

# Determination of agronomic properties of tobacco (*Nicotiana tabacum* L.) voor- oogst on krosok production using path analysis

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## Determination of agronomic properties of tobacco (*Nicotiana tabacum L.*) voor-oogst on krosok production using path analysis

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**Abstract.** Tobacco is an important trade commodity in Indonesia because it supports the country's economy through taxes and excise. The path analysis is used to measure the direct and indirect effects of agronomic character parameters that are strongly correlated with the results. The path analysis in this study aims to find the agronomic characteristics of tobacco that can be used as selection criteria to get high krosok production. The number of samples used was 50 plants. Observation parameters included plant height, stem diameter, number of leaves per plant, foot leaf length, foot leaf width, middle leaf length, middle leaf width, shoot leaf length, shoot leaf width, leaf wet weight, yield, heavyweight. The results showed the wet weight of the leaves can be used as direct selection criteria. The fresh weight of the leaves has a high positive correlation ( $R_{x10y} = 0.812$ ), a high positive direct effect ( $P_{x10y} = 0.924$ ), and a contribution value of 75.007%.

### 1. Introduction

One of the important trading commodities in Indonesia is tobacco. This summer plant is one of Indonesia's many natural resources that has been popular for decades. Indonesian tobacco consumers come from all over the world on average, tobacco is generally used as a cigar wrapper and also as a raw material for clove cigarettes. Currently, the use of tobacco can be used as a raw material for biopesticides, bioinsecticides, and most importantly in the cigarette industry.

The development of superior tobacco varieties can be through plant breeding programs. The assembly of tobacco varieties in plant breeding can be done through a deeper study of the agronomic traits that affect the yield of krosok. Krosok is a dried tobacco leaf used as a cigar. Krosok or dry weight leaf is also the desired result in the tobacco drying process. This agronomic trait is a selection criterion for enhancing or enlarging new varieties [1]. For soybean commodity, to determine the relationship between yield components and agronomic properties can be done through correlation analysis. The agronomic properties that correlated positively with soybean were seed weight per plant, namely flowering age, harvesting age, number of productive branches, number of one seed pods, number of two seed pods, number of three seed pods, number of filled pods, number of pods on branches, total number pods, the total number of seeds and the weight of one hundred grains [2].



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The emergence of agronomic traits will be followed by other characteristics so that the emergence of correlations between agronomic traits. Based on [3] the correlation between agronomic properties and results, a closeness relationship can be determined by calculating the value of the correlation coefficient. The strength of the correlation relationship can be further tested through path analysis. Path analysis is a measurement of the direct and indirect effect of agronomic character variables which can have a strong correlation with yield power [1]. Based on the research [4], it was stated that those which had a positive direct effect on the fruit weight of pineapples were plant height, fruit stalk length, fruit diameter, pulp thickness, and total acid. The number of shoots and the harvest age had an indirect effect through fruit diameter and total acid on fruit weight.

Previous research on tobacco breeding resulted [5] in agronomic characters affecting the yield and quality of dry chopped tobacco with total effects of 92.8% and 76.7%, respectively. The five main agronomic factors affecting dry chopped yield are leaf area per blade, number of leaves, specific leaf weight, plant height, and leaf dry weight. Thus, this study aims to determine the direct and indirect effect of an observed agronomic character of tobacco on the results of krosok of voor-oogst tobacco.

## 2. Material and Methods

### 2.1. Material

This research was conducted from May to August 2019 in the Jember State Polytechnic. The tools used are pruning shears, bamboo baskets, sacks, scales, sujen bamboo (the bamboo is thick), slop, tarpaulin, tape measure. The material used by the Voor-Oghst tobacco plant is ready for harvest.

### 2.2. Methods

This study used a cross-analysis test of the agronomic traits of voor-oogst tobacco. The tobacco observed was Jepon voor-oogst tobacco. The spacing used is 100 cm x 50 cm. The number of samples used was 50 plants. Observations consist of 11 independent variables and 1 dependent variable. The variables observed were plant height, stem diameter, number of leaves, leg length, foot leaf width, middle leaf length, middle leaf width, shoot length, shoot width, leaf wet weight, yield, the weight of krosok.

#### 2.2.1 Correlation Analysis

Further data analysis through calculating the correlation coefficient to determine the closeness of the relationship between independent and dependent variables. According to [6] correlation coefficient formula:

$$R_{XY} = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{\{n\sum x^2 - (\sum x)^2\}\{n\sum y^2 - (\sum y)^2\}}} \quad 1$$

Note :

R<sub>XY</sub> = correlation between independent variable (X) with dependent variable (Y)

n = data count

X = independent variable

Y = dependent variable

#### 2.2.2 Path Analysis

Path analysis was performed after calculating the correlation coefficient:

$$R_{XY} = R_{XIXj} \times P_{XY} \quad 2$$

$$P_{XY} = R_{XIXj}^{-1} \times R_{XY}$$

Note :

$P_{XY}P_{XY}$  = coefficient of path analysis of inverse correlation between independent variables with correlation with independent variables between dependent variables

$R_{XIXj}R_{XIXj}$  = correlation matrix between independent variables

$R_{XIXj}^{-1}R_{XIXj}^{-1}$  = matrix invers from  $R_{XIXj}R_{XIXj}$

$R_{XY}R_{XY}$  = Coefficient of correlation between independent variable with dependent variable

### 2.2.3 Directly contribution and residual

Directly contribution can be calculated using the following formula:

$$\text{directly contribution} = (R_{Xiy} \times P_{XY}) \times 100\%$$

$$\text{directly contribution} = (R_{Xiy} \times P_{XY}) \times 100\% \quad 3$$

$R_{Xiy}R_{Xiy}$  = Coefficient of correlation between independent variable with dependent variable

$P_{XY}P_{XY}$  = coefficient of path analysis of inverse correlation between independent variables with correlation with independent variables between dependent variables

The effect that cannot be explained in a model is called the path coefficient of residual. The path coefficient of residual can be calculated using the following formula:

$$\text{residual} = 100\% - \{(R_{Xiy} \times P_{XY}) \times 100\% \} \quad 4$$

## 3. Results and Discussion

### 3.1 Correlation Between Tobacco Agronomic Characteristics and Krosok Production

There is a correlation between the agronomic properties of tobacco and there is a correlation between the agronomic properties of tobacco and krosok

**Table 1.** Correlation Coefficient between Tobacco's Agronomic Characteristics with Krosok Production

Variables	R XiY
X1 plant height	0,245
X2 Steam diameter	0,289
X3 number of leaves	0,222
X4 Leaf length	0,423
X5 Leaf width	0,313
X6 Middle leaf length	0,179
X7 Middle leaf width	0,363
X8 Panjang daun pucuk	0,152
X9 Shoot leaf length	0,194
X10 Leaf wet weight	0,812
X11 yield	0,442

Table 1 shows the value of the correlation coefficient between the agronomic properties of tobacco plants and the production of tobacco krosok. From the results of the correlation analysis, it can be seen that the largest positive correlation coefficient is the leaf wet weight ( $R_{X10Y} = 0.812$ ), which means that there is a strong influence between leaf wet weight and krosok production. Then the weight of krosok has a moderate correlation, namely the yield ( $R_{X11Y} = 0.442$ ), leaf length ( $R_{X4Y} = 0.423$ ), middle leaf width ( $R_{X7Y} = 0.363$ ), leaf width ( $R_{X5Y} = 0.313$ ), stem diameter ( $R_{X2Y} = 0.289$ ), plant

height (RX1Y = 0.245). There was a low correlation of shoot leaf width (RX9Y = 0.194), middle leaf length (RX6Y = 0.179), shoot leaf length (RX8Y = 0.152). So that if there is an increase in diameter, leaf number, yield, leaf width, middle leaf length, shoot length, plant height, leg leaf length, leaf wet weight, middle leaf width, leaf width, it will also be followed by increased production from krosok tobacco. The increase is adjusted for the magnitude of the correlation.

### 3.2 Analysis of Across the Agronomic Traits of Tobacco with Krosok Production

Determining the best character, it is not enough if only by correlation analysis. In correlation analysis, it has a weakness, namely that it is not sufficient to describe the relationship between the components of the results.

**Table 2.** Direct and Indirect Effects of Xi through Xj on the Production of Krosok Tobacco

character	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11
X1	0.025	0.005	0.009	0.010	0.008	0.003	0.005	0.007	0.006	0.007	-0.001
X2	-0.002	-0.008	0.000	-0.002	-0.003	-0.001	-0.003	-0.001	-0.001	-0.003	0.001
X3	-0.010	0.000	-0.028	-0.001	0.001	0.006	0.000	0.000	0.003	-0.006	-0.002
X4	-0.012	-0.007	-0.001	-0.029	-0.020	-0.018	-0.008	-0.009	-0.008	-0.018	0.006
X5	0.005	0.005	0.000	0.009	0.014	0.007	0.004	0.004	0.002	0.008	-0.005
X6	-0.002	-0.002	0.004	-0.011	-0.010	-0.019	-0.005	-0.006	-0.005	-0.006	0.004
X7	-0.004	-0.006	0.000	-0.005	-0.006	-0.005	-0.019	-0.002	-0.004	-0.008	0.001
X8	0.014	0.008	-0.001	0.014	0.014	0.015	0.006	0.047	0.037	0.012	-0.008
X9	-0.009	-0.005	0.004	-0.010	-0.006	-0.010	-0.008	-0.029	-0.037	-0.010	0.003
X10	0.275	0.384	0.187	0.564	0.524	0.321	0.412	0.243	0.247	0.924	-0.139
X11	-0.035	-0.085	0.048	-0.116	-0.204	-0.119	-0.022	-0.102	-0.047	-0.088	0.583
Total	0.245	0.289	0.222	0.423	0.313	0.179	0.363	0.152	0.194	0.812	0.442
RXY	0.245	0.289	0.222	0.423	0.313	0.179	0.363	0.152	0.194	0.812	0.442

Table 2 describes the relationship between the agronomic properties of tobacco plants and result of krosok, directly or indirectly. Through path analysis, the correlation value between independent variables (X) and dependent variables (Y) can be separated into the direct effects of a dependent variable and indirect effects through other dependent variables.

