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Correlation Between Quantitative Traits and Dry Land Sugarcane (Saccharum hybrid) Yield

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ABSTRACT

This study aims to determine the relationship (correlation) between quantitative traits and biomass of sugarcane Saccharum officinarum L.). The hypothesis that can be put forward in this study is that there is a positive and negative correlation between quantitative traits and biomass yield of sugarcane Saccharum officinarum L.). Sugarcane (Saccharum officinarum L.) is a plantation commodity that is widely developed in Indonesia because Indonesia's climate is suitable for the growth of sugar cane. In Indonesia, so far the cultivation of sugar cane is mostly done in paddy fields. However, because the need for rice continues to increase, more and more paddy fields are used for rice cultivation. This causes sugarcane land in paddy fields to shrink and shift to dry land or dry land. The average sugarcane yield on dry land in Java is only 67% of that of irrigated paddy fields. Meanwhile, the productivity of dry land outside Java is only 58% of that of irrigated paddy fields in Java. The decrease in sugarcane productivity is thought to be due to the shift in sugarcane planting from wet to dry land. Yield loss due to drought (water stress) can reach 40% of its production potential if it occurs during a critical plant phase. The success of efforts to obtain plants that have good quality and quantity of yield is greatly supported by the ability of plant breeders to obtain superior genotypes in the selection stage. In carrying out selection, plant breeders are often faced with the problem of making a choice of genotypic traits that are considered superior, therefore it is necessary to know the relationship (correlation) between quantitative traits and yields in these plants.

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1. INTRODUCTION

Sugarcane (Saccharum officinarum L.) is a plantation commodity that is widely developed in Indonesia because Indonesia's climate is suitable for the growth of sugar cane. Sugar cane can be found from the lowlands to the highlands with an altitude of not more than 1300 m above sea level. Good humidity for sugarcane plant growth is > 70%, with temperatures ranging from 28oC - 34oC.

Sugar cane growth will be optimal at an altitude of 5-500 m above sea level. The best soil is fertile soil and enough water but not stagnant. This plant is planted in paddy fields to dry land or moor. Sugarcane plants can produce sugar which is one of the basic needs. Sugar cane stalks contain liquid sugar which is up to 20% (Slamet, 2006).

Sugarcane plants have two kinds of fibrous roots, namely root cuttings and root shoots. The root of the cuttings comes from the stem cuttings of the sugarcane plant. The life span of cutting roots is not long and only functions when the plants are young or in the form of seeds. The root of the cuttings grows in the root ring of the cuttings of the sugarcane plant. While the root of the shoot comes from the bud. Shoot roots grow perpendicularly downwards and horizontally near the soil surface (Indriani and Sumiarsih, 1992). The shoot roots have a long life and persist as long as the sugarcane plant grows. The stem of the sugarcane plant is unbranched, grows upright and has segments where at the nodes of the stem segments there are buds that can grow into sugarcane buds.

In each segment of the stem of the sugarcane plant there is at least one bud (bud), but there is also a pair of buds (furia bud), whereas if there are many buds it is called multiple buds. paddy field. However, because the need for rice continues to increase, more and more paddy fields are used for rice cultivation.

This causes sugarcane land in paddy fields to shrink and shift to dry land or dry land. Sugarcane plants on dry land according to Soeprijanto and Sastrowijono, (1988) have a low productivity so that it will affect the final yield, namely sugar. The average sugarcane yield on dry land in Java is only 67% of that of irrigated paddy fields. Meanwhile, the productivity of dry land outside Java is only 58% of that of irrigated paddy fields in Java. Hidayat (2002), also stated that the decrease in sugarcane productivity is believed to be due to the shift in sugarcane cultivation from wet land to dry land. Sugarcane plants are usually propagated vegetatively.

Plants initially using seeds or called first plants (plant cane), then the rest of the harvest plants that are treated again are called keprasan plants (ratoon). The seeds for planting sugarcane come from the part of the sugarcane stem that contains buds. At this time, planting with seeds derived from meristem culture and side shoot culture (micropropagation) has been developed.

In addition, sugarcane can also be propagated generatively. The availability of water for sugarcane plants affects the process of sugar formation in the stem (Alexander, 1973). In sugarcane, more than 70% of the wet weight is water. Assuming about 30% is dry weight, a ratio close to 2.5: 1 is obtained so that it can be estimated that the absorption of 250 ml of water is needed to form 1 gram of plant dry weight (Lakshmikantham, 1989) According to Poespodarsono (1988) that there is a relationship (correlation) between one trait with another trait has an important meaning in selection activities.

To predict certain traits of a plant, estimators of certain traits can be used which are easy to observe, compare and can show their genetic abilities. Forecasting is often intended for quantitative traits that are difficult to provide an overview of genetic ability due to external influences that obscure, for example population. If there is a close relationship between the character of the predictor and the trait aimed at selection, the selection activity will be more effective. In sugarcane, correlation is important. This is because sugarcane breeding has always been to find out which characteristics of the sugarcane plant can support the productivity of the sugarcane plant itself. As in the study Walker (1965) reported that brix is a good selection criterion because it has a high correlation with other quantitative traits, and the number of tillers can also be used as a selection criterion.

