GAU Res. J. 1998. 24 (1) : 67-72

Plot Technique in Potato (*Solanum tuberosum* L.)

H. M. Bhatt, P. R. Vasihnav and V. B. Darji

Department of Agricultural Statistics, B. A. College of Agriculture,
Gujarat Agricultural University, Anand Campus, Anand - 388 110

ABSTRACT

An uniformity trial on Lowker variety of potato was conducted at the College Agronomy Farm, B. A. College of Agriculture, Gujarat Agricultural University, Anand, to work out optimum size and shape of the plot and block using maximum curvature method and Fairfield Smith's variance method. The variability as judged by coefficient of variation per unit area (C.V.) decreased with the increase in plot size. The optimum plot (net) size obtained was 7.2 sq. m. covering 16 rows (45 cm. apart) each of one meter length for field experiments on potato but, for conveniency of agronomical operations, 8 rows each of two meter length (7.2 sq. m.) could be taken as net plot.

(Received on 2nd May, 1997)

INTRODUCTION

For efficient planning of field experiment, choice of suitable size and shape of plot is one of the important factors. The optimum plot size depends on the nature of experimental material, soil variability, kind of crop, number of treatments per block and the cost of various operations. The knowledge of soil variability which could be evaluated through uniformity trial, helps in determining the optimum size and shape of plot.

The potato (*Solanum tuberosum* L.) is the most popular vegetable crop grown throughout the world. In Gujarat. Kheda district ranks the first in terms of area and production. In India Sardana *et al.* (1967), Bist *et al.* (1975) and Sharma (1991) conducted uniformity trials on potato. However, such information is not available for potato crop grown on sandy loam soils of Middle Gujarat. Therefore, the uniformity trial on potato (variety Lowker) was conducted at the College Agronomy Farm, B. A. College of Agriculture, Gujarat Agricultural University, Anand during winter season of the year 1992 with a view to determine optimum size and shape of the plot and block for field experimentation on potato.

MATERIALS AND METHODS

An uniformity trial was conducted on potato, with inter and intra-row spacings of 45 and 15 cm. respectively. The net experimental area had a dimention of 43.2 m x 24 m (i.e. 96 rows each having 24 m length). The other crop cultivation practices in vogue on the

farm were followed. The potato tuber yield data recorded for 1152 basic units each having a dimention of 0.9 m x 1.0 m (i.e. 2 rows each of 1 m length). Two methods viz., maximum curvature method (Federer,1955) and Fairfield Smith's method (Smith, 1938) were employed to determine optimum plot size for field experimentation on potato.

RESULTS AND DISCUSSION

The results presented in Table 1 revealed that maximum coefficient of variation (33.86 %) was observed in the smallest sized plot i.e. one unit (0.90 sq. m.) and it decreased with the increase in plot size upto 64 units size (12.84%). Sardana *et al.* (1967), Bist *et al.* (1975), Jaggard (1975) and Sethi *et al.* (1989) also reported similar trend. The decrease in C.V. was not proportional to the increase in plot size beyond 6 units plot (Fig.1). Therefore, 6 units size could be taken as point of maximum curvature and 8 units size plot i.e. just adjacent to 6 units size, appeared to be optimum plot (net) size for field experiments on potato crop.

TABLE 1

Coefficient of variation per unit size in per cent for potato tuber yield.

*Plot and U**	*Size shape W*	*L*	*Coefficient of variation (%)*	*Average for plot size*	*Difference in C. V. #*	*Per unit decrease in C. V.*
1	1	1	33.86	33.86	—	—
2	2	1	27.93	27.77	6.09	6.09
2	1	2	27.61			
3	3	1	25.14	25.26	2.51	2.51
3	1	3	25.39			
4	4	1	23.36	23.64	1.62	1.62
4	2	2	23.49			
4	1	4	24.08			
6	6	1	21.72	21.93	1.71	0.86
6	3	2	21.89			
6	2	3	21.68			
6	1	6	22.45			
8	8	1	19.40	20.48	1.45	0.72
8	4	2	20.73			
8	2	4	20.85			
8	1	8	20.92			
12	12	1	19.08	19.60	0.88	0.22
12	6	2	19.69			
12	4	3	19.30			
12	3	4	19.74			
12	2	6	19.80			
12	1	12	20.01			
16	16	1	13.71	17.11	2.49	0.62
16	8	2	17.61			
16	4	4	18.80			
16	2	8	18.32			

