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Relative Effectiveness of Alpha Lattice Design and Complete Randomized Block Design in Maize

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Abstract

The trial was performed at the research site of Department of Plant breeding and Genetics, University of Agriculture, Faisalabad. Total Fifty Genotypes of maize was collected from different maize research stations. Alpha lattice layout was followed. The lower values of standard error for alpha lattice layout aids to observe minimum variations for assessment of means. Alpha lattice design gave productive control within replicate variation. The results revealed that alpha lattice design increases the probability of observing genotypic variations to a great degree. Relative efficacy of alpha lattice was also judge against randomized complete block design (RCBD). The results revealed that alpha lattice design increases probability level of observing genotypic variations. To manage variation in trials, it is purposed that a trial with a randomized complete block model could be changed with an alpha lattice plan when entries in the trial are more than 10. The value of relative efficiency for each trait indicated that exploitation of alpha lattice layout in replace of RCBD enhanced experimental effectiveness by 1, 5, 2, 8, 6, 6, 9 and 3 percent for ear diameter and length, plant height, grain yield, ear height, hundred grain weight, number of grains per row and number of rows per cob respectively. Findings emphasized that randomized complete block design (RCBD) should be replace by alpha lattice when treatments exceed than ten due to the less consistency of homogenous blocks under situation. Findings explained that Alpha Lattice design give better control on experimental variations among experimental units under field circumstances.

Introduction

Randomized complete block design (RCBD) is one of frequently used layout in field experiments. The accuracy of RCBD depends on control of variations within blocks. The competence of RCBD is objurgated by the scientists in advanced countries while handling with large field experiments. As RCBD is suitable only for treatments less than ten in a single block which is one of the drawbacks of RCBD. The researchers have replaced RCBD with lattice square layout established by (Cochran and Cox, 1957; William and Talbot, 1993). Some notably works are discussed below:

Qiao et al. (2000) performed thirty three field trials from 1994 to 1996 in the Northern Grains Region of Australia to assess the effectiveness of experimental models and contagious examination to assessed genotype effect for production and their effect on selection decision. Relative effectiveness of substitute models and evaluation was accurately calculated by mean standard error of variation among line means. Both lattice models are more efficient and enhanced the effectiveness relative to the RCBD, with favored model giving a average relative efficacy of 138 percent over all 33 experiments.

Masood et al. (2008) compared the effectiveness of RCBD and Alpha Lattice Design in 2 research experiments at NARC, Islamabad, Pakistan. Alpha lattice models are utilized for field experiments as they supply better control on experimental variations betwee experimental elements under field environment. The relative effectiveness of experiments revealed that alpha lattice layout was more proficient. Value of relative efficacy (1.25 and 1.47) revealed that employ of alpha lattice design as an alternative of randomized complete block design improved experimental precision by 25 and 45 % correspondingly. The increase is substantial in stipulations of effectiveness attained by means of Alpha Lattice Layout which favors more utilization of these models under field environment.

Kashif et al. (2011) conducted 2 experiments in research institute, Kala Shah Kako Pakistan to find out effectiveness of alpha lattice model in field trial. The mean standard error of variation among inbred lines is used to compute R.E of alpha lattice layout. Both trials undoubtedly acknowledged the rewards of little blocks. Mean increase in efficacy was 119% with highest 128%. Average position evaluation for both alpha lattice and randomized complete block design were performed.

It was seen that position were not regular across the trial. Findings showed that the conventional design should be replaced by alpha lattice in field trials when number of genotypes to be analyzed in a trial is more than ten. In such a condition finding a uniform block is fairly tricky in field trials.

Mohsen et al. (2013) conducted a research in 2011 and 2012 at farm of Cairo University, Giza, Egypt. They analyzed 20 wheat varieties in alpha lattice model with 3 repetitions for 9 traits. The purpose was to evaluate relative efficacy of two field models based on error mean squares. Alpha lattice design showed better efficiency than RCBD in plummeting equally error mean squares and coefficient of variation accordingly. The findings showed that conventional field design should be changed by alpha lattice in agricultural trials when enteries to be analyzed in an trial is more than 10, where a uniform block is fairly complicated to locate in field experiments.

Khan et al. (2015) conducted field trials for wheat, maize and potato for three years in Agricultural Research Institute, Tarnab, Peshawar, Pakistan to check efficacy of alpha lattice model in contrast to RCBD. The results suggest that RCBD should be change by alpha lattice when entries are more than ten due to low reliability of homogenous blocks under field conditions. Findings revealed that alpha lattice design gave good control on experimental unpredictability between tentative units under field environment.

