Pak. J. Agri. Sci., Vol. 21 (3-4), 1984

SIZES AND SHAPES OF PLOTS FOR FIELD PLOT EXPERIMENTS ON WHEAT — UNIFORMITY TRIAL DATA

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ABSTRACT

Data taken from a uniformity trial on wheat were utilized to see the best possible plot size by making 1152 plots each of size 1.52 x 1.22 m. The plots of various sizes and shapes were constructed by pooling the yields of adjoining plots. The values of coefficient of variation (C. V.) decreased with the increase in plot size. The study also revealed that the plots of the same size with length along the breadth of the actual field gave lesser C. V. than other types. A plot size of 44.16 sq. m has been found to be more suitable as the declining trend of C. V. values becomes almost negligible for larger plots. Sample size and variance have been evaluated for different random sampling procedures. The method of stratified random sampling with optimum allocation is considered as the most appropriate one.

INTRODUCTION

It is of considerable importance for the research workers of crop science to have adequate knowledge on plot technique. It is also importance to use the most efficient shapes, sizes and arrangements of plots in a particular experiment for obtaining the reliable results. The precision of significance tests in field trials is largely controlled by the size and shape of an area available for the particular trial, the nature of fertility or other variations and the availability of funds.

Wheat is one of the major cereal crops cultivated over a considerable area of Pakistan and is under constant and intensive research in the country. This problem has therefore been selected so as to see a scientific basis for using plot shapes and sizes within 'optimum limits'. The data collected from a uniformity trial have been analysed for the following objectives :

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1. To see the best possible size for field research experiments on wheat.
2. To study the possible method of random sampling as far as soil analysis or other characteristics are concerned.

PROCEDURES

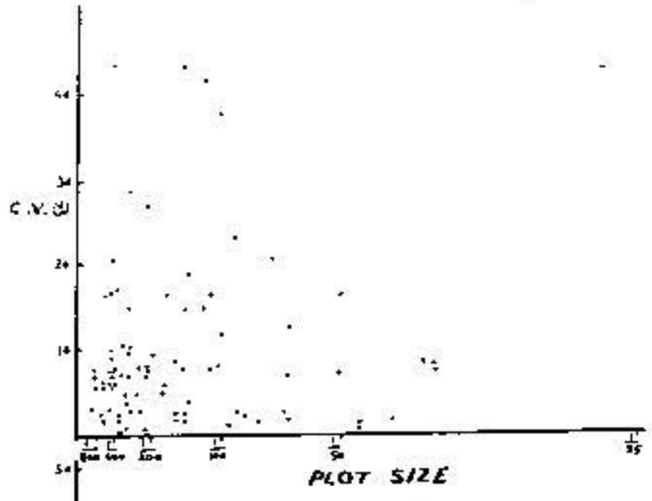
Data for the present study were taken from a uniformity trial on wheat. The experimental area was under regular wheat rotation. The manuring and other operations were uniform all over the area. The entire field was 73.15 x 29.26 m. It was harvested by making 1152 plots each of the size of 1.52 x 1.22 m. The plots of various sizes and shapes were constructed by pooling the yields of adjoining plots. For example a plot of size 15′ x 20′ was taken by pooling 3 basic plots along the length and 5 basic plots along the breadth of the field. In this way each of the plots of 1, 2, 3, 4, 6, 8, 12, 16, 24 and 48 units in length with 1, 2, 3, 6, 8, 12, and 24 units in breadth were combined to get various sizes and shapes. A plot is considered to be rectangular if length to width or width to length ratio is less than $\frac{1}{2}$, otherwise it is considered as squarish. The C. V. values were worked out for various sizes and shapes to see the suitability of any size and shape. A graph has been drawn by plotting number of units against coefficients of variation. Simple random sample, stratified random sample with different allocations and systematic random sample were selected and their variances computed by using methods given by Cochran (1977).

RESULTS AND DISCUSSION

Coefficient of variation values calculated for different sizes and shapes of plots indicated a decrease with the increase in plot size. This fact is quite clear from Graph 1, plotted between size of plot and C. V. Moreover, this graph shows that plots of the same size whose length is along the breadth of the actual field, give lesser values of coefficient of variation than those of square shaped or whose length is along the length of actual field. The rate of decline in the C. V. is quite high up to the plots of 44.16 sq. m size. This size seems to be allright because further increase in size only increases the cost without sufficient decrease in C. V. value. Table 1 shows the distribution of C. V.

