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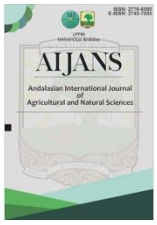

Article

Growth Analysis of Three Soybean Varieties on Ultisol

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Abstract

Expansion of planting areas by utilizing sub-optimal land and the use of superior varieties is one of the alternatives in increasing soybean production in Indonesia. Therefore, this study aims to analyze the growth of three soybean varieties on Ultisol land in the Experimental Garden of the Faculty of Agriculture, Andalas University. This activity was conducted from September to November of 2022. The soybean varieties used in this study were Dena 1, Devon 1, and Demas 1. This research was designed using a Randomized Group Design with 1 factor, namely the type of variety with 3 groups of replications. The observation results of each treatment were analyzed statistically. If F count is greater than F table, then continued with Tukey's Further Test at the 5% level. It was concluded that some of the observed characters of the three soybean varieties showed that there were significant differences in growth in the observation of plant height and leaf area index. While in the observation of plant growth rate and the ratio of crown: root there was no significant difference between the tested varieties.

INTRODUCTION

Indonesia's need for soybean commodities increases every year, this is in line with the development of the soybean-based food industry and the continuity of population growth. Increased crop production is strongly influenced by the quality and quantity of seeds followed by the application of appropriate cultivation technology. The Ministry of Agriculture [1] revealed that the increase in the average price of imported soybeans in February 2022 to Rp 12,600/kg, the highest since 2018, is one of the opportunities in the development of soybeans in the country, which currently only contributes no more than 20%. The expansion of planting areas by utilizing sub-optimal land and the use of superior varieties is one of the alternatives in increasing soybean production in Indonesia.

In 2018, it was recorded that the area of critical land in Indonesia was around 14 million ha, with 4.67% of it located in West Sumatra [2]. The soil order in West Sumatra is dominated by Ultisol and Inceptisol. Because of its wide distribution, Ultisol is very potential in agricultural development, but Ultisol has many problems and shortcomings. The main problems faced by Ultisol if used as agricultural land are Al and iron (Fe) poisoning and nutrient deficiencies, especially P. Al and Fe elements that are widely dissolved in acidic soils will easily bind P.

Arsyad [3] stated that several approaches have been taken to overcome these problems, one of which is by providing adaptive/tolerant plant varieties. This approach is more efficient and easier for farmers to adopt. The use of improved varieties that have wide adaptation can increase soybean productivity [4]. The Agricultural Research and Development Agency through the Research Center for Various Beans and Tuber has produced several soybean varieties that are adaptive to drylands and have high yield potential. Rozi & Heriyanto [5] added that many superior varieties of soybean have been released by the government, but not many of these varieties have been adopted by farmers, these superior varieties have diversity, yield potential, harvest age, seed size, seed color, and different adaptation areas. However, the high yield potential of superior varieties in the field will be influenced by the interaction between genetic factors and the management of good growing environment conditions [6]. Therefore, this study aims to analyze the growth of three soybean varieties on Ultisol land in the Experimental Garden of the Faculty of Agriculture, Andalas University.

EXPERIMENTAL SECTION

This activity has been carried out at the Experimental Farm, Faculty of Agriculture, University of Andalas, Limau Manis village, Padang City, West Sumatra Province with an altitude of ± 318 m above sea level, from September to November 2022. The materials used in this study were soybean seeds of Dena 1, Devon 1, and Demas 1 varieties, NPK Phonska fertilizer, cow manure, and dolomite. While the tools used in this study were hoes, paddles, raffia, scissors, label paper, machetes, meters, ovens, digital scales, stationery, and leaf area meters. This research was designed with a Randomized Group Design with 1 factor, namely the type of variety with 3 groups of replications so that 9 plots of experimental units were obtained. Each plot consisted of 8 plant samples. The observation results of each treatment were analyzed statistically. If F count is greater than F table, then continued with Tukey's Further Test at the 5% level.

The land used is of the Ultisol order. The soil was processed at a depth of approximately 20 cm. Land processing also includes making beds, with a size of 1.2 m x 1.8 m, then a spacing of 30 cm x 30 cm. Before planting, basic fertilizer was applied in the form of cow manure 5 kg/bedeng, and dolomite 1.4 kg/bedeng. Variables observed included: plant height, leaf area index, plant growth rate, and root crown ratio. Observations were made at the age of 2 weeks, 3 weeks, 4 weeks and 5 weeks.

RESULT AND DISCUSSION

Plant Height

Table 1 shows that the three soybean varieties tested gave a significant effect on the observation of plant height, where the highest average value was found in Devon 1 (34.96 cm) followed by Dena 1 (30.60 cm) and Demas 1 (25.91 cm). However, this plant height is much lower when compared to the description of each variety. It is known that the description of plant height in Devon 1 variety is 58.1 cm, Dena 1 variety is 59.0 cm and Demas 1 variety is 66.3 cm [7].

Table 1. Plant Height of Three Soybean Varieties on Ultisol Land Age Five Weeks After Planting.

Varieties	Plant Height(cm)
Dena 1	30,60 b

Devon 1	34,96 a
Demas 1	25,91 c

The unoptimized plant height in this study indicates the poor adaptability of the three varieties to the study location. Low plant height is caused by environmental factors, especially edaphic, it is known that Ultisol is characterized by soil chemical properties with low pH and high Al and iron (Fe) content. Al and Fe elements that are widely dissolved in acidic soils will easily bind the element P (Phosphorus). Phosphorus is known to play a very important role in the formation of new cells in growing tissues. The same thing was also reported by Thompson & Troeh [8] that phosphate is needed by plants for cell formation in growing root and shoot tissues. So it can be concluded that when plants lack these macronutrients, it will affect the growth and development of these plants.

