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PATH COEFFICIENT ANALYSIS OF YIELD COMPONENTS OF WHEAT (VARIETY SINDH-81)

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Abstract

The direct and indirect effects of four different characters (causal variables) on grain yield / plant (resultant variable) of wheat are measured using path coefficient analysis (PCA). It is observed that the two characters, viz. No. of Spikes/Plant and No. of Grains/Spike have the major direct effect on grain yield/plant. The direct effect of Spike Length is insignificant while the indirect effect of No. of Spikelets/Spike is significant. Thus No. of Grains/Spike can be used as most reliable character in the selection of high yielding variety.

Key words: Path coefficient analysis, wheat yield components

Introduction

The goal of path Analysis is to provide plausible explanation of observed correlation by constructing models of cause-and-effect relation among variables. Path coefficients are standardized partial regression coefficients.

Path coefficient can be defined as the ratio of the S.D of the effect, due to a given cause, to the total S.D of the effect; for instance the path coefficient for the path from cause X_i to the effect Y is • xi/ • y.

The analysis proceeds in stages. At each stage a new dependent variable is chosen and new coefficients are computed with the analysis guiding the sequence of fitting and interpretation. The results lend themselves well to diagrammatic presentation. This method requires cause and effect situation among the variables. It also permits the separation of the correlation coefficient into components of direct and indirect effects. The direct effect of a specified independent variable is referred to as the path from X to Y.

The path analysis consists of two major components:

1. The path diagram.

2. The decomposition of observed correlation into a sum of path coefficient terms representing simple and compound paths. These features enable us to measure both the direct and indirect effects that the one variable has upon another.

The present study was undertaken:

To determine the interrelationships of yield with some important yield components.

To partition the phenotype correlation coefficients into their direct and indirect effects on wheat using the real world data.

Review of Literature

PCA has been used in plant breeding and crop production since 1959.

Dewey and Lu (1959) conducted PCA on crested wheat grass and analyzed its different characters. They observed that fertility and plant size had strong direct and indirect effects upon seed yield.

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Bhatti (1973) studied four different characters of Spring Wheat. PCA revealed that grain yield per plant was greatly influenced by plant height and ear number per plant.

Larik *et al* (1987) conducted study on different characters. They reported that the direct effect of plant height on yield was very low and positive. The indirect effects of pant height via the yield components were negative. The high positive indirect path coefficient of spike number and grains per spike contributed to high value of total correlation coefficient (r) . The relatively unimportant indirect path coefficient values indicate that the majority of the variation in yield was accounted for its association with grains per spike number.

Kumbhar et al (1981) worked out the correlation and PCA of yield components in wheat (variety Sindh-81) He observed that the direct effect of spike length on yield was low and negative. The direct effect of spikelets was positive but not so pronounced, and seeds per spike had major contribution to yield.

Virk and Singh (1972) studied PCA of grain yield in eleven varieties of wheat. Their study revealed that yield was positively correlated with plant height and number of ear heads per plant; the later having the most influence on yield.

Akbani et al (1990) worked out breed wheat correlation, PCA and path regression analysis. They observed the direct effect of four causal variables, viz, tiller number/plant, spike length, spikelets/spike and grains/spike on grain yield/plant. The direct effect of tiller number/plant was very high and positive.

Partial regression analysis also confirmed the findings of PCA and suggested that tiller number/plant is the most effective yield component of the wheat cultiver.

Materials and Methods

The study was to examine the behavior of path coefficient for some important quantitative characters of wheat (variety Sindh–81). The experiment was conducted at the experimental area of Sindh Agriculture University, TandoJam. The seed was sown in a complete Random design with four replications.

<a> Phenotypic correlation coefficient (r) was calculated for the following characters using the standard formula
Number of Spikes / Plant.

Spike Length.

Spikelets / Spike.

Number of Grains / Spike.

Grain Yield / Plant. Multiple correlation coefficient was calculated by using the formula of steel & torrie [10].

Phenotypic correlation coefficients were partitioned into path coefficients using the techniques outlined by Dewey and Lu [2]. This involves partitioning of r to determine unidirectional path ways 'p' and indirect influences through alternate pathways {Path ways 'x' correlation coefficient, i.e. P_{xr}} of various variables over grain yield per plant.

The path coefficients were calculated through the solution of the following equations:

<1> $r_{1y} = r_{11} P_{1y} + r_{12} P_{2y} + r_{13y} P_{3y} + r_{14} P_{4y}$

<2> $r_{2y} = r_{12} P_{1y} + r_{22} P_{2y} + r_{23y} P_{3y} + r_{24} P_{4y}$

<3> $r_{3y} = r_{13} P_{1y} + r_{23} P_{2y} + r_{33y} P_{3y} + r_{134} P_{4y}$

<4> $r_{4y} = r_{14} P_{1y} + r_{24} P_{2y} + r_{34y} P_{3y} + r_{44} P_{4y}$

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$$P_{xy} = \sqrt{1-(P^2_{1y} + P^2_{2y} + P^2_{3y} + P^2_{4y} + 2P_{1y}P_{2y}r_{12} + 2P_{1y}P_{3y}r_{13} + 2P_{1y}P_{4y}r_{14} + 2P_{2y}P_{3y}r_{14} + 2P_{2y}P_{4y}r_{24} + 2P_{3y}P_{4y}r_{34})}$$

Where $P_{iy} = b_i \; S_i = \sqrt{\frac{\sum X_i - (\sum X_i)^2 / n}{n-1}}$

Results and Discussion

<a> Simple Correlation Coefficients between all possible combinations (Table). Result reveal that all the characters are positively correlated.

Table 1. Phenotypic Correlation among all possible combinations of quantitative characters

S. No.	Characters	No. of Spike per Plant	Spike length	Spikelets per Spike	No. of Grains / Spike	Grain Yield per Plant
01	No. of Spikes/Plant	1.000	0.241	0.394*	0.453**	0.834**
02	Spike Length		1.000	0.751**	0.726**	0.488**
03	Spikelets/Spike			1.000	0.927**	0.570**
04	No. of Grains/Spike				1.000	0.662**
05	Grain Yield/Plant					1.000

D.F = n – 2 = 28, t (0.25) = 2.048, t (.015) = 2.763

* is for only Significant, ** is for Highly Significant

Multiple Correlation and Regression

The effectiveness of various yield components and their contribution towards final yield was observed by working out multiple correlation between grain yield/plant and various yield components. The results are listed in Table. 2.

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Table. 2. Regression Analysis of yield and yield components.

Square of Variation	D F	S S	M s	F
Regression on Variables	4	10.5067	26.267	27.44**
Residual	24	23.928	0.957	
Total	29	128.995		

D.F= n-k-1 = 25

Multiple Correlation Coefficient = 0.90249

Table (2) shows that significant amount of variation has been explained by regression (i.e. 90%)

Estimated Standard Error = 1.0694

Path Coefficient Analysis

Table 3 Direct and Indirect Effect of various characters on ggrain yield per plant.

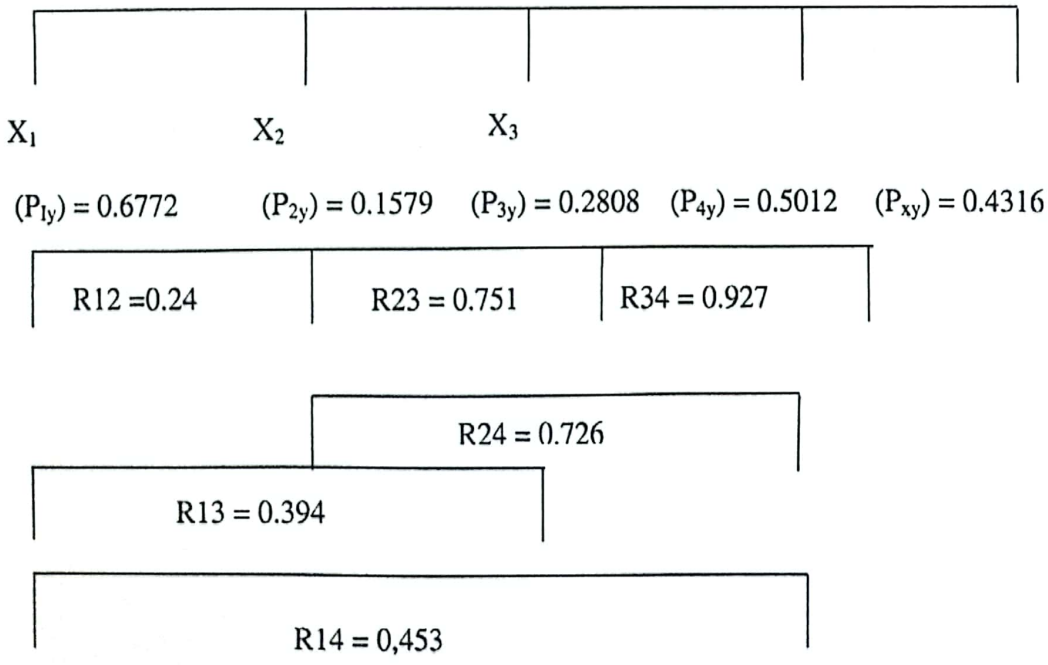
S. No	Path ways of Association	DirectEffect(P)	Indirect Effect (P_{xr})	Correlation Coefficient (r)
01	No. of Spikes/Plat.vs. Yield (a) Direct Effects (P_{1y}) (b) Indirect Effect via <i> Spike Length (P_{2y} r_{12}) <ii> Spikelets/Spike (P_{3y} r_{13}) <iii> No.of Grains/Spike (P_{4y} r_{14}) <c> Total Effects	0.6772 (81%)	0.0412 (5%) -0.1109 (13%) 0.2271 (27%)	0.8248
02	Spike Length. V.s Yield (a) Direct Effects (P_{2y}) (b) Indirect Effect via <i> Spike Length (P_{1y} r_{12}) <ii> Spikelets/Spike (P_{3y} r_{23}) <iii> No.of Grains/Spike (P_{4y} r_{24}) <c> Total Effects	0.1579(32%)	0.1769 (36%) -0.2109 (43%) 0.3641 (74%)	0.4883