FIG. 1 DISTRIBUTION OF COEFFICIENTS OF VARIATION IN RELATION TO PLOT SIZE.

a) GRAIN YIELD



b) STRAW YIELD

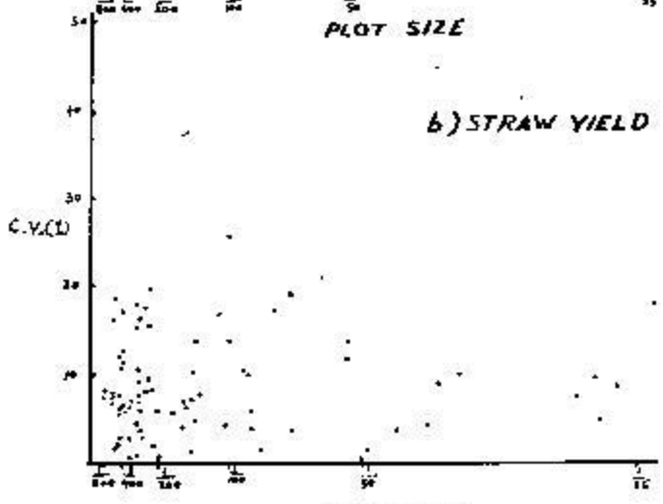
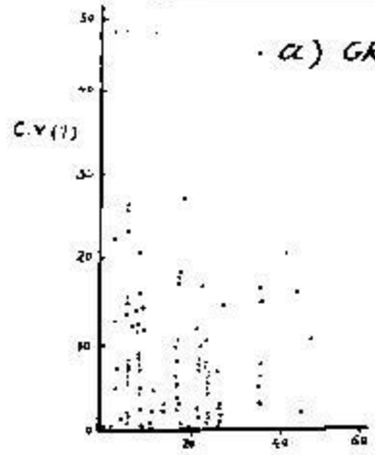
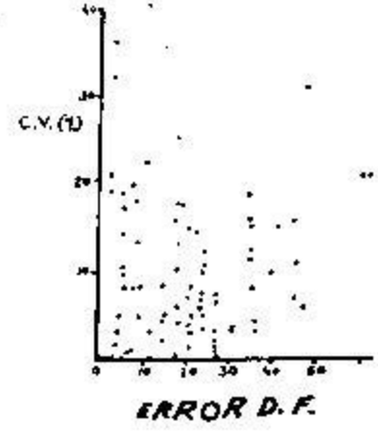


FIG. 2 DISTRIBUTION OF COEFFICIENTS OF VARIATION IN RELATION TO ERROR DEGREE OF FREEDOM

a) GRAIN YIELD



b) STRAW YIELD



according to different sizes (small, medium and large) and shapes (rectangular and square). This table also reveals that the rectangular plots of medium size (27.69 to 55.2 sq. m) are suitable keeping in view the limitations of very small and very large plots. Unduly large plots cause wastage of time, money and labour and too small plots cause difficulties in mechanical harvesting and some other treatments. The researcher has to compromise between these two types so that the maximum precision is reached at the lowest possible cost.

Table 1. *Distribution of C. V. as affected by plot sizes and shapes*

C. V.	Upto 27.5 sq. m (small size)		27.6 to 55.0 sq. m (medium size)		55.0 sq. m and above (large size)	
	Rectan-gular	Square	Rectan-gular	Square	Rectan-gular	Square
Low (below 10%)	—	—	2	—	6	8
Medium (10-16%)	11	6	6	4	6	1
High (above 16%)	3	3	—	—	—	—

These results are in line with those reported in the literature. Ashfaq and Zafar Yab (1973 & 1974) constructed the plots of different shapes, i. e., square, oblong in the direction of field length and oblong in direction of field breadth. The C. V. for second type showed maximum values followed by the values of square plots and minimum values for the third type. They observed a plot size of 1/198th of a hectare as more suitable as the declining trend of C V. values became almost negligible for larger plots.

Hutchinson (1935) reported that there was a gradual decrease in the percentage error per plot as the plot size increased either in length or breadth.

Ashfaq *et al.* (1983) studied distribution of C. V. from the experimental data by selecting 96 researcher's work. They found surprisingly high C. V. in most of the cases. This was attributed to poor planning of experiments;

blocking in most of the cases was unnecessary as the intrablock variation was noted to be similar to a block. Plot sizes of *1/500th* of a *hectare* or less were used by a few investigators who also showed lesser C. V. values.

In laying out field experiments, one of the problems is the shape of the plot. This study shows that long narrow plots with their length in the direction of field breadth are suitable. Graph 1 shows that this type of plots give smaller values of C. V. as compared to the plots of the same size but different shapes, i. e., square and long narrow whose length is in the direction of field length.

The graph on C. V. values for different sizes appears to follow an exponential trend of the form of $Y = ab^x$. This equation was fitted and its goodness of fit proved by Chi-square test. To study the characteristics of soil, it is essential to select the soil samples. In order to know the proper procedure of sampling, the yield data on various sites of the field was taken by using various methods of sampling.

Table 2 shows the sample size and variance of different random sampling methods for these data. The table indicates that the variance is minimum in case of a stratified random sample with optimum allocation; sample with proportional allocation has a little bit greater variance followed by stratified random sample with equal size, simple random sample and systematic sample. Systematic sampling should be avoided as it gives much more variance than all of the other methods.

Table 2. *Allocation by various random sampling procedures for n = 105*

Strata	Nh	Equal	Proportional	Optimum	Systematic	Random
I	507	26	46	67	—	—
II	327	26	30	17		
III	220	26	20	9	105	105
IV	98	26	9	12		
Variance		0.0587	0.0377	0.0309	1.0723	0.2360

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