INDIRECT SELECTION OF YIELD COMPONENT SEVERAL SOYBEAN GENOTYPE AT F₂ GENERATION

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ABSTRACT

Soybean is called a commercial commodity in society because soybeans contain a lot of vegetable protein and high nutrients. On the other hand people want soybeans that have high quality with large seeds and early maturity. While the need for soybeans every year continues to increase inversely with decreasing production. One way to overcome some of these problems is to assemble superior varieties through plant breeding by crossing elders to be selected using correlation analysis. Determination of soybean seed yield using correlation analysis will not be effective if the independent variables that affect the main dependent variable have increased. Therefore the analysis needs further analysis called cross analysis. Cross analysis is an analysis used to find out the direct and indirect effects of agronomic traits on soybean yield. This study was conducted at the State Polytechnic Jember trial area in October 2017 until completion. This study uses a randomized block design (RBD) sub-sampling with three replications, if the calculation results are significantly different, then it will be followed by Scott-Knott's further test. The varieties used were the Dega-1, Gemasugen 1, Gemasugen 2, Sinabung, and Gema varieties.

Keywords: Soybean, Production Results, Path Analysis

INTRODUCTION

Soybean is one of the most important food crops. Soybeans are an important plant because they have a high nutrient content, especially proteins that reach 35-38% (almost close to cow's milk protein). Other content of soybeans such as phenolic compounds and unsaturated fatty acids can prevent cancer. Therefore soybeans are widely used for food, animal feed mixtures and industrial raw materials (Saputra, 2016).

Indonesian people choose soybeans as a commercial commodity because soybeans contain a lot of vegetable protein. The protein standard needed by the Indonesian population per day is 46 g of protein per person and can only be fulfilled around 37-39 g. Soybean seeds contain protein (34.9 g), fat (18.1 g),

carbohydrates (34.8 g), Ca (227 mg), P (585 mg), Fe (8.0 mg), vitamin A and thiamine in 100 g (Pulungan, 2016). On the other hand, the Indonesian people want soybeans that have high quality with large seeds and high yield, considering soybeans are one of the alternative commodities after rice and corn.

Efforts to develop soybean plants as alternative food commodities still face obstacles. This is due to the decline in soybean production that occurs almost every year, because agricultural land is increasingly limited. On November 1, 2016 soybean seed production (BK) reached 886 thousand tons with a harvest area of 588 thousand ha and productivity of 15.06 qu / ha. When compared with 2015 production of 963 thousand tons, there was a decrease of 77.61 thousand tons

(8.06%). The decline in soybean production was due to a decrease in harvest area of 26 thousand ha (4.24%) and productivity of 0.62 ku/ha (3.98%) (Central Statistics Agency, 2016). As a result of soybean needs reaching 2.5 million tons while production is only around 800 thousand tons, Indonesia needs to import soybean at 1.7 million tons (Sutarto, 2013). Low productivity is suspected because farmers are still cultivating traditionally and other factors such as farmers always use varieties from generation to generation and knowledge of the importance of using new location-specific superior varieties has not been realized. The seeds used by farmers are seeds derived from production for consumption that are not pure anymore. Varieties play an important role in soybean production, because to achieve high yields is largely determined by their genetic potential (Marilah, *et al.*, 2012).

These problems can be overcome by assembling superior varieties so that soybeans are able to produce maximally through directed and planned plant breeding activities. In addition, another thing that can be done to meet soybean needs in Indonesia is to accelerate the age of soybean cooking and pay attention to the yield components using a selection program (Poerwoko, 2014).

One method of soybean breeding is through crossing parents. Selection criteria is an iden-tification or assessment carried out on a genotype as an estimation of the ability of the plant genotype. The selection criteria that are com-monly used are based on the character of the results or components of results. Selection can be done directly or indirectly. The correlation between characters causes selection to be applied to one character to simultaneously include other characters that correlate with selected characters. The basis of the selection program is carried out using correlation analysis, but the correlation coefficient will only explain the closeness of the relationships between characters so that there needs to be continuation to find out the characters that have a direct relationship to the yield of seeds.

Determination of soybean production using correlation analysis will not be effective if the independent variables that affect the main dependent variable have increased. This condition does not indicate the cause and influence of relationships between characters, consequently the independent character that most directly affects the age of cooking is unknown, so to answer this, in this study a cross-analysis was conducted. Cross analysis is used to find out the causal relationship between two plant characters. This analysis can be used to find out plants that have a direct or indirect relationship to production results which can then be used as selection information to obtain high yielding F2 generation soybean plants. In addition, cross analysis is also used to determine the diversity of phenotypes based on agronomic characters to obtain new soybean varieties that have superior charac-teristics, including high production and extensive adaptability (Rismayuli, 2017)

RESEARCH METHODS
Place and Time
This experiment was carried out on the Jember Polytechnic field, with altitude of 89 m asl, average temperature of 25.8 °C and average rainfall of 2396 mm/year. This experiment was conducted in June until completion.

Material
The materials used during the study included the Dega-1 variety soybean seeds, Gamasugen-1, Gamasugen 2, Sinabung, and Gema. Fertilizers used include ZA, SP36, KCL, leaf fertilizer (Gandasil D and Gandasil B), insecticides used are Decis 2.5EC (to control leaf-damaging pests such as caterpillars and grasshoppers), and Demolish 18 EC (to control whitefly)

Experimental Design
The experiment was designed using a sub-sampling randomized block design with 3 replications. Sampling is done by 3 sampling on each block. The experimental treatment used 5 soybean seed elders and 20 crosses as follows:

From the results of these calculations, if the calculated value is significantly different the meal will be continued by Scott-Knott's further test. Experimental data that has been obtained, then tested with an analysis model according to Sudjana (1982), as follows:

RAK: $Y_{ij} = \mu + \tau_i + \beta_j + \varepsilon_{ij}$

I = 1,2, ... 13 (number of genotypes)
j = 1,2, ... 3 (number of replications)
Y_{ij} = Observation on the first genotype and jth
μ = Population average
τ_i = Additive effect of the i genotype
β_j = Additive effect from jth test
ε_{ij} = Random effects of the first genotype and jth test

Table 1 Twenty-five Soybean Genotypes

No.	Geno-type	Information
1.	A	Dega-1
2.	B	Gemasugen-1
3.	C	Gemasugen-2
4.	D	Sinabung
5.	E	Gema
6.	A x B	Dega-1 x Gemasugen-1
7.	A x C	Dega-1 x Gemasugen-2
8.	A x D	Dega-1 x Sinabung
9.	A x E	Dega-1 x Gema
10.	B x A	Gemasugen-1 x Dega-1
11.	B x C	Gemasugen-1 x Gemasugen-2
12.	B x D	Gemasugen-1 x Sinabung
13.	B x E	Gemasugen-1 x Gema
14.	C x A	Gemasugen-2 x Dega-1
15.	C x B	Gemasugen-2 x Gemasugen-1
16.	C x D	Gemasugen-2 x Sinabung
17.	C x E	Gemasugen-2 x Gema
18.	D x A	Sinabung x Dega-1
19.	D x B	Sinabung x Gemqasugen-1
20.	D x C	Sinabung x Gemasugen-2
21.	D x E	Sinabung x Gema
22.	E x A	Gema x Dega-1
23.	E x B	Gema x Gemasugen-1
24.	E x C	Gema x Gemasugen-2
25.	E x D	Gema x Sinabung

Estimating Correlation of Genotypes

Genotypic correlation according to Singh and Chaundhary (1979) can be predicted by the formula:

rg $(X_1 X_2)$ = Correlation of genotypes between the properties of X_1 and X_2

Covg. $X_1 X_2$ = Covariance of genotypes between the of X_1 and X_2

$\sigma(g)^2(X_1)$ = Variance of genotypes X_1

$\sigma(g)^2(X_2)$ = Variance of genotypes X_2

The results of the correlation coefficient have a strong level of different relationships. The level of correlation can be seen based on the interval of values, where 0.8-1.00 is very strong, 0.6-0.79 is strong, 0.4-0.59 is strong enough, 0.2-0.39 is low and 0, 00-0.19 is very low (Akdon and Riduwan, 2009). The results of the calculation of the correlation coefficient are obtained, then proceed with testing the significance of the correlation coefficient by using a statistical test. The hypothesis tested is H0, which means the correlation coefficient is equal to 0 and H1 which means that the test of the correlation coefficient is not equal to 0 or significant. Testing the correlation coefficient using the t-test method so that:

t = $(r \sqrt{(n-2)}) / \sqrt{((1-r \wedge 2))}$:

t = t-test value (t hitung)

r = Genotypic correlation value

n = Number of genotypes

After that, it is necessary to determine the value of

table with a real level of 5 percent and db = n-2 which then compares between the t-count and the value of t table. The test criteria are rejecting H0 and accepting H_1 if the t count> t Table, and vice versa accepting H0 and rejecting H_1 if t count < t Table.

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Path Analysis

Path analysis is a continuation of a correlation analysis that describes a causal relationship between two characters. This analysis was used to find out the direct and indirect effects of agronomic traits on the age of full ripe soybeans. Path analysis based on simultaneous equations is used the following formula (Singh and Chaundhary, 1979): or A = B.C. Based on this equation, the value of C (direct effect) can be calculated using the following formula:

C = B-1 A

B = correlation matrix between independent variables

B-1 = inverse matrix B

C = cross coefficient matrix which shows the direct effect of each standardized variable that has been standardized on non- inde-pendent variables

A = correlation coefficient matrix between varia-bles X1 (i = 1,2, ... p) with non-independent variable Y

After calculating the direct effect (C), it is possible to get a residual value (R). The residual effect (Residue) on Y (Pry) is calculated by the equation:

Pry = (I-$\sum$ (Piy x Rij) 1/2 I = 1

The results of the cross-sectional analysis will have direct effects and indirect effects, which then obtain residual or residual values and are illustrated in the cross diagram as follows:

Mixed variables are other factors that affect the age of pod cooking. Mixed variables are also referred to as sis / residue (Pry) and are assumed to be independent.

Singh and Chaundhary (1979) state that in drawing conclusions the results of cross analysis need to pay attention to the following: If the correlation between variables is almost the same as the direct effect, then the correlation explains the actual relationship and direct selection through these variables will be effective. If the correlation is positive but the direct effect is negative, then it is the indirect effect that causes the correlation. In this case the variables that bring indirect influence become variables that must be considered further.

Observation variable

This observation was carried out on the stage of plant growth until harvesting with several parameters, including the following:

1. Age of flowering (days), calculated based on n the day when flowers first appear per plant, determined based on 50% of the population in one plot that has flowered.
2. Cook pod age (days), calculated based on 90-95% brown pods per plant, determined based on 60% of the population in one plot to start cooking.
3. Plant height (cm), measured at harvest starting from the base of the stem to the end of the stem.
4. The number of branches per plant, calculated the number of branches on the main stem at harvest.
5. The number of fertile books (segments), calculated by the number of fertile books that produce pods on the main stem and counted after harvesting.
6. The number of seeds per plant, calculated per plant that produces soybean seeds.
7. The number of pods per plant, is the number of pods containing seeds (not including empty pods).
8. The number of empty pods, calculates the number of empty soybean pods and does not succeed in forming seeds.
9. The weight of 100 seeds per plant (g), is carried out by weighing 100 seedy seeds from the sample plant.
10. Seed weight per plant, calculated based on dry seeds on plants.

RESULTS AND DICUSSION

Variance analysis is a method of analyzing data in an experiment. Variety analysis is often used as a way to draw various conclusions that occur on an object, for example in experiments in agriculture, animal husbandry and so on (Nurhasanah, 2012). The results of the variance analysis are used to test the hypotheses proposed by performing the calculated F test. F count test can be done by comparing F count with F table. The criteria for testing the hypothesis are, if F is>> of F table then reject H0 and accept H1 and will accept H0 and reject H1 if the calculated F value is ≤F table. On the other hand, to find out how far diversity in the experimental population is from each agronomic trait, the diversity coefficient value is calculated. Calculation of diversity coefficient is done by means of the square root of the error center divided by the average then multiplied by 100%. A summary of the diversity coefficient and calculated F on some agronomic traits is shown in Table 1.

Table 2. Summary of CV and F Count of All Trait Observed

No.	Caracters	CV (%)	F Calc
1.	Floweer age (days)	5.52	1.98*
2	Cook pods	3.04	1.33**
3.	Plant Height (cm)	17.20	1.63**
4.	Number of branch.	23.22	1.49**
5.	Number of fertile nodes	20.61	2.10**
6.	Number of Seed yield per plant.	17.50	12.18**
7.	Number of frilled pods	21.94	7.31**
8.	Number of empty pods	53.36	1.07**
9.	100 seed weight (g)	15.72	6.62**
10.	Seed yield per plant (g)	16.16	18.37**

Calculation of analysis of various agronomic traits shows different results. In observing the agronomic characteristics of flowering age, pod maturity, number of branches, number of fertile books, and number of empty pods showed a different appearance that was not real. In other agronomic properties such as plant height, number of seeds / plants, number of filled pods, weight of 100 seeds / plants and weight of seeds / plants showed a very different appearance. Real differences between traits will increase the chances of successful selection. The coefficient of diversity between agronomic traits also shows different results. The highest percentage of diversity coefficients is indicated by the agronomic nature of the number of empty pods with a percentage reaching 56.53%. According to Wijayati (2014), genetic diversity greatly influences

the success of a selection process in plant breeding programs. Before determining the selection method and time of selection, it is necessary to know the value of genetic diversity in the plants tested. The lowest diversity coefficient of agronomic traits exists at pod maturity, which is 3.22%. Based on the criteria of Miligan et al. (1996) in Arifin (2009), the coefficient of genetic diversity is divided into three categories, namely large, small and medium. Large category if the coefficient of genetic diversity is of greater value equal to 14.5%. Medium category if the coefficient of genetic diversity is worth between 5% to 14.5% and a small category if the coefficient of genetic diversity is below 5%.]

Scott-Knott Test Results Nature of Agronomy of Soybean Plants

The Scott-Knott Test is a statistical test method that can be used to evaluate the mean values of several treatments compared in one trial. The advantage of the Scott-Knott test, which is to give the results of the separation of the middle values of treatment that is clear and not overlapping. The lack of the Scott-Knott test, which is a more complex calculation than other statistical tests, Separation will produce single notations, making it easier to read and draw conclusions (Gates and Bilbro, 1978). The execution of the Scott-Knott test begins by separating the average group to get the number of squares between the highest groups (max Bo). Each group formed can be divided again if the new average group has a non-uniform mean value. This test is stopped if the group has a homogeneous average value (Bhering et al., 2008). The following is a summary of the Scott-Knott test results.

The Scott-Knott test results (Table 3) at flowering age (X_1) showed that there were differences in flowering ages between genotypes one and the other genotypes. Genotypes with the shortest flowering age were in the CxD genotype (Gemasugin-1 x Sinabung) which was 28.00 days after planting and was not significantly different from the parents A, B, C, D, which was 29.00 days after plants, 29.67 days after planting, 30, 00 days after planting and 31.00 days after planting. Apart from not being significantly different from parents, the CxD genotype was also not significantly different from other genotypes,

Table 3. Scott-Knott Test Results Properties of Soybean Plant Agronomy

Geno-type	X1	X2	X6	X7	X9	X10
A	29.0 b	13.9 b	28.0 c	20.3 b	18.4 a	4.6 c
B	29.7 b	19.5 b	66.5 b	36.7 a	10.9 b	6.9 b
C	30.0 b	17.6 a	34.8 c	17.6 b	7.8 c	3.1 d
D	32.0 b	15.2 b	56.6 b	33.3 a	11.7 b	5.8 b
E	32.7 a	14.8 b	66.7 b	29.2 b	11.8 b	7.0 b
A x B	29.7 a	17.7 a	83.1 a	31.8 b	16.2 a	8.7 b
A x C	29.3 b	14.7 b	57.7 b	33.8 a	14.5 a	6.8 b
A x D	32.0 b	14.0 b	31.5 c	16.7 b	14.0 a	4.2 c
A x E	29.7 b	11.6 b	33.4 c	15.1 b	9.7 b	2.7 d
B x A	30.3 b	12.0 b	39.5 c	19.0 b	8.9 c	3.8 b
B x C	31.7 b	12.0 b	40.2 c	23.6 b	9.6 b	4.8 c
B x D	30.7 b	13.4 b	33.8 c	49.3 a	8.8 c	3.2 d
B x E	29.0 b	15.0 b	37.3 c	46.1 b	9.0 c	3.0 c
C x A	30.7 b	11.7 b	41.5 c	23.6 b	9.5 b	4.5 c
C x B	31.3 a	11.6 b	50.2 c	19.1 b	8.3 c	2.5 d
C x D	29.7 b	13.7 b	60.1 b	24.9 b	8.9 c	4.9 c
C x E	29.3 b	11.1 b	34.3 c	19.1 b	8.8 c	3.0 d
D x A	30.7 b	19.6 b	68.9 b	35.4 a	12.0 b	7.2 b
D x B	30.7 b	16.8 a	92.3 a	40.9 b	12.7 b	9.7 a
D x C	32.3 a	16.2 a	85.3 a	46.1 b	11.6 b	7.5 b
D x E	32.7 a	17.5 a	71.9 b	41.6 b	10.7 b	8.5 a
E x A	31.0 b	20.0 b	77.6 b	47.0 b	11.2 b	7.4 a
E x B	32.3 a	16.8 a	76.7 a	38.5 a	8.7 c	7.3 b
E x C	33.3 a	21.0 b	65.4 b	37.0 a	11.5 b	6.2 b
E x D	30.7 b	15.8 a	84.4 a	40.8 b	12.4 b	8.8 a

A = Dega-1   B = Gemasugen-1   C= Gemasugen 2
D = Sinabuntg   E = Gema
X1 = Flower age   X2 = Cook Pods   X6 = Number of Seed yield per plant
X7 = Number of frilled pods   X9 = 100 seed 3weight
X10 = Seed yield per plant
Scott-Knott Test 5 %

namely AxB, Axes, BxC, BxD, BxE, CxA, CxE, DxA and ExA which were 29.67 days after planting, 29.67 days after planting, 31,00 days after planting, 30.67 days after planting, 29.00 days after planting, 30.67 days after planting, 29.33 days after planting, 30.67 days after planting and 31.00 days after planting. Whereas the highest flowering age was shown by ExB and ExC genotypes with the same long flowering age of 33.33 after planting. According to Sa'diyah (2016), the longer the flowering age will cause an increase in harvest age, plant height, number of branches, number of pods and weight of crop seeds. This condition can occur if the age of flowering is long, then the vegetative phase of soybean plants will be longer so that the growth of soybean plant height and the number of productive branches formed will be even greater. Rukmana and Yuniarsih (1996) add that the age of flowering of soybean plants depends on the variety of soybeans used, the effect of environmental temperature and the intensity of solar radiation.

Plant height (X3) is an indicator of plant growth. In Table 3 the highest plant height is shown by ExC genotype with plant height reaching 20.97cm and different not significantly with genotype A, B, D, E, AxC, AxD, Ax, BxA, BxC, BxD, BxE, CxA, CxB, CxD , CxE and DxA with plant height value of 13.90cm, 19.53cm, 15.17cm, 14.73cm, 14.00cm, 11.57cm, 12.00cm, 12.03cm, 13.37cm, 14.97cm, 11, 73cm, 11.63cm, 13.37cm, 11.13cm, 19.60cm. The higher the soybean plant,

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the higher the chance of obtaining high yield soybean genotypes. High soybean plants will trigger the growth of many branches and produce fertile book segments and abundant number of pods (Krisnawati, 2016). While the lowest plant height is indicated by the AxE genotype with plant height that is only around 11.57cm.

The number of seeds per plant (X6) is one of the agronomic properties related to seed weight per plant. The more number of seeds produced, the more weight of seeds produced by soybean plants. The highest number of seeds was produced by the DxB genotype (Sinabung x

Gemasugin-1) with a number of seeds of 92.27 fruits and was not significantly different from the AxB genotype, which had 83.13 fruits per plant. Apart from not significantly different from the AxB genotype, the DxB genotype was also not significantly different from the DxC, ExA, ExB and ExD genotypes with each number of seeds 85.33 fruits, 77.60 pieces, 76.67 fruits and 84.40 pieces. The number of seeds is a character that has a direct influence on seed weight per plant. The more number of seeds produced by soybean plants, the more weight of seeds produced per soybean plant (Wijaya, 2018). This is also reinforced by Dwiputra's (2015) statement, the higher the number of seeds will increase seed weight per plant. The number of seeds per plant also affects the weight of 100 seeds per plant, the fewer the number of seeds will result in smaller seed weight so that the weight of 100 seeds will decrease. While in table 4.3 the lowest number of seeds is

produced by genotype A (Dega-1) with the number of seeds that only reaches 28.00 pieces per plant.

The number of filled pods (X7) is related to the number of seeds per plant. The more pods that grow, the more seeds produced by soybean plants. In Table 3, the highest number of polog contents was produced by the BxD genotype crossing, which was 49.27 pieces per plant. The BxD genotype is not significantly different from other genotypes, namely genotypes A, C, E, AxD, Axes, BxA, BxC, BxD, BxE, CxA, CxB, CxD, CxE, DxB, DxC, DxE, ExA and ExD with each the number of pods produced was 20.33 fruit, 17.60 fruit, 29.20 fruit, 16.73 fruit, 15.07 fruit, 19.00 fruit, 23.60 fruit, 22.40 fruit, 23.60 fruit, 19 , 07 fruits, 24.93 fruits, 19.13 fruits, 40.93 fruits, 46.07 fruits, 41.60 pieces, 47.00 fruits and 40.80 pieces. The number of pods on soybean plants is not always influenced by the large number of fertile books on each plant. Genetic factors also play a role in the formation of pods in soybean plants. These genetic differences cause differences in pheno-typic appearance of plants by displaying special characteristics and characteristics that differ between each other with environmental influences (Sulistyowati, 2015).

Character weight of seeds per plant (X_{10}) is an important character which can be used as a direct selection criterion to obtain genotype

Table 4 Value of Genotypic Correlation of Components of Results for Soybean Seed

rij	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
X1	1.00**									
X2	0.90**	1.00**								
X3	0.52**	0.73**	1.00**							
X4	-0.43ns	0.31ns	0.37**	1.00**						
X5	0.92**	0.92**	0.73**	0.20ns	1.00**					
X6	0.47**	0.49**	0.76**	0.;31**	0.46**	1.00**				
X7	0.53**	0.47**	0.71**	-0.20ns	0.52**	0.80**	1.90*			
X8	-0.72**	0.05ns	0.20ns	0.80**	0.73**	0.23ns	0.47**	1.00**		
X9	0.12ns	0.28**	0.35**	-0.58**	-0.37**	0.19ns	0.13ns	0.06ns	1.00**	
X10	0.46**	0.64**	0.76**	0.05ns	0.24**	0.99**	0.82**	-0.01ns	0.48**	1.00**

Flowering age is very significantly positively correlated with pod age, plant height, fertile books, number of seeds per plant, number of filled pods, and seed weight per plant. This means that the flowering age has a very strong closeness to the age of cooked pods and the number of fertile books because the correlation value of both reaches almost 1.00. While the correlation between age of

flowering with plant height, number of seeds per plant, number of filled pods, and seed weight per plant has a fairly strong closeness because the numbers shown range from 0.4-0.59. Ismachin (1985) states that flowering age has a very significant positive correlation with plant height, meaning that with a longer flowering age, the plants will be higher. Plant growth causes more numbers

of branches and fertile books that allow genotypes to form pods and produce more seeds. Flowering age is also positively correlated with no significant weight of 100 seeds per plant, meaning that the longer the flowering age, the weight of 100 seeds will be lower. Sa'diyah (2016), adding that there is no significant correlation between the age of flowering with a weight of 100 seeds per plant due to the length of the vegetative phase in plant growth which results in plants that are tall, widely branched and potentially have many pods. Table 4. also shows no significant negative correlation between flowering age and number of branches and number of empty pods. This is also reinforced by Krisnawati (2016), that the longer the flowering age of soybean plants, the higher the soybean plant will also increase, but the increase in plant height will reduce the number of branches and reduce the size of seeds.

The pod age is very positively correlated with plant height, number of fertile books, number of crop seeds, number of filled pods, weight of 100 seeds per plant and seed weight per plant. There is a very strong correlation between the age of cooking pods to the number of fertile books with a correlation value that is close to 1, which is 0.92. Poerwoko (2016) states that the increasing age of growing pod pods will increase the height of the number of plants which will be followed by the increase in the number of fertile books and the number of pods that are more likely. This is made clear by Hapsari and Adie (2010) who stated that the longer the plant life will be followed by the addition of plant height, and the number of pods filled with plants, so that it will increase soybean seed yield. Table 4. shows a negative correlation that is not significantly different between the age of ripe pods and number of branches and number of empty pods. This is because the number of empty pods is not very influential on the yield of plant seeds but affects the production of the number of seeds per plant. The large number of empty pods is caused by abiotic factors and maintenance carried out on soybean plants. In Table 4. the parameters of plant height showed

a very significant positive correlation with the number of branches, number of fertile books, number of seeds per plant, number of filled pods, weight of 100 seeds per plant, and seed weight per plant. Besides that the positive correlation is not real also indicated by the correlation between the height of the plant to the empty pod. Strong correlation occurred between plant height to seed weight per plant with a correlation value of 0.76, followed by the number of seeds per plant with a correlation value of 0.75, the number of fertile books with a correlation value of 0.74, and the number of pods filled with values of correlation amounting to 0.71. Krisnawati (2016), in her research also stated the same thing where plant height has a very significant positive correlation with seed weight per plant. The higher the plant, the more likely it is to obtain soybean genotypes that have high yields, the meaning of high plants will increase the twenty-five agronomic characters studied.

The number of branches in Table 4 shows a positive correlation with the number of seeds per plant and the number of empty pods with a correlation value of 0.31 and 0.80. The correlation is very strong indicated by the correlation between the number of branches to the number of empty pods. This explains that the more number of branches per plant will increase the number of pods on soybean plants, the number and weight of seeds per plant will also increase (Wirnas, 2006). The number of branches was also positively not significantly correlated with seed yield per plant and negatively correlated not significantly with the number of books fertile in the number of filled pods and weight of 100 seeds per plant. The number of fertile books is highly correlated with the number of seeds per plant, number of filled pods, number of empty pods and seed weight per plant. According to Hakim (2017), the number of fertile books that have a very significant positive correlation with seed weight, the meaning of soybean varieties that have a number of fertile books that have the potential to have a large number of pods. Number of books
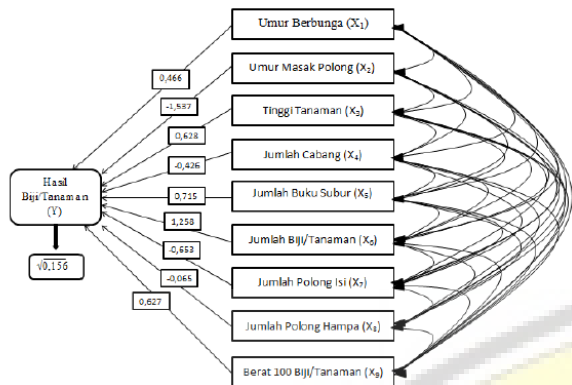
Gambar1 The cross diagram in Figure 1 explains the correlation and the relationship between one agronomic

trait and another. Singh and Chaundary (1979) state that in drawing conclusions the results of cross analysis need to be noted that if the correlation between variables and direct effects is positive, the correlator explains the actual relationship and direct selection through these variables will be effective. If the correlation is positive but the direct effect is negative, then it is the indirect influence that states the correlation. If the negative correlation coefficient but a positive direct effect and a large value, in this case the selection model must be done with the right restrictions. The magnitude of the direct or indirect influence carried out in this study is presented in Table 4 as follows:

Table 5. Direct and indirect Causal of yield component

rij	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
X1	**0.466**	-1.390	0.329	0.186	0.659	0.580	-0.348	0.047	-0.078	0.452
X2	0.421	**-1.537**	0.479	0.133	0.661	0.611	-0.305	0.003	0.178	0.644
X3	0.244	-1.172	**0.628**	-0,157	0.526	0.947	-0.465	-0.013	0.221	0.761
X4	-0.204	0.478	0.231	**-0.426**	-0.143	0.395	*0.131*	-0.052	-0.362	0.048
X5	0.429	-1.421	0.462	0.085	**0.715**	0.584	-0.337	-0.048	-0.233	0.237
X6	0.215	-0.747	0.473	-0.134	0.332	**1.258**	-0.517	-0.015	0.116	0.981
X7	0.248	-0.716	0.447	0.086	0.369	0.995	**-0.653**	-0.031	0.081	0.825
X8	0.248	0.074	0.123	-0.342	0,522	0.283	-0.308	**0.065**	0.038	-0.013
X9	-0.337	-0.437	0.222	0.246	-0.266	0.233	-0.084	-0.004	**0.627**	0.479

The results of cross-component analysis of results on soybean seeds indicate that not all variables that have a positive correlation with the weight of soybean seeds per plant have a positive direct effect. This is due to a correlation besides the direct influence of a character, there are also indirect effects through other characters that produce the correlation coefficient (Sa'diyah, 2016). The direct effect that has the biggest contribution to soybean yield is found in the components of the number of seeds per plant, which is 1.258 by indirect effects through plant height of 0.473 so that certain components can determine the yield of soybean seeds. Another yield component that has a direct effect is quite large, namely the number of fertile books of 0.715 through the indirect effect of the number of seeds per plant, which is 0.584. Besides the high yield components of plants also have a large contribution to the yield of plant seeds with a direct effect value of 0.628 through the indirect effect of the number of seeds per plant with a value of 0.947. Other yield components which also have a large direct effect on the yield of soybean seeds are indicated by the weight of 100 seeds per plant with

a value of 0.627 through the indirect effect of the number of branches with a value of 0.246. Flowering age also shows a high direct influence value of 0.466 with an indirect effect on the number of fertile books with a value of 0.659. This shows that the number of plants per plant, plant height, weight of 100 seeds per plant, number of fertile books and flowering age determine the weight of seeds produced by soybean plants.

Direct and indirect influences and correlations in Table 5 show that flowering age, plant height, fertile books, number of seeds per plant, and weight of 100 seeds per plant have a positive correlation with soybean yield and a direct positive effect. This means that the components of the results explain the actual relationship and selection of seed yields through flowering age, plant height, number of fertile books, number of crop seeds, and weight of 100 seeds per plant will be effective. Hakim (2012), in the results of his research stated that morphological characters and yield components that directly influence soybean seed yield are plant height and number of crop seeds. The higher the plant, the more fertile books will increase and produce large-sized soybean

seeds that can increase seed weight per plant. The components of ripe pod age, number of branches, and number of filled pods have a positive correlation value to soybean seed yields of 0.644, 0.048 and 0.825 but the direct effect is negative, ie - 1.537, -0.4426 and -0.065. This means that it is the indirect influence that causes the correlation. Cook pod age has a direct influence on soybean seed yield of -1.537 through the indirect effect of fertile books amounting to 0.661. The number of branches has a direct influence on soybean yield of -0.426 through the indirect effect of pod pod age of 0.478 while the number of filled pods has a direct effect on soybean yields of -0.653 through indirect effects on the number of seeds per plant. So it can be seen that the age of cooking pods, number of branches, and number of filled pods are less effective if used as a guide for seed yield selection per plant, but need to be considered further in the selection of indirect effects, namely the number of fertile books and number of seeds per plant. The components of the amount of empty pods have a negative direct effect on soybean seed yields of -0.065 and also a negative correlation value of -0.013. This indicates that the components resulting from the amount of empty pods cannot be used as a guide in the selection of soybean yields without having to pay attention to indirect influences and do not have to limit the indirect effects of the number of empty pods.

Table 6. Summary of Correlation of Soybean Seed Results (rxy), Direct Effect on Soybean Seed Results (Pxy) and Total Component Contribution to Yield of Soybean Seeds

No.	Agronomi Characters	r iy	P iy	Total contri-bution
1.	Flower age	0.452	0.466	
2.	Cook pods	0.644	-1.517	
3.	Plant height (cm	0.761	0.628	
4.	Number of branch	0.048	-0.426	
5.	Number of fartile nodes	0.237	0.715	
6.	Number of seed per plant	0.981	1.258	
7.	Numbert of filled pods	0.825	-0.653	
8.	Number of empty pods	-0.013	-0.065	
9.	100 seed weight	0.479	0.627	
	Tota;l			0.844
	Residu P xy			0.156
	P xy			V0.156

The results of cross analysis not only know the direct or indirect effects, but also know the total contribution of each agronomic trait and residual or residual value. The total contribution of each component of this result is obtained from the multiplication of the correlation between the yield components and the soybean weight with the direct effect of each component on the yield of soybean seeds. The residual or residual effect is the residual value of the total direct or indirect influence, but cannot be explained through cross-analysis of the actual relationship between the independent variable and the dependent variable. If the residual value or residue gets smaller then the value of the direct effect and its correlation shows the actual value in influencing the weight of soybean seeds.

Table 6 shows that the highest total contribution to soybean seed weight is in the number of seeds per plant at 1,234. This property also has a correlation value and a positive direct effect with the greatest value from the others, which is equal to 0.981 and 1.258, so that the number of seeds per plant is very effectively used for selection. Variation of flowering age, plant height, number of fertile books, number of empty pods and weight of 100 seeds per plant both had a correlation and a positive direct effect and had a positive total contribution value but were of small value, ie 0.211 days after planting 0.478 cm 0.170 segments 0.001 and 0.300 g / plant. This shows that the components of flowering age, plant height, number of fertile books, number of empty pods and weight of 100 seeds per plant can be used for indirect selection of soybean seed yields although the effect is smaller than the number of seeds per plant. Singh and Chaundary (1979), in drawing conclusions of cross analysis if the direct effect of a positive character and correlation between variables is positive, then direct selection through these traits is effectively carried out. The total value of the total contribution and the analysis of cross-component yield analysis on soybean yield can explain the amount of residual or residual value. Residual or residual values obtained are √0.156. The residual value explains that soybean seed yield is not only influenced by the direct and indirect influence of the yield components but also other factors that cannot be explained using cross analysis tests, for example environmental factors such as climate, temperature, rainfall, and so on. This residual effect causes the value of the total contribution of the yield components to the soybean seed yield to decrease. According to Junaedi (2011) the lower the residual or residual value, the better information obtained because most direct and indirect effects on soybean seed yield can be explained by the properties that have been observed.

CONCLUSION
Based on the results of cross-component analysis research results on the results of several geno-

types of soybean (*Glycine max*. L. Merril) genera-tion F2 the following conclusions can be drawn:

1. Components of results that can be considered for direct selection of the results of several F2 generation soybean genotypes based on cross analysis are the number of seeds per plant and through the direct influence of plant height.

2. 2. The number of seeds per plant has the largest total contribution to soybean yield with a total contribution of 1,234 with the value of direct influence and a positive correlation value, so it can be ascertained that the number of seeds per plant is effect-tive when used as a basis for selection of the results of several generation F_2 soybean genotypes.

3. The results of research on soybean genotypes that have high yields are shown by the highest seed weight found in the DxB (Sinabung x Gema) genotype of 9.70 g/plant and not significantly different from the AxB genotype (Dega-1x Gemasugen-1), DxC (Sinabungx Gemasugen-2), ExA (GemaxDega-1), and ExD (GemaxSinabung) with seed weight reaching 8.71 g/plant, 9.23 g/plant, 8.37g/plant and 8.79 g/plant.

Suggestions

Based on the research that has been carried out, it is recommended to obtain high soybean yields that need to pay attention to plant height and the number of seeds produced by pods that grow in each fertile book of soybean plants.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest".

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AUTHOR CONTRIBUTIONS

Moh. Setyo Poerwoko designed his plant breeding program as a whole. Nurul Sjamsijah designed field of Plant Breeding.

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