Determination of optimum plot size, shape and no. of replications in wheat yield trial

Syed Asghar Ali Shah*, Sajad Ali*, Jan Ayaz*, Ihsan Ullah*

1Agricultural Research Institute Tarnab, Peshawar, Pakistan
2Higher Education Department Khyber-Pakhtunkhwa, Pakistan
3Elementary and Secondary Education Department, Khyber-Pakhtunkhwa, Pakistan

Key words: Size and shape, Standard error, Ratio of length to width, Mean squares, Coefficient of variation

http://dx.doi.org/10.12692/ijb/10.6.202-207  Article published on June 30, 2017

Abstract

The need of determining a standard size and shape for an experimental plot of major crops in different area of the Khyber-Pakhtunkhwa, under different climatic conditions like irrigated or rainfed. The experiment on size and shape of plot with wheat variety Pirsabak-2004 was conducted in Agriculture Research Institute Tarnab, Peshawar during the year 2014-15. The land under experiment trial was under wheat rotation in previous year, and all operation like cultural manuring etc. were uniformly applied. The co-efficient of variation for the most feasible ratio of length to width (i.e. 2.50) in the experimental plot was found to be 23.95%. The long and narrow plots are more efficient as compared to shorter and wider plots of the same size. Based upon theoretical numbering of replications in order to bring down C.V to 5%, the suitable number of replication in case of plot size (3.05 m × 1.22 m) was found between 2 to 6. The fertility trend moves gradually from West to East, as compared to the North to East. The South-Western side also gave the high rate of fertility, based on the study of plot size of (3.05 m × 1.22 m) which was found most suitable for experimental purpose.

*Corresponding Author: Syed Asghar Ali Shah  shah_asghar@yahoo.com
Introduction

The efficiency of field experiments largely depends on reduced standard error and standard plot size and shape having optimum limits. To study the size and shape of plot for any particular crop in research experimentation, it is most important to use the most suitable plot size, shape and number of replications for obtaining the favorable results and to ensure the highest possible precision. Furthermore, among the many factors that contribute to the magnitude of errors in agriculture field experimentations, the following are of considerable importance;

1. Shape and Size of the individual plot
2. Shape and Size of the block division (by eliminating soil heterogeneity)
3. The position and orientation of the plots and of the blocks in the experimental field.

In any field experiment, one of the basic questions is the size of the plot along with the number of replications. Generally the plot size and number of replications are based on the previous practice of the experimenter or results of a uniformity trial conducted in that particular area used.

The need of Information on plot variability derived from uniformity trials is of value in planning future experiments. To resolve the problem of research worker and to reduce the experimental error, it is utmost necessary to standardize the suitable plot size and shape particularly for major food crops grown under different climatic conditions. To improve the quality as well as credibility of research results, there is immense need to carry out research on similar lines. Different studies have also been in this regard at different period of times.

According to Gomez and Gomez (1984) who argued that uniformity experimental trial usually involves single crop variety, uniformly cultural and management practices and also all possible sources of variability are kept under constant conditions. The planted area is further subdivided to smaller units of the same size, which is generally referred as basic experimental unit from which measurements are made.

The smaller the basic unit, more informative is the measurement. Similarly, practices of uniform plot size and shape has been made by research scientist in which Leilah and Al-Khateeb (2007) carried out study to estimate optimum plot size in the desert rangeland of Saudi Arabia. He estimated the soil heterogeneity index to be 0.69, which shows lower correlation among the adjacent plots. Mohammad et al (2001) analyzed 29 different data sets to determine the suitable plot size and shape in wheat under different situations of plant height, grain yield and straw yield. Also, Nasr (1997) and Masood et al (2006) conducted an experiment to estimate the optimum plot size, shape and number of replications for wheat yield under different fertilizer doses and estimated suitable plot sizes.

The present study is undertaken with the objective to estimate the suitable plot size, shape and number of replication on wheat variety Pirsabak-2004 in Agricultural Research Institute Tarnab, Peshawar and to suggest suitable plot size, shape as well as No. of replications.

Materials and methods

The data were collected from Agricultural Research Institute, Tarnab, and Peshawar in the year 2014-15. By considering all management practices as uniform as possible all over the area and the field dimensions were recorded to be 240 feet long by 96 feet wide.

