Journal of Resources Development and Management
ISSN 2422-8397 An International Peer-reviewed Journal
Vol.11, 2015

Comparative Efficiency Of Alpha Lattice Design And Complete Randomized Block Design In Wheat, Maize And Potato Field Trials

Muhammad.Ilyas Khan[1], S.Asghar Ali Shah[1], Murtaza Khan[2], Kalim Ullah[3], Rehmat Ullah[4]
Shahid Iqbal Khatak[1]
[1] Agriculture Research institute, Dera Ismail Khan, Pakistan
[2] Agriculture Research institute, Tarnab Farm, Peshawar, Pakistan
[3] PCCC, Cotton Research Station, Dera Ismail Khan, Pakistan
[4] Department of of agricultural extension education and communication, The University of agriculture, Peshawar

ABSTRACT
Field trials on each wheat, maize and potato were conducted for three years Viz. 2011 to 2014 in Agricultural Research Institute, Tarnab, Peshawar, Pakistan to gauge the efficiency of Alpha Lattice Design (ALD) in comparison to randomized complete block design. The results emphasize that randomized complete block (RCB) design should be replaced by alpha lattice when treatments exceed ten due to the less reliability of homogenous blocks under circumstances. Results depicted that Alpha Lattice design provide better control on experimental variability among the experimental units under field conditions. Improvement in the precision level in terms of decline in the mean square error, coefficient of variation and standard error of difference were recorded for the ALD. The coefficient of variation (CV) calculated for wheat, maize and potato yield trials were (9.20, 17.8 and 14.5) for alpha lattice and (17.32, 23.70 and 18.53) for RCB design respectively. The standard error of mean squares calculated for these trials were (292, 3.67 and 2.41) for alpha lattice and (437, 5.40 and 3.23) for RCB design respectively. The relative efficiency of trials shows that alpha lattice design was more efficient than RCB design. The value of relative efficiency (1.49, 1.47 and 1.34) indicates that the use of alpha lattice design instead of randomized complete block design (RCBD) increased experimental efficiency by 49, 47 and 34 percent respectively.

***Key Words*:** Alpha Lattice Design, Mean Square Error, Coefficient of Variation, Standard Error Difference, Relative Efficiency.

INTRODUCTION

Randomized complete block (RCB) design is one of the widely used design in field trials. The precision of RCB relies on the control of heterogeneity within blocks. The efficiency of RCBD is criticized by the researchers in advance countries while dealing with large field experiments. As RCB design is suitable only for treatments less than ten in a single block which is one of the drawbacks of RCB design. The scientists have replaced the RCBD with incomplete block (IB) and lattice square design introduced by (Cochran and Cox, 1957; William and Talbot, 1993). These designs are widely used in plant breeding and variety testing around the world and are more efficient than RCBD (Pilarczyk, 1997; Cullis, 1991). RCB design are restricted to very limited number of treatments. In contrast alpha lattice design must be used for unlimited entries (Masood *et al.,* 2006).

Recent developments in several countries showed that considerable improvement in precision can be attained by using alpha lattice design. Generally, the greater the heterogeneity within blocks, the poorer the precision of variety effect estimates. Incomplete block designs are arranged in relatively small blocks that contain fewer varieties than the total number of varieties to be compared (Kempton, 1994). Consequently, there is a gain in precision due to use of small blocks. Because of large number of treatments, the homogeneity among experimental units/plots within a large block cannot be maintained. As a result, estimate of experimental error is inflated and results are low in precision (Masood *et al.,* 2008). Alpha designs introduced by Patterson and Williams, 1976 are now routinely used for statutory field trials in the United Kingdom and are also widely used for breeding and varietals trials in Australia and elsewhere (Patterson and Silvey, 1980). They are more flexible than lattice designs and can accommodate any number of varieties. A computer programme ALPHA$^+$ (Williams and Talbot, 1993) is available for constructing efficient designs. Additional improvement is possible through modelling field variability using spatial features of the field layout.

The advantage of alpha designs is that they are easy to construct, and can be constructed in cases where balanced incomplete block designs and lattice designs don't exist. The early alpha designs were aimed primarily at

controlling variation down the columns of plots in the field. This is often adequate when plots are long and narrow. Patterson and Hunter (1983) have demonstrated the value of alpha designs in such circumstances in terms of gain in efficiency. YAU, (1997) reported the use of alpha lattice design in international yield trials of different crops and found average efficiency 18 % higher than the RCBD. Keeping in view the importance of alpha lattice design in agriculture field trials the present study was supposed to find out the relative efficiency of Alpha Lattice Deigns in contrast to Randomized complete block design.