Devon 1 has the highest average when compared to the other two varieties, Mildaerizanti [9] states that differences in plant height are more determined by genetic factors, which are influenced by the conditions of the plant's growing environment. If the growing environment is suitable for plant growth, it can increase production. The results of Ferayanti & Idawanni's research [10] stated that soybean variety Devon 1 has a better response on plant height variables than other varieties when planted on acidic drylands. From the beginning of observation (2 weeks after planting), the height of soybean plants in Devon 1 variety was superior to Dena 1 and Demas 1 varieties, this can be seen in Figure 1. While the growth rate of plant height in each variety increased significantly at 4-5 weeks after planting.

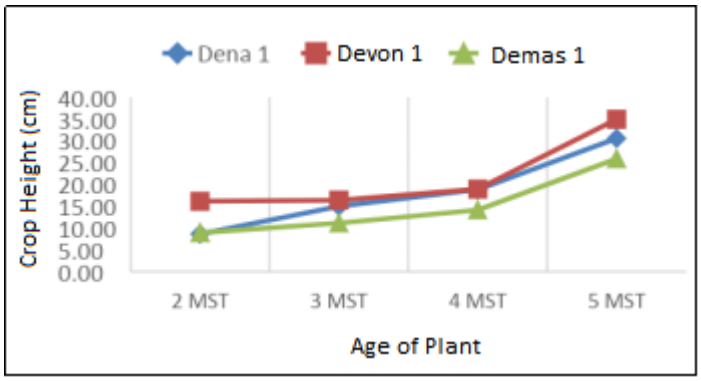

Fig 1. Graph of plant height of three soybean varieties on ultisol land aged 2 weeks to 5 weeks.

Leaf Area Index

Leaf area index is the ratio of leaf area to shaded area. Leaves have a very important role in the place of photosynthesis in plants. Leaf area index is closely related to leaf area, plant population and number of leaves [11]. Based on the description of the three varieties tested, each variety has medium-sized leaves. However, based on Table 2, it can be seen that the leaf area index in Demas 1 variety has the smallest value, this will certainly be directly proportional to the condition of a narrower leaf area and the number of leaves that are less than the optimal condition. The average value of leaf area index obtained from the three varieties tested is still lower, based on the results of Pramanda's research [12] soybeans planted at a spacing of 30 x 30 cm and observed at the age of 5 MST have a leaf index value of 2.63. The leaf area index can explain whether plant growth is optimal or not. A low leaf area index value indicates that the spacing used is too wide or the plant growth conditions are not optimal [13].

Table 2. Leaf Area Index of Three Soybean Varieties at 7 Weeks After Planting in Ultisol Soil..

Varieties	Leaf Area Index
Dena 1	1,26 a
Devon 1	1,22 a
Demas 1	0,74 b

The difference in response shown in the value of soybean leaf area index due to the use of different varieties is thought to be due to differences in the genetic characteristics of the three varieties tested. These differences in genetic traits cause differences in the response of the three varieties to the environmental conditions that exist at the trial location, so that the growth activity shown will also be different.

Plant Growth Rate

Based on the research results shown in Table 3, it shows that of the three varieties tested, there is no significant effect on the observation of plant growth rate. Plant growth rate is influenced by the ability of plants to produce dry matter assimilated per unit area per unit time, of the three varieties tested showed that there is similarity in the value of plant growth rate.

Table 3. Plant Growth Rate of Three Soybean Varieties on Ultisol Land Age 6 - 7 Weeks After Planting.

Varieties	Plant Growth Rate (g/cm^2/week)
Dena 1	3,02
Devon 1	2,41
Demas 1	2,59

The results of research by Santana *et al*. [14] mentioned that the growth rate of soybean plants in the R1 - R5 phase of Tanggamus and Biosoy 1 varieties given Nitrogen fertilization treatment at planting and in the R5 phase was 1.64 g/m2/day and 2.45 1.64 g/m2/day. Whereas in Pramanda's research [12] the treatment of 30 x 25 cm spacing gave a plant growth rate of 0.17 mg/cm2/week which was observed in soybeans aged 4 weeks - 5 weeks. It is known that the rate of plant growth is the ability of plants to produce dry matter from assimilation per unit area per unit time. The interaction between temperature - solar radiation intensity - soil moisture determines the growth rate of soybean plants [15].

Root-Crown Ratio

Based on the analysis of variance on the root-crown ratio of soybean plants, it shows that the varieties of Dena 1, Devon 1, and Demas 1 do not show a significant effect with an average value of 11.09 - 12.93. However, this average value is higher than some research results, such as Selvia [16] stated that soybean planted on ultisol land has an average root-crown ratio with treatment without lime application is 5.01, while Bertham & Nusantara [17] found that the root-crown ratio of four soybean genotypes tested on ultisol land is 4.50 in Slamet genotype, 1.99 in 19BE genotype, 1.84 in 25EC genotype, and 2.01 in 13ED genotype. The large root-crown ratio indicates that the plant assimilates more for crown growth than roots [18], so that root growth is not optimal.

Table 4. Crown - Root Ratio of Three Soybean Varieties on Ultisol Land Age 6 - 7 Weeks After Planting

Varieties	Root-Crown Ratio
Dena 1	12,93
Devon 1	12,32
Demas 1	11,09

CONCLUSION

Some of the observed characters of the three soybean varieties showed that there were significant growth differences in the observation of plant height and leaf area index. While in the observation of plant growth rate and the ratio of crown: root there was no significant difference between the tested varieties.

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