The whole area was sown uniformly with the single variety Pirsabak-2004 in 96 rows. The row to rows distance was kept as one feet. The field was harvested in 4 rows having dimensions 5 feet long and 4 feet wide, and there were 1152 total plots. The harvesting was completed in 6 days from 6th May to 11th May, 2013. After harvesting and threshing operation, wheat bags were weighed separately for yield of each basic unit having measurement 1 m x 1 m and also the yield moving average of 3 m x 3 m were computed for each unit respectively by using Microsoft Excel package.

The standard error between plots, within the blocks was calculated for 80 different sizes and shapes of plots, after harvesting entire plots. On the basis of these combinations of plots the measurement of 48 units in length and 1, 2, 3, 4, 6, 8, 12, and 24 rows wide were made.
The plot sizes of different combination were recorded with respect to their dimensions, ratio of length to width, variance, standard deviation and coefficient of variation.

**Variance of different Plot Sizes and Shapes**

To calculate variance $V(x)$ for all sets of combination from among plots of all possible sizes and shapes that fit exactly within the basic units. First the variance $V(x)$ is calculated for the set of values as:

$$V(x) = \frac{\Sigma (Y_i - Y \text{ bar})^2}{n - 1} \quad (1)$$

**Coefficient of Variation**

The coefficient of variation can be calculated as follows:

$$CV = \frac{\sqrt{V(x)}}{Y \text{ bar}} \times 100 \quad (2)$$

The plot of CV versus plot size (X) can be drawn to check the status of each plot size. The coefficient of variations (CVs) was calculated for the experiments on wheat crop with all possible plot sizes.

**Percentage Efficiency**

The Percentage efficiency of different plot sizes can be computed by using the expression as;

$$\text{Percentage Efficiency} = \frac{\text{Different computed Plot Sizes}}{\text{Standard basic unit Plot}} \times 100 \quad (3)$$

**Number of Replications**

The theoretical number of replication in case of suitable plot size can be calculated by the relation of square of standard error to the standard error of the mean presented in equation (4).

$$r \geq \frac{t_{a,d,s} \times s^2}{d^2} \quad (4)$$

Where;

- $r$ is the number of replications
- $t$ is the critical t with $r-1$ degree of freedoms
- $d$ is the limit of the confidence interval.

**Results and discussions**

From the collected wheat yield data the analysis was made as shown in Table-1 i.e. by increasing the width and length of the plot, the ratio co-efficient of variation presents declining pattern. The different plots sizes along with their plot dimension, ratio of length to width and their corresponding variance, standard deviation, co-efficient of variation are presented in detail form in Table 1.