2. METHOD

2.1 Types of research

The research method used in this study is the experimental method. The experimental method is a form of observation under artificial conditions, where these conditions are created and regulated by the researcher. That is, basically conducting an experiment to see the results, and the results of the experiment will confirm how the causal position is between the variables being investigated

2.2 Research variable.

Observational variables included: plant height, stem diameter, number of stems per clump, number of green leaves, brix, leaf area, number of stomata, plant biomass. As supporting data, observations are made of measuring soil water content.

2.3 Research design

This study was arranged using a randomized block design with 3 replications. Each replicate consisted of 54 sugarcane clones. The number of plants per section/replication was 4 plants with 2 plants per section/replication. The total number of plants is 648 plants.

2.4 Sampling location

the research sample consisted of 54 sugarcane clones. The number of plants per section/replication was 4 plants with 2 plants per section/replication. The total number of plants is 648 plants.

2.5 Time and Place of Research.

The research was carried out at the P3GI Experimental Garden (Indonesian Sugar Plantation Research Center) Pasuruan City. With an altitude of 4 m above sea level, the average temperature is 26.20 C - 28.50 C with alluvial soil types. The research was conducted from June 2008 to January 2009.

2.6 Tools and materials

The tools used in this study were: top loading scales, binocular microscope, caliper, ruler, tape measure, scissors, glass slide, over glass, stationery, drill, ring sample, oven, hand refractometer, hand counter.

The materials used in this study were: 50 clones from the P3GI Pasuruan collection garden and 4 control clones consisting of 2 resistant clones and 2 sensitive clones, label paper, raffia rope, ZA fertilizer, SP 36 fertilizer, KCl fertilizer, furadan, cimedine C, masking tape.

2.7 Research procedure

The research began with nurseries carried out in hardening, the seedlings came from single-eyed mules taken from eye number 9-14 from the first leaf, then land processing. followed by planting and maintenance and ends with observation.

2.8 Data analysis.

Observational data were analyzed by analysis of the F test of variance (5%) and then continued with the Honest Significant Difference (BNJ) test to determine differences between treatments. Followed by an analysis of variance to determine the mean squared value and the estimated mean squared.

3. RESULTS AND DISCUSSION

3.1 Research result

Genotypic and phenotypic correlations between quantitative traits and biomass The magnitude of the degree of closeness of the relationship between quantitative traits can be known based on the calculation of the phenotypic genotypic correlation coefficient. The results of calculating the values of the genotypic and phenotypic correlation coefficients show that genotypic and phenotypic correlations vary widely, but in general almost all genotypic correlations have a higher value than phenotypic correlations. that genotypic and phenotypic correlations varied, ranging from 0.03 to 0.85 and 0.02 to 0.53, respectively.

Based on the results of statistical analysis, it was found that the correlation between quantitative characters showed positive values. There were significant positive genotypic and phenotypic correlations between plant height and number of leaves (0.53 and 0.43); the number of leaves with the number of stems (0.85 and 0.47). Meanwhile, the correlation between plant height and number of stems showed no significant difference even though the genotypic and phenotypic correlations were positive (0.03 and 0.02). At the age of 6 months after planting, the plant height of all clones increased quite a lot (appendix 5). This can be seen from the increase in the average plant height to 141.31 cm from the previous average plant height at 4 months of age which was only 97.79 cm. The range of plant height at the age of 6 months is between 55.17-189.5 cm. Clone POJ 3016, which was a drought-sensitive comparison clone, had the lowest plant height when compared to the other clones, namely 55.17 cm and PS 81 – 272 clones had the lowest height when compared to the clones tested which were only 92 cm tall. While the highest plant height was found in clone PS 81-556 with a height of 189.5 cm and the height was higher than the 2 drought resistant comparison clones.

There was also an increase in plant height at the age of 8 months compared to the previous age. However, the increase in plant height is not too much. The average plant height of all clones after observation was 178.6 cm with a height range between 81.33-232.5 cm. At the age of 8 months, clone PS 81-556 still had the highest plant height, the same as the previous age, namely 232.5 cm. The same thing was also found in the PS POJ 3016 clone where the plant height was always the lowest compared to all clones as at the previous age with a height of 81.33 cm. Whereas PS 81 – 272 clones also had the lowest plant height, which was 129 cm. The results of the analysis of variance at 4.6 and 8 months of age showed that the sugarcane clones tested on the variable number of stems had a very significant effect.

At 4 months after planting, clone PS 81-187 had the highest number of stems in one clump with an average of 14.33 and these clones produced better results when compared to the 2 drought resistant comparison clones. Meanwhile, for the clone that had the fewest number of stems, namely clone PS 81-361 with an average of 6, the results were lower when compared to 2 clones sensitive to drought. At this age the value range for the number of stems in one clump is between 6-14.33 with an average value of the number of stems for all clones which is 10.33.

