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Research Article

Prediction of gene action content of Na, K, and Chlorophyll for Soybean Crop Adaptation to Salinity

Fachrina Wibowo[1*], Armaniar[1]

[1]University Panca Budi

Abstract

Salinity area experienced an expansion that is the caused contamination of irrigation water, seawater intrusion, drought stress and excessive uses of fertilizers.varieties is one of the plant breeding programs to resolve the salinity problem, before that, however, the breeder must know plant adaptation mechanisms in morphology, physiology and biochemical so that the plant can be categorized adapt and as having potential for the tolerant varieties. This writing aims to know the action of genes through skewness and kurtosis estimation pattern Na, K, and chlorophyll content, so it is known if plant-able to adapt with salinity. This research used a destructive analysis. (A) Anjasmoro varieties, (G) Grobogan varieties, (N) Grobogan varieties that have been through repeated selection as a comparison. Research result shows the tolerant varieties having high K + ions.

Keywords: Soybean, Salt Tolerance Varieties

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Corresponding Author: Fachrina Wibowo, University Panca Budi

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Introduction

Salinity one threat to food production systems, including soybeans. germination and growth of soybean plants germinated will go down with increasing salinity levels. Soybeans are not able to germinate on soil salinity> 7 ds / m (Kristiono et al. 2013). The mechanism of plant resistance to salinity varies between species and varieties from the most vulnerable to the most resistant. This plant response caused by the changes in metabolism to saline environments.

In plants that are tolerant to saline, NaCl deposited in leaf cell vacuole. In the cytoplasm and organelle, salt concentrations remain low so as not to disturb activity of enzymes and metabolism. Additionally saline tolerant crops also able to achieve thermodynamic equilibrium without significant tissue damage, because the plant can adjust the cell osmotic pressure for dehydration. (Farid and Sjahril, 2006). Na + and Cl element can suppress the growth and reduce production. In the process of plant physiology, Na + is expected to affect the binding of water by plants, causing plants resistant to drought. While the Cl required on photosynthetic reactions associated with the production of oxygen (Mindari, 2009).

One strategy to take advantage of saline land is choosing soybean genotypes were tolerant to high salinity. Selection of genotypes of soybean can be through the method of predictive value of action of genes that control the character based on the pattern of distribution, for example quantitative characters that can be distinguished based on the value or size, characters associated with growth or crop yield, generally character controlled by a number of genes to the appearance of a character (Welsh , 1991). Genes controlling all activities that support life within the cell. The plant made up of many cells, which have the function corresponding to the function on its network. The diversity of genes in cells that regulate tissue growth and development process which led to the extensive diversity in the character of the plant was observed.

Characters are controlled by many genes indicated through the normal distribution of polygenic nature. Quantitative character tends to follow a normal distribution and continuous. Characters are controlled by many genes show platykurtic graph form, with the value of kurtosis <3. Characters are controlled by a few genes show leptokurtic graph form, with the value of kurtosis> 3. The distribution is not a normal value is negative skewness means the character is controlled by additive gene action with duplicate epistasis effect. The distribution is not normal to have positive skewness means the character is controlled by additive gene action with complementary epistasis effect (Roy, 2000).

The purpose of this paper provides information about the performance and prediction of gene action against the character of the content of Na, K, and chlorophyll of plants that can be used in the assembly of high-yielding varieties.

Materials and Methods

Research conducted Central Laboratory Faculty of Agriculture, University of North Sumatra, use of crossbred F2 seeds of (AXN) and (GxN). Varieties A (Anjasmoro), varieties G (Grobogan) as female parents and N = varieties Grobogan (N) which has been through the selection phase of saline soils as the male parent. The method used is the analysis of Descriptive statistics, where the distribution normality test data and genotype frequencies do for K absorption, Na Absorption, and chlorophyll content. The shape of the graph the value of skewness and kurtosis are calculated using the formula Pearson, then the result obtained is defined and characterized as follows:

Table 1. Prediction of gene action skewness and kurtosis

Data Normality Test	Graph Form	Description
Skewness = 0	Normal distribution	Additive gene action
Skewness < 0	Abnormal distribution	Additive gene action with duplicate epistasis
Skewness > 0	Abnormal distribution	Additive gene action with complimentary epistasis
Kurtosis = 3	Mesokurtic	
Kurtosis < 3	Platykurtic	The character is controlled by many genes
Kurtosis > 3	Leptokurtic	The character is controlled by a few genes

Results and Discussion

K absorption(%)

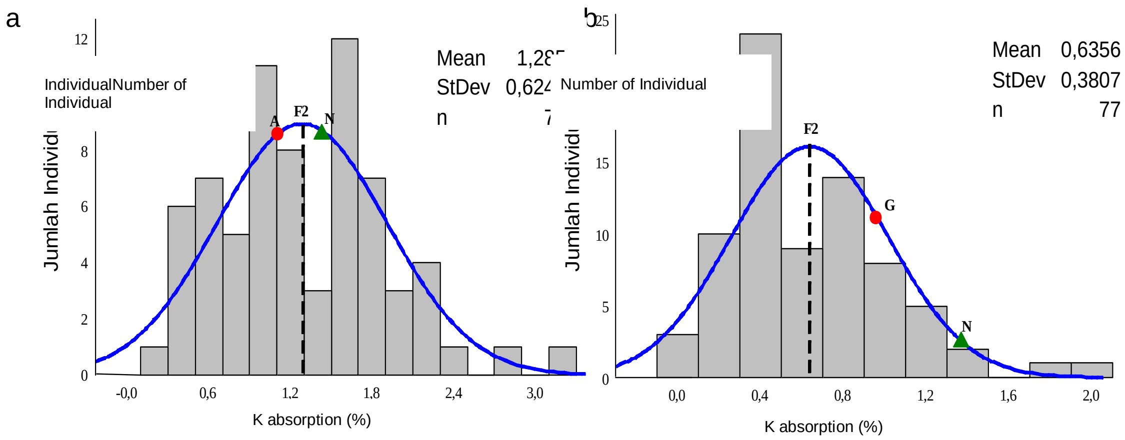

Figure 1. Graph K Absorption distribution activity (%) cross (a) AXN and (b) GxN

The observation of absorption K (%) at the intersection (Figure 1.ab) shows the result is not normal. The result of crosses AXN (Figure 1a) shows the average Absorption of K 1.285. The highest K Absorption 3.161 and 0.249 and the lowest K higher than the results of a cross elders N and lower than the elders A. Results GxN cross (Figure 1.b) shows the average Absorption of K 0.636. The highest K Absorption 2.050 and 0.078 and the lowest K Absorption of crossbred higher than the elders N and A.

Na absorption (%)

The observation of the absorption of Na (%) at the intersection (Figure 2.ab) shows the result is not normal. The result of crosses AXN (Figure 2.A) shows the average absorption of Na 0.0018 and the result of crossbreeding higher than elders N. Absorption highest Na Na 0.011 and lowest Absorption 0 and have the same value with elders A.

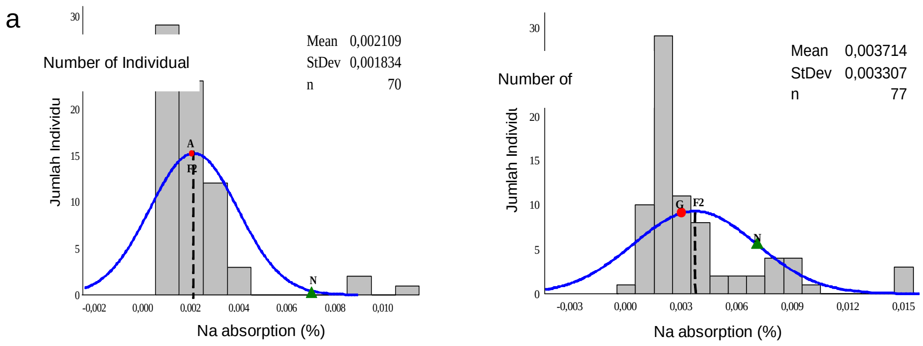

Figure 2. Graph distribution activiti b Ia Absorption (%) cross (a) AXN and (b) GxN

The results of a cross GxN (Figure 2B) shows the average absorption of Na 0.0037. Absorption of 0,015 Highest and lowest Na 0 and the results of a cross is higher than elders N and lower than the elder G.

The total chlorophyll (mg / g)

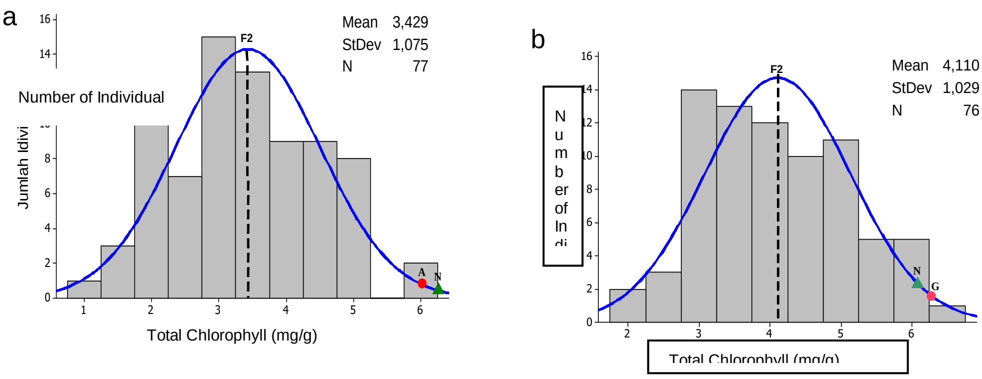

Figure 3. Graph distribution of chlorophyll activity crosses (a) AXN and (b) GxN

The observation of the total chlorophyll (mg / g) at the intersection (Figure 3.ab) shows the result is not normal. The result of crosses AXN (Figure 3A) shows the average chlorophyll total 3,429. 6,004 total chlorophyll highs and lows and the result of crossing 1,079 lower than the elders N and A. The results of a cross GxN (Figure 3b) shows the average chlorophyll total 4,110. The highest chlorophyll 6.405 and the lowest total of 2.11 and lower than the result of cross elders N and G.

Prediction of gene action

The results of the distribution graph K absorption activity (Figure 1), the absorption of Na (Figure 2) and total chlorophyll (Figure 3) show the average result of crosses which is lower than the parent. This is because of the F2 offspring of segregation. The level of segregation would be higher if both parents have the gene with a lot of difference. According to Mendel law, if there is no influence of female parents, there is no influence of the maternal inheritance of quantitative characters on the plant, meaning indicated quantitative character controlled by genes in the nucleus. If the dominant component value is greater then the action of genes that control the gene is a dominant gene. Acquaah (2007) in F2, the maximum genetic variation, 50% of F2 is a heterozygous genotype, 10% of the crop for the selection of plants having the desired gene combinations.

Table 2. Prediction of Adsorption Character Action Gen K, Na Absorption and Chlorophyll Total

Crossing	K absorption (%)		Na absorption (%)		Total Chlorophyll (mg/g)	
	Skewness	Kurtosis	Skewnes s	Kurtosis	Skewnes s	Kurtosis
AxN	3,171	0,477	0,011	11,447	0,233	-0,486
GxN	1,994	1,216	2,072	4,096	0,244	-0,776

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The results of the performance of absorption K (Figure 1) and the absorption of Na (Figure 2) shows the plants that have high physiological adaptations have a lower Na content compared to plants with a low or sensitive adaptation. Na sensitive plants absorb more. The highest Na Absorption had growth rates and low manufacturing otherwise small Na Absorption value has growth rates and high production. This can be explained because the plants have episodes of stress (water deficit, the toxicity of ions, and the imbalance of nutrients), with increasing Absorption of Na can reduce the Absorption of K, this is because the Na + concentration that occurs in the leaves resulting in competition ions other nutrients including ion K +. According Kristiono et al. (2013) a high concentration of Na + in soil solution causes the ratio of Na + / Ca2 + or Na + / K + extreme. Imbalance amount of Na transferred in the network is larger than lower the element content of K + and Ca2 + plant tissue, then if the absorption of Na + and Cl above the optimal level, there will be the toxicity of specific ion which will inhibit the absorption of water and nutrients so plants will wither and die from lack of water causes disturbances in the processphotosynthesis. Djukri (2009) on the extension of the saline stress conditions with their roots suspended high with low calcium salts as well as the extension leaf downs related to the change of leaf water status. under normal conditions, the rate of return on the rate of leaf extension before being treated with salt.

The concentration of Na + and Cl in saline conditions can exceed the needs and cause toxicity to the genotype of the plant does not tolerant. Adie and Krisnawati (2013) which explains salinity also impact on the increase in sodium and chloride because it can reduce the accumulation of potassium, calcium, and magnesium in the soil. In salinity Plant, sensitive chloride concentration in soybean leaves 10 times more compared with soybean resistant yet chloride ions travel from the root to the stem and leaves on resistant genotypes are very slow. Differences soybean genotypes tolerance to salinity associated with toxicity chloride. because it can reduce the accumulation of potassium, calcium, and magnesium in the soil. In salinity Plant, sensitive chloride concentration in soybean leaves 10 times more compared with soybean resistant yet chloride ions travel from the root to the stem and leaves on resistant genotypes are very slow. Differences soybean genotypes tolerance to salinity associated with toxicity chloride. because it can reduce the accumulation of potassium, calcium, and magnesium in the soil. In salinity Plant, sensitive chloride concentration in soybean leaves 10 times more compared with soybean resistant yet chloride ions travel from the root to the stem and leaves on resistant genotypes are very slow. Differences soybean genotypes tolerance to salinity associated with toxicity chloride.

The observation of the value of skewness (Table 2) the parameters of observation Absorption of K and Na (%), chlorophyll content (mg / g) cross AXN and GxN known value of skewness> 0 means the gene additive effects of epistasis complementary, skewness is positive, interpreted a character can passed on to offspring and complementary epistasis effect means an interaction between pairs of dominant genes complement each other giving rise to these characters. Skewness portrait of the slope in the distribution and trends of skewness a curve based on the concept of data centralization relationship between the average value is calculated, mode and median (Fauziah, 2016). Griffiths et al (2005) are that the genes that control a character can be influenced by genes additive, dominant or epistasis (dominant/complementary). Additive gene action is the interaction of alleles - alleles to produce a phenotype that causes equality and heredity elders. Epistasis is an interaction between two or more genes in different loci can form a phenotype. Duplicate epistasis is an interaction that can take place only if the two genes produce the same material to the same phenotype. Complementary epistasis is the interaction of genes in which gene function will complement each other genes in the formation of a character. Duplicate epistasis is an interaction that can take place only if the two genes produce the same material to the same phenotype. Complementary epistasis is the interaction of genes in which gene function will complement each other genes in the formation of a character. Duplicate epistasis is an interaction that can take place only if the two genes produce the same material to the same phenotype. Complementary epistasis is the interaction of genes in which gene function will complement each other genes in the formation of a character.

The observation of the value of kurtosis (table 2) the parameters of observation Absorption of K (%), chlorophyll content (mg / g) cross AXN and GxN known value of kurtosis <3 shows the chart pattern platykurtic, distribution which has a peak which is almost flat means that the character is controlled by many genes, If the character is controlled by many genes then passed on to offspring is likely to be smaller. Kurtosis value of the observation parameter Absorption Na (%) cross AXN and GxN known value of kurtosis> 3 shows leptokurtic chart patterns, the distribution of which has a relatively high peak means that means the character is controlled by few genes then passed on to their offspring is likely to be greater. Jambornias (2014) in his dissertation writing skewness analysis of potentially passed on to offspring is skewness with positive value with complementary epistasis gene action with positive kurtosis shown by the graph leptokurtic where only a few genes involved in the formation of character. Kartika (2015) describes skewness called also the size of the slope may indicate the symmetry in the form of a distribution curve. If the frequency curve extends to the right means that the distribution pattern is positive if the frequency curve is elongated left means the distribution pattern is negative if the inclination symmetrical data mean and the mean value is the same mode.

Conclusions

Plants that have a high physiological adaptation has a lower content of Na, K Absorption is high and able to maintain their chlorophyll levels when compared to plants with little or no adaptation can adapt well. Based on the value swekness and kurtosis genotype which can be used in the assembly of high yielding varieties is swekness which is positive with complementary epistasis gene action and has a value of kurtosis> 3 leptokurtic chart patterns.

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