**Table 1.** Analysis of yield data of Wheat variety Pirsabak-2004 for the year 2014-15.

<table>
<thead>
<tr>
<th>Length x Width</th>
<th>Plot Dimension</th>
<th>Ratio of Total length to width</th>
<th>No. of plots</th>
<th>SD</th>
<th>Variance</th>
<th>C.V</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x1</td>
<td>5x4</td>
<td>1.25</td>
<td>1152</td>
<td>26.95</td>
<td>20.08</td>
<td></td>
</tr>
<tr>
<td>1x2</td>
<td>5x8</td>
<td>0.63</td>
<td>96</td>
<td>26.43</td>
<td>25.83</td>
<td></td>
</tr>
<tr>
<td>1x3</td>
<td>5x12</td>
<td>0.42</td>
<td>144</td>
<td>26.24</td>
<td>25.73</td>
<td></td>
</tr>
<tr>
<td>1x4</td>
<td>5x18</td>
<td>0.31</td>
<td>192</td>
<td>26.53</td>
<td>25.88</td>
<td></td>
</tr>
<tr>
<td>1x6</td>
<td>5x24</td>
<td>0.21</td>
<td>288</td>
<td>27.15</td>
<td>26.18</td>
<td></td>
</tr>
<tr>
<td>1x8</td>
<td>5x32</td>
<td>0.16</td>
<td>389</td>
<td>24.60</td>
<td>24.92</td>
<td></td>
</tr>
<tr>
<td>1x12</td>
<td>5x48</td>
<td>0.10</td>
<td>576</td>
<td>25.32</td>
<td>25.28</td>
<td></td>
</tr>
<tr>
<td>2x1</td>
<td>10x4</td>
<td>2.50</td>
<td>24</td>
<td>34.76</td>
<td>22.73</td>
<td></td>
</tr>
<tr>
<td>2x2</td>
<td>10x8</td>
<td>1.25</td>
<td>48</td>
<td>34.14</td>
<td>21.56</td>
<td></td>
</tr>
<tr>
<td>2x3</td>
<td>10x12</td>
<td>0.83</td>
<td>72</td>
<td>34.04</td>
<td>24.34</td>
<td></td>
</tr>
<tr>
<td>2x4</td>
<td>10x16</td>
<td>0.63</td>
<td>96</td>
<td>34.25</td>
<td>25.44</td>
<td></td>
</tr>
<tr>
<td>2x6</td>
<td>10x24</td>
<td>0.42</td>
<td>144</td>
<td>25.29</td>
<td>24.74</td>
<td></td>
</tr>
<tr>
<td>2x8</td>
<td>10x32</td>
<td>0.31</td>
<td>192</td>
<td>24.63</td>
<td>24.42</td>
<td></td>
</tr>
<tr>
<td>2x12</td>
<td>10x48</td>
<td>0.21</td>
<td>288</td>
<td>22.39</td>
<td>23.77</td>
<td></td>
</tr>
<tr>
<td>3x1</td>
<td>15x4</td>
<td>1.57</td>
<td>16</td>
<td>26.49</td>
<td>25.90</td>
<td></td>
</tr>
<tr>
<td>3x2</td>
<td>15x8</td>
<td>0.86</td>
<td>32</td>
<td>26.26</td>
<td>25.74</td>
<td></td>
</tr>
<tr>
<td>3x3</td>
<td>15x12</td>
<td>0.56</td>
<td>48</td>
<td>26.69</td>
<td>25.96</td>
<td></td>
</tr>
<tr>
<td>3x4</td>
<td>15x16</td>
<td>0.42</td>
<td>64</td>
<td>25.87</td>
<td>25.65</td>
<td></td>
</tr>
<tr>
<td>3x6</td>
<td>15x24</td>
<td>0.31</td>
<td>96</td>
<td>25.51</td>
<td>24.87</td>
<td></td>
</tr>
<tr>
<td>3x8</td>
<td>15x32</td>
<td>0.24</td>
<td>128</td>
<td>24.56</td>
<td>24.80</td>
<td></td>
</tr>
<tr>
<td>3x12</td>
<td>15x48</td>
<td>0.17</td>
<td>192</td>
<td>23.00</td>
<td>21.60</td>
<td></td>
</tr>
<tr>
<td>4x1</td>
<td>20x4</td>
<td>0.00</td>
<td>12</td>
<td>26.83</td>
<td>21.62</td>
<td></td>
</tr>
<tr>
<td>4x2</td>
<td>20x8</td>
<td>0.25</td>
<td>24</td>
<td>25.90</td>
<td>25.89</td>
<td></td>
</tr>
<tr>
<td>4x3</td>
<td>20x12</td>
<td>1.67</td>
<td>36</td>
<td>25.20</td>
<td>25.21</td>
<td></td>
</tr>
<tr>
<td>4x4</td>
<td>20x16</td>
<td>1.25</td>
<td>48</td>
<td>25.21</td>
<td>24.60</td>
<td></td>
</tr>
<tr>
<td>4x6</td>
<td>20x24</td>
<td>0.83</td>
<td>72</td>
<td>23.97</td>
<td>24.60</td>
<td></td>
</tr>
<tr>
<td>4x8</td>
<td>20x32</td>
<td>0.63</td>
<td>96</td>
<td>32.31</td>
<td>24.26</td>
<td></td>
</tr>
<tr>
<td>4x12</td>
<td>20x48</td>
<td>0.42</td>
<td>144</td>
<td>22.98</td>
<td>23.67</td>
<td></td>
</tr>
<tr>
<td>6x1</td>
<td>30x4</td>
<td>0.75</td>
<td>8</td>
<td>23.89</td>
<td>26.09</td>
<td></td>
</tr>
<tr>
<td>6x2</td>
<td>30x8</td>
<td>0.35</td>
<td>16</td>
<td>25.36</td>
<td>25.53</td>
<td></td>
</tr>
<tr>
<td>6x3</td>
<td>30x12</td>
<td>0.23</td>
<td>24</td>
<td>25.62</td>
<td>25.43</td>
<td></td>
</tr>
<tr>
<td>6x4</td>
<td>30x16</td>
<td>0.18</td>
<td>32</td>
<td>25.79</td>
<td>25.49</td>
<td></td>
</tr>
<tr>
<td>6x6</td>
<td>30x24</td>
<td>0.12</td>
<td>48</td>
<td>24.99</td>
<td>24.84</td>
<td></td>
</tr>
<tr>
<td>6x8</td>
<td>30x32</td>
<td>0.10</td>
<td>64</td>
<td>24.49</td>
<td>24.74</td>
<td></td>
</tr>
<tr>
<td>6x12</td>
<td>30x48</td>
<td>0.07</td>
<td>96</td>
<td>22.77</td>
<td>23.97</td>
<td></td>
</tr>
<tr>
<td>8x1</td>
<td>40x4</td>
<td>0.00</td>
<td>6</td>
<td>26.79</td>
<td>26.00</td>
<td></td>
</tr>
<tr>
<td>8x2</td>
<td>40x8</td>
<td>0.00</td>
<td>12</td>
<td>26.05</td>
<td>26.55</td>
<td></td>
</tr>
<tr>
<td>8x3</td>
<td>40x12</td>
<td>0.33</td>
<td>18</td>
<td>25.85</td>
<td>25.55</td>
<td></td>
</tr>
<tr>
<td>8x4</td>
<td>40x16</td>
<td>0.23</td>
<td>24</td>
<td>25.49</td>
<td>25.37</td>
<td></td>
</tr>
<tr>
<td>8x6</td>
<td>40x24</td>
<td>0.17</td>
<td>36</td>
<td>23.97</td>
<td>24.60</td>
<td></td>
</tr>
<tr>
<td>8x8</td>
<td>40x32</td>
<td>0.15</td>
<td>48</td>
<td>24.73</td>
<td>24.47</td>
<td></td>
</tr>
<tr>
<td>8x12</td>
<td>40x48</td>
<td>0.83</td>
<td>72</td>
<td>23.37</td>
<td>24.29</td>
<td></td>
</tr>
<tr>
<td>12x1</td>
<td>60x4</td>
<td>1.50</td>
<td>4</td>
<td>27.00</td>
<td>26.10</td>
<td></td>
</tr>
</tbody>
</table>
In Table 2, the standard errors in percentage form regarding the mean yield of varying sizes of different length to width combinations are presented.

