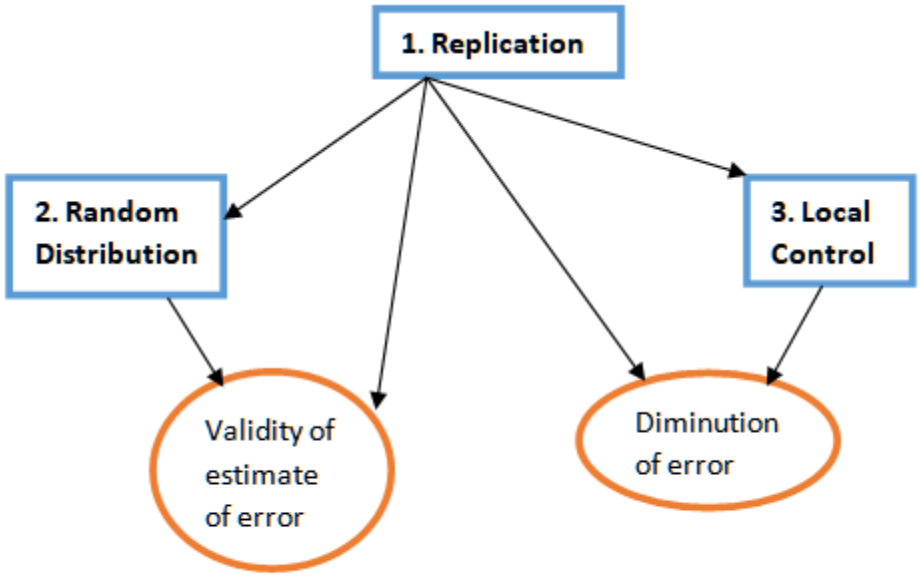
LECTURE-2

PRINCIPLES OF EXPERIMENTAL DESIGN

BASIC PRINCIPLES OF EXPERIMENTAL DESIGN:-

The following figure illustrates the functions of various principles of experimental design.



1. PRINCIPLE OF REPLICATION:-

By replication we mean that the experiment is repeated more number of times. An experimenter uses the principle of replication in order to average out the influence of chance factors on different experimental units. Thus, the repetition of treatments results in more reliable estimates than is possible with a single observation. The following are the chief advantages of replication:-

a. We know that if the replication number increases, precision also increases viz. by increasing precision we can control error variance since precision is given by $1/V(\bar{x}) = r/\sigma^2$. Thus, the precision of the experiment is inversely proportional to the square root of the replication. Consequently replication has an important but limited role in increasing the efficiency of the design.

b. The most important purpose of replication is to provide an estimate of the experimental error without which we cannot test the significance of the difference between any two treatments.

c. The adequate number of replications for various treatments in an experiment depends upon the knowledge of the variability of the experimental material. A general rule is to get as

many replications which will provide at least 12 degrees of freedom for the error. Usually one should not use less than 4 replications.

2. RANDOMIZATION:-

By replication the experimenter tries to average out as far as possible the effects due to uncontrolled factors. This brings to him the question of allocation of treatments to experimental units so that each treatment gets an equal chance of being selected. In the absence of the prior knowledge of the variability of the experimental material, this objective is achieved through randomization. It is a process of assigning the treatments to various experimental units in a purely chance manner.

Randomization is essential for a valid estimate of the experimental error and also to minimize bias in the result. We know that one of the assumptions in the ANOVA model is the independence of errors. If we consider agricultural experiments, it is a fact that soil fertility is not distributed at random and nearby plots happens to be correlated. By randomization, the objective of independence of errors can be achieved.

By randomization the validity of the statistical test of significance can be derived viz. the F-test and t-test are valid only in case of random sampling. Thus, the assumption of randomness is necessary for any experiment.

Randomizing the treatments over the experimental units is essential in any experiment since it ensures that the effects are randomly distributed and thus it eliminates bias in any form.

3. PRINCIPLE OF LOCAL CONTROL:-

If the experimental material say field for agricultural experiment is heterogeneous and different treatments are allocated to various units at random over the entire field, then the soil heterogeneity will also enter the uncontrolled factors and thus increase the experimental error. In order to separate out the soil fertility effects from the experimental error, the whole area is divided into different homogeneous blocks or groups, row wise or column wise or both, according to the fertility gradient of the soil such that the variation within each block is minimum and between the blocks is maximum, then the treatments are allocated at random within each block.

The process of reducing the experimental error by dividing the relatively heterogeneous area into homogeneous blocks is known as local control.

Thus, the principle of local control increases the efficiency of the design by reducing the experimental error.