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Research article

INVESTIGATE THE RELATIONSHIP BETWEEN STUDIED TRAITS WITH GRAIN YIELD USING REGRESSION ANALYSIS AND PATH ANALYSIS IN 34 BARLEY LINES AND CULTIVARS

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ABSTRACT: Path analysis has great significance in determine the relationship between important characteristics with economic performance. This experiment was conducted in Agriculture and Natural Resources Research Station of Ardabil in 2011-12. In this experiment, 39 barely lines and cultivars were evaluated in the form of augmented designs. Several varieties of these numbers called Bulbul, Sadik-02, Radical, Tokak and Makooye that is grown in the region were cultured in triplicate and 34 other lines were distributed randomly within these repeats and were studied. Results showed that the number of spikelet per spike, spike weight and length with 37% explained the maximum yield variation. The results showed that number of spikelet per spike and spike weight had respectively highest positive impact and spike length negative effect on increasing grain yield. Also results showed that characteristics such as number of spikelet per spike and spike weight had respectively 0.743 and 0.3 direct positive effect and spike length (-0.654) had a negative direct effect on grain yield.

Keyword: Barley, Regression, Path Analysis.

INTRODUCTION

Barley cropping is for grain production and it used to be feed humans and animals, in addition, barley malt produced in the industry and is used in pastry [1]. Barley is one of the most important grains and essential resources for provide animal food and human in the world. They are growing in areas where other crops not grow well due to low rainfall, soil salinity, high height and heat and cold. Almost a third of the world's total land 85 percent of land in Iran located in the dry zone [2]. The most important use of barley is as human and animal food, and preparing the malt. The area under cultivation of barley in the world is over 56 million hectares in 2006 and its performance is over 137 million tons and 7.1 million acres in Iran in 2005, also it is the most important comprehensive product which is proportional to extensive growth under stress conditions. Barley cropping is for grain production and it used to be feed humans and animals, in addition, barley malt produced in the industry and is used in pastry [1]. Path analysis has great significance in determine the relationship between important characteristics with economic performance. Calculation of correlation coefficients does not specify the nature of the characters. However, using path analysis (path) there is the possible to identify direct and indirect effects of effective traits on performance. For this purpose, plant breeding specialists use path analysis as a means to determine the importance of effective traits in the grain yield. Neyestani et al [3] with the implementation of path analysis and estimates heritability of yield and its components on 10 barley cultivars, estimated that the correlation between the numbers of grains per spike with grain yield was positive [3]. Number of per spike is one of components of grain yield and a large number of grains per spike, the yield also increase. Indeed, there is a positive correlation between the number of grains per spike and yield.
The purpose of this experiment was to determine the proportion of traits in determination of grain yield.

MATERIALS AND METHOD

This experiment was conducted in Agriculture and Natural Resources Research Station of Ardabil in 2011-12. Research Station is located at 12 km Ardabil road to Khalkhal with an elevation of 1350 m above sea level and longitude 48 ° 20' and latitude 38° and 15'. The climate of semi-arid and cold regional is with average rainfall 310.9 Mm in 30 years and the average minimum and maximum annual temperature is -1.98 and 15.18 ° C.

The soil in farm was clay loam and in terms of poor organic matter (0.7%) is with the electrical conductivity 1 ml mouse, PH 7.5, soil P level 12 ppm and potassium400 ppm with the favorable air situation. In this experiment, 34 barley lines received from the International Research Institute of ICARDA and varieties of Bulbul, Sadik-02, Radical, Tokak and Makooei were investigated as control. Pedigree of tested lines is included in Table 1. In this experiment, 39 barely lines and cultivars were evaluated in the form of augmented designs[i]. Several varieties of these numbers called Bulbul, Sadik-02, Radical, Tokak and Makooye that is grown in the region were cultured in triplicate and 34 other lines were distributed randomly within these repeats and were studied. Each cultivar in the 0.8 m² the line spacing of 20 cm and 7cm deep were planted manually on the ridge width of 0.6 m. Seed rate was calculated based on 350 seeds per m² and seed weight. Traits were including plant height, number of kernels per spike, spike length, grain weight per spike, days to cluster days to maturity, number of spikelet per spike, spike weight seed weight and seed yield. Before statistical analysis, data were examined in terms of normality using Kolmogorov-Smirnov index[1]. Then ensure normal distribution of the data, Stepwise regression and path analysis was used Path analysis software and SPSS-16.