From the observed data, the standard error in percentage of the mean was found to be decreased with increased plot size. It is also indicated that by increasing the width of plots from one row to another represents significantly reduced standard error. The standard error of the 3.05 m x 1.22 m plot was calculated to be 23.95 percent of the mean yield. Moreover, the shape of plot has been decided not only on the basis of least value of co-efficient of variation, but also by convenience of cultivation. Based on the calculated results, the ratio of length to width of the experimental plot is found to be at least 2.50. Moreover, results showed that long and narrow plots are more efficient than shorter and wider of the same size.

Moreover, by increasing the length of the plots resulting reduced standard error of the means. In all the above experiments although the CV is greater but in most cases the difference is very small. These results do not endorse the usual assertion of long and narrow plots. Wiedemann and Leininger (1963) also concluded that there is very little difference in variance due to shape. Similar results are obtained by Kempthorne (1952), Rampton and Petersen (1962) Crews et al. (1963) and Reddy and Chetty (1985) in practicing field plot technique to different crops.

From Table 3, the number of replications needed to reduce the standard error of the mean to 5 percent. The standard errors of mean for several replications are calculated by dividing the standard error of a single plot by the square root of N, where “N” is the number of replications.

### Table 2. Standard error of mean yields of plot varying in Size and Shape.

<table>
<thead>
<tr>
<th>Length x Width</th>
<th>Plot Dimension</th>
<th>Ratio of Total length to width</th>
<th>No. of plots</th>
<th>SD</th>
<th>Variance</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>12x2</td>
<td>6x08</td>
<td>7.50</td>
<td>8</td>
<td>5.131</td>
<td>26.39</td>
<td>25.78</td>
</tr>
<tr>
<td>12x3</td>
<td>6x12</td>
<td>5.00</td>
<td>12</td>
<td>5.050</td>
<td>25.50</td>
<td>25.37</td>
</tr>
<tr>
<td>12x4</td>
<td>6x16</td>
<td>3.75</td>
<td>16</td>
<td>5.070</td>
<td>25.71</td>
<td>25.47</td>
</tr>
<tr>
<td>12x6</td>
<td>6x24</td>
<td>2.50</td>
<td>24</td>
<td>4.911</td>
<td>24.13</td>
<td>24.68</td>
</tr>
<tr>
<td>12x8</td>
<td>6x32</td>
<td>1.88</td>
<td>32</td>
<td>4.933</td>
<td>24.34</td>
<td>24.79</td>
</tr>
<tr>
<td>12x12</td>
<td>6x48</td>
<td>1.25</td>
<td>48</td>
<td>4.794</td>
<td>22.99</td>
<td>22.09</td>
</tr>
<tr>
<td>16x1</td>
<td>8x04</td>
<td>20.00</td>
<td>3</td>
<td>5.193</td>
<td>26.97</td>
<td>26.09</td>
</tr>
<tr>
<td>16x2</td>
<td>8x08</td>
<td>10.00</td>
<td>6</td>
<td>5.140</td>
<td>25.42</td>
<td>25.82</td>
</tr>
<tr>
<td>16x3</td>
<td>8x12</td>
<td>6.77</td>
<td>9</td>
<td>5.058</td>
<td>25.58</td>
<td>25.41</td>
</tr>
<tr>
<td>16x4</td>
<td>8x16</td>
<td>5.00</td>
<td>12</td>
<td>5.087</td>