MATERIALS AND METHODS

The data were collected from wheat, maize and potato yield trials, which were conducted at Agricultural Research Institute, Tarnab, Peshawar during 2011-12, 2012-13 and 203-14, using alpha lattice design layout. Three experiments each having Alpha Lattice Design with 4 replications, 16 entries, 4 blocks and 4 plots per block for wheat, maize and potato crop were conducted. The yield data were analyzed by RCBD and alpha lattice design using computer software named ALPHA. The mean square error from each analysis was used to estimate the relative efficiency of an alpha lattice design compared with a RCBD according to the following formula:

$$\text{Relative Efficiency} = \frac{\text{Standard Error (RCB design)}}{\text{Standard Error(Alpha lattice design)}} \times 100$$

Relative efficiency less than one indicates that a RCBD is a more efficient design and should be used for presentation of results, while value nearly equal to one suggests that the two designs yield similar results and the value greater than one suggests that Alpha lattice design is more efficient design than RCBD.

RESULTS AND DISCUSSION

The results of the collected data shows that there is large difference between error mean squares under alpha design and RCB design. The coefficient of variation (CV) of alpha lattice design is comparatively low (9.20, 17.8, 14.5) as compared to RCBD (17.32, 23.70, 28.53) for Wheat, Maize and Potato respectively which indicates good index of reliability. Relative efficiency indicates that the use of alpha lattice design instead of RCBD increased experimental precision by 49, 47 and 34 percent in wheat, maize and potato crops respectively. Increased relative efficiency of Alpha lattice design have also been reported by Patterson and Silvey, 1980 much earlier and now widely used for breeding and variety testing throughout the world. In this case, the trail is analysed as a RCBD and means are not adjusted for block effects. There is big difference between standard error of difference under RCBD and average standard error of difference under alpha design. The smaller values of S.E. difference for alpha lattice design helps to detect smaller differences for the comparisons of means. The value of relative efficiency greater than one for both the experiments show that Alpha lattice design was clearly more efficient than RCBD (Table 1).

Conclusions

The instant results suggest that Alpha lattice Design must be used in field experiments because it provides smaller standard errors of differences, coefficients of variation and error mean squares as compared to RCBD. However to evaluate its wider applicability, more experiments must be conducted through-out the country.

REFERENCES

Cochran, W. G. and G. M. Cox.1957. Experimental Design, 2nd Edition (John Wiley & Sons, New York).

Cullis, B. R., and A. C. Gleeson. 1991. Spatial analysis of field experiments- An extension to two dimensions. Biometrics 47 1449-1460.

Kempton, R. A., J. C. Seraphin, and A. M. Sword. 1994. Statistical analysis of two dimensional variation in variety yield trials. Journal of Agricultural Science, Cambridge, 122, 335-342.

Masood A. A., M. Yaqoob, M. I. Khan and A.,Saleem. 2006. Improving Precisions of Agricultural Field Experiments. Journal of Sustainable Development, Vol.3 (1,2), 11-13 Africa .

Masood, M. A., S. N. Malik and N. Nazakat. 2008. The Blocks Within Replication Improve Experimental Efficiency in Preliminary Yield Trial on Groundnut. Pakistan Journal of Agricultural Research Vol. 3-4.

Patterson, H. D. and E. A. Hunter. 1983. The efficiency of incomplete block designs in National List and Recommended cereal variety trials. J. Agric. Sci., Cambridge, 101, 427-433.

Patterson, H. D. and Silvey, V. 1980. Statutory and recommended list trials of crop varieties in the United Kingdom (with discussion) J. R. Statist. Soc. A. 143, 219-253.

Pilarczyk, W. 1997. Plant Varieties and Seeds. Journal of Agricultural Science, Cambridge, 128 (5).
Williams, E. R. and Talbot, M. 1993. ALPHA+ (version 1.0). Experimental designs for variety trials. Design user manual. CSIRO, Australia, and SASS, Edinburgh.
YAU, S. K. 1997. Efficiency of alpha-lattice designs in international variety yield trials of barley and wheat. The Journal of Agricultural Science, 128, 5-9 Cambridge University Press.

Table1. Results of Preliminary Yield Trials, Agricultural Research Institute Tarnab,Peshawar

Exp:	Year	CV		S.E		R.E
		RCBD	ALPHA	RCBD	ALPHA	
Wheat	2011-12	17.32	9.20	437	292	1.49
Maize	2012-13	23.70	17.8	5.40	3.67	1.47
Potato	2013-14	18.53	14.5	3.23	2.41	1.34

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Academic conference: http://www.iiste.org/conference/upcoming-conferences-call-for-paper/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar