

## CORRELATION ANALYSIS AND CROSS-PRINT BETWEEN THE SEVERAL CHARACTERS OF LOCAL GOGO RICE CULTIVARS (*Oryza sativa* L.)

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### ABSTRACT

The relationship between several characters of yields is very important for developing effective selection criteria. The total correlation between the result character and the result component may be misleading as a result of its relationship with other characters. Separating the total correlation into direct and indirect effects provides a more significant explanation of the cause of the relationship between dependent variables such as yield and independent variables such as yield components. This study aims to determine several traits that can be used to make selections indirectly and directly to increase the yield of upland rice. This research has been carried out on agricultural land in the village of Tamarenja (Kalama), Sindue District, Donggala Regency. Starting from August to December 2019, using a Randomized Block Design (RBD) with seven genotypic cultivars and three groups of cultivars so that there were twenty one experimental plots. The results showed that the number of leaves, leaf length, number of tillers, number of productive tillers, flowering age, thickness of seeds and weight of 1000 grains had a positive and significant correlation to yield. Flowering age, 1000 grain weight, and number of tillers are some of the characteristics that have a high direct effect and significant correlation to upland rice yield.

**Keywords:** Correlation, Path Analysis, Upland Rice Cultivars.

### INTRODUCTION

Rice is a staple food for around 2.5 billion of the world's population, it is even predicted that the world's population will increase to 4.6 billion by 2050 so that the need for rice is increasing (Kiani and Nematzadeh, 2012). In Indonesia, rice is the main strategic food commodity and is

prioritized in agricultural development. The need for rice as one of the main food sources for the Indonesian population continues to increase, due to the growing population at an increasing rate of about 2% per year (Sadimantara and Muhidin, 2012). In addition, there is a change in the consumption pattern of the population from non-rice to rice. More than 95% of

Indonesia's population makes rice as the main consumption material so that their needs exceed the production produced. According to (Handayani et al., 2008). the average consumption of rice per year is 27,859.14 thousand tons in a period of 37 years, which is still higher than the average annual rice production which only reached 26,725.78 thousand tons. So far, the contribution of national rice production has been obtained from lowland rice which is generally cultivated by farmers from the Java region, while the contribution of upland rice spread across various islands in Indonesia is still very limited. According to (Sadimantara and Muhidin, 2012) the contribution of upland rice to national rice production is still relatively low, so its development is still being pursued.

Upland rice productivity in 2011 was 3,091 tons ha<sup>-1</sup>, much lower than lowland rice productivity which reached 5,179 tons ha<sup>-1</sup>. Thus, the development of superior upland rice varieties needs to be done so that domestic production is able to keep pace with the increase in population. The development of superior varieties is carried out through manipulation of the genetic diversity of the population which is carried out through plant breeding. The effectiveness of genetic improvement through plant breeding depends on genetic parameters. One of them is the correlation between traits.

Rice yield is a complex character and determining superior genotypes in terms of crop yields is very difficult due to the structure of the plant, where the character component is controlled by a large number of genes (Bagudam et al., 2018a). It has been reported that yields are affected by the number of productive tillers (Rashmi et al., 2017), panicle length and effective tillers per plant (Sha et al., 2017), plant height (Gandhi and Vishwavidyalaya, 2015) number of grains per panicle (Akinwale et al. al., 2011), weight of 1000 grains, (Singh et al., 2014) biomass, harvest index and number of tillers per plant (Patel et al., 2014), panicle weight and productive tillers (Rashmi et al., 2017) and harvest index (Bagudam et al., 2018a).

The level of relationship between a trait with a higher yield will be very helpful for selecting traits that will provide significance in the selection process (Mustakim et al., 2019). A positive relationship between traits will bring about a concurrent change of both traits while limiting the determination to any of the related attributes. Negative relationships between traits necessitate equal weighting of both traits in the middle of the selection. At the genetic level, a positive correlation occurs because of the coupling period of the relationship and a negative correlation arises because the rejection phase of the gene linkage controls two different traits, (Bagudam et al., 2018b).

Cross-print coefficient studies assist plant breeders in identifying traits on which selection pressure should be exerted to increase yields. The relationship of the character of the different components between them and with the results is very important for establishing effective selection criteria for the results. The total correlation between yield characters and yield components may be misleading, as they may be overestimated or underestimated as a result of their relationship to other characters. Thus, indirect selection by correlated responses may not be productive, (Bagudam et al., 2018a). In essence, when multiple characters affect the intended character, splitting the total correlation into direct and indirect effects provides a more significant explanation for the cause of the relationship between dependent variables such as outcomes and independent variables such as outcome components. This type of data will be useful in formulating selection criteria, suggesting selection of these characters is likely to lead to an overall increase in single crop yields directly. This study aims to determine several traits that can be used for indirect and direct selection to increase the yield of upland rice plants.

## **MATERIALS AND METHODS**

### **Research site**

This research was carried out in Tamarenja Village (Kalama Valley), with

an altitude of 180-250 meters above sea level with a latitude of 00o26'51.5" and east longitude 119o49'50.6" Sindue District, Donggala Regency. The time of the study started from August to December 2019.

### Tools and Materials

The tools used in this study were hoe, machete, bucket, meter, camera, lirang and writing tools. The materials used included manure, NPK Mutiara (16:16:16), insecticides and local upland rice cultivars namely Jahara, Pomegranate, Pulu Tau Leru, Pulu Konta, Buncaili, Pae Bohe and Uva Buya.

### Research Design

This study used a Randomized Block Design (RBD) with seven cultivars as treatments, namely Jahara, Delima, Pulu Tau Leru, Pulu Konta, Buncaili, Pae bohe and Uva Buya. Each treatment consisted of four groups so that there were 28 experimental plots with a size of 1.2 x 2.1 m.

### Observed Variables

The variables observed were plant height, number of leaves, length of leaf blade, maximum number of tillers, number of productive tillers, age of panicle exit, panicle length, harvest age, number of grain/panicle, length of grain, width of grain, weight of 1000 grains, production (tons) .ha-1).

### Data Analysis Technique

The collected data will be analyzed by diversity analysis. The phenotypic and genotypic correlation coefficients between the two traits were calculated according to the formula (Pantalone et al., 1996) as follows:

$$r_p = \frac{\sigma_{pxy}}{\sqrt{\sigma_p^2x \cdot \sigma_p^2y}}$$

$$r_g = \frac{\sigma_{gxy}}{\sqrt{\sigma_g^2x \cdot \sigma_g^2y}}$$

Where  $r_p$  is the phenotypic correlation coefficient,  $\sigma_{pxy}$  is the phenotypic variance between traits x and y,  $\sigma_p^2x$  is the phenotypic variance for trait

x,  $\sigma_{py}$  is the phenotypic variance between traits x and y,  $\sigma_g^2x$  is the genotypic variance of trait x,  $\sigma_g^2y$  is the genotypic variance of trait y.

To determine the direct and indirect effect of a trait on rice yields, phenotypic and genotypic cross coefficient analysis was used based on the formulation (Samonte et al., 1998) as follows:

$$R_{1y} = P_{1y} + r_{12}P_{2y} + r_{13}P_{3y} + \dots + r_{1n}P_{ny}$$

$$R_{2y} = P_{12}P_{2y} + P_{2y} + r_{23}P_{3y} + \dots + r_{2n}P_{ny}$$

$$R_{ny} = r_{1n}P_{1y} + r_{2n}P_{2y} + r_{3n}P_{3y} + \dots + P_{ny}$$

where:

$R_{1y}$  = simple correlation coefficient genotypic and phenotypic from trait 1 to trait Y (plant yield)

$R_{2y}$  = simple correlation coefficient genotypic and phenotypic from the 2nd trait with the Y trait (plant yield)

$P_{1y}$  = direct effect of genotypic and phenotypic trait 1 on crop yields

$P_{ny}$  = direct effect of genotypic and phenotypic properties of the nth trait on crop yields

$R_{1n}P_{1y}$  = indirect effect of genotypic and phenotypic of the 1st trait on plant yields after going through the nth trait

The nature of plant yields (y-th trait) is not only influenced by the 1st, 2nd, 3rd, ..., n properties but is also influenced by the unobserved properties. So the magnitude of the influence of the unobserved properties (PSIS) is:

$$P_{sisa} = \sqrt{\left(1 - \sum r_{iy}P_{iy}\right)}$$

Where:

$\sum r_{iy}P_{iy}$  = sum of all indirect effects of the studied properties

## RESULTS AND DISCUSSION

### Correlation Between Traits.

The results of this study indicate that the genotypic treatment has a significant effect on all observed traits (13). The real genotypic treatment means that there are differences in the genetic makeup contained in all the genotypes used, (Rathod et al., 2020). The correlation

(closeness of relationship) between a trait and the desired trait (outcome) will be very helpful in selecting certain traits that will contribute most significantly to the results so that they will be used in the selection process.

The results showed that the genotypic and phenotypic correlation coefficients were positive and negative. A positive genotypic/phenotypic correlation means that increasing a trait will increase the target trait while a negative genotypic/phenotypic correlation means that an increase in a trait will decrease the target trait.

The results showed that in general the value of the genotypic correlation coefficient was greater than the phenotypic correlation. This shows that the relationship that occurs between the various observed traits is caused by genetic influences, (Kar et al., 2018). Several researchers have conducted research on rice commodities and obtained results in accordance with this study, (Babu et al., 2012; Kar et al., 2018; Savitha and Kumari, 2014).

The correlation coefficients between several traits and yields are presented in table 1. The table shows that plant height has a significant negative genotypic correlation with leaf length. This means that the higher the habitus of the rice plant, the less the number formed leaves. The number of leaves has a positive and significant genotypic correlation with panicle age, meaning the more leaves the longer the plant blooms.

Leaf length had a significant negative genotypic correlation with grain width, grain thickness and 1000 grain weight. This means that the longer the leaves, the smaller the size of the grain and the resulting weight of 1000 grains is of small value. The number of productive tillers had a significant negative genotypic correlation with panicle length. This condition means that the more panicles in one clump, the shorter the panicle size. Grain thickness has a significant positive genotypic correlation with 1000 grain

weight. Consequently, the thicker the grain size, the higher the 1000 grain weight value.

The results (Table 1) showed that there were several traits that had a positive genotypic correlation coefficient on the yield, namely the number of leaves, leaf length, number of tillers, number of productive tillers, flowering age, and grain thickness. The number of grains per panicle is a trait that has a positive and significant genotypic correlation coefficient on yield. On the other hand, plant height, panicle length, harvest age and grain width and weight of 1000 seeds had a negative genotypic correlation coefficient on yield.

The results of this study have similarities and differences with the results of previous studies that have been carried out by a number of researchers. (Kishore et al., 2015) found a significant positive genotypic correlation between number of tillers and yield. The results of the study (Srivastava et al., 2017) showed that the number of tillers and the number of productive tillers and the weight of 1000 grains had a positive and significant genetic correlation with yield. (Akinwale et al., 2011) showed that the number of tillers per plant was positively and significantly correlated with yield. (Gyawali et al., 2018) and (Patil et al., 2011). (Kar et al., 2018) found that the weight of 1000 grains was positively and significantly correlated with rice yields. Traits that have positive and significant genotypic correlation coefficients on yields can be used for indirect selection to increase upland rice yields.

### **Cross print analysis**

Selection based on correlation without considering the interaction between the components of the character sometimes proves to be misleading, (Ratna et al., 2015). This is because simple correlations cannot reveal the relative importance of the direct and indirect effects of various characters on the results. In cross-cutting analysis, the correlation

coefficient between two traits is separated into components that measure direct and indirect effects, (Ahmadizadeh et al., 2011). Thus, this cross-cutting analysis will provide an accurate picture of the relative importance of direct and indirect effects. of each character component to the results. The direct and indirect influence values of the twelve observed traits /characters are presented in Table 2.

The table shows that the direct effect is positive and negative. Some traits that have a direct negative effect are plant height, number of tillers, number of productive tillers, panicle length, grain thickness and 1000 grain weight. Traits that have a positive direct effect value are number of leaves, leaf length, age of panicle exit, age of harvest, number of grain per panicle, and grain thickness. The results of this study have similarities and differences with the results of research that have been found by several previous researchers. (Mustakim et al., 2019) found that the weight of 100 seeds had a direct effect and a high genetic correlation to increase upland rice yields (Kar et al., 2018) found that the number of tillers and the weight of 1000 grains had a strong direct effect on yield. (Kumar et al., 2017) found a positive and strong direct effect between 1000 grain weight and rice yield. (Chuchert et al., 2018) found that the weight of one thousand grains had a positive direct effect on yield. In addition, number of tillers and age of flowering had a direct negative effect on yield. The high direct influence of a trait on the results indicates that the trait has a very large contribution to the results. The residual effect of direct and indirect effects in this study is 0.19. This means, 81% of causal relationship factors and direct and indirect effects can be explained by cross-cutting analysis while 19% are factors outside this analysis and cannot be explained.

The high direct effect of panicle exit age (flowering age) on yields is not only caused by a high direct effect but is also determined by indirect effects through leaf number, leaf length, number of tillers,

number of productive tillers, panicle length, harvest age, number of grain per panicle, positive grain thickness and grain width and plant height and weight of 1000 grains on yield.

The high direct effect of leaf length on yields, apart from a high direct effect, is also determined by indirect effects through plant height, flowering age, panicle length, grain width and weight of 1000 grains which are positive and the number of leaves, number of tillers, number of productive tillers, age of harvest. , the number of grain per panicle, and the thickness of the negative grain. According to (Hairmansis et al., 2013) this cross-print analysis can be used to determine the selection criteria directly to improve the intended trait. Thus, several properties such as leaf length, flowering age, harvest age, grain amount and grain thickness can be used to make direct selection to increase upland rice yields because they have a high direct influence on yield. Some researchers suggest that a high direct effect cannot necessarily be used for direct selection but must pay attention to the high correlation coefficient value. (Sari et al., 2019) suggest that direct selection indicators can be selected for traits that have a high correlation and a strong direct effect on the results.

## CONCLUSION

Number of leaves, leaf length, number of grain per panicle and grain thickness are some of the traits that have a positive genotypic correlation coefficient on yield. Leaf length, flowering age, number of grain per panicle and grain thickness were some of the traits that had a direct positive effect on height and positive genotypic correlation.

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Attachmnet :

Table 1. The Value of The Genotypic Correlation Coefficient (Above The Diagonal Line) And The Phenotypic Correlation (Below The Diagonal Line) Between Several Traits of Local Upland Rice Plants.

Charaters	TT	JD	PD	JA	JAP	UKM	PM	UP	JGPM	LB	KB	1000	Results
TT	-	-0.02	-0.57*	-0.08	-0.06	0.16	-0.07	0.16	-0.26	0.29	0.09	0.24	-0,11
JD	0.17	-	-0.29	-0.07	-0.07	0.31*	-0.16	-0.03	0.17	0.07	0.13	0.07	0,22
PD	0.16	-0.05	-	0.21	0.22	0.03	-0.25	-0.16	-0.29	-0.31*	-0.42*	-0.37*	0,24
JA	-0.03	0.05	0.03	-	0.23	0.00	-0.03	-0.20	-0.11	-0.25	-0.18	-0.22	0,12
JAP	-0.02	0.03	0.05	0.45*	-	-0.02	-0.33*	-0.22	-0.13	-0.24	-0.19	-0.22	0,12
UKM	0.23	0.04	-0.22	0.00	-0.01	-	-0.23	0.02	0.25	-0.05	0.15	0.07	0,21
PM	0.22	-0.13	0.09	-0.10	-0.09	-0.24	-	0.01	-0.11	0.17	-0.22	0.10	-0,32
UP	-0.07	-0.03	-0.20	0.03	0.22	0.15	0.07	-	0.04	0.19	0.30	0.29	-0,03
JGPM	0.01	0.17	-0.06	-0.17	-0.18	0.14	0.00	0.04	-	0.04	0.16	0.08	0,33*
LB	0.15	0.07	-0.17	-0.22	-0.21	-0.05	0.15	0.14	0.05	-	0.24	0.30	-0,13
KG	0.10	0.15	-0.13	-0.13	-0.14	0.14	0.02	0.22	0.11	0.24	-	0.31*	0,22
1000	0.10	0.15	-0.18	-0.12	-0.13	0.02	0.06	0.21	0.08	0.29	0.30	-	-0,05
Hasil	0.23	0.28	0.21	0.12	0.12	0.18	-0.25	-0.02	0.02	-0.12	0.16	-0,13	-