Materials and methods

The present study was performed at the research site of the Department of Plant breeding and Genetics, University of Agriculture, Faisalabad. Total Fifty Genotypes were collected from different maize research stations. Alpha lattice layout was used, with 2 replications and 5 blocks for each replication, keeping PxP and RxR distance 20 cm and 75 cm correspondingly. The gathered germplasm was grown during March, 2019. Humidity values in air for March, April, May, June were 68.5%, 42.5%, 46.5% and 43.3% respectively. Average temperature recorded for these months 19.9 ºC, 27.8ºC, 31.4ºC and 33.7ºC respectively.

The data were collected from maize field for seven yield traits, following alpha lattice design layout. The data were analyzed by RCBD and alpha lattice design using computer software. The mean square error from each analysis was used to estimate the relative efficiency of an alpha lattice design compared with a RCBD

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 data were collected from maize field for seven yield traits and was analyzed by using computer software. Results showed that lower values of standard error for alpha lattice design for each trait aids to observe smaller variations for the comparisons of means. Alpha lattice design gives productive control within replicate variation. Findings revealed that alpha lattice increases probability level of observing varietal variations. To manage variation in field experiments, it is proposed that a trial with a randomized complete block design could be changed with an alpha lattice layout when number of genotypes in trial is above ten. The results were discussed separately for each trait.

According to results of plant height showed that there were large variations between error mean squares of randomized complete block layout and alpha lattice layout. One percent relative efficacy pointed out that use of alpha lattice design as a substitute of RCBD improved experimental accuracy. Increased relative efficacy of Alpha lattice had also been reported by (Patterson and Silvey, 1980). In RCBD means are not modified for block affects. Values for non adjusted and adjusted of error mean square are 322.018 and 317.315 correspondingly. The lower values of standard error for alpha lattice design aids to observe minimum variations for assessment of means. The alpha lattice design gives productive control within replicate variation. The results revealed that alpha lattice design increased probability level of observing varietal variations.

In case of cob diameter large variations was observed between error mean squares of randomized complete block layout and alpha lattic layout. 5 percent relative efficacy pointed out that use of alpha lattice design as a substitute of RCBD improved experimental accuracy. In RCBD means are not modified for block affects. Values for non adjusted and adjusted of error mean square are

25.8383 and 24.3870 respectively. The alpha lattice design gives productive control within replicate variation and increases the opportunities to focus on varietal variations more precisely.

High values of variations between error mean squares of randomized complete block layout and alpha lattice design for cob length. Two percent relative efficacy pointed out that use of alpha lattice design as a substitute of RCBD improved experimental precision. In case of RCBD means are not modified for block affects. Values for non-adjusted and adjusted of error mean square are 8.038 and 7.7796 respectively. The alpha lattice design compare the means more precisely as compared to RCBD.

As per kernel yield significant variation was observed between error mean squares of randomized complete block design and alpha lattice layout. Eight percent relative efficacy pointed out that use of alpha lattice design as a substitute of RCBD improved experimental accuracy. Values for non-adjusted and adjusted of error mean square are 26.8651 and 24.7010 respectively. The lower values of standard error for alpha lattice design helps to observe smaller variations for assessment of means. The alpha lattice design gives productive control within replicate variation and increases probability level of observing varietal variations.

The results showed larger variations between error mean squares of randomized complete block design and alpha lattice layout for ear height. Relative efficacy value (6%) pointed out that use of alpha lattice design as a substitute of RCBD improved experimental accuracy. Non-adjusted and adjusted values of error mean square are 140.012 and 132.036 respectively. The lower values of standard error for alpha lattice design facilitate to focus more precisely smaller variations for the assessment of means. The alpha lattice design strongly control within replicate variation. So, alpha lattice design enhances the power to observe varietal variation to a great extent.

Large variations between error mean squares of randomized complete block layout and alpha lattice design was reported for 100 kernel weight. Total 6% relative efficiency value recommends the use of alpha lattice design as a substitute of RCBD by increasing experimental precision. In RCBD means are not modified for block affects. Values for non-adjusted and adjusted of error mean square are 12.8858 and 12.130 respectively. The lower values of standard error for alpha lattice design aids to observe minimum variations for assessment of means. Regarding this parameter, the alpha lattice design gives productive control within replicate variation by improving the opportunities of minute observation of varietal variations.

Larger variations between error mean squares of randomized complete block design and alpha lattice layout was recorded for number of grains per row. Relative efficiency value (9%) indicates that use of alpha lattice design as a substitute of RCBD improved experimental accuracy. Values for non-adjusted and adjusted of error mean square are 12.0818 and 11.0104 correspondingly. For this trait, the alpha lattice design gives productive control within replicate variation by increasing the opportunities of minute observation of varietal variations.