3.2 Discussion

The correlation that occurs is the end result of the influence of all the segregating genes or environmental factors that control the correlated traits so that a positive correlation occurs when the genes controlling the two correlated traits increase both, while the negative correlation occurs when the opposite occurs. According to Falconer and Mackay (1972), genetic factors that cause correlations are partly due to pleiotropy, namely the expression of several traits that are controlled by one gene. As in sugar cane, the increase in stem height will also be followed by the elongation of the stem segments.

Sugarcane plant height on dry land planting at the age of 4 and 6 months had a significant positive genotypic and phenotypic correlation with the number of leaves. This indicates that any increase in plant height will be followed by the formation of new leaves resulting in an increase in the number of leaves. Whereas at the age of 8 months the plant height showed a significant correlation both genotypic and phenotypic with brix. This is because the results of photosynthesis in the form of sugar formation are also affected by the stem, in this case the stem is a place for storing photosynthate products. So the taller the stem, the more sugar it will contain.

Plant height also had a significant positive phenotypic genotypic correlation with the number of stems at the age of 8 months. This means that the plant height is directly proportional to the number of stems where each sugarcane plant grows taller so new stems will form. These results are in accordance with the correlation value of the number of leaves which is significantly correlated genotypicly and phenotypicly with the number of stems. The number of stems is formed due to the influence of the number of leaves where when abscisic acid accumulates in the leaves it results in disruption of the cytokinin hormone which causes the accumulation of the cytokinin hormone in the roots and triggers the emergence of side shoots or stems in one clump.

So that in this case the formation of stems or shoots is influenced by plant height and number of leaves. The number of leaves on the same planting that is on dry land at the age of 8 months has a significant genotypic and phenotypic correlation to brix characters. Between the number of leaves with brix has a directly proportional relationship. This shows that each time there is an increase in the number of leaves it will affect the brix value of sugarcane where the brix value will increase. This relationship is due to the fact that the leaves are the place where the photosynthetic process occurs, where the result is in the form of brix, so that the more sugar formation occurs which is the result of photosynthesis, the higher the brix value.

The correlation between leaf area at 8 months of age showed a significant phenotypic correlation with the number of leaves. This correlation indicates that an increase in the number of leaves per clump will also increase the leaf area in that clump so that it can be said that if a plant has a small number of leaves per clump, the leaf area will be narrower. This is seen from the condition of dry land where according to Garrity et.al. (1984), the response of plants to drought can reduce the photosynthetic area in 2 ways, namely: 1) by reducing photosynthetic activity per unit leaf area or 2) by reducing the number of photosynthetically active leaf areas.

The correlation between stem diameter at the age of 8 months has a genotypic correlation and a phenotypic correlation with plant height. This shows that the stem diameter variable has a directly proportional relationship where the increasing plant height will also increase the size of the stem diameter. According to Kuntohartono (1999), the enlargement of stem diameter in sugarcane occurs almost simultaneously with the process of stem elongation. In addition, the enlargement of the diameter of the stem is an indication of the optimum growth of the sugarcane plant, because the sugarcane plant stores assimilate in the stem. Variable stomata density significantly correlated genotypic with plant height and number of leaves. The relationship between stomata density and the two variables is very close with the respective plant height and number of leaves values, namely 1.34 and 1.29. This correlation can be assumed to be a one-valued correlation so that the relationship between variables is very close. Meanwhile, the correlation between stomatal density and brix or biomass showed no significant difference.

Biomass at all ages of observation had a significant positive genotypic correlation with all observed variables except stomatal density. This shows that the value of biomass is strongly influenced by these variables. From the correlation value, it was found that the biomass has the closest relationship with the variable plant height and number of leaves even though the category is classified as moderate. So it can be said that these two variables are very suitable to be used as a reference in the implementation of selection observations that can produce high biomass. The variable biomass increases if there is an increase in the variable plant height and number of leaves.

The genotypic and phenotypic correlation values in the correlation between plant height with stem diameter, plant height with brix and number of leaves with brix show relatively similar values. This is in accordance with the opinion of Singh and Caudhary (1981) in Anshori (2002) that genotypic correlation values that are almost the same will be able to reduce selection errors based on the phenotypic. So that when using this variable as a reference for selection, you can look at the phenotypic without looking at the genotypic.

4 CONCLUSION

From the results of the research that has been carried out, it can be concluded that at the age of 4 months, there is a correlation between plant height and number of leaves and number of leaves and number of stems. The correlations that occur are genotypic and phenotypic correlations and at the age of 6 months the correlation that occurs is in the correlation between plant height and number of leaves, plant height and number of stems and number of leaves and number of stems. Particularly for plant height and number of stems, the correlation that occurred was only genotypic. At 8 months of age, biomass had a positive genotypic correlation with quantitative variables, namely plant height, number of leaves, number of tillers, stem diameter, leaf area and brix.

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In this study, it is necessary to carry out further tests in drought conditions, in order to obtain sugarcane clones that are able to grow on dry land with better results.

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