Description: \* = significantly different; TT= plant height; JD= number of leaves; PD = leaf length; JA = maximum number of tillers; JAP = number of productive tillers; SMEs = flowering age; UP = harvest age; JGPM = number of grain per panicle; LB = width of grain; KG = grain thickness; 1000 = weight of 1000 grain; yield (ton.ha-1).



Table 2. Values of Direct and Indirect Effects of Several Traits of Local Upland Rice Plants.

Characters	TT	JD	PD	JA	JAP	UKM	PM	UP	JGPM	LB	KB	1000	Kor.	Peng. lsg
TT	-0,466	-0,002	-0,259	0,162	0,147	0,189	0,068	0,176	-0,031	-0,093	0,014	-0,016	-0,110	0,466
JD	0,009	0,085	-0,132	0,055	0,055	0,173	0,119	-0,114	0,020	-0,022	0,020	-0,048	0,220	<b>0,085</b>
PD	0,195	-0,025	0,254	-0,164	-0,172	0,017	0,187	-0,076	-0,035	0,099	-0,066	0,025	0,240	<b>0,454</b>
JA	0,437	-0,006	0,595	-0,781	-0,180	-0,111	0,082	-0,118	-0,030	0,158	-0,028	0,101	0,120	0,781
JAP	0,108	-0,006	0,100	-0,180	-0,781	-0,011	0,446	-0,104	-0,015	0,577	-0,030	0,015	0,120	0,781
UKM	-0,248	0,226	0,014	0,000	0,016	0,357	0,172	0,009	0,030	0,016	0,023	-0,405	0,210	<b>0,557</b>
PM	0,033	-0,014	-0,113	0,090	0,258	-0,128	-0,746	0,105	-0,013	-0,054	0,270	-0,007	-0,320	0,746
UP	-0,375	-0,203	-0,173	0,156	0,172	0,011	-0,107	0,473	0,071	-0,061	0,025	-0,020	-0,030	<b>0,473</b>
JGPM	0,121	0,014	-0,132	0,086	0,101	0,139	0,082	0,019	0,119	-0,113	0,025	-0,133	0,330	<b>0,119</b>
LB	-0,135	0,006	-0,141	0,195	0,101	0,139	0,082	0,019	0,005	-0,320	0,039	-0,120	-0,130	0,320
KB	-0,042	0,011	-0,191	0,140	0,101	0,139	0,082	0,100	0,019	-0,277	0,156	-0,021	0,220	<b>0,156</b>
1000	-0,112	0,038	-0,168	0,172	0,172	0,039	-0,075	0,137	0,010	-0,096	-0,099	-0,068	-0,050	0,068

Note: bold letters = direct or indirect referents; TT= plant height; JD= number of leaves; PD = leaf length; JA = maximum number of tillers; JAP = number of productive tillers; SMEs = flowering age; UP = harvest age; JGPM = number of grain per panicle; LB = width of grain; KG = grain thickness; 1000 = weight of 1000 grain; yield (ton.ha-1), kor.=correlation; Peng. lsg = direct influence.