<td>25.88</td>
<td>25.56</td>
</tr>
<tr>
<td>16x6</td>
<td>8x24</td>
<td>3.33</td>
<td>18</td>
<td>4.936</td>
<td>24.36</td>
<td>24.80</td>
</tr>
<tr>
<td>16x8</td>
<td>8x32</td>
<td>2.50</td>
<td>24</td>
<td>4.947</td>
<td>24.48</td>
<td>24.86</td>
</tr>
<tr>
<td>16x12</td>
<td>8x48</td>
<td>1.67</td>
<td>36</td>
<td>4.806</td>
<td>23.10</td>
<td>24.15</td>
</tr>
<tr>
<td>24x1</td>
<td>12x04</td>
<td>30.00</td>
<td>2</td>
<td>5.193</td>
<td>26.97</td>
<td>26.09</td>
</tr>
<tr>
<td>24x2</td>
<td>12x08</td>
<td>15.00</td>
<td>4</td>
<td>5.139</td>
<td>26.41</td>
<td>25.82</td>
</tr>
<tr>
<td>24x3</td>
<td>12x12</td>
<td>10.10</td>
<td>6</td>
<td>5.051</td>
<td>25.51</td>
<td>25.38</td>
</tr>
<tr>
<td>24x4</td>
<td>12x16</td>
<td>7.50</td>
<td>8</td>
<td>5.073</td>
<td>25.74</td>
<td>25.49</td>
</tr>
<tr>
<td>24x6</td>
<td>12x24</td>
<td>5.00</td>
<td>12</td>
<td>4.934</td>
<td>25.34</td>
<td>24.79</td>
</tr>
<tr>
<td>24x8</td>
<td>12x32</td>
<td>3.75</td>
<td>16</td>
<td>4.946</td>
<td>24.46</td>
<td>24.85</td>
</tr>
<tr>
<td>24x12</td>
<td>12x48</td>
<td>2.50</td>
<td>24</td>
<td>4.821</td>
<td>23.24</td>
<td>24.22</td>
</tr>
<tr>
<td>48x1</td>
<td>24x04</td>
<td>60.00</td>
<td>48</td>
<td>5.200</td>
<td>27.05</td>
<td>26.13</td>
</tr>
<tr>
<td>48x2</td>
<td>24x08</td>
<td>30.00</td>
<td>24</td>
<td>5.135</td>
<td>26.37</td>
<td>25.77</td>
</tr>
<tr>
<td>48x3</td>
<td>24x12</td>
<td>20.00</td>
<td>3</td>
<td>5.068</td>
<td>25.69</td>
<td>25.42</td>
</tr>
<tr>
<td>48x4</td>
<td>24x16</td>
<td>15.00</td>
<td>4</td>
<td>5.095</td>
<td>25.96</td>
<td>25.57</td>
</tr>
<tr>
<td>48x6</td>
<td>24x24</td>
<td>10.00</td>
<td>6</td>
<td>4.973</td>
<td>24.53</td>
<td>24.87</td>
</tr>
<tr>
<td>48x8</td>
<td>24x32</td>
<td>7.50</td>
<td>8</td>
<td>4.981</td>
<td>24.81</td>
<td>24.52</td>
</tr>
<tr>
<td>48x12</td>
<td>24x48</td>
<td>5.00</td>
<td>12</td>
<td>4.883</td>
<td>23.85</td>
<td>24.52</td>
</tr>
<tr>
<td>12x4</td>
<td>6x06</td>
<td>0.05</td>
<td>24</td>
<td>5.219</td>
<td>27.24</td>
<td>26.22</td>
</tr>
<tr>
<td>24x2</td>
<td>10x08</td>
<td>0.10</td>
<td>48</td>
<td>4.690</td>
<td>22.00</td>
<td>23.57</td>
</tr>
<tr>
<td>3x24</td>
<td>15x09</td>
<td>0.16</td>
<td>72</td>
<td>4.649</td>
<td>21.61</td>
<td>23.36</td>
</tr>
<tr>
<td>4x24</td>
<td>20x09</td>
<td>0.21</td>
<td>96</td>
<td>4.639</td>
<td>21.52</td>
<td>23.31</td>
</tr>
<tr>
<td>6x24</td>
<td>30x06</td>
<td>0.31</td>
<td>144</td>
<td>4.580</td>
<td>20.98</td>
<td>23.01</td>
</tr>
<tr>
<td>8x24</td>
<td>40x06</td>
<td>0.42</td>
<td>192</td>
<td>4.573</td>
<td>20.91</td>
<td>22.96</td>
</tr>
<tr>
<td>12x4</td>
<td>6x09</td>
<td>0.63</td>
<td>288</td>
<td>4.570</td>
<td>20.88</td>
<td>22.96</td>
</tr>
<tr>
<td>16x4</td>
<td>8x06</td>
<td>0.83</td>
<td>384</td>
<td>4.161</td>
<td>17.31</td>
<td>20.91</td>
</tr>
<tr>
<td>24x4</td>
<td>12x06</td>
<td>1.25</td>
<td>576</td>
<td>4.412</td>
<td>19.96</td>
<td>22.16</td>
</tr>
</tbody>
</table>

