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Trends of Crop Productivity in Long Term Experiment

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ABSTRACT

The yield data from a long term experiment conducted at two different locations of Gujarat Agricultural University were utilized for the period 1979 to 1992. Two crop sequences tried were specific to the respective regions. Curve fitting approach was used to study the trend in crop yield. In all, 24 different equations were tried using original treatment means and three years moving averages. Use of moving average values reduced the seasonal/irregular fluctuations in the data effectively and gave better fit as compared to that of original set of data. The best fitted equation for defining the trend in yield due to treatments within a crop differed, except in case of groundnut. In majority of the cases, polynomial equations with varying degree and bases defined the trend of productivity of the crops.

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INTRODUCTION

Long term field experiments help in studying the changes in the productivity of the soil over the time alongwith direct, residual and cumulative effects of fertilizer application. In all the long term experiments, time is a quantitative factor, hence a common practice is to partition time into components associated with orthogonal polynomials (Gomez and Gomez, 1984). In most of the cases, a simple linear trend either positive or negative may be sufficient to describe a long term trend. However, in the case, where the yield fluctuates substantially over the time, the trend may not be easily described. The method of adjustment of such fluctuations in statistical analysis can be studied using time series analysis. Keeping this in view, an attempt has been made in the present investigation to examine the possibility of adjustment of such fluctuations in statistical analysis using time series (moving average) analysis and to explore the trend in yield due to various fertilizer treatments in different crops through curve fitting approach.

MATERIALS AND METHODS

The data for the present study were collected from a long term experiment conducted by the Department of Agricultural Chemistry in collaboration with the Department of Agronomy, at two different locations of Gujarat Agricultural University, for the period 1979 to 1992. The crop sequences tried were specific to the respective region.

In order to explore the possibility of adjustment of climatic/irregular fluctuations and

identifying the trend equations for various treatments over the period of time, 24 different equations were tried (Table 1) using curve fitting approach (i) using original treatment mean and (ii) using three years moving average.

TABLE 1

List of equations.

	Equation number and form	*Equation name*
1.	Y = A + B*X	Straight line
2.	Y = B* X	Line through origin
3.	Y = A + B* X^ .5 +C*X	2nd deg. poly. with X^.5 as base
4.	Y = A + B/X^. 5 + C/X	2nd deg. poly. with 1/X^.5 as base
5.	Y = A + B*X + C/X	Linear and reciprocal
6.	Y = A + B/X	Hyperbola
7.	Y = X / (A* X + B)	Reciprocal hyperbola
8.	Y = A + B*X^.5 + CX + D*X^ 1.5	3rd deg. poly. with X^ .5 as base
9.	Y = A + B / X + C / X^ 2	2nd order hyperbola
10.	Y = A + B* X + C* X^ 2	Parabola
11.	Y = A + B* X + C / X^ 2	Mod. parabola
12.	Y + A + B* X + C* X^ 2 + D* X^ 3	3rd deg. polynomial
13.	Y = A + B / X + C / X^ 2 + D / X^ 3	Reciprocal 3rd deg. polynomial
14.	Y = A + B / X^ .5 + C / X + D / X^ 1.5	3rd deg. poly. with 1/X^.5 as base
15.	Y = A * X^ B	Power function
16.	Y = A* B^ X	Mod. power function
17.	Y = B^ (1/X)	Root function
18.	Y = A* X^ (B*X)	Super geometric
19.	Y = A* X^ (B/X)	Mod. geometric
20.	Y = A* e^ (B*X)	Exponential
21.	Y = A* e^ (B/X)	Mod. exponential
22.	Y = A + B* ln (X)	Logarithmic
23.	Y = 1 / [A + B* ln (X)]	Reciprocal logarithmic
24.	Y = A*B^ X*X^ C	Hoerl function

Using original treatment means the respective equations for each of the treatments for various crops were fitted and the best fitted equation was identified as the one having the

TABLE 2

Comparison of coefficients of determination for the best fitted trend equations fitted through original data and moving average values in various treatments.

Crop	*Groundnut*		*Wheat (J)*		*Sorghum*		*Bajra*		*Wheat (A)*	
Treatment	R^2	R^2	R^2	R^2	R^2	R^2	R^2	R^2	R^2	R^2
Control	-0.04	0.78	0.72	0.97	0.72	0.98	-0.15	0.34	-0.26	0.08
FYM	-0.06	0.82	0.63	0.65	0.38	0.89	-0.10	0.30	0.04	0.35
N50	-0.05	0.78	0.86	0.99	0.80	0.99	-0.17	0.33	0.54	0.66
NP50	-0.04	0.74	0.33	0.86	0.60	0.96	-0.22	0.31	0.54	0.69
NPK50	-0.04	0.71	0.38	0.83	0.50	0.96	-0.19	0.30	0.22	0.68
N100	-0.05	0.78	0.89	0.96	0.80	0.98	-0.24	0.20	0.70	0.89
NP100	-0.03	0.78	-0.03	0.54	0.69	0.97	-0.24	-0.09	0.45	0.63
NPK100	0.02	0.77	0.41	0.85	0.33	0.97	-0.15	0.29	0.01	0.70
NsPs	-0.09	0.73	0.38	0.81	0.75	0.96	-0.25	0.37	0.70	0.83
NsPsKs	0.03	0.79	0.52	0.87	0.39	0.95	-0.12	0.49	0.45	0.68

Note : R^2 = Adj. R^2 of the best fitted equation using original data R^2 = Adj. R^2 of the best fitted equation using moving average.

highest adjusted coefficient of determination (R^2). In the second approach taking first year of the experiment as the base year, three years moving average values of the original treatment means were obtained and using these values, the best fitted equation was identified from the equations tried for each treatrment of the crops under study.

RESULTS AND DISCUSSION

The best fitted trend equations by both the methods are presented in Table 2. The results indicated that the use of moving average values reduced the seasonal/irregular fluctuations in the data remarkably and gave better fit (adjusted R^2) as compared to original treatment mean equations.

The results presented in Table 3 revealed that best fitted equation for various treatments for a crop differed, indicating that the quantum, form and combinations of the nutrients affected the trend in crop productivity. However, in case of groundnut, which require quite low level of nutrients, a consistent behaviour was noticed, while for the rest of the crops various degree of polynomial with different bases explained the trend in yield over the time.

TABLE 3

Best fitted trend equation for different treatments in different crops.

Treatment	*Crops*				
	Groundnut	*Wheat (J)*	*Sorghum*	*Bajra*	*Wheat (A)*
Control	8	8	9	8	14
FYM	8	7	12	10	4
N50	8	8	9	8	6
NP50	8	8	1	8	6
NPK50	8	12	4	8	9
N100	8	8	9	8	3
NP100	8	8	1	12	3
NPK100	8	8	4	8	10
NsPs	8	4	1	8	6
NsPsKs	8	12	4	12	9

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