For number of rows results revealed that there were larger variations between error mean squares of randomized complete block design and alpha lattice layout. Relative efficiency (3%) indicates that use of alpha lattice design as a substitute of RCBD improved experimental accuracy. Values for non-adjusted and adjusted of error mean square are 5.06714 and 4.9020 respectively. Smaller the values of standard error for alpha lattice design more precise mean comparisons are possible for variations. This proved that alpha lattice design provides firm and confident control within replicate variation. The results revealed that alpha lattice design increased probability level of observing varietal variations.

Conclusion

Randomized complete block design is one of frequently used layout in field experiments. The precision of RCBD depends on control of variations within blocks. The proficiency of RCBD is criticized by the scientists in advanced countries while handling with large field experiments. So, mostly scientists use alpha lattice design instead of RCBD when treatments are more than ten.

Results revealed that alpha lattice design enhances the power to observe varietal variation to a great extent. The lower values of standard error for alpha lattice help to observe smaller variations for the assessment of means. Alpha lattice design gives productive control within replicate variation. The results revealed that alpha lattice design increases

probability level of observing varietal variations to a great extent. To control variation in field experiments, it is purposed that an experiment with a randomized complete block layout could be replaced with alpha lattice layout when number of treatments in experiment are more than ten.

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Tables

Table 1 Analysis of Variance (ANOVA) for Plant Height

S.O.V	DF	SS	MS	F	P
Replication	1	271.9	271.920		
Blocks	18	7520.418	417.801		
Genotypes	49	29222.7	596.381	1.87**	0.01
Error	31	9836.765	317.315		
Total	99	46851.783			

Table 2 Analysis of Variance (ANOVA) for Cob Diameter

S.O.V	Df	SS	MS	F	P
Replications	1	8.53	8.5264		
Blocks	18	23.18	1.2878		
Genotypes	49	3263.68	66.6098	2.73**	0.001
Error	31	756.08	24.3870		
Total	99	3295.39			

Table 3 Analysis of Variance (ANOVA) for Cob Length

S.O.V	Df	SS	MS	F	P
Replication	1	1.082	1.0816		
Blocks	18	13.84	0.7689		
Genotypes	49	299.58	6.1138	0.79**	0.008
Error	31	241.17	7.7796		
Total	99	555.72			

Table 4 Analysis of Variance (ANOVA) for Kernel Yield

S.O.V	**Df**	**SS**	**MS**	**F**	**P**
Replication	1	2.38	2.3808		
Blocks	18	739.289	41.0716		
Genotypes	49	3112.28	63.5159	2.57**	0.001
Error	31	765.731	24.7010		
Total	99	20234.14			

Table 5 Analysis of Variance (ANOVA) for Ear Height

S.O.V	**Df**	**SS**	**MS**	**F**	**P**
Replication	1	389.3	389.273		
Blocks	18	2967.75	164.875		
Genotypes	49	13216.6	269.727	2.04**	0.01
Error	31	4093.116	132.036		
Total	99	20666.7			

Table 6 Analysis of Variance (ANOVA) for Hundred Kernel Weight

S.O.V	**Df**	**SS**	**MS**	**F**	**P**
Replication	1	0.03	0.0289		
Blocks	18	238.73	13.263		
Genotypes	49	4696.13	95.8393	7.90**	0.001
Error	31	376.03	12.130		
Total	99	5310.92			

Table 7 Analysis of Variance (ANOVA) for Number of Grains Per Row

S.O.V	**Df**	**SS**	**MS**	**F**	**P**
Replication	**1**	**32.490**	**32.4900**		
Blocks	18	253.705	14.0947		
Genotypes	49	797.210	16.2696	1.47*	0.047
Error	31	341.322	11.0104		
Total	99	1424.727			

Table 8 Analysis of Variance (ANOVA) for Number of Rows Per Cob

S.O.V	Df	SS	MS	F	P
Replication	1	1.210	1.2100		
Blocks	18	129.074	7.1708		
Genotypes	49	443.890	9.0589	1.84**	0.02
Error	31	151.962	4.9020		
Total	99	726.136			

Table 9 Values of relative efficiency percentage of all traits for comparison of alpha lattice design and complete randomized block design.

Parameters	Relative Efficiency Percentage
Plant Height	1
Cob Diameter	5
Cob Length	2
Kernel Yield	8
Ear Height	6
Hundred Kernel Weight	6
Number of Grains Per Row	9
Number of Rows Per Cob	3