1.	2.	3.	4.	5.	6.	7.
18	6	3	18.49	18.68	-1.57	-0.79
18	3	6	18.86			
24	24	1	16.41	17.39	1.29	0.22
24	12	2	17.55			
24	8	3	16.48			
24	6	4	18.06			
24	4	6	18.03			
24	3	8	17.52			
24	2	12	17.97			
24	1	24	17.11			
32	16	2	12.25	15.05	2.34	0.29
32	8	4	16.18			
32	4	8	16.72			
36	12	3	16.81	17.19	-2.14	-0.54
36	6	6	17.39			
36	3	12	17.34			
48	48	1	4.95	13.99	3.20	0.27
48	24	2	15.43			
48	16	3	11.23			
48	12	4	16.43			
48	8	6	15.64			
48	6	8	16.15			
48	4	12	16.82			
48	2	24	15.28			
64	16	4	11.07	12.84	1.15	0.07
64	8	8	14.60			
72	24	3	14.89	15.42	-2.58	-0.32
72	12	6	16.14			
72	6	12	16.27			
72	3	24	14.40			

* U = Basic units; W = Width and L = Length # of consicutive values given in Col. 5.

The trend in C.V. expressed in equation form using original data as well as log transformed data was as under :

C. V. = 23.72 — 0.25 x + 0.0012 x^2 . . . . . (R^2 = 0.83)

C. V. = 29.05 — 3.74 ln x . . . . . (R^2 = 0.96)

ln C. V. = 3.095 — 0.0067 x . . . . . (R^2 = 0.82)

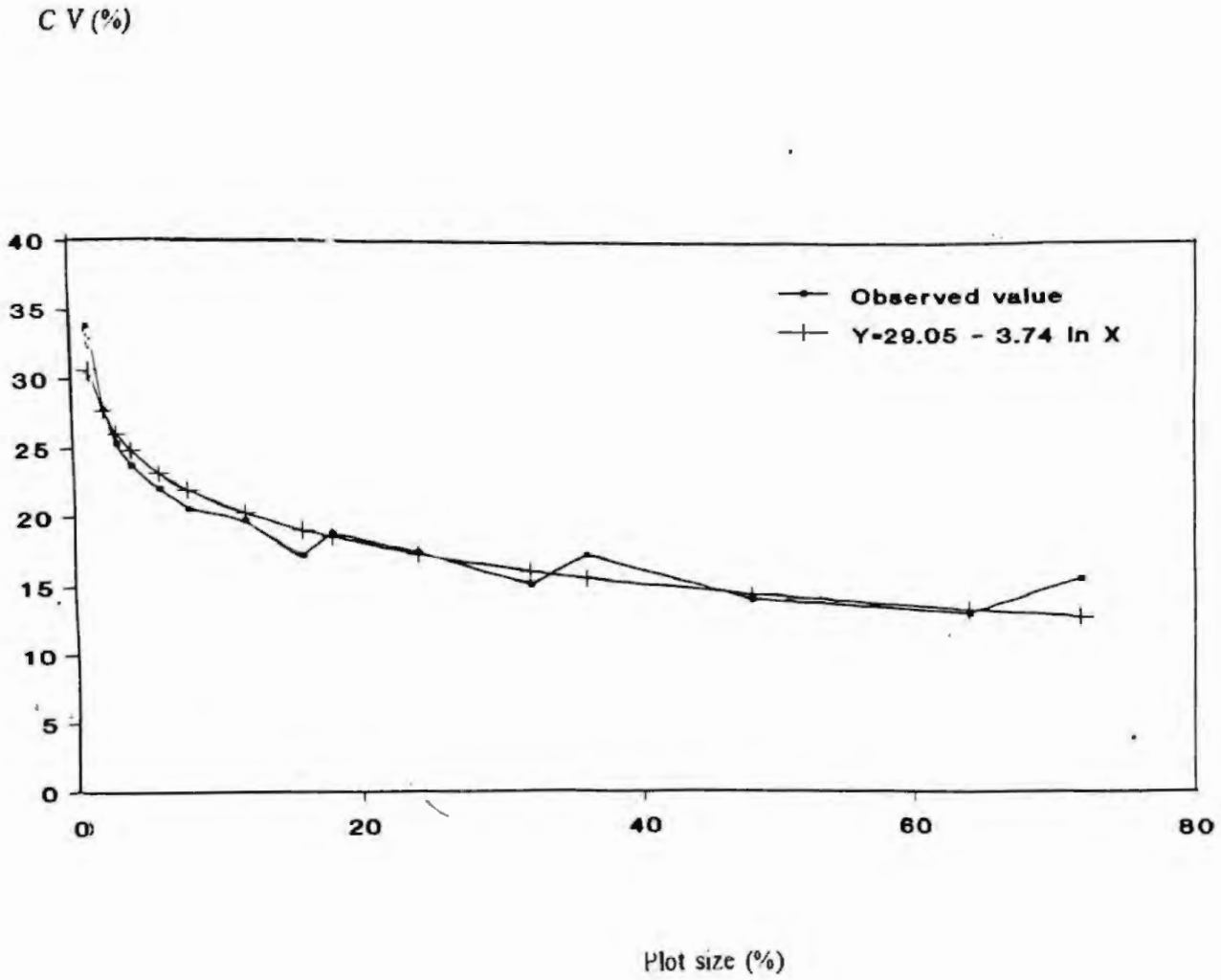

Fig. 1 : Coefficient of variation for different sized plots.

The regression of coefficient of variation on the plot size (x) indicated that the efficiency of prediction of C. V. was high when the variable x was transformed to log scale (R^2 = 0.96). The quadratic prediction equation based on original data accounted for 83 per cent of variation.

The rate of reduction in C. V. was more with the increase in width of the plot (i.e. number of rows) than that with the increase in length of the plot (Table 1). In fact such plots are long and narrow plots. The results thus revealed that long and narrow plots covering more number of rows (rather than length of rows) should be preferred for field experiments on potato. The per unit decrease in C. V. for different plot sizes estimated from the differences between C. V. of the consecutive points indicated that the effective decrease in C. V. due to increase in plot size was upto 8 units sized plot. The graphical presentation of C. V. (Figure 1) also revealed similar trend. Therefore, 8 units size i.e. 7.20 sq. m. size was considered as an optimum plot size. Sardana *et al.* (1967) obtained a corresponding area of 8.40 sq. m. for potato in plains while Bist *et al.* (1975) obtained 5.58 sq. m. for potato in hills.

Among all combinations of 8 units plot, (8 x 1), a plot of 7.2 m x 1 m had minimum coefficient of variation per unit area (19.4%). Therefore, it was concluded that a plot of 7.20 m x 1 m (a plot of 16 rows each of one meter length) was optimum. These findings are in agreement with those reported by Sardana *et al.* (1967) and Bist *et al.* (1975). Keeping in view the above results as well as practical difficulties for carrying out the agricultural operations, the plot having dimentions 2 m x 3.6 m i.e. 8 rows each of two meter length could be used instead of the plot having dimention of 1 m x 7.20 m. This shape had little higher C.V. (20.73%) than that for 1 m x 7.20 m shape (19.4%).

In the varying cost ratio K_1/K_2 i.e. the ratio of cost proportional to the number of plots required per treatment to the cost proportional to the total area per treatment, and soil heterogeneity index, `b', were considered for estimating optimum plot size (Table 2).

TABLE 2

Optimum plot size in units under varying cost considerations.

	K_1		
b'	*30%*	*40%*	*50%*
0.30	1.00	0.64	0.43
0.40	1.56	1.00	0.67
0.41	1.60	1.03	0.68
0.50	2.33	1.50	1.00
0.60	3.50	2.25	1.50

The results (Table 2) revealed that the plot size increased with the increase in the cost ratio i.e. K_1/K_2. For b' = 0.41 the plot size varied from 0.68 to 1.60 units for the K_2 ranging from 50 to 30 per cent. Generally K_2 varies between 30 to 50 per cent. For a given cost K_2, plot size increased with the increase in soil heterogeneity. These results are akin to those reported by Sardana *et. al.* (1967), Bist *et al.* (1975) and Sharma (1991).

The optimum plot size obtained by the Smith's variance method is very small and inconvenient for laying out the field trials. Thus the plot of size 7.20 sq. m. as obtained from the Maximum Curvature method, covering 16 rows (45 cm. apart) each of one meter length should be considered as a optimum (net) plot size for field experimentation on potato. [For conveniency of agronomical operations, 8 rows each of two meter length (7.20 sq. m.) can be taken as net plot].

REFERENCES

Bist, B. S., V. P. Malhotra and P. R. Sreenath, 1975. Size and shape of plots and blocks in field\ experiments with potato crop in the hills. *Indian J. Agric. Sci.*, 45 (1) : 5-8.

Federer, W. T. 1955. Experimental design. The Mac Millan Co., New York. Second ed. pp. 40.

Jaggard, K. W. 1975. The size and shape of plots in sugarbeet experiments. *Annals of Applied Biology*, 80 : 351-357.

Sardana, M. G., P. R. Sreenath and V. P. Malhotra 1967. Size and shape of plots and blocks in fiel trials with potato. *Indian J. Agric. Sci.*, 37 : 33 355.

Sethi, A. S.; M. L. Kapur and R. S. Kanwar, 1989. Determination of optimum size and shape of experimental plots for sugarbeet. *Indian J. Agric. Sci.*, 59 (1) : 36-41.

Sharma, H. C. 1991. Some observations on estimation of plot size and shape, Bartlett's rate index and yield loss adjustments. *J. Indian Potato Assoc.*, 118 (1-2) : 9-18.

Smith, H. F. 1938. An empirical law describing heterogeneity in the yields of *Agricultural Crops J. Agric. Sci.*, 28 : 1-23.