### Table 3. Theoretical number of replications needed to reduce the standard error.

<table>
<thead>
<tr>
<th>Length of plot</th>
<th>Number of replications for plots of indicated number of rows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>27.2 6.7 3.0 1.0 0.8 0.4 0.2 0.1 0.04 0.01 0.003</td>
</tr>
<tr>
<td>2</td>
<td>5.7 1.7 0.7 0.4 0.2 0.1 0.04 0.01 0.003</td>
</tr>
<tr>
<td>3</td>
<td>3.0 0.7 0.3 0.2 0.1 0.04 0.02 0.01 0.003</td>
</tr>
<tr>
<td>4</td>
<td>1.7 0.4 0.2 0.1 0.04 0.02 0.01 0.003</td>
</tr>
<tr>
<td>6</td>
<td>0.8 0.2 0.1 0.0 0.04 0.04 0.04 0.04 0.04</td>
</tr>
<tr>
<td>8</td>
<td>0.4 0.1 0.03 0.01 0.01 0.003 0.003 0.003 0.003</td>
</tr>
<tr>
<td>12</td>
<td>0.2 0.1 0.02 0.01 0.01 0.003 0.001 0.003</td>
</tr>
<tr>
<td>16</td>
<td>0.1 0.03 0.01 0.01 0.003 0.001 0.003 0.003 0.003</td>
</tr>
<tr>
<td>24</td>
<td>0.1 0.01 0.003 0.001 0.003 0.001 0.003</td>
</tr>
<tr>
<td>48</td>
<td>0.001 0.003 0.001 0.003 0.001 0.003 0.001 0.003 0.003</td>
</tr>
</tbody>
</table>
The main purpose of replications is to reduce the amount of error. For each plot sizes, it has been examined to see whether the available used land is consistent with theoretical number of replications required. Theoretical number of replications which bring down the Coefficient of variation to 5% has been calculated in case of each plot size and it was found that in case of plot size 3.05 m×1.22 m the number of replications required is in between 2 to 6 as presented in Table-3. Similarly, by fixing the plot size the number of replications decreases for small differences (15, 16,... 25) and for large differences the decrease is not clearly detectable. Similar results have been obtained by Rampton and Petersen (1962) and Crews et al. (1963) in performing field plot techniques to different crops.

