

Comparison of Different Methods for the Analysis of Long Term Fertilizer Experiments

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ABSTRACT

With a view to compare the various methods employed for the analysis of long term fertilizer experiments on crop sequence, yield data were collected from a long term fertilizer experiment conducted at Gujarat Agricultural University, Anand for seventeen years. The methods of analysis (i) groups of experiments (ii) split plot analysis (iii) principal component analysis and (iv) rank analysis were compared using four different criterion viz. 'F' test, coefficient of variation, presence of year x treatment interaction and consistency in the results and agreement of the ranking of treatment responses by Duncan's New Multiple Range Test and rank correlation coefficient. On the basis of results obtained, it was inferred that principal component method proved slightly more efficient than the usual split plot analysis and the analysis of groups of experiments. However, it did not provide any information on year x treatment interaction.

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INTRODUCTION

In the field of agricultural research, long term experiments play a very important role. The main purpose of conducting such experiments is to study the long term effects of given treatments and crops on soil fertility and on economic return. Such type of long term experiments are essential to understand slow changes occurring in soil productivity under constant fertility, tillage, irrigation or crop management treatments. Exact method of analysis for combining the results of long term experiments are not available. With a view to examine the utility of different methods of analysis for valid interpretation of data from the long term fertilizer experiments, this study was undertaken.

MATERIALS AND METHODS

The yield data for the present study were collected from a long term fertilizer experiment conducted under the Department of Agronomy, Gujarat Agricultural University, Anand. Three crops were tried in a crop sequence. The crop sequence was Pearl millet (*kharif*), Wheat (*rabi*) and Greengram (summer). Seventeen years data were available for the analysis. The data for summer crop were not available for all the years due to change in crop and hence it was not considered for the analysis. The layout of the experiment was randomized block design. The following treatments were imposed on both the crops of the sequence.

1. Control.
2. Application of FYM @ 25 t/ha every third year to Pearl millet crop only.
3. Half of recommended nitrogen for all the crops.
4. Half of recommended nitrogen and phosphorus for all the crops.
5. Half of recommended nitrogen and phosphorus for all the crops along with potash application same as nitrogen.
6. Recommended dose of nitrogen for all the crops.
7. Recommended dose of nitrogen and phosphorus for all the crops.
8. Recommended dose of nitrogen and phosphorus for all the crops along with potash application same as nitrogen.
9. Application of nitrogen and phosphorus according to soil test value.
10. Application of nitrogen and phosphorus according to soil test value along with potash application same as nitrogen.

The methods employed to analyse the yield data were :

Method 1 : Combining the results of experiments repeated over time i.e. groups of experiments (Panse and Sukhatme, 1978).

Method 2 : Combining the results of experiments repeated over time on the same site with same randomization i.e. split plot analysis (Rowell and Walters, 1976).

Method 3 : Principal component analysis (Prabhakaran and John 1996).

Method 4 : Rank analysis (Rai and Rao, 1980 & 1984).

After analysing the yield data, the comparisons of results of various approaches were made by employing the following four criteria :

- (i) Statistical significance of treatment differences by 'F' value which was available from the analysis of variance in various approaches.
- (ii) Comparison of the experimental variability using coefficient of variation (C.V. %) obtained from the error mean squares of different methods of analysis.
- (iii) Consistency of the behaviour of treatment effects over years i.e. year x treatment interaction which were also available from the analysis of variance except principal component analysis.
- (iv) Agreement of the results of treatment means were compared by the following two criterion :
 - (a) Duncan's new multiple range test i.e. DNMRT (Gomez and Gomez, 1983).
 - (b) Rank correlation method (Steel and Torrie, 1960).

RESULTS AND DISCUSSION

The yield data were analysed by different methods. Cropwise summary of the results is presented in the following tables :

The results presented in Table 1 revealed that, in parametric as well as non-parametric approaches, the 'F' ratios and 'K' values were highly significant. The lowest experimental variability was observed in method 3, whereas it was the highest in method 2.

The year x treatment interaction was found highly significant in first two approaches,

TABLE 1

Yield data obtained from the four methods of analysis in pearl millet and wheat.

Trts.	Pearlmillet				Wheat			
	Method 1 (kg/ha)	Method 2 (kg/ha)	Method 3	Method 4	Method 1 (kg/ha)	Method 2 (kg/ha)	Method 3	Method 4
1.	1015.91 g	1015.91 g	1.84 g	9.38	1091.11 e	1091.11 e	1.52 e	9.57
2.	1383.41 f	1383.41 f	2.47 f	6.80	1278.19 e	1278.19 e	1.77 e	8.76
3.	1457.77 ef	1457.77 def	2.64 def	6.61	2026.55 d	2026.55 d	2.83 d	6.57
4.	1425.08 f	1425.08 ef	2.60 ef	6.82	2066.46 d	2066.46 d	2.89 d	6.36
5.	1573.59 de	1573.59 cde	2.87 cde	5.53	2212.43 cd	2212.43 cd	3.10 cd	5.19
6.	1585.78 cde	1585.78 cd	2.91 cd	5.26	2226.89 cd	2226.89 cd	3.12 cd	5.28
7.	1674.99 bcd	1674.99 bc	3.03 bc	4.71	2455.04 bc	2455.04 bc	3.43 bc	4.06
8.	1791.46 b	1791.46 b	3.26 b	3.64	2705.60 ab	2705.60 ab	3.77 ab	2.65
9.	1734.22 bc	1734.22 bc	3.22 b	4.18	2435.31 c	2435.31 bc	3.41 bc	4.16
10.	2095.57 a	2095.57 a	3.83 a	2.07	2780.88 a	2780.88 a	3.92 a	2.40
Treatment effects								
S. Em.	47.11	48.26	0.09	0.35	77.09	87.00	0.12	0.35
CD 0.05	130.59	140.06	0.26	0.97	213.68	252.48	0.34	0.97
CV %	16.32	25.29	6.28	—	16.03	33.72	7.96	—
Cal F	37.02**	35.27**	35.06**	—	52.20**	40.98**	43.89**	—
K value	—	—	—	307.93**	—	—	—	418.77**
Year x Treatment interaction effects								
S. Em.	128.42	145.34	—	—	170.51	174.23	—	—
CD 0.05	355.96	402.86	—	—	472.63	482.95	—	—
CV %	16.32	18.47	—	—	16.03	16.38	—	—
K value	—	—	—	134.61*	—	—	—	77.73 NS

* : Significant at 5 per cent level of significance.
** : Significant at 1 per cent level of significance.
NS : Non Significant.

TABLE 2

Rank correlation coefficient between different approaches in pearl millet and wheat.

Methods	Pearlmillet				Wheat			
	Method 1	Method 2	Method 3	Method 4	Method 1	Method 2	Method 3	Method 4
Method 1	1.00	1.00	1.00	0.99	1.00	1.00	1.00	0.99
Method 2		1.00	1.00	0.99		1.00	1.00	0.99
Method 3			1.00	0.99			1.00	0.99
Method 4				1.00				1.00

whereas it was significant at five per cent level of significance in the last approach for pearl millet crop and it was non significant for wheat.

The consistency in various treatment effects was more or less same in all the methods and it was also confirmed by rank analysis which gave very high degree of association among the ranks obtained by all the approaches.

The treatment ranking was almost same among all the approaches. Rank correlation coefficient values were very high among all the methods (Table 2).

Thus, based on the experimental variability and test of significance, it was inferred that principal component method was slightly more efficient than the usual split plot analysis and the analysis of groups of experiment.

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