of variation was determined by making all possible comparisions between plots of the same size. Variance between 800 basic units was assumed to contribute 100 per cent relative information. The between plot variance was then divided by the number of basic units per plot to obtain comparable variance for estimation of optimum plot size as suggested by Keller (1949). Soil heterogeniety index following Smith's law (1938) was computed for fruit weight to know the nature of hetrogeniety present in the field.

## RESULTS AND DISCUSSION

It was observed that CV decreased as the size of the plot increased. The decrease in CV was rapid at the beginning and there was no appreciable decrease after 20 basic units or plot size having an area of 9.00 sq. m. and hence the optimum plot size was estimated at 20 times the basic units as suggested by Federer (1955) and also considering the practical conditions. Regarding shape of the plot, difference among CV of plots of the same size for different shapes were in general small. However plots elongated in east-west direction showed less variability than plots elongated in north-south direction in majority of the cases. Therefore it is suggested to have rectangular plots with length along east-west direction. Working in tomato crop in America, Currence (1947) studied yields at different length x width plot sizes namely 3x24', 6x24', 9x24', 12x24', 18x24', 27x24', 36x24', 54x24' and 108x24' and recorded CV per cent as 12.4, 9.5, 8.3, 9.3, 7.4, 6.4, 6.3, 6.4 and 4.6 respectively indicating efficiency of plot size when length was increased. Similar results were observed by him consistently for different lengths of the plots as mentioned above for constant widths of plots at 6 and 12'. He however did not work out the optimum plot size. From the data (Table 1) it could be concluded that the plot size consisting of four plants in north-south direction and four plants in each row along east-west direction with an area of 9.00 sq. m. as the optimum plot size for conducting field experiments in tomato.

The comparable variance increased as the size of the plot increased and corresponding relative information in general decreased. The decrease in relative information was more rapid at the beginning and after 20 basic units the decrease was less noticeable. Further, more relative information was obtained in plot shapes with more length in east-west direction.

The coefficients of soil heterogeneity and the correlation coefficient between plot size and CV were -0.992 and

TABLE 1. Coefficient of variation (CV) in per centage and relative information for different sizes and shapes of plots for fruit weight in tomato crop.