From Table-4, the efficiency of plots of varying size and shape has been calculated on the basis of variance per unit area. By calculating the variance of a single row as a standard, we may determine the efficiency of all other plots in relation to the efficiency of this ultimate unit of size.

<table>
<thead>
<tr>
<th>Length of plot</th>
<th>Percentage efficiency of plot of indicated width (rows)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  6  8  12 24</td>
</tr>
<tr>
<td>1. 100</td>
<td>50.98 34.24 25.40 16.54 13.69 8.87 4.12</td>
</tr>
<tr>
<td>2. 59.28</td>
<td>25.77 17.25 13.14 9.26 7.13 5.02 2.55</td>
</tr>
<tr>
<td>3. 33.40</td>
<td>17.11 11.22 8.68 5.87 4.57 3.26 1.73</td>
</tr>
<tr>
<td>4. 25.11</td>
<td>13.01 8.91 6.68 4.69 3.61 2.44 1.39</td>
</tr>
<tr>
<td>5. 16.65</td>
<td>8.47 5.84 4.36 3.06 2.29 1.69 0.89</td>
</tr>
<tr>
<td>6. 12.58</td>
<td>6.46 4.34 3.00 2.34 1.78 1.20 0.67</td>
</tr>
<tr>
<td>7. 8.30</td>
<td>4.26 2.94 2.18 1.55 1.15 0.81 0.45</td>
</tr>
<tr>
<td>8. 6.25</td>
<td>3.19 2.20 1.63 1.15 0.86 0.61 0.41</td>
</tr>
<tr>
<td>9. 4.16</td>
<td>2.13 1.47 1.09 0.77 0.57 0.40 0.23</td>
</tr>
<tr>
<td>10. 2.08</td>
<td>1.07 0.73 0.59 0.38 0.28 0.20 ..</td>
</tr>
</tbody>
</table>

The estimated plot size 3.05 m×1.22 m, based on the criteria of reduced standard error (calculated value 4.768) and minimum value of the ratio i.e. coefficient of variation (recorded as 23.95 percent).

The number of replications two (2) to Six (6) was found suitable, possessing less amount of error. Therefore, it can be suggested that less number of replication should be at least two (2) and not more than six (6).

The results of the study revealed that for wheat variety pirsabak-2004 which was grown in Agricultural Research Institute Tarnab, Peshawar under uniform soil and climatic conditions, the optimum plot size was recorded to be 3.05 m×1.22 m, and based on the criteria of reduced standard error (calculated value 4.768) and minimum value of the ratio i.e. coefficient of variation (recorded as 23.95 percent).

The shape of plot was determined by computing the ratio of length to width of the experimental plot which was found to be 2.5. It was quite clear that long and narrow plots are more efficient than shorter and wider of the same size.

Conclusions and recommendations

The number of replications two (2) to Six (6) was found suitable, possessing less amount of error. Therefore, it can be suggested that less number of replication should be at least two (2) and not more than six (6).

The estimated plot size 3.05 m×1.22 m with long and narrow shape and having at least 2 to 6 number of replication at Agricultural Research Institute Tarnab, Peshawar, Khyber-Pakhtunkhwa is recommended for future field experiments on wheat yield trials particularly for wheat variety Pirsabak-2004 and in general vice versa. Moreover, by using the suitable plot size, shape and No. of replication shall be helpful and improve the quality of research results contributing to the generation of more advanced technology which ultimately reduce the deficits in the productivity.

References