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03	Spikelets / Spike. vs. Yield (a) Direct Effects (P_{3y}) (b) Indirect Effect via <i> Spike Length (P_{1y} r_{12}) <ii> Spikelets/Spike (P_{2y} r_{23}) <iii> No.of Grains/Spike (P_{4y} r_{34}) <c> Total Effects	-0.2808 (49%)	0.2674 (46%) 0.1186 (20%) 0.4668 (81%)	0.5702
04	No. of Grains/Spike. Va. Yield (a) Direct Effects (P_{4y}) (b) Indirect Effect via <i> Spike Length (P_{1y} r_{14}) <ii> Spikelets/Spike (P_{2y} r_{24}) iii No.of Grains/Spike ($P_{3y}r_{34}$) <c> Total Effects	0.5012 (75%)	0.3068 (46%) 0.1147 (17%) -0.2604 (39%)	0.6625
05	Residual Effect (P_{xy})			0.4316

Path Diagram Between Yield and Yield Components

(Y)



1 Number of Spikes/Plant . vs. Grain Yield/ Plant.

i . The direct effect of No. of Spikes/Plant was 0.6772, i.e, 81.12% of r. It is very high contribution as compared to other characters

ii. The indirect effect via Spike Length was 0.04128, i.e. 4.94% or r. It is very low but positive contribution.

iii. the indirect effects via Spikelets/Spikes and No. of Grains./Spike were –0.1109 (i.e 13%) and 0.2271 (i.e 27%), respectively.

Total r between No. of Spikes/Plant and Yield being 0.8348, indicates that selection of this character is most useful for getting high grain yield. This is consistent with the results of Larik [5] and Bhatti [1].

2. Spike Length. Vs. Grain Yield / Plant.

i . The direct effet of Spike Length was 0.1579, i.e 32.3% of r. It is positive but low.

ii. The indirect effects via No. of Spikes/Plant and Spikelets/ Spike were 0.177 (36.2%) and – 0.221 (43%) 0.211 (43%),
respectively.

iii. The indirect affect via No. of Grains/Spike was 0.364 (i.e 746%). It is very high and positive.
Total r between Spike Length and Yield being 0.4883 was mostly due to the indirect effect of No. of Grains./Spikes.

These results are consistent with those obtained by Siddiqui [8] and Larik [4].

3. Spikelets/Spike. V.s. Grains Yield / Plant.

i. The direct effect of Spikelets/Spike was –0.2808, i.e 49.2% of r or moderate and negative.

ii. The indirect effects via No. of Spike/Plant and Spike Length were 0.2674 (46.9%) and 0.1186 (20%)

iii. The indirect effect via No. of Grain/Spike was 0.4668, i.e. 81.5% of r (very high and positive).

Total r between Spikelets/Spike and Grain Yield was 0.5702 which is mainly the indirect effect via No. of Grains/Spike, and also via No. of Spikes/Plant.

Hence, Spikelets/ Spike can not be regarded as a suitable selection criterion. It may be noted that Kumbher [3], Deway, Lu [7] and Larik [4] reported that Spikelets / Spike has positive effect of low magnitude on yield.

4. No. of Grains/Spike V.S Grain Yield/Plant.

i . The direct effect of No. of Grain/Spike on Yield was 0.0512, i.e. 75.6% of r (high and positive).

ii. The indirect effects via Spike Length and No. of Spikelets were 0.1148 (17%) and –0.26 (39%) respectively.

iii. The indirect effect via No. of Spike/Plant was 0.3068, i.e. 46% of r (moderate and positive).

The r between No. of Grains/Spike and Yield was 0.6625. It was mainly due to the direct effect of No. of Grains/Spike

on Yield and also indirect effect via No. of Spikes/Plant. Thus No. of Grains/Spike may be considered as the most reliable character in the selection of high yielding wheat. These results are consistent with those obtained by Larik [5].

Conclusion

The path coefficient analysis showed that No of Spikes/Plant and No. of Grains/Spike were the only characters having subsequently the direct effect on Grain Yield/Plant. Therefore it maybe concluded that only these two characters contribute towards the improvement of yield potential.

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