| Plot size | df | Shape in basic units | Variance | Coefficient of variation % | | Relative information | |
|---|---|---|---|---|---|---|---|
| | | | | Plot | Mean | Plot | Mean |
| 1 | 799 | 1 x 1 | 2.091 | 49.63 | 49.63 | 100.00 | 100.00 |
| 2 | 399 | 1 x 2 | 4.582 | 36.73 | 36.73 | 54.80 | 54.80 |
| | | 2 x 1 | 4.580 | 36.73 | | 54.80 | |
| 4 | 199 | 1 x 4 | 11.514 | 29.11 | 28.89 | 34.41 | 33.90 |
| | | 4 x 1 | 11.440 | 29.02 | | 34.19 | |
| | | 2 x 2 | 11.071 | 28.55 | | 33.09 | |
| 5 | 159 | 1 x 5 | 15.293 | 26.85 | 26.71 | 29.25 | 28.96 |
| | | 5 x 1 | 14.980 | 26.57 | | 28.66 | |
| 8 | 99 | 2 x 4 | 28.827 | 23.04 | 23.33 | 21.54 | 22.09 |
| | | 4 x 2 | 30.848 | 23.83 | | 23.05 | |
| | | 8 x 1 | 29.021 | 23.11 | | 21.07 | |
| 10 | 79 | 1 x 10 | 32.674 | 19.62 | 20.86 | 16.62 | 17.71 |
| | | 10 x 1 | 35.842 | 20.55 | | 17.14 | |
| | | 2 x 5 | 42.517 | 22.38 | | 20.33 | |
| | | 5 x 2 | 37.092 | 20.90 | | 17.74 | |
| 16 | 49 | 4 x 4 | 85.212 | 19.80 | 19.72 | 15.92 | 19.79 |
| | | 8 x 2 | 83.785 | 19.64 | | 15.65 | |
| 20 | 39 | 2 x 10 | 92.789 | 16.53 | 16.92 | 11.10 | 11.81 |
| | | 10 x 2 | 109.155 | 17.93 | | 13.05 | |
| | | 4 x 5 | 121.476 | 18.91 | | 14.52 | |
| | | 5 x 4 | 113.957 | 18.32 | | 13.65 | |
| | | 20 x 1 | 102.468 | 17.37 | | 12.25 | |
| | | 1 x 20 | 52.654 | 12.45 | | 6.29 | |
| 25 | 31 | 5 x 5 | 174.210 | 18.12 | 18.12 | 13.33 | 13.33 |
| 32 | 24 | 8 x 4 | 258.471 | 17.25 | 17.25 | 12.07 | 12.07 |
| 40 | 19 | 2 x 20 | 131.519 | 9.84 | 14.84 | 3.93 | 9.17 |
| | | 20 x 2 | 250.150 | 16.05 | | 10.46 | |
| | | 4 x 10 | 297.578 | 14.80 | | 8.90 | |
| | | 10 x 4 | 349.126 | 16.03 | | 10.44 | |
| | | 8 x 5 | 391.970 | 16.99 | | 11.72 | |
| | | 40 x 1 | 319.904 | 15.35 | | 9.56 | |
| 50 | 15 | 5 x 10 | 413.786 | 13.96 | 15.05 | 7.91 | 9.24 |
| | | 10 x 5 | 552.152 | 16.13 | | 10.56 | |
| 80 | 9 | 20 x 4 | 1149.830 | 14.54 | 12.90 | 8.59 | 7.05 |
| | | 4 x 20 | 377.616 | 8.33 | | 2.82 | |
| | | 8 x 10 | 1064.198 | 14.00 | | 7.96 | |
| | | 40 x 2 | 1179.862 | 14.73 | | 8.82 | |
| 100 | 7 | 5 x 10 | 599.693 | 8.40 | 11.89 | 2.87 | 6.01 |
| | | 20 x 5 | 1778.408 | 14.47 | | 8.50 | |
| | | 10 x 10 | 1390.375 | 12.80 | | 6.65 | |
| 160 | 4 | 8 x 20 | 1314.612 | 7.78 | 10.61 | 2.46 | 4.90 |
| | | 40 x 4 | 3929.278 | 13.44 | | 7.34 | |
| 200 | 3 | 10 x 10 | 1244.463 | 6.05 | 10.82 | 1.49 | 5.23 |
| | | 20 x 10 | 5368.355 | 12.57 | | 6.42 | |
| | | 40 x 5 | 6500.916 | 13.83 | | 7.77 | |
| 400 | 1 | 20 x 20 | 768.320 | 2.37 | 7.77 | 0.23 | 3.64 |
| | | 40 x 10 | 23579.233 | 13.17 | | 7.04 | |
| 800 | — | 40 x 20 | — | | | | |

-0.283. The highly significant correlation between plot size and CV indicated the depedency of CV on plot size and consequently the significance of the optimum plot size. Ths soil heterogeniety index was considered as a measure of correlation between adjacent units with b = 0 indicating perfect correlation and b = 1 indicating no correlation between adjacent plots. The low 'b' value obtained in this study indicated the use of smaller plots in

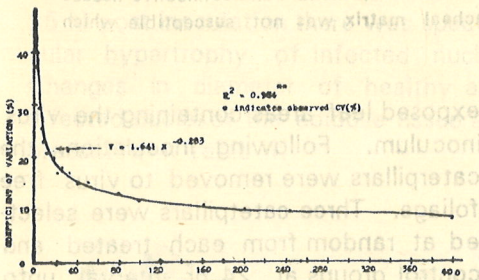


Fig. 1 RELATIONSHIP BETWEEN COEFFICIENT OF VARIATION (%) AND SIZE OF PLOT IN TOMATO CROP

field experiments. The equation obtained was $y = 1.641\ x - 0.283$ (Fig.1). The $R^2$ value between plot size and CV was computed as 0.984 which was significant at 1 per cent level.

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