Based on table 2, it is stated that there is a direct effect of the agronomic properties on the weight of the tobacco crop. The direct positive effect is plant height, leaf width, shoot length, wet weight, yield. The negative direct effect was stem diameter, count of leaves, leaf length, middle leaf length, middle leaf width, and shoot width. From the path analysis, the biggest direct effect on krosok production was leaf wet weight, which was 0.924, which means that the effect of the path analysis was categorized as high. The existence of a high direct effect indicates that other agronomic properties are fixed, the increase in leaf wet weight will increase the weight of tobacco krosok.

### 3.3 Directly contribution and residual

Based on table 3 to see the large and small contribution of the agronomic properties of tobacco plants to krosok. The results of the correlation coefficient and path analysis can be calculated for the total and direct contribution value. The direct contribution is the product of the correlation coefficient with the direct effect of the agronomic character on the yield of tobacco krosok. This means that if the value of directly contribution is greater, the agronomic character will have a high effect on the result of krosok tobacco. The total positive contribution to the production of krosok tobacco includes plant

height, leaf width, shoot length, wet weight and rendement. The biggest contribution was the leaf wet weight character with a contribution value of 75.007%.

**Table 3.** Value of Total and Residual Contribution in Tobacco Krosok Production

character	R XiY	PXiY	Contribution
plant height	0,245	0,025	0,606 %
Steam diameter	0,289	-0,008	-0,242 %
number of leaves	0,222	-0,028	-0,618 %
Leaf length	0,423	-0,029	-1,247 %
Leaf width	0,313	0,014	0,433 %
Middle leaf length	0,179	-0,019	-0,333 %
Middle leaf width	0,363	-0,019	-0,680 %
long leaf shoots	0,152	0,047	0,710 %
Shoot leaf length	0,194	-0,037	-0,714 %
Leaf wet weight	0,812	0,924	75,007 %
yield	0,442	0,583	25,765 %
Total			98,687 %
Residual			1,313 %

Based on table 3, the total contribution given by the agronomic character to the production of krosok tobacco was 98.687%. This means that the observed agronomic character affects 98.687% of the production of krosok tobacco. From the total results, there is a residual value of 1.313%. This means that there are external factors of 1.313% that influence tobacco production. Residual or residual value is the residual value that is influenced by external factors. External factors that influence are environment, climate, soil, temperature, cultivation and harvesting systems. These external factors affect the reduction in the total contribution value.

### 3.4 Selection Criteria

Knowledge of the correlation and direct and indirect effects of yield components on the yield of tobacco krosok can be determined by the appropriate yield component characteristics to be used as selection criteria for results [7]. According to [8] a character can be used as a selection criterion, if the correlation value and direct effect are almost as high and have the same sign.

There are 3 things to consider in the selection of the selection criteria, namely the magnitude of the direct influence on the results ( $P_{xy}$ ), the magnitude of the correlation between traits and results ( $R_{xy}$ ), the difference between the correlation to the results and the direct effect on the results ( $(R_{xy} - P_{xy}) < 0.05$ ). Based on the results obtained, several characters that meet the selection criteria can be selected. For leaf wet weight with a high correlation coefficient value ( $R_{X10Y} = 0.812$ ) and cross analysis value having a large effect ( $P_{X10Y} = 0.924$ ) on krosok production, the difference between the two is also small, namely  $< 0.05$ . So that the agronomic character of the wet weight can be used as a selection criterion for the production of krosok tobacco. Because wet weight is highly correlated and has a high direct effect on tobacco yield. Not only seen from the correlation coefficient but also seen from the direct contribution, the wet weight of the leaves gave the largest contribution, which was around 75.007% to the tobacco krosok. So it is hoped that the more wet weight of tobacco, the weight of krosok will also increase.

The increase in leaf wet weight can be seen when the plants have not been harvested, namely by looking at the value that has a positive correlation between height and wet weight, namely the length

of the leaves and the width of the leaves. The leaves of the feet are the leaves of the tobacco plant that are round and rather thick, usually amounting to 4 - 6 leaves on one plant. So that if the size of the leaves of the legs is longer and wider, it will be followed by an increase in the weight of the wet leaves.

#### 4. Conclusion

Based on the results and discussion, it can be concluded that from the magnitude of the correlation coefficient on the results ( $R_{X10Y} = 0.812$ ), the magnitude of the direct effect on the results ( $P_{X10Y} = 0.924$ ) and the magnitude of the direct contribution of agronomic properties (75.007%), the agronomic properties that can be used as selection criteria straight is the wet weight of the leaves.

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