Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 3, No. 10, p. 24-30, 2013
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Path coefficient analysis for the yield components of rice cultivars in Iran under different nitrogen levels

Ebrahim Azarpour

Department of Agriculture, Lahijan Branch, Islamic Azad University, Lahijan, Iran

Article published on October 1, 2013

Key words: Rice, path analysis, correlation, stepwise regression.

Abstract

In order to determine the relationships among yield and yield components in rice (*Oryza sativa L.),* an experiment as factorial in RCBD with three replications was conducted during 2009 year in the Rice Research Institute, Iran, Rasht, central of Guilan and Rudsar, East of Guilan. Factors were cultivar (Khazar, Ali Kazemi and Hashemi), and nitrogen fertilizer levels (0, 30, 60, and 90 Kg N/ha). Results showed that grain yield in rice had significant and positive correlation at 1% with panicle weight (r = 0.96) and biological yield (r = 0.71). Results of path coefficient analysis showed that, number of grain and number of panicle had the highest and positive effect on grain yield. The direct effects of number of grain and number of panicle on grain yield were 1.135 and 0.711 receptivity.

***Corresponding Author:** Ebrahim Azarpour ✉ e786_azarpour@yahoo.com

Introduction

Rice is an important food crop for a large proportion of the world's population. It is staple food in the diet of the population of Asia, Latin America, and Africa. Rice provides 35-60% of the dietary calories consumed by more than 3 billion people (Fageria *et al.*, 2003). Globally, it is also the second most cultivated cereal after wheat. Unlike wheat, 95% of the world's rice is grown in less developed nations, primarily in Asia, Africa, and Latin America. China and India are the largest rice producing and consuming countries in the world. By the year 2025, it is estimated that it will be necessary to produce about 60% more rice than what is currently produced to meet the food needs of a growing world population. In addition, the land available for crop production is decreasing steadily due to urban growth and land degradation. Hence, increases in rice production will have to come from the same or an even less amount of land. This means appropriate rice production practices should be adopted to improve rice yield per unit area (Fageria, 2007). Guilan province has allocated more 35 and 42 percent of paddy production and cultivation land area cultivation area of Iran, respectively. In this province more than 181 exploiters on productive and talented areas with more than 230000 hectares, are busy rice farming (Peykani *et al.*, 2006). Indeed, rice cultivation is considered the most important agricultural activity in this province and the economy of the province is also based on agriculture, with rice cultivation in top. Most of the under cultivation area of local varieties in Guilan are including Hashemi and Alikazemi. Most of the under cultivation area of breed varieties in Guilan are including Khazar, Hybrid and Gohar (Azarpour and Moraditochaee, 2013).

Path coefficient analysis is a statistical technique of partitioning the correlation coefficients into its direct and indirect effects, so that the contribution of each character to yield could be estimated. It is used in plant breeding programs to determine the nature of the relationships between yield and yield components that are useful as selection criteria to improve the crop yield. The goal of the path analysis is to accept descriptions of the correlation between the traits, based on a model of cause and effect relationship and to estimate the importance of the affecting traits on a specific trait (Cyprien and Kumar, 2011). Surek and Beser (2003) with study correlation and path coefficient analysis for some yield-related traits in rice (Oryza sativa L.) under Thrace conditions, were reported that When the results of correlation and path coefficient analysis are examined, it is observed that the number of filled grains per panicle, the number of productive tillers per square metre, biological yield and harvest index recorded a direct positive effect on grain yield, and they had a positive indirect effect via each other except between biological yield and harvest index and between the number of productive tillers per square metre and the number of filled grains per panicle. Therefore, they do not affect each other adversely. In addition, these traits had significant and positive correlations with grain yield. Thus, selection for the improvement of grain yield can be efficient, if it is based on biological yield, harvest index, the number of filled grains per panicle and the number of productive tillers per square metre in temperate conditions. These traits may be utilised for pure line selection in late generations; however, both high biological yield and high harvest index should be taken into account together in this selection due to their negative correlation and indirect effect via each other.

In this research we use of path analysis with goal of determination the more important part in rice cultivars grain yield under nitrogen management, which can be useful for other studies.

Materials and methods

Materials

Agricultural research in 2009 at Rice Research Institute in Rasht, Iran, township in Guilan province Center (latitude 37 degrees 16 minutes North and longitude 41 degrees 36 minutes East) and located in East Guilan, Rudsar city (latitude 37 degrees 7 minutes north and longitude 49 degrees 35 minutes

East) was performed. Factors tested, including cultivars in three levels (the Khazar, Ali Kazemi and Hashemi) and nitrogen fertilizer at four levels (0, 30 kg ha-1 pure nitrogen: one part at the time of transfer seedlings from the nursery to the main field, 60 and 90 kg ha-1 of nitrogen: in two part at the time of transfer seedlings from the nursery to the main field and in the tillering stage) was the source of urea. In late February the first plowing was done in the second half of May main field after secondary plowing, drawing trowel and after leveling, the scheme was implemented. Sowing in nursery in the first half of May was done and seedlings after 4-3 leaf were transferred to the main field in early Jun. The number of seedlings per hill 3-4 and plant spacing between two seedlings for Hashemi and Ali kazemi cultivars 20×20 cm and for Khazar cultivar 25×25 cm in plots with 12 m2 spaces was determination. For chemical combat with stem borer worm of rice diazinon 5% was used and for weeds chemical combating satrin herbicide (3-3.5 lit/ha) one week after transplantation was used. Also handy weeding in twice (25 and 50 day after transplantation) was performed. Among the cultivars, improved and late maturity cultivars of Khazar later than the other two cultivars were harvested. Ali-Kazemi and Hashemi cultivars were the native cultivars of Guilan province but Khazar cultivar was obtained through crossing between TNAU7456 cultivar and IR2071-625-1-52 line. Grain yield and biological yield with harvest from 4 m2 per plot was measured.

Methods

Path coefficient analysis was performed using PATH 2 program. SPSS program was used for stepwise regression and phenotypic correlations between examined characters.

Result and discussion

Correlation

With attention to correlation coefficients (Table 1.), results showed that grain yield in rice had significant and positive correlation at 1% with panicle weight (r = 0.96) and biological yield (r = 0.71). With attention to correlation coefficients (Table 1.), results showed that panicle weight in rice had significant and positive correlation at 1% with grain yield (r = 0.96) and biological yield (r = 0.75). With attention to correlation coefficients (Table 1.), results showed that panicle length in rice had significant and positive correlation at 1% with plant height (r = 0.78), 1000 grain weight (r = 0.90), number of panicle (r = 0.71) and number of tiller (r = 0.73).With attention to correlation coefficients (Table 1.), results showed that plant height in rice had significant and positive correlation at 1% with plant length (r = 0.78), number of panicle (r = 0.98) and number of tiller (r = 0.98). With attention to correlation coefficients (Table 1.), results showed that 1000 grain weight in rice had significant and positive correlation at 1% with plant length (r = 0.90). With attention to correlation coefficients (Table 1.), results showed that number of panicle in rice had significant and positive correlation at 1% with panicle length (r = 0.71), plant length (r = 0.98) and number of tiller (r = 0.99). With attention to correlation coefficients (Table 1.), results showed that number of tiller in rice had significant and positive correlation at 1% with panicle length (r = 0.73), plant length (r = 0.98) and number of panicle (r = 0.99). With attention to correlation coefficients (Table 1.), results showed that biological yield in rice had significant and positive correlation at 1% with grain yield (r = 0.71) and panicle weight (r = 0.75). Haider *et al.* (2012) indicate that root length (0.465**), root shoot ratio (0.242*), thousand grain weight (0.476**), grains per panicle (0.733**), spikelet fertility (0.709**) and drought response index (0.642**) showed positive and significant association with yield per plant under drought stress at genotypic level; whereas, leaf drying (-0.599**) had significantly negative correlation with yield. Similar findings were earlier reported by Basavaraja *et al.* (2011) and Shanthi *et al.* (2011) for panicles per plant and Kole *et al.* (2008) for panicle length and Gulzar *et al.* (2012) for total grain number.

Table 1. Correlation coefficients between studied traits.

Parameter	1	2	3	4	5	6	7	8	9	10
1- Grain yield	1									
2- Panicle weight	0.96**	1								
3- Panicle length	-0.17	-0.06	1							
4- Plant height	0.064	0.10	0.78**	1						
5- 1000 grain weight	0.041	0.25	0.90**	0.54	1					
6- No. of grain	0.45	0.39	-0.80**	-0.85**	-0.48	1				
7- No. of panicle	0.026	0.042	0.71**	0.98**	0.42	-0.86**	1			
8- No. of tiller	0.056	0.077	0.73**	0.98**	0.47	-0.85**	0.99**	1		
9- Biological yield	0.71**	0.75**	-0.03	0.06	0.18	0.24	0.08	0.09	1	
10- Harvest index	0.44	0.31	-0.52	-0.24	-0.49	0.52	-0.28	-0.29	-0.24	1

** significant at 1% levels.

Stepwise regression

The regression coefficient between the variables in stepwise regression with single grain yield emissions is shown in Table 2.

Model 1: Grain yield= -0.941.88 + 1865.94 (Panicle weight); R2: 0.93.

Model 2: Grain yield= 1179.95 + 1974.5 (Panicle weight) – 87.53 (1000 grain weight); R2: 0.98.

Model 3: Grain yield= 1397.39 + 1984.5 (Panicle weight) – 108.143 (1000 grain weight + 1.22 (No. of tiller); R2: 1.

Model 4: Grain yield= -1839.49 + 1336.27 (Panicle weight) – 44.26 (1000 grain weight) + 15.12 (No. of grain) + 6.96 (No. of tiller); R2: 1.

Model 5: Grain yield= -4871.86 + 852.30 (Panicle weight) + 22.38 (1000 grain weight) + 27.19 (No. of grain) + 8.28 (No. of panicle) + 2.71 (No. of tiller); R2: 1.

Model 6: Grain yield= -3854 + 1014.98 (Panicle weight) + 23.14 (No. of grain) + 5.98 (No. of panicle) + 4.1 (No. of tiller); R2: 1.

Table 2. Results of stepwise regression.

Step	1	2	3	4	5	6
Constant number	-0.941.88	1179.95	1397.39	-1839.49	-4871.86	-3854
Panicle weight	1864.94	1974.58	1984.5	1336.27	852.30	1014.98
1000 grain weight		-87.53	-108.143	-44.26	22.38	
No. of grain				15.12	27.19	23.14
No. of panicle					8.28	5.98
No. of tiller			1.22	6.96	2.71	4.1
R^2	0.93	0.98	0.99	1	1	1

Path coefficient analysis

The nature of the causal system is represented diagrammatically in Fig.1. The results of path coefficient analysis showed that, number of grain and number of panicle had the highest and positive effect on grain yield. The direct effects of number of grain and number of panicle on grain yield were 1.135 and 0.711 receptivity (Table 3.). The maximum amount of indirect effect was related to indirect effect of number of panicle from way of number of tiller (0.99) (Table 3.). It seems that with increased number of tiller, the number of panicle was increased and due to this reason grain yield was growth.

Bhadru *et al.* (2011) with study on 93 rice genotypes involving hybrids and their parental lines reported that plant height, filled grains per panicle, days to 50 percent flowering and panicle weight had a significant

positive association with yield and also had a positive direct effect on yield both at the phenotypic and genotypic levels. Satish Chandra *et al.* (2009) with study of path coefficient analysis noted that the number of grains per panicle exerted the highest direct effect on grain yield followed by days to 50 percent flowering, 1000-grain weight and number of productive tillers per plant. In another investigation Seyoum *et al.* (2012) studied fourteen rice genotypes and demonstrated that grain per panicle had maximum positive direct effect and highly significant genotypic correlation coefficient with grain yield.

Table 3. Direct and indirect effects of studied traits on grain yield.

Traits	Direct effect	Indirect effect from way of				
		X1	X2	X3	X4	X5
X1	0.459	-	0.12	0.18	0.02	0.035
X2	0.045	0.02	-	-0.03	0.02	0.03
X3	1.135	0.45	-0.55	-	-0.98	-0.97
X4	0.711	0.03	0.3	-0.62	-	0.71
X5	0.259	0.02	0.13	-0.22	0.26	-

X1= Panicle weight, X2= 1000 grain weight, X3= Number of grain, X4= Number of panicle, X5= Number of tiller, Y= Yield, P= Direct effects, r= correlation

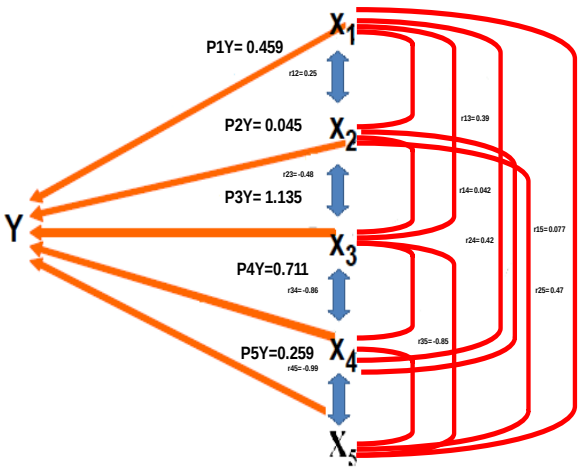

Fig. 1. Path analysis diagram in rice.

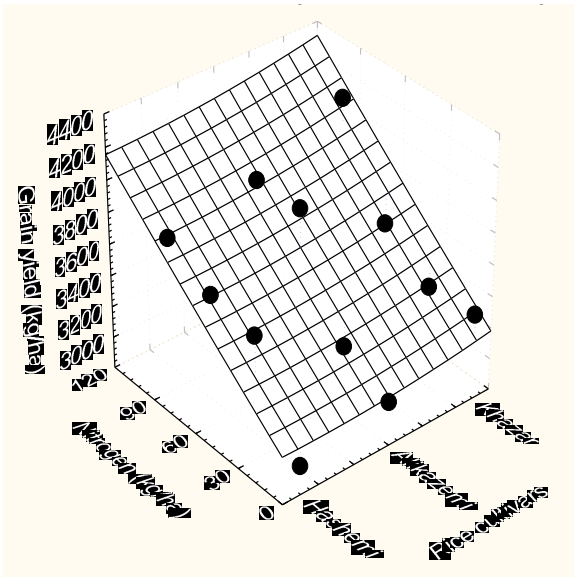

Fig. 2. The effect of nitrogen fertilizer on grain yield for rice cultivars.

Grain yield

With attention to Fig. 2., with increase of nitrogen fertilizer for all rice cultivar, grain yield increases. Optimum nitrogen consumption by use of N4 level (90 Kg N/ha) case to highest grain yield. For an optimal yield, the N supply must be available according to the needs of the plant. Nitrogen deficiency generally results in stunted growth, chlorate leaves because lack of N limits the synthesis of proteins and chlorophyll. This leads to poor assimilate formation and results in premature flowering and shortening of the growth cycle. The presence of N in excess promotes development of the above ground organs with relatively poor root growth. Synthesis of proteins and formation of new tissues are stimulated, resulting in abundant dark green (high chlorophyll) tissues of soft consistency. This increases the risk of lodging and reduces the plants resistance to harsh climatic conditions and to foliar diseases (Lincoln, 2006).

Conclusion

Correlation coefficient was important to determine traits, which had directly effect on grain yield, could not determine indirect effects of these traits on yield. In path analysis, the correlation coefficient between two traits is separated into the components which measure the direct and indirect effects. Results showed that grain yield in rice had significant and positive correlation at 1% with panicle weight (r = 0.96) and biological yield (r = 0.71). Results of path coefficient analysis showed that, number of grain and number of panicle had the highest and positive effect on grain yield. The direct effects of number of grain and number of panicle on grain yield were 1.135 and 0.711 receptivity.

References

Azarpour E, Moradi M. 2013. A comparative study on energy use and cost analysis of Rice Varieties under Traditional and Semi-mechanized Farming Systems in North of Iran. Biomass, InTech-Open Access Company 1-37.

Basavaraja T, Gangaprasad S, Dhusyantha Kumar BM, Hittlamani SH. 2011. Correlation and path analysis of yield and yield attributes in local rice cultivars (Oryza sativa L.), Electronic Journal of Plant Breeding **2,** 523 -526.

Bhadru D, Lokanadha Reddy D, Ramesha MS. 2011. Correlation and path coefficient analysis of yield and yield contributing traits in rice hybrids and their parental lines. Electronic Journal of Plant Breeding **2,** *112-116.*

Peykani GR, Kavoosi Kelashemi M, Sadat Barikani SH, Sasouli MR. 2008. Comparison of Production Productivity of 3 Rice Varieties Including Long Grain Good Quality, Long Grain High Yielding and Hybrid Rice in Iran (Case Study: Gilan Province). American-Eurasian Journal of Agricultural & Environmental Sciences **4,** 625-632.

Cyprien M, Kumar V. 2011. Correlation and path coefficient analysis of rice cultivates data. Journal of Reliability and Statistical Studies **4,** 119-131.

Fageria NK, Slaton NA, Baligar VC. 2003. Nutrient management for improving lowland rice productivity and sustainability. Advances in Agronomy **80,** 63-152.

Fageria NK. 2007. Yield physiology of rice. Journal of Plant Nutrition **30,** 843–879.

Gulzar S, Sanghera Subhash C, KASHYAP. 2012. Genetic Parameters and Selection Indices in F3 Progenies of Hill Rice Genotypes. Notulae Scientia Biologicae **4,** 110-114.

Haider Z, Salam Khan A, Zia S. 2012. Correlation and Path Coefficient Analysis of Yield Components in Rice (Oryza sativa L.) Under Simulated Drought Stress Condition. American-Eurasian Journal of Agricultural & Environmental Sciences **12,** 100-104.

Kole PC, Chakraborty NR, Bhat JS. 2008. Analysis of variability, correlation and path coefficient in induced mutants of aromatic non-basmati rice. Tropical agriculture research and extension **11,** 60-64.

Lincoln T, Edvardo Z. 2006. Assimilation of mineral nutrition. In: Plant physiology (4th ed.), Sinaur Associates, Inc. Pub. P.O. Box. 407, Sunderland. 705p.

Satish Chandra B, Dayakar Reddy Tansari NA, Sudheer Kumar S, 2009. correlation and path coefficient analysis for yield and yield components in rice (Oryza sativa L.). Agricultural Science Digest **29,** 45-47.

Seyoum M, Alamerew S, Bantte K. 2012. Genetic variability, heritability, correlation coefficient and path analysis for yield and yield related traits in

upland rice (Oryza sativa L.). Journal of plant sciences **7,** 13-22.

Shanthi P, Jebaraj S, Geetha S. 2011. Correlation and path coefficient analysis of some sodic tolerant physiological traits and yield in rice (Oryza sativa L.). Indian Journal of Agricultural Research **45,** 201-208.

Surek H, Beser N. 2003. Correlation and Path Coefficient Analysis For Some Yield-Related Traits in Rice (Oryza Sativa L.). Under Thrace Conditions. Turkishan Journal Agriculture **27,** 77-83.