Table 1. Pedigree and characteristics of 39 barley lines and cultivars

No	SOURCE11	SN11	ORIGIN	FAO_Status	SCTH11	RTTH11
Bulbul	CHECK11	25	TURKEY	U	W	2
Radical	CHECK11	24	RUSSIA	U	W	6
Makooei	National_Check	-	-	-	-	6
Tokak	CHECK11	23	TURKEY	U	W	2
Sadik-02	CHECK11	43	ICARDA	U	W	2
L1	IBON12_W_INC11	3	ICARDA	U	W	2
L2	IBON12_W_INC11	7	ICARDA	U	W	2
L3	IBON12_W_INC11	13	ICARDA	U	W	2
L4	IBON12_W_INC11	18	ICARDA	U	W	2
L5	IBON12_W_INC11	21	ICARDA	U	W	2
L6	IBON12_W_INC11	24	ICARDA	U	W	2
L7	IBON12_W_INC11	30	ICARDA	U	W	2
L8	IBON12_W_INC11	33	ICARDA	U	W	2
L9	IBON12_W_INC11	41	ICARDA	U	W	2
L10	IBON12_W_INC11	51	ICARDA	U	W	2
L11	IBON12_W_INC11	54	ICARDA	U	W	2
L12	IBON12_W_INC11	61	ICARDA	U	W	2
L13	IBON12_W_INC11	67	ICARDA	U	W	2
L14	IBON12_W_INC11	68	ICARDA	U	W	2
L15	IBON12_W_INC11	77	ICARDA	U	W	2
L16	IBON12_W_INC11	93	ICARDA	U	W	2
L17	IBON12_W_INC11	98	ICARDA	U	W	2
L18	IBON12_W_INC11	107	ICARDA	U	W	2
L19	IBON12_W_INC11	113	ICARDA	U	W	2
L20	IBON12_W_INC11	120	ICARDA	U	W	2
L21	IBON12_W_INC11	122	ICARDA	U	W	2
L22	IBON12_W_INC11	132	ICARDA	U	W	2
L23	IBON12_W_INC11	135	ICARDA	U	W	2
L24	IBON12_W_INC11	139	ICARDA	U	W	2
L25	IBON12_W_INC11	146	ICARDA	U	W	2
L26	IBON12_W_INC11	150	ICARDA	U	W	2
L27	IBON12_W_INC11	159	ICARDA	U	W	2
L28	IBON12_W_INC11	162	ICARDA	U	W	2
L29	IBON12_W_INC11	163	ICARDA	U	W	2
L30	IBON12_W_INC11	170	ICARDA	U	W	2
L31	IBON12_W_INC11	171	ICARDA	U	W	2
L32	IBON12_W_INC11	175	ICARDA	U	W	2
L33	IBON12_W_INC11	176	ICARDA	U	W	2
L34	IBON12_W_INC11	180	ICARDA	U	W	2

RESULTS AND DISCUSSION

To determine the contribution of traits effects in determining yield, the stepwise multiple linear regression method was used. Initially independence test of experimental errors was performed using the Camera - Watson and showed that errors are independent of each other. Also the statistics of variance inflation factor lower than 10 showed that there is no several same linear (Table 2, 3). Stepwise regression analysis, yield as the dependent variable (Y) and other traits evaluated was considered as an independent variable (X). Results showed that the number of spikelet per spike, spike weight and length with 37% explained the maximum yield variation (Table 2). Considering the number of spikelet per spike (X1), spike weight (X2) and spike length (X3), the following equation were obtained:

$$Y = 2.14 + 0.453^{**}_{X1} - 1.03^{**}_{X2} + 1.42^{*}_{X3}$$

The significant coefficient in the successful regression equation indicating these attributes are to be effective in increasing yield. The above equation showed that number of spikelet per spike and spike weight had respectively highest positive impact and spike length negative effect on increasing grain yield. By comparing the regression coefficients and correlation coefficients turned out that there is a significant positive relationship between yield with the number of spikelet per spike and spike weight. In other words, with the increase of this specification, performance will also increase. Afzali Far et al (2011) according to the stepwise regression analysis traits such as total grain yield, biomass and plant height introduced as an effective traits on the yield [4]. Dadashi et al (2010) using stepwise regression and at the 5% level three traits such as grain per spike, number of fertile tillers and seed weight introduced as an effective traits on the yield [5].

Path Analysis

In order to understand the causal relationships between the dependent variable in the yield and variables that had a significant effect on economic performance, the path analysis was used. The results (Table 4) showed that characteristics such as number of spikelet per spike and spike weight had respectively 0.743 and 0.3 direct positive effect and spike length (-0.654) had a negative direct effect on grain yield. Most direct positive effect was related to the number of spikelet per spike (+0.743) and the positive correlation coefficient (0.374*) between the number of spikelet per spike and grain yield was related to the direct effect of spikelet per spike and indirect effects of these traits through spike weight has little role on grain yield. And it reduce grain yield through spike length. Spike length had the highest direct negative effect (-0.654) that this is due to indirect effects is controlled by the other characters. The largest indirect effect was related to the number of spikelet per spike.

Spike weight directly with the severity 0.3 increase grain yield through number of spikelet per spike. But will decrease grain yield through spike length.

Residual effects (0.763) indicate that in addition to the above variables, there are other factors in explaining the variation in yield. Seyed-Aghamiri et al (2010) that based on path analysis, biological yield 0.992 had the highest positive direct effect on grain yield is similar with the results of this study about HI and spike weight, but it was unlike each other about biological function [6]. Mobasser et al (2000) in the study of path analysis for grain yield in barley reported that the number of grains per spike with the direct effect 1.36 is considered one of the most important components affecting on the grain yield. Also direct effects of the number of spikes per square and grain weight were positive [7]. Mohammadi (2000) with investigation of the relationship of yield 600 genotypes of landraces bread wheat showed the highest direct effect on grain yield was related to the hundred grain weight [8].

Table 2. Stepwise Regression Analysis

S.O.V	df	Sum square	Mean square	F
Regression	3	41.65	13.88	8.36**
Residual	35	58.13	1.66	
Total	38	99.79	-	
R^2 Adjective: 0.37				
* and **: Significant at p < 0.05 and < 0.01, respectively				
Predictors: (Constant): Number of spikelet per spike, spike weight and spike length				
Dependent Variable: Grain yield				

Table 3. The regression coefficients standardized and the R^2 coefficients of related traits with grain yield

Characters	Regression coefficient	R^2 Cumulative	T	Probe	VIF
Number of spikelet per spike	0.745	0.140	4.34	0.000	1.77
spike length	-0.654	0.334	-3.76	0.001	1.82
spike weight	0.300	0.417	2.24	0.032	1.07

Table 4. Path analysis of Grain yield with related traits in 39 barley lines and cultivars

Characters	Direct effect	Indirect effect			Total correlation
		spike weight	spike length	Number of spikelet per spike	
spike weight	0.3	-	-0.173	0.149	0.277
spike length	-0.654	0.079	-	0.489	-0.086
Number of spikelet per spike	0.743	0.06	-0.431	-	0.374
Residual effects: 0.763					

CONCLUSIONS

Regression analysis showed that number of spikelet per spike, spike weight and length explained the highest yield variation. Also path analysis showed that traits such as spikelet per spike and spike weight had positive direct effect and spike length had a negative direct effect on grain yield. As a result, lines and genotypes will be selected that have more value in terms the number of spikelet per spike and spike weight and have less value in terms of spike length